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DUAL SQUARE REPORT

In early 1992 the U.S. Army Parachute Team, in conjunction with PIA, conducted a series of test jumps on the flight characteristics of two square parachutes (main and reserve) in flight at the same time. The study was undertaken in an effort to evaluate the ram-air canopy as main and reserve for student use. The Army was interested, also, because some of their troops use square main/square reserve equipment.

The Army had planned on making about 50 jumps but was only able to do about 10. The canopies used were 288 sq. ft. Mantas with Raven III (249 sq ft.) and Raven IV (282 sq ft.) reserves. On the jumps conducted, the reserve was deployed manually while under a fully inflated and flying main.

In late 1992 and into 1993, Scott Smith made an additional 21 jumps using Crickets (147 sq ft.), Fury (220 sq ft.), and Sharpchuter (244 sq ft.). The jumps were performed along the same lines as the Army tests with basically the same results and conclusions.

Both of these studies, while encouraging, were felt to be inconclusive by the PIA technical committee. Chairman of the committee, Sandy Reid, said that "In order to do a complete study, other canopy combinations need to be jumped such as: large main/small reserve, large reserve/small main, and small main/small reserve." "In addition, we need to consider factors such as line lengths, zero porosity fabric, and wing loading."

In 1994 Performance Designs Inc. proposed to the technical committee a series of test jumps designed to fulfill these unanswered questions. While realizing it would be an impossible task to test every conceivable canopy combination and situation, the tests were an effort to get a good cross section of possibilities.

Both the Army Parachute Team and Scott Smith came up with conclusions that still stand true. Our test jumps allowed us to verify much of what they submitted and give additional input.

The following is the report on those test jumps:

DUAL SQUARE TEST EQUIPMENT

The equipment used in the dual square test jumps was extensively thought through and planned. Every jump was conducted using a three or four parachute system. When deploying a canopy while under its fully deployed mate, the appropriate container and pack tray were used as well as normal riser lengths, and deployment systems. This was done to gather the most accurate data possible.

Note: During the 12 intentional cutaways from a biplane, the reserve was deployed using a hand deploy pilot chute with a main d-bag modified as a free bag. This was done to save on the loss of expensive spring loaded pilot chutes and free bags. The cutaway was being evaluated in these scenarios, not the deployment.

In all except the simultaneous/near simultaneous tests jumps both the main and reserve were on risers that had the capability to be cutaway. A chest mounted back up reserve was worn that was not capable of being cut away.

During the simultaneous/near simultaneous deployments a special system was assembled that would house 4 canopies. Two would be deployed from their normal locations. One of these could be cut away separately or they could both be cutaway together. The third parachute if needed could also be cutaway, and the fourth was on risers that could not be cutaway.

Great care was used to assemble this equipment in such a manner that the sequence of deployment and breakaway would be in as much a normal sequence as possible.

Common Results of a Dual Square Deployment

The most likely canopy configuration from a simultaneous or near simultaneous deployment is a **biplane** with the main canopy in front and the reserve in the rear.

*A **biplane** is both canopies flying in the same direction with one behind the other. Excluding extremes, the shorter rear canopy's leading edge rests against the steering lines below the trailing edge of the taller front canopy.*

The next most common configuration is a **side-by-side** with the main risers behind the reserve risers.

*A **side-by-side** is both canopies flying side by side in the same direction. They are usually touching end cell to end cell, or the end cell of the shorter canopy resting against the outside lines of the taller canopy.*

Another fairly common configuration would be a fully inflated canopy (either main or reserve) with a **trailing pilot chute, p.c. and bag, or trailing uninflated second canopy** behind the jumper. This scenario if left unattended would sometimes remain as it is, or result in one of the other configurations.

A less frequently occurring configuration is a **downplane**.

*A **downplane** is both canopies flying away from each other and toward the ground.*

Another infrequent configuration is an **entanglement** of the two canopies.

Note: Some people have always believed that you must choose a reserve that is smaller than the main. While this is probably a safe thing to do it is not an entirely accurate gauge. For example: a PD-143R has shorter lines than a STILETTO 135. This combination flew well in a biplane with the main in front. 7 cell canopies typically have shorter lines than equally sized 9 cells.

Conclusion: Use great care to choose proper equipment. Choose a reserve that is similar in size to the main canopy.

THE BIPLANE

From looking at the simultaneous/near simultaneous deployment results, as well as numerous reports from the field, the biplane with the taller main canopy in front and the shorter reserve in the rear, is the most common result of both canopies deploying. This personal biplane seems to be stable and easy to control.

Several combinations of canopies were used in the test jumps with some being greatly mismatched. Canopies with a difference of 100 sq ft. or more could cause results out of the norm. We consider this type of combination to be extreme and not advisable.

The most commonly preferred method of flying the personal biplane is to leave the brakes stowed on the rear canopy and fly the front canopy using smooth, gentle toggle input. A few canopy combinations were reported to be slightly more solid with the brakes released on both canopies, but the majority seemed to be most solid with brakes set on the rear canopy.

With the canopies in a compatible biplane it did not seem necessary or wise to attempt to move the configuration into a side by side to cut away the main canopy. In moving one canopy or the other to a side by side it always seemed necessary to maintain outside input to one canopy or the other, or both, to keep them in that configuration. They seemed to always want to return to a biplane. Cutting away while the canopies are returning to a biplane could be dangerous.

In addition while maneuvering canopies back and forth between side-by-sides and biplanes there were times when the two canopies tried to foul with each other or did in fact foul with each other. It does not make any sense to take a docile, maneuverable, and landable biplane configuration and try to change it.

Landing a personal biplane proved to be easy with large canopies, small canopies, heavily loaded canopies, and lightly loaded canopies. Flaring the front canopy seemed to be the preferred method of landing. However it must be noted that flaring the front canopy, or both, did not produce a significant effect in the landing. The canopy would pitch in attitude, but it did not plane out or slow in descent rate much if at all. The descent rate on all canopy combinations was very slow, even in full flight.

Recognizing the student and novice jumper's propensity to flare high, combined with the noneffectiveness of a dual square flare, leads us to believe that not flaring at all is the best way to land a dual square.

Conclusion: *If a biplane is present and the jumper has directional control, leave the brakes stowed on the rear canopy and fly the biplane using gentle toggle input on the front canopy. Do not flare either canopy for landing. Be prepared to do a PLF.*