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Wing Loading and its Effects
A seminar by Performance Designs, Inc.
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I. Wing Loading Defined

Wing loading is a measurement of how much total weight is supported by how large a wing,and is usually expressed in pounds per square foot. Everything the jumper exits with, including all clothing, the rig and both canopies must be included in the weight.

Example: Exit weight Canopy size Wing Loading
190 pounds 190 square feet 1.0 lb./sq. ft.
150 pounds 150 square feet 1.0 lb./sq. ft.
190 pounds 95 square feet 2.0 lb./sq. ft.
150 pounds 75 square feet 2.0 lb./sq. ft.

In very general terms, the heavier the wing loading of a parachute, the more quickly everything happens in flight, and the more critical correct flight techniques becomes.

II. General Concepts that are frequently misunderstood

A. Different canopy models of the same size may perform differently, but they will fly approximately the same speed. Wing loading is the biggest determinant of speed. A Stiletto 190 is not really faster than a Sabre 190, or even a PD 190! Other aspects of performance will be different, however. (Turn rate, glide angle, etc.) These differences may influence a person's impression of speed.

B. A person evaluates a canopy's speed according to their individual frame of reference, which has been created through their own, unique experiences.
Example: Jumper A and jumper B weigh the same, jump the same canopy, and have the same number of jumps. They may have completely opposite opinions of the speed and handling of their canopies. Why? Different frames of reference! The canopy may be the smallest one jumper A has flown. He may have chosen it to get more speed, quicker turns and hotter landings, and might feel that it's a handful! Yet jumper B may have moved up one or two sizes to this canopy, to create more forgiving handling and easier landings than he had previously.

C. When discussing the speed and forgiveness of a particular canopy, remember the different frames of reference of the individuals involved.
Be careful to avoid projecting your frame of reference onto a person to whom you're describing a canopy. Example: If a person is asking advice about trying a new canopy that is much larger than what you are currently jumping, you'll likely consider it rather slow and docile. But telling them so could be a big mistake if they've spent their whole skydiving career on a much larger canopy. Regardless of how you feel about the canopy, it will be the fastest, most responsive canopy they've ever jumped.This is true regardless of any wing loading calculations you might make.

D. It is not necessary to heavily load a high performance canopy to make it fly and land correctly. This is a common misconception even with many experts. If a person's canopy is going the speed they are comfortable with, then that should be fine. If they're not getting good landings on a properly designed canopy flown at a lower wing loading, they're probably not flaring it correctly.

E. Choose your canopy size by reflecting on your impression of the canopy sizes and models you have recently flown, combined with your desire to go faster or slower. Choosing a canopy this way is much safer than using only a chart published by a manufacturer. Such a chart may be a rough guide, but cannot be used effectively without applying your own experience. If you don't want to go faster, don't go smaller than what you are using!

III. More advanced concepts about wing loading

A. Test your beliefs about canopy Wing Loading:
Which of these general statements are true and which are false?

1. Two jumpers with widely different exit weights will get the same performance if they have the same model of canopy, sized for the same wing loading.

2. Its possible for two jumpers with widely different exit weights to get the same performance, but the lighter jumper must load their canopy a little more heavily.

3. Its possible for two jumpers with widely different exit weights to get the same performance, but the lighter jumper must load their canopy a little more lightly.

B. Do equal wing loadings on a given design give the same performance?

4. When you downsize to a smaller canopy of the same type, you will have the same glide angle, but you'll go faster. The following questions concern two jumpers with exit weights of 135 and 230
pounds, flying a Sabre 135 and 230 respectively. They have the same wing loading of 1.0 lb./sq. ft. Which of the following statements about these two jumpers are true and which are false?
5. The canopies will provide identical performance for both jumpers.
6. The jumpers will have the same glide angle and speed.
7. The canopies will have similar handling and responsiveness in turns.
8. The canopies will have similar stall characteristics.
9. Assume the lighter jumper above stays with a Sabre (a rectangular canopy) but the heavier jumper changes to a highly elliptical canopy at the same wing loading, for quicker turns. In this case, the heavier jumper will definitely be capable of out turning the lighter jumper.
10. Assuming that both jumpers have similar skill levels, and both are planning to transition to smaller Sabres that give a 1.3 lb./sq. ft. loading. In this situation, they will have similar challenges with getting good no wind landings because their change in wing loading was the same.
1. Though many canopy models may come in several different sizes that are usually scaled geometrically from one to another, they don't fly the same at equivalent wing loadings. Why? Because the physical and aerodynamic laws that the parachute must obey don't scale up and down with the parachute.
2. Most jumpers do not normally consider the above point. They assume that a change in performance when downsizing is due purely to a change in wing loading. Since they normally don't change their exit weight very much when jumping a particular canopy, they don't ever load that canopy at wing loadings similar to what they would if they downsized.
3. However, the change in handling from one size to another is due to much more than a change in wing loading. This can be proven by jumping a small canopy at your normal exit weight, and then jumping a much larger, scaled canopy, with enough extra ballast so that the wing loading is the same. The difference is dramatic. The larger canopy certainly goes faster when carrying the additional weight, about the same speed as the smaller canopy flown at the same wing loading. However the handling still feels very similar to when it was lightly loaded. C. Some reasons for differences in performance between large and small canopies:
IV. Applications of these ideas in today's canopy environment:
A. Lighter jumpers face a greater challenge than heavier jumpers do when jumping typical first - jump student gear, due to very slow flight and sluggish controls.
B. Lighter student graduates face considerably different challenges when they start downsizing.

1. Turns: In general, the smaller the canopy, the shorter the lines. Its true that
two proportionally scaled canopies may have similar full glide speed at the same wing loadings, but they turn very differently. The big canopy, with its long lines, has relatively sluggish reaction to the controls, and the small canopy has relatively quick reaction to the controls. This is due to the fact that the large canopy must move the jumper a much greater distance out to the side, in order to achieve a certain bank angle needed for any given turn rate. This means that the smaller version of a canopy will feel much more agile, even if flown at the same wing loading.
2. Flaring: A dynamic flare is one that results in a change in flight direction from a descending path to one parallel with the ground. This requires a change in the angle of the canopy, when viewed from the side. (Initially, the amount of the angle change is about equal to the angular change of the flight path.) This angle change is accomplished using toggle a movement that causes the jumper to move out in front of his natural hanging place under the canopy. The long lines of a big canopy require the jumper to be moved a greater distance out in front to achieve the same angle. Shorter lines mean that the jumper doesn't need to move as great a distance forward to achieve the same angle. This means the toggle movement must be more aggressive on the larger canopy, compared to the smaller canopy, even at the same wing loading.
3. For similar reasons to those above, the smaller canopy will also dive more in hard turns, when compared to a larger scaled canopy, even when flown at the same wing loading.
1. Lighter students usually start at lighter wing loadings and very slow flight speed, compared to larger students, because they often use the same canopy.
2. The instructors are less likely to give a lighter student the attention to canopy
control they deserve. It's easier for an instructor to notice a slight problem with the larger student's performance, and they are more likely to correct it. The instructor is likely to be less concerned about the lighter student, because the canopy is so slow that the landing is likely to be soft, even with poor technique, and the possibility of injury is remote. C. We have been erroneously attributing the lighter jumper's general preference
for lower wing loading to the wrong reasons.
D. We have been attributing the lighter jumper's preference to more conservative models of canopies to the wrong reasons.
E. Highly experienced lighter jumpers should be very careful in the logic they use to justify their downsizing process.
1. Lighter students are normally encouraged to be more aggressive when down sizing, making much larger changes in wing loading than their heavier counterparts. Though the resulting speed may be similar or even less than that of a heavier novice, they've experienced a much bigger change in speed compared to what they started with.
2. Due to the fact that the smaller jumper will likely be transitioning to a smaller canopy than the larger jumper will, they'll get quicker responsiveness from that canopy. Again, this is true even though they're wing loading is probably lower.
3. There is a bigger difference between what a lighter jumper is told and what they are experiencing. Though the lighter novice may be jumping a fairly small canopy with fairly responsive controls, they may be incorrectly told that they are still being very conservative, because their wing loading is low compared to a heavier novice jumper. The heavier jumper, on the larger but more heavily loaded canopy, will still have more sluggish response from the canopy, which dampens the effect of his incorrect control inputs.
1. Looking at the entire skydiving population, females are generally lighter, on the average, than the males. The fact that female jumpers generally settle on a lower wing loading is usually attributed to the fact that society considers them to be somewhat conservative and less aggressive, whether this is

justified or not.
2. I believe that experienced jumpers, whether light or heavy, are probably looking for a certain degree of responsiveness from their canopy. The lighter jumpers will get that responsiveness at a lighter wing loading. The heavier jumpers will get that responsiveness at a heavier wing loading. This is the main reason for canopy wing loading differences.
1. The typical experienced jumper's choice in a style or model of canopy may also be examined in the same way. A smaller jumper gets plenty of responsiveness from their smaller canopy. Therefore, it is likely that they will be less attracted to the quick responses of a highly elliptical canopy, and instead will prefer a more conservative model of canopy. This will allow them to go quite small on the canopy to get the speed they may want, but without getting handling that is too "twitchy".
1. Until very recently, very small canopies were not available to the smaller jumpers who wanted to experiment with very high wing loadings. Now that V. Conclusions:
As you can see, the answers to the questions in the quiz are all false. We must be very careful when discussing canopies with those who are downsizing. Do not recommend specific canopies to individuals without spending some time to learn about the jumper's particular frame of reference. Assist others in making small changes in canopy size from what they are used to, and only if they're ready to deal with the higher speeds and more agile handling. Have fun, but be careful!
they are becoming more common, lighter jumpers are often encouraged to downsize to similar wing loadings as their heavier counterparts. They are often pressured to downsize against their own judgment
2. We need to consider the fact that at equal wing loadings, the smaller jumper has a much more responsive canopy than the heavier jumper has ever had to deal with. This responsiveness of the small canopy tends to magnify small errors in technique. A larger jumper, at a similar wing loading, is flying a larger canopy, which will tend to minimize the effect of small errors in technique.