Canopy Handling Manual

A BPA Guide to Canopy Handling

BPA

CH1

CANOPY HANDLING MANUAL

Authors

Mark Bayada

Chris Allen

Mike Rust

CONTENTS

1. Introduction

This manual is designed to help improve your canopy handling skills and provide the requisite information to complete the British Parachute Association's written examination for qualification as a category A Certificate holder.

Please note; this manual is designed to supplement your initial and any subsequent training provided by a British Parachute Association Affiliated parachute centre instructor or coach. It does not replace proper training or instruction.

The information in this manual is based on the personal opinion of the authors. Whilst all efforts have been made to ensure that it is correct and up to date, it may contain information that is incorrect and / or out of date.

You must gain instruction and / or coaching from a properly qualified instructor / canopy handling coach before attempting any of the techniques described in this manual.

2. How The Canopy Flies

Flying a square canopy can be quite simple. Pull the left toggle to go left, the right to go right, and pull both toggles down equally to land. This is simple stuff, but if you want to get better at canopy control, understanding how the canopy actually flies will not only help you achieve that aim but also help you avoid flying it badly, or even worse, dangerously.

The square canopy operates in a very similar fashion to any other wing be it a glider, Cessna or even Concord. It is essentially a semi rigid aerofoil, which produces lift by having a difference in air pressure between the canopies top and bottom surfaces, commonly known in aviation circles as the Bernoulli principle. It does this by design. Figure 1 above shows us that the lines of the canopy are labelled A, B, C, D, and steering lines (or brakes).

The A lines, located at the front of the canopy, are slightly shorter than the B, B slightly shorter than C, and C slightly shorter than the D lines. This design creates what is known as an angle of incidence. Essentially the angle of incidence (see figure 2) is a tilt in the canopy created by the manufacturer.

Figure 1

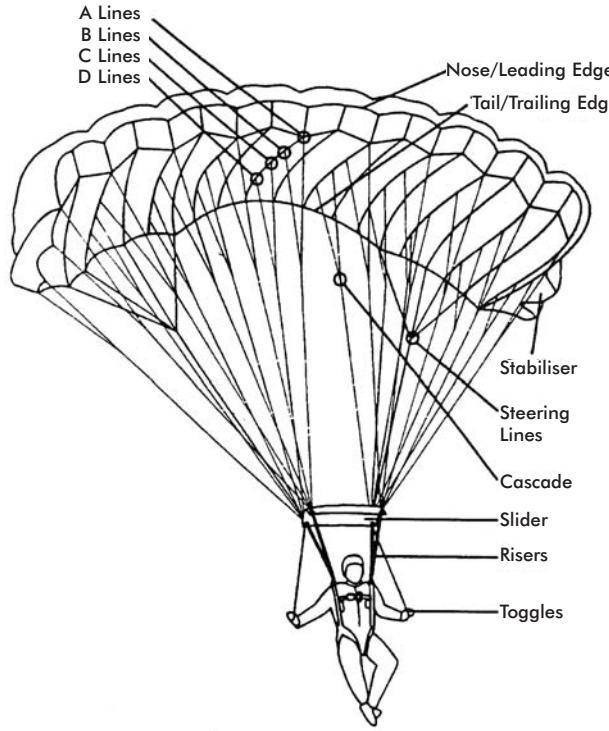
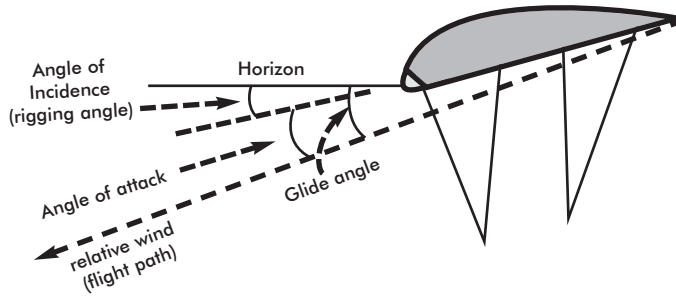


Figure 2



Your weight under the canopy forces it to slide forwards across the sky. Although there is a limit, essentially the more weight, or wing load, applied the faster the canopy will go. Air is forced into the cells giving the canopy its rigidity (this is where the term ram air canopy comes from), and below and above giving lift. The angle of attack (see figure 2) is the angle that relative air hits the canopy. The glide angle (see figure 2) is the angle that the canopy moves across the sky. The angle of incidence is produced by design and does not change unless you initiate that change by pulling on the risers. Similarly so, the angle of attack remains the same unless we do something to the canopy e.g. when we flare the canopy it produces more lift and slows down, this has the effect of making the pilot swing forwards like a pendulum. As the pilot swings forwards, the angle of attack is changed by tilting the canopy (nose up, tail down), causing the relative air to hit the canopy at a different angle and thus changing the angle of attack. Bear in mind that the increased lift gained during a flare is a product of converting forward speed for lift and only lasts for a short period of time. This is why the timing of your flare is critical, as the best time to make contact with the ground is when the canopy is creating its optimum amount of lift.

Essentially the angle of incidence and the angle of attack remain constant until we do something about it, and any change to either creates a change in the glide angle.

The final part of the equation is drag. Drag is friction with, and disruption to, the airflow produced as the canopy and pilot fly through the air (see figure 3). The faster we go through the air the more lift and drag are produced. We can reduce drag by using collapsible pilot chutes, sliders, thinner lines and tighter clothing. We can also increase drag on the canopy by, amongst others things, making toggle inputs. When you pull the right steering toggle down, a portion of the tail, or back, of the canopy is pulled into the relative airflow. This produces drag and the left side of the canopy, having less drag, produces more lift, therefore the canopy banks on the side of the drag and starts to turn. The turn rate of the canopy is determined by the amount of toggle input; less toggle input equals less drag equals less bank and a flatter turn.

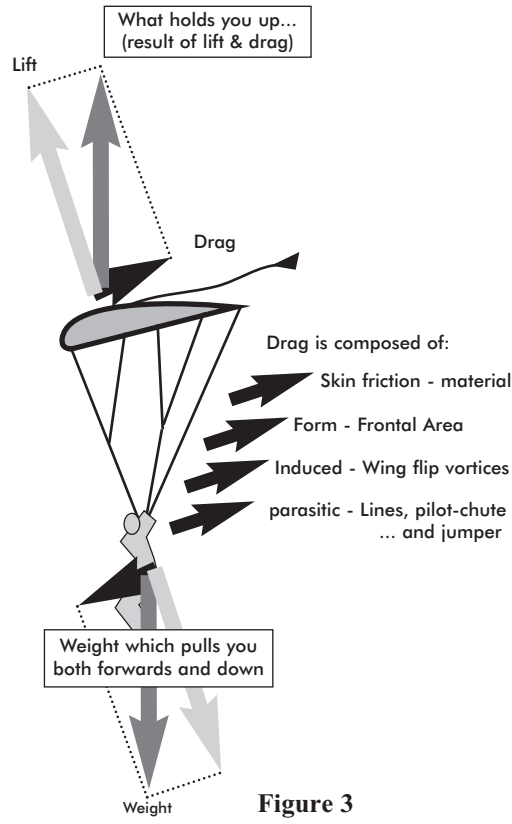


Figure 3

The turn can be made even flatter by reducing lift, or inducing drag, on the opposing side of the turn i.e. for a right turn also apply input with the left steering toggle. (Obviously this needs to be a lesser amount

of input otherwise you will turn left). By pulling a steering toggle all the way down we produce the maximum amount of drag and bank that the canopy will allow. As the canopy turns, the pilot starts to swing out from the centre of the mass due to the bank of the canopy and centrifugal forces. These centrifugal forces artificially increase the weight of the pilot and thus produce more forward speed and a higher descent rate from the canopy. When the toggle is returned to its full drive position, the turn stops and the pilot swings back under the canopy. It is during this transition that the greatest speed is reached as a product of the increased weight and descent rate built up during the turn. For quite obvious reasons, this is not a good time to make contact with the ground and therefore you should never start a turn that you can't fully complete before making contact with the ground.

3. Getting To The Parachute Landing Area

To land successfully on the Parachute Landing Area (PLA) on each descent, or know when you are not going to land on the PLA and give yourself optimum time to chose an alternate landing area, it is imperative that you:

- Have a plan.
- Understand that the plan is flexible and can change.
- Review the original plan during your canopy flight.

Have a Plan

Before getting on the plane you must have a plan. To make that plan it is imperative that you know:

- The direction and strength of the wind.
- What direction the aircraft run in is.
- Where you are expecting to open.
- Where your holding area will be.
- Where your turning point will be.

Understand that the plan is flexible and can change.

Because winds can and do change, sometimes over a very short period, your canopy plan has to be flexible and will need to be reviewed whilst under canopy.

During canopy flight review your original plan:

- **On opening** - Have you opened in the area you were expecting or are you deeper (further away), shorter (closer), on or off the wind line?
- **On the way to the holding area** - will you actually make it, are the winds the same as the original plan?
- **In the holding area** - have the winds increased / decreased from the original plan? What is the traffic pattern (are other canopies likely to interfere with your intended landing pattern)?
- **On final approach** - have you selected the correct turning point or will you need to apply brakes and / or do S turns or select another landing area? Is your intended landing area clear of obstacles (people, vehicles, wind sock etc.)?

Canopy ride A No wind changes:

Before getting into the plane you should have already ascertained the wind direction (in this case from the South) and strength, likely opening point, holding area (holding area 1) and turning point (turning point 1.).

You should also make note of prominent landmarks from the aerial photograph to aid finding the PLA after you have initially opened. It is also a good idea to ascertain where the sun should be when you are facing towards the PLA i.e. when facing the PLA the sun should be on my right.

On opening you should carry out your normal drills for gaining control of the canopy and avoiding other skydivers. Find the PLA and holding area (to help with this make use of the prominent landmarks already identified before getting into the plane, the position of the sun and other canopies) Steer towards the holding area.

On the way to the holding area review your canopy plan. Is the wind direction still the same? To ascertain this you can make use of the windsock (it should indicate a straight line between you and the holding area) and / or the direction that other canopies are facing for landing (they should be facing towards your intended holding area).

On arrival in the holding area you should check your airspace and then turn back into the wind and assess your drift. You are looking to make sure that the wind strength hasn't changed (become stronger / weaker). If it has, you will need to change your turning point i.e. if the wind is stronger than anticipated the turning point will be closer and if weaker, the turning point will be further away.

You should use your time in the holding area to carry out your designated canopy exercises. Remember to check your airspace before making any turns.

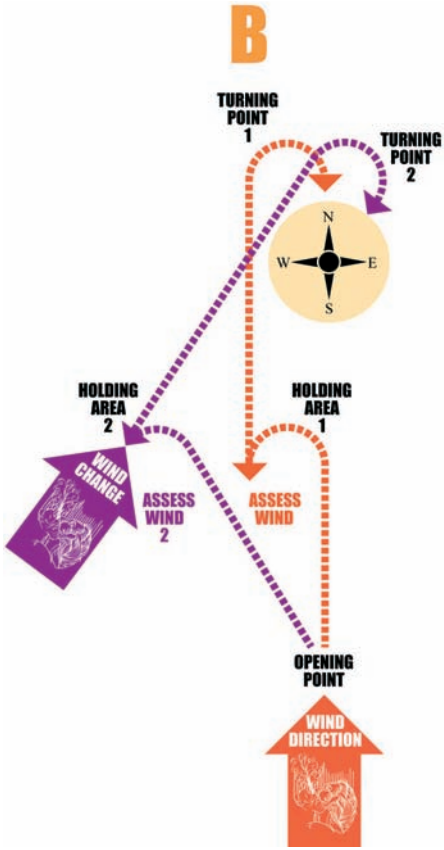
Just prior to starting the downwind leg of your landing pattern you should check for other traffic (canopies that are likely to interfere with your planned route) and adjust as necessary to stay out of the way.

On arrival at the turning point, check your airspace and make a slow, arced turn onto your final (into wind) leg. It is at this stage that you will need to review whether you chose the correct turning point and adjust as necessary (apply brake, S turn, or choose an alternate landing area).

On landing you should immediately collapse your canopy and keep an eye out / avoid people that are about to land.

Canopy ride B change in Wind Direction:

By thinking of your holding area and turning point as being direct opposites on a compass bezel, you will see that if your holding area changes, your turning point also has to change by the same number of degrees i.e. your original plan had winds from the South, therefore the holding area was to the South and the turning point was to the North. In canopy ride B, you can see that the wind direction has changed so that it now comes from the South West. Therefore the holding area will be in the South West and the turning point will also need to change to the North East.



Before getting into the plane, you should have already ascertained the wind direction (in this case from the South) and strength, likely opening point, holding area (holding area 1) and turning point (turning point 1.).

Remember, on your way back to the holding area you should be reviewing your canopy plan to see if conditions have changed. Look for the windsock and the landing direction of other canopies. If, as in diagram B, you notice that the wind direction has changed, in this case to the South West, by either the windsock or canopies landing in a direction other than towards your original holding area, you will need to shift your holding area to correspond with the change in the wind. The direction of your turning point also needs to change to turning point 2.

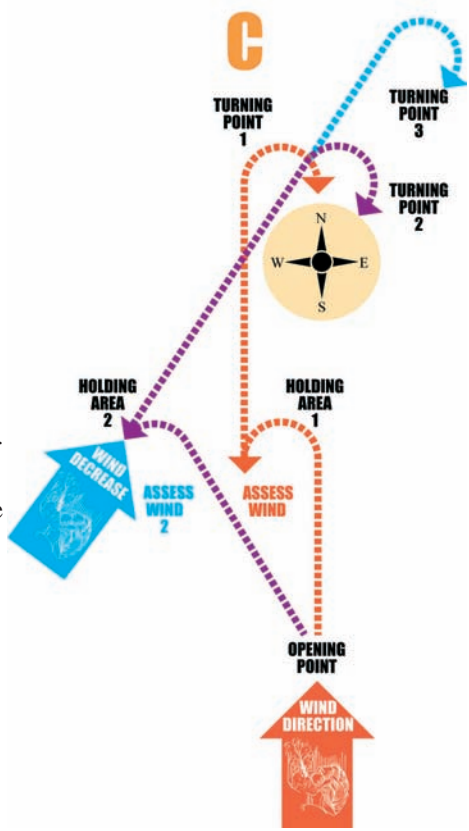
On arrival in your new holding area, check your airspace and then turn into the wind to assess your drift and carry on as per canopy ride A.

Remember, on light wind days and in particular if combined with high temperatures, the wind sock is likely to move around quite a bit. If this is the case, then rather than trying to be degree perfect just chose an average of what the wind sock is doing i.e. if the wind sock is swinging between North and West chose North West as your average heading for your holding area and South East for the turning point.

Canopy Ride C change in the Wind Direction and Wind Strength.

Remember, each time you arrive in a holding area you should check your airspace and then turn into the wind to check if the wind speed has changed from your original plan. An obvious exception to this rule would be if you have opened a long way from the PLA and there isn't time / altitude to do so and you are therefore committed to continuing on the down wind leg of your landing pattern.

Changes in wind speed, particularly if combined with changes in wind direction, often catch skydivers out and can cause off landings. When thinking about wind speed it is often easier to think of the effect that the wind has on your ability to travel across the ground i.e. when facing into wind, will I be going forwards quite fast, quite slow, going straight down, or backwards.



Once you have the hang of this, it becomes quite easy to choose the distance from the target for your holding area and turning point. Basically, the windier it is the further away your holding area should be from the target and the closer your turning point. The reverse is also true for lighter winds i.e. closer holding area to the target and the further away for the turning point. Another way of describing this is, “when windy, keep your landing options behind you” (as you won't be covering much ground when facing into the wind) and “when not windy, keep your landing options in front of you” (as you will be covering a lot of ground when facing into the wind).

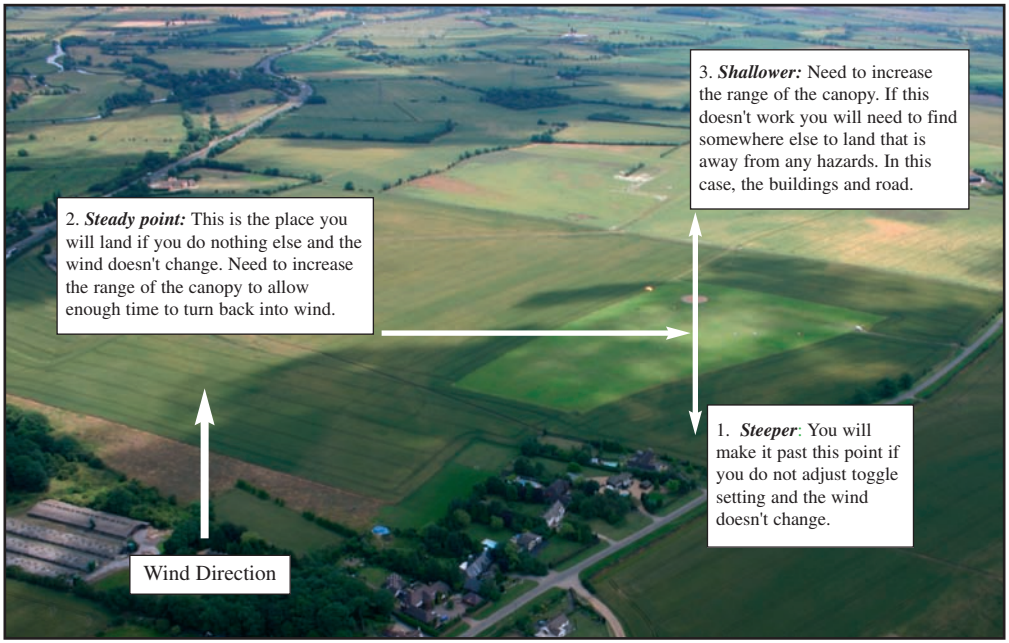
In canopy ride C, we are going to pick up from canopy ride B at the point where you have realised that the wind direction has changed, you have already moved to holding area 2 and changed the direction of the turning point to turning point 2. We shall also assume that in your original plan, you thought that you would be moving forwards quite slowly when facing into the wind. Remember, on arrival in holding area 2, assuming you have the altitude to do so; you should check your airspace and turn into the wind to assess your drift. The blue arrow in canopy ride C indicates that the wind has decreased. Under the canopy you should notice that instead of moving forwards quite slowly you are actually moving forwards faster than expected. Therefore, to avoid over shooting the target on your final / into wind leg, you should review and change the original plan by extending the distance past the target for your turning point to turning point 3. If altitude permits, you should continue with your canopy exercises, remembering to check for traffic, and adjust if necessary when starting your landing pattern.

4. Assessing Where You Will Land

As already mentioned, it is vital that you have a plan before getting into the aircraft. Having a plan will allow you to ascertain almost immediately whether you have opened in your expected place or somewhere else. If the latter, it should cause you to re-evaluate your plan with the prime question being, will I actually make it back to the drop zone (PLA)?

Working out where you will land is a technique that should be practiced on every jump, regardless of whether you open in your intended area or not. The more you practice, the more competent you will be at working out where you are actually going to land and, if this is to be off the drop zone, the sooner you will be able to make a decision on any alternate landing area allowing you more time to plan a safe approach and landing.

The technique is popularly known in the skydiving world as “the Accuracy Trick.” Here's how it works when you are upwind of the PLA:



1. Whilst under the canopy, pick the centre of the drop zone as your reference point on the ground. If the point is getting ***steeper*** (is falling) then, assuming you do nothing else and the wind doesn't change, you will make it to that point and beyond. This is obviously a good situation to be in, as you should be able to fly down wind of your point and have time to turn back into wind.

2. If the point remains ***steady*** in your view, (the angle doesn't appear to change) then this is the point where, if you did nothing else and the wind didn't change, you would land. Obviously this isn't so great as you will probably have to take a down wind landing to land on that point. If this is the case then you will need to try and increase the distance that your canopy will cover given its time in flight.

3. If the point is getting ***shallower*** (is raising) then you won't make that point and will have to try and increase the distance that your canopy will cover. If this doesn't work, you will need to choose another landing area. Remember to look out for obstacles. Using the accuracy trick will enable you to gauge whether you can make it to your alternate landing area and have time to turn into wind. It will also allow you to work out whether you will clear any obstacles when choosing an alternate landing area.

Increasing the range of the canopy using toggles

If you have found that your intended landing area either remains steady in your view point or is getting shallower (points 2 and 3 above). This should lead you to realise that you need to try and increase the range of the canopy.

We can increase the range of the canopy by applying brake (pulling down evenly on the steering toggles). How much brake we will need to apply depends on a number of factors but quite simply here's what you need to do:

1. Keep your eye on the point that remains steady and apply about a quarter brakes. Hold that position for about 5 seconds and look to see if your steady point starts to get any steeper in your viewpoint. If it does then you have just increased the range of your canopy and will make it past that point, go on to stage 2. If it doesn't, try half brakes and re-assess any effect on the steady point.

2. Choose your new steady point and apply a bit more brake. Again if that point starts to get steeper in your viewpoint then you will make it to that point and beyond.

3. Assuming stages 2 and 3 above have actually increased the range of the canopy. If you continue this sequence, you will inevitably find a brake setting where the steady point starts to get shallower in your viewpoint. This indicates that you gone beyond the optimum brake setting for that day (you have applied too much brake). Go back to the last brake setting that gave the best glide angle.

Remember:

1. This technique will only work if you are upwind of the drop zone. If you find yourself down wind, applying brake will decrease the forward speed of the canopy and, in most instances, the distance covered. If you are downwind use the accuracy trick to work out whether you will make it back to the drop zone. If you are not going to make it back, then work on choosing the safest area to land in that you can find.

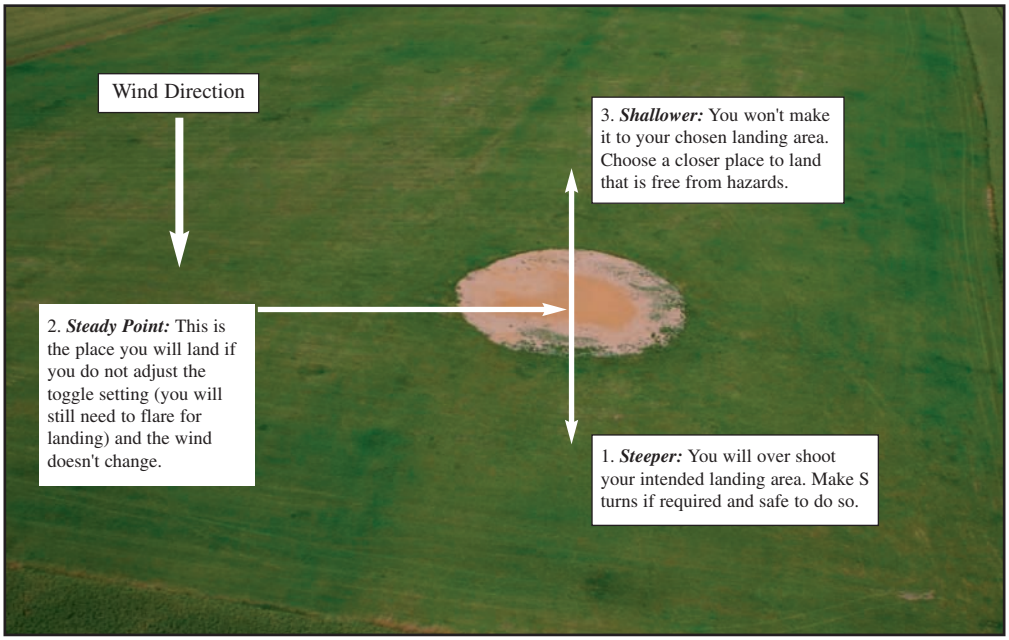
2. The steady point is the place where you will land if you do nothing else and the wind does not change. This inevitably means a downwind landing. Therefore, the place you choose to land should be the point that is getting steeper in your viewpoint.

3. When using the accuracy trick and trying to increase the range of the canopy, make sure you keep your head at the same angle. Lifting your head up as you apply brake will give you false information on where the canopy is actually going to land.

4. Avoid getting so fixated on angle changes (steady point shifts) that you lose altitude and space awareness. Always keep an eye on your altitude and other canopies around you. Make sure you leave yourself plenty of altitude and space to plan a safe approach and landing, be it on the PLA or otherwise.

Final or into wind leg

The accuracy trick can also be used on the final, or into wind, leg of your landing pattern, although the best viewpoint is different because you are, ideally, facing into wind rather than downwind:



1. When on your final leg, if your chosen landing point is getting ***steeper*** in your viewpoint then you will overshoot that point. Making S turns will allow you to lose altitude and keep the same distance from the target. The secret to a good S turn is to put your self at 90 degrees to the target. Move along this line until the target just starts to go out of your

view, and then make a slow 180 turn, (keeping the target in view), and go back until you are back in line with the target. Turn again so that you are facing the target and re-assess the situation using the accuracy trick. Remember: your main priority is to land safely rather than accurately; always check your airspace before making any turns; make your turns gentle and as flat as possible; stop S turning at a safe altitude.

2. If your chosen landing point remains ***steady*** in your view point that is the place you will land providing you do not adjust the toggle setting (you will still need to flare the canopy on landing) and the wind does not change.

3. If your chosen landing point is getting ***shallower*** in your viewpoint, you will drop short of it. In this case there isn't much that you can do except make sure that the place where you are going to land, (the point that remains steady) is free from obstacles. If it isn't, then adjust in plenty of time to allow a safe landing.

Down wind

The same principles also apply if you find your self down wind of the PLA on opening.

Remember:

- Applying brake when you are down wind will reduce the forward speed of the canopy and, in most instances, reduce the distance covered.

- If the PLA is getting ***shallower*** in your viewpoint, you won't make it back there and will need to choose somewhere closer to land that is free from hazards. You can use the accuracy trick to decide whether you will overshoot any hazards around your alternate landing area.

- If the PLA stays ***steady*** or gets ***steeper*** in your viewpoint, you will make it back. Look out for traffic making its way from the upwind side of the PLA and adjust accordingly.

5. Set Ups And How To Use Them

The “Have a Plan” section used terminology (holding area, turning point etc) that may have been alien to you. This section is designed to explain the “Set Up” method and allow you to link it in with the “Have a Plan” section.

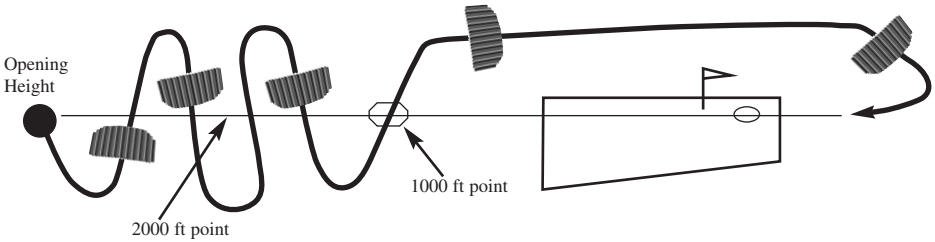
Earlier in this manual, the importance of having a plan for your canopy flight was emphasised as an important aid to actually landing on the drop zone / PLA and thus contributing towards having a safe landing.

Once you have become conversant with creating a plan before every jump, and being able to modify the plan as needed during your flight back to the landing area, it is then time to start working on landing where you want to.

In order to do this you can introduce some set up points. These are points on the ground that you will fly through at set altitudes. Typically these altitudes may be opening height, two thousand and one thousand feet.

Opening height.

This can be a reasonably large area from where you start your canopy flight.



Two thousand foot point.

By this time, you need to be thinking about your landing pattern. By having a set up point at this height, you give yourself a better chance of starting your landing pattern in the right place. This set up should be smaller than your opening point, but still large enough to allow a degree of flexibility. It allows an early assessment of whether you are going to be at your one thousand foot point at the right time or not. If you are going to get there too high, you can work on losing height by, for instance, using S turns. If you are too low, you can work on maintaining your altitude by applying some brake (see chapter on increasing the range of the canopy using toggles), or even miss it out altogether and join your landing pattern at another point.

One thousand-foot point.

This is the point from which the landing begins. Remember, the smaller the set up point, the more accurate the landing. If you pass over this point at exactly one thousand feet then you can go straight into you landing pattern. If you are too high, or too low, you can amend your plan to suit, by either controlling the canopy to maintain or lose altitude, or by changing the landing pattern, or even choosing a new landing point.

Approaching canopy handling in this way has many advantages. Not only will it help improve your landings, but it will also add to your safety. It does this by teaching you to always be thinking one stage ahead i.e. not only where you are now, but where you want to be at two and one thousand feet, and by two thousand feet where you want to be at one thousand feet and your landing.

In the real world, you will rarely pass through the set up points at the exact altitude, but that doesn't matter because you will be constantly assessing your flight and learning how to control your canopy to fly though the set ups more accurately each time.

The real advantage to this system is that by beginning the process at opening and not leaving it until landing to decide what to do, you reduce the chance of having to make that **last minute decision which all too often goes wrong and either seriously injures or kills.**

The location and altitude of the set up points depends on the canopy, jumpers weight and weather conditions. It will take several jumps to learn where you should be on any given day. To do this, you will have to spend time under canopy learning how it flies in all conditions, how quickly it descends, how slow and how fast you can fly, in order to build up an appreciation of where you want to be at any given altitude.

A great deal can also be learnt by watching other canopies from the ground, asking yourself if they look like they are in the right place or if they are making hard work of it.

Flat turns

As already explained, it is critical to land under a canopy that is level with the ground. Carrying out a sharp turn at low altitude may well cause serious injury or kill you.

When faced with a landing problem such as avoiding other parachutists, a hazard or overshooting the target area, it is preferable to use a flat turn with a minimal amount of toggle input. This is a life saving skill and should be practised at a safe altitude until proficient.

To carry out a flat turn, both toggles should be depressed to about half brakes. One toggle then needs to be pulled down further to carry out the turn. The lesser the toggle input, the flatter the turn.

There are a few things that must be considered when carrying out a flat turn. Applying too much brake may stall the canopy so it is important to be aware of how far you can pull down the toggles on the canopy you are jumping at the time without stalling the canopy. This will change with all jumpers and canopies, so should be confirmed each time you change canopies. Remember, the idea is to carry out a flat turn, which by its very nature will be slow and controlled with little loss of height.

Because this is a skill that may be required relatively close to the ground, it is possible that it will lead straight into the landing. If this happens, then both brakes should be depressed fully to carry out the flair and a tight landing position adopted to minimise the chance of injury.

Landing Technique

Many people find it difficult to judge the correct height to flair the canopy for landing. The most efficient flair is one that is carried out smoothly and timed so that the hands reach their lowest point just as the feet touch the ground. Until the correct height for starting the flair is learnt, landings become more luck than judgement. This problem can be overcome by using a technique known as the two-stage flare.

The Two Stage Flare

The landing flare can be broken down into two stages:

The initial stage:

The initial flair is achieved by moving the toggles from full drive to the half brake position. This should start when you first think that you are about to land. When going from full drive to half brakes, the canopies descent rate will slow down but still maintain some forward speed. The ground should be watched throughout this stage and the toggles should be pulled down slowly until you feel that the ground is no longer getting any closer. Note: you may still be moving forwards.

Final stage:

The final stage of the flare is from half to full brakes. This part of the flair should be carried out smoothly and evenly to allow a landing that has a slow descent rate and minimum forward speed. The final stage of the flare should be started when the ground appears to be getting closer again.

By way of explanation, the canopy achieves enough lift during the first half of the flair to slow down its descent rate. As air speed is reduced, the canopy ceases to generate as much lift and therefore starts to descend towards the ground. By applying more brake at this stage, we convert the remaining airspeed into lift for a controlled landing.

The advantages of this method of landing are:

- Only using half a flare prevents you from committing to landing until you are at the correct height and travelling at the correct speed.

- The second and more critical part of the landing is performed at a slower speed, thus making it easier to judge.

- By performing the flare over a longer period of time more speed is lost allowing a slower and more controlled landing in any wind condition.

Practising this technique over a period of jumps will allow you to better gauge the correct height for both parts of the flair. With practice, you will be able to combine both stages into one flare, creating a smooth application of the brakes without any visible pause in between stages.

Common Mistakes

Leg straps and / or harness adjusters uneven:

If the harness is not fitted correctly more weight will be suspended from one side of the canopy than the other. This can be achieved by having your leg straps and / or harness adjusters tightened unevenly. The problem will normally go unnoticed during the early stages of the canopy flight, as you are most likely to compensate with the steering toggles subconsciously. The turn may also be so slight that it goes unnoticed at higher altitudes. The problem becomes more apparent when both toggles are depressed fully for landing as one side of the canopy effectively flares more than the other due to the imbalance in canopy loading and causes a turn. To avoid this, make sure your leg straps and harness adjusters are evenly tightened.

Cross wind landing.

Landing crosswind can sometimes give the impression that the canopy is turning during landing. To overcome this problem it is important to remember to **keep flying the canopy until it has collapsed at the end of the landing**. By thinking about the landing in this way it becomes easier to assess what toggle input is required at every stage of the landing. Make sure you pick a heading for each landing and keep the canopy on that heading until the landing is complete. If the canopy feels as if it is turning, (either due to uneven toggle input or being affected by the wind), continue the flare but increase toggle input in the direction needed to maintain the heading. Remember to keep your toggle inputs smooth and controlled throughout the whole landing.

Different wind conditions

High winds

Higher wind conditions generally make landing the canopy easier. It does however have its own problems.

When landing into wind the ground speed of the canopy (the speed that you appear to be moving across the ground) is slowed down considerably. Having a reduced ground speed makes it easier to judge the height for landing. If however, the flare is started too early, it can be unnerving as it may feel as if you have completely stopped and are hovering above the ground. If the canopy is not directly into wind at this stage, the strength of the wind will affect the canopy by making it turn. (See cross wind landing above.)

Both of these problems can be overcome by, as already mentioned above, continuing to fly the canopy. Using the two-stage flare technique can reduce the chances of flaring too high and make it easier to maintain a heading throughout the landing.

Low winds

Low wind landings have the advantage of being less extreme if the canopy is not facing into whatever wind is available. They also have the disadvantage of making all landings faster. You will cover a lot of ground on your final (into wind) leg, so it is important to look well ahead for hazards and avoid them by making smooth toggle inputs. A faster landing can be harder to judge, as the canopy is unlikely to come to a complete stop. In this situation a longer (slower) flare will definitely help, as it will reduce the speed of the canopy before landing. Make sure that you fly the canopy until the landing is over and if you think you are going to fall over, adopt a PLF position and accept the fall / slide.

Down Wind

If landing down wind, it is important to remember that you are not descending any faster; all that has increased is your ground speed, (which may appear to be pretty fast). Your increased ground speed will cause you to cover a lot more ground than on a normal landing. Therefore, it is important to look forwards and check for hazards. If there are any, look to the left and right of the hazard and steer the canopy only enough to miss the hazard. **Do not panic - a sharp turn at this stage may well be your last!** The added ground speed will quite probably scare you, possibly tempting you into a high flare. Keep calm and concentrate on performing a smooth and even flare. Adopt your PLF position and expect to fall over.

6. Landing Problems

Many people, of all standards, encounter landing problems. In this section we will look at how to improve landing technique.

Firstly we are going to look at landing priorities, then at some common mistakes and how to rectify them.

Priorities:

- **Land under a flat and level canopy**
- **Into a hazard free area**
- **Into wind** (this is ideal, but not at the expense of the above)

Land under a flat and level canopy

This is a fundamental for any safe landing. Yes, we all see the experts turning their canopies at, what appears to the uninitiated, to be close to the ground. But this is not the time for you to experiment. Even the top canopy pilots get it wrong sometimes and the consequences can be fatal.

If you are unable to get the canopy into wind in time don't panic. A well executed flare and PLF position is much safer than a low turn. **Never start a turn that you can't complete before making contact with the ground.**

Into a hazard free area

It is important to land into a hazard free area if at all possible. Landing on a hazard, or turning late to avoid one, may well result in injury or worse, so think ahead and make sure that your intended landing area is safe i.e. clear of hazards.

Into wind

We are taught on the first jump course that it is important to land into wind. By way of explanation, it is preferable to land into wind, as it is the slowest and generally safest way to land. Also, if we all land facing the same way, the chance of a collision is decreased. However, landing into wind should not be attempted at the expense of our other landing priorities. Many jumpers have been hurt by making an error of judgement and turning too late. In summary, land into wind but only when it is safe to do so.

Landing problems

Some landing problems are familiar to low experienced jumpers but can be easily rectified. The following are the most common:

- **Flare too high/low**
- **Uneven flare**
- **No flare**

Flare to high/low

This is very common especially during the first couple of jumps. Looking straight down can cause ground rush, (an optical illusion that makes the ground appear as though it is rushing towards us, distorting our ability to assess our actual distance from the ground). A great remedy is to look forwards at an angle about 30 degrees towards the ground, (look beyond where you are actually going to land). By looking ahead, rather than straight down, it is easier to judge your height above the ground.

Work on the timing of your flare by matching it with the speed that you are approaching the ground. If approaching fast, flare slightly quicker and if approaching slowly, use a slower timed flare.

If your problems persist, ask to have some landings videoed. This is a great tool to compare what you think you are doing, with what you're actually doing.

Uneven flare

An uneven flare occurs when one toggle is pulled down further than the other. This is definitely one to be avoided. As the canopy turns there is a natural tendency to put a hand out in order to prevent a fall. This pulls the offending toggle down even further, and increases the rate of turn. A simple solution is to concentrate on pulling down evenly on both toggles, whilst executing your flare. This will be easier to achieve if you can see what your hands are doing. Try keeping your hands slightly in front of you, so that you can see them during the flare and adjust as necessary to keep them even throughout. Concentrate on flying the canopy all the way until your feet are firmly on the ground. If you feel that you are going to fall over, adopt a PLF position and accept the fall. Again, viewing a video of your landing can really pay dividends.

High wind landings can cause you to think more about collapsing the canopy than actually landing it. This causes a similar situation to that explained above, where the jumper, subconsciously preparing to collapse the canopy, ends up causing a turn before landing by pulling down on one toggle more than the other. In higher winds you will need to collapse the canopy, but only do this after the landing is fully completed and your feet are firmly on the ground. In other words, keep flying the canopy all the way to touchdown, and if you have got it wrong, or are unsure, adopt your PLF position and accept the fall.

No Flare

Sounds simple, but it is fundamental to any good landing that the canopy must be flared. Often those who have difficulties are seen to not flare enough. Try the remedy of practising high whilst you have time. Once you are happy that you can make the landing area safely, try a few practice flares. As mentioned above, pushing your hands slightly forwards, will allow you to keep an eye on how far your hands are actually going down during your practice flares, and aid you to committing the correct flare technique to memory.

7. Landing Direction

In the previous section “Landing Problems”, we discussed landing priorities, one of them being to land into wind. Remember, landing into wind is preferable but not essential. Having a must get into wind for landing mindset is a dangerous practice which should be avoided. If you have messed up and are low, just land straight ahead, Flare and PLF. This is a safer alternative than trying to turn near the ground, just to get into wind. If you do not have enough height to complete a turn don't start one. If you've started a turn that you can't complete safely, then stop turning.

Remember **DO NOT TURN NEAR THE GROUND** it is not clever and it hurts!

Hazards

Avoiding hazards is a fundamental on each and every jump. The following principles will help you to avoid hazards.

- **Plan ahead**
- **Avoid hazards early**
- **If you can't see it, you won't hit it**

Plan ahead

Objects will not just suddenly jump out in front of you. Most hazards are stationary and can be avoided if planned for early enough. The priority, should you be unable to make it back to the PLA, is to choose and plan a safe route into an alternative landing area which is free from hazards.

Avoid hazards early

The best way to avoid hazards is to identify and steer clear of them as early as possible. Be careful in the event of an off landing. If landing in an unfamiliar area, look for the not so obvious e.g. power-lines and plan to avoid them early. Make an early decision and if necessary land cross or down wind. Remember to flare and PLF.

If you can't see it, you won't hit it

This doesn't mean close your eyes and hope for the best. If you keep looking directly at an object, there will be a tendency to steer towards it. This is known as object fixation. Therefore, if you turn your canopy, so that you can no longer see the hazard, you won't hit it.

Bear in mind, turns made close to the ground are dangerous, particularly if made with large amounts of toggle input. If you have to make a late manoeuvre in order to avoid a hazard, look for a clear area and steer the canopy with a minimum amount of toggle input. (See “Flat Turns” in the “Set Ups and How To Use Them” section). Flare and PLF.

8. Glossary

Aerofoil: The shape of a canopy.
Base leg: Phase of the landing pattern that takes you across the wind line. Also known as cross wind leg.
Brake: To apply brake by pulling down a on both steering toggles.
Brake fire: Premature release of brake control / steering toggle from its half brake setting. Note; steering lines are set on their half brake setting during packing.
Canopy: Parachute.
Collapsible slider: A slider which is intentionally collapsed to reduce drag.
Collapsible pilot chute: A pilot chute that is designed to collapse during deployment of the parachute.
Cocking the pilot chute : To set the pilot chute so that it inflates when deployed.
Cross Wind Leg: Phase of the landing pattern that takes you across the wind line. Also known as the base leg.
Deep Spot: An exit point (point when you leave the aircraft) or opening area that is a great distance from the PLA. Also known as long spot.
Down wind leg: First leg (phase) of your landing pattern.
Drop Zone: A notified portion of airspace within which parachute descents are made. The normal radius is 1.5 nautical miles and up to the altitude notified. Sometimes called DZ, PLA or landing area.
Elliptical: A canopy shape designed to give more performance.
Final leg: Final phase of your landing pattern which should be made facing into wind. Also known as into wind leg.
Full drive: When a parachutist has both steering toggles all the way up (arms fully extended upwards) the canopy is on full drive. Also known as full flight, full speed.
Flare: Technique used for landing a canopy.
Flat turn: A steering toggle input which, if executed correctly, causes the canopy to turn with a minimum amount of bank and altitude loss.
F 111: Material used in the construction of parachutes. Normally made of a fabric called Ripstop nylon. Ripstop nylon is designed to allow a minimal amount of air to pass through it when inflated. The amount of air that is allowed to pass through the material is known as porosity. Canopies generally become more porous as they get older.
Half brakes: By pulling down approximately halfway on both steering toggles at the same time, we apply half brakes. This causes the canopy to fly at half its (full drive) speed.
Holding Area: An area that is upwind of the PLA from which you can easily make it onto the PLA. Also known as Play area.
Into wind leg: Final phase of your landing pattern which should be made facing into wind. Also known as final leg or finals.
Intermediate Canopy: A parachute which is not suitable for a student, but is the type that someone who is becoming more experienced may wish to fly.
Opening shock: The amount of force applied to equipment and a person when a canopy opens.

Pilot Chute: A device that, once fully inflated in the airflow, pulls on the bridal line which in turn extracts the pin from the closing loop and then lifts the deployment bag out of the container.
PLA: A suitable area where it is intended that parachutists should land. Sometimes called DZ, Drop Zone or landing area.
Play Area: An area that is upwind of the PLA from which you can easily make it onto the PLA. Also known as Holding area.
Quarter brakes: When both steering toggles are pulled down a quarter of their full length of travel (about 6 to 10 inches) the canopy will be said to be on quarter brakes and will fly at 3 quarters of its (full drive) speed.
Riser: Webbing which attaches the lines of the canopy to a harness/container system via the three ring circus. There are normally 2 front risers, attached to the front portion of the canopy and 2 rear risers, attached to the rear portion of the canopy. Some harnesses, normally designed for the more experienced, have a third set of risers.
S Turn(s): Flat turns (see above) that are used to lose altitude.
Student Canopy: A canopy which is suitable for students under a certain wing loading, normally large and relatively docile.
Semi-elliptical: (see elliptical canopy above) but not as radical in shape.
Set up point: A point where you should intend to be at a certain altitude
Short spot: An exit point (point when you leave the aircraft) or opening area that is a short distance from the PLA.
Steering Toggle: A device, normally material, which is manufactured into a webbing loop / hoop and attached to the brake / steering lines.
The three A's: Altitude/Airspace/Area. These should be checked before any turn / canopy exercise.
Traffic: Other canopies in the air.
Kill Line: A method of collapsing a pilot chute when a canopy opens.
Zero porosity material (ZP): A material used in the construction of canopies. Fabric which starts out as F111 (see F111 above) and is given a coating which greatly reduces its porosity.

CH2

CANOPY HANDLING MANUAL

Authors

Mark Bayada

Chris Allen

Mike Rust

Contents

1. Introduction to CH2

This manual is designed to enhance the techniques and concepts discussed in the CH1 manual and provide the requisite information to complete the British Parachute Association's written examination for qualification as a category B Certificate holder.

Please note; this manual is designed to supplement your initial and any subsequent training provided by a British Parachute Association affiliated parachute centre instructor or canopy handling coach. It does not replace proper training or instruction.

The information in this manual is based on the personal opinion of the authors. Whilst all efforts have been made to ensure that it is correct and up to date, it may contain information that is incorrect and / or out of date.

You must gain instruction and / or coaching from a properly qualified instructor / canopy handling coach before attempting any of the techniques described in this manual.

2. Increasing the range of the canopy using risers

Before reading this section we would advise you to re-read the section entitled **"Assessing Where You Will Land"** in the CH1 manual.

Rear Risers:

Taking up from the "Assessing Where You Will Land" document at the point where you find yourself **upwind** of the PLA and after carrying out the accuracy trick, you find that you need to increase the range of the canopy. In CH1 we discussed how we could do this by applying varying amounts of brake (pulling both steering toggles down evenly) to the canopy in order to change its glide angle and thus increase the distance travelled. We can also achieve a similar effect by using rear risers. All you need to do is pull down on both rear risers evenly (you can also push outwards on the rear risers for a similar effect). The first thing you will notice is that it is far more difficult to pull down on the risers than the steering toggles. In terms of practicing increasing the range of the canopy, we would advocate that you use the same method as described for using the steering toggles, i.e. pull down a couple of inches, check to see if your view of the steady point is changing for the better, if so, choose a new steady point and increase the riser input etc.

A couple of points to note:

- There is currently a difference of opinion in the sport as to whether the use of rear risers is better (more efficient) than using toggles to increase the range of the canopy with a tail wind. Technically, by using the rear risers you are altering the angle of incidence on the canopy (see section on "How the Canopy Flies" in the CH1 manual) and therefore riser input should be more efficient in terms of what you wish to achieve for this exercise. By way of opposition to this theory, it could be argued that most modern canopies do better using brakes, and the reason that some are convinced that rear risers are better, is only because they usually haven't fully explored the efficiency of the deep brake settings on their canopies. It should perhaps also be pointed out that, as it is harder to pull down / push out on rear risers, it must therefore be harder to be as accurate with the riser input over a period of time, because your arms will get tired and you won't be able to hold a constant setting. Both arguments have their merits; by experimentation it is up to you to decide which is best given the canopy that you are on at the time.

- A stall induced with risers can occur quite quickly. This isn't a problem if it happens at altitude, but is obviously a different story near to the ground. To this end, avoid playing around with your risers close to the ground, until you are fully acquainted with the stall characteristics of your canopy. The stall recovery procedure is described later on in this manual.

Front Risers

Converse to using your rear risers to increase the range of the canopy when you are upwind, if you find yourself **down wind**, you can use the front risers in an attempt to increase the range of the canopy. Please note that when you pull down on front risers you change the canopy's angle of incidence. Essentially you are swapping lift for forward speed. This means that although your penetration into the wind should be better, you will also lose altitude faster. As explained in the “Assessing Where You Will Land” section, when you are facing into wind the ideal viewpoint is changed so that the steady point is actually the place where you want to land e.g. the place on the PLA that you have chosen for your landing. If this point remains steady in your view then you won't need to use your front risers to get back. If this point is getting steeper in your view you also won't need to use front risers to get back. If it is getting shallower in your viewpoint then you will need to use front risers to see if it will gain you enough ground to make it back. Obviously if using the front risers isn't working then you will need to choose somewhere else to land.

So, you have opened downwind of the PLA, have used the accuracy trick and found that the PLA is getting shallower in your view. You now wish to try and increase the range of the canopy using front risers. The technique to use is similar to using rear risers. Reach up and take hold of your front risers. Pull down evenly for a couple of inches. Review the steady point, if it is getting steeper you have just increased the range of the canopy and will make it past that point if you keep the current settings. Pick a new steady point and pull down a little more. As explained in the “Assessing Where You Will Land” section, you will eventually find a point where the steady point gets shallower. When this happens you have used too much input on the front risers, go back to the setting that gave the best glide angle.

A couple of points to note:

- If you have to make an avoiding manoeuvre, you won't want to lose time relocating your steering toggles, so keep your hands in your steering toggles when using the front risers.

- There are a number of factors involved, but as a general guideline about 6 inches of front riser input is the most you will need to increase the range of the canopy when down wind.

- Check whether the equipment you are using has front riser bars / handles / loops or not. Either way, before jumping get a proper brief on how to take hold of the risers / riser bars / handles / loops on the equipment you are going to use.

- Remember; when you pull down on the front risers your descent rate will increase. Obviously this could be potentially hazardous near to the ground. Avoid using your front risers at any stage during your landing pattern and / or near to the ground.

3. Using a rear riser as an avoidance manoeuvre

When your canopy first opens, an immediate hazard to be concerned about is the proximity of other skydivers. Obviously, if another canopy is very close on opening, you may not have time to carry out your normal drills before making contact. In this scenario, you should reach up and pull down on one rear riser so that the canopy turns to avoid the collision.

Like many techniques in the CH system it is best to practice avoidance turns with a rear riser so that you are proficient enough to use the technique when you really a need to. Remember, when the canopy first opens, the steering toggles should still be fixed in the half brake position. Therefore, you will get more turn for the input that you use when compared to a canopy that is in full drive.

A good way to practice this technique, so that it becomes natural, is to use it after the canopy has first opened as a method of turning the canopy so that you are facing towards the drop zone (PLA). You can then release the brakes from their half brake setting as you make your way back to the landing area.

A couple of points to note:

- Practicing this technique requires you to make a rear riser input just after the canopy has opened. Remember to check your canopy properly before making the turn.

- If during a practice session you have end cell closure and / or twists on opening, then abandon the riser turn and carry out your normal drills for getting out of the twists and / or re-inflating the end cells. Obviously if you are about to make contact with another canopy on opening, then make the rear riser turn and deal with the twists / end cell closure after you have moved away from the danger.

- Make sure that your airspace is clear before making any turns.

- Remember, the first step towards avoiding a canopy collision on opening is to ensure that you have created enough separation between yourself and other skydivers at the end of each skydive. To this end, get a proper brief on the most efficient tracking methods and practice your tracking at every opportunity.

- Be aware of what is going on around you as you track away from other skydivers e.g. if you know there is someone over to your left as you throw your pilot chute and find that your canopy does a left turn during opening, you should also realise that you are probably going to need to make an avoidance manoeuvre.

- Just because you are jumping on your own, doesn't necessarily mean that no one will be near you on opening. Keep looking forwards during your safety count to make sure that you have clear airspace.

4. Wind assessment in other directions

As a student you would have been taught how to assess the strength of the wind. This is normally done by facing the canopy into wind and looking straight down. You can then work out from the speed you are moving forward how strong the wind is and how it is affecting your canopy. Now that you have qualified A Certificate, you can jump in higher wind conditions and may well find yourself not going forwards, or even backwards, indicating a strong or very strong wind.

Remember to check the 3 A's [**altitude** (have you got enough), **airspace** (other canopies) and **area** (location in relation to the holding area and PLA),] before making any turns. There may be occasions when you would not wish to turn your canopy into wind because it would result in you facing away from the landing area. This could be because you are on a very deep spot (a long way from the landing area) or perhaps there are other canopies that you want to steer away from. It is still important however to know how strong the wind is and how it is going to affect you during your flight so you should learn other methods of assessing the wind.

The first and most simple method is to use features on the ground such as windsocks, flags, smoke etc. This should have been done prior to take off when making your canopy flight plan and needs to be reviewed after opening. (See the section entitled, “Getting to the Parachute Landing Area,” in the CH1 manual).

The second method is if you are up-wind and is used in conjunction with the accuracy trick (see the section entitled, “Assessing Where You Will Land,” in the CH1 manual). As you are assessing where you will land, you can also work out not only where you will land but also how fast you will get there. This can be done on full drive, on brakes or risers. To help you judge your speed you can also look straight down in the same way as you were taught as a student, but this time when facing down wind. The faster you are moving the stronger the wind.

The third method can be used if you are not in the correct place and have to fly cross wind to get to the landing area. Again you will want to assess the wind without steering away from the landing area. In this case you need to be able to work out which way you are travelling over the ground and compare it to the direction the canopy is facing. The more the canopy is going sideways the stronger the wind.

The last two methods both require you to be fully familiar with the canopy you are flying. You can achieve this by practising on every jump. Once you have carried out all your safety checks, are happy that you are in the correct place and clear of traffic, use some of the time under canopy to monitor your ground speed in whichever direction you are facing. This needs to be done in all conditions. In just a few jumps, you will have learnt enough about your canopy to be able to assess the strength of the wind in a matter of seconds, without the need to take time out from your flight plan.

5. Landing Patterns

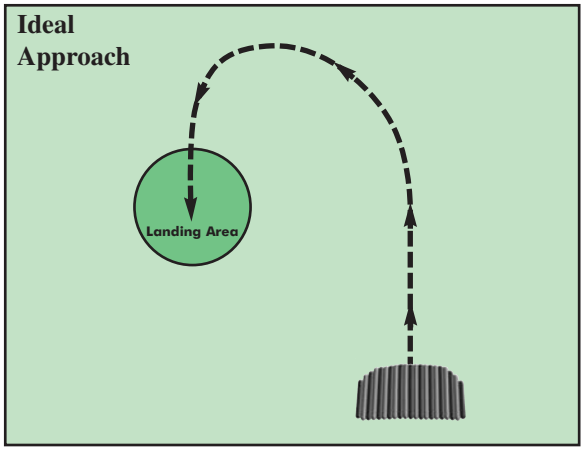
Landing patterns are flexible and can be changed, providing the change occurs at an appropriate altitude and you do not interfere with the traffic pattern. Having made a plan, assessed the wind and used the set ups (see the section entitled, “Set Ups and How to Use Them,” in the CH1 manual) you should have a good idea of where and at what height you want to start your landing pattern.

Below are some different scenarios to show you how you can modify your landing pattern to allow for safe and accurate landings in all conditions.

The ideal situation.

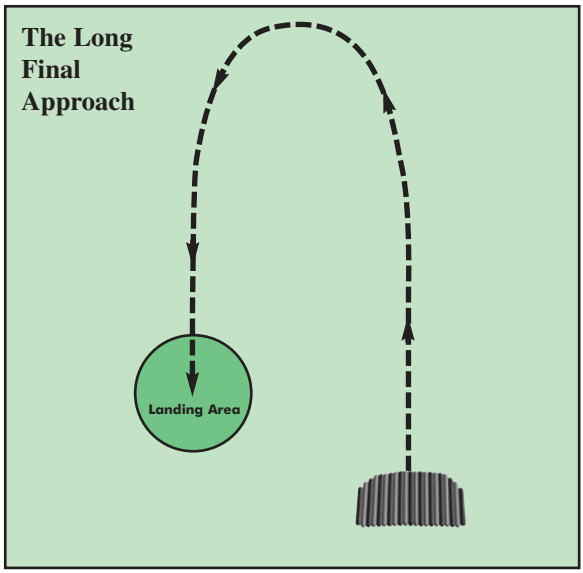
A straightforward landing pattern allowing you to leave your final set up, carry out smooth turns at the correct height and the final approach takes you to the centre of your target area.

To achieve this you have planned your canopy flight well, assessed the winds correctly and set up for landing in the correct place



The long final approach - Can be used if there are light winds and no hazards down wind of the target area.

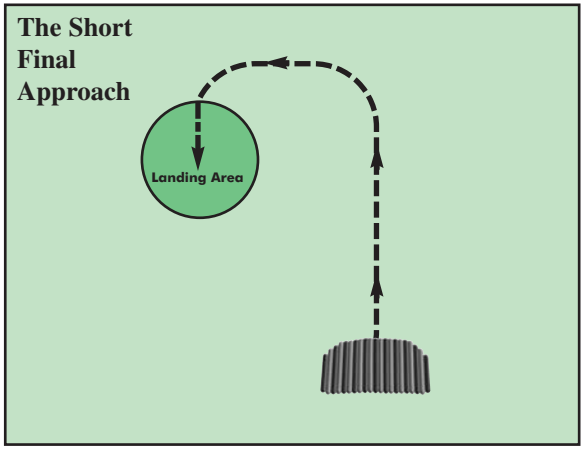
If you arrive at your final turn point too high you can lose some of that extra altitude by extending your downwind leg and final approach.



The short final approach - Ideal for high wind conditions.

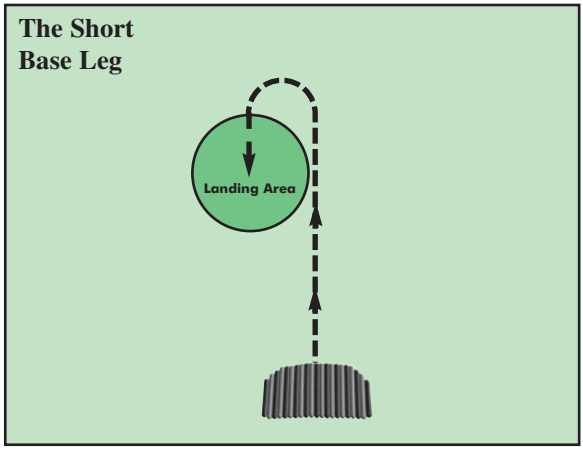
In this case it is unwise to go too far behind your target as this frequently leads to landing downwind of it.

After having assessed the strength of the wind you should have a good idea of how far you will travel during your final approach allowing you to judge where to start your final turn. Remember that in strong wind conditions the canopy will be pushed sideways during your base leg. This will need to be considered when planning your final turns.



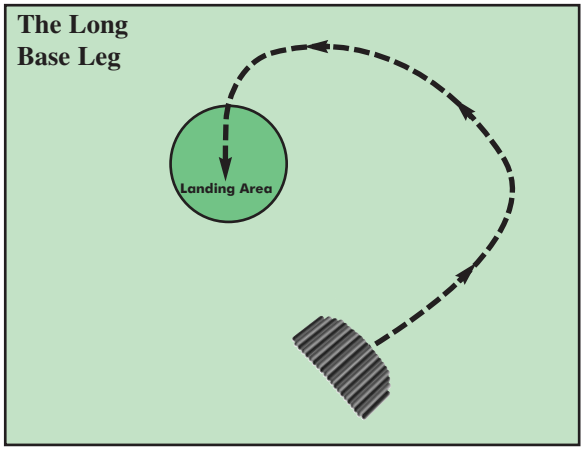
The short base leg - Ideal for high wind conditions for the reason stated above.

Because of the sideways drift of the canopy during the base leg it is often easier to plan a very narrow pattern with a shorter base leg. In some cases the base leg can be left out altogether. In general the windier it is the shorter the base leg.



The long base leg - When the winds are light but you don't want to go downwind of the target area.

If there are hazards downwind of the target area or traffic that needs to be avoided and you are still a little higher than planned, you can fly a wider pattern to lose altitude in time for your final turn. In this case the more altitude to be lost the wider the pattern should be.



Throughout all these scenarios you must stay aware of your position and altitude and all other canopies. For best results you will need to be constantly reassessing your plan and be prepared to amend it if needed.

Safety first

The idea of a landing pattern is to get all canopies travelling in the same direction to minimise the risk of collisions.

Most DZs have a set pattern and this should be planned for and stuck to whenever possible.

The final turn must be carried out with sufficient altitude to allow the canopy to recover fully (get back above your head and slow down) before it is time to flare.

Any manoeuvre that will catch out other jumpers should be avoided.

The final approach should be in a straight line and ideally into wind

The stronger the wind the closer in to the target you should stay on your down wind leg

If it all goes wrong remember your priorities for landing

LAND UNDER A FLAT AND LEVEL CANOPY

LAND IN A HAZARD FREE AREA

LAND INTO WIND IF POSSIBLE

6. Turbulence

Now you are able to jump in stronger wind conditions you may encounter turbulence at any time during your descent. Turbulence can be caused by a number of factors, the most common of which are thermal activity or the result of the wind being deflected around, over, or through objects and from the wake turbulence produced by other canopies. A good indication of the degree of turbulence to expect under canopy is how smooth the ride to altitude in the aircraft is. There are two opposing schools of thought on tackling turbulence: slowing down and speeding up.

Slowing the canopy down

Applying about a quarter brakes (too much can allow the canopy to stall in high winds) to slow down the canopy's speed through the turbulence can reduce the amount of buffeting.

Speeding up the canopy

Speeding up the canopy allows the cells to remain fully pressurised and therefore keeps the canopy more rigid as it flies through the air. This can be done by keeping the canopy on full drive as much as possible and carrying out smooth turns.

You will realise now that both of these methods are opposites; however both seem to be effective. The second method is ideal at high altitudes, with the first better for turbulence near the ground. Flying through turbulence is largely a game of confidence and the important thing is to stay relaxed in the harness and don't try to compensate for the canopy buffeting. You will need to try both methods to find out what works best for you under your particular canopy.

Although highly unlikely that the effect on the canopy will be dangerous, it is advisable not to make any radical turns in bumpy conditions. Landings are generally more unpredictable; therefore, it is well worth anticipating the worst and adopting a PLF position for landing just in case.

On turbulent days it is also a good idea to plan your canopy flight to minimise the risks. You should try to avoid landing downwind from large obstacles such as high trees or buildings. On hot days you may also avoid over flying large concrete or tarmac areas as the extra heat rising from these causes thermal activity. Never fly behind another canopy close to the ground as the wake turbulence can collapse your canopy.

Turbulence Basic Principles:

- Be aware of the different types of turbulence - Heat, wind and wake.
- Do your best to avoid it.
- If unavoidable, learn how to keep control of your canopy whilst flying through it.

7. Traffic Avoidance

We can minimise the risk to ourselves and other jumpers by learning to avoid traffic. We can start this before we even take off by knowing the characteristics of our canopy and of the others on our lift. This does not have to be overcomplicated, but it is very useful to know how fast our canopy flies in comparison to those around us. Different people like to fly their canopies in different ways, some like to take their time while others prefer to race to the ground and all these factors will influence where you fit in to the flow of traffic.

As a student you were taught the importance of all round observation, now it is absolutely critical. Instead of just looking to see if you are clear of traffic, you should now be looking to positively identify every other jumper in your group and work out a plan to avoid them all. Remember to check the 3 A's [altitude (have you got enough), airspace (other canopies) and area (location in relation to the holding area and PLA),] before making any turns.

It is also good idea to look for any other groups on the lift and assess if you are going to catch up the group before you or be caught up by the group after you. This is where knowing your canopy comes in. You should try to fit yourself into the order of canopies in a place that will allow you to fly on full drive without catching up the canopy in front or causing the one behind a similar problem. Sort out any possible canopy confliction high to allow everyone enough time to plan a safe landing. If you need to overtake, check the 3A's to ensure it is safe to do so and that you will not interfere with anyone else's flight plan, before speeding up your descent by carrying out a few turns. If you find that you are constantly catching up the parachutist in front, but do not want to pass them, use your steering toggles, or rear risers, to stay above them. Be aware of causing difficulties to the people behind you. If this does not work, then think about using another part of the landing area to allow you a safe landing pattern in clear space.

If in doubt remember:

- If your canopy is faster - overtake high - don't leave it until finals to have a traffic problem
- If your canopy is slower - don't overtake - take your time and fit yourself in with the traffic flow -use brakes or risers to maintain your distance if needed.
- Check the 3 A's [**altitude** (have you got enough), **airspace** (other canopies) and **area** (location in relation to the holding area and PLA),] before making any turns.

8. Choosing a Canopy

This section gives advice on choosing a new canopy. Up until now you may have only jumped student canopies and / or are possibly considering downsizing. Your choice of canopy is a very important and personal decision. We will cover various aspects to aid choice, but can not advocate strongly enough that you must gain advice from appropriately qualified people before making your choice. You should also bear in mind that by choosing to go smaller in size, you will increase the risk factors associated with flying a canopy. We will take into consideration the following factors:-

- 7 or 9 cell
- Zp or F111
- Square or elliptical
- Wing loading
- Collapsible sliders and pilot chutes

7 or 9 cell

Generally we tend to fly 9 cell main canopies and 7 cell reserves. It is well known that 7 cell canopies tend to have more consistent openings than 9 cells, but that 9 cell canopies tend to have better landing characteristics.

There have been some very popular 7 cell canopies made in recent years. However, it is generally accepted that unless you specialise in a particular discipline, the best all round main will be a 9 cell canopy due to the increased performance and lift that this design can give for landing. It is also probably true that you have gained all of your current experience on a nine cell and are more used to its handling characteristics.

Zp or F111

These days nearly all main canopies are made of Zp (zero porosity) fabric, the idea being that the fabric does not allow air to pass through it. It allows a higher performance for a given size of material, which means the canopy has more pressure in the cells, will hold a greater weight and produce more lift.

Reserve canopies are generally made of F111 material due to a lesser pack volume and opening shock, although some reserves are being produced which have either Zp top skins or most rarely are all Zp.

If you are looking at second hand equipment, you may come across a number that have an F111 main canopy. These tend not to last as long as their modern counterpart and although they may be sound, you should bear this in mind when negotiating the price. Also refer to

the manufacturer's recommendation regarding wing loading. An F111 canopy will not support the same suspended weight as a similar sized Zp canopy. (This is covered in more detail later on in the Wing Loading section).

The downside of Zp material is discovered during packing. Initially it can be difficult to place the canopy in the bag, as it always seems to want to fill with air. Also the material can be slippery due to the manufacturing process, especially when new. Nearly all modern canopies are made of Zp, if you want to own one, you will have to accept that some perseverance will be required to master the correct packing technique. If buying second hand, be aware that a canopy may require a replacement line set once it has done a few hundred jumps and this should be taken into consideration when negotiating the price.

There are also some very good hybrid main canopies available which will have a ZP top skin and F111 bottom skin. This combination provides a good alternative, especially in an intermediate canopy. Hybrid canopies can also be easier to pack, especially the “putting it in the bag” bit, which many struggle with initially.

Square or elliptical

Heavily loaded elliptical canopies are high performance products that have fast turn rates and are not designed for low experience jumpers. It is not recommended that you move onto a highly elliptical canopy at this stage. There are many modern designs known as “semi elliptical,” which means that the canopy will be fairly high performance, but not too radical. One of the disadvantages of highly elliptical canopies is that they have a higher potential to produce a turn during opening. This can cause problems with other canopy traffic, especially when associated with line twists. In certain situations, twists can mean a cutaway on an elliptical, as the canopy may dive towards the ground during its turn, which in some circumstances can be quite violent. This latter problem is less severe if the canopy has a reasonably conservative wing loading (see wing loading section later on).

Canopy manufacturers generally claim that their product opens softly and on heading. If we factor in the low experienced jumper who may not always be in the best body position at opening time and possibly also a relatively inexperienced packer, soft, on heading openings will not always be achievable. Canopies can develop less than ideal opening characteristics as they grow older. Any canopy displaying such characteristics should be inspected by a rigger.

Wing loading

Wing loading is a subject that is often misunderstood and has many interpretations. Put simply, the higher the wing loading the more radical the canopy. By radical we mean that it will go faster in almost all respects. For example, when turned, a canopy will lose a great deal of height compared to a similar design and size with less weight under it. The basic advice is not to load up a canopy too highly initially, especially when you only have a low number of jumps. Nearly all manufacturers have recommended wing loading criteria and we advise that you do not exceed these.

When we talk about wing loading we are referring to exit weight, which means a person wearing all his or her equipment including jumpsuit, rig, helmet, camera, goggles and weight belt if applicable. It's no good saying that you weigh 10 stone (140lbs) so to give a wing loading of 1 to 1(1 lb to 1 square foot) you will need a 140 square foot canopy. With equipment you will be more like 12.5 stones (175lbs) which, with a 140 square foot canopy, will actually give you a wing loading of 1.25.

Note; - First jump students in the UK are only allowed to jump a maximum wing loading of .8 and then .85 thereafter. By comparison, a wing loading of 1.3 is very high and should only be used by the very experienced.

To work out your own wing loading use the following calculation: - Take your exit weight (wearing all gear), take the canopy size in square feet and divide your weight into the square footage of the canopy, e.g. Exit weight of 175 lbs, divided by canopy size of 140 square feet, equals a wing loading of 1.25.

Downsizing

At some stage you will no doubt consider downsizing your canopy. There are two points to think about before doing so, when and by how much? As a bare minimum you should only consider downsizing when you can comfortably complete fairly accurate stand up landings in all types of wind conditions and are at ease with the turn rate and slow flight characteristics of your current canopy. In terms of how much you should downsize by, we would advocate an absolute maximum of 15% smaller than your current canopy size.

Overloading a main parachute is asking for trouble. Over loading a reserve parachute is potentially suicidal. When choosing a reserve parachute, consider what type of performance it will produce, given the wing loading you will be subjecting it to. Although you are far less likely to end up using your reserve parachute, the circumstances that you will find yourself in can be far worse than on a normal descent. Generally you will be a lot lower than normal, reducing the time available to plan your flight, and are also far more likely to miss the drop zone, meaning that you will have to steer and land a canopy that you have never jumped before, into an area that has the potential to be a lot smaller than you are used to.

When buying canopies remember this basic advice **“The smaller the canopy the faster you can get into trouble.”** Be conservative and do not succumb to peer pressure from others. Listen and talk to those who have lots of experience and we mean thousands of jumps not hundreds, before to deciding which canopies will be best for you.

Collapsible Sliders and Pilot Chutes.

Collapsible sliders and pilot chutes have been developed to allow equipment to perform more efficiently and we will endeavour to explain the reason behind these developments.

Collapsible sliders and pilot chutes are designed to reduce drag and allow the canopy to travel through the air more quickly. Collapsing the slider will reduce its size and therefore

reduce drag. Most collapsible sliders have a standard draw cord system which is simple and works quite well. Depending upon the equipment you are jumping, it may be possible to pull the slider down over the brakes. If you have the right equipment and wish to pull the slider down over the brake toggles, it must be done before releasing the brakes. Be aware, pulling the slider over the brakes can cause a brake to fire if you are not careful. Should a brake fire, simply release the other one and carry out a control check. You must be careful when first attempting to collapse the slider as it will require some attention. Beware of other traffic whilst completing the collapse and take avoiding action if required. The manoeuvre should be completed above 2000 feet. Just because you have a collapsible slider doesn't mean you have to use it. Become acquainted with your new canopy before attempting to collapse the slider. Make sure you get a proper brief before having a go at collapsing your slider for the first time.

Note; remember to use the three A's: **Altitude** (have you got enough), **Airspace** (other canopies) and **Area** (location in relation to the holding area and PLA) before collapsing sliders, removing booties etc.

Collapsible pilot chutes reduce drag and also help to stop the pilot chute pulling on the top skin of the canopy, causing it to distort. Generally the system used is known as a “kill line,” there is also a bungee version used by certain manufacturers. The systems are automatic in that as the bag comes off the canopy they retract and collapse the pilot chute. One of the downsides to the “kill line” system is that it must be cocked prior to use. If you don't cock the pilot chute it may not work! If you purchase or use a “kill line” system, seek advice prior to packing and remember to check to make sure it is cocked before you jump. Conversely, the bungee system relies on the pilot chute fabric being strong enough to open against the pull of the bungee. Make sure that you check the serviceability of the pilot chute fabric before each jump.

Seek advice

When considering what to buy, keep at the forefront of your mind that you are purchasing a life and limb saving device. Cheapest is not always best, quality, fit and suitability is paramount. Always seek advice from independent instructors / riggers prior to making a decision on what to buy and don't be afraid to get a second opinion. As well as getting canopies that are the correct size and type, it is also very important to get a correctly fitted harness. This should not be an issue if buying new, providing you have been measured correctly, because the harness will be made to your measurements. A second hand harness that feels relatively comfortable on the ground can be a whole different story in the air. If buying second hand, ask an instructor or rigger to check the equipment over before test jumping it. You wouldn't buy a second hand car without taking it for a test drive, why should second hand parachute equipment be any different. If the vendor won't allow you to test jump his or her second hand equipment before purchase, walk away. Always choose favourable weather conditions for your first couple of jumps on any new / unfamiliar or second hand equipment.

9. Canopy Drills

This section is designed to provide you with recommended drills for your first jumps on a canopy that you are unfamiliar with. This could be, rental, loaned, or new equipment, when considering downsizing or, when you end up on your reserve after a cutaway. These drills can also be used and expanded upon to improve your canopy handling skills and overall awareness of the flight characteristics for whatever canopy you may jump, both now and in the future.

Recommendations for Canopy Drill Jumps:

- **Jump solo**. It will give you more control over where and at what height you open and should allow clearer airspace to carry out the manoeuvres.
- **Open high**. Between 5000 - 7000 feet should be adequate. Let the manifest / DZ control / jumpmaster / other people on the load know you are opening high.
- **Have a plan**. See the section entitled “Getting to the Parachute Landing Area” in the CH1 manual.
- **Use the 3 A's**. Before carrying out any canopy exercise always check your altitude (have you got enough), airspace (other canopies) and area (location in relation to the holding area and PLA).

Canopy drills:

Jump 1: Finding the stall point and practice flares.

Finding the stall point:

There are many factors that can influence the point at which a canopy will enter a stall, or indeed, not enter a stall at all. These include, but are not limited to: canopy loading, riser length, location of the steering line guide ring, toggle setting, harness fit, and even the length of your arms. As you gain experience you will find that toggle settings (the place where the steering toggles are attached to the steering lines) become a matter of personal preference. Your canopy manufacturer's manual should provide details on their recommendations for brake settings. If not, a good general guideline is to have about 2 inches (5cm) of slack in the steering lines. This means that when the canopy is flying with the brakes released and on full drive, the steering lines will appear to have a slight bow in them and it should take about 2 inches of toggle input to have an affect on the tail of the canopy i.e. when you pull the toggle down there will be 2 inches of slack to go through before the tail of the canopy starts to move. Most people start off with their toggles set on what are known as factory settings and adjust for personal preference from there. Note; there is a fairly wide difference of opinion on what is the ideal amount of slack to have in your steering lines. Therefore, do not be surprised if your local rigger or instructor disagrees with the above recommendation. Always seek the help and guidance of a properly qualified person before making any changes to your equipment set up.

During an ideal landing, the canopy should continue to create lift until after you have transferred your weight from the harness to the ground i.e. when your feet are firmly on the ground and your weight is no longer suspended from the canopy by the harness. It is not necessary to stall the canopy to get a good landing. The reason we wish to find the stall point is so that we know how much toggle input is required to make the canopy stall. The point just above where the canopy stalls is our 100% brake setting. This is the setting that, during a flare, will allow the canopy to level off and reach a minimum rate of descent and speed without stalling, which also happens to be the best time to make contact with the ground.

Exercise 1: Finding the stall point:

Standard practices:

- On opening, if the canopy is fully inflated and without line twists, check your airspace and then use a rear riser to turn, so that you are facing towards the Holding area / PLA, then release the brakes as normal.

- Use the accuracy trick (see “Assessing Where You Will Land” section in the CH1 manual) to ascertain whether you will make it back to the PLA. Note; the following exercises can be conducted on the way back to the holding area, providing you are up wind and will make it back easily.

Finding the stall point exercise:

- Make sure you have plenty of clear airspace in front of you, then look at the tail of the canopy and note the amount of slack / bow in the steering lines. Pull down both toggles evenly and stop at the point where the tail of the canopy just starts to move. Make a mental note of how far you had to pull the steering toggles down. (If you want to adjust the toggle settings at a later date, this is the absolute most that they should be adjusted by).

- Keeping the steering toggles at that same setting, check the 3 A's (as we are going to purposely stall the canopy, make sure to check the airspace behind you as well) then look back to the tail of the canopy. Gradually pull the steering toggles down. (As you do this you will notice the canopy gaining lift, slowing down and getting quieter, this is all normal stuff). At some stage, normally below hip height, the canopy will reach a point whereby it runs out of airspeed, loses its normal shape and starts to fall backwards. This is your stall point; as the canopy starts to fall backwards, make a quick mental note of where your hands were when this occurred and then conduct a stall recovery by gently letting the steering toggles back up until the canopy regains its forward speed and normal shape.

- It is important that you are able to feel when the canopy is at its stall point. Check the 3 A's (remember to check behind you) and have another go without looking at the canopy. Try to recognise the point where the canopy starts to fall backwards. This can feel a little weird; remember to keep your toggle inputs smooth.

Notes:

- It is possible, particularly if you hold on to the stall for too long, that after the recovery you may have end cell closure and, particularly if you aren't smooth on the recovery and / or let one toggle up faster than the other, twists. To this end, in order to give enough time to rectify any problems make sure you start this exercise no less than 1000 feet above your normal cutaway decision height.

- Many low experience jumpers have concerns over stalling the canopy, as they believe that it will cause a malfunction. Providing your toggle inputs are smooth and you only hold the stall for just a second or two before smoothly letting the toggles back up to recover, then it is very difficult to self induce a malfunction. Holding onto the stall for a period of time and making radical toggle movements, such as letting go of one of the toggles during a stall, particularly on a highly loaded elliptical canopy, is another matter.

- You may find that your canopy doesn't actually stall during this exercise. As mentioned above, there can be a number of reasons for this. Move on to exercise 2, practice flares and remember to ask an appropriately qualified person for further advice on the set up of your equipment after you have landed and certainly before even considering making any changes to the set up of your equipment.

- There does seem to be an alarming practice within the sport called “taking wraps” in the steering lines. Essentially, this means wrapping the steering lines around your hands to shorten them and thus allowing the canopy to stall. We would suggest that this is an inherently dangerous technique that should not be used due to the possibility of being unable to disentangle your hands should the need to cutaway or any other occasion arise where you need to let go of the steering toggles. If you do seem to have an inordinate amount of bow in your steering lines, it is acceptable to take your hands out of the steering toggles and move your grip upwards to the point where the steering toggles are attached to the steering lines i.e. so that the steering line goes between your fingers with your grip being at the top of the steering toggle.

- It is vital that you become fully conversant with the slow flight characteristics of the canopy that you are on, before even considering downsizing. Being fully comfortable in slow flight is only achievable if you are proficient at stalls and stall recovery.

Practice Flares:

Although it could be said there are many different variations on the type of flare technique to be used, dependent upon weather conditions, type of canopy, wing loading, experience etc. It is also fair to say that there are two basic flare techniques taught throughout the world, one continuous flare and the two-stage flare (see the “Landing Technique” section in CH1 for a more in depth explanation of the two stage flare). It is not within the remit of this manual to go into the advantages and disadvantages of both, indeed different canopies react in very different ways to the same amount of toggle input. This is particularly noticeable if moving from a slow docile (square) type canopy to one that is more elliptical. What is important to remember is that during the ideal flare, the canopy will continue to produce lift right up until the point where you make contact with the ground. Therefore, the maximum amount of toggle input required at the end of a flare is your 100% brake setting, which you should have gleaned from the “Finding the Stall Point” exercise above. As also mentioned above, when carrying out the “Finding the Stall Point” exercise, you may find that your canopy does not stall. This isn't something to be alarmed about, carry on with the practice flare exercise.

Exercise 2: Practice Flares:

Below are brief guidelines for each basic technique, these are not intended to replace a proper brief by an appropriately qualified person.

One Continuous Flare

Check the 3 A's and pick a heading. Make sure that the canopy has been in full flight for at least ten seconds. (This is also a good habit to get into for your actual landings as well). Depress both toggles down evenly to your 100% brake setting. You are trying to get a feel for the type of toggle input that gives the most optimum flare. As a general rule you will need to depress the toggles smoothly and evenly, so that you can feel the canopy level out and then continue to produce lift right up until the point where you are at your 100% brake setting. At this point the canopy should just continue to move forwards slowly and you should still be on your chosen heading. Slowly let the steering toggles back up on to full flight / drive. Check the 3 A's and have another go.

The Two stage Flare

Check the 3 A's and pick a heading. Make sure the canopy has been in full flight for at least ten seconds, (this is a good habit to get into for your actual landings as well), then initiate the first stage of the flare to level the canopy out. As you feel the lift starting to fade then increase your toggle input slowly and evenly down to your 100% brake setting. At this point the canopy should just continue to move forwards slowly and you should still be on your chosen heading. Slowly let the steering toggles back up on to full flight / drive. Check the 3 A's and have another go.

Whichever technique is used, try and complete as many practice flares as possible. This should at least give you a higher rate of confidence when it comes to landing the canopy at the end of your flight.

Creating a good flare from your canopy is much a case of developing a feel for how the canopy is reacting to your toggle input. To further develop your flaring technique, you can also try the above exercise with your eyes closed. An obvious point on safety here, make sure you check the 3 A's before closing your eyes and only have them closed for the period of time it takes to complete the flare.

Notes:

- The above flare technique descriptions have been kept deliberately short, as there are many different factors that will affect the flare technique used. To this end, it is imperative that you get a briefing from an appropriately qualified instructor or canopy handling coach before jumping an unfamiliar parachute or practicing the above techniques.

- If you have had a cutaway and are under your, we will assume, unfamiliar reserve canopy, it is be important to carry out as many practice flares as possible. However, these exercises should not be done in preference to making sure that you land in a safe area.

- If, during your practice flares, you find that the canopy is not staying on heading, it may well be because you are not depressing the toggles evenly, are leaning to one side in the harness, or the canopy is not trimmed / set up properly. Try flaring with your hands in front of you, to visually check that they are coming down evenly. Relax in the harness and just allow your arms to do the work during the flare. If neither of these appear to work, then adjust the level of toggle input i.e. one hand slightly higher than the other, so that the canopy stays in a straight line during the flare and have the equipment checked out by a rigger before jumping it again.

Jump 2: Flat Turns

Flat turns

It is imperative that you learn how to make your canopy turn with a minimum amount of bank and altitude loss. If you find yourself in a tight situation this skill may very well save your life.

Exercise: flat turns

Standard practices:

- On opening, if the canopy is fully inflated and without line twists, check your airspace and then use a rear riser to turn so that you are facing towards the Holding area / PLA, then release the brakes as normal.

- Use the accuracy trick (see “Assessing Where You Will Land” section in the CH1 manual) to ascertain whether you will make it back to the PLA.

- Ideally this exercise will need to be carried out into wind. Assuming you have opened upwind of the PLA. Use the technique described in the CH1 section entitled “Increasing the Range of the Canopy Using Toggles,” on your way back to your holding area. Do not attempt this exercise if you have opened downwind of the PLA. Concentrate on getting back to the PLA / holding area and conduct the exercise only if it is appropriate to do so.

- On arrival in the holding area, check the 3 A's and turn back into wind.

Flat Turns exercise

Depress the steering toggles so that they are at about half brakes, this should be just below chest level. The canopy speed and rate of descent will decrease. Check your airspace and try to make the canopy turn through 90-degrees with as little bank as possible. You can do this by either pulling one toggle down a bit, letting one toggle up a bit, or mixture of both. Once the turn is complete, keep the steering toggles at half brake, check the 3 A's and make another turn through 180 -degrees. Continue to make your 180-degree flat turns until it is time to leave the holding area for the downwind leg of your landing pattern.

Notes:

- What works best will really be dependent upon the type of canopy you are jumping and the amount of loading on it. Your aim is to make the canopy turn as flat as possible and with a minimum amount of altitude loss. This can only be achieved through practice and experimentation.

- Remember to check the 3 A's before making any turns.

Jump 3: Slow Flight Characteristics

Slow Flight Characteristics

By exploring and becoming comfortable at flying your canopy around in deep brakes, you will uncover a whole new range of control over the canopy and develop a much higher level of canopy awareness and skill.

Exercise: Slow Flight

Standard practices:

- On opening, if the canopy is fully inflated and without line twists, check your airspace and then use a rear riser to turn so that you are facing towards the Holding area / PLA then release the brakes as normal.

- Use the accuracy trick (see “Assessing Where You Will Land” section in the CH1 manual) to ascertain whether you will make it back to the PLA.

- Ideally this exercise will need to be carried out into wind. Assuming that you have opened upwind. Use the technique described in the CH1 section entitled “Increasing the Range of the Canopy Using Toggles,” on the way back to your holding area. Do not attempt this exercise if you have opened downwind of the PLA. Concentrate on getting back to the PLA / Holding and conduct the exercise only if it is appropriate to do so.

Slow Flight Exercise

Whilst increasing the range of the canopy on the way back to the Holding area. Try and concentrate on keeping the canopy in its deepest brake setting that you can. You will probably be quite surprised at how much brake you can actually apply before the canopies glide angle starts to decrease.

When you arrive back in the holding area, check the 3 A's and turn back into wind.

Carry out the flat turn exercise described above, but this time try applying 3/4 brakes, which should mean that the toggles are at about waist level. Remember, you may be quite close to the stall point on the canopy (see “Finding The Stall Point” above) so only make your turns by lifting one toggle slightly.

Notes:

- What works best will really be dependent upon the type of canopy you are jumping and the amount of loading on it. Your aim is to make the canopy turn as flat as possible with a minimum amount of altitude loss. This can only be achieved through practice and experimentation.
- Being on deep brakes will decrease your descent rate and increase the length of the canopy ride. Be aware, this may well mean that Tandem and other high opening canopies will catch up with you and, in a multiple aircraft operation, the canopies from another load. Therefore, make sure that you carefully check the 3 A's before each manoeuvre.

Summary

The above exercises are designed not only to allow you to become more conversant with a new or unfamiliar canopy, or indeed, if you are on a familiar canopy but have never tried the exercises before, but to open up a whole new range of control over the canopy during an extended period of time. Canopy control is quite literally a life saving skill. We would urge you to practice and continue to master the above skills on every single canopy flight.

Cover photo courtesy of Helen Carroll
Figures 2 & 3 kindly supplied by John Leblanc of Performance Designs