

Reserve Information and Flight Characteristics

1. Introduction

In 1986 Performance Designs began an effort to build a better reserve. PD was still a very small, very new company back then, but they had successfully developed tandem canopies for the Relative Workshop and their line of sport main canopies were becoming extremely popular. Bill Coe, PD's founder and president, and John LeBlanc, the company's vice president, believed they could also design a reserve that would be structurally and aerodynamically superior to the ones that were available at the time. They wanted to create a reserve that was built better, would open better, fly better, and land better than any other reserve on the market.

They succeeded in achieving this goal. In 1989 the PD Reserve was approved by the Federal Aviation Administration (FAA). This reserve set new standards for quality and performance when it was first introduced, and more importantly, it has withstood the test of time. By 2003 PD had built over 30,000 reserves and had introduced several new sizes to the product line, all based on the original, proven design. You will find countless skydivers, riggers, and equipment dealers around the world who feel that PD Reserves are, without a doubt, the best reserve canopies you can buy.

2. General Information

The PD Reserve is a rectangular 7-Cell canopy available in sizes ranging from 99 to 281 square feet. It is made from 0-3 cfm low-porosity ("F-111" type) fabric, and is available with Dacron lines or Spectra "Microline". The 7-cell design and low-porosity fabric create a smaller pack volume for a given size. We have also found that this fabric does not tend to stick together when packed for long periods of time, compressed, or exposed to extreme temperature changes. For this reason, we also use non-coated lines on the PD Reserve instead of the coated lines found on our main canopies. PD Reserves have additional span-wise and chord-wise reinforcement to increase their strength. They have successfully been test-dropped at weights and speeds considerably higher than those required for FAA certification.*

3. Openings

A reserve needs to open quickly at low airspeeds, in case you have to break away from canopy that is malfunctioning but still flying very slowly. You might also have to deploy your reserve at terminal velocity, so it must open quickly but comfortably at higher speeds, too. In most cases, the FAA requires a reserve to open within either 300 feet or three seconds from the time the container opens. It must also be able to survive three drops at a weight and speed at least 20% higher than the maximum placarded weight and speed.*

PD Reserves provide good openings throughout this entire spectrum. They open quickly and reliably at both high and low airspeeds, but without an excessive amount of force. Although the openings at terminal velocity are considerably faster than most main canopies being used today, even camera flyers wearing multiple cameras on their helmets have been comfortable deploying their PD reserves at terminal velocity after a total main malfunction.

* IMPORTANT NOTE: The FAA requires reserves to be tested beyond their placarded weights and speeds to provide an additional margin of safety. PD Reserves have been tested beyond the FAA's minimum requirements to increase this margin; however, you should NEVER exceed the maximum placarded weight for a reserve, or deploy it at a higher airspeed than the maximum placarded speed. The deployment time and altitude described here should not be used to determine a minimum safe altitude for reserve deployment. You should always perform emergency procedures at or above the minimum altitude recommended in USPA's Basic Safety Requirements or according to the recommendations of your country's national parachute association.

4. Flight Characteristics

A Note on Comparing Canopies: When describing the performance characteristics of a particular canopy, it is important to consider a person's frame of reference. Your impression of your reserve's performance will be influenced by the size and type of main canopy you normally jump, and by other canopies that you have jumped in the past.

The way your main canopy is "set up" can also affect your impression. Two identical canopies will perform differently if one has the toggles attached at the location specified by the factory, but the other has had the steering lines shortened a few inches. There may be differences between a canopy with new lines and one that has several hundred jumps on the line set. There will also be significant differences between a main canopy that has a collapsible pilot chute and one that does not, even if both are fairly large canopies.

It's also important to remember that a main and reserve may have very different flight characteristics if they are significantly different in size.

Straight Flight at Full Glide: A PD Reserve will fly at about the same airspeed as most main canopies of a similar size. In other words, if you are jumping a Spectre 150, Stiletto 150, or a 150 Sabre2, the full glide speed of a PD-143 Reserve will not be drastically different. However, the glide angle may be very different. The PD Reserve has a relatively flat glide for an "F-111," 7-cell canopy, but it does not glide as far as many zero-porosity main canopies will.

Straight Flight in Brakes: Early ram-air canopies tended to "sink," or descend at a steeper glide angle, when they were flown in brakes. Canopies made for disciplines such as traditional accuracy are still designed to do this, but modern "high performance" main canopies usually perform very differently. Many canopies being used today descend more slowly, or "float," when flown in brakes, and will actually glide farther in many situations when flown this way.

A PD Reserve will tend to float when a small to medium amount of brakes are used, descending more slowly than it does at full glide. On a no-wind day, or with the wind at your back, you may glide slightly farther this way. Once the toggles are pulled down past a certain point, the canopy will start to sink like a traditional accuracy canopy. However, it may only take a small amount of toggle input to pass from a sink into a stall, especially if you are jumping a small reserve or have a high wing loading. You should be very careful about flying in brakes close to the ground unless you are very familiar with the flight characteristics of the canopy you are jumping.

Stall Characteristics: A canopy will stall when the toggles or back risers are pulled down to a certain point called the "stall point." When a canopy stalls there is a dramatic decrease in lift: the canopy basically stops "flying" and starts to descend very quickly. The stall point of a particular canopy will depend mainly on the size and design of the canopy. A smaller canopy will tend to have a higher stall point, meaning you will not need to pull the toggles down as far to make the canopy stall.

Modern zero-porosity main canopies often have a very low stall point. A large zero-p main might not stall even when the toggles are held all the way down, and the stall point of a smaller canopy may still be at a very deep toggle position. A reserve of a similar size will usually have a higher stall point.

The PD Reserve will drop back into a stall rather quickly once you reach the stall point, but will also recover quickly when the toggles are let back up, repressurizing cleanly and returning to normal flight. Like any canopy, the PD Reserve will surge and dive for a few seconds if the toggles are let up too quickly. Stalls and other radical maneuvers should obviously be avoided close to the ground.

Toggle Turns from Full Glide: If you have been flying a rectangular zero-p canopy like the original PD Sabre, or even a slightly tapered canopy like the Spectre or Sabre2, your PD Reserve will probably feel slightly more responsive when making toggle turns. This may be true even if the reserve is slightly larger than your main. Although the reserve may seem to turn a bit more quickly, the response will still be smooth and predictable. You might also notice that the reserve turns in a slightly tighter radius.

If you are jumping a highly tapered or "elliptical" type canopy such as the Stiletto, the PD Reserve might still feel fairly responsive, but probably not as responsive as your main. The reserve may feel like it doesn't dive as much at the start of a turn, and will not react as much when you shift your weight in the harness.

Toggle Turns in Brakes (Flat Turns): Flat turns are an important technique to learn on any canopy. By pulling the toggles down to the _ brake position, then slowly raising or lowering one toggle to start a turn, you will lose much less altitude than when making a turn from full glide. Like many 7-cell canopies, the PD Reserve is very responsive in braked flight. It tends to bank (roll to the side) less when making flat turns than most 9-cell canopies. It can be very easy to make precise turns and heading adjustments when flying a PD Reserve in brakes.

Rear Riser Inputs: The rear riser pressure is relatively high on a PD Reserve, and turns made using the rear risers may feel slow compared to your main. It is still quite possible to steer a PD Reserve using the rear risers, but it may require more effort to do this than your main does.

Recovery Arc: A maneuver such as a riser turn or toggle turn will cause a canopy to dive toward the ground. Even pulling the toggles down and letting them up quickly will cause a canopy to dive. "Recovery arc" is a term used to describe the amount of time and altitude a canopy takes to recover from a dive and return to normal flight. The PD Reserve has a short recovery arc, meaning it recovers quickly from a dive. By comparison, some higher-performance canopies designed for highly experienced jumpers have a very long recovery arc, and will require much more altitude to recover from a similar maneuver. It is important to remember that a canopy's recovery arc is also affected by wing loading: a higher wing loading generally causes the recovery arc to become longer.

Landings: Many people will find it easier to land a zero-p main than a canopy of the same size made from "F-111" type fabric. Most zero-p main canopies can create more lift during the flare than an "F-111" canopy, and a zero-p main may be more forgiving if you don't time your flare correctly. Smaller canopies generally require more skill to land than larger ones, so the difference between landing a small zero-p main and landing a small "F-111" reserve will be even more noticeable than the differences between larger ones. In spite of these differences, there are a number of advantages to building a reserve from "F-111" type fabric, and significant disadvantages to using zero-p fabric.

The PD Reserve still offers excellent flare performance compared to other canopies of the same type. Most people are pleasantly surprised by how well a PD Reserve performs, and soft, stand up landings are common even for people who are landing a reserve for the first time. Our test jumpers have successfully landed PD Reserves at wing loadings of over 2.2 lbs./sq.ft.; however, these landings were performed by expert canopy pilots who were very familiar with the reserve's flight characteristics, and the jumps were made under controlled conditions.

The first time you fly your reserve, it is likely to be under very different conditions. Most skydivers jump with reserves that are at least slightly smaller than their main canopies. Your reserve may in fact be the smallest canopy you have ever jumped, and it may be the first time you have flown a 7-cell "F-111" canopy. You are likely to be at a lower altitude than normal, and may not have much time to practice flaring or explore the canopy's other flight characteristics. Your adrenaline level may also be slightly higher than normal. All of these factors should be considered when choosing the size reserve you will jump with.

Any time you use your reserve, you should do at least one practice flare before your actual landing if at all possible. Determining if you can reach your intended landing area should always be your first priority. If not, you must immediately locate a safe, open landing area that is clear of obstacles. You must be able to reach your landing area at a safe altitude to avoid making a low turn on to final approach. If you still have enough altitude after these objectives are met, then do at least one practice flare. If you have lots of altitude, you should do several practice flares. Even if you are able to do several practice flares, you should always be ready to perform a Parachute Landing Fall when landing an unfamiliar canopy.

5. Reserve Sizing

There are several factors to consider when choosing the size of your reserve. The most important factor to consider is the maximum exit weight limit for a particular size. Many jumpers exceed the maximum weight limit for their main canopies. While this may be foolish, it is not illegal. **The maximum exit weight for a reserve is a legal limit.** In the United States, it is a violation of federal law to jump a reserve if your exit weight exceeds this limit, and other countries may enforce this limit as well. The maximum exit weight is published on the Warning Label sewn to the tail of every PD Reserve, in the PD Series Ram-Air Reserve Owner's Manual, and in the product information on our web site at www.performancedesigns.com.

Even if you are a highly experienced skydiver, you need to be cautious if you plan to jump with a small or highly loaded reserve. We recommend a minimum of 300 jumps on ram-air canopies before using a reserve that will be loaded more than 1 lb/sq.ft., including at least 50 jumps on a canopy no more than 15% larger than that reserve. **There are additional skill and experience requirements that** *must* be met if your wing loading will be greater than 1.4 lbs./sq.ft. These requirements are listed in the *PD Series Ram-Air Reserve Owner's Manual*, along with additional information about reserve sizing, wing loading, and their effects on a reserve's performance.

If you fly a highly loaded main canopy you may need to choose a larger reserve to stay within the reserve's weight limits. However, in most cases it is best to choose a reserve that is close to the size of your main. If your reserve is more than 15% smaller than your main, there will probably be dramatic differences between the canopies' flight characteristics. In the mid-1990's PD conducted a series of tests to investigate dual-square situations, where both a main and reserve were open at the same time. We found that these situations are usually easier to handle when the main and reserve are similar in size. The results of these tests were published in the *Dual Square Report*, which can also be found in the Education section of our web site.

The best way to find out how any canopy performs is to jump that specific size and type of canopy. Performance Designs has demo Reserves available, allowing you to find out how a certain size PD Reserve will fly and land before you buy it. Our demo Reserves are identical to actual PD Reserves, except they are attached to main risers and built with pilot chute attachment points so they can be jumped as main canopies (since PD Reserves were designed specifically to be used as reserves, they normally do not have pilot chute attachment points). We encourage you to take advantage of this opportunity to "fly before you buy." Jumpers in the USA can contact us by phone at (386) 738-2224 for more information about our reserve demos. European skydivers should contact one of our European Demo Centers, and information is also available on our web site.

| PD Reserve Sizing Chart | | | | | | | | | | | |
|---|------------------|---------------------------|----------------------------------|-----------|-----------|------------|------------|-----------|-------|-------|--------|
| The weights listed below are the MAXIMUM weight limits for each category and size. There are many reasons why you might wish to stay below the maximum limit for your canopy. It is perfectly acceptable for your weight to be below these limits, as long as wind and landing conditions permit. | | | | | | | | | | | |
| CANOPY MODEL | AREA (SQ.FT.) | MINIMUM EXIT WEIGHT | MAXIMUM EXIT WEIGHT – LBS / (KG) | | | | | | SPAN | CHORD | ASPECT |
| | | | STUDENT | NOVICE | INT. | ADV. | EXP. | MAX. | (FT.) | (FT.) | RATIO |
| Reserve-99 | 99 | VLC | N/R | N/R | 99 (45) | 119 / (54) | 149 / (67) | 220 (100) | 14.42 | 6.87 | 2.1:1 |
| Reserve-106 | 106 | VLC | N/R | N/R | 106 (48) | 127 (57) | 159 (72) | 220 (100) | 14.92 | 7.10 | 2.1:1 |
| Reserve-113 | 113 | VLC | N/R | N/R | 113 (51) | 130 (59) | 149 (68) | 220 (100) | 15.40 | 7.30 | 2.1:1 |
| Reserve-126 | 126 | VLC | N/R | N/R | 126 (57) | 145 (66) | 176 (80) | 254 (115) | 16.27 | 7.75 | 2.1:1 |
| Reserve-143 | 143 | VLC | N/R | 122 (55) | 143 (65) | 165 (75) | 200 (91) | 254 (115) | 17.33 | 8.25 | 2.1:1 |
| Reserve-160 | 160 | VLC | N/R | 136 (62) | 160 (73) | 184 (84) | 224 (102) | 254 (115) | 18.33 | 8.73 | 2.1:1 |
| Reserve-176 | 176 | VLC | 150 (68) | 150 (68) | 176 (80) | 202 (92) | 246 (112) | 254 (115) | 19.22 | 9.15 | 2.1:1 |
| Reserve-193 | 193 | VLC | 164 (75) | 164 (75) | 193 (88) | 222 (101) | 254 (115) | 254 (115) | 20.13 | 9.59 | 2.1:1 |
| Reserve-218 | 218 | VLC | 185 (84) | 185 (84) | 218 (99) | 235 (107) | 254 (115) | 254 (115) | 21.40 | 10.19 | 2.1:1 |
| Reserve-235 | 235 | VLC | 200 (91) | 200 (91) | 235 (107) | 254 (115) | 254 (115) | 254 (115) | 22.22 | 10.58 | 2.1:1 |
| Reserve-253 | 253 | VLC | 254 (115) | 254 (115) | 254 (115) | 254 (115) | 2254 (115) | 254 (115) | 23.05 | 10.98 | 2.1:1 |
| Reserve-281 | 281 | VLC | 281 (128) | 281 (128) | 281 (128) | 300 (136) | 300 (136) | 300 (136) | 24.29 | 11.57 | 2.1:1 |

VLC = Varies with weather and landing conditions. N/R = Not Recommended.