"FIND YOUR SWEET SPOT"

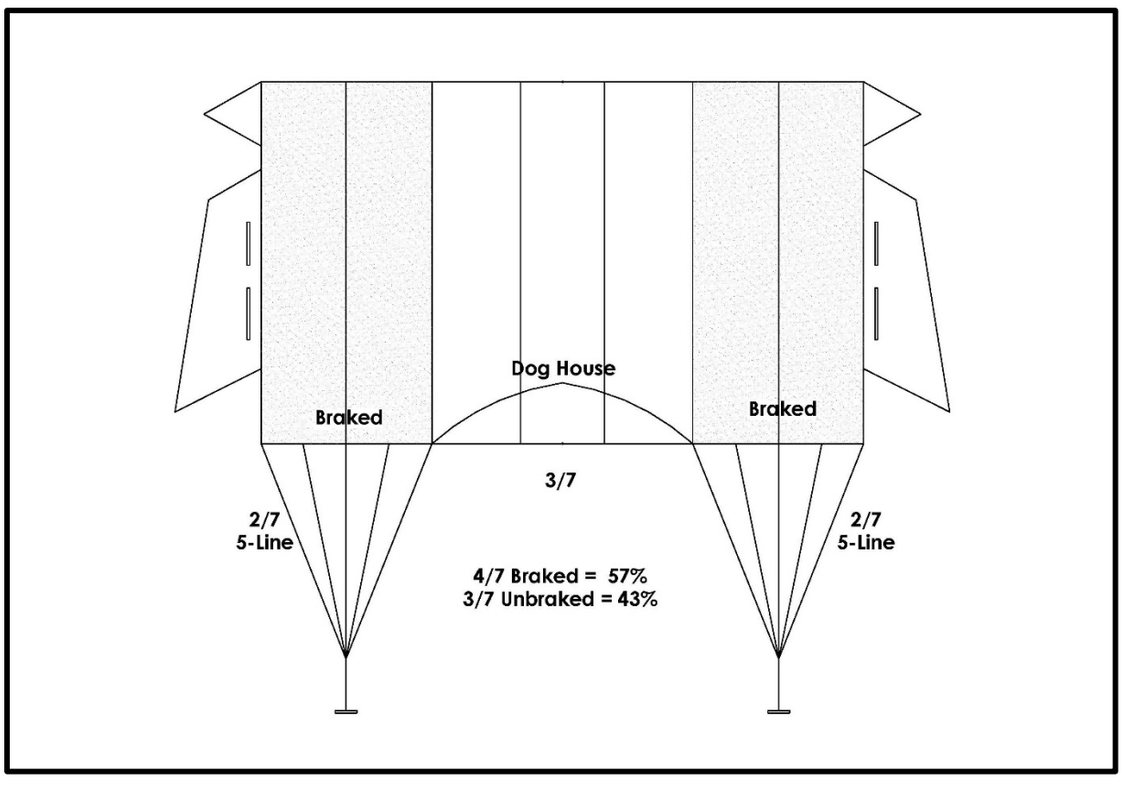
The Plus Mod ™ ("Mod" for modification) is the invention of James Hayhurst, noted precision accuracy canopy designer (co-designer of the Eiff Classic and PD Zero) and long-time accuracy competitor, informally known as "The Canopy Doctor"—an expert at fine-tuning any accuracy canopy to make it fly better, finding "the sweet spot" for its owner—that combination of line trim, braking and venting that gives the best all-around performance.

The Plus Mod is the pinnacle of this quest for "fine tuning" performance—a collection of modifications that work in harmony to optimize your canopy's performance, to give you that "sweet spot." None of the modifications change the fundamental way your canopy flies, nor are any irrevocable—you can use them or not use them—even after installation of the mod. The Plus Mod improves any accuracy canopy—Eiff Classic, NAA Parafoil, PD Zero, Spekon RL-16/3 series, and so on.

How does it work? What does it do?

The first part of the modification involves the braking system. Accuracy jumpers have long used various combinations of steering line on the tail of their canopies—the standard being five upper lines per each main steering line, starting from the corner of the trailing edge (TE)—a steering line set-up known as "5-line steering" (10 total upper steering lines, five per side).

In the center, between the upper brake/steering lines is a gap, an unbraked portion of the TE, with the nickname "the doghouse," because in flight, without steering lines holding it down, this portion of the canopy looks something like the opening to a doghouse (when viewed from behind, not so obvious when viewed from the front). This unbraked/center of the canopy TE represents 43% (3/7ths) of the TE of a 7-cell accuracy canopy. Hence, 57% of the TE is braked:

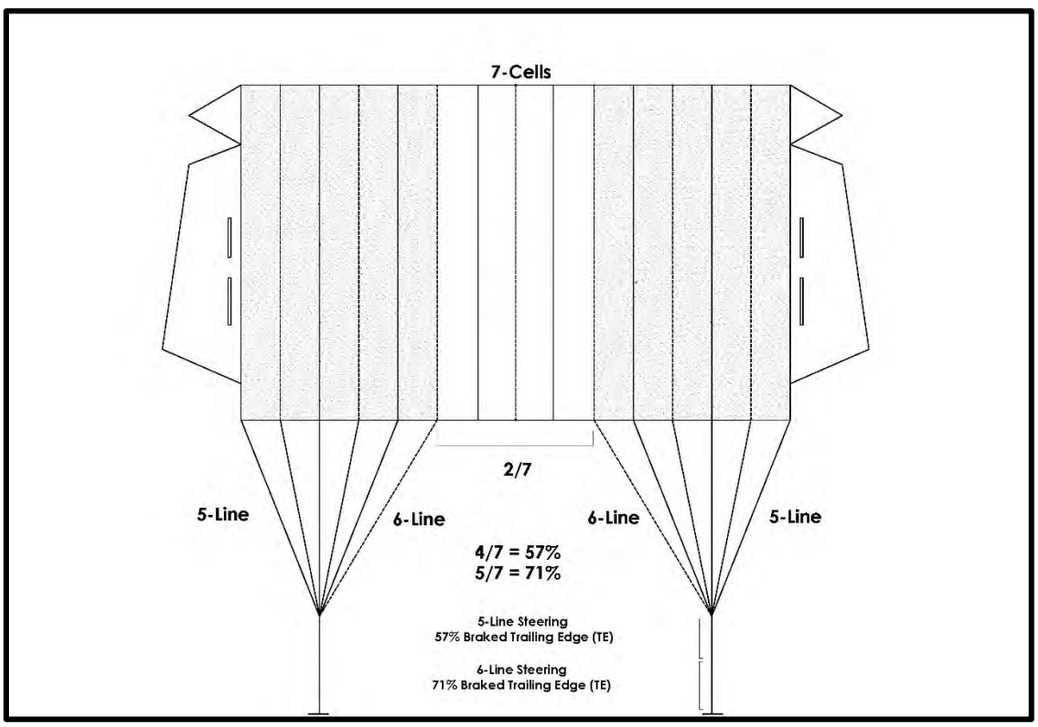


Over the years, competitors have learned that by expanding the braked portion of the TE to six lines on each side ("6-line steering") they get more "braking power," with a quicker stop, avoiding putting the canopy in a prolonged sink (aka "long drop") in order to transition down to the scoring pad—especially important in light winds.

(Side note: The transition of an accuracy canopy from flight to the "drop" in the last seconds onto the scoring pad, consists of two parts—Part 1, the "stop," and Part 2, the "drop." The drop occurs when airflow separates off the top of the airfoil. Prior to that, the "stop" occurs because the TE (trailing edge) is deflected down, creating drag, like the flaps on an airplane.

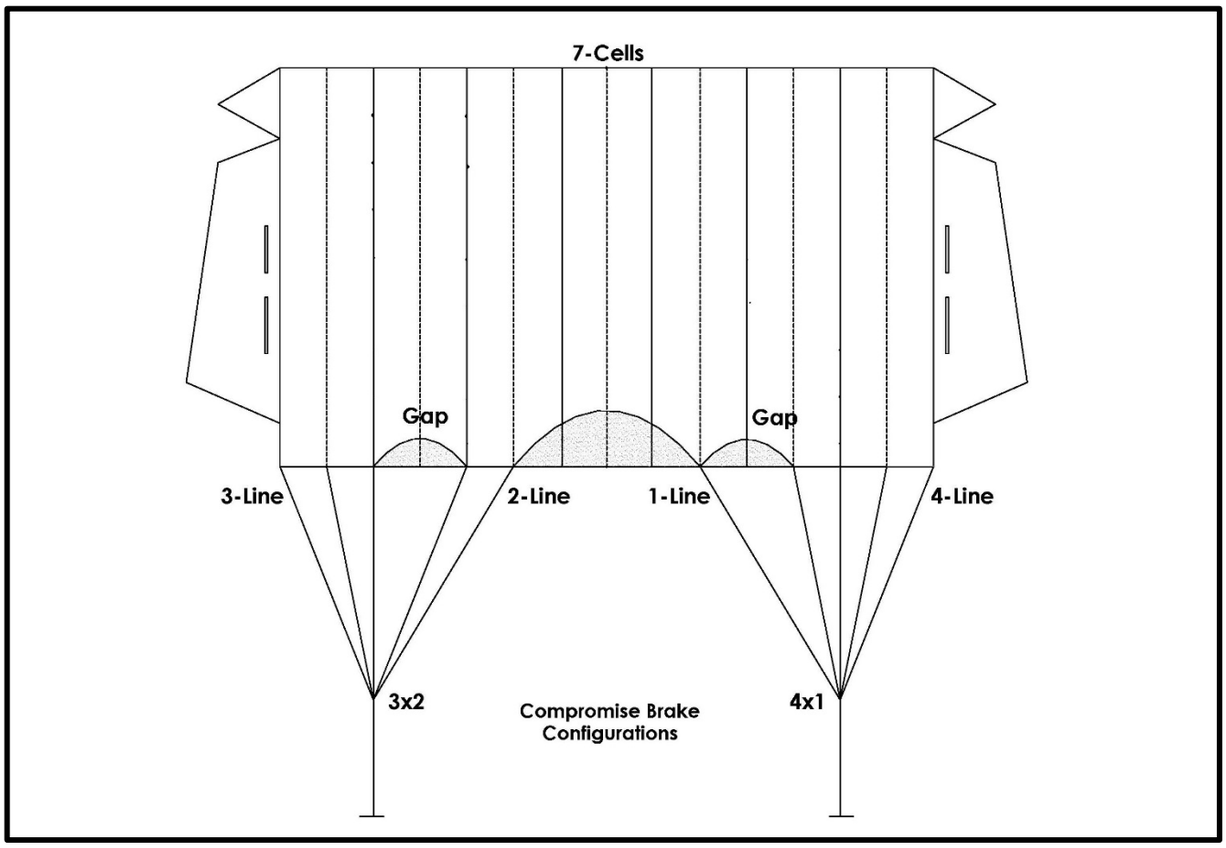
The more "Part 1" stop, the less "Part 2" drop required—the competitor can approach the tuffet in a comfortable 66% braked mode (with "overfly") and then, near the end, slow to 100% braked, putting the jumper in an ideal position to "drop" the canopy on a small vertical distance (by further deflection of the controls) and thereby drop only 1 to 3 meters onto the scoring pad (short drop). If the canopy is configured with 5-line steering, the competitor has to fly a higher approach in low winds, slow it down as much as they can, then do a longer drop (3 to 5 meter drop) down to the pad. A longer drop means more acceleration and faster closure.

Obviously, a shorter drop is desired for slower closure rate and precision of foot placement to get the desired "zero-point-zero-zero" score (0.00m). Therefore, 6-line steering is desired and considered superior, especially for more heavily loaded canopies in all conditions, and for every canopy (regardless of wing loading) in low winds.



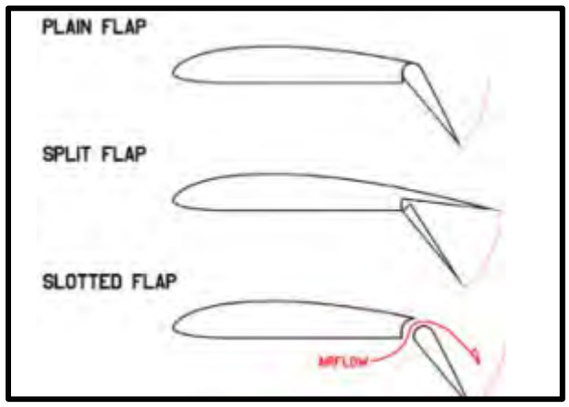
Designers know that at the heart of all design is compromise. You make a change like 6-line steering to get a better stop, but at the cost of less overall forward speed in full flight, and less stability in turbulence. Remember that 3-cell doghouse with 5-line steering? That big hole in the middle of the TE lets a lot of air pass through, giving approximately 1 m/s greater forward speed in full flight, and allowing air to flow through the center of the canopy during all modes of flight, improving overall stability. In summary: 5-line steering provides faster top-end speed and greater stability in turbulence and during "long drops." The 6-line steering geometry with its small "doghouse" gets unstable after a short period of sink (more than 2 seconds). Not to mention, you lose approximately 1 m/s top speed.

To get around these limitations, for years, coaches/designers/competitors have tried alternate steering geometries, notably "3 & 2" and "4 & 1"—their concept being that a "venting" gap in the TE lets air flow through, while the overall span of the brake lines is same as 6-line steering:

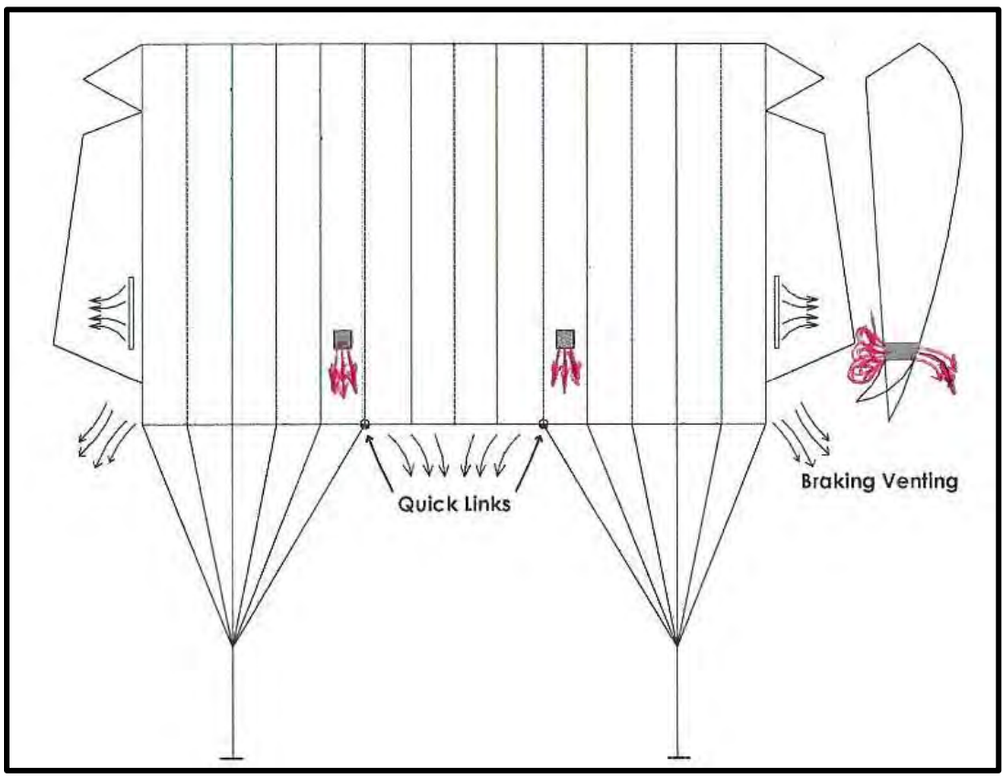


These are compromise solutions. They are the best solution the accuracy community has come up with to date. But what if you could have the best of both 5-line and 6-line steering geometry?

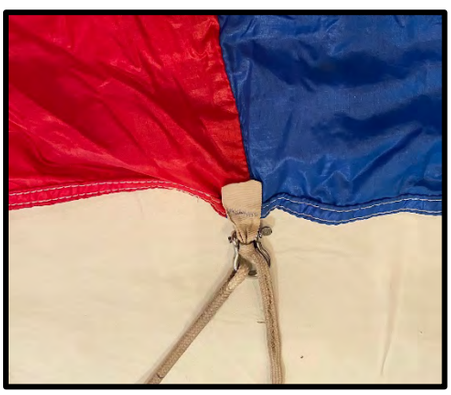
That question is the heart of the Plus Mod braking solution—which entails using 6-line steering, with venting of excess air during deep braking excursions through a "chimney" vertical vent positioned in the ideal location to capture excess air during dynamic braking and vent it through the chimney in the tail, much like the gap in a slotted flap or fowler flap.



This diagram portrays the various flows for air during dynamic braking—air flows out the wingtip vents, the gap between the rear wingtip and the trailing edge corners, through the "doghouse" in the middle, and out the "chimney vents" between the 5th and 6th steering line. The net result is the advantage of greater stopping power with 6-line braking geometry, but with stability provided by the additional braking vents. Further, during prolonged sinks, as the canopy depressurizes, the two chimney vents expand and grow larger, allowing even more air to flow through—allowing a stable sink during prolonged "long drops."



In addition, the inner (6th) line is attached with a quick-link, allowing the competitor to move it to the 5th line attach point in a matter of seconds—most particularly if they anticipate high-wind jumps. With the 6th line moved to the 5th line attach point, forward speed increases approximately 1 m/s (2.2 mph). Voilà! . . . you have the best of both steering geometries, normally 6-line with the special "Plus Mod" vents; then for high-winds—5-line braking.



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Now, to the second part of the Plus Mod—the "Super Soft Cells." Traditionally, "soft cells" are made via ports cut in the bottom of the canopy, to depressurize that half-cell (and through the rib cross-ports, depressurizing the entire canopy to an extent). This also reduces the braking pressure to a small (~8%) degree—by reducing the tension on the lines attached on either side of the "soft cell" (technically, a half-cell). You can see the open "soft cell" ports in this photo:

The problem with soft-cell ports has always been that it's *permanent*. Once you cut the ports open, they're open full time—which improves stability in turbulent conditions, but with the negative side effect of a higher descent rate in low wind situations (after all, there are two holes in the bottom of the canopy). A canopy with soft cells flies approximately 8% "smaller" than its originally designed size, due to overall canopy depressurization, which is visible to the eye, presented as increased nose-in wedge shape (nose smaller than the tail).

What if you could have both? Soft cell <u>closed</u> for smooth light winds, open for all other jumps? This is other main benefit of the Plus Mod: ***pilot-controlled soft cells*** (aka, "super" soft cells).

How? Well, after considerable experimentation & trial-and-error, a solution was found: put the soft-cell port on the ***top*** of the airfoil, with an internal flap and return mechanism to make sure it stays closed when you want it closed. It's easy to operate. Two small handles on the rear of the front risers are connected to control lines going up to the internal flaps.

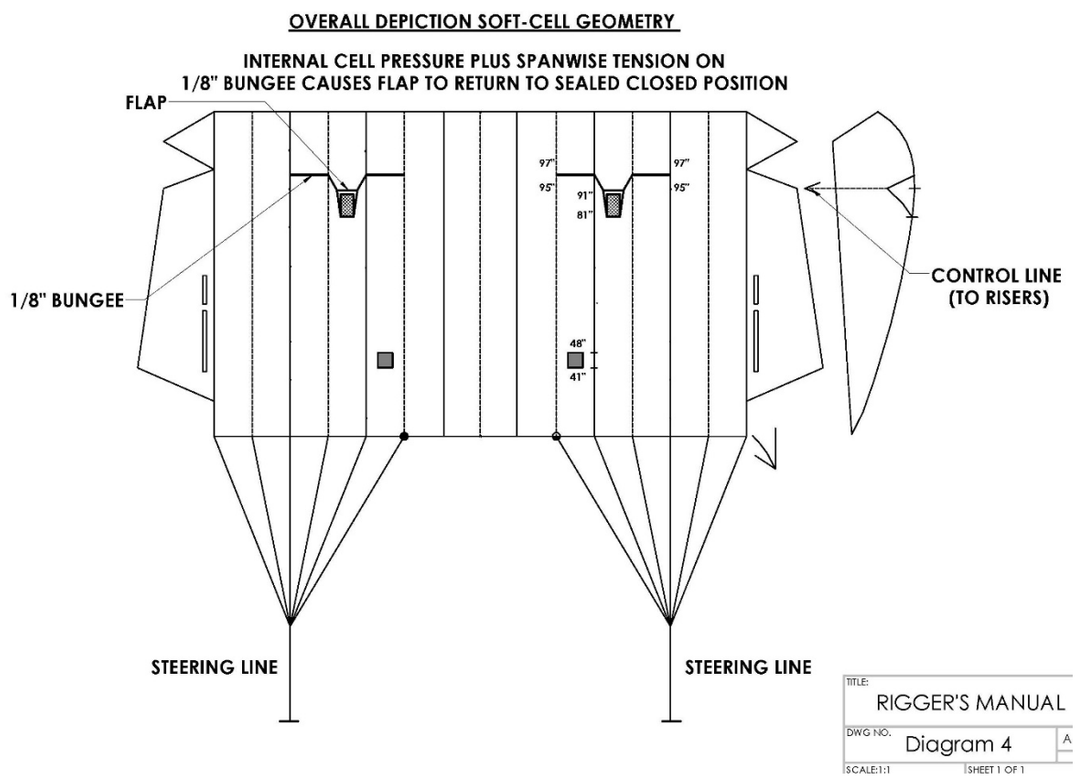
Operation is easy—a quick tug-and-set motion—two seconds per side. Or, if you wish, having jumped with the soft-cells in various open configurations, you can attach the control line directly to the front connector link and make it permanent. (Note: opening shock is noticeably less with the super soft cells open—they vent internal canopy pressure out during the inflation. This is something the #1 person on a team stack can take advantage of for comfort. Conversely, the last person on the team should have the super soft cells closed to insure quicker inflation).

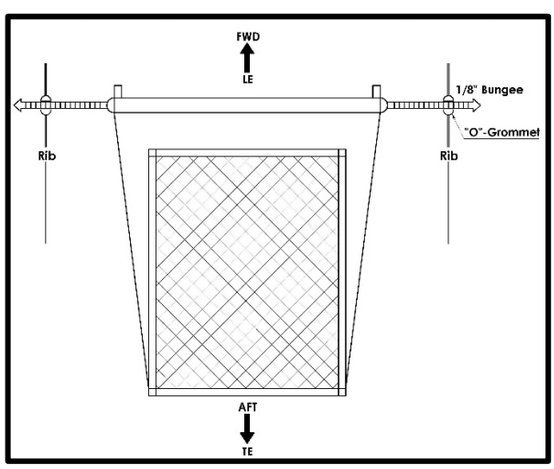
The pilot-controlled design allows you to jump the canopy with the soft cells closed in light winds—giving you the "largest" possible canopy (its original design) and the slowest possible descent rate. Leave them closed for light wind approaches (winds <1/m/s) and open them the rest of the time. All it takes is to pull the handles down and snap them in place.

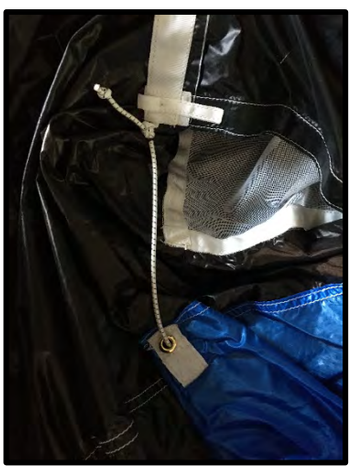
With the super soft cells open, you'll notice a distinct difference, much more than when the soft cell port is on the bottom. It *really* makes the canopy handle better, gives it a "rock solid" feel—especially in turbulent/tricky conditions. If after opening, the air feels bumpy and

unstable, open the soft cells—it's that simple. Decide to return them to closed during flight? Only takes a second—pop both the handles off their snaps. An internal return mechanism and the internal pressure of the cell instantly return the flaps to their full-closed position.

Depicted below is the SSC flaps and return mechanism. A 1/8" bungee on either side of each flap becomes tensioned when the canopy is inflated. This spanwise tension acts to pull the flap up and seal it against the upper/interior topskin of the canopy, underneath the mesh vent. Between the bungee and internal cell pressure, and because the flap is hinged in the aft portion, aerodynamic peak forces near the peak of the airfoil create a powerful force to seal the flaps. Only sustained pull on the control lines (which are "set and forget") can keep the flap deflected downward inside the cell, in the interior of the canopy). The open flap allows depressurization of the half-cell, and through the cross-porting between ribs, the entire canopy:







The third part of the Plus Mod is a refinement of the nose-down trim and the rear wingtip vent. First the trim—with 6-line steering and the brake vents, the canopy can benefit from a slightly lower nose position, specifically the interior A-lines: A-2 through A-7. They are shortened ¾". This slight increase in nose-down gives the canopy more "power" (dynamic pressure) which would normally increase toggle pressure, but with the brake/chimney vents, toggle forces remain the same. This slightly lower nose position helps in making sinking turns to the pad, not uncommon in tricky conditions when thermals cause sliding motion just above the tuffet.

Finally, adding a zipper (as it turns out, standard women's dress zippers work just fine—they are strong, light and flexible) on the rear wingtip vent is a great convenience, with lock tabs for the full-closed and 2/3rds open positions. This way, the rear wingtip vent can be "fine-tuned" for a jumper's wing-loading, helping them to find their "sweet spot."

So that's the Plus Mod:

1) Super Soft cells – pilot controlled in flight, or pre-set at a preferred vent opening.
2) Six-line braking/steering with braking vents (chimneys).
   —Quick link on 6th (innermost line) for easy movement to 5th tab for high winds
   —The 5th line is 10cm longer than the others (optimum for average wing-loading).
   —The 5th line can be shortened to find the jumper's ideal brake force "sweet spot."
3) Center six A-lines shortened ¾".
4) Rear vent zipper for ease of finding "sweet spot."

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