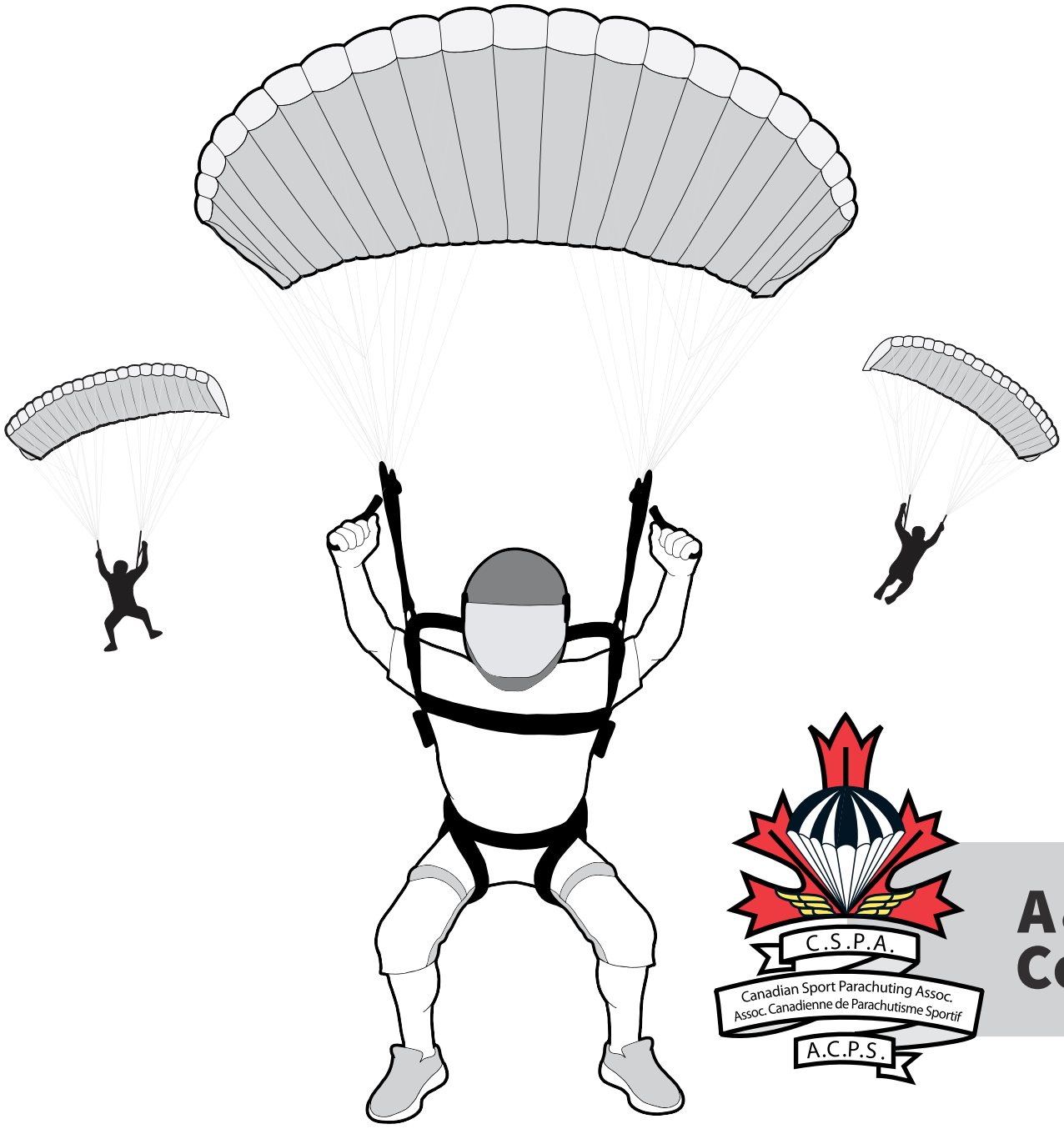
SPORT CANOPY ENDORSEMENTS



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LIST OF REVISIONS/CHANGES

DATE	SECTION	CHANGES
September 2026	Full Manual	Full revision
June 2024	Full Manual	Layout & additional graphics
January 2024	Full Manual	New graphics
April 2023	SCE A Skills List	Revision (flat turns)
April 2021	SCE A Skills List SCE B Skills List	Revision Revision
February 2020	Full Manual	Formatting revisions
November 2018	SCE A Skills List SCE B Skills List	Revision Revision
April 2018	Full Manual	First publication

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OVERVIEW

The transition from round canopies to square (ram-air) canopies in all areas of the sport, including the first jump, has led to the need to clearly specify what constitutes suitable training to fly ram-air canopies safely. Although the first jump course provides enough information to safely handle a student ram-air, further training and information is required prior to leaving the forgiveness of the student canopy and moving on to the less forgiving higher performance ram-air canopies. This endorsement was originally created in 1997 and has now been further expanded to make a safer environment for novice and experienced skydivers.

CSPA has developed the requirement for all jumpers to transition through the Sport Canopy Endorsement (SCE) system with specific training and skills requirements to be met along the way. This is to ensure a safe transition during training for all jumpers and to assist in their overall skills development and awareness. The SCE system is broken down so as to not overwhelm the novice and to gradually provide canopy knowledge appropriate to the level of the jumper. The A CoP is more focused on survival skills and improving accuracy, whereas the B & C CoP cover knowledge that will help refine knowledge and improve accuracy, as well as more appropriate information related to the canopy types/sizes that skydivers will be flying and the experience they will need for those types of canopies as they start downsizing to smaller canopies.

Coach 2s and SSEs have the privilege of administering and signing off this endorsement. Coach 1s and SSIs are part of the teaching process on the way to completion of the endorsement.

Coaches and novices should reference PIM 2B Section 6 and Sections 6.2 through 6.8.2 for additional information beyond what is covered here.

As canopy incidents are the leading cause of death and injury in the sport of parachuting, it is highly recommended that you also seek appropriate canopy coaching from a qualified and experienced coach. The information gained from canopy control courses given by third party providers can be a very good supplement to these endorsements.

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SPORT CANOPY ENDORSEMENT A

The SCE A primarily covers safety related information and basic survival skills in addition to and expanding on FJC and Solo canopy tasks. Coaches, instructors, and novices should be using the downsizing chart in PIM 2B to guide the downsizing progression, along with the skills outlined in these endorsements. There is a checklist associated with each of the SCEs to follow for the skills that need to be attained.

SPORT CANOPY ENDORSEMENT B

This endorsement is more focused on appropriate intermediate knowledge about downsizing, canopy types, and information that will prepare skydivers for Canopy Formation (CF), downsizing, improved landing patterns, and purchasing equipment. SCE B should also review SCE A material.

SPORT CANOPY ENDORSEMENT C

This advanced endorsement should be a conclusive review of the material from SCE A & B in addition to shaping skydivers to becoming coaches. The C CoP candidate should be prepared to sit with a Coach 2 or SSE and be able to provide the content of SCE A and B to the Coach 2 or SSE, as opposed to being taught the information covered here.

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A CoP - SPORT CANOPY ENDORSEMENT GUIDELINES

Signing off the SCE A states that the person has demonstrated enough skills and knows enough technical knowledge about canopies that they are now cleared to fly a canopy that would be considered a non-student canopy.

A novice's introduction to sport canopies is a crucial part of their survival training. One of the highest incidents of fatalities in the sport of parachuting in the past 10 years has been under a perfectly functioning canopy. It is important that coaches educate novice skydivers as early as possible, as these are the most formative moments of their skydiving career.

It is recommended that student/novice skydivers stay on rental gear from a dropzone (as long as the dropzone can facilitate this). They should use the downsizing chart to determine an appropriate size of canopy to fly until they have completed the SCE A, prior to considering purchasing their own gear.

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SPORT CANOPY ENDORSEMENT A: SKILLS LIST

Outlined below is a list of canopy control skills that a novice must learn and demonstrate. These skills are required to be signed off for the Sport Canopy "A" Endorsement required for the A CoP. Additionally, these are skills that should be done prior to and after downsizing.

SPORT CANOPY ENDORSEMENT A: SKILLS LIST

	SKILL	INSTRUCTOR/COACH
-	Complete the Sport Canopy "A" ground briefing	Coach 2 (C2), Coach 3 (C3) - Canopy Piloting (CP)
-	Complete 10 self-guided, stand-up, safe accuracy landings to within 30 m. of target	Coach 1 (C1), Competition Development Coach (CDC)
1	Conduct the "sweet spot" drill (above 2,000 ft.)	C2, C3 - CP
2	Demonstrate a 180° flat turn in both directions (above 2,000 ft.)	C1, C3 - CP
3	Demonstrate a 360° front riser turn (above 2,000 ft.)	C1, CDC
4	Demonstrate a 360° rear riser turn (above 2,000 ft.)	C1, CDC
5	Demonstrate a canopy stall and recovery with toggles (above 2,000 ft.)	C2, C3 - CP
6	Demonstrate a rear riser flare (above 2,000 ft.)	C2, C3 - CP
7	Demonstrate a canopy stall and recovery with rear risers (above 2,000 ft.)	C2, C3 - CP
8	Demonstrate harness turns of more than 90 degrees	C2, C3 - CP
9a	Demonstrate a crosswind landing in winds greater than 7mph	C2, C3 - CP
9b	Demonstrate a landing in no wind conditions	C2, C3 - CP
10	Demonstrate low turn recovery (above 2,000 ft.)	C2, C3 - CP

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CANOPY CONTROL SKILLS/DRILLS EXPLAINED

SAFETY FACTORS FOR COMPLETING THESE DRILLS:

a) Should be done on a low jump from 5,000 ft.

b) Apply all of the principles outlined in Post Opening Procedures:

   i. Traffic: Clear and free, identify other canopies on the jump

   ii. Altitude: Do you have enough to do your maneuvers, and can you then carry out your intended flight plan?

   iii. It is important: Where are you, and where do you need to be?

c) All drills should be completed by the designated altitude outlined in each skill and you should be preparing for your landing pattern.

d) Always keep your toggles in your hands during these maneuvers.

► 1. THE SWEET-SPOT DRILL

Every modern sport canopy has what the industry refers to as the "sweet spot", the point of toggle pressure at which the canopy levels out, stops descending and converts the perfect amount of forward speed to a matching amount of lift. The sweet spot will be different for each canopy and for different wing loadings of the same canopy. This spot will also change depending on the speed of the canopy. Start by finding this spot while the canopy is flying in natural, full flight without any additional speed induced by a turn or front-riser input. There are three different ways to find the sweet spot. You should try them all, in this order:

a) Look at the horizon while applying steady toggle pressure. When the horizon appears to stop coming at you (or if you no longer feel you are moving toward it), this is the sweet spot.

b) Analyze how far you pendulum forward while applying brakes. At full flight, your body will hang toward the back of the canopy, somewhere between the C and D lines. As you are applying toggle pressure, the point at which you are hanging between your A and B lines is the sweet spot.

c) The final method, which you should try only if you have plenty of altitude and clear airspace, is to close your eyes and feel the canopy stop its descent as you apply toggle pressure. This is the scariest but most efficient way to discover the sweet spot.

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You should use the same amount of toggle pressure for all three of these drills. Once you've determined where the sweet spot is, look at where your hands are for future reference. The better you know this spot, the more consistent you will become in your landings.

▶ 2. FLAT TURN 180°

Every year, serious injuries and fatalities occur when skydivers attempt low-altitude turns using toggle input alone. This causes the parachute to dive, potentially resulting in high-speed ground impact.

To prevent this, a skydiver must not only understand how to perform a flat turn, but practice it until the response becomes automatic. When a low-altitude correction is required, there is no time to stop and think.

Flat turns are one of the most important canopy skills. The objective of this manoeuvre is to change your direction while losing as little altitude as possible (by reducing roll and pitch and trying to maximize yaw). It is a braked turn that keeps the canopy level above your head. Some of its uses are:

a) Assessing a situation (looking around)

b) Managing traffic (moving out of the way of another jumper)

c) Obstacle avoidance (jumpers and hazards)

d) Turns closer to the ground than usual (emergency)

Three ways to practice these manoeuvres:

1. Start by toggle-turning the parachute gently. Immediately follow that with some opposite toggle. The idea is that you want to flare just a little to counteract the canopy's dive. Continue adding opposite toggle until you've stopped the turn. At this point, let both toggles all the way up. If you feel the parachute accelerate after you let up on the toggles (i.e. it feels like you are recovering from a flare), use less opposite toggle next time. If you feel like the parachute is diving as if you just did a toggle turn, use more opposite toggle next time. Basically, you want to start the turn with one toggle, stop it with the other one, and use just enough toggle to keep the wing from diving, but not so much that you flare.

2. Go to half brakes and then let one brake up. This gives you a flat turn, but by flaring first you use up some of the canopy's energy, so you can't turn as effectively. On the plus side, the turn happens more slowly. If you are about to hit a tree and feel that you can safely make a low turn, this variation might be the way to go, as it combines a turn and a flare, thus reducing your speed before impact.

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3. To flare turn, start with a normal flare, then flare just slightly more with one toggle. The canopy will turn. Bring the other toggle down to match it, and the canopy will straighten out. It's a dynamic process; rather than putting the toggles at a certain position, you have to increase your pull on one toggle for a second, then catch up with the other before you finish the flare. If you feel a rise upward under your canopy, then don't flare as quickly. If you drop to the ground, bring both toggles down more aggressively when they are at different heights.

One thing that helps is to think about where your canopy is (in relation to your body) rather than what it's doing. In other words, use the toggles to move the canopy off to one side for a moment, then use the toggles to put the canopy back over your head. You will need to know the stall point of your canopy, and make sure you don't pull the toggles down so far that the canopy stalls before you land. Smooth and gentle input will help you stay in control during these manoeuvres.

Before considering downsizing, it is important to be able to perform at least some degree of flat turn when you're low; jumpers are terrible judges of exact altitudes when they're at 1,000 ft. and it's hard to tell if you've lost 50 or 200 feet in a turn. This is where a digital altimeter comes in handy, which will allow you to determine exactly how much altitude you have lost.

▶ 3. FRONT RISER TURNS

The purpose of front riser turns is to develop an understanding of how front riser input affects canopy flight, including the increased dive produced by such inputs.

How to do the manoeuvre:

a) Keep toggles in your hands at all times;

b) Be aware of traffic, altitude, and position;

c) Brake the canopy to ¼ brakes (this will change the pitch to canopy nose slightly upwards);

d) Release the toggles, reach up as high as possible, grab one of the front risers and pull it down;

e) Complete two 90 degree turns to feel the effects;

f) Note your altitude loss during each turn; and,

g) Stop all work by 2,000 ft.

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▶ 4. REAR RISER TURNS (TOGGLES STOWED & UN-STOWED)

There are many reasons to use rear riser turns: to avoid a canopy collision during opening, to maintain heading during opening and for heading control. The use of rear risers will allow you to better maintain higher airspeed and expand your knowledge of your canopy controls. You should understand the difference between doing rear riser turns with toggles stowed and un-stowed.

How to do the manoeuvre:

a) Keep toggles in your hands at all times;

b) Be aware of traffic, altitude, and position;

c) Reach up as high as possible, grab one of the rear risers and pull it down;

d) Turn 90 degrees and release, then repeat this with a 180 degree turn;

e) Note your altitude loss; and,

f) Stop all work by 2,000 ft.

▶ 5. TOGGLE STALLS AND RECOVERY

This is an important skill to understand the control range you have with your canopy. This is important during a flare and for understanding where you will no longer have enough lift for landing. It is also important to understand the effects of your canopy during slow speed flight during flat turns, during braked approaches, on landing and in turbulence. Most lightly-loaded canopies will not stall with a single stroke of the toggles. You may have to take some wraps of the control lines to achieve this. However, as you downsize canopies or fly different canopies that have shorter control lines, or the control lines have been shortened (from wear and friction), it is important to understand where the stall point is. By understanding where the stall point on the canopy is, it will give you a better understanding of the control range of your canopy and will build confidence in your canopy when you need to conduct a quick dive recovery in a dangerous low to the ground situation.

Most students or A CoP holders will never get to a point where the canopy will completely stall (due to the size of the canopy, line length, or because it is so lightly loaded) unless they take wraps of the control lines to shorten their length enough to make this happen. Manufacturers build this safety feature into the canopies on purpose. Another thing that will affect the stall point on a canopy is twists in the control lines. If a jumper never takes the twists out of their lines it will shorten the control lines up to 2-3 inches, which will dramatically affect the stall point (shorten it). It is recommended that conducting stalls on highly loaded canopies or parachutes under 150 sq. ft. be avoided, as they

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will react with a greater amount of sensitivity and have a potential for a more volatile response during recovery (line twists or diving).

How to do the manoeuvre:

a) Keep toggles in your hands at all times;

b) Be aware of traffic, altitude, and position;

c) Bring both hands (in your toggles) symmetrically all the way down as far as possible, while watching the tail of the canopy, until you see it start to "buckle" and the end cells touch behind you. You should also see the pilot chute move from behind the canopy to above the canopy. This happens because forward movement stops and downward movement starts;

d) To recover you will slowly and symmetrically allow the toggles to go back to full flight into their original position; and,

e) Stop all work by 2,500 ft.

Note: If you release too quickly the tendency is to lose symmetry in your hands and the canopy will dive quickly and asymmetrically. This will induce an aggressive turn and potentially cause line twists.

▶ 6. REAR RISER FLARES

If below the designated hard deck for emergency procedures and a broken or hung-up brake line is identified, rear riser flares may be used for landing. It is critical to understand the rear riser stall point to avoid an inadvertent loss of lift during landing.

How to do the manoeuvre:

a) Keep toggles in your hands at all times;

b) Be aware of traffic, altitude, and position;

c) Reach up as high as possible, grab both of the rear risers, pull them down applying equal force until you reach level flight, then go just a little bit further until you slow your speed. You should feel yourself pitch under the nose of the canopy as if you were in the sweet spot;

d) To recover you will slowly and symmetrically allow the risers to go back to full extension into their original position; and,

e) Stop all work by 2,000 ft.

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▶ 7. REAR RISER STALLS AND RECOVERY

It is important to understand the stall point on rear risers so that in an emergency situation with a broken brake line or hung up brake line you have the option to fly your canopy to the ground and land safely with your rear risers.

How to do the manoeuvre:

a) Keep toggles in your hands at all times;

b) Be aware of traffic, altitude, and position;

c) Reach up as high as possible and grab both of the rear risers and pull them down, applying equal force. You should see the rear of the canopy where the C & D lines connect to the bottom skin start to fold. Eventually the tail of the canopy will buckle and fold inwards allowing the end cells to touch. This will result in a significant loss of altitude;

d) To recover you will slowly and symmetrically allow the risers to go back to full extension into their original position; and,

e) Stop all work by 2,500 ft.

▶ 8. HARNESS TURNS

Harness turns are important to understand in order to maintain a symmetric body position during opening, preserve heading, and support active piloting.

Conducting a harness turn on final to adjust heading is more efficient than using a toggle as it will allow you to maintain as much air speed as possible so as to increase lift and flare power on landing. The smaller the canopy and the higher the wing loading, the more responsive harness turns will be.

A key component of the harness turn is to start with a neutral body position by ensuring that your lower body is symmetrical in the harness and knees up (like sitting in a chair). A couple of things you can do to make harness turns more effective are positioning the leg straps under the upper part of your leg or loosening the chest strap (allows the canopy to flatten out more).

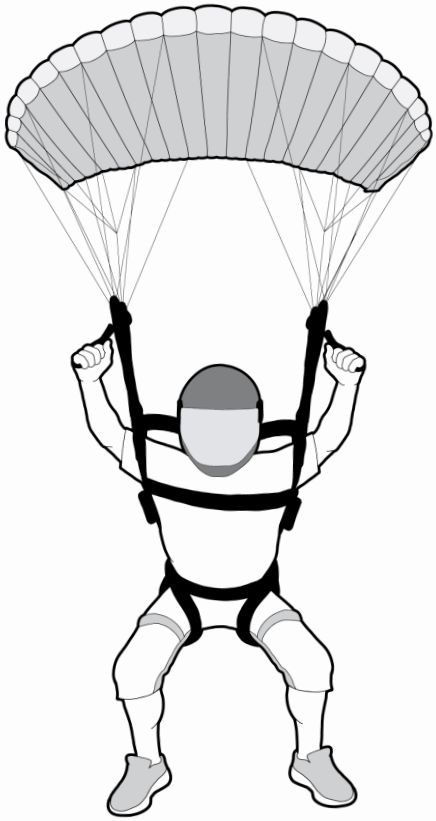


Figure 1: Active Piloting Postion

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Harness turns are a method of initiating and controlling a canopy turn through deliberate weight shift in the harness rather than through riser or toggle input. Harness turns are generally more effective under moderate to higher wing loading and may be less effective when lightly loaded.

Adjustment of chest and leg straps is not required to perform harness turns; however, appropriate harness fit may increase effectiveness. Strap adjustments should only be made with proper instruction and coaching.

1. Clear all airspace and ensure adequate altitude.
2. Maintain a straight body axis from the top of the head through the spine to the sit bone, avoiding twisting or bending of the torso.
3. To initiate the turn, lean the entire body toward the risers on the side of the intended turn while keeping the body square to the canopy.
4. Transfer body weight into the leg strap on the turning side, applying downward pressure to the main lift web which transfers to the associated front and rear risers on that side.
5. Maintain consistent body alignment throughout the turn. When viewed from the front, body position should appear unchanged except for a uniform lean in the direction of the turn.
6. Harness turns may be less effective under light wing loading. In these conditions, coordinate harness input with rear riser input as necessary.
7. As strength, fitness, and wing loading increase, progressively reduce reliance on riser input.
8. Under light wing loading, harness turn effectiveness may be increased without riser input by straightening the leg on the side of the intended turn, lifting the opposite knee, and tilting the body toward the direction of the turn.

This technique may be useful for minor heading corrections or for straightening the canopy flight path, such as on final approach, but may produce inconsistent results, introduce unintended yaw or pitch, and may unnecessarily reduce airspeed.

In addition to directional control, harness input can influence airspeed. In some contexts, this effect is utilized by trained canopy pilots during high-performance landings. Inducing speed on landing must be approached with caution and requires appropriate training and experience, as it can produce rapid and significant changes in canopy performance.

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▶ 9. CROSSWIND AND NO WIND LANDINGS



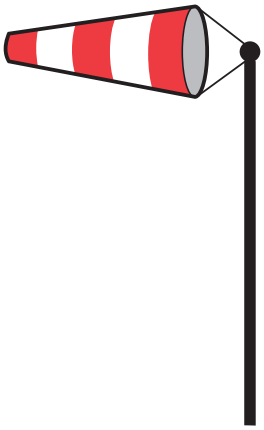
NO WIND LANDINGS

These are straightforward. The only issue is that your perception of speed and altitude will be off. Since you seem to be moving more quickly over the ground when there is no wind (which you actually are), it can seem like a good idea to add just a little brake to slow yourself down before you land.

Resist that urge! Keep that speed from your canopy; converting speed to lift is how you can achieve a full flare.

CROSSWIND LANDINGS

These can be a little trickier because of the strong tendency to reach out to break your fall. Your goal should be to keep your wing level with the ground throughout the landing flare.



It requires careful attention, finesse, and quick-but-subtle reactions to really land well in crosswind conditions—especially if the winds are stronger than five mph.

Be ready to make a parachute landing fall (PLF) in case the landing is not as smooth as you would like. The best way to maintain speed and heading in a crosswind landing is to shift the weight in your harness as if you were doing a harness turn as described above.

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▶ 10. LOW TURN RECOVERY

This drill teaches how to stop an aggressive dive, a critical skill to master prior to starting to make aggressive turns. This drill, which should be performed up high well before entering the landing pattern, is a 90 degree toggle turn followed immediately by stopping the turn.

How to do the manoeuvre:

a) Be aware of traffic, altitude, and position;

b) Place yourself into a hard toggle-induced 90 degree turn;

c) Apply the opposite toggle at mid-turn (halfway through stroke), then apply additional pressure to both toggles. In other words, pull down one toggle, match the other toggle to it, and then "punch" both toggles equally, stopping the turn and minimizing altitude loss. Try this several times with lots of space around you and altitude beneath you. You'll know you're doing it right by feeling the strain from your leg straps pulling up on you; and,

d) Stop all work by 2,000 ft.

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PRE-BOARDING CONSIDERATIONS (CANOPY INFORMATION)

Canopy control starts even prior to any skydiver getting into a plane and a lot of factors need to be considered/coached:

a) Are the winds within your limits and not expected to increase before you get back on the ground?

b) What direction are the winds coming from?

c) Where is the release point?

d) How big is the formation you are with and how many people will be around when you open?

e) What is the exit separation between groups, dependent on the winds aloft? The higher the winds the more exit separation is required. Is it an into-the-wind jump run or a crosswind jump run, as this will affect exit separation. With higher winds aloft there will need to be more separation between groups. This is due to the reduced ground speed of the aircraft if it is flying into the wind. This is an important topic that should be discussed at length.

f) What are the different opening altitudes of people on your load and how will that affect you?

g) Will you expect to see someone from the next group close by on opening?

h) How big are the canopies behind you?

i) Will you expect the videographer from the tandem behind you, flying a 96 sq. ft. canopy, to fly past you under canopy? Do you have the same landing area and landing pattern? Will this create a conflict on landing or during the set up?

j) What is the established landing pattern (left or right)?

k) Did you select an alternate landing zone prior to taking off, in the event you cannot make it back to your intended landing area?

l) What are the hazards around your selected landing areas (primary and alternates)? High-tension wires, water, main roads, buildings, wind direction, turbulence, etc.?

m) Where are the set-up points for your landing patterns (primary and alternate)? Where do you enter the downwind leg? Where do you turn on to base leg? Where and at what altitude do you turn on final?

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POST OPENING PRIORITIES

As soon as we deploy our parachutes it is imperative to keep our heads on a swivel all the way to the ground to avoid a canopy collision. There are some very important issues that need to be addressed, even prior to entering the landing pattern.

1. Priority number ONE is to check your canopy to ensure that there is no malfunction, and if there is, deal with it appropriately. After a malfunction it is even more important to follow the following steps.

2. Priority number TWO is to avoid any potential canopy collision. This can be done by placing your hands on the rear risers immediately on deployment and looking for other canopies in the sky. If there is potential for a canopy collision, the common response is for:

    a) Both skydivers to pull on the RIGHT REAR riser to avoid collision. Rear risers are a much faster response than trying to un-stow brakes to execute a turn; or,

    b) If both skydivers are offset to the left and heading towards one another they will pull a left rear riser;

    c) Next you should look to locate other skydivers to further avoid any canopy collision (count canopies).

3. Priority number THREE is to check altitude and determine if you can reach your intended landing area. If not, assess how you should adjust the flight mode of the canopy to reach the intended landing area. If you still cannot then select an alternate landing area. Where are you? Where do you need to be? You can use the 45-degree rule (“accuracy trick”) to determine if you will make your intended landing area or not (see Figure 2 on the following page).

    If you are unable to make the intended landing area, make a decision early to locate your predetermined alternate landing area. This should be considered by 2,000 ft. AGL. Remember, if you are not going to make your intended landing area, you should apply the same pattern (right hand, left hand, or modified pattern) that you were going to use for your intended landing area and apply it to your alternate landing area.

4. Priority number FOUR is be predictable! The number one killer right now is people flying perfectly good canopies into other perfectly good canopies. This is generally because they are not flying predictably or are performing high performance landings without a separate pass. Always keep your head on a swivel and fly your predictable pattern: holding area, downwind, base, and final approach. The aviation industry has been doing this for a number of years with great effect. We need to be doing the same in order to keep our sport safe!

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ACCURACY TRICK (45° RULE)

a) If the target is rising away on the horizon from you, you will not make the target (Figure 2A);

b) If the target is going below your feet, you are going to overshoot the target (Figure 2B);

c) If the target is not moving, you are going to land on it (Figure 2C).

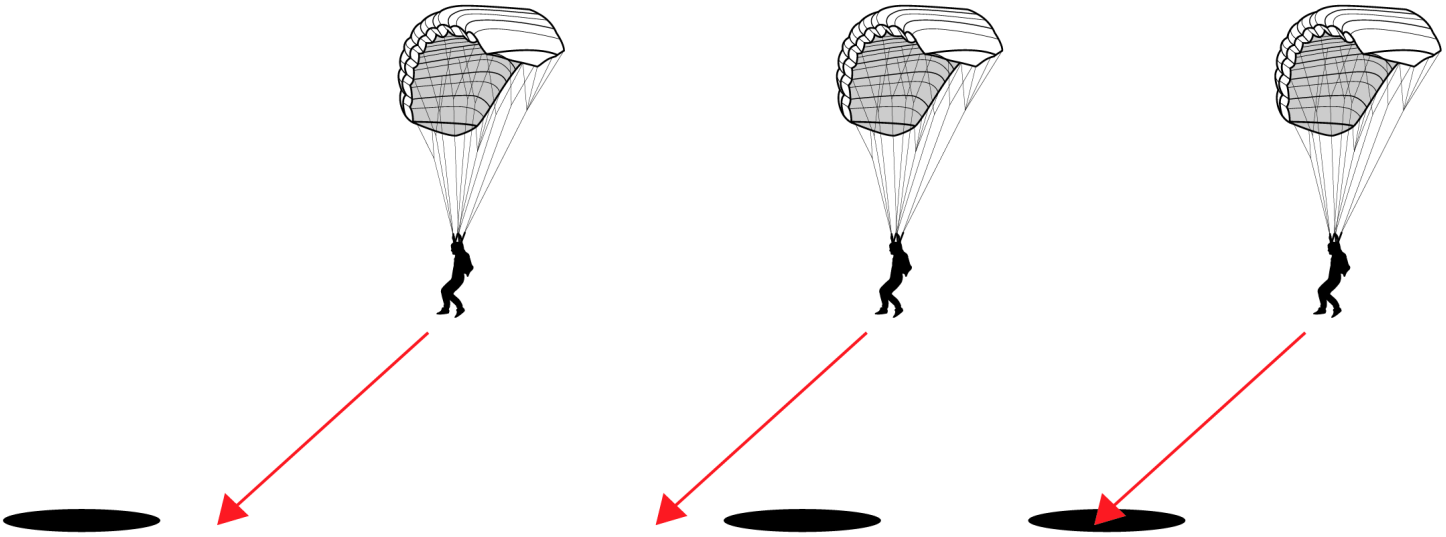


Figure 2A **Figure 2B** **Figure 2C**

Figure 2: Accuracy Trick (45 Degree Rule)

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LANDING PATTERNS

Landing patterns are important and are typically established daily at a dropzone. They will depend on the direction of the release point (spot), hazards on the ground, and what the winds are doing that day. It is important to understand what the established landing pattern is on any particular day. This should also be confirmed prior to every jump in case it has changed based on the spot or winds on the ground.

BASIC PATTERN ENTRY ALTITUDES

a) **DOWNWIND** leg approx. **900 ft.**

b) Turn on to the **BASE** leg at approx. **600 ft.**

c) Turn on to **FINAL** at approx. **300 ft.**

These altitudes are based on student-sized canopies (e.g. Navigator 240 sq. ft.) and are safe starting points, but may vary dropzone to dropzone by 50-100 ft. in some cases. As you progress you should always seek to refine your altitude turn points to improve your accuracy. Altitude turn points will vary considerably based on wind conditions and the type of canopy you are flying. For example, for a more experienced jumper flying a sub-100 sq. ft. canopy, these turn altitudes will go up considerably. Wing loading also needs to be taken into consideration in these situations.

LEFT HAND APPROACH

The target is on your left side on your downwind leg and you are doing left turns to get to your target (Figure 3).

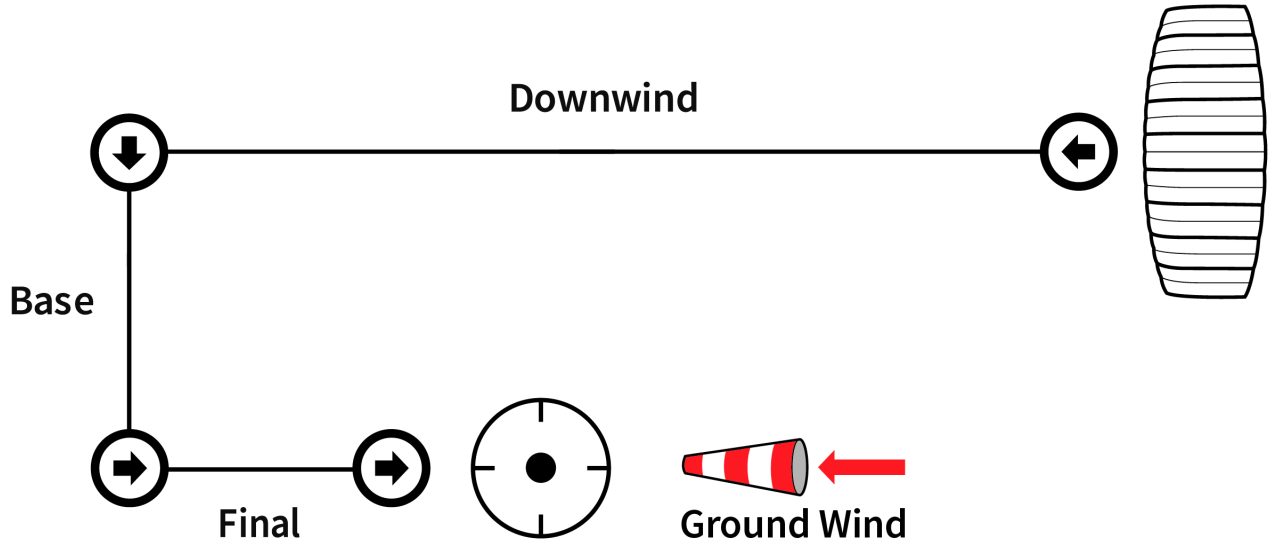


Figure 3: Left Hand Approach

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▶ RIGHT HAND APPROACH

The target is on your right side on your downwind leg and you are doing right turns to get to your target (Figure 4).

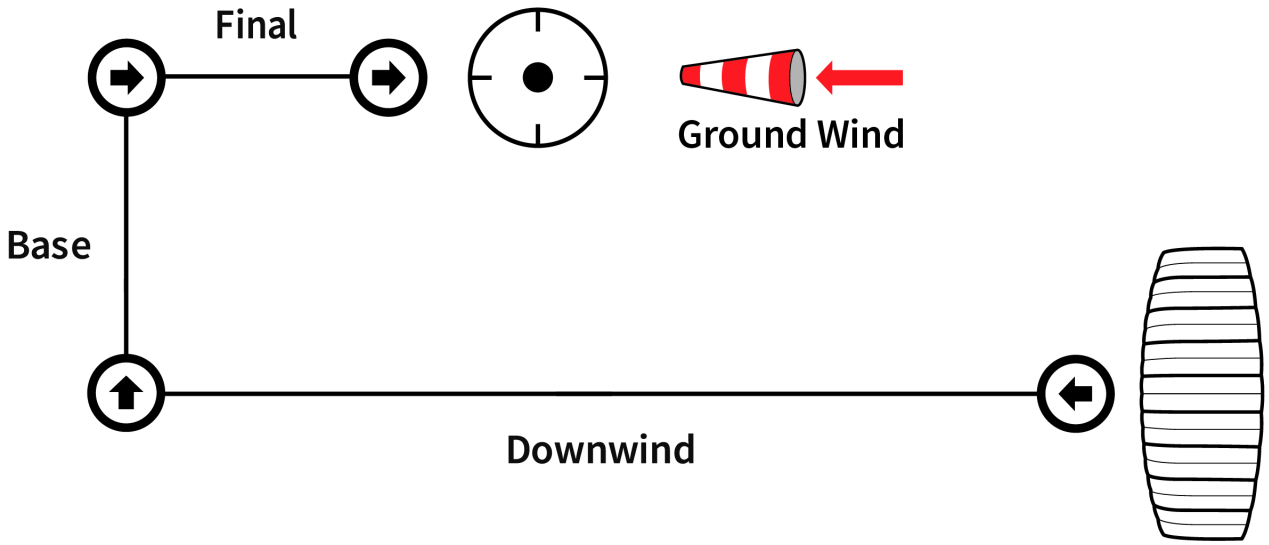


Figure 4: Right Hand Approach

▶ MODIFIED RIGHT OR LEFT HAND APPROACH (Z PATTERN)

This is a situation where you are off the wind line and are not able to get to the proper spot to initiate your downwind leg at 1,000 ft. to conduct a perfect left or right hand pattern. It also applies when you have experienced a wind shear where you need to fly straight back to the landing area to land into the wind. Figure 5, below, is a modified right hand pattern (or Z pattern).

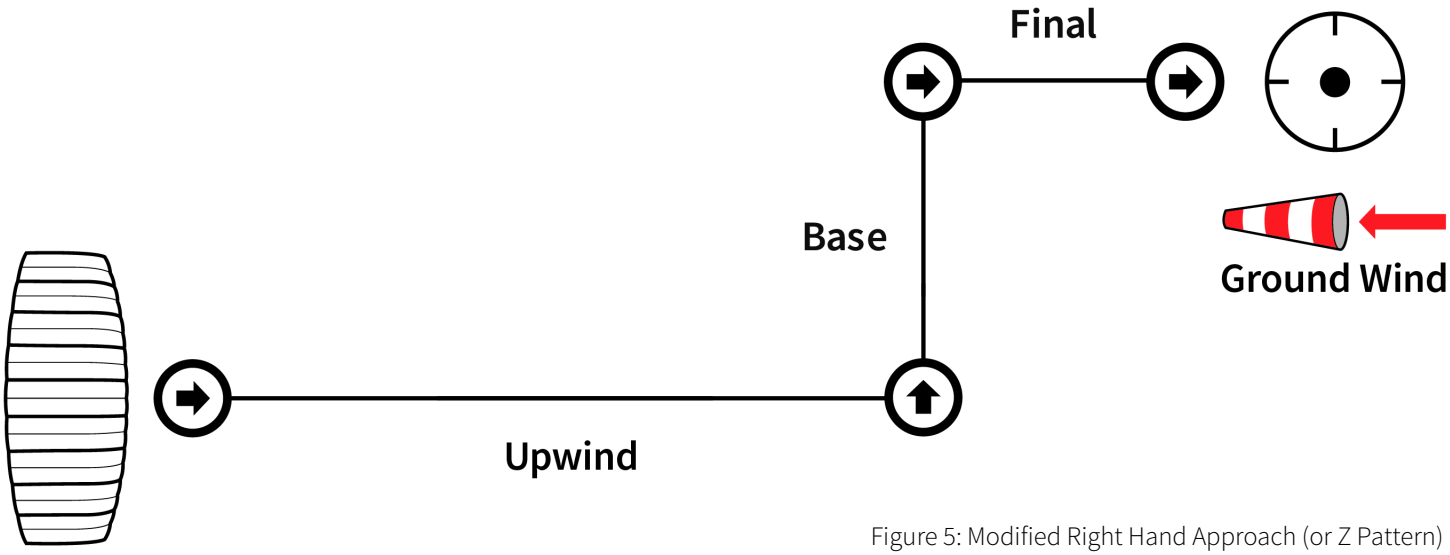


Figure 5: Modified Right Hand Approach (or Z Pattern)

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IMPROVING YOUR ACCURACY

Before even leaving the ground, determine the following things:

a) Where do you want to land?

b) Landing direction (based on):
   i. Obstacles
   ii. Turbulence
   iii. Dropzone rules
   iv. Wind direction

With this information we need to work backwards from our target to our release point to determine our flight plan. We work backwards to better enable ourselves to compensate for the above factors. For example, we would not set up a left hand pattern over top of an obstacle, such as a tree-line; if we were to do this and did not compensate for the winds being higher, we might end up short and in the trees.

Another critical component of improving your accuracy is identifying where your setup points are. You also need to understand how to offset them for different wind conditions, canopies, and wing loadings. You can choose these a number of different ways: watching other jumpers landing to see where they are turning, looking at forecasted winds, identifying turn points on an aerial photo, or by using Google Earth. These points will consistently change from jump to jump depending on the different variables.

FINAL LEG

When determining where your turn point is going to be for your final leg, factor in enough height and distance for the final turn, a solid straight in approach (wing level and reduction of the flight cycle), and a good two stage flare. The issue is that we do not have accurate information (wind speed, wind direction, and ground speed), so this has to be refined on each jump. You need to understand what your baseline setup points are (medium winds) and adjust setup points throughout the day based on current wind conditions. Most novice jumpers will overshoot in low winds and undershoot in high winds.

BASE LEG

The best tool for accuracy is using a LONG base leg to become more accurate. By doing this you can adjust your angle to target based on any crosswind component you might get. For example, if you have high crosswind you will want to aim more towards your target, but if you have light winds you can aim away from your target on base. You will use DRIFTING and CRABBING on your base leg to arrive at your final turn point. While doing this you will use the 45 degree rule to determine how much you need to aim off.

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DRIFTING

Drifting is pointing your canopy in a direction so that the nose is slightly downwind of your target so that you are moving away from your target but are still somewhat parallel to it (Figure 6).

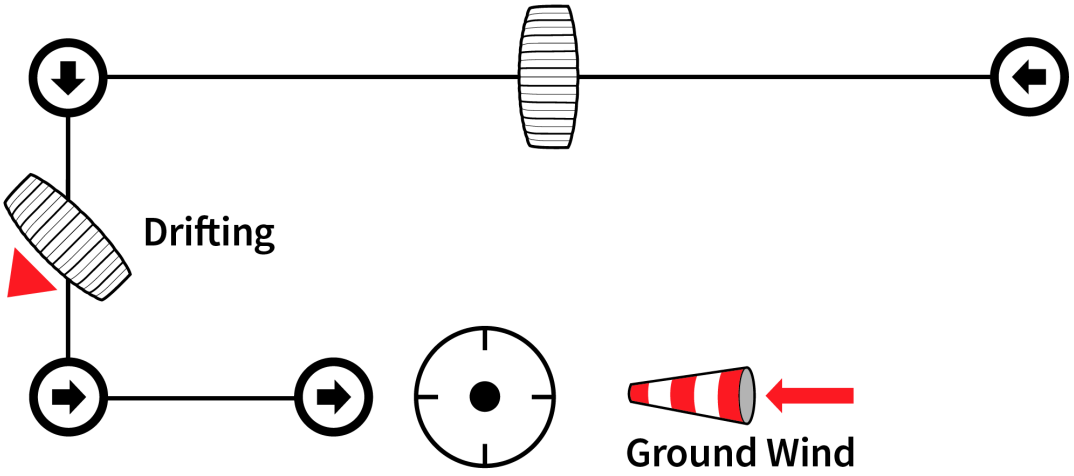


Figure 6: Drifting

CRABBING

Crabbing is pointing your canopy's nose in a direction so it is slightly into the wind while you are parallel to the target, but still moving away from the target (Figure 7).

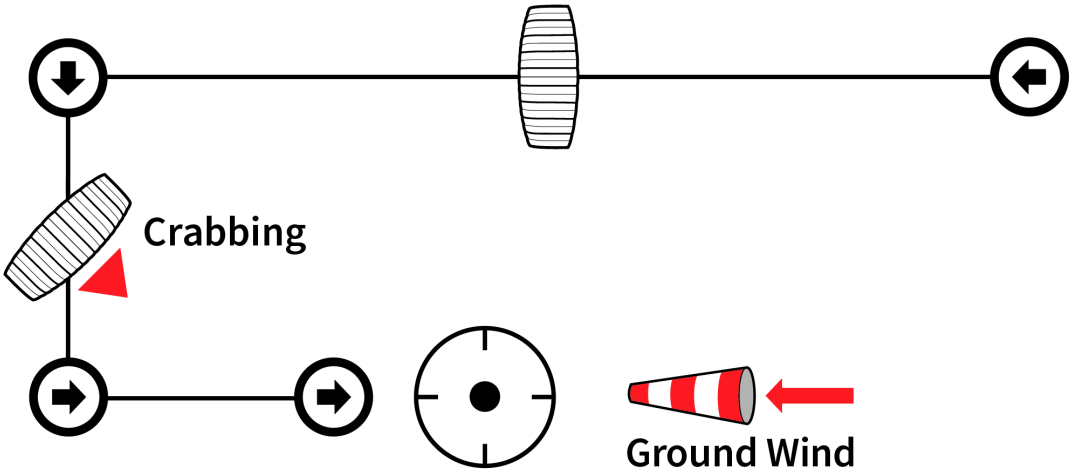


Figure 7: Crabbing

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DOWNWIND LEG

Downwind legs will need to be adjusted according to the wind strength you have behind you. If the winds are higher (behind you), you will want to set up your downwind leg further back as you will have more travel under canopy. If the winds are low you will want to set up closer to the target as you will have less travel under your canopy.

Once you have determined your turn heights for that specific canopy, theoretically your turn height will never change regardless of wind conditions. The only component of your set up that will change is your set up point. It will take a while to figure out those heights.

HOLDING AREA

Your holding area should be upwind of your intended landing area and allow you the flexibility (height/distance) to be close enough to your downwind leg to enter at the proper height.

ALTIMETERS:

- **Analog altimeters** are what students typically use while they are learning to skydive and are a good starting point. However, due to their limited accuracy they are sometimes difficult to use for refining exact heights. Most modern day canopy pilots use more accurate means to determine exact altitudes for their turns as described below.
- **Digital altimeters** are always going to give you the most accurate information vs. using an analog altimeter, which does not give as accurate a display of information. It is a good habit to get into to start using a digital altimeter as soon as possible to help refine your turn altitudes in the landing pattern.
- **Audible altimeters** are also a good adjunct to assisting you in being altitude aware as you can set them to have canopy alarms, which will give you a series of beeps until you hit your designated set up points over the ground. This gives you the ability to focus more on your surroundings and keeping your head and eyes up.

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GETTING AWAY FROM 90° TURNS IN THE LANDING PATTERN

We use 90 degree turns in our landing pattern because it is easy to understand for students learning. However, as you develop your awareness, understand that you do not need to always do 90 degree turns. You can crab or drift (do not sashay) off the line slightly to make the accuracy trick work, while still flying a predictable pattern. However, remember the landing pattern can be one of the most congested parts of the sky as everyone is converging into the same area, so FLY PREDICTABLY. You do not want a collision at this altitude.

The following illustration shows the flexibility you have inside your left hand pattern to maneuver your canopy in accordance with the wind that you are given. The blue lines indicate the area you have to fly your canopy while still staying inside the wind cone (Figure 8). The green line indicates the actual line of canopy flight.

Always be aware of the traffic around you, so as to avoid a mid-air collision at the most critical time of your canopy flight (during the landing pattern). The more turns you make, the more likely you are to have a collision.

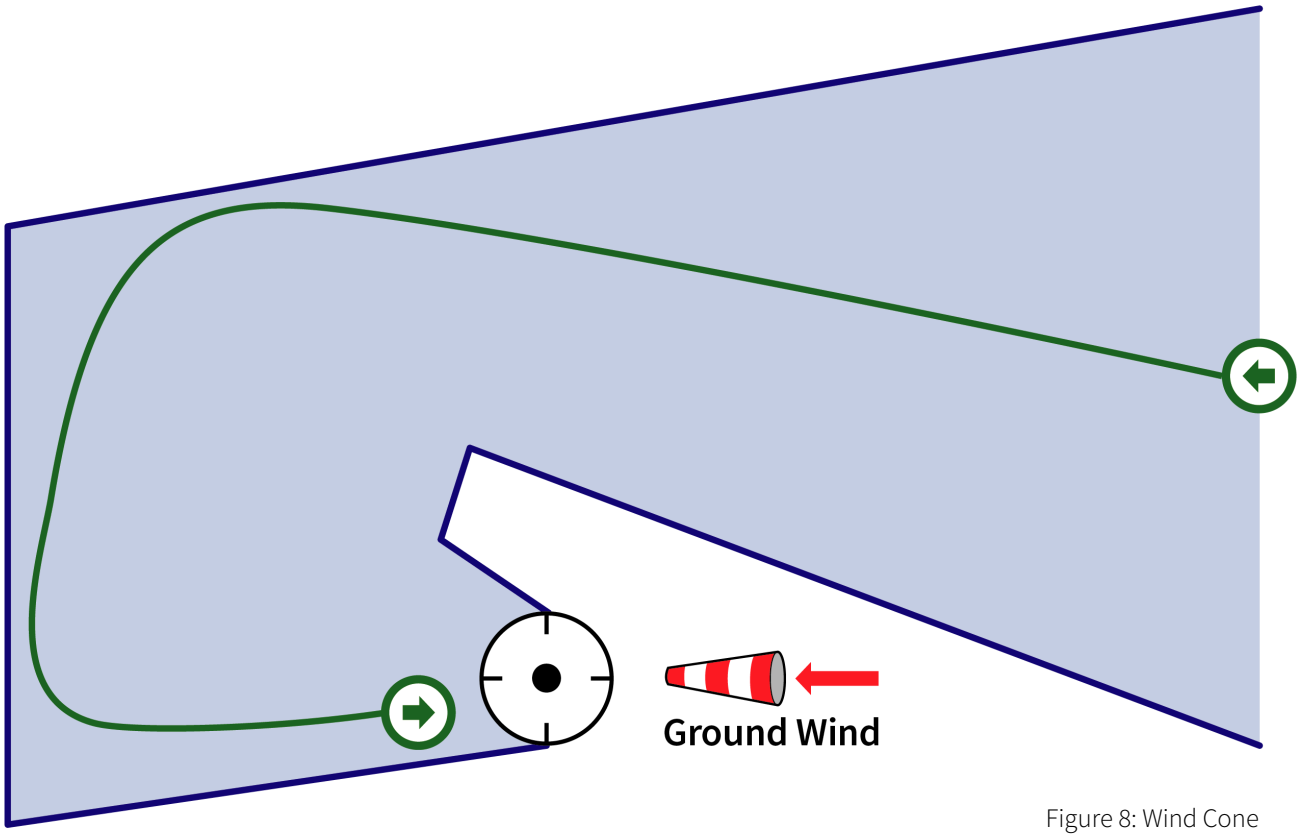


Figure 8: Wind Cone

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LANDING PRIORITIES

Source: Flight 1

1. Land with your wing level to the ground and above your head. It is important to land with the wing level, as any manipulation of the toggles in either direction will turn the canopy and increase speed, potentially resulting in injury.

2. Land free and clear of obstacles. Obviously landing into an obstacle can be detrimental to your health and should be avoided. This should be done by doing a FLAT turn to maintain a LEVEL WING while you avoid any obstacles.

3. Flare symmetrically and to at least 50%. Flaring symmetrically will also allow the canopy to land level to the ground. Flaring to at least 50% will stop or minimize vertical descent to help prevent injury. Of course, finish your flare where possible.

4. Land into the wind IF POSSIBLE. It is a big misunderstanding that you must land into the wind. Of course, it is preferred to land into the wind to manage ground speed more easily, however if you have found yourself low it is much safer to do a flat turn and land crosswind or just accept a downwind landing instead of making a low turn into the ground. If you are landing downwind still flare with your proper technique and prepare for a PLF.

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TURBULENCE

Turbulence is a violent or unsteady movement of air (bumpy air). It is created by many factors and can affect our canopies in a negative manner if not dealt with properly (especially as we get closer to the ground).

MECHANICAL TURBULENCE

Mechanical turbulence is caused by airflow changes across a physical obstacle (i.e. a hangar near the landing area). Indicators of this and its occurrence are the presence of strong winds plus the presence of an obstacle. Turbulence will occur in front of, behind, or above the obstacle (Figure 9). Variables that may make the turbulence worse are the size of the obstacle, wind speed, and the shape of the obstacle. Examples of this are buildings, trees, and hills. A general rule of thumb to go by is that turbulence will occur:

a) 1 time (x1) the height of the obstacle in front of the obstacle;

b) 2 times (x2) the height of the obstacle above the obstacle; and,

c) 10 times (x10) the height of the obstacle behind the obstacle.

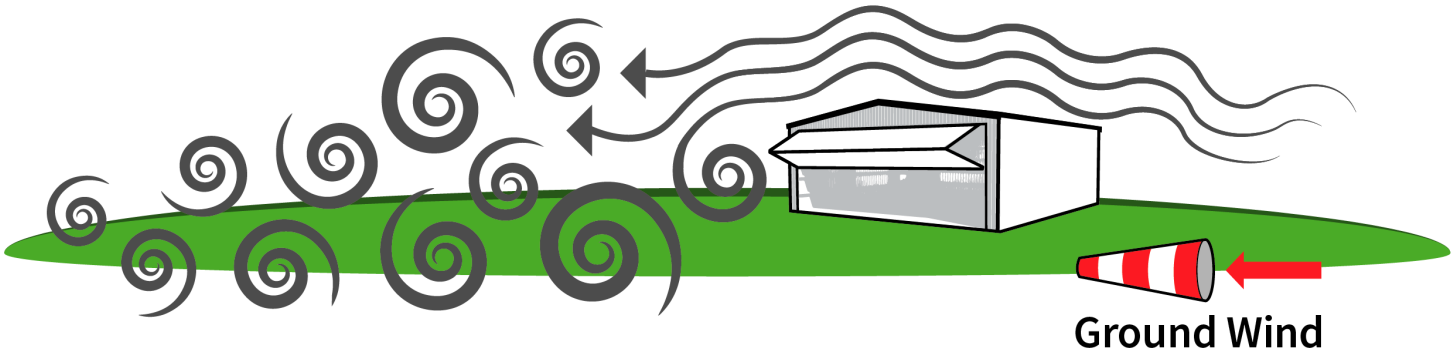


Figure 9: Mechanical Turbulence

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SHEAR TURBULENCE

Shear turbulence is created when wind direction or speeds change between two layers of air (Figure 10). Indicators would be if your canopy buffets while you are flying, or that bumpy feeling in the airplane.

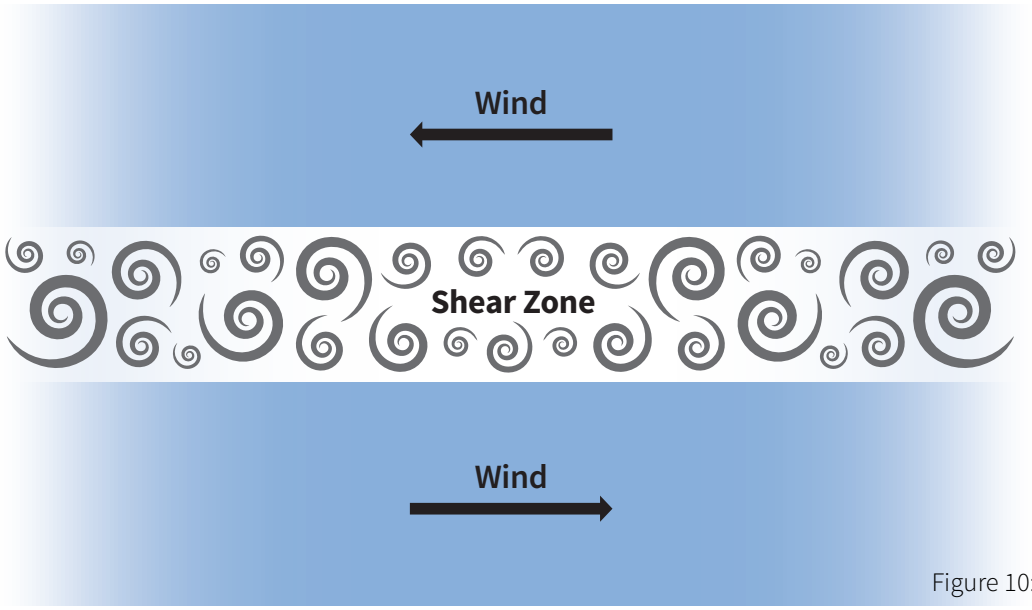


Figure 10: Shear Turbulence

THERMAL TURBULENCE

Thermal turbulence is caused when you have changing surface temperatures. For example, you fly over a grassy area that transitions to over a runway. Because of the contrasting temperatures above the different surfaces, you will experience turbulence.

AERODYNAMIC TURBULENCE

Aerodynamic turbulence is caused by the disruption of airflow from an object moving through the air mass, such as a canopy, body, lines of a canopy, or an airplane. One example is when a landing area is close to a runway and an airplane is taking off, you might experience the vortices from the aircraft taking off causing turbulence (Figure 11). You may also feel turbulence if you are following too close to another canopy (directly behind). You should be especially cautious of this in the landing pattern as to not adversely affect your canopy's performance.



Figure 11: Aerodynamic Turbulence

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Adverse effects of turbulence can range from poor canopy performance to the extreme of having the canopy collapse. One of the major things we need to understand is that the canopy will start another flight cycle after each bit of turbulence you go through.

A flight cycle is induced when there is any input on the canopy (e.g. toggle input, turbulence). This flight cycle will have the canopy dive and recover repeatedly until there is a 8-10 second lull in movement of the canopy from inputs. What is important to know is that the canopy will start out in a dive (which might not be noticeable) that pitches the nose down. Understanding this is important because, as the canopy pitches forward in turbulence close to the ground, the toggle stroke that has to happen to get the canopy back to level flight is longer than your normal toggle stroke for a two-stage flare. (Further discussed in the canopy control skills later on.)

How do you deal with turbulence?

a) Avoid it! Stay on the ground if conditions are not safe or suitable for your skills.

b) Whenever possible, land in a clear area free of objects and clear of turbulence.

c) Keep your canopy flying at full flight (hands all the way up). Some older methodology with original Ram Air canopies stated to fly in 25-50% brakes. This is NOT an efficient way to fly with today's canopies. The best way to manage turbulence is to fly 100% and keep the canopy pressurized. A dangerous situation that could happen is deformation of your canopy on landing due to turbulence. If the canopy pitches towards the ground you will need to be aggressive to recover from the dive (flight cycle). The key factor here to remember is to ensure you respect the first landing priority: keep the canopy level above your head and stop it from diving!

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AXIS OF CANOPY FLIGHT

Understanding a couple of terms with regards to the canopy and its flight will greatly assist in being able to fly your canopy more effectively (Figure 12).

PITCH

Pitch is the symmetrical movement of the canopy up or downwards on the axis from the nose to the tail (i.e. flaring the canopy or using double front/rear risers).

ROLL

Roll is the asymmetrical movement of canopy banking left or right (i.e. single toggle or riser input).

YAW

Yaw is an asymmetrical heading change (i.e. flat turn).

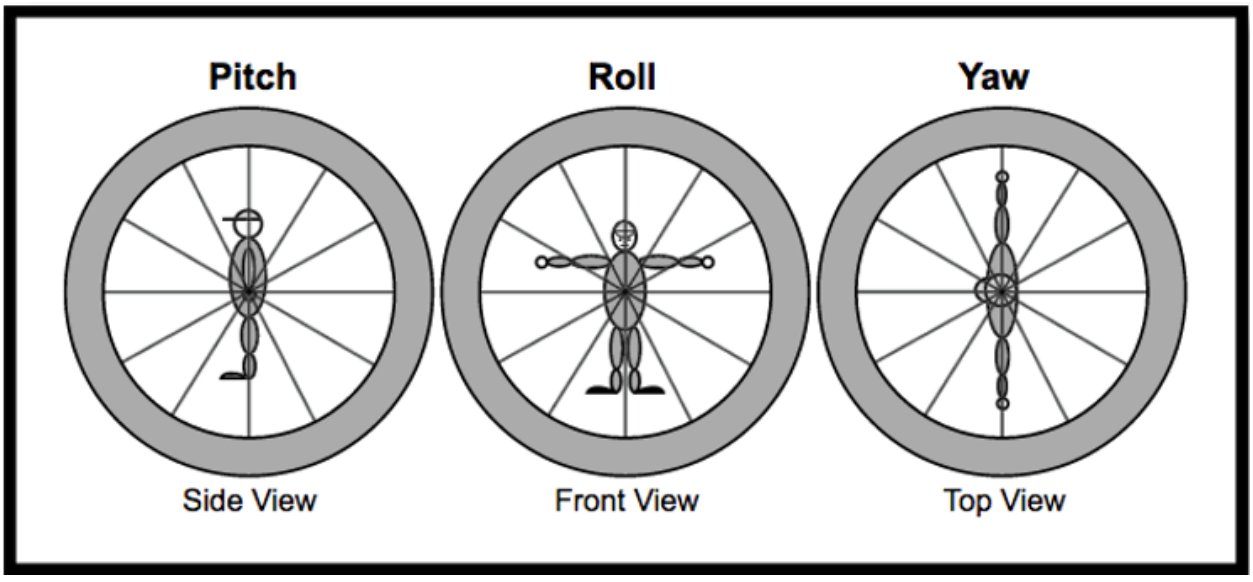


Figure 12: Pitch, Roll, Yaw

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CANOPY SKILLS ESSENTIAL TO SURVIVAL & DOWNSIZING

Instructors and coaches spend a considerable amount of time telling people they shouldn't be loading their canopies so heavily. However, 90% of the time, novice jumpers don't listen. Skydivers can have a bit of an ego, and many simply hear, "I think you're a crappy canopy pilot who can't handle a smaller wing." So they downsize anyway and hurt themselves with some regularity. To that end, the skills discussed earlier are canopy control skills that everyone should have before downsizing, every time they downsize. Some are survival skills (being able to flat-turn could save people every year), and some are canopy-familiarization skills (such as harness turns).

It is important that jumpers do these skills before each downsize, because some manoeuvres are a little scary (like turning at 50 ft.), and the jumper should perform them on a larger canopy they're completely comfortable with, above 2,000 ft., prior to executing them close to the ground.

When performing anything other than a standard landing approach, take into consideration the following safety factors:

- Seek out appropriate coaching for new canopy skills. This is much safer than trying to do it on your own and you will learn much faster.
- Have a landing area separated from other jumpers by time (exiting on a separate pass) or distance (an area specifically designated for such manoeuvres, away from those flying standard patterns).
- Attempt all new canopy skills up high (complete above 2,000 ft.).
- Ensure you have clear airspace around you prior to practicing a new skill.
- Ensure you have enough altitude to make it back to your intended landing area.

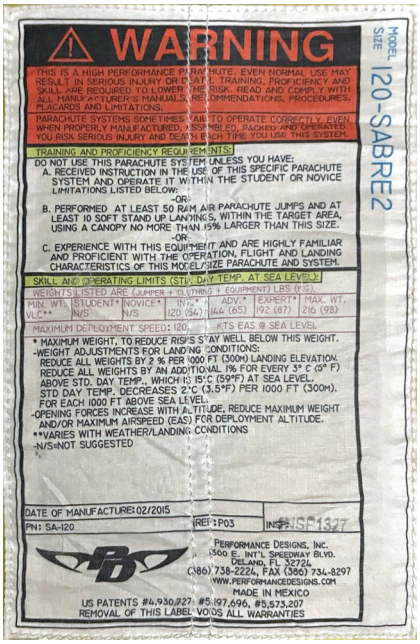


Figure 13: Manufacturer Warning Label

Even though there are recommendations outlined here, each canopy has a manufacturer's warning label (Figure 13). Do not exceed the manufacturer's recommendations. The label outlines limits for that specific canopy with regards to the maximum weights and experience level for that specific canopy. It also provides additional information related to jumping that canopy at different landing altitudes above sea level.

Each manufacturer should have the **recommended wing loading** for each of their canopies **on their website**.

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DOWNSIZING CHART

The CSPA suggests using the downsizing chart below, which is based on standard sea-level conditions.

### (###)	MIDDLE OF RANGE (SMALLEST ALLOWED)

EXIT WEIGHT (LBS.) JUMPS	110 FT²	121	132	143	154	165	176	187	198	209	220	232	243	254	265
1	190 (170)	190 (170)	190 (170)	190 (170)	190 (170)	190 (170)	210 (178)	210 (189)	230 (200)	230 (211)	230 (222)	260 (230)	260 (230)	260 (230)	260 (230)
20	170 (170)	170 (170)	170 (170)	170 (170)	190 (170)	190 (170)	210 (176)	210 (187)	230 (198)	230 (209)	230 (220)	230 (230)	230 (230)	230 (230)	230 (230)
40	170 (150)	170 (150)	170 (150)	170 (150)	170 (150)	190 (160)	210 (171)	210 (182)	230 (192)	230 (203)	230 (214)	230 (224)	230 (230)	230 (230)	230 (230)
60	170 (150)	170 (150)	170 (150)	170 (150)	170 (150)	190 (156)	190 (166)	210 (177)	210 (187)	230 (198)	230 (208)	230 (218)	230 (229)	230 (230)	230 (230)
80	170 (150)	170 (150)	170 (150)	170 (150)	170 (150)	190 (152)	190 (162)	210 (172)	210 (182)	230 (193)	230 (203)	230 (213)	230 (223)	230 (230)	230 (230)
100	150 (135)	150 (135)	150 (135)	150 (135)	170 (150)	170 (150)	190 (158)	190 (168)	210 (178)	210 (188)	230 (198)	230 (208)	230 (217)	230 (227)	230 (230)
120	150 (135)	150 (135)	150 (135)	150 (135)	150 (135)	170 (145)	190 (154)	190 (164)	210 (174)	210 (183)	220 (193)	230 (203)	230 (212)	230 (222)	230 (230)
140	150 (135)	150 (135)	150 (135)	150 (135)	150 (135)	170 (141)	190 (151)	190 (160)	190 (170)	210 (179)	210 (188)	230 (198)	230 (207)	230 (217)	230 (226)
160	150 (135)	150 (135)	150 (135)	150 (135)	150 (135)	170 (138)	170 (147)	190 (156)	190 (166)	210 (175)	210 (184)	230 (193)	230 (202)	230 (212)	230 (221)
180	150 (135)	150 (135)	150 (135)	150 (135)	150 (135)	150 (135)	170 (144)	190 (153)	190 (162)	210 (171)	210 (180)	210 (189)	230 (198)	230 (207)	230 (216)
200	135 (120)	135 (120)	135 (120)	135 (120)	150 (123)	150 (132)	170 (141)	170 (150)	190 (158)	190 (167)	210 (176)	210 (185)	230 (193)	230 (202)	230 (211)
220	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	150 (129)	170 (138)	170 (146)	190 (155)	190 (163)	210 (172)	210 (181)	210 (189)	230 (198)	230 (207)
240	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	150 (126)	150 (135)	170 (143)	190 (152)	190 (160)	190 (168)	210 (177)	210 (185)	230 (194)	230 (202)
260	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	150 (124)	150 (132)	170 (140)	170 (148)	190 (157)	190 (165)	210 (173)	210 (181)	210 (190)	230 (198)
280	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (121)	150 (129)	170 (137)	170 (145)	190 (154)	190 (162)	190 (170)	210 (178)	210 (186)	230 (194)

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EXIT WEIGHT (LBS.) JUMPS	110 FT²	121	132	143	154	165	176	187	198	209	220	232	243	254	265
300	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	150 (127)	150 (135)	170 (143)	170 (150)	190 (158)	190 (166)	210 (174)	210 (182)	210 (190)
320	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	150 (124)	150 (132)	170 (140)	170 (148)	190 (155)	190 (163)	190 (171)	210 (179)	210 (186)
340	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (122)	150 (129)	150 (137)	170 (145)	170 (152)	190 (160)	190 (168)	190 (175)	210 (183)
360	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	150 (127)	150 (135)	170 (142)	170 (149)	190 (157)	190 (164)	190 (172)	210 (179)
380	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	150 (125)	150 (132)	170 (139)	170 (147)	170 (154)	190 (161)	190 (169)	210 (176)
400	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (122)	150 (130)	150 (137)	170 (144)	170 (151)	190 (158)	190 (166)	190 (173)
420	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	150 (127)	150 (134)	170 (142)	170 (149)	170 (156)	190 (163)	190 (170)
440	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	150 (125)	150 (132)	150 (139)	170 (146)	170 (153)	190 (160)	190 (167)
460	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (123)	150 (130)	150 (137)	170 (143)	170 (150)	190 (157)	190 (164)
480	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (121)	150 (128)	150 (132)	170 (141)	170 (148)	170 (155)	190 (161)
500	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	150 (126)	150 (132)	150 (139)	170 (145)	170 (152)	170 (159)

The chart gives two different values:

A) Top Number: **Middle of Range** (Not an absolute figure. See "Relevant Variables" below.)

Due to individual differences in natural ability, judgment and demonstrated in-air awareness, there must be allowances for variability with the recommended size. To fit every canopy pilot into a finite formula is not reflective of the true nature of the situation.

B) Bottom Number: Smallest Size Allowed

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SECTION 3 | B CoP - Sport Canopy Endorsement

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B CoP - SPORT CANOPY ENDORSEMENT GUIDELINES

SSEs and Coach 2s should do a thorough review of the SCE A prior to the administration of the SCE B during this review. The endorsement should be mostly question based, with the coach confirming the parachutist's SCE A knowledge rather than re-teaching it.

A novice's introduction to sport canopies is a crucial part of their survival training. One of the highest incidents of fatalities in the sport of parachuting in the past 10 years has been under a perfectly functioning canopy. It is important that coaches and instructors educate intermediate skydivers as early as possible in the art of safe and efficient canopy flight, as these are the most formative and dangerous moments of their skydiving career.

SCE B is where the parachutist receives more information on downsizing, different types of canopies and their characteristics, further develops their canopy skills, learns a deeper knowledge of how to better deal with canopy collisions and dual deployments, and understands what type of equipment they should be looking to purchase.

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SPORT CANOPY ENDORSEMENT B: SKILLS LIST

Outlined below is a list of canopy control skills that a novice needs to be taught and have demonstrated. These skills are required to be signed off for the Sport Canopy "B" Endorsement required for the B CoP. Additionally, these are skills that should be done prior to and after downsizing.

SPORT CANOPY ENDORSEMENT B: SKILLS LIST

	SKILL	INSTRUCTOR/COACH
-	Review all canopy control skills covered in Sport Canopy "A" Endorsement	Coach 2 (C2), Coach 3 (C3) - Canopy Piloting (CP)
-	Complete the Sport Canopy "B" Ground Briefing	C2, C3 - CP
1	Complete 10 self-guided, stand-up, safe accuracy landings to within 15 m of target	Coach 1 (C1), Competition Development Coach (CDC)
2	Land on, or discuss landing on, an upslope or downslope	C2, C3 - CP
3	Land downwind	C2, C3 - CP
4	Braked approach	C2, C3 - CP
5	Coordinated turns	C2, C3 - CP

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CANOPY CONTROL SKILLS EXPLAINED

SAFETY FACTORS FOR COMPLETING THESE DRILLS:

a) Should be done on a **dedicated jump** on a 5,000 ft. pass, not after a freefall.

b) Apply all of the principles outlined in Post Opening Procedures:

   i. **Traffic**: Clear and free, identify other canopies on the jump.

   ii. **Altitude**: Do you have enough to do your maneuvers, and can you then carry out your intended flight plan?

   iii. **It is important**: Where are you, and where do you need to be?

c) All drills should be completed by the **designated altitude** outlined in each skill and you should be preparing for your landing pattern.

d) Always keep your **toggles in your hands** during these maneuvers.

▶ 1. LAND RELIABLY WITHIN A 15 METER CIRCLE

Becoming more accurate is critical because your accuracy skills are what will keep you from having to turn low in the first place. It's very comforting to know that you can land in any 50-ish foot clearing if you find yourself landing out. It's especially important as you progress to smaller canopies that need longer landing areas to land well. Your only option may be a small field, and you may have to hit the beginning of the small field spot-on to have enough room to slow down.

▶ 2. LAND ON A SLIGHT UPSLOPE OR DOWNSLOPE

Often, landing areas away from the dropzone aren't perfectly flat, and sometimes you can't tell until you're at 20 feet. To prepare for this, find a place on your landing zone that's not perfectly flat. Scope it out and plan on landing there. There's no magic trick for landing on a slope. You flare more aggressively to land going uphill, less aggressively to land going downhill. Obviously not all dropzones have slopes. If you don't have a good slope somewhere on your dropzone, you may have to wait to try this skill until you're at a dropzone that does have one.

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▶ 3. LAND DOWNWIND

This is another exercise you should perform on a separate pass and announce to the other jumpers on your load prior to attempting. Because landing downwind requires you to fly an opposite landing pattern from jumpers landing into the wind, it's critical that you perform this drill without other canopy traffic in the air with you.

Start off trying no-wind landings and slowly progress to making 4 - 5 mph downwind landings as you get better at flying your canopy. Remember, your flare technique will never change regardless of the landing direction (headwind, crosswind, or downwind). As you slow down, make sure to flare all the way to arm's length and continue to fly your canopy until you come to a stop. Keep your feet off the ground as long as possible. Depending on your speed when you put your feet down, you may need to run out the remainder of the landing or slide to a stop. Since there is more ground speed, proceed with extreme caution and be prepared to perform a parachute landing fall (PLF) if necessary.

Downwind landings can be scary, but this skill can come in handy on days with light and variable winds, or in an off-dropzone situation when landing downwind is preferable to making a low turn to avoid an obstacle.

▶ 4. BRAKED APPROACH

This skill will really help you on the day that you're flying your main or reserve into the middle of someone's back yard.

When practicing a braked landing, apply about 25-50 percent brakes as you turn onto final and hold it. You'll need to adjust your flare altitude as you prepare for landing. As your canopy flies slower, it will respond as if it is a larger, less responsive canopy, so if you're flying in 25 percent brakes, you will have to flare about 25 percent harder. (These numbers become less and less reliable as you increase the amount of brake input you are giving the canopy.) Your flare will have a little bit more of a "stab" look to it.

Make sure you have got the feel for this manoeuvre many times up high before trying it near the ground. Be aware that without a ground reference it may be difficult to visualize how the braked approach and flare will work during an actual landing. Start conservatively and be prepared to PLF.

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▶ 5. COORDINATED TURNS

A coordinated turn is a turn using your body weight to lean in the harness as you look in the direction of your turn. Rotate your hips and torso in the direction of the turn to coordinate body position with toggle input, producing smooth and balanced movement. There are more than just safety reasons for looking in the direction of your turn; it also helps you focus your visual and physical attention on where you plan to move.

To make a coordinated turn, line up your head, shoulders, and hips; lean in the harness, lining up the geometry of your rig to put as much weight on the correct side of the canopy before and during your toggle or riser input. This sort of coordination will give you maximum performance turns and becomes increasingly important as you fly smaller and more responsive canopies. You may want to use a harness and container system with variable geometry (i.e. hip and chest rings) to help you emphasize your turns and improve your overall canopy flight.

WORDS OF CAUTION WITH COORDINATED TURNS

Coordinated turns can be a lot of fun and can significantly increase the speed of your turn. The caution comes with turning in the opposite direction abruptly. If you gain too much momentum in one direction (e.g. multiple coordinated turns in a series), then suddenly turn in the opposite direction, the lines can become slack due to the abrupt direction change and the canopy trying to change direction. Once this happens, the suspended weight and the canopy are traveling in different directions, and now there is a potential to induce line twists. This can be particularly daunting for a novice, especially close to the ground, and can create a very dangerous situation. Remember that we should complete all new canopy control tasks on a low pass (5,000 ft.), with clear airspace, and all tasks should be completed by 2,000 ft.

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WINDS, EFFECTIVE GLIDE & INCREASED PERFORMANCE

There are many views on how to get the most effective glide from your canopy. Some of these are guesses and some are educated perspectives. Wouldn't it be nice to know exactly how to get back from that long spot and make the dropzone? Applying the following concepts with the accuracy trick described in SCE A, you will get the performance from your canopy when you need it most.

First off, let's understand the difference between **Relative Wind** and **Atmospheric Wind** as they relate to our canopies. We also need to understand what **Ground Speed** and **Airspeed** actually mean.

▶ RELATIVE WIND

Relative Wind is the wind generated by movement; that air being displaced is the relative wind. You already understand relative wind from the airplane on exit so let's apply that to our canopy. As we are flying our canopy we feel wind on our face. This is the relative wind being caused due to our movement through the air.

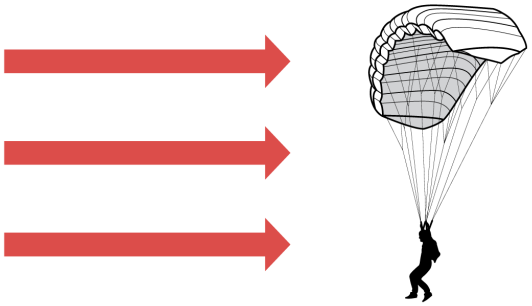


Figure 14: Relative Wind

This relative wind has an adverse affect on our "ground speed" due to the drag created as we move against it. As our pilot chute collapses, we collapse our slider, and get smaller, we reduce the effects of relative wind by decreasing drag and are able to increase the speed of our canopy and achieve further distances. By using this "Active Piloting" position, you can increase the speed of the canopy by getting smaller (decreasing drag on your body) and slow the canopy by getting bigger (increasing the drag on your body).

▶ ATMOSPHERIC WIND

Atmospheric Wind is generated by the wind in any specific air mass you are traveling in. An example would be if your canopy flies at 25 mph and you have an "atmospheric winds system" that you are flying in at 25 mph; you are now traveling 50 mph across the ground, but your overall "system" speed is still 25 mph. Your system speed does not change, but your ground speed does. Conversely, if you are traveling 25 mph under canopy into the wind and have a 20 mph headwind, you have a ground speed of 5 mph.

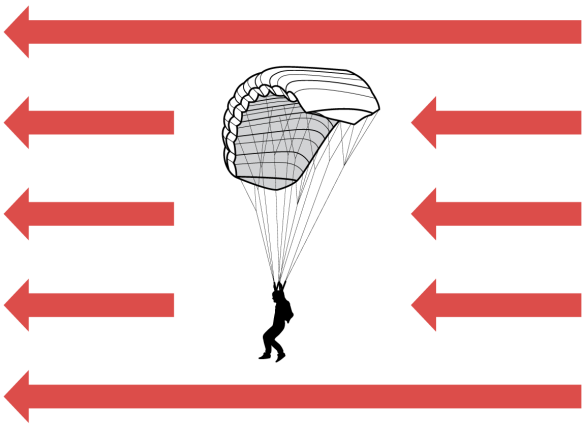
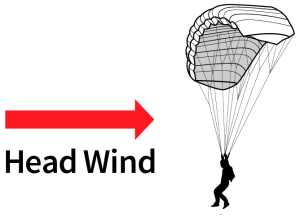


Figure 15: Atmospheric Wind

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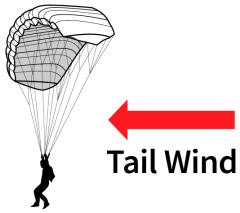
HEAD WIND

Head Winds will decrease your overall ground speed. The faster the velocity of the wind, the greater the decrease in ground speed.



TAIL WIND

Tail Winds will increase your overall ground speed. Again, the higher the velocity, the higher the ground speed.



GROUND SPEED

Ground Speed is the combined speed of your canopy's airspeed plus the speed of the atmospheric wind that you are traveling in over the ground.

AIRSPEED

Airspeed is the speed with which you are actually flying through the air, under your canopy, without any influence from atmospheric wind.

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USING EFFECTIVE GLIDE BY ADJUSTING FLIGHT MODES (Rear Risers, ¼ Brakes, ½ Brakes, ¾ Brakes, Full Glide)

1/4 BRAKES

Flying in a ¼ brake setting provides options, allowing the canopy to both slow down and accelerate as conditions require. This gives us the ability to slow down and speed up from a slower position. Example: We don't drive our cars as fast as they go all the time, so let's use the same principle to fly our canopies to give us more flexibility to react to different situations.

REAR RISERS

There is an efficiency point with your rear risers. If you pull them too far down you will get past that efficiency point and lose altitude without getting the glide you desire. You have already done rear riser stalls, so now go up and find where you can get the most efficient glide with the use of your rear risers.

To understand how to manage effective glide, you must understand that distance flown across the ground is affected by atmospheric wind and changing flight modes. You can adjust your flight mode to gain distance across the ground while you are flying in that mass of air. You will need to know where the atmospheric wind is (head wind or tail wind) to determine the most effective flight mode.

Figure 16, below, depicts the most efficient flight modes to gain distance with no winds.

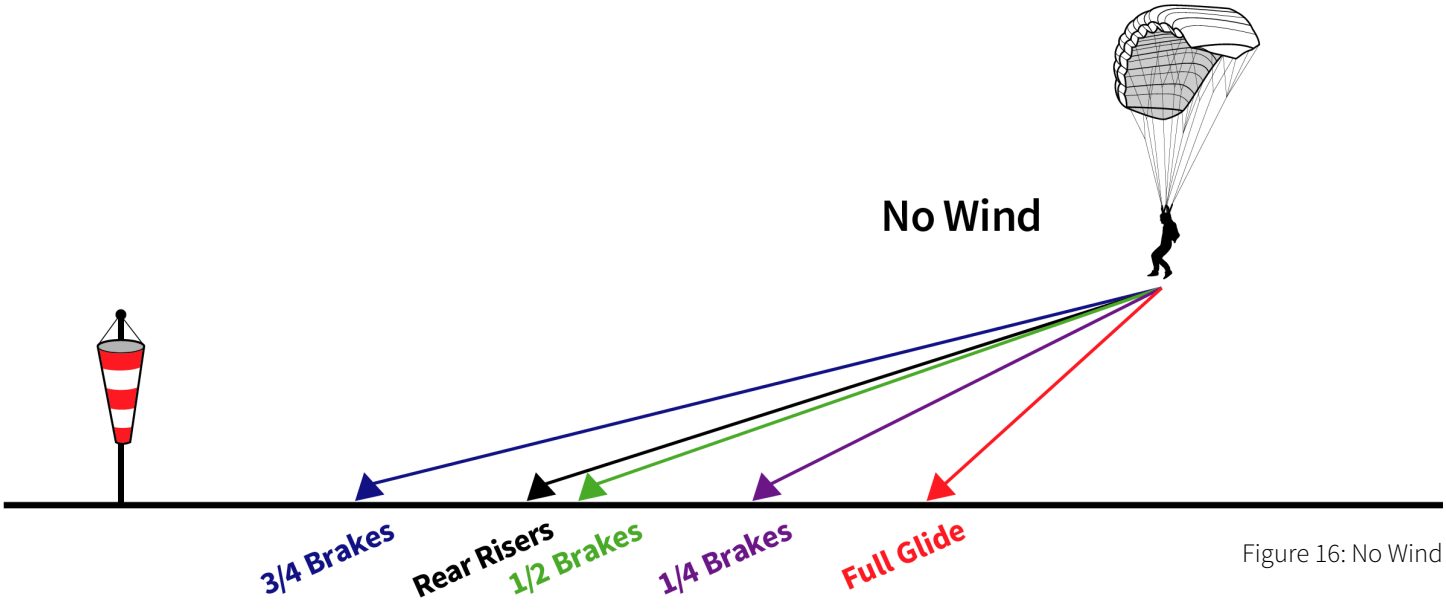


Figure 16: No Wind

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In a tail wind we can increase our distance with the flight modes shown in Figure 17. The tail wind is effectively allowing us to travel further in the mass of atmospheric wind.

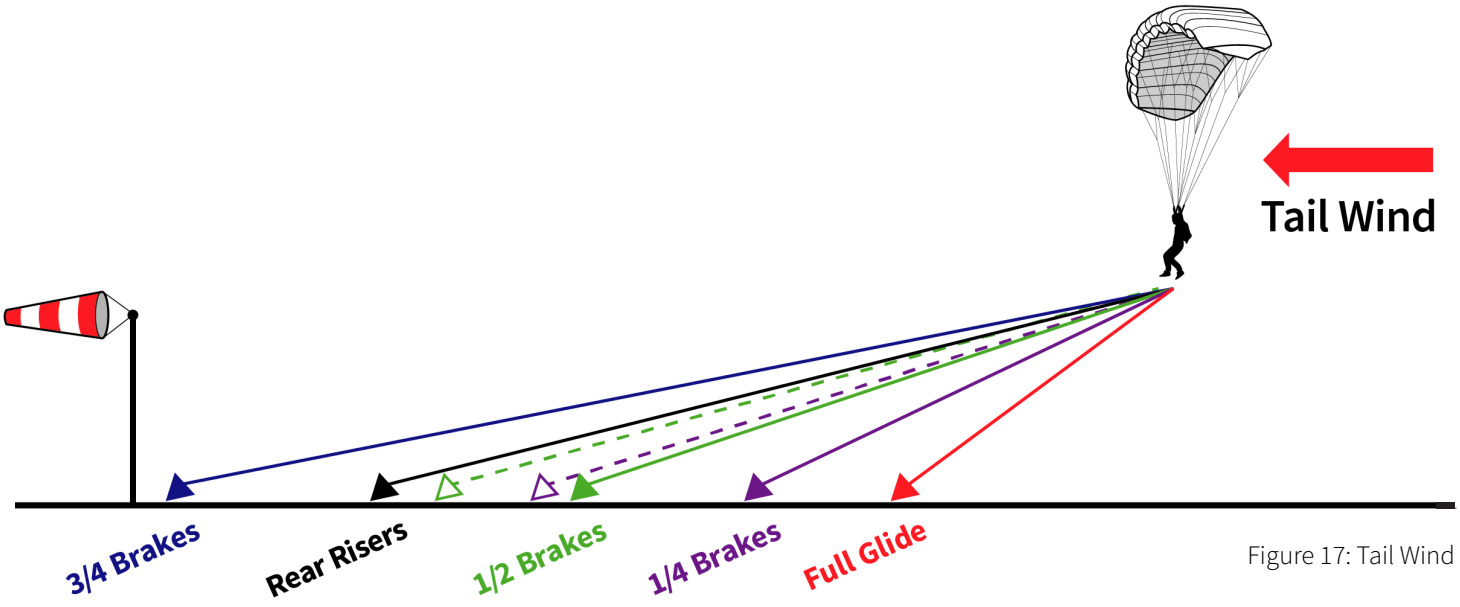


Figure 17: Tail Wind

In a head wind, when toggle inputs are applied it reduces forward airspeed (drag from atmospheric wind) but still increases lift. However, in a head wind this slowed forward speed may offer no advantage unless doing a braked approach for accuracy on final.

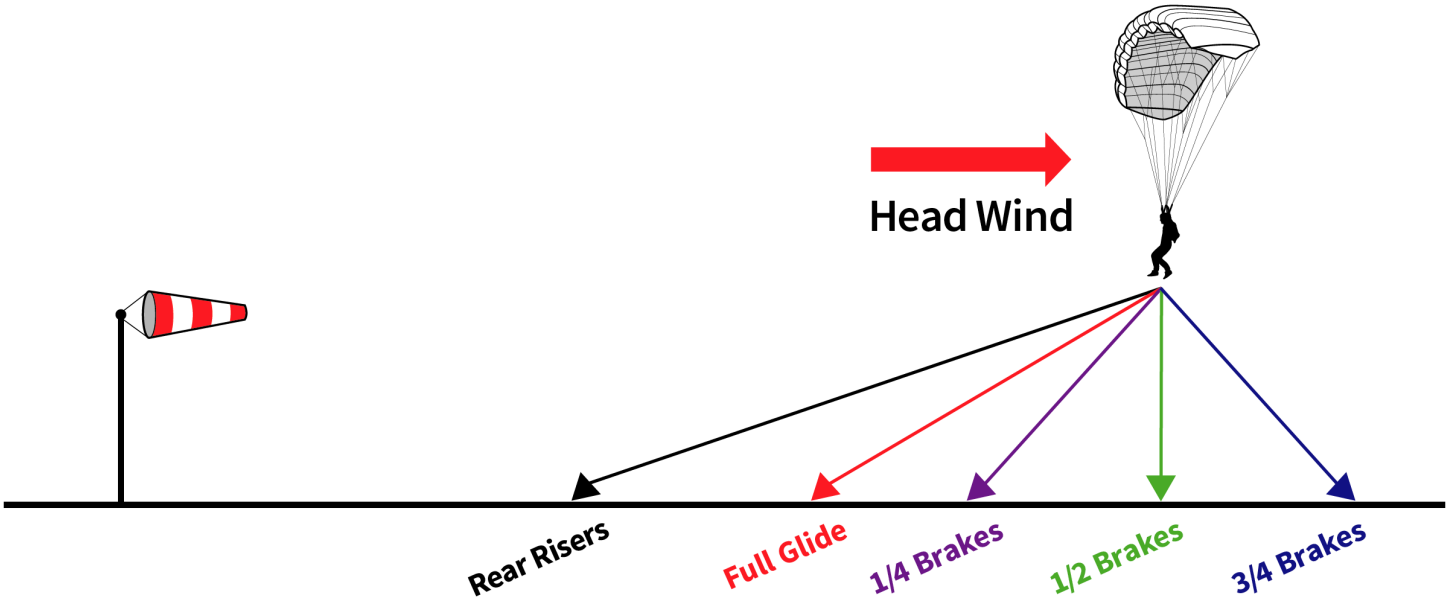


Figure 18: Head Wind

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Adjusting your glide ratio to achieve your intended landing point:

1. Look at your target or obstacle and use the "Accuracy Trick" to determine if you will make the dropzone or pass over an obstacle.
2. Get into a small body position if you need to maximize your distance, which reduces the drag on your body from the relative wind, increasing your ability to move forward.
3. Adjust your flight mode until the target is moving downwards or appears to stay in one spot on the horizon.
4. If you cannot make your intended dropzone, make your decision early. Prior to your pattern entry altitude:

    a) Locate an alternate landing area; and,

    b) Recheck accuracy for that landing area.

▶ HOW CAN YOU GET MORE PERFORMANCE OUT OF YOUR CURRENT CANOPY?

1. **What kind of pilot chute (PC) does your canopy have?**

    a) A normal **student pilot chute** will have more drag, reducing performance of the parachute due to the drag it causes.

    b) Canopy Formation (CF) parachutes have **retractable pilot chutes** to reduce snag points for building formations, but they still have drag.

    c) A **collapsible pilot chute** will reduce drag thus increasing forward speed.

    d) A **Removable Deployment System** (RDS) is the most effective because it removes the pilot chute and slider completely, reducing all of its drag. However, an RDS complicates post-deployment procedures and is not compatible with all systems.

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2. What kind of slider does your canopy have?

a) Student canopies have **normal sliders**, which create a significant amount of drag, reducing speed.

b) **Collapsible sliders**—when collapsed—will decrease the amount of drag from the relative wind, therefore increasing the speed of your canopy and increasing its performance.

c) **Removable sliders** decrease the drag the most.

3. What type of suspension lines are on your parachute?

a) The **larger** the lines are, the **more drag** will be created, which will slow the overall speed (e.g. Dacron lines are big and bulky).

b) The **smaller** the lines your parachute has, the **less drag** there will be, which will increase speed (e.g. HMA lines are very thin compared to other types of lines).

c) Decreasing line size has proven to be one of the **most effective ways to reduce drag** in the parachute system to improve your speed.

4. If your risers have soft links connecting your suspension lines to your risers and the grommets on your slider are large enough to fit over your risers:

a) You can **bring your slider down** to the bottom of your risers and behind your head. This will allow your risers to spread out and in turn flatten your canopy to allow for a **better glide ratio**.

b) This will also **reduce the drag** from the relative wind on your system, thus increasing its forward speed.

c) The other benefit to doing this is **reducing the wear on your lines** from the friction that is created by the relative wind creating vibration of the grommets on your lines.

d) Additionally, having your slider down behind your neck gets the **extra material away from your control area** (risers).

e) Be careful when moving your slider down over your toggles **not to induce a brake fire**.

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5. To further increase the glide ratio of your canopy you can loosen your chest strap:

a) This will allow the harness to open up and allow the **canopy to flatten out**.

b) **Never completely remove your chest strap** in the event you get into an emergency situation and need to cutaway.

6. Reducing your body surface area to the relative wind:

a) By making your body smaller you will **reduce the amount of drag** on your body (from the relative wind) and **increase your airspeed**.

b) This is particularly effective when trying to make it back from a **long spot** or trying to increase your **speed for landing** (speed = lift).

c) Conversely, if you have a bigger body position you will increase the amount of drag (from relative wind) and you will not travel as far.

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CANOPY WRAPS & ENTANGLEMENTS

(Source: Jim Cowan, Gravity Powered Flight LLC)

Canopy wraps and entanglements with other jumpers can be very daunting to work through due to the complicated issues involved and the stress of the situation. This is a guide to assist jumpers through these situations. However, the guidelines can be made useless unless everyone is on the same page. It is important to discuss these with fellow jumpers at your dropzone because they are just as important as emergency procedures.

Most importantly: avoid a collision altogether!

As soon as you have opened your canopy you should be looking around for other jumpers and immediately place you hands on your rear risers and steer to avoid another jumper by following these simple rules:

- **Turn right** if head on to another jumper.
- Be prepared to **turn left if not a direct head on**.
- **Avoid body on body contact at all cost**, however, be prepared to turn towards the other jumper to avoid body on body contact.
- **Spread Eagle**: If collision is imminent, spread arms and legs wide to prevent passing through the other canopy's suspension lines (passing through lines will create an entanglement). If you are flying a small canopy with HMA lines for example, you might want to consider getting as small as possible with the hopes of passing right through.
- **Protect your handles**: With the left arm (using the big bones to act as deflectors) place it over the reserve ripcord handle and the hand over the cutaway handle.
- **Prepare for a violent impact**: Even if the canopy or lines are the only contact points, at 60 mph closing speeds, they become hard and lines become cheese slicers, cutting through risers, lines, fabric, etc.
- **Communicate**: Attempt to communicate with the other jumper, and let him/her know that you are aware of the situation and contemplating extraction options.
- **Say altitudes**: The most important info is the current altitude, because that will directly influence the options available.
- **Attempt to free yourself**: If you are above 1,500 ft. AGL, protect your handles and follow risers and suspension lines out of the entanglement.

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- **Use positive commands**: Only say what you want the other jumper to do, or ask what he wants you to do. If you want the other jumper to not do something, don't understand, or disagree with what they are saying, use words like "WAIT" or "STOP". Use only positive commands, such as "HOLD ME". Never use the word "CUTAWAY" unless you want the other jumper to cutaway. If you want to cutaway, use "I AM OUT OF HERE, SEE YA LATER" or "BYE BYE".

THERE ARE GENERALLY THREE TYPES OF ENTANGLEMENTS:

1. **In the fabric**: upper jumper is engulfed in the lower jumper's canopy.
2. **In the lines**: upper jumper is entangled in the lines of the lower jumper.
3. **Neither in fabric nor in lines**: canopies and lines are entangled, both jumpers are clear of both lines and fabric.

▶ 1. IN THE FABRIC

The most common situation is where the upper jumper is in the fabric of the lower jumper's canopy. Good news, you're in the fabric! So, you most likely have a good canopy above you, since the other canopy is wrapped around you, below your controls and suspension lines (thus not interfering).

Three possible responses:

ABOVE 1,500 FT.

- Follow lines/fabric in an attempt to get free from the other canopy while protecting handles.
- If freed, check handles and major components for dislocations or damage, then do a canopy serviceability check.

ABOVE 1,500 FT. & UNABLE TO DISENGAGE

- Upper jumper tells lower jumper to "**CUTAWAY, CUTAWAY, CUTAWAY**".
- Upper jumper clears canopy and controls it as to not interfere with his canopy.

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BELOW 1,500 FT.

- Hold onto lower jumper and both jumpers prepare for a hard landing PLF.
- If possible, attempt to control upper canopy, stop any turn and go to 50% brakes.
- If upper canopy is uncontrollable or has a high rate of descent, either jumper may deploy a reserve to slow descent.
- You cannot cut away in this situation.

▶ 2. IN THE LINES

Situation: Upper jumper is entangled in lines of lower jumper, possibly up against bottom skin of the other canopy, and probably does not have a good canopy either since lower jumper's canopy is up in the suspension lines of the upper canopy.

Three possible responses:

ABOVE 1,500 FT.

- Follow risers and lines out and attempt to get free from other canopy's lines, while protecting handles.
- If freed, check handles and major components for dislocations or damage, then do a canopy serviceability check.

ABOVE 1,500 FT. & UNABLE TO DISENGAGE

- Lower jumper tells upper jumper to "**CUTAWAY, CUTAWAY, CUTAWAY**".
- Upper jumper should disconnect RSL if not done already, so that the reserve is not deployed into the entanglement.
- Cutaway, then once clear, deploy reserve.
- The lower jumper should attempt to steer clear of upper jumper's canopy. If unable to clear canopy, execute cutaway procedures.

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Why does the upper jumper cutaway first in this case?

If the lower jumper were to cutaway first, the upper jumper would become hopelessly entangled in the lower jumper's canopy. The upper jumper needs lower jumper to stay attached to maintain tension on the suspension lines for the upper jumper to have a chance to untangle himself.

BELOW 1,500 FT.

- Hold on to lower jumper and both jumpers prepare for a hard landing PLF.
- If possible, attempt to control upper canopy to stop any turn and go to 50% brakes.
- If upper canopy is uncontrollable or has a high rate of descent either jumper may deploy a reserve to slow descent.
- You cannot cut away in this situation.

▶ 3. NEITHER IN THE FABRIC NOR IN THE LINES

If the canopies are entangled and neither jumper is in the fabric or lines of the other, either jumper may carry out emergency procedures (EPs).

ABOVE 1,500 FT.

- Attempt to steer free of the other canopy's suspension lines.
- If disengagement is achieved, both jumpers need to check handles and major components for dislocation or damage, then complete a canopy control check.

ABOVE 1,500 FT. & UNABLE TO DISENGAGE

- Attempt to communicate and tell the other jumper to "**CUTAWAY, CUTAWAY, CUTAWAY**".
- Or let the other jumper know you are going to cut away by saying "**BYE BYE**" or "**I AM OUT OF HERE**".
- At this point the other jumper may be able to clear the other canopy (or not), then cut away as required.

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BELOW 1,500 FT.

- Attempt to control the canopies by stopping a turn and going to half brakes for landing.
- If canopies are uncontrollable, then one or both jumpers should deploy reserves to slow descent.
- Neither jumper can cut away at this point because you are too low.

In all cases the best thing to do is AVOID other jumpers:

- Ensure proper exit separation.
- Ensure proper break-off separation.
- Keep your head on a swivel.
- Know your canopy avoidance drills.

▸ HOOK KNIVES

Hook knives should only be used as a last resort, most jumpers will cut the wrong thing or too much of the right thing and make most situations worse. A single line caught on equipment, around your throat, or other snag would be an appropriate use.

▸ RESERVE STATIC LINE (RSL)

An RSL does not usually have a negative impact on any of the above situations, other than the recommendation that it be disconnected prior to the upper jumper in lines executing a cutaway. It does not represent an obstacle to any of the other above situations.

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DUAL DEPLOYMENTS

(Source: Jim Cowan, Gravity Powered Flight LLC)

A dual deployment means that both RAM air canopies are deployed out of your container.

Causes:

1. Dislodged reserve ripcord due to movement in the airplane or during a freefall collision.
2. Collisions or bad body position during deployment.
3. AAD activation (low pull) or improper setting.

THERE ARE FIVE POSSIBLE CONFIGURATIONS:

1. **Side by Side**: Canopies are flying next to each other in the same direction, end cell to end cell.
2. **Biplane**: Canopies flying in same direction, one in front of the other.
3. **In Between**: Canopies are transitioning between a Biplane and Side by Side.
4. **Downplane**: Canopies are diving towards the ground.
5. **Partially deployed**: Both containers are open, one has full deployment and the other has partial deployment.

What should you do? The first thing to do is identify the configuration! Procedures will differ slightly for each configuration, but all begin with the same common response:

- **Keep the brakes stowed:** Keep the canopies flying as slow as possible, steer with the rear risers and keep them flying in the same direction to a safe location for landing.
- **Check for entanglements:** Is the main deployed through the risers of the reserve? If so, you risk a serious problem if you cut away.

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- **Separate and cutaway main:** While two canopies of similar size may be flown and landed safely, canopies that differ significantly in size or shape may not fly compatibly. In such cases, if the main canopy is not entangled with the reserve, inducing separation and transferring to the reserve canopy may be the more appropriate option. This decision depends on canopy configuration and flight characteristics and should only be made when separation is expected to reduce the risk of entanglement.

- When this option is selected, the following actions may be used to facilitate separation and cutaway of the main canopy:

    a) First, place your right hand on your cutaway handle, then;

    b) apply downward input to the left rear riser with the left hand to encourage separation and establish a downplane;

    c) Once the canopies have separated into a downplane, cutaway the main.

- **Steer both canopies together:** If the canopies are entangled, if you are not sure if they are entangled, or you are below 1,500 ft., steer both canopies towards each other using the rear risers (or toggles if released) and keep them touching above you.

- **Steer towards an obstacle free area** and prepare to PLF.

▶ 1. SIDE BY SIDE

- Keep the canopies touching by steering the best functioning canopy gently with the inner rear riser towards the other.

- In order to steer towards an obstacle free landing area, keeping both canopies touching, push one canopy with the other in the direction desired.

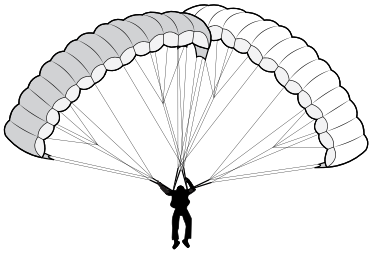


Figure 19: Side by Side

▶ 2. BIPLANE

- Keep canopies touching front to back.

- Steer the front canopy gently in either direction and the rear canopy will follow along, like a truck towing a trailer.



Figure 20: Biplane

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▶ 3. IN BETWEEN

- Keep canopies touching front to back.
- Steer the canopy that's primarily over your head gently.
- Make turns toward the other canopy.

Depending on canopy configuration and controllability, it may be easier to transition from an in-between configuration to a side-by-side configuration by using rear riser input on the rear canopy, after which side-by-side procedures may be followed.



Figure 21: In Between

▶ 4. DOWNPLANE

- If not entangled conduct a canopy transfer to the reserve (as described above).
- If entangled bring the canopies together by steering towards each other to bring them into a side by side.

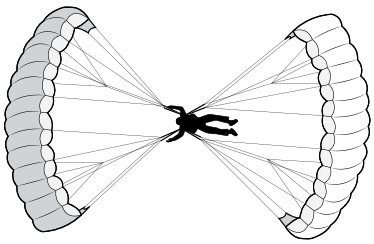


Figure 22: Downplane

▶ 5. PARTIALLY DEPLOYED

- Attempt to collect the un-deployed parachute and try to control it as much as possible and place it between your legs.
- The key factor is to keep the un-deployed parachute from deploying into the fully deployed parachute.



Figure 23: Partially Deployed

▶ 6. OTHER RESULTS

There are various situations in which canopy lines—or even both canopies—may become entangled or experience partial or complete loss of functionality.

Some issues require a cutaway whereas others can be managed.

The procedure to deal with the situation should be taught by an appropriately rated Instructor.

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FACTORS TO CONSIDER WHEN CHOOSING A CANOPY

Individually, skydivers will choose different types of parachutes for various purposes and disciplines. Make sure you master the canopy you're currently flying before changing to a smaller or faster type of canopy. You should also be efficient and current at performing all of the canopy skills outlined in the SCE A & B to an advanced level prior to downsizing. Here are some factors to consider before changing canopies.

▶ EXPERIENCE & CURRENCY

Generally, a higher jump number will lead to more experience in flying and landing parachutes, but this does not necessarily mean that the amount of total jumps has an influence on better canopy control. By taking longer breaks from jumping, we lose some feeling for the canopy and judgment of ground references. It takes some jumps again to feel and fly the same as before. Jumping regularly, or training in blocks, will give you a great learning experience in a shorter time. Judge your own experience objectively and ask experienced skydivers or instructors for their opinion. If you're flying at a new dropzone, at 1,200 ft. elevation, 30°C temperature, and you're not current, be aware of your limitations!

▶ EXIT WEIGHT

The suspended weight is the factor that influences the wing loading (more on wing loading later on in SCE B). The right choice depends on the individual pilot's ability to understand the canopy, to handle it safely and to react correctly in cases of emergency situations or difficult landings.

You should follow the recommended wing loading chart described here. Further downsizing will get you into an area where even little mistakes can have painful results. Make sure that you have successfully managed your canopy in difficult landing situations before going smaller.

▶ AGE & PHYSICAL FITNESS

Different types of parachutes show a different behaviour on opening. Some designs open slowly, others open quickly. The faster the opening, the more physical stress on the jumper's body. Older bodies tend to heal more slowly. Landing smaller parachutes in no-wind conditions often ends up with running or sliding off the speed. Not being able to run off the speed can result in a crash landing (we must also take the landing surface into account). Big and high cambered canopies fly less horizontally with more vertical speed on touchdown, which can result in a hard landing.

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ELEVATION

Air pressure at sea level is higher than at altitude. The higher the elevation, the less performance your canopy will have on landing. For every 1,000 ft. of elevation, we lose about 4% of performance. If you are jumping at a dropzone with 3,000 ft. ground elevation instead of at sea level, the canopy loses about 12% of its performance. This is about one canopy size difference! This means you can expect a faster landing at higher altitudes, so be careful!

AIR TEMPERATURE

Cold air has a denser air pressure than warm air. In cold temperatures, canopies perform better than in warm weather.

LANDING AREA & LOCATION

Faster landings with more highly loaded canopies need more landing space. Accurate landings are generally easier with a classical design 7-cell, compared to a small 9-cell (or high performing) canopy that flies further across the ground. Normal landing areas on airfields offer a lot of space to land parachutes safely. Looking at an aerial picture and studying the surroundings of the dropzone will help you to find alternative landing areas in case of an emergency or off landing. The aerial picture of the landing area can also show us expected areas of turbulence, in different wind directions. Plan every landing considering turbulence in that landing area.

TRAFFIC

Busier dropzones typically use bigger aircraft; this normally means more traffic over the landing area. First clear your airspace of traffic by creating separation, then fly your planned approach. In case your Plan A approach is not possible, remember your landing priorities and have a Plan B. Don't think of a Plan B in the last moment; think about it high up, or better still, on the ground before you jump. Stay attentive during your complete flight and landing.

WINDS

Every location has its typical winds in strength and direction. Knowing about typical winds and possible changes in wind direction at the particular landing spot will help you to work out a Plan B for every landing approach and avoid last second decisions. The more difficult the wind conditions in the landing area, the more careful your approach should be.

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▶ FACTOR IT IN

Just as the factors here affect your choice of canopy, they also affect the performance of the canopy you choose. For example, if you're flying at a new dropzone, at 1,200 ft. elevation, in 30°C temperature, and you're not current, be aware of your limitations!

▶ PURPOSE

Because there are different motivations for jumping and flying parachutes, there are different types of parachutes on the market. Most parachutes are elliptical or semi-elliptical, apart from student, canopy formation (CF), and accuracy parachutes. In most cases, parachutes with a higher aspect ratio will have a more elliptical shape and will be more responsive to pilot inputs.

The smaller and more elliptical a canopy's shape is, the better the piloting skills required to safely land it. Some open slower, fly faster, or produce more lift. Think about your own motivation for flying parachutes and find the parachute that meets most of your requirements.

▶ DIFFERENT CANOPY TYPES & MAKING THE RIGHT CHOICE

STUDENT CANOPIES

These are reliable, stable, and easy to handle parachutes. Their design and construction result in an extremely stable canopy with gentle, predictable stall characteristics and a slow rate of descent. They also have very forgiving control ranges, which makes them hard to stall without taking wraps of the control lines.

7-CELL CANOPIES

In general, 7-cells will come in steeper and be more stable in deep brakes (tougher to collapse). They are less likely to have collapsed end cells and are considered more docile (although that's not necessarily true). They will typically have a weaker (or different) flare than a 9-cell. Some modern 7-cell canopies can fly just as well as a 9-cell canopy. 7-cell canopies are typically preferred for disciplines like CF and wingsuiting.

9-CELL CANOPIES

In general, 9-cells will have a flatter glide, are easier to collapse, will fold like a bow tie when stalled, and are considered to be higher performance (although that's not necessarily true). The difference

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is because, in general, 9-cells will have a wider aspect ratio. There's less pressure to keep the outside cells inflated, but those cells contribute more to your turns.

SEMI-ELLIPTICAL CANOPIES

Canopies described as “tapered” or “semi-elliptical” are generally more responsive than rectangular ones. They often have lighter toggle pressure and turn more easily. Although large rectangular canopies can be a bit sluggish, especially when lightly loaded, some larger tapered canopies feel surprisingly agile. These canopies are ideal for jumpers who want a larger, more forgiving canopy that is still fun to fly. Small tapered canopies can be extremely responsive.

ELLIPTICAL CANOPIES

Elliptical refers to a wing that has some type of taper towards the tip or a tapered shape. This is typically a more aggressive canopy with regards to performance of the canopy, dive, dive recovery, plane out, and of course, speed.

CROSS-BRACED CANOPIES

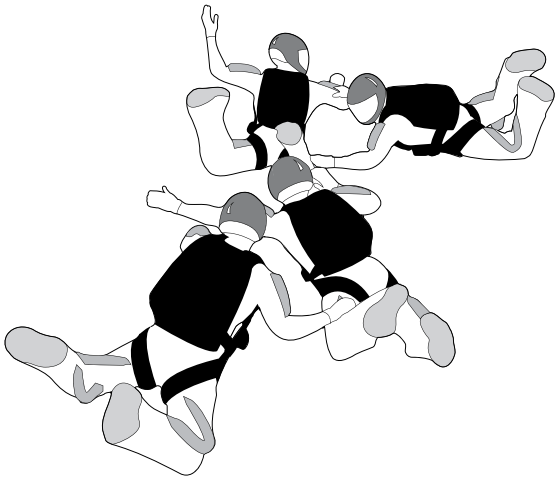
The internal structure of a cross-braced canopy makes better use of the flight surface, keeping it flatter and extending its effective wingspan. Cross bracing also reduces the ballooning of the fabric between the cells inherent in any inflatable wing and it makes the wing more rigid. The flatter top-to-bottom profile reduces drag, so the wing can cut through the air more easily and go faster for the same square footage, as well as maintain speed induced from the dive following a turn. Manoeuvres, including stalls, are more abrupt. These canopies are for highly experienced canopy pilots, mostly seen for swooping.

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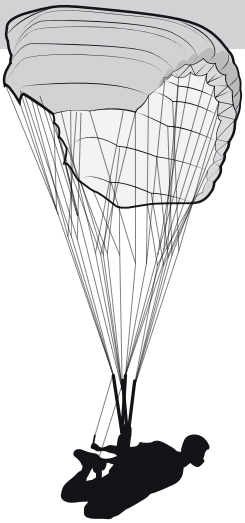
Now that we have a better understanding of different types of canopies, let's talk about what kind of canopy you want to purchase, what discipline you want to participate in, and what type of canopy might be most appropriate (9-cell, 7-cell, square, or semi-elliptical). Try and forecast where you would like to go in the sport and purchase appropriately, but don't get too aggressive too quickly. Be conservative and have a long career in the sport.

FORMATION SKYDIVING (FS) OR VERTICAL FORMATION SKYDIVING

As we add multiple people on a skydive we need to start thinking about breakoff altitudes and separation between people. The more people we put on a skydive, and with faster canopies, we now start to decrease our closing time between jumpers when there are off heading openings. The bigger the formation, the more the people, the more the chances of an off-heading opening, the more congestion in the sky and the landing area.



Something else to think about is what are the opening characteristics of the canopy. Does it always open on heading? Do you always fly your opening to maintain your heading to avoid flying back towards someone? These are factors you need to consider when looking to purchase or select the correct canopy.



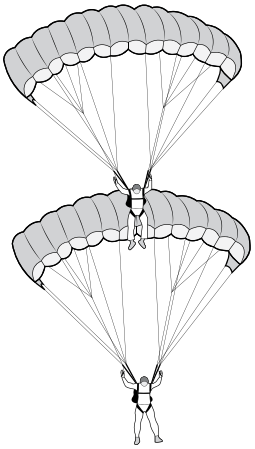
CANOPY PILOTING (CP)

As a new B CoP jumper you should not be purchasing a canopy for CP yet! It's great to have the goal of wanting to become a canopy pilot, however, take it slow and work your way there with slow progressive downsizing and appropriate coaching. The more coaching on basic skills you get early on, the more efficient a canopy pilot you will be later on in your career.

PIM 1 Excerpt: 3.21 CANOPY PILOTING: Introduced as an IPC competitive discipline in 2003, Canopy Piloting was a new, exciting facet of our sport, with a potential for serious injury to the uninitiated. Skydivers entering a canopy piloting competition should have at least 500 high performance landings—100 of which should have been in the 12 months prior to the competition. Having said that, let's take our time getting to those high-performance canopies.

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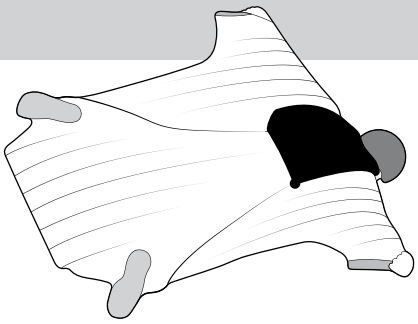
CANOPY FORMATION (CF)



Do you want to learn CF? Consider a 7-cell canopy that is appropriate for this discipline. Look at the appropriate wing loading (and your skill level) to jump with local CF jumpers. Talk to other coaches and instructors to get guidance.

PIM 1 Excerpt: 3.20 CANOPY FORMATION: Participants must have received the Canopy Formation & Canopy Relative Work Briefing, hold a CSPA B CoP, and have demonstrated competence with a ram-air canopy.

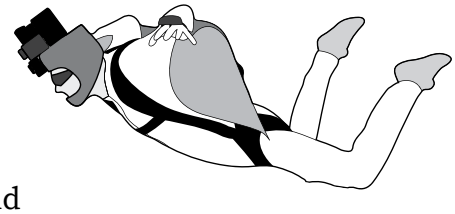
WINGSUITING



It will take some time to get there, but if you are serious about jumping you could easily get to 200 jumps in a season and start wingsuiting, so you should take this into consideration when purchasing gear if this is your goal. Canopies for wingsuiting should have very consistent on-heading opening characteristics. Talk to an experienced wingsuit coach or instructor to get some advice.

PIM 1 Excerpt: 3.24 WINGSUIT JUMPS, Experienced skydivers must possess a minimum of a B CoP and 200 jumps. They should receive one-on-one instruction from an experienced wingsuit jumper. This instruction should include training in gear selection; rigging and proper wearing of the suit, pilot briefing, and aircraft exit, heading awareness, basic flight techniques, deployment and emergency procedures.

CAMERA FLYING



Again, like wingsuiting, it is not unreasonable that you might have enough jumps to start flying a camera after your first season. Having said that, you will want to take into consideration all the factors around what canopy to purchase and how it fits with all of your other equipment and all the factors we discussed with regards to FS (if that's the discipline you are thinking of flying camera for). You should also be considering a canopy that has softer opening characteristics, especially if you are starting to load up a heavy camera helmet. Again, you should be talking to experienced camera people (coaches and instructors) for advice.

PIM 1 Excerpt: 3.23 CAMERA JUMPS (Videographers): Experienced skydivers must possess a minimum of a B CoP and 200 jumps. They should be competent in the freefall discipline in which they wish to participate as a videographer, should seek advice from experienced freefall videographers regarding the type of equipment to be used in order that they may safely engage in this activity. At least one functioning audible altimeter must be used, and an Automatic Activation Device should also be used.

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WING LOADING & ITS EFFECTS

(Source: John Leblanc, Performance Designs, Skydive Mag July 2014)

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. Divide the total exit weight by the size of the canopy and you come up with your wing loading.

WING LOADING EXAMPLES

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 become.

Why increase wing loading? What's the point of moving to a higher wing loading? Usually it's one of six reasons:

1. Fun: We skydive for fun! The extra speed under canopy generated by increased wing loading can add to that fun.
2. More response: More nimble handling and crisp response; small movements of the controls produce noticeable changes in flight. This could be a double-edged sword; the canopy doesn't care if your control input is correct or not!
3. Smaller rig: You may want a tiny rig like the one your friend has. Everybody gets the itch for a new toy once in a while, but remember, it must save your life and return your body unharmed to the ground.

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4. The "right" wing loading: You may think you need to achieve the "right" wing loading. But what exactly is correct? There is some confusion. The maximum recommended weight is often misinterpreted to mean a required weight, or even a minimum weight. PD's canopy chart shows minimum weights frequently much lower than most would expect.

   Wing loading is a personal choice. If you feel a certain canopy might be a bit over your head in a tight situation, consider going one size bigger—or two. You'll still get great performance and landings if the canopy is a good design and you fly it efficiently.

5. Swooping: Long swooping landings are fun; the ability to achieve zero descent rate during flaring permits landing without injury at higher wing loadings. But don't forget that the refined aerodynamics do not automatically provide good landings, only the potential for one. As wing loading goes up, there is less forgiveness.

6. No backing-up: Higher wing loading can help you avoid backing up in winds. But, high winds often mean heavy turbulence. The increased ability to penetrate headwinds may give you a false sense of security in winds that should probably be waited out on the ground.

   These are all valid reasons but can be taken too far, possibly with dangerous results.

> "Don't be too quick to drop to another size simply because you landed well this time in an open field with no traffic."
>
> **- John LeBlanc, Performance Designs**

▶ WHAT IS THE "BEST" WING LOADING?

This question involves trade-offs that make a definite answer impossible. A number can't be broken out for two reasons:

1. Different canopies are more capable of safe flight and landings at certain wing loadings than others. For example, if a jumper with a 170 lb. exit weight finds the Sabre 150 flies and lands the way they want, they should be careful not to assume that the same applies to all 150-square foot parachutes.

2. People judge flight characteristics according to their own frame of reference, which varies greatly. Many get caught making too large a change in wing loading because some expert said their intended wing loading was "conservatively low". Well, by whose standards?!

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Example: Consider two students.

1. **A 100-pound jumper:** This skydiver's rig and clothing weigh 25 pounds, they have been jumping a 260-square foot canopy as a student, and they are ready to buy their first set of gear. They have heard that 1.0 lb/sq. ft. wing loading is "correct", but a friend says to go bigger for the first canopy at a wing loading of 0.8. The skydiver chooses the more conservative guideline and runs the numbers: 125 pounds divided by 0.8 equals 156 square feet. What a huge change from the 260! While the 260 seemed to float all over the sky, the 156 just screams at the ground!

   It would be better to try a 230 and see what it's like, then a 210, and so on until a reasonable size feels right.

2. **A 200-pound jumper:** The second jumper has the same number of skydives but weighs 200 pounds. They started on the PD-300, but transitioned to the 260 on the last few jumps. If they went to the same wing loading of 0.8, they would probably be disappointed. Why? 225 pounds exit weight, divided by 0.8, equals 281 square feet. They would be jumping a bigger canopy!

   So, the same wing loading might feel quite slow to one jumper but positively frightening to another.

▶ WHAT ABOUT EXPERIENCE LEVEL?

Defining experience level has become more complicated. These two jumpers may have the same number of jumps and similar freefall skills, but their experience under canopy is certainly different. The "type" of experience, rather than the number of jumps, is most important when referring to canopy skills. Remember that it's all relative to what you are used to. Don't be too quick to drop to another size because you landed well this time in an open field with no traffic. You may be surprised how difficult it can then be to land accurately in a tight area.

Be careful talking about "high" and "low" wing loadings to others. If you happen to be comfortable with a wing loading of 1.6, then one jump on a friend's new canopy at 1.2 lbs/sq. ft. will probably seem pretty docile. But don't describe it as "docile" to the new owner, or even to someone with twice as many jumps as you! You'll likely mislead them.

Number of jumps (experience), wing loading, and type of canopy are the over-riding principles in deciding what canopy you are going to fly. Example: Your exit weight is 135 lbs and you want to fly a Stiletto 135 (1:1 wing loading) and have 35 jumps. Do you think this is a good idea? NO! But why not? Here is why:

EXPERIENCE

Your experience needs to match the type of canopy you are flying. Experience relates to how many jumps you have done on different types of canopies, understanding the flight characteristics of

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those canopies, how consistently you have landed standing up and been exactly where you wanted (accuracy), having experienced landing in different wind speeds and different directions (into the wind, crosswind, quartering wind, and downwind). How much experience do you have landing off dropzone? It is a completely different story landing in your standard landing area vs. taking that same size landing area (100 m x 100 m), moving it off dropzone, and putting trees on one side, a river on one end, and a road with power lines along the other side. This changes your mindset considerably.

CURRENCY

It's not just about how many jumps you have. You need to be honest and remember how often you are jumping. After a long layoff from jumping with low experience, it might be a good idea to upsize canopies until you are current again. What if you are only doing 50 jumps in a season? Maybe you should be flying a larger canopy.

CANOPY TYPE

This is a very important component of the equation. A semi-elliptical canopy is going to fly with a lot more performance than a student canopy. Be very cautious when choosing canopies, as some are much less forgiving than others.

CHANGES IN PERFORMANCE

It is important to become fully prepared for the changed flight characteristics of flying at a higher wing loading before you make an increase.

SPEED

The most obvious change is more speed. However, the new feeling of greater speed will one day feel normal, and perhaps even slow, though it certainly isn't. Many people then bring this additional experience to the next smaller size, and the rush is back. But at what cost? Clearly one can push this too far, too fast.

DESCENT RATE

By going to a smaller size of a particular design, the small increase in speed comes mostly from a large increase in descent rate—which means less hang time, less time to collapse your slider, and less time to play. At high wing loadings, the flight might be fun, but the time aloft is usually short.

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GLIDE RATIO

The ratio of the forward movement compared to the downward movement in the air reduces under an increased wing loading. Glide ratio is the ratio of lift to drag. When we increase the parachute's wing loading, we hang a bigger person out there, so the person's body is a proportionally higher percentage of the drag. The result is a poorer glide.

WIND

Another change is how a jumper under canopy is affected by the wind. Keep in mind that glide ratio is not the same thing as the distance covered across the ground, because the atmospheric winds come into play. A higher wing loading makes it easier to penetrate headwinds. In a tailwind however, you might find that someone flying a big 7-cell may go further than you at full glide on your trusty 170 9-cell, even though their glide ratio is lower.

However, anyone can hold some brakes to slow the descent rate when flying back, and the exact right amount of brakes helps considerably at high wing loadings.

SPEED/STALL POINT

When you go to a higher wing loading, the stall speed increases. A stall may happen more abruptly, with less warning, and at a higher airspeed. You have to understand where your stall point is on your canopy because this will significantly change where your canopy stalls. This means it may not be possible to fly an approach into a tight area as slowly as you could with a lower wing loading.

LANDINGS

The landing speed is also higher. Since you will descend much faster on final, the canopy must do more work in the flare to achieve zero rate of descent. With less canopy, it must also work more efficiently. To extract this efficiency, the flaring method must be more precise. Moving either toggle even a few inches may have a big effect on the resulting landing.

On the other hand, a large student canopy descends slowly on final. It doesn't have to do much work to get to a zero rate of descent, and there is lots of surface area to work with. Therefore, a variety of rather crude flaring methods will all give reasonable landings. Toggle movements of as much as one foot will hardly affect the landings. Since poor technique can still produce soft landings under a big canopy, many students develop poor canopy control habits. In many cases, the student carries poor technique to smaller and faster canopies later, and eventually it causes problem landings.

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▶ SOME QUESTIONS TO ASK YOURSELF BEFORE DOWNSIZING

Now, with the majority of incidents in skydiving occurring under fully open (and fully functional) canopies, it's that much more important to talk about when it is and is not appropriate to downsize. So if you're thinking about downsizing, here are some questions you should ask yourself first:

Do I really need to downsize?

When jumpers who are thinking of downsizing talk to a Coach 2 or SSE, the first question that should be asked is, "Why do you want to downsize?". You'd be surprised at how many people don't know how to answer this question.

1. Consider the reasons you might give:

a) Is it because other people tell you that you're ready to downsize?

b) Are you in a hurry to downsize so you can eventually learn to swoop?

c) And, let's be honest here... do you want to look "cool" under a smaller, faster canopy?

d) Have you maximized the full potential of your current canopy?

e) Now ask yourself: Are your reasons appropriate?

2. Do you understand which performance factors will change with a new canopy?

3. Do you have enough experience with the current canopy you are flying? (See all the discussions above and can you perform all the canopy skills outlined in SCE A & B?)

4. Can you comfortably land your current canopy in conditions that are less than ideal?

5. Have you asked advice from a credible canopy coach/instructor?

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CONSIDERATIONS WHEN NOVICES WANT TO BUY GEAR

Generally, it's better if a novice uses the dropzone's gear until they have transitioned from the larger "student" canopies to a smaller one. Since containers are sized to fit the main and reserve canopies, it's not a good idea to buy a rig with the plan of putting smaller canopies in it later. It also makes sense to learn with rental gear rather than new stuff because novices tend to put more wear and tear on gear than more experienced jumpers do. Also, when calculating a training budget, it's better to spend money on jumps than on gear so you can accumulate experience as quickly as possible. It's a great idea if you can downsize using dropzone rental gear until you are ready to commit to something that you can hold on to for years.

But now that you are looking at achieving your B CoP, it is probably a good time to transition off student and rental gear. You also should have a better understanding of what discipline you want to start to learn and what canopy is suitable for that discipline. Additionally, you now better understand the canopy and the effects of inputs, how to better plan for off dropzone landings, hazards, and the effects of wing loading. Now let's talk about what to buy!

First off, this is not the bible on purchasing a new canopy. Get the advice of a rigger, coach, and/or instructor. These people will have your best interests in mind when helping you select the proper canopy and corresponding container. They will also hopefully understand your experience level and help guide you through this process.

▶ WHAT IS THE RIGHT EQUIPMENT AT 50 JUMPS?

Question:

I have 50 jumps. I want to buy equipment, but since it'll be my first rig, I'm not sure what route to go. Money is an issue.

Answer:

At this point in your career, get used gear. Get a "conservative" canopy, one sized so it will be loaded in accordance with the downsizing chart. Make a number of jumps on it, getting familiar with handling your canopy in a variety of situations. Give yourself some time to let your skills mature: spotting, freefall, landing, and packing.

Be sure to get real transition training with your new gear. A jumper who's used to a 260-sq. canopy will likely be somewhat terrified on their first jump under a 170. Transition training that covers the canopy, as well as the rig, is very important.

At some point, you'll be ready to buy gear that you know you'll want to keep for a few years.

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Many experienced jumpers forget what it was like learning to handle the smaller canopies during their downsizing, or they didn't get proper training and just got lucky. Because they've lost touch, they're convinced any jumper can quickly and safely learn to handle a canopy loaded at 1.0 or more. Get proper coaching and take a canopy control course.

Don't get talked into buying something so small that you load it beyond the recommendations in the downsizing chart. Getting hurt will stall your progression, or stop it completely! Play safe.

It's like putting new drivers in powerful sports cars. Although they can drive them well enough in easy conditions, they're likely to lose control if something unexpected happens.

There's plenty of good used gear on the market, available in pieces or as complete, ready-to-jump rigs. Look at the complete rigs from reliable manufacturers. Get some help in the pre-purchase inspection, ideally from an independent rigger. Buy mainstream components, ones that enjoy wide popularity. There are reasons they're popular, and they tend to keep their resale value better.

If you don't like the rig or canopy because it doesn't "seem right," then don't buy it, because you'll probably never be happy with it. If you're patient and buy intelligently, you'll be able to recover much of what you paid for your first set of gear when you sell it. And if you beat it up a bit with a little runway rash, so what? At least you didn't scuff up your new stuff.

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DOWNSIZING CHART

The CSPA suggests using the downsizing chart below, which is based on standard sea-level conditions.

(###) MIDDLE OF RANGE (SMALLEST ALLOWED)

EXIT WEIGHT (LBS.) JUMPS	110 FT²	121	132	143	154	165	176	187	198	209	220	232	243	254	265
1	190 (170)	190 (170)	190 (170)	190 (170)	190 (170)	190 (170)	210 (178)	210 (189)	230 (200)	230 (211)	230 (222)	260 (230)	260 (230)	260 (230)	260 (230)
20	170 (170)	170 (170)	170 (170)	170 (170)	190 (170)	190 (170)	210 (176)	210 (187)	230 (198)	230 (209)	230 (220)	230 (230)	230 (230)	230 (230)	230 (230)
40	170 (150)	170 (150)	170 (150)	170 (150)	170 (150)	190 (160)	210 (171)	210 (182)	230 (192)	230 (203)	230 (214)	230 (224)	230 (230)	230 (230)	230 (230)
60	170 (150)	170 (150)	170 (150)	170 (150)	170 (150)	190 (156)	190 (166)	210 (177)	210 (187)	230 (198)	230 (208)	230 (218)	230 (229)	230 (230)	230 (230)
80	170 (150)	170 (150)	170 (150)	170 (150)	170 (150)	190 (152)	190 (162)	210 (172)	210 (182)	230 (193)	230 (203)	230 (213)	230 (223)	230 (230)	230 (230)
100	150 (135)	150 (135)	150 (135)	150 (135)	170 (150)	170 (150)	190 (158)	190 (168)	210 (178)	210 (188)	230 (198)	230 (208)	230 (217)	230 (227)	230 (230)
120	150 (135)	150 (135)	150 (135)	150 (135)	150 (135)	170 (145)	190 (154)	190 (164)	210 (174)	210 (183)	220 (193)	230 (203)	230 (212)	230 (222)	230 (230)
140	150 (135)	150 (135)	150 (135)	150 (135)	150 (135)	170 (141)	190 (151)	190 (160)	190 (170)	210 (179)	210 (188)	230 (198)	230 (207)	230 (217)	230 (226)
160	150 (135)	150 (135)	150 (135)	150 (135)	150 (135)	170 (138)	170 (147)	190 (156)	190 (166)	210 (175)	210 (184)	230 (193)	230 (202)	230 (212)	230 (221)
180	150 (135)	150 (135)	150 (135)	150 (135)	150 (135)	150 (135)	170 (144)	190 (153)	190 (162)	210 (171)	210 (180)	210 (189)	230 (198)	230 (207)	230 (216)
200	135 (120)	135 (120)	135 (120)	135 (120)	150 (123)	150 (132)	170 (141)	170 (150)	190 (158)	190 (167)	210 (176)	210 (185)	230 (193)	230 (202)	230 (211)
220	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	150 (129)	170 (138)	170 (146)	190 (155)	190 (163)	210 (172)	210 (181)	210 (189)	230 (198)	230 (207)
240	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	150 (126)	150 (135)	170 (143)	190 (152)	190 (160)	190 (168)	210 (177)	210 (185)	230 (194)	230 (202)
260	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	150 (124)	150 (132)	170 (140)	170 (148)	190 (157)	190 (165)	210 (173)	210 (181)	210 (190)	230 (198)
280	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (121)	150 (129)	170 (137)	170 (145)	190 (154)	190 (162)	190 (170)	210 (178)	210 (186)	230 (194)

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EXIT WEIGHT (LBS.) JUMPS	110 FT²	121	132	143	154	165	176	187	198	209	220	232	243	254	265
300	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	150 (127)	150 (135)	170 (143)	170 (150)	190 (158)	190 (166)	210 (174)	210 (182)	210 (190)
320	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	150 (124)	150 (132)	170 (140)	170 (148)	190 (155)	190 (163)	190 (171)	210 (179)	210 (186)
340	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (122)	150 (129)	150 (137)	170 (145)	170 (152)	190 (160)	190 (168)	190 (175)	210 (183)
360	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	150 (127)	150 (135)	170 (142)	170 (149)	190 (157)	190 (164)	190 (172)	210 (179)
380	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	150 (125)	150 (132)	170 (139)	170 (147)	170 (154)	190 (161)	190 (169)	210 (176)
400	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (122)	150 (130)	150 (137)	170 (144)	170 (151)	190 (158)	190 (166)	190 (173)
420	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	150 (127)	150 (134)	170 (142)	170 (149)	170 (156)	190 (163)	190 (170)
440	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	150 (125)	150 (132)	150 (139)	170 (146)	170 (153)	190 (160)	190 (167)
460	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (123)	150 (130)	150 (137)	170 (143)	170 (150)	190 (157)	190 (164)
480	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (121)	150 (128)	150 (132)	170 (141)	170 (148)	170 (155)	190 (161)
500	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	135 (120)	150 (126)	150 (132)	150 (139)	170 (145)	170 (152)	170 (159)

The chart gives two different values:

A) Top Number: **Middle of Range** (Not an absolute figure. See "Relevant Variables" below.)

Due to individual differences in natural ability, judgment and demonstrated in-air awareness, there must be allowances for variability with the recommended size. To fit every canopy pilot into a finite formula is not reflective of the true nature of the situation.

B) Bottom Number: Smallest Size Allowed

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