

# CSPA

## Coach 3

# Canopy Formation

# Reference Manual

Canadian Sport Parachuting Association  
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## FOREWORD

This 2024 version of Coach 3 canopy formation is the inaugural release of this rating. Please send in your suggestions, updates, new ideas, and technical advancements that will help keep all of our manuals on the cutting edge and up to date. The submission of graphics and photos are also welcomed. This is a living document and it will only grow with your help and input.



This document is intended for electronic reading in PDF/online format. Click on resource links located throughout the document for additional information. Please print only if necessary.

If you have questions, suggestions, corrections or additional material relevant to this or any CSPA manuals, please forward them to [cwc@cspa.ca](mailto:cwc@cspa.ca) so that your ideas can be considered.

The Canadian Sport Parachuting Association (CSPA) provides these manuals to our Members and Registered Participants to ensure that standards and proven methods of training and skydiving are being followed across Canada. The sport of parachuting continues to grow around the world, and as the sport enlarges, so does our knowledge of the technical and training complexities. As new ideas and systems are introduced into our sport and they are proven to be sound, they are adopted by the CSPA and new information is distributed. To ensure that the best available techniques are being utilized, it is your responsibility to keep abreast of them by participating in Coaching and Instructor programs and seminars offered by both local organizations and the CSPA.

This manual will not answer all the questions regarding our sport. It is to be used only as a guide and to be used in conjunction with the CSPA coaching program and CSPA qualified coaches and instructors. To guarantee the most enjoyment, remember to always...

THINK SAFETY - JUMP SAFELY - STAY CURRENT

Skydiving questions not answered in this manual, or in other CSPA publications, may be directed to CSPA's Coaching Working Committee at [cwc@cspa.ca](mailto:cwc@cspa.ca) or the National Office at [office@cspa.ca](mailto:office@cspa.ca)

## ABOUT THIS MANUAL

The purpose of this part of the manual is to provide the Coach 3: canopy formation with relevant information in preparation to train parachutists in canopy formation. It follows from the Coach 1 and Coach 2 CSPA programs.

The manual is laid out in the standard skydiving progression format of preparation, equipment, in-flight, freefall, and canopy control. Technical knowledge and information for endorsements is associated with the appropriate skill section.

## ACKNOWLEDGEMENTS

Thank you to Lee Bibby who drafted this initial document so that we can have an instructional manual to build upon. Thank you also to Tom Begic, Monique Andrie, and the specific contribution from members of the CWC and the canopy formation community.

Also, thank you to the Australian Parachute Federation for permission to use multiple illustrations within this reference manual.

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As a licensed skydiver, you understand that skydiving and canopy formation in particular, can result in severe injuries and death. You are responsible for your own safety. As a result, the information in this manual is provided “as is” and without any warranties or representations as to its completeness or accuracy. While our goal is to improve the overall safety of the canopy formation community, your use of or reliance on this manual does not guarantee that your canopy formations will be incident free. This manual is not intended to establish a legal standard of care with respect to canopy formation instruction. As a result, no inference should be drawn from the use or reliance upon this manual (or the failure to use or rely on this manual) by any person in connection with canopy formation instruction.

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## SECTION 1: COACH 3 CANOPY FORMATION

### 1.1 OVERVIEW

**Coach 3 (C3):** The C3 primarily coaches beginning recreational skydivers to develop discipline-specific skills following a progression to intermediate and advanced levels of canopy formation. The training for this rating is self-directed under the guidance of the CWC.

This manual is intended as a resource for CSPA Coach 3: canopy formation, who are regarded as being highly experienced canopy formation pilots in 2/3/4 way vertical and offset formations, and large canopy formations.

This manual and the method of coaching described in it are provided for educational purposes and as a reference tool. Your use of this manual does not indicate endorsement by the CSPA (or its members, affiliates, employees, or sponsors).

It is not intended as a training program that does not include a coach and should not be used by any person who is not a CSPA-trained coach, as the methods and techniques are designed for a specific progression. By using this manual, you are agreeing to indemnify and hold harmless, CSPA (and its owners, affiliates, employees, and sponsors) from any claims (whether by you or by a third party) relating to this manual or its use.

Canopy formations can be completed with two or several parachutists; as a Coach, you must instruct and / or coach new canopy formation parachutists using the necessary progression and techniques given in conjunction with CSPA Coach 1 and 2 programs. As such, you should become a properly qualified Coach before attempting to coach any of the techniques described in this manual. This manual is designed to supplement your canopy formation coaching; it does not replace proper training and instruction.

The information in this manual is based on the information collected from experienced sources. While 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.

### 1.2 RESOURCES

<https://www.dropzone.com/articles/safety/canopy-formation-parachuting-r28/>

The Low Down on Low Turns: [http://www.performancedesigns.com/docs/98\\_low.pdf](http://www.performancedesigns.com/docs/98_low.pdf)

Canopy Collision Decisions: <https://uspa.org/Discover/News/canopy-collision-decisions>

Flying and Landing Parachutes Safely <http://www.performancedesigns.com/docs/flylnd.pdf>

Wing Loading and its Effects <http://www.performancedesigns.com/docs/wingload.pdf>

### 1.3 PRE-COURSE TASKS AND REQUIREMENTS

|                                                                                                                             |
|-----------------------------------------------------------------------------------------------------------------------------|
| <b>Roles and Tasks</b>                                                                                                      |
| Coach advanced canopy control programs                                                                                      |
| Mentor aspiring Coach 3s                                                                                                    |
| Be recognized within CSPA (and on website) as a subject matter expert                                                       |
| <b>Prerequisites</b>                                                                                                        |
| SSE verification that the candidate is a subject matter expert in canopy formation with a safety-oriented attitude          |
| DZO or DZSO verification that the candidate is a subject matter expert in canopy formation with a safety-oriented attitude. |
| Submission of Technical Assessment Jump #1 and Jump #2 as per C3-CF Portfolio, OR                                           |
| Participate in two judged events or competitions (e.g., formation record, demonstrations, performance competition)          |
| Coach 2 certified                                                                                                           |
| Minimum of 400 canopy formation jumps verified by a SSE                                                                     |
| Complete the Coach 3 Common Exam (Open Book)                                                                                |
| <b>Currency Requirements</b>                                                                                                |
| Coach at least 5 candidates (1:1 or in seminars)                                                                            |
| 10 canopy formation jumps in the previous 12 months.                                                                        |

### 1.4 CANOPY FORMATION PROGRESSION PLAN

- Canopy Formation Theory
- 2 way Canopy Formations
- Beginners Levels 1-4 (LTAD 3)
- Intermediate Levels 5-7 (LTAD 4)
- Advanced Level (LTAD 5 & 6)
- 3 and 4 way Canopy Formations
- Beginners Levels 8-9 (LTAD 4)
- Intermediate Levels 10-13 (LTAD 4)
- Advanced Level (LTAD 5 & 6)
- Large Canopy Formations (LTAD 4, 5 & 7)



## 1.5 CANDIDATE'S PREVIOUS EXPERIENCE

State your previous parachuting and/or coaching experience:

Detail your educational background:

List any courses related to coaching you have attended:

List any parachuting or other athletic experience you may have:

List any certifications you have achieved - include where and when you received them:

List any other achievements:

## 1.6 SAFETY PREPARATION

Provide support to athletes in training; the coach must ensure that the practice environment is safe.

- Coach implements safety measures and preventative actions that reflect learning from past experiences.
- Coach recommends actions or procedures that can contribute to enhancing established safety practices.
- Coach can teach others how to implement effective safety measures and preventative actions.
- The coach's safety measures and preventative actions are used as a model within the sport.
- Coach critically reflects on safety concerns prior to and following practice.
- Coach can effectively implement an emergency procedure adapted to the sport in case of injury or accident.
- Coach is able to present an Emergency Action Plan with all (6) of the following critical elements.
  - i. Emergency telephone numbers are listed
  - ii. Location of telephones are identified (cell or land lines)
  - iii. Location of medical profiles for each athlete under the coach's care is identified
  - iv. Location of fully stocked first-aid kit identified
  - v. Advance "call person" and "control person" are designated
  - vi. Directions to reach the activity site are provided

## 1.7 EMERGENCY ACTION PLAN (EAP)

In learning to conduct canopy formations, there will inevitably be off-dropzone landings. It is important for coaches to perform headcounts after each dive and have a plan for missing jumpers. An Emergency Action Plan (EAP) is a plan designed by coaches to assist them in responding to emergency situations. The idea behind having such a plan prepared in advance is that it will help you respond in a responsible and clear-headed way if an emergency occurs. An EAP should be prepared for all dropzones.

## 1.8 COACH LIABILITY

Review coaches' liability, risk management plan, legal questions and answers.

Link - [Coach 1 Reference Manual](#) Section 2.7 Safety and Liability

## SECTION 2: CANOPY FORMATION THEORY

Content and recommendations for coaches:

- Explain what the aim of the first jump will be and talk through the process for obtaining Coach 3.
- Talk about equipment compatibility and the differences between CF purpose-built canopies and most other canopies.
- In detail, talk about the first dive you will be doing, use video footage or use a PowerPoint presentation if possible.
- For the first few CF jumps, the participant should leave the aircraft first. Explain why this is and talk about the importance of a good stable exit, the correct delay and keeping on the correct heading.
- Talk through how you will fly next to the participant under canopy and once you are in position, the participant will then be signalled to come across and dock.
- Ensure the participant understands that they will be docking onto the rear and not the front of the coach.
- Explain about how to approach a target canopy, docking techniques and how to plane.
- Make sure the participant knows how to lose height effectively.
- Teach to the participant's ability. (It is up to the coach to decide how much the participant is to do on each jump)

### 2.1 EQUIPMENT

The Coach 3 should be prepared to discuss different equipment (canopy, harness, communication devices and accessory items) with a high degree of competency. Novice canopy pilots will be looking to you for unbiased recommendations that will benefit that individual. Simply because you jump canopy X and use harness Y, it may not be the best for the individual you are coaching. You must consider only what is best for that individual.

### 2.2 CANOPY FORMATION CANOPY TYPES

The Coach 3 should be able to have a discussion with their novice about the pros and cons for each different type of canopy available on the market. Beginner parachutists need to understand the different flight characters of the different types of parachutes.

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. A rigger should inspect any canopy displaying such characteristics.

### Common Canopy Formation Main Canopies

PD Storm  
PD Tango  
Icarus Matrix

PD Lightning  
Aerodyne Triathlon

**Cross braces:** Give the canopy a more ridged feel. Pack volume and price are disadvantages to cross-braced canopies. “Cross braces are extra diagonal ribs that keep the canopy more rigid, allowing thinner airfoils and fewer lines to be used...These canopies are generally faster, and create more lift on landing than non-cross-braced canopies of the same size. Because they are only available in smaller sizes and require a good amount of skill to be flown safely, they are only recommended for pilots who already have experience jumping small elliptical canopies.” (Retrieved from <http://www.performancedesigns.com/docs/choosing2.pdf> )

“Cross Brace tri-cell means the cell is divided into three chambers instead of two, with the chambers diagonally braced to force each cell back into shape...the cells are 'locked' into position rather than being free floating and able to breathe.

<https://www.nzaerosports.com/helpsupport/what-does-crossbraced-mean>

**EXERCISE:** Create a grid of pros and cons pertaining to the different types of canopies for different experience levels (e.g., novice vs. expert vs. competitor). Use this to build a knowledge base to discuss with novice canopy pilots.

| Jumper Level | Canopy Type  | Pros | Cons |
|--------------|--------------|------|------|
| Novice       | Elliptical   |      |      |
|              | Flat         |      |      |
|              | Cross braced |      |      |
| Expert       | Elliptical   |      |      |
|              | Flat         |      |      |
|              | Cross braced |      |      |
| Competitor   | Elliptical   |      |      |
|              | Flat         |      |      |
|              | Cross braced |      |      |

## 2.3 PILOT CHUTE & P/C RETRACTION SYSTEM

The important thing is for the bridle to be fully retracted and the pilot chute to be fully depressurized. They must be kept out of the way of other parachutists while flying within and near the formation. A well-designed retraction system will also minimize the movement of the bridle if the canopy is collapsed. The pilot chute needs to be depressurized so that it does not affect the aerodynamics of the canopy or interfere with jumpers and their equipment. Modification of pilot chute size without main manufacture recommendations may increase off-heading openings.

The smaller your canopy, the shorter the distance between cells. This means that given the same design of retraction system, smaller canopies need to have shorter bridles. There are a few issues to consider here. The length of the bridle needs to be considered in relation to the burble created behind a parachutist's back during deployment. An excessively short bridle will be caught in the burble and consequently may not inflate to commence the deployment sequence. If the bridle is too long, then the retraction system may not fully retract the canopy. This will affect the flying characteristics of the canopy. Hence, if you do have a relatively short bridle, you must be extra careful to ensure it is deployed into clean airflow and that you are ready to expose it to airflow (expose your back to airflow) if it suffers burble related issues.

## 2.4 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 high 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 of their equipment including jumpsuit, rig, helmet, camera, goggles and weight belt if applicable.

*Note 1:* First jump participants in Canada typically fly a parachute with a wing loading less than 0.90. By comparison, a wing loading of 1.4 is considered to be very high, and should only be used by the very experienced.

*Note 2:* Wing loading is not to be confused with the CSPA downsizing chart. The wing loading chart is a tool to match parachutists' weight and equipment to have the best chance of success while performing Canopy Formation parachuting.

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.

EXIT WEIGHT (JUMPERS WEIGHT + GEAR) ÷ CANOPY (SQUARE FT) = WING LOADING

Resource: <http://www.performancedesigns.com/docs/wingload.pdf> "Wing Loading and its Effects", Performance Designs Inc., John Leblanc. See Section III - More advanced concepts about wing loading.

**EXERCISE:** Create a grid participant wing loading chart and discuss suitable pairing.

|               | Exit Weight | Canopy | Wing Loading |
|---------------|-------------|--------|--------------|
| Participant 1 |             |        |              |
| Participant 2 |             |        |              |
| Participant 3 |             |        |              |
| Participant 4 |             |        |              |

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

| EXIT WEIGHT<br>(LBS.) | 110             | 121          | 132          | 143          | 154          | 165          | 176          | 187          | 198          | 209          | 220          | 232          | 243          | 254          | 265          |
|-----------------------|-----------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| JUMPS                 | FT <sup>2</sup> |              |              |              |              |              |              |              |              |              |              |              |              |              |              |
| 1                     | 190<br>(170)    | 190<br>(170) | 190<br>(170) | 190<br>(170) | 190<br>(170) | 190<br>(170) | 210<br>(178) | 210<br>(189) | 230<br>(200) | 230<br>(211) | 230<br>(222) | 260<br>(230) | 260<br>(230) | 260<br>(230) | 260<br>(230) |
| 20                    | 170<br>(170)    | 170<br>(170) | 170<br>(170) | 170<br>(170) | 190<br>(170) | 190<br>(170) | 210<br>(176) | 210<br>(187) | 230<br>(198) | 230<br>(209) | 230<br>(220) | 230<br>(230) | 230<br>(230) | 230<br>(230) | 230<br>(230) |
| 40                    | 170<br>(150)    | 170<br>(150) | 170<br>(150) | 170<br>(150) | 170<br>(150) | 190<br>(160) | 210<br>(171) | 210<br>(182) | 230<br>(192) | 230<br>(203) | 230<br>(214) | 230<br>(224) | 230<br>(230) | 230<br>(230) | 230<br>(230) |
| 60                    | 170<br>(150)    | 170<br>(150) | 170<br>(150) | 170<br>(150) | 170<br>(150) | 190<br>(156) | 190<br>(166) | 210<br>(177) | 210<br>(187) | 230<br>(198) | 230<br>(208) | 230<br>(218) | 230<br>(229) | 230<br>(230) | 230<br>(230) |
| 80                    | 170<br>(150)    | 170<br>(150) | 170<br>(150) | 170<br>(150) | 170<br>(150) | 190<br>(152) | 190<br>(162) | 210<br>(172) | 210<br>(182) | 230<br>(193) | 230<br>(203) | 230<br>(213) | 230<br>(223) | 230<br>(230) | 230<br>(230) |
| 100                   | 150<br>(135)    | 150<br>(135) | 150<br>(135) | 150<br>(135) | 170<br>(150) | 170<br>(150) | 190<br>(158) | 190<br>(168) | 210<br>(178) | 210<br>(188) | 230<br>(198) | 230<br>(208) | 230<br>(217) | 230<br>(227) | 230<br>(230) |
| 120                   | 150<br>(135)    | 150<br>(135) | 150<br>(135) | 150<br>(135) | 150<br>(135) | 170<br>(145) | 190<br>(154) | 190<br>(164) | 210<br>(174) | 210<br>(183) | 220<br>(193) | 230<br>(203) | 230<br>(212) | 230<br>(222) | 230<br>(230) |
| 140                   | 150<br>(135)    | 150<br>(135) | 150<br>(135) | 150<br>(135) | 150<br>(135) | 170<br>(141) | 190<br>(151) | 190<br>(160) | 190<br>(170) | 210<br>(179) | 210<br>(188) | 230<br>(198) | 230<br>(207) | 230<br>(217) | 230<br>(226) |
| 160                   | 150<br>(135)    | 150<br>(135) | 150<br>(135) | 150<br>(135) | 150<br>(135) | 170<br>(138) | 170<br>(147) | 190<br>(156) | 190<br>(166) | 210<br>(175) | 210<br>(184) | 230<br>(193) | 230<br>(202) | 230<br>(212) | 230<br>(221) |
| 180                   | 150<br>(135)    | 150<br>(135) | 150<br>(135) | 150<br>(135) | 150<br>(135) | 150<br>(135) | 170<br>(144) | 190<br>(153) | 190<br>(162) | 210<br>(171) | 210<br>(180) | 210<br>(189) | 230<br>(198) | 230<br>(207) | 230<br>(216) |
| 200                   | 135<br>(120)    | 135<br>(120) | 135<br>(120) | 135<br>(120) | 150<br>(123) | 150<br>(132) | 170<br>(141) | 170<br>(150) | 190<br>(158) | 190<br>(167) | 210<br>(176) | 210<br>(185) | 230<br>(193) | 230<br>(202) | 230<br>(211) |
| 220                   | 135<br>(120)    | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 150<br>(129) | 170<br>(138) | 170<br>(146) | 190<br>(155) | 190<br>(163) | 210<br>(172) | 210<br>(181) | 210<br>(189) | 230<br>(198) | 230<br>(207) |
| 240                   | 135<br>(120)    | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 150<br>(126) | 150<br>(135) | 170<br>(143) | 190<br>(152) | 190<br>(160) | 190<br>(168) | 210<br>(177) | 210<br>(185) | 230<br>(194) | 230<br>(202) |

7 The following canopy downsizing chart (with permission from Big Air Sportz) is provided to CSPA Members and Registered Participants to help skydivers make their own decisions about appropriate canopy sizes. Copyright © Big Air Sportz, Inc., Tampa, Florida, USA. [www.bigairsportz.com](http://www.bigairsportz.com)



| EXIT WEIGHT<br>(LBS.) | 110             | 121          | 132          | 143          | 154          | 165          | 176          | 187          | 198          | 209          | 220          | 232          | 243          | 254          | 265          |
|-----------------------|-----------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| JUMPS                 | FT <sup>2</sup> |              |              |              |              |              |              |              |              |              |              |              |              |              |              |
| 260                   | 135<br>(120)    | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 150<br>(124) | 150<br>(132) | 170<br>(140) | 170<br>(148) | 190<br>(157) | 190<br>(165) | 210<br>(173) | 210<br>(181) | 210<br>(190) | 230<br>(198) |
| 280                   | 135<br>(120)    | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(121) | 150<br>(129) | 170<br>(137) | 170<br>(145) | 190<br>(154) | 190<br>(162) | 190<br>(170) | 210<br>(178) | 210<br>(186) | 230<br>(194) |
| 300                   | 135<br>(120)    | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 150<br>(127) | 150<br>(135) | 170<br>(143) | 170<br>(150) | 190<br>(158) | 190<br>(166) | 210<br>(174) | 210<br>(182) | 210<br>(190) |
| 320                   | 135<br>(120)    | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 150<br>(124) | 150<br>(132) | 170<br>(140) | 170<br>(148) | 190<br>(155) | 190<br>(163) | 190<br>(171) | 210<br>(179) | 210<br>(186) |
| 340                   | 135<br>(120)    | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(122) | 150<br>(129) | 150<br>(137) | 170<br>(145) | 170<br>(152) | 190<br>(160) | 190<br>(168) | 190<br>(175) | 210<br>(183) |
| 360                   | 135<br>(120)    | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 150<br>(127) | 150<br>(135) | 170<br>(142) | 170<br>(149) | 190<br>(157) | 190<br>(164) | 190<br>(172) | 210<br>(179) |
| 380                   | 135<br>(120)    | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 150<br>(125) | 150<br>(132) | 170<br>(139) | 170<br>(147) | 170<br>(154) | 190<br>(161) | 190<br>(169) | 210<br>(176) |
| 400                   | 135<br>(120)    | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(122) | 150<br>(130) | 150<br>(137) | 170<br>(144) | 170<br>(151) | 190<br>(158) | 190<br>(166) | 190<br>(173) |
| 420                   | 135<br>(120)    | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 150<br>(127) | 150<br>(134) | 170<br>(142) | 170<br>(149) | 170<br>(156) | 190<br>(163) | 190<br>(170) |
| 440                   | 135<br>(120)    | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 150<br>(125) | 150<br>(132) | 150<br>(139) | 170<br>(146) | 170<br>(153) | 190<br>(160) | 190<br>(167) |
| 460                   | 135<br>(120)    | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(123) | 150<br>(130) | 150<br>(137) | 170<br>(143) | 170<br>(150) | 190<br>(157) | 190<br>(164) |
| 480                   | 135<br>(120)    | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(121) | 150<br>(128) | 150<br>(132) | 170<br>(141) | 170<br>(148) | 170<br>(155) | 190<br>(161) |
| 500                   | 135<br>(120)    | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 135<br>(120) | 150<br>(126) | 150<br>(132) | 150<br>(139) | 170<br>(145) | 170<br>(152) | 170<br>(159) |

\* Size must be increased as necessary to reflect "Relevant Variables"

\* See footnotes and explanations (below)

\* The chart is based on "Total Exit Weight": [Jumper + All Equipment]

Figure 9: Downsizing Chart

## 2.5 COMPATIBILITY AND EQUIPMENT

For the sake of aerodynamic & organizational simplicity, a perfect canopy formation will contain parachutists with exactly the same flying characteristics. This implies the same descent rate, the same forward speed, the same wing loading, no grip tension and the same canopies.

**Canopy:** If possible, use the same type of canopy throughout the formation. This means matching the manufacturer, model, options (ZP versus F111), line type (thickness) and degree of wear and tear.

**Lines:** Canopies should be fitted with non-cascading centre and outside A lines. This facilitates movement up and down the lines. The lines normally come from the manufacture coloured red so they are easily identified. CF canopies can be equipped with target panels or entire cells and are a different colour.

**Line trim:** Many manufacturers have different trims designed for different disciplines in CF. In particular, many manufacturers have sequential and rotations trims. The trims will affect descent rates and forward speeds. There is also the issue of line retraction due to wear and tear and age as well as damage, repairs, and replacements.

**Red centre 'A' lines:** Explain about non-cascading lines and show the crossbar connectors if they are fitted, (if there are no cross connectors see if you can get some fitted).

Measure and compare the line lengths and trims within an individual canopy - measure the outer A line on the left side of the canopy and compare it to the measurement of the outer A line on the right side of the canopy. They should be the same. Do this for each pair (centre A, brakes, outer C, etc.).

Do this for all canopies in a formation and compare the line lengths and trims between canopies. If there are vast differences in the lengths, then you may encounter problems in the formation. For example, if one canopy has 9-foot lines trimmed at a high angle of attack, and another has 7-foot lines with a flat trim, they are going to struggle to fly together.

**Brake settings & toggle length:** You should have already measured and compared the brake lengths when checking the line lengths and trims. Check that length from the tail to cascade, cascade to brake setting, and brake setting to toggle. Also check that the toggles are equal lengths.

**Large loop toggles:** Are useful as they are easier to locate if you have to transition quickly from catching to braking. Ensure that they do not have any catch points as they may tangle in the suspension lines of another canopy. They are also useful in that they mitigate the affects of using front risers while holding toggles on rear risers. This is due to the effective lengthening of the distance from the brake setting to the end of the toggle. The other option is to have shorter toggles and a longer brake setting to toggle line length.

Packing for an on-heading opening can be covered at this stage.

## 2.6 SPIDER SLIDERS

Spider sliders have been developed to allow equipment to perform more efficiently. Spider sliders are designed to increase the speed of the main canopy deployment sequence. This allows canopy formation parachutists to increase their working time; this is advantageous in the competition theatre. However, this increases opening shock and increases the possibility of neck injury.

## 2.7 RISERS

Talk about the use of dive blocks or modifications that help you to front riser and talk about purpose-made CF toggles if they are fitted.

The risers should be considered in conjunction with line length and trim. For all practical purposes, the risers are an extension of the lines and add to their total length. Everyone should have the same riser and line length.

## 2.8 HARNESS GEOMETRY & SETUP

The size, setup, and geometry of the harness can affect the flying performance of a canopy. Canopies fly more efficiently when the chest strap is loosened up as it flattens the canopy out across its span. Loose leg straps effectively lengthen the risers. You could also consider the design of particular types of harness and container systems. Their geometry may be different.

## 2.9 SAFETY DEVICES

**Chest Strap:** For comfort and performance, parachutists will often loosen the chest strap. “Sun Path Products does not recommend the removal of the chest strap on the Javelin series of harness and container systems.”

Retrieved from <https://www.skydivemag.com/new/2015-06-01-20131030-canopy-piloting-belly-band/>

Without the chest strap routed, it is still possible for the parachutist to lean too far forward and fall out of their harness. An extra-long chest strap, or a chest strap extender, which can remain routed through the lift web, allows the parachutist to lean as far forward in the harness as they wish.

**AAD:** It should be mentioned that during a high-performance landing that it is possible to reach vertical speeds high enough to fire your standard AAD and that there are AADs on the market designed specifically to prevent this possibly catastrophic event.

**EXERCISE:** The Coach 3 should be ready with a list of Pros/Cons when using an AAD.

| Pros                                                                | Cons                                     |
|---------------------------------------------------------------------|------------------------------------------|
| Incident on exit leaving jumper unconscious<br>jumper will be saved | No control over when reserve will deploy |
|                                                                     |                                          |
|                                                                     |                                          |
|                                                                     |                                          |

**Altimeters:** There are advantages and disadvantages of chest-mount and wrist-mount altimeters such as, a wrist-mounted altimeter allows the pilot to read the altitude in their hand when looking up at the toggles/canopy while holding in a formation. A disadvantage is jumper's hand may be snagged and rendered inoperable in the event of entanglement. A chest-mounted altimeter allows the pilot to see the altitude while viewing the ground, or when lower docks are in progress.

**Hook Knives:** Two hook knives are recommended, one on the chest strap and other in leg pocket.

## 2.10 DRESS

Landing off dropzone is a concern when taking part in small and large canopy formations or intense competition training. Dressing appropriately can help avoid unnecessary injuries.

Helmets that have openings for hearing and use of eye protection can decrease injury from unexpected conditions and should be promoted. An altimeter can be worn on the harness or hands. Gloves with some tack such as golf, baseball or football receiver (sticky) gloves to protect hands against line burns and to grip canopies. Two hook knives are encouraged, as one arm can become disabled or you drop your first knife. CF pants with heat resistant material below the knee and an instep strap to ensure the pant remains covering the ankles. Clothing should be relatively snug fitting to help reduce parasitic drag, except for a few exceptions in large formations.

Shoes with minimal snag points on upper part and smooth soles are recommended for line work while conducting canopy formation. Wrestling or boxer style shoes have been successfully used. Ankle protection similar to a figure 8 ankle brace may also prevent line burns or discomfort while holding A lines.

## 2.11 CANOPY FORMATION TERMINOLOGY

Speaking the same language in canopy formation on the ground and in the air improves communication.

**Chord:** Measurement of canopy from the nose to tail.

**Cross Connectors:** Straps that attach one front rapid link to the rear rapid link. Used as foot grips once a jumper is planed down.

**Dance:** When a canopy in a formation moves side-to-side or front-to-back rapidly.

**Dive handle blocks:** Blocks or handles attached to the front risers to assist pulling down on front risers.

**Fan:** The command to transition from a plane to a side-by-side configuration.

**Float:** The tendency to rise relative to other canopies.

**Formation:** Consists of two or more parachutists linked by grips.

**Line locks:** Hand grips taken on the A lines of the lower canopy in a plane formation, intended to increase the stability or decrease tension on the feet.

**Lurk:** To fly near a formation while waiting your turn to approach and dock.

**Grip:** In accordance with FAI a grip consists of:

(a) A hand hold on an "A" line or front riser

(b) Contact with the "A" line from behind with the front of the lower leg or ankle, defined as between the instep of the foot and below the knee. (The instep of the foot needs to be clearly identifiable on the video footage submitted, for example: by tape in a contrasting colour to that of the shoe)

so that a formation is built in accordance with the configurations as depicted in the dive pool.

**Offset formation:** A formation that is not vertical (stairstep).

**Pilot:** The parachutist at the top of the formation that maintains heading or steers and calls for transitions.

**Pin:** The lower jumper in a 2 way dock.

**Planning:** The top parachutist "planes down and the lower jumper "planes up" changing the formation from a stack to a plane formation.

**Plane:** The head of the upper jumper must be below the lower surface of the lower canopy. A grip must be on a front riser or an "A" line attached to the centre cell.

**Plane/Stack:** Plane, stack or any position on a riser or an "A" line attached to the centre cell between these configurations. A correct grip must be maintained.

**Rotation:** The top canopy in a formation drops grips and moves to the bottom of the formation.

**Setup position (2way):** The final reference point prior to moving into the target position. Two span widths over, two cords lengths forward and two parachutes up from the pilot or pin.

**Setup position (formation):** This reference point is two span widths over, two cords lengths forward and two parachutes up. This positioning creates approximately a 45° angle forward of the lowest jumper in the formation larger than a 2way.

**Sight picture:** Direct line of sight from your eye, along the front edge of your bottom skin of your intended target. Normally this is the head of the person you are docking on.

**Sink:** The tendency to drop relative to other canopies.

**Span:** Measurement of a canopy from end cell to end cell.

**Target position (2way):** The final reference point prior to initiating the docking on a single jumper. The pin and pilot fly level, the pin is a half cord back, with a cord to span between canopies. The pilot is able to see the open nose of the pin, and the pin can see the pilot's back.

**Target position (formation):** The final reference point prior to docking on a formation. It is two span widths over, two cord lengths back and two parachutes high. Looking down on approximately 45° angle to the lowest jumper in the formation larger than a 2way.

**Transitional lift:** The gain in altitude created by applying deep front risers for a period of time and releasing them. This can also occur with vigorous sashay and immediately allows the toggles to fly full glide.

**S-turn:** Turning away from the formation then back to the formation returning to formation heading. This manoeuvre is used to reduce forward movement of jumpers in relation to the formation.

**Stack:** The shoulder of the upper jumper must be above the upper surface of the lower canopy and/or the hip of the upper jumper must be above the lower surface of the lower canopy. A grip must be on an "A" line attached to the centre cell.

**Stair step:** The shoulder of the upper jumper must be above the upper surface of the lower canopy and/or the hip of the upper jumper must be above the lower surface of the lower canopy. The grip must only be on the outside "A" line of the end cell. The grip must be taken with the inside foot; this may include an additional handhold, if desired.

**Wrap:** When a canopy becomes wrapped around a jumper or parachute.



## 2.12 CANOPY FORMATION STANDARD OPERATION PROCEDURES

A detailed safety brief should be completed covering all aspects of SOPS and emergencies, and if the coach thinks it is necessary, use a suspended harness.

- Each parachutist will wear a minimum of two hook knives.
- No docking will be carried out below 2,000' (2,500' during training camps) AGL.
- With the exception of the downplane and pinwheel, transitions will not be carried out below 1,500' AGL.
- Downplanes and pinwheels will not be held past approximately 100' AGL. It is recognized that below 500' AGL the altimeter is an approximation and the key to safe landing is the jumper's ability to eyeball distance above the ground, distance from the target area, and required approach path.
- No more than two novices per coach in any formation. i.e., 4-stack/plane - two novices = two coaches.
- The minimum exit altitude for 'one on one' training should be 3,500' AGL.
- Canopy formations will not be flown through clouds, whenever possible.
- Do not dock with sideways motion, too fast or too high relative to the formation.
- Do not dock too fast or too high.
- Do not dock on a formation that is oscillating or that contains a collapsed canopy.
- Do not drop a person with a collapsed canopy until it is safe to do so.
- No docks are to be conducted if jumper has crossed their legs.
- Never perform CF on or with a reserve parachute.
- No docks are to be conducted while flying through clouds. Should the formation be completed prior to entering a cloud, maintain heading until out of the clouds if possible.
- Canopy formations will have priority/right-of-way for landing before any single canopies.
- In a conventional downplane or 3/4 stack drag while transitioning, the bottom jumper will offer their right leg and pull on their left toggle to downplane or drag the formation.
- Whenever a formation requires a jumper to move down to the next jumper, for the purpose of transitioning into a side by side. The top jumper will move down the right side of the bottom jumper.
- Break formations above 1,500' unless you intend to land them.
- When exiting from the top of a stack or a biplane the pilot will go to the left. If exiting from the bottom you will go to the right.
- Never fly under or in front of a canopy formation.
- Canopy formations of 3 or more canopies with the intention of being landed will have adequate alternate landing zones.
- Canopy formations of 3 or more will cease all aggressive turns as of 500' AGL.

## SECTION 3: PREPARATION: MENTAL AND PHYSICAL

### 3.1 PHYSIOLOGY

- Advanced Stretching
  - Pilates, yoga, warm up partner stretching, visualization, progressive muscle relaxation, stretch, cardio, strength, diet, daily plan
- Morning briefing
- Nutrition

### 3.2 PSYCHOLOGY

- Mental training
- Conflict resolution
- Team building
- Emotional control
- Visualization training and techniques
- Distraction control: internal and external and action plan w/implementation
- Progressive muscle relaxation
- Meditation
- Strengthen visualization (strengths and weaknesses) training plan
- Team building, develop supportive network
- Annual planning meeting
- Situation analysis
- Arousal identification and control
- Visualization for arousal control
- Cross brain exercises
- Focus: personal best

In sport parachuting, development of mental training is equally as important as physical skill development and commences from the very first training session. There is a saying in this sport: “99% Mental, 1% whatever”. This sport is like few others for the intensity and emotional rush for a beginner or novice skydiver. The “fight-or-flight” response is very apparent in the first- (or second-) time jumper. Even the advanced athlete can experience a new rush when performing a new sequence of dives, evaluation jumps (for certificate levels), performance during a rating (Coach or Instructor) course, or during a competition event, whether for fun or challenge.



As the athlete becomes more experienced and performing at a higher level, this initial anxiety starts to dissipate. In time, the coach will need to work to bring up the arousal / activation level to an ideal state of being. Too relaxed, the athlete will not perform at peak efficiency (under-activation). Sleeping on the plane for the ½ hour ride to altitude can lower the energy level such that performance will not be at a prime. Advanced skydiver mental training skills include anticipation of the events, forward thinking (while performing move “A”, think about what needs to happen during move “B”); concentration on the task that is about to happen (not letting the mind wander). The sequence of introduction of the various techniques are shown in the attachment “Skydiving Skills Grid”.

For the advanced skydiver, use of **Visualization** and **Imagery** play an important role. The ability to practice on the ground will simulate what will happen in the air. It is important that the individual athlete can see both their own physical placement, and potentially, their placement in relation to others in the air around them. Development of Visualization starts with physically seeing the small (self) and big (group) picture. This visualization training will lead into a stronger ability to produce a mental picture. This Imagery is used during the ride to altitude where, obviously, physical rehearsal is now impossible. The athlete focuses on their mental picture of what will happen, both in their own position (self) and the bigger picture of the group. After seeing enough video footage (during debrief), the athlete can develop a sense of seeing the formation from the view of the camera. Seeing this big picture from above will help the athlete to then focus and concentrate on where they need to be positioned.

Wherever the skydiver is in their level of development, performing at or near potential on each jump will not only enhance the learning process and skill development, but will save the jumper money (learning more in fewer jumps). These skills need to be taught from the start, and continued practice and development of the mental training skills throughout the skydiving career. With one’s maturity in the sport, the strength of use of these techniques will continue to flourish, and thus, performance can only improve.

At each phase of the training, mental training concepts are introduced and practiced with the athlete, then monitored for continued and correct usage throughout their progression.

### 3.3 STRESS

“The stress is not in the situation but how a person perceives the situation.” There is an optimal level of stress that will complement or heighten the quality or level of performance. When the level of stress is too high or too low, the quality of the performance suffers. Stress may be controlled in the following ways:

- relaxation techniques
- arousal techniques
- mental preparation (rehearsal and practice)
- concentration on what is occurring rather than what might or did go wrong

### 3.4 REHEARSAL WITH RELAXATION

Both activities will improve performance, therefore, it would seem worthwhile to combine these in the time period immediately before the skydive, that is during the climb to altitude. The three steps in sequence are:

- Mentally rehearse the performance 3 times through correctly, after the takeoff; should take no more than 3 minutes
- Plan to mentally rehearse the performance at preset altitudes (e.g., 3,000', 8,000')
- Perform the relaxation exercise for the duration of the climb to altitude between mental rehearsals
- About 2 minutes prior to exit (1,000' below jump run) repeat the mental rehearsal (once or twice through)

### 3.5 CONCENTRATION

You are encouraged to concentrate on the skills presented to you as much as possible. Get a simple explanation of an activity, and then practice it undisturbed. You should then be able to perform the skill without constant repetition of instructions or encouragement. Activities that require a large amount of concentration should only be done when you are well rested. Shift focus occasionally between the overall activity and key details. Improving your concentration skills will decrease the number of repetitions required to master the correct procedures for a skill, on the ground and in the air. Using a good level of concentration during your skydive training will ensure that you get maximum canopy time and progression. Establish self-reminders about safety; this is particularly important for the few seconds prior to docking or landing the canopy.

### 3.6 ANTICIPATION

This title is a shorter version of the perhaps more appropriate label of “keeping pace with the action during the jump”. The skill is simply that of being ready to act when the moment arrives. Your anticipatory skills can be improved if you learn and practice skydiving skills in the sequence in which they occur, and rehearse the skydive without being prompted or encouraged by your coach prior to the jump.

### 3.7 BRAIN LOCK

Although the “brain lock” phenomenon is common to us all, it is not something that we want to happen often. We have responsibility to ourselves not to waste precious canopy time and we have a responsibility to the other jumpers not to be the cause of them wasting their canopy time. Preparation is the key to avoiding “brain lock”. As with any memory task or concentration effort, some simple techniques and standard practices can help to make the job easier and more

reliable. Skydivers should learn to use these procedures and apply them on every jump. A little discipline and thoroughness in preparation will easily reduce “brain lock” problems.

Some techniques for avoiding “brain locks” are:

- Get the big picture
- Become fluent with the terminology of skydiving (names of manoeuvres)
- Look for the rhythm and flow in the sequence of formations and manoeuvres
- Do a realistic dirt dive to learn your moves, especially for your eyes
- Use the time before the jump to mentally rehearse the proper sequence of the jump and the correct execution of your role
- Use mental practice on the way to altitude

It is important that you go through mental practice after instruction, so the lesson is reinforced. This is also true when you have decided on the actual methods during the dirt dive. Sometimes jumpers will take a break after designing a skydive so that each jumper can think about their role in the final version.

There is also time to use mental practice after the dirt diving is completed and before the jump. Example: While you are gearing up and especially on the climb to altitude in the plane.

Mental practice should consist of going through the skydive in the proper sequence. Imagine the events as they will happen, one after the other. The mental rehearsal can be done in the same manner as the dirt dive. The sequence of tasks can be reviewed by saying key words for the actions to be performed. These key words should be Big Picture flashes of what is about to be performed. Then imagine the exact physical actions as the events take place. Do this reviewing in as much detail as can be imagined. Fine points like the direction to look, what to grip, which colour to follow or dock on, and the keys should all be reviewed. Think: when ‘This’ happens, I will do ‘That’. Always focus on the correct execution. Carry a positive approach and do not think of possible errors or miscues. One of the biggest obstacles to curing “brain lock” is negative thoughts and worrying about “brain locking”. As you concentrate, think of your job in the skydive going as planned and feel yourself doing it.

**EXERCISE:** Describe four ways you can incorporate mental training into your practices.

### 3.8 PILOT BRIEF

**ALWAYS** notify manifest, Dropzone Safety Officer and the Pilot-In-Command that there are canopy formations jumping to create a safe working space. This is done at the beginning of the training day and is adjusted as required and covers:

- Winds aloft
- Exit speed
- Height
- Jump run
- Spot

Confirm with the pilot the canopy formation plan prior to take-off when possible. Do not distract the pilot during take-off - a critical phase of flight - or in the first 2,000' of flight.

### 3.9 CAMERAS ON CANOPY FORMATION JUMPS

A first canopy formation participant **may not wear a camera on this skydive**. Entanglement issues are very possible.

It is recommended *at least* 10 clean docks prior to attaching a camera to the participant's helmet.

### 3.10 GEARING-UP: SAFETY CHECKS

Don't forget the really basic things such as goggles or gloves; new canopy formation parachutists can get so involved in the training that they forget the basic accessories.

- The risers and the three-ring attachment loops
- The cut-away handle
- The reserve handle
- The reserve cable and its housing
- All harness straps
- The reserve pin
- The main pin
- The bridle
- The pilot chute
- Ensure the AAD is activated and reads zero down

### 3.11 PRE-BOARDING PREPARATION

Depending on the strength of the winds and the planning of the jump, the canopy formation if going to altitude, may be the last to board or the first. This can should be confirmed with the DZSO. This needs to be announced in the waiting area to be in the correct exit order. It is critical that canopy formation jumpers are not late, ready to board at the 5-minute call.

Before getting on the aircraft:

- Communication check (radios if used)
- Hook knives are present
- Pin checks are completed
- Handles are secure
- Understand the spot
- Landing pattern is confirmed

## SECTION 4: IN FLIGHT

### 4.1 GROUND ORIENTATION

On the first few jumps of the day, one should start to observe your dropzone at 2,000' - 3,500'. This normally is the breakoff altitude where canopy formation jumpers start looking for the dropzone.

On subsequent jumps, as you climb to a higher altitude, the dropzone will be smaller, perhaps more distant, and harder to locate. You should learn to find key landmarks around the airport, identify north, and know what the ground wind direction is from an altitude of 5,000' so that you can check out the canopy flight path. Coaches should practice pointing out landmarks that will help participants locate the dropzone.

### 4.2 SPOTTING

You will typically use a downwind jump run for canopy formation. This keeps you orientated towards the dropzone, and in competition allows the judges a clear view of the front of your formation throughout the dive.

When doing canopy formation, it is particularly important to understand that there may be several layers of wind between you and the ground. Whereas a freefall jumper will plummet through all but the lowest of these layers, a canopy formation jumper will spend much longer time exposed to the changing winds.

Use a rate-one turn to determine the upper winds. As a general rule of thumb, you should spot load the load one mile away from the drops on for every quarter mile covered in the right one turn.

Plan your spot so you will pass over the drop at no higher than 2,000' AGL, so that you don't interfere with freefall canopies opening at that altitude. If necessarily, turn back into the wind short of the dropzone, continue the dive until break-off altitude, and return to the dropzone. On subsequent jumps, the spot can be adjusted so that this is not necessary.

The term "spotting" involves three individual tasks. Each time you are spotting, you may be doing some or all of these tasks. These include:

- Determining the ground, middle and upper winds strength and direction. So, you can estimate an appropriate exit point that will allow you to get back to the dropzone under canopy.
- With the exit point known, you will direct the plane to fly directly over this point.
- A final safety check to make sure you are not jumping into clouds, over water, etc. and that there are no other aircraft in the area.

### 4.3 IN FLIGHT SAFETY CHECKS

- A visual check of the reserve pin to ensure that it is properly seated
- A visual check of the main pin to ensure that it is properly seated
- A visual check of bridle to ensure that it is properly routed and stowed
- A visual check of the pilot chute to ensure that it is properly stowed
- Altimeter check (tolerances: below 10,000' AGL plus or minus 200', above 10,000' AGL plus or minus 500')

### 4.4 EXIT ORDER

Depending on the winds and the planning of the jump, it happens that the canopy formation parachutists are the first to exit the plane, sometimes even a good moment before those who are freefalling. However, in general, the exit order is as follows:

- Tracking skydivers/groups
- FS groups, large groups then small groups
- Freefly/VFS groups, large groups then small groups
- PFF Participants/higher deployments
- Tandems
- Wingsuits
- Canopy Formation
- High pulls

Remember to communicate at the mock-up or boarding area to save boarding/loading time.

## SECTION 5: FREEFALL

Different exits will be required to reduce the wasting of working time in canopy formation. The size and speed of aircraft and size of formation being built must be taken into consideration when planning canopy formation exits.

### 5.1 EXITS

Canopy Formation exits will be specific to the aircraft being used. The following “hop n pop” exits are included for your reference. Remember to communicate with the pilot. Always. Even if it is just to let them know you are there.

#### Otter/Caravan Exits

Reducing the speed to approximately 85 knots is preferred if opening speeds have been modified.

**Competition:** both jumpers outside the aircraft and camera inside provide the tap when ready to forward jumper to start the count (ready/set/go). Aft jumper leaves first after set waits to deploy until they see the forward jumpers chute leave their container.

**Single exits:** 3 seconds deployment delay for first jumper. When the second jumpers see fabric coming out of the first jumper, the second jumper exits and gives a 2 second deployment delay.

#### Cessna Exits

**Single exits:** 3 seconds between 2 second deployment delay for first jumper.

#### Skyvan Exits

Competition or single exits

#### Helicopter Exits

Exits from rotary aircraft takes more time to build up enough velocity to properly deploy your parachute. This can take up to six to eight seconds and jumpers should have five seconds of separation when leaving the aircraft.

### 5.2 OPENING DELAY CHART

Distance fallen in each second, to terminal velocity

| SECONDS | DISTANCE (M) | DISTANCE (FT) |
|---------|--------------|---------------|
| 1       | 5            | 16            |
| 2       | 19           | 62            |
| 3       | 42           | 138           |
| 4       | 74           | 242           |

### 5.3 UNUSUAL SITUATIONS ON EXIT

Pilot chute in tow can occur leaving one jumper well below the normal opening altitude. Recognition and execution of emergency procedures normally rectifies the situation and the formation builds on the lowest jumper.

### 5.4 COMMUNICATION

Clear and concise communication is important when doing canopy formation; the following signals should become habitual:

**Incoming:** Shouted by anyone who is second or two canopies away from docking on another jumper. This alerts the jumper so they are ready to accept the dock.

**Get out:** The command given to someone who is trying to dock on a formation in an unsafe manner.

**Complete:** Shouted by the person making the final dock in the formation, this signals that the point has been built.

**Go:** To signal the next point in a formation of 4 or fewer parachutists.

**Fan:** The transition of canopies from a nose to tail configuration to an end cell to an end cell.

**Dance:** A side to side and front to back motion of a canopy in a formation. This is normally caused by turbulence of another jumper docking on the stack too fast or with sideways motion.

**Reset:** Shouted by a pilot/pin to signal that they are going to put themselves in position to begin a rebuild of the current point.

**Set your nose:** In a stack, the action taken to prevent the rear canopy nose from folding under. Applying 1/4 toggle will separate the canopies allowing for full inflation of the rear canopy.

**Drop-me:** Lower jumper wants to be let go from the formation.

**Hold-me:** The command given in CF when a jumper does not want to be let go from the formation.

**Stand-by:** The precautionary command repeated by everyone just prior to a planned break-off.

**Break Down or Break:** Shouted by the pilot at break off altitude. If a jumper sees something that the pilot could be missing, they can call "Break it down!" Break it down disassembles from the last person who docked, until the situation settles.

**Starburst :** Only the pilot or designated jumper can call a starburst to announce the final separation.

**Run back :** Shouted by the pilot to announce a separation followed by a reconstruction of the formation a little further behind.

**Sequential:** Shouted by the pilot to announce a separation followed by a reconstruction of the formation on the spot.

**Pieces:** Shouted by the pilot to announce a partial separation of the formation according to the plan established during dirt dive.



**Break:** The calls "Starburst", "Run back", "Sequential" and "Pieces" are followed by a countdown which ends with "Break" and is repeated in synchronism by everyone.

**EXERCISE:** Dirt dive the exit that will be planned for the jump and confirm terminology.

## 5.5 CANOPY MANOEUVRING REVIEW



### Full Glide

Toggles are up and parachute is flying at full glide ratio.



### Front Risers

Pulling on the front risers has an effect similar to increasing the angle of attack of the canopy. This increases forward speed and increases downward speed. Relative to a canopy at full flight, a canopy with front riser input will move downward and forward.



### Rear Risers

Pulling on the rear risers has an effect similar to decreasing the angle of attack of the canopy. Gentle pressure on the rear risers will increase forward speed and decrease downward speed, causing the canopy to skate forward and up relative to a canopy at full flight. By applying greater pressure to the rear risers, the canopy eventually reaches a point where it is no longer able to produce lift. Eventually, the canopy will stall. It may become hard to control and will certainly sink downward and backward with respect to canopies in full flight.

### Toggles

Pulling on the brakes cups the tail of the canopy, causing it to produce more lift, but also slowing its forward flight. Relative to a canopy at full flight, a braked canopy will float up and backward.

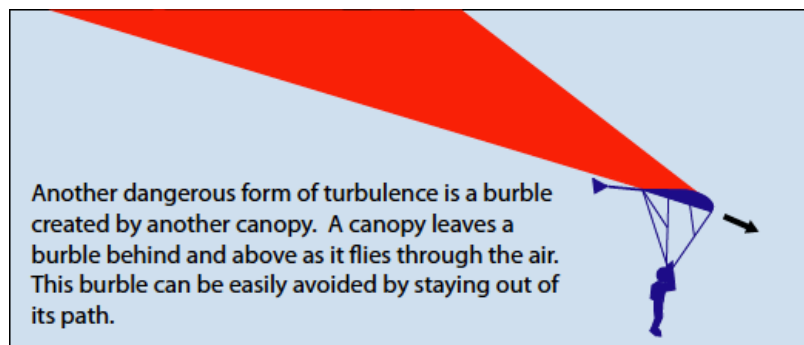
### Harness Turns

By shifting your weight left or right in the harness, you can cause the canopy to turn left or right, respectively. You will sometimes use these effects to your advantage, but if you are careless, they can work to a great disadvantage. For example: Your partner is coming in for a dock. They

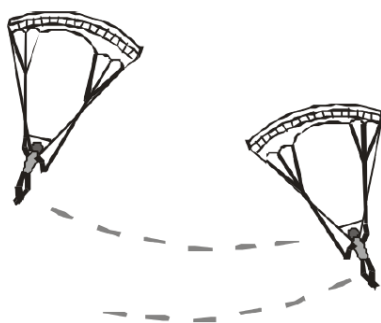
are close, but not quite there. You reach back with your right hand to snag the canopy. Suddenly, your canopy turns to the right. With your partner's canopy gripped firmly in your right hand, you spin around into a wrap or entanglement. It is important not only that you are mindful of your ability to turn the canopy by shifting your weight, but also that you use discipline, keeping your body square in the harness when it is not your intention to turn.

### The Burble

Any object moving through the air creates a turbulent wake behind it called the burble. Flying through another jumper's burble may cause your canopy to perform poorly. If you are trying to close the last few inches to make a dock, it could take a very long time if one of your canopy's cells is behind the other jumper's body – your canopy is effectively flying on 6 cells instead of 7.



Flying through another jumper's canopy-burble could cause your canopy to turn unexpectedly if you are flying in partial brakes or rear risers. When doing CF, you must be aware of the burble behind other canopies and pilots in the formation.



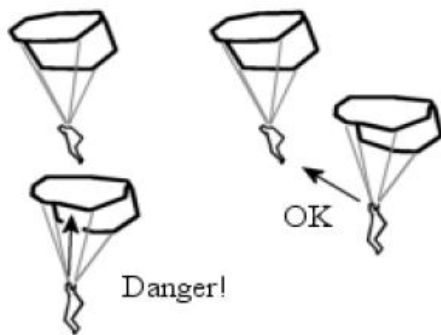
### Sashay

Used to reduce altitude in relation to the formation. Toggles or one or two front risers can be used to complete this manoeuvre.

## 5.6 RULES OF FLIGHT

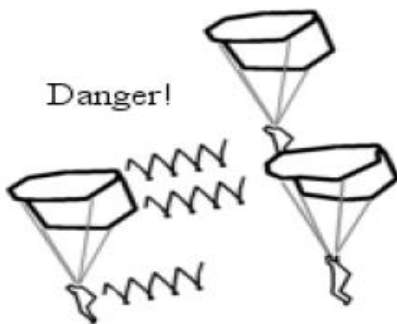
The following three rules of flight should be taken very seriously. There is no excuse for violating them, since each represents a completely preventable, but very dangerous, error.

**Keep sight of the target:** If you've lost sight of your target, you no longer know where you are relative to it. In particular, if you fly under another jumper and touch your brakes, you may wrap them from the bottom up. Therefore, losing sight of another jumper should be considered an extremely dangerous situation. The situation needs to be recognized before it develops. If you think you are in danger of passing under the formation, simply stop your forward motion using a quick stab of the rear risers before you pass under the formation, and reset the dive.



**Stay in your quadrant:** Generally, your quadrant will be the left or right side of the jumper you are docking on. Even if you are centre docking the jumper, you should choose which side you will approach from, and stay on that side. The reason for this is that there may be another canopy approaching on the other side of the centre line. Even if you are doing a 2-way jump, it is very important to develop the habit of staying to one side.

**Keep out from in front of the formations:** By flying in front of the formation, or in front of any other canopy, you are putting that canopy inside your burble. If you pass in front of a formation, it is likely to cause some instability in the formation, which could result in an entanglement or wrap. If you pass in front of another jumper, that person's canopy will behave erratically, and may be turned in an unexpected direction. The jumper may also have to perform evasive manoeuvres to avoid colliding with you.



## 5.7 UNUSUAL SITUATIONS

You should review your emergency procedures, Section 3.3 of PIM 2A. Although many unusual situations are unique to CF, the techniques used to assess your situation and to activate your reserve are very similar.

Unusual situations in canopy formation can be divided into two categories: entanglements and wraps. An entanglement occurs when two or more canopies become entangled with each other. A wrap occurs when a canopy becomes wrapped around another jumper's body. In spite of precautions taken to avoid them, wraps and entanglements do sometimes occur.

The first step toward surviving an emergency situation is to have a plan prior to the onset of the emergency. Your plan should take into account the experience of those who have come before you, as well as careful analysis of errors committed by others, and by yourself. You should not, however, limit yourself to one course of action.

For example: You are wrapped! The canopy is wrapped around your head, and the lines are wrapped around your neck, cutting off the supply of blood to your brain. You are unable to communicate with the jumper below you, and your consciousness is fading. You cross your legs to signal the jumper below to cut away. Unknown to you, the jumper below has also become wrapped, and is unable to cut away. Realizing that your partner is not responding, and desperate to relieve tension on their lines, you take hold of as much as possible of the canopy wrapped around you, reach for your hook knife, and cut the lines wrapped around your neck, thereby restoring the supply of blood to your brain and saving your own life.

A primary plan is necessary, but don't limit yourself to a single emergency procedure and convince yourself that it is going to work every time.

The second step toward surviving an emergency situation is to practice your emergency procedures. You should go over your plan until it becomes second nature to you. Review your emergency procedures before each skydive.

The third step is to do it. When you become involved in a rapidly deteriorating situation, you should quickly review your emergency procedures. Remain calm, maintain altitude awareness, and deal with the situation one step at a time.

You should initiate your cutaway no lower than 1,000 feet. A cutaway below 500 feet has almost no chance of being successful.

For further information, at any time, PIM 2C Section 6: Canopy Formation.

## 5.8 WRAPS

A wrap can be compared in severity to a low-speed malfunction. With sufficient altitude, there will be time to consider the situation and deal with it one step at a time. The canopy of the top jumper should remain inflated, giving you substantially more time to deal with the situation than you would have in a high-speed malfunction.

The most important rule in dealing with a wrap is that the bottom jumper must cut away first and must cut away only when instructed to do so by the wrapped jumper. It is very important that the bottom jumper does not cut away without specific instructions from the wrapped jumper. The cut-away canopy may behave unpredictably and can make a tricky situation much worse.

Usually, the wrapped jumper can extricate themselves from the wrapped canopy by sliding it down their body. If they are unable to do this, it may be necessary for the bottom jumper to cut away in order to release tension on the canopy. This decision belongs to the wrapped jumper, and as usual, the bottom jumper should not cut away without clear instructions from the wrapped jumper.

Always maintain altitude awareness in an emergency situation. Just like a low-speed malfunction, there is a limited amount of time to deal with a wrap.

If the wrapped jumper cannot completely extricate themselves, and if altitude is running out, they may simply control the fabric of the wrapped canopy as best as possible, and then give the command for the lower jumper to cut away. The wrapped jumper may land with the wrapped canopy tucked between their legs.

If you are in a larger formation and the jumper below you gets wrapped, hold onto their canopy until you are able to sort things out. This gives the wrapped jumper more time, and also keeps their canopy on heading.

## 5.9 ENTANGLEMENTS

An entanglement usually results from one jumper passing through the lines of another jumper's canopy, or from a part of one jumper's gear becoming entangled on another jumper's gear. This causes the two canopies to become entangled, with the jumpers dangling beneath the partially inflated or completely collapsed canopies.

In an entanglement, the two jumpers will usually orbit around the entangled canopies. The rotation may be very rapid, and the jumpers may tumble violently as the canopies fight for control.

Entanglements will often not clear themselves. Altitude permitting, jumpers should take a moment to determine if the canopies will disentangle on their own.

The general rule with entanglements is that the top jumper should cut away first. If the bottom jumper cuts away first, their risers and lines may recoil into the top jumper, which could make the situation much worse.

In dealing with an entanglement, it is important to maintain altitude awareness and communicate with other jumpers involved in the entanglement.

**Coaches Notes:**

- When entanglements occur, jumpers must be prepared to react quickly and creatively.
- In the event of multiple cutaways and if altitude allows, jumpers should stagger reserve openings to avoid possible canopy collisions.
- In many cases, the emergency is one that can't be prepared for in advance; it may even be a problem no one imagined could happen.
- If the entanglement occurs with sufficient altitude, the jumpers should attempt to clear the entanglement by following lines out before initiating emergency procedures.
- Jumpers should try to land together following a canopy relative work emergency.

## 5.10 COMMUNICATION

The first thing to do when you become involved in a wrap or entanglement is to communicate. You need to communicate the altitude, the problem, and the plan.

The bottom jumper in a wrap should call out the altitude at regular intervals since the wrapped jumper may not be able to see their altimeter or may have lost track of altitude in dealing with the situation. In addition, it can be very comforting for the wrapped jumper to know if they have a good canopy over their head.

In some cases, a wrapped jumper may be unable to communicate verbally. Non-verbal signals should be arranged beforehand. A common non-verbal signal is for the wrapped jumper to cross their legs if lines or fabric is choking them. The bottom jumper should cut away immediately if they see this.

If you become wrapped in another person's canopy, you should let the other jumper know what you are doing, if you can. This information should be communicated at regular intervals, so that the bottom jumper is constantly informed of the situation.

Clear verbal signals or positive words of command such as "Cut Away!" or "Hold!" should be used. Avoid using signals that could be misinterpreted if one or two words are misheard – for example, a signal such as "Don't Cut Away!" should be replaced with something less ambiguous, such as "Hold!" Certain signals should be agreed upon beforehand, so that everyone knows what to listen for.

## 5.11 AVOIDING WRAPS AND ENTANGLEMENTS

A bad dock is most often the cause of a wrap or entanglement. Three factors contribute to the problem: speed, angle, and distance from centre.

If you have too much speed, your canopy and body will continue to move forward after the dock has been taken. The point where a grip is taken will remain stationary, but the rest of the canopy will engulf that point. The best way to avoid this situation is to practice no-momentum docks – the target jumper should be able to reach down and pick up your canopy.

Every dock should be made with the aggressing canopy moving on the same heading as the target canopy. Often you will approach your target from an angle other than straight behind, but you need to turn your canopy to match the target's heading before you make the dock.

Rising docks should also be avoided. In a rising dock, the aggressing canopy approaches from below using brakes. When the target takes a grip on the rising canopy, it collapses against them because it is in a low-pressure, braked configuration. To avoid this problem, all docks should be made from above and behind the target.

Finally, docking unintentionally with an end cell is much more likely to cause a wrap than docking with your centre cell. If you are the target jumper, you can choose not to take any dock that comes in too hot from the wrong angle, or in the wrong position.

## 5.12 GIVING ADVICE

When considering what to buy, novices should keep at the forefront of their mind that they are purchasing a *life and limb saving device*. Cheapest is not always best; quality, fit and suitability are paramount. Advise your novice to always seek advice from independent instructors / riggers prior to making a final decision on what to buy, and to always get a second, third, fourth... opinion. As well as getting canopies that are the correct size and type for their skill level, it is also very important to get a correctly fitted harness. This should not be an issue if buying new, providing one is measured correctly, because the harness will be made to specific measurements.

*Note:* that canopy formation is difficult to master. Using unmatched equipment may cost more money in the end trying to learn the sport. Competition teams measure each component of the main and container to rule out inconsistencies. This allows them to see a mirror image while working with each other and is one less hurdle to overcome.

## 5.13 DOWNSIZING

<http://www.performancedesigns.com/docs/choosing1.pdf> "Downsizing Intelligently: Choosing the Best Canopy Size", Scott Miller

See PIM2B Section 3.13 Parachute Downsizing Criterion.

**EXERCISE:** Test participant's comprehension with questions on terminology and emergency procedures.

## SECTION 6: IN- FLIGHT CANOPY FORMATION PROGRESSION – 2 WAY

If not managed properly, CF can be riskier than standard skydiving and parachuting activities. Hence it is imperative that all prospective CF jumpers undergo a ground-based theory course prior to attempting aerial practical training course. The theory course should be mandatory. If you follow fundamental CF safety procedures, the risk is quite minimal.

### 6.1 BEGINNER 2 WAY CANOPY FORMATION

Beginner Canopy Formation training involves learning the fundamental principles of ram air aerodynamics, CF safety principles, basic equipment configuration, flight characteristics, and basic docking methods. The practical component starts with 2 way formations (participant & coach). It includes non-contact control input emulations; docking (both as pilot and pin). To address a terminology issue long standing in CF, this manual will call the top jumper as the pilot and the lower jumper as the pin. In the early days of CF, the terminology was pin and base, as the base held position as flew passively. As the evolution of CF continues both positions must work together to be successful.

Step 1 - Theory Course (equipment, aerodynamics, techniques, safety)

Step 2 - Canopy Handling Exercises (end cell bumps, centre docks, monkey crawl, and wing docks)

#### **Prerequisites:**

In accordance with PIM 1 Advanced Recommendations section 3.20 Canopy Formation (CF):

Participants must hold a CSPA B CoP and have demonstrated competence with a ram-air canopy. The following safety guidelines should be followed:

If not already docked, do not attempt to dock lower than 600 m (2,000') AGL

Minimum break-off altitude for a canopy formation is 300 m (1,000') AGL unless the intention is to land the canopy formation.

Participants shall do their first 5 to 10 jumps with a Coach 2, who has reasonable canopy formation experience. Reasonable experience is defined as demonstrating the following:

10 completed 4-stacks

The ability to safely perform a side-by-side and a down-plane



## LEVEL 1: END CELL BUMPS

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### KEY TRAINING POINTS FOR THIS TASK:

- Spotting
- Exits
- Closing vertical and horizontal distances
- Flying relative to another jumper

### DIVE FLOW:

Both jumpers should be outside the aircraft in preparation for the exit. On a Cessna 182, the first jumper may be hanging, and the second poised. On a large aircraft, jumpers should be lined up in the door with the first jumper at the rear (aft), and the last jumper towards the front of the plane. The first jumper should be the more experienced of the two jumpers.

The first jumper should take a two or three second delay before pulling. The second jumper should exit about five seconds after the first, and pull after a one-second delay. This will put the second jumper approximately 500 feet in front of the first and approximately 100 feet higher. In CF, this is known as a position of advantage. It is fairly easy to come down or back to someone else, but it's very difficult and time-consuming to move forward upward or upward relative to another jumper.

After completing a visual check of their own canopy, the Pin releases their toggles and sits in half-brakes. This will allow the Pilot to move slower or faster than Pin by applying more or less brake, respectively. The Pin should choose some landmark against which to judge their heading, and should make appropriate corrections to stay pointed toward that landmark.



Pilot is going to fly a pattern that puts them in a position to bump the Pin's end cell. The Pin will have the option of using their toggles, front risers, or rear risers to make each turn. This decision should be made based on the amount of altitude remaining between Pilot and Pin. If there is little altitude remaining, gentle rear riser turns can be used to conserve altitude. Toggles can be used with a moderate amount of altitude, and front risers can be used to close a large difference in altitude. Be aware of the side-effects of using each control – front risers, for example, will also increase your forward speed. When you are practicing this drill initially, be conservative with your choices, and try to maintain a position of advantage.

Pilot's flight pattern is as follows:

**Step 1:** First, turn 90° right or left. Hold that heading for about 2 seconds, and then turn another 90° in the same direction. When the angle between your heading and that of the Pin is approximately 45°, turn in toward the Pin. As you approach, turn to face the same heading as the Pin. Pilot's goal is to arrive next to the Pin in exactly the right spot to bump end cells. Initially, you may need to perform some corrections to get there.

Note: A sashay can be used to bleed off some altitude, and at the same time move slightly backward.

Information on performing sashays can be found in PIM 2B, Section 6.6.

**Step 2:** To close distance when the pilot is quite far in front of the Pin, and there is sufficient vertical separation, the Pilot can perform a 360° turn in a direction away from Pin. It is important always to keep an eye on the target, and to be prepared to abort the turn if you have misjudged the distance. To close the distance with less altitude loss, Pilot can perform a gentle 45° turn away from the Pin, hold for several seconds, and turn 90 ° back toward Pin.

These manoeuvres are time-consuming, so of course the goal in this exercise is to wind up in the right place the first time.

**Step 3:** To reset the exercise, either the Pin or Pilot (depending on who needs more practice) can turn 180° in direction away from the other, hold that heading for several seconds to build horizontal separation, and then turn 180° to return to the original heading. These turns can be made with toggles or risers, to vary the exercise. Try to set things up a little differently each time by varying the horizontal or vertical distance that Pilot needs to close.

It is important in CF to learn to close large distances accurately, and to be able to judge horizontal and vertical separation. Although it is tempting to perform them from close proximity, any of the following exercises can be modified by introducing a large horizontal or vertical separation.

## LEVEL 2: CONVERGING TOP DOCK

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### KEY TRAINING POINTS FOR THIS TASK:

- Move into a Target position
- Judging speed and angle
- Placing a dock
- Altitude and flight path awareness

### DIVE FLOW:

Use the same exit as for end cell bumps. Pilot will first close the horizontal and vertical distance to get to a position beside Pin. Pin sits in half-brakes. Once in position the following five steps will take place:

**Step one:** Pilot and Pin will fly directly alongside each other on the same level with the span of a cord length between the canopies and be flying in moderate breaks to match the forward speeds.

**Step two:** When the Pin is called over, they make a slight turn towards the pin so the front end of their cell passes behind the pilot 's end cell. The pilot will assist by turning their canopy slightly in at the same direction to allow the Pin canopy to get behind it (if required only).

**Step three:** The Pin is targeting the Pilot's head lets off somewhat on toggles. The Pin targets the centre A line attachment point of the bottom skin and maintains or increases their toggle pressure and simultaneously adjusting heading to converge with their target. The Pin's canopy moves down and forward while the Pilot's canopy floats and slows up. It is very important that the parachutes are both travelling in the same direction before establishing contact. All docks should be made level and are moving slightly down.

**Step four:** Once the Pin's canopy is square on the Pilot's back, and it is touching or close enough to the Pilot to grab, the Pilot lets go of both their toggles and takes a grip on the Pin's centre A lines or canopy. If the dock is not completely centred on the pilot's back, but one cell left or right of centre, the Pilot can grab the top skin of the Pin's canopy and hand over hand to the centre cell.

Coach's note: it is important that the pin release the steering toggles before they grab the Pin's parachute.

**Step five:** Once the Pilot is positioned in the centre of the Pin's canopy, by hooking their feet into the Pin's centre A lines. They then turn the two-stack on to target heading and calls for the Pin to apply toggles. The application of the Pin's toggles will allow the Pilot to plane down the centre A lines and places their feet in the Pin's cross connectors (optional) forming a biplane.

Coach's note 2: Skipping the first step of setting up side-by-side is one of the major causes for failed docks. It is tempting once you are near another canopy to simply skip that step of flying side-by-side and go for the dock. This usually has the result that the Pin ends up position below and behind the Pilot trying and failing to catch up. Also setting up side-by-side with too large of a gap between the canopies can also result in a failed dock.

Note 3: Another common mistake in step one is for the Pin to set up with their canopy on the same level as the Pilot's body. When they attempt steps 2 and 3, the Pin will inevitably end up blowing behind the Pilot.

Note 4: When setting up side-by-side, one canopy may outdrive or have more float than the other. This is a result of mismatched wing loading and you will have to adjust accordingly. If you are trying to get set up and one canopy is above and ahead of the other, the higher canopy must come back and down to the lower.

Note 5: When executing step three, where the Pilot's body rises up relative to the Pin's canopy and makes contact, the Pilot must be careful not to use too much toggle pressure too quickly, as this can shoot them up at an alarming rate. The Pin should also be careful not to apply too much toggle pressure that they stall the canopy, this could also be dangerous. Once again, the Pin must ensure that they release their toggles prior to grabbing the Pin's canopy or lines.

At this time, show the video of a converging top dock emphasizing on the key points of a peer confirmation and clarify any questions the class may have.

### LEVEL 3: CENTRE DOCK (ADVANTAGE DOCK)

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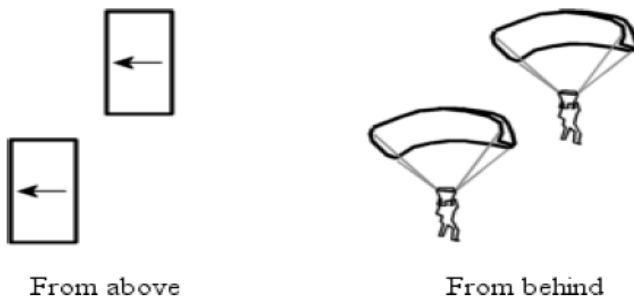
#### KEY TRAINING POINTS FOR THIS TASK:

- Move into a setup position
- Judging speed and angle
- Receiving a dock
- Altitude and flight path awareness

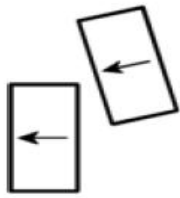
#### DIVE FLOW:

Use the same exit as for end cell bumps. Pilot will first close the horizontal and vertical distance to get to a position beside Pin. Pin sits in half-brakes.

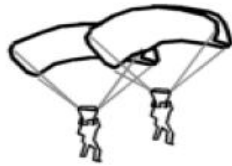
By applying three-quarter brakes abruptly, and holding them for about one second, Pilot will move up and behind Pin, into what is called the set-up point.



From the set-up point, Pilot has the advantage. Using their inside front riser to turn toward Pin. The Pilot's canopy should pass under Pin's burble, through clean air.

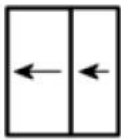


From above



From behind

Using the opposite front riser, Pilot aims their centre cell at Pin's lower back while bringing their heading back around to match Pin's. When Pilot is one or two seconds from completing the dock, they should yell, "Incoming!" to alert Pin.



From above



From behind

Pin should stay in one-quarter to half brakes throughout this manoeuvre. When Pilot is very near completing the dock, the Pin lets up gently on the brakes and removes their hands from the toggles in preparation. The Pin should be careful to maintain a consistent heading, but should also keep an eye on where Pilot is.

When looking to see where Pilot is, it is very important that Pin look only left, right, or down under their arm. By looking up toward the tail of their canopy, Pin exposes their chin and neck as a potential snag point for Pilot's canopy, and risks a neck injury.

When Pilot's canopy touches Pin's back, they can reach down with their hands and grab the top skin. By passing their feet inside Pilot's centre A lines and hooking their toes around the outside of the lines, Pin takes a grip. The role of Pin and Pilot may change as the Pin now becomes the Pilot.

To reset the exercise, the top jumper kicks out of the bottom jumper's lines and releases any grip they may have with their hands. Either Pin or Pilot can turn to set up the next go around to change positions. Pin can use a smooth application of their brakes to pass up and over Pin's canopy before turning to reset. Pilot can use their brakes to put a short distance between their canopy and Pin's back before turning if they are going to act as Pin on the next go-around.

#### Landing procedures:

At this level, jumpers will now experience landing in a biplane formation. Communication and landing procedures are paramount for safety. Considerations should include:

- Proper instruction to the participant shall happen on the ground to properly prepare.

- Formation pilots should avoid all obstacles, including suspected areas of thermal activity, such as paved surfaces, ploughed fields, buildings, etc.
- The landing of canopy formations should be attempted by only those with a high level of CF proficiency.
- Breakoff for landing should take place no lower than 1,500 feet AGL because of the danger of entanglement at breakoff time.
- Jumpers should not attempt to land formations in high or gusty winds, high-density altitudes, or high field elevations.
- The Pilot will make gentle corrections while establishing the landing pattern. The participant should be dropped higher to allow for landing preparations. The Pilot will use the commands “standby and break”. The Pilot will then remove their legs from the Pin’s A lines and drop the Pin. Each jumper in the formation shall have adequate altitude to flare and land.

## LEVEL 4: MONKEY CRAWL

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### KEY TRAINING POINTS FOR THIS TASK:

- Communication
- Use of grips hands and feet
- Awareness of riser pressure required in wing dock

### DIVE FLOW:

The goal of this exercise is to prepare for wing docks. When Pilot takes a grip on Pin’s end cell in a wing dock, it has the effect of slowing down that side of the canopy, and reducing the lift it produces. The opposite side of Pin’s canopy tends to overtake and lift with respect to Pilot’s side, which can cause a wrap. In order to prevent this, Pin must apply front riser pressure on the side opposite Pilot. This has the effect of keeping that side down, and also hampers the performance of that side somewhat so that it does not overtake Pilot’s side.

Use the same exit as for end cell bumps. Pilot will first close the horizontal and vertical distance to get to a position beside Pin. Pin sits in half-brakes.

Pilot moves back and up to the set-up point, and completes a converging top dock. Pin needs only to take handgrips this time. Once they have a grip, they call out to Pin, “Crawling Right!” and begin to shuffle their hands along Pin’s top skin, behind their back, toward the right side of Pin’s canopy. Pin applies increasing pressure on the left front riser to compensate. If the left side of the canopy seems to be lifting or overtaking the Pilot, greater pressure is required.

Because Pilot is still steering the formation, it is very important that they maintain heading, and keep their weight distributed evenly in their harness throughout this exercise. It helps to keep looking forward while edging along Pin’s canopy.

When Pilot reaches the right side of Pin's canopy, they call out, "Crawling Centre!" and crawl toward the centre. Pin slowly lets up on the front riser pressure until the Pilot is in the middle of their canopy, they are no longer applying any pressure. Pilot then repeats the exercise for the left side of Pin's canopy, with Pin applying pressure to the right front riser.

If altitude permits, Pilot can yell, "Reset!" and the exercise can be reset in the usual way so jumpers can switch roles.

## LEVEL 5: WING DOCKS

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### KEY TRAINING POINTS FOR THIS TASK:

- No horizontal or vertical momentum while docking
- Using outside riser pressure

### DIVE FLOW:

Use the same exit as for centre docks. Pilot will first close the horizontal and vertical distance to get to a position beside Pin. Pin sits in half-brakes, and Pin moves into the set-up point.



The wing dock is similar to a converging top dock, except that Pin aims to place the outside edge of their end cell against Pilot's lower back.

Although a converging top dock can be completed safely with quite a high closing speed to the centre, a wing dock must be placed with little or no horizontal or vertical momentum, in order to avoid a wrap or entanglement.

Pilot must be very disciplined in not accepting any dock that comes in too fast – if the dock is not accepted, Pin will simply pass by the Pilot, and the exercise can be reset.

Pilot must also be very disciplined with heading control. Especially with wing docks, it can be very tempting to reach back and help Pin close the last few inches. Pilot's primary concern should be keeping a consistent heading so that Pin has a stationary target to hit, and to avoid entanglements and wraps that could result from Pilot turning toward Pin's canopy.

As soon as Pin's canopy comes into contact with Pilot's body, they should take a handgrip. At this point, Pin should apply opposite front riser to compensate. Pilot can take a leg grip once Pin has applied front riser. Pin should fly the formation for a few seconds to get a feel for it, and then the exercise can be reset as usual.

## 6.2 INTERMEDIATE

The exit procedures (converging top dock or centre/advantage dock) are the same, prior to the next four types of parabolic manoeuvres. Learning how to transition into a side-by-side and

obtaining a firm grip is key to be able to do multiple types of 2 way formations. Canopy Transitions can be used in three and four way canopy formations.

## LEVEL 6: PARABATICS

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### KEY TRAINING POINTS FOR THIS TASK:

- Formation heading
- Communication
- Use of grips hands and feet
- Awareness of riser pressure required in wing docs

### DIVE FLOW:

Parabatics starting point is the Biplane configuration. Prior to any canopy formation transition the Pilot/Pin checks the formation heading. The Pilot removes hands from the toggles and reaches down while squatting to grab as close to the rapid links of the Pin. The Pilot unhooks their feet and continues to pull their body lower, as the Pin guides the Pilot to a scissor grip by grabbing the Pilot's left leg and pulling down to the Pin right hip. Once this is completed, the word a command fan will separate the canopies into a side-by-side formation. This is a good time to correct heading if required. The Pin is now responsible for keeping the canopies together. The final stage of the parabolic transition has the Pilot calling for the front foot. The Pin will present their front foot to the Pilot which will be placed under the Pilot's left side. Then the rear foot will cross overtop to right leg and be placed under the right side of the Pilot. The Pilot's legs should be in a W style configuration. The Pin's legs will be crossed. Ensure both reserve and cutaway handles are seated correctly and are guarded from the Pin's feet. They can be displaced during the transition. The Pilot will again check heading and correct by using the commands "my way" or "your way". The Pin continues to monitor the separation between canopies and is careful not to lean back causing more separation between canopies.

## LEVEL 7: PARABATIC MANOEUVRES

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### KEY TRAINING POINTS FOR THIS TASK:

- Communication
- Use of grips hands and feet of parabatics
- Awareness of both canopies
- Understanding the flight characteristics of canopies in unusual positions safely

### DIVE FLOW:

Once the parabolic formation has been established and heading confirmed, a series of different manoeuvres can be made.

**Inside Out:** Pilot and Pin can use inside toggle to complete an inside out manoeuvre changing their direction to the opposite direction flight. This momentarily puts the canopies front to front as the formation rotates to the inside.



**Barrel Roll:** This manoeuvre is performed by the Pilot using outside toggle turning continuously to the right. The Pin uses inside toggle to follow the Pilot's canopy performing a downward controlled spiral of the formation.

## LEVEL 8: DOWNPLANE

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### KEY TRAINING POINTS FOR THIS TASK:

- Communication
- Use of grips hands and feet
- Awareness of other jumpers, wind direction, and altitude

### DIVE FLOW:

**Parabolic down plane:** To have an effective downplane, the Pilot positions the side-by-side directly over target or slightly downwind to adjust for wind direction and speed. The Pilot ensures the airspace below the formation is clear before transitioning into a downplane. The parabolic grip may need to be tightened at this point. The Pilot uses the word command “down” cueing both Pilot and Pin to pull outside toggle at the same time. This is used to direct the formation towards the ground. More tension will be experienced on the legs and parabolic grip. The downplane can be steered by the Pilot and Pin by using the same side toggle input. This is an important correction method to learn. By correcting the position of the downplane, it sets jumpers up for a better landing into the wind with a better degree of accuracy.

**Conventional down plane:** The advantage of the conventional down plane is it can be done quickly without having to go into a parabolic grip. This may be a better option due to altitude or canopy compatibility.

The Pilot positions the biplane directly over target or slightly downwind of the intended landing point. The Pin can set the nose prior to the transition. The Pilot determines point by adjusting for wind direction and strength. The Pilot ensures the airspace below the formation is clear before transitioning into a downplane. The Pin will grab the hips or leg straps of the Pilot and pull the Pilot down to the Pin's thigh. The Pin presents their right leg canted to the left; this will assist the Pilot to keep a solid bear hug grip. Once the Pilot has a positive grip, the next call is “fan”. The Pin will use left toggle separating the canopies as the canopy rotates into a ground facing orientation. As the predetermined breakoff approaches, the Pin needs to turn the formation to split the wind line in the landing area. Caution needs to be made if the downplane is held too long and not turned to split the wind line, as one jumper can be sent into a dangerous down wind landing situation.

**Note:** At any time, the Pin or Pilot can call for the break to ensure safety.

## SECTION 7: 3/4 WAY CANOPY FORMATION

There are two main planes that canopy formations are built, vertical (stack or plane) or offset (stair step). Beginner 3/4 way vertical formations start with the introduction of larger vertical formations (3 and 4 jumpers) and builds into offset skills.

Prior to participating in intermediate CF activities, the participant should meet the following criteria:

- Have successfully completed both the basic theory and practical courses and can apply all the skills developed.
- Have an advanced understanding of basic safety principles and emergency procedures.
- Have an understanding of CF terminology, including safety, equipment, formations, and grips.
- Know CF communications.
- Have a basic understanding of the differences in flying characteristics of various types and sizes of canopies, and can conduct Pilot/Pin docks

Prerequisites:

In accordance with PIM 1 Advanced Recommendations section 3.20 Canopy Formation (CF):

Participants must hold a CSPA-B CoP and have demonstrated competence with a ram-air canopy. The following safety guidelines should be followed:

- If not already docked, do not attempt to dock lower than 600 m (2,000') AGL
- Minimum break-off altitude for a canopy formation is 300 m (1000') AGL unless the intention is to land the canopy formation.

Participants shall do their first 5 to 10 jumps with a Coach 2, who has reasonable canopy formation experience. Reasonable experience is defined as demonstrating the following:

- 10 completed 4-stacks
- The ability to safely perform a side-by-side and a down-plane

### 7.1 BEGINNER 3/4 WAY VERTICAL FORMATIONS

The next step is to learn to dock on multiple person formations as opposed to just one parachutist. The main differences here are that the descent rate and forward speed of the formation you are docking on will be faster than a single parachutist. Levels 1 through 7 have Pilot and Pin moving towards each other to make a dock, docking 3<sup>rd</sup> requires more flying. As long as the Pilot and Pin is stable and you set up appropriately, docking 3<sup>rd</sup> or 4<sup>th</sup> will actually become easier than building a Pilot/ Pin formation.

## LEVEL 9: 3/4 STACK

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### KEY TRAINING POINTS FOR THIS TASK:

- Timing exit and opening
- Learning slot positions
- Docking without horizontal or vertical momentum
- Piloting
- Breakoff procedures

### DIVE FLOW:

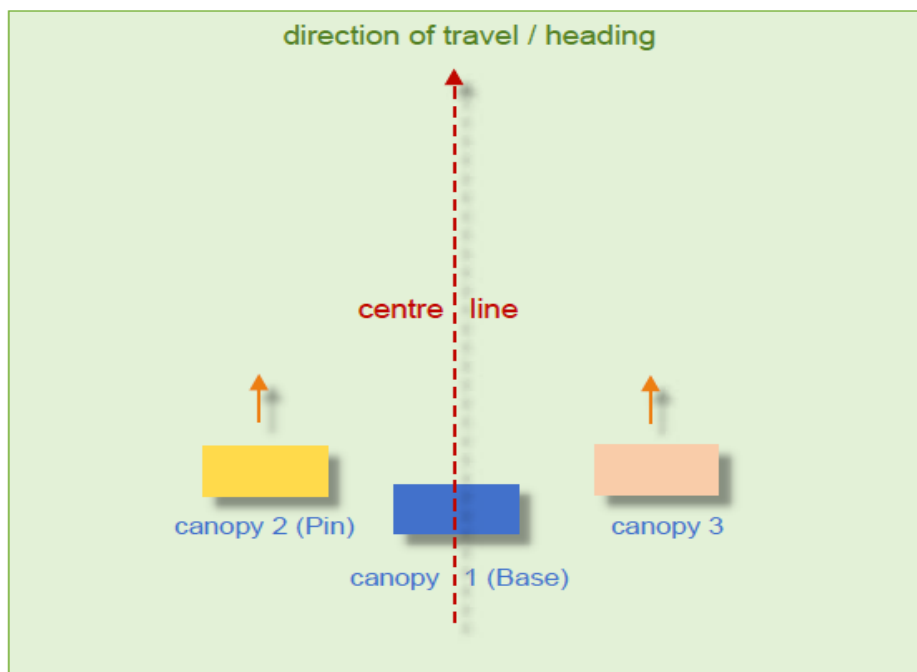
Verbal commands should be concise and direct. The Pilot should fly the formation with limited control movements to minimize oscillations and facilitate docking. The formation Pilot should never use deep brakes in the formation.

Oscillations are a primary concern in canopy formations because they can result in collapsed canopies and entanglements. To reduce their effect and frequency, jumpers must reduce docking angles. If on the bottom, apply the appropriate control to reduce or increase tension. Manipulate a lower jumper's lines to dampen the oscillation. Drop the bottom jumper before the oscillation develops into something worse.

Exits for the Pin and Pilot are the same as mentioned prior in section 5 of this manual. The third and fourth jumpers will give 5-second separation and one second delay on opening.

Three or four stacks are similar during and the build the components can be broken down into several stages:

- Pilot - Pin exit
- 3<sup>rd</sup> exit
- 4<sup>th</sup> exit
- Pilot - Pin docking
- 3<sup>rd</sup> docking
- 4<sup>th</sup> docking



#### Canopy Collapse:

- Improper docks are the most common cause of collapsed canopies.
- Collapsed canopies should be released to allow re-inflation.
- Experienced participants may be able to re-inflate a collapsed canopy by continuing to plane down the lines.
- The jumper with the collapsed canopy can try using brakes or rear risers to back the canopy off and re-inflate it.
- The term “drop me” should be used by a jumper wishing to be released from the formation. This command is to be obeyed immediately, unless it will drop the jumper into a worse situation. The jumper issuing the command should be sure to check behind for other canopies on approach before asking to be dropped.

Build larger vertical formations to give the participant practice at setting up on formations of various sizes and flying characteristics. Move the participants around the various positions of the formation to give them experience at the various skills required for each slot. The participant should be given experience at piloting the formations throughout the training. Participants learn about heading control, control of descent rate and forward speed, dampening oscillation in the formation below, and emergency procedures.

## LEVEL 10: THREE OR FOUR STACK DRAG

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### KEY TRAINING POINTS FOR THIS TASK:

- Timing exit and opening
- Docking without horizontal or vertical momentum
- Piloting
- Formation Transitions

### DIVE FLOW:

This manoeuvre requires cross connectors on the Pin's risers. This provides the pilot foot grips to hold the Pin. The advantages of a three or four stack drag are:

- The 3 stack is a very solid formation that can handle turbulence.
- Communication is easier and the pilot is able to position the downplane accurately
- Fast to build

The pilot positions the three stack directly over the target or slightly downwind of the intended landing point. The #3 can set the nose prior to the transition. The pilot determines the transition point by adjusting for wind direction and strength. The pilot ensures the airspace below the formation is clear before transitioning into a 3 stack drag. The #3 will grab the hips or leg straps of the Pin and pull the Pin down to the #3's thigh. The #3 presents their right leg canted to the left, this will assist the Pin to keep a solid bear hug grip. Once the Pin has a positive grip the Pin calls for the "fan". The #3 will use left toggle separating the canopies as the canopy rotates into an upside-down orientation. The pilot ensures the airspace below the formation is clear before dropping the downplane. The pilot kicks out of the Pin's cross-connectors releasing the Pin and #3 into a down plane. As the predetermined breakoff approaches the Pin needs to turn the formation to split the wind line in the landing area.

Caution needs to be made if the downplane is held too long and not turned to split the wind line as one jumper can be sent into a dangerous down wind landing situation. The pilot/pin removes hands from the toggles and reaches down while squatting to grab as close to the rapid links of the Pin.

## 7.2 INTERMEDIATE 3/4 WAY VERTICAL FORMATIONS

At this level, jumpers will now be learning how to land larger formations. Communication and landing procedures are paramount for safety.

Breakoff and landing procedures:

- Formation pilots should avoid all obstacles, including suspected areas of thermal activity, such as paved surfaces, ploughed fields, buildings, etc.
- The landing of canopy formations should be attempted by only those with a high level of CF proficiency.
- Breakoff for landing should take place no lower than 1,500 feet AGL because of the danger of entanglement at breakoff time.

- Jumpers should not attempt to land formations in high or gusty winds, high-density altitudes, or high field elevations.
- Canopy formation groups landing off the airport should try to land together.

## LEVEL 11: 3 WAY CANADIAN T

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### KEY TRAINING POINTS FOR THIS TASK:

- Timing exit and opening
- Docking without horizontal or vertical momentum
- Piloting
- Safe transition
- Breakoff procedures

### DIVE FLOW:

This formation begins once a 3 stack has been built. Prior to any canopy formation transition the Pilot checks the formation heading. The Pilot removes hands from the toggles and reaches down while squatting to grab as close to the rapid links of the Pin. The Pilot unhooks their feet and continues to pull their body lower, as the Pin guides the Pilot to a scissor grip by grabbing the Pilot's left leg and pulling down until the Pilot reaches the Pin's right hip. Once this is completed, the Pilot will give the word of command "fan" separating the canopies into a side-by-side formation. This is a good time to correct heading if required. The #2 Pin is now responsible for keeping the canopies together. The #3 can provide tension increasing formation stability by using front risers. The feeling of little weight on the Pin's feet holding the #3 can identify this situation.

**Breakdown:** The Pilot will call "standby" then "break" a couple of seconds later, all grips are released.

**Landing breakoff:** If the formation is going to be landed, all turns below 500 feet must be gentle with the #3 applying front riser weight to keep the formation solid by providing tension. The formation sinks more than a single canopy and may undershoot the landing area. The Pilot will call "standby" then "break" a couple of seconds later. All grips are released, the wings move slightly outward never crossing the centre line and #3 will land in the centre.

## LEVEL 12: ROTATIONS

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Rotations can be done in three or four stacks. This is normally decided by equipment or personnel limitations. The major obvious difference is the distance traveled from the top of the formation to the bottom with the extra jumper. The technique for CF rotations varies between individuals. It will depend on wing loading, flying characteristics of the canopy, personal injuries, compatibility, etc. However, the objective in rotations is to have a common team flow to maximize equipment compatibility, and then to achieve as much discipline and consistency as possible.

Each task in a rotation jump has an impact on someone else attempting to perform another task. A person who rotates in record time but dramatically upsets the equilibrium of the formation with a poor dock will gain a few seconds for themselves but lose many more seconds for the team. Stack discipline is the most important factor in improving a team's rotation performance.

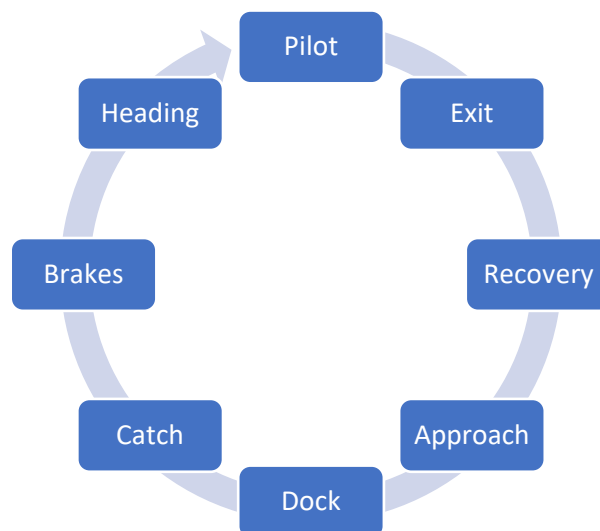
It is much easier for a rotator to move quickly from the top of the formation to the bottom if the formation has very predictable & consistent movements. It is also easier for the catcher to regain control of their canopy and the formation as they head to the Pilot role if the person who docks with minimal momentum and maximum cleanliness. To draw a parallel, excellent stack discipline allows the rotator to have an easy target to dock on.

The easiest way to understand how rotations work, is to break it down into the working parts. The CF rotations 8-point wheel breaks down each rotation into simpler steps and allows people to understand what their responsibilities are throughout a CF rotation jump.

### KEY TRAINING POINTS FOR THIS TASK:

- To understand the eight-point wheel and jumper's responsibility at each point.

#### 8 Point Wheel



**DIVE FLOW:****Pilot**

- Stacked position (feet under bottom skin at A lines).
- Maintain heading.
- Squat on top (bend knees). Sit on the second canopy.
- Load up on brakes (toggle tension) as required to control descent rate and forward speed of the formation.
- Position feet so that they are ready to leave. Ensure all suspension lines are untangled.
- Be ready to exit ("explode") off the top in a controlled manner.
- Keep your ears & eyes open for your key/signal to begin your rotation.

**Exit / Leave**

- Do not lose sight of the formation at any stage.
- Be prepared for variations in descent rate, forward speed, and heading changes.
- Do not affect/distort the canopy below you as it will affect its flying characteristics and make your job harder.
- Give one strong input on the outer toggle. You can use the drag technique here to reduce the distance you travel from the formation. This entails leaving your feet in the canopy below you as you begin to make your first input.
- While this toggle is still down, commence another strong input on the inner toggle. If dragging, you should already have your feet out by now. Otherwise, the reserve packer is going to be busy.
- Release the outer toggle first, followed by the inner toggle. These toggle inputs should be made in fractions of a second.
- When you release the inner toggle, you must initiate front riser input as soon as possible. This is the "explosion" referred to above. This is where you gain seconds per rotation and maintain control of your wing (parachute)
- Minimize pendulum action as you lose a great deal of time while suspended under an unloaded & inefficiently flying canopy.
- Pull your knees up when leaving as this reduces the impact of any pendulum action and it also helps with the force of input on the front riser.

**Recover**

- Accelerate down the side of the formation by maintaining your front riser input. The input is only required for a very short time and its magnitude (time & force) will depend on your position relative to the formation. You should be positioned outside the formation away from the burble/turbulence of the formation you are rotating on.
- Let up on your risers as you approach a predefined point between the top two canopies. It is important not to let up on your front riser for too long as you will pass your docking



position. This is another common area where people lose time as they travel once down past the formation, stop, and then have to travel back up a little.

- Be ready for any variations in the flight characteristics of the formation you are rotating on.
- Be ready to respond to variations in the flight characteristics of your canopy.

### **Approach**

- When you reduce your riser input and progress to your toggles, try to make a smoother transition. A deep front riser input followed by a large toggle input will undermine the flying characteristics of your canopy. This will all depend upon your position relative to the formation.
- As you release your risers, begin to introduce some toggle input. Alter your heading so that it corresponds with the formation you are docking onto.
- Throughout this process, position your canopy such that it never flies behind the formation until you make your final approach. This means moving one canopy out to the side and one canopy length backwards on the exit. Then rising down the side at an angle (heading back towards the centreline) to the formation. Then you should make the final approach by positioning your canopy just underneath that of the person you are docking on.
- Finally, square up and begin matching your flying characteristics to the formation as you get close.
- Verbally signal the catcher by yelling “incoming”.

### **Dock**

- DO NOT dock with momentum.
- If the approach is looking good, call for the next rotation a few feet out.
- Put the centre A lines into the hands of your catcher.
- Match the flying characteristics of your canopy with the formation you are docking onto.
- Dock in the same direction that the formation is flying.
- Ensure your canopy is above the head of the catcher. This is to present better to the judges and to minimize the workload of the catcher (they do not have to move down your lines for a low dock or get their feet into your lines for a high dock).
- Do not do a riser dock as it can sometime be difficult to get your feet into the lines. A line dock is best.
- Apply brakes as required or requested by the catcher.
- Catch.
- Keep a visual on the rotator. Look at the lines you are supposed to be catching as they approach you.
- Present both your arm and leg for the rotator so that they have a bigger target to aim at.

- If the approach & your catch is looking good, call for the next rotation before the rotator hits you.
- Ensure you initiate some limb movement as you call for the next rotation.
- Catch with both your feet and hands if possible.
- Keep your hands down when catching (i.e., try to catch below your hips and not above your head).
- Ensure that your catching is VERY visible to the judges - minimal movement will create uncertainty.
- In competition, DO NOT DROP ANYTHING.
- Move down the lines quickly and in a symmetrical fashion.
- Do not pull the lines out in front of you at any stage. This will alter the flying characteristics of the canopy that has docked onto you.
- Do not put your feet under cross connectors, as you will have to take them out in a few seconds.

If you have to deal with a momentum dock, sometimes it is beneficial to allow the lines to run through your hands as it passes you. If you lock your grip at the first point of contact, the dock may induce too much downward force on the formation which will lead to the second and third person spreading apart. It may also induce a swing if the momentum is sideways.

### **Toggles**

- The person who docked onto you should apply sufficient brakes to assist you in moving down the lines, if required.
- Get onto your toggles as quickly as possible and apply sufficient brakes.
- If you are moving up the lines due to excess wing loading, lock onto the centre A lines. Lock on both centre lines above your head or jam your first under the bottom skin of the canopy above (full arm stretch).
- You can also put your arms under the bottom skin of the canopy above you and force yourself to stay down.

### **Heading**

- As the person above you exits, start your movement upwards. Give the rotator just enough space to get behind the formation before commencing your journey to Pilot.
- Slide up the lines evenly while maintaining heading. One technique is to choose a feature on the horizon before you start moving up the lines. Then keep heading towards that feature. It is difficult to maintain heading while looking straight down.
- This is another area where time is lost. People lose track of heading which makes the job of the rotator difficult. If the dock was bad, it makes the catch difficult. Then you have to deal with lines as you are heading towards Pilot.

- Ensure your toggle pressure is even on both sides and that you are balanced in your harness.
- If the formation is swinging, do not try to correct the swing as you will more than likely make it worse. It takes incredible timing to dampen a swinging tail.
- Toggles in hand.
- Be ready to be formation Pilot.

## **LEVEL 13: 3 WAY TRI BY SIDE**

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### **KEY TRAINING POINTS FOR THIS TASK:**

- Timing exit and opening
- Piloting
- Transition from one formation to another using parabatics
- Breakoff procedures

### **DIVE FLOW:**

Start with building a three stack then transition into the Canadian-T. Pilot checks heading and looks for other jumpers. The Pilot and Pin complete parabolic grips by reaching down and holding the #3's canopy. The #3 provides some toggle to keep the weight light while in transition. Once in the parabolic, grip the Pilot and Pin, hand over hand, move down the #3's A lines till they reach the #3's risers. The #3 places their hands into the leg straps and calls for the "Fan" of the Pilot's and Pin's canopies by using outside toggle or leaning back.

The "Fan" is complete once the #3's canopy is in the middle forming a 180° arc of canopies. Tri-By-Side is complete for left and right manoeuvres by using the commands "my way, your way" by using corresponding toggles. This formation can be finished by Tri-downplane, or can be broken and reformed with the Pin and #3 changing positions.

## **LEVEL 14: STAIR STEP DOCKS**

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The second stage of advanced CF is where we start attempting offset formations. Effort should be made to consolidate and refine all the skills learned in the 2 way and vertical formation progression of CF.

### **KEY TRAINING POINTS FOR THIS TASK:**

- Perform wing docks
- Understand how outside riser prevents of 360° movement of a wing
- How to reduce angle and speed

### **DIVE FLOW:**

Stair steps and wing docks cause more wraps than planes and stacks. Hence, it is important to focus on safety when making offset formations. The main reason for the extra caution is only

one attachment point between the two canopies and it is offset. Hence, if one canopy moves relative to another, it will pivot on this attachment point and tend to spin around it. If both canopies move towards each other at the same time, then the spin and collapse will happen even quicker.

The stair step is when you position the end cell of your canopy onto the leg of another parachutist and then grips your outer A line with their closer leg.

The stair step is the most common docking technique for any offset formation involving 2 or more persons. The important stages of a successful stair step dock are: assess situation, approach, set up position, move into slot (matching flying characteristics of the parachutist you are docking onto), adjust control inputs to stabilize your canopy (it must be in "equilibrium" with the remaining parachutists - usually an outside front riser and inside toggle), continue flying your slot while awaiting other parachutists and/or break off.

The participant should also learn how to monkey crawl an offset formation. This means building a stack and then moving over to the end cell.

### **Wedges**

Similar to a diamond formation but missing the bottom parachutist. This is a good formation to practice wing docking with three jumpers without the risk of falling into the bottom normally seen in the diamond. The Pilot and Pin will build a stair step to the right or left, then the third jumper docks on the open slot. The Pilot takes a leg grip on the third jumpers outside A line closest to the centre of the formation, the third jumper uses outside front riser to prevent the outside of wing outdriving the formation.

### **Vee**

Similar to the Canadian T formation but free flown rather than a transitioned from the three stack. The Pilot and Pin will build a stair step to the right or left, then the third jumper docks on the open slot at the same level as the pilot.

## **LEVEL 15: DIAMOND**

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Diamonds can be built in two ways - free fly or from a four-stack transitioned to a diamond.

### **Freefly Diamond**

It is more difficult to build by requiring more skill to lurk, setup and doc. However, this is the first step to learning 4 way sequential and other formations such as a stair step.

The Pilot and the Pin will build a stair step to the right or left, then the third jumper docks on the open slot. The Pilot takes a leg grip on the third jumpers closest wing A line, then the third jumper uses outside front riser to prevent the outside of wing outdriving the formation. The formation is locked down by the fourth jumper docking in the centre as the second and third take leg grips on the outside A lines of number four's canopy.

**Transition from a Four-stack**

Once the four-stack has been completed, and prior to any canopy formation transition the Pilot checks the formation heading. The Pilot removes hands from the toggles and grabs the nose of the Pin's canopy and unhooks feet. The Pilot lets the formation know they will start to monkey crawl by yelling "going over". Moving from the centre to the left wing, the Pilot takes a grip with the right leg into the left wing "A" line of the #2 Pin. This is a good time to check heading before calling the transition. The Pilot calls "transition", the #2 Pin takes hands out of the toggles and unhooks their feet. The #2 Pin pulls their body lower, the #3 guides the #2 Pin into a scissor grip around the #3's right hip by grabbing the #2 Pin's left leg and pulling down. Once this is completed and the Pin has a firm scissor grip, the Pin gives the word command "fan" separating the canopies into a side-by-side formation. Simultaneously the Pilot hooks their left foot into the #3 right wing. The #4 can apply front riser to ensure the canopies do not float up on the Pilot. The wings assist turning the formation by applying outside riser to the inside of the formations turn.

**Breakdown:** The Pilot will call "standby" then "break" a couple of seconds later, all grips are released.

**Landing breakoff:** If the formation is going to be landed, all turns below 500 feet must be gentle with the #4 applying front riser weight to keep the formation solid by providing tension. The formation sinks more than a single canopy and may undershoot the landing area. The Pilot will call "standby" then "break" a couple of seconds later. All grips are released, the wings move slightly outward never crossing the centre line and the Pilot and #4 land in the centre.

**Note:** Once dropped from the formation #4's canopy tends to have less lift. For safety, care must be given to #4 to have enough altitude to properly land.

## SECTION 8: ADVANCED CANOPY FORMATIONS

Advanced CF is where instruction merges into coaching. It is at this point in canopy formation training that equipment and coaching become very important. At this stage, the parachutist is competent in all fundamental areas of CF and may start to specialize, or use the skills in other areas such as, coaching, competing, or conducting CF demonstrations.

### Prerequisites:

- Have successfully completed all the skills in the basic theory course, basic practical course, intermediate practical course, and be able to apply all the skills developed.
- Understand everything taught in the above courses and be able to explain them.
- Have a complete understanding of basic safety principles and emergency procedures.
- Have a basic understanding of the differences in flying characteristics of various types and sizes of formations.
- Be able to teach basic theoretical and practical CF to beginners.
- Show good set-up & formation discipline and have clean docking skills.
- Have a high success rate building formations or flying slots with people of similar ability and experience and have a good success rate doing the same with beginners.

## LEVEL 16: ADVANCED

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### 2 way Sequential

Teams of 2 skydivers, supported by a team videographer, have 1 minute of working time to complete a pre-determined series of formations. A point is scored for each formation correctly completed in accordance with a draw made at the start of the event. The pool for the draw contains 12 separate formations. For each competition jump, there are 5 different formations and the team has to complete the series as many times as possible during the working time.

In accordance with PIM 4B Competition Rules – Canopy Formation:

**Exit altitude:** shall be 2,150 metres (7,000 ft) AGL with a working time of 60 seconds.

**The Draw:** Each round consists of five (5) formations that have been drawn from the dive pool of 12 formations (2 of each). After each sequence is drawn, the five (5) formations shall be returned to the dive pool so that they may be drawn again.

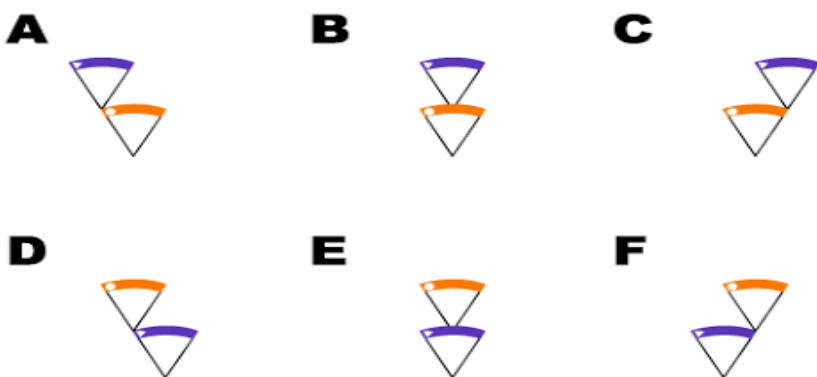
**Scoring:** Teams will be awarded one point for each correctly completed formation, which apart from the first formation, is preceded by total separation within the working time. Teams will not be awarded points for incorrect formations. There will be no penalty.

**Omissions:** For each omission of a formation in a round, the team will not score the point for the omitted formation, and an additional two points per omission will be deducted from that round as a penalty. However, the scoring will not be affected if the team goes back to correctly

complete the omitted formation within working time. Formations built correctly after the omitted formation will be scored in the normal manner.

Each formation must be performed in accordance with the illustrations in the drawn sequence. Jumper position for each random is set by the draw, i.e., the dark canopy position on the first formation built within a round must remain in the dark canopy position on all subsequent formations of that round. There must be release of all grips between each formation. No mirror formations are allowed. All formations shall be performed as shown in the dive pool, as seen from behind.

Draw



#### KEY TRAINING POINTS FOR THIS TASK:

The build can be broken down into several components:

- Pre-exit preparedness
- Pilot - Pin exit
- Docking
- Holding position while transitioning
- Minimizing space between canopies

#### DIVE FLOW:

As competitive teams develop they have their own way of exiting. Here is an example of one method. During the setup of the exit, it is critical the videographer is able to position themselves so they can see the first jumper's feet prior to exit. This is to capture the start time of the jump. The videographer cues the count caller they are in position. The count is given by the second jumper to exit. The first exiting jumper takes a delay keying their opening as the second jumpers chute leaves the container. The second jumper has the advantage and moves into the setup position, then target position. Pilot and Pin terminology is no longer used in 2 way sequential rather top jumper and bottom jumper. Top jumper and bottom jumper are established depending on the advantage of the sequence planed in the dirt dive. Conduct one main sequence of two way sequential listed below.

### **Main Sequences of 2 way Sequential**

Once the first grip is taken, the Bottom jumper visually confirms the camera person is in position and calls “ready”. This is the cue for the Top jumper to begin the sequence. Excess energy in the chutes should be at a minimal. Weight on the top jumper’s feet should be light to prevent separation after dropping the grip.

Wing to Wing (C to D): Top jumper drops foot grip and uses slight left toggle pressure. Once the jumper crosses the centre of the canopy, the jumper changes body position or hip switch and reaches back with inside leg while using slight right toggle pressure.

Bottom jumper uses slight right toggle pressure and matches speed of the top jumper. Once the top jumper crosses the centre of the canopy, the bottom jumper uses slight right toggle and raises left toggle fully, handing the top corner of the canopy up.

Wing to Centre (C to B): Top jumper drops foot grip. Bottom jumper uses slight right toggle pressure.

Centre to Wing (B to A): Top jumper drops foot grip and uses slight left toggle pressure. Once the jumper crosses a quarter of the canopy, the jumper changes body position or hip switch and reaches back with inside leg while using slight right toggle pressure.

Bottom jumper uses slight right toggle pressure and matches speed of the top jumper. Once the top jumper crosses the centre of the canopy, the bottom jumper uses slight right toggle and raises left toggle fully, handing the top corner of the canopy up.

Wing drop-down (A to F): Top jumper drops foot grip and uses left front riser to drop down to lower jumper’s level. Bottom jumper slightly turns to the right and applies brakes. Watches the top jumper match speed and angle and waits to take the grip with right.

Crossover (A to D): Top jumper drops foot grip and uses front risers to drop down to lower jumper’s level and uses the right toggle to move across the lower jumper’s back, then stands the canopy up to make the dock. Bottom jumper slightly turns to the right and applies brakes and watches the top jumper move behind and presents the right leg as a target.

## **LEVEL 17: 4 WAY ROTATIONS**

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Teams of 4 skydivers, supported by a skydiving videographer, are allowed up to 30 seconds to build a 4-stack formation. Once the initial formation (worth 1 point) is built, the top jumper rotates to the bottom of the stack to score another point. As soon as the rotating jumper is linked onto the bottom of the stack, the next skydiver on top may commence a rotation to the bottom, thus scoring an additional point. The team has 1½ minutes to score points. The team with the most points wins.

In accordance with PIM 4B Competition Rules – Canopy Formation:

### **Rules**

Exit altitude shall be 2,500 metres (~8,000 ft) AGL with a working time of 90 seconds.



Scoring teams will be scored from the first point, whether correct or not. Teams will be awarded one point for the first correctly completed formation and every correctly completed 4-way plane/stack formation within the working time, according to the performance requirement. Team members rotating from the top of the plane/stack formation before the bottom team member has taken a grip will not receive credit for that formation. The following formation (the rebuild) shall be scored as zero (0) points, except for the formation following the first formation after the start of working time.

#### KEY TRAINING POINTS FOR THIS TASK:

- Building the 4-stack in under 60 seconds
- Piloting
- Minimize separation between canopies

#### DIVE FLOW

The eight-point wheel is still utilized when conducting competition 4 way Rotations.

### LEVEL 18: 4 WAY SEQUENTIAL

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Teams of 4 skydivers, supported by a skydiving videographer, have 2 minutes from the time of exit to score points. A point is scored for each formation correctly completed in accordance with a draw made at the start of the event. The pool for the draw contains 14 separate sequences of two points and random formations worth 1 point each. For each competition jump, there are either 4 or 5 different formations in the jump sequence, which is repeated during the jump to score as many points as possible.

Some of the set sequence pairs of jumpers stay connected to move from one formation to another. This is called “flying pieces”. For example, if the sequence calls for diamond to diamond this requires the formation to split into two stair-steps and redocked in reverse order. Jumpers normally fly biplanes or stairsteps to build different 4 way formations. Biplanes are easier to fly but have a slower characteristic than a single canopy. Common mistakes are not shutting down sideways motion early enough before docking. To prevent floating, the Pilot can apply breaks while the Pin can apply front risers. Flying stairsteps takes great care while turning toward the Pin or lower canopy. Good communication from top and bottom parachutists on direction is needed. The bottom jumper can use outside riser to prevent their canopy from doing a 360° turn while attached to the pilot.

In accordance with the FAI rules:

#### Rules

Exit altitude: shall be 2,750 metres (9,000 ft) AGL with a working time of 120 seconds.

The draw of the sequences: Each block sequence or random from the Dive Pool will be drawn only once for each competition. All rounds shall consist of four or five scoring formations, whichever number is reached first.

Scoring: Teams will be awarded one point for each correctly completed formation which, apart from the first formation, is preceded by an inter correctly completed within the working time. Teams will not be awarded points for incorrect formations. There will be no penalty.

Omissions: For each omission of a formation in a round, the team will not score the point for the omitted formation, and an additional one point per omission will be deducted from that round as a penalty. However, the scoring will not be affected if the team goes back to correctly complete the omitted formation within working time. Formations built correctly after the omitted formation will be scored in the normal manner. An attempt to complete a formation, although incorrect or incomplete, demonstrated by at least 3 canopies connected with grips and in the formation required by the drawn sequence, will be judged as an incorrect formation, not as an omission.

An attempt to complete a formation, although incorrect or incomplete, demonstrated by at least three canopies connected with grips, OR the two 2 way formations in an inter clearly attempting to build the formation required by the drawn sequence, will be judged as an incorrect formation, not as an omission.

Each formation and inter requirement must be performed in accordance with the drawn sequence. Where there is no inter requirement between formations, there must be release of all grips between all canopies at one point in time. Mirror images are acceptable for complete blocks and random formations. Formations need not be symmetrical. At the end of a sequence, there must be release of all grips before restarting the sequence as drawn.

To start learning how to complete 4 way sequential formations, refer to the randoms and block pools. Print the pools off in the FAI rules and follow the below progression.

#### KEY TRAINING POINTS FOR THIS TASK:

- Understand how to move from one formation to another
- Piloting

#### DIVE FLOW:

Beginners:

A, H, E, G, C, F, K then:

B, L, D, N, I, J, M (basically starting with vertical randoms, snake formations, then double wings)

For intermediate start the block sequences:

10, 11, 1, 3, 4, 8, 6, 5, 13, 14 (basically the blocks where you do not pull pieces except stack 2 stack) then:

2, 9, 7, 12 (diamond 2 diamond and stair step 2 diamond would be last)

## SECTION 9: LARGE FORMATIONS

To increase the likelihood of successfully and safely designing and building large formations, parachutists should use compatible equipment, design aerodynamically stable formations, use skilled & competent parachutists, and build up the skill & experience level of the participants over a number of increasingly larger & more complex jumps. It is recommended that parachutists complete up to level 4 in this coaching manual before moving onto larger formations. This will provide basic CF skills to properly meet the challenges of flying in a larger formation. When parachutists deviate from the recommendations in this section, problems occur.

For formations beyond 9 canopies, the new norm is to have a wing load between 1.3 and 1.35 within the formation to give everybody the same forward speed and lift. Flying larger formations means facing new challenges regarding wing loads. In some key positions, heavier and lighter wing loads can be useful, especially if the diamonds are to be built bigger.

Past experience 100 way in 2007

- The world record 100-way specifications were 1.30 to 1.375. The larger the formation the tighter the specs should be for safety.
- Actual weights from 109 participants (100 way); 12 jumpers weighed in from 1.370 up to 1.4 wing loading. These jumpers were used on the centre line to help punch the formation out and fly faster. 88 jumpers weighed within 1.30-1.370. 9 jumpers weighed 1.28 – 1.295 which included the top 3 and 4 of the lower wings. The other 2 had older canopies and could use the lift inside the formation.
- The participants from the 100 way had an average wing loading of 1.34. The Gransee 2018 event had an average wingload of 1.39.
- The 1.3-1.4 range has been used at “casual CF” events and is supported usually by not going very large. Larger formations such as, the Spring Fling in 2018 built 50- ways and heavy wing loaded jumpers did not participate for safety reasons.
- Concessions on wing loads do cause an unhealthy formation and will lead to multiple wraps. Experience has shown that going over a wing load of 1.4 is not healthy for the very big formations and sometimes even the smaller ones. More than once, experienced wings are taken by surprise and “go around” on high wing loaded formations.
- Flying smaller bigways up to 25 with a heavy group (1.40+) can sometimes fly wonderful and healthy. But when flying bigger formations, the line must be drawn to keep the formations healthy and keep wraps from occurring spontaneously.

The slots in specific sectors of the bigger diamond formation and their wing loads are described below.

| Idealistic wing loads and canopy size in Big-Way CF |             |              |             | 1,28/218 |          |          |          |          |          |          |          |          |
|-----------------------------------------------------|-------------|--------------|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
|                                                     |             |              |             | 1,28/218 | 1,28/218 |          |          |          |          |          |          |          |
|                                                     |             |              | 1,31/193    |          | 1,36/193 |          | 1,31/193 |          |          |          |          |          |
|                                                     |             | 1,32/160     |             | 1,35/176 | 1,35/176 |          | 1,32/160 |          |          |          |          |          |
|                                                     | 1,32/160    |              | 1,35/160    |          | 1,37/176 |          | 1,35/160 |          | 1,32/160 |          |          |          |
|                                                     | 1,31/143    |              | 1,35/160    |          | 1,35/160 |          | 1,35/160 |          | 1,35/160 |          | 1,31/143 |          |
| 1,32/126                                            |             | 1,35/143     |             | 1,35/160 |          | 1,38/160 |          | 1,35/160 |          | 1,35/143 |          | 1,32/126 |
|                                                     | 1,35/113    |              | 1,35/143    |          | 1,35/160 |          | 1,35/160 |          | 1,35/143 |          | 1,35/113 |          |
|                                                     |             |              | 1,35/143    |          | 1,39/143 |          | 1,35/143 |          |          |          |          |          |
|                                                     |             |              |             | 1,35/126 |          | 1,35/126 |          |          |          |          |          |          |
| $x < 1,25$                                          | $< x < 1,3$ | $< x > 1,35$ | $< x > 1,4$ |          | 1,40/143 |          |          |          |          |          |          |          |

## 9.1 AIR RESISTANCE:

A baggy jumpsuit with a rough surface will create more air resistance than a tight suit made of F111 fabric. A tall, large parachutist will have a greater surface area exposed to the relative airflow than a short, slim parachutist. This creates more resistance. You could also consider parasitic drag (types of shoes, headgear, camera gear, line dimensions, frayed canopies etc.). You could consider putting the large person in a tight, smooth jumpsuit and the small person in a baggy jumpsuit. Most jumpers need to dress tight to allow the formation to fly fast and healthy. Only the low wings need to dress baggy.

## 9.2 WEATHER CONDITIONS:

Flying cross wind versus into the wind, versus with the wind will affect the formation in various ways. Turbulence will also affect how sections of the formation will fly relative to other sections. The ideal situation is for zero wind and no turbulence.

How does the wind affect a formation? Let's look at the extreme example of a cross wind flight. The side that is directly exposed to the wind will be hit by a clean and direct relative air flow. As the air flows over these canopies, people and equipment, it gets disturbed and localized pockets of turbulence are created. The canopies that are adjacent to the "clean canopies" may be hit with an altered or disturbed air flow. This would result in different flying characteristics. They will be less efficient. This is compounded as you move further into the formation. The canopies furthest away will probably have a higher descent rate due to their inefficiency. Remember that this is an extremely theoretical example.

What if a large formation is flying above localized sources of thermal activities? If one side of the formation is affected by the thermal and the other remains in clean air, the thermal affected side will tend to suffer rapid changes in pressurization, descent rates, and forward speeds. This will be transmitted to other parts of the formation due to changes in grip tension throughout the formation.

### 9.3 COMPATIBILITY:

Prior to building large formations, it helps to do a practical test of compatibility. Ideally, you would check each person with every other person on the formation. But this is very impractical. So you can test in groups and then cross test with other groups. For example, if you are building a 16 way diamond, you might choose four 4 way formations. Initially, you would choose one member of each 4 way to form a "master group" that "calibrates forward speed and descent rate to one another. They can then go back to their original groups and perform the same calibration. This way, you could have everyone perfectly in sync in only 10 jumps. Members of the master group would perform 4 jumps and the others only 2 jumps. You could also choose to just make theoretical calculations and send the whole group up in one go. Given that you usually make a series of jumps from developing the base to building the final formation, it does not hurt to include these compatibility calibrations after break off on each jump.

### 9.4 PROBLEMS ASSOCIATED WITH INCOMPATIBLE EQUIPMENT:

After having considered all the factors above, it is important to explain why we are aiming for compatibility. What problems does incompatible equipment give us? Firstly, it makes organization extremely difficult. Instead of dealing with an already complex equation involving matched wing loadings and canopies and about 20 variables for the whole formation, you may have to deal with the same complexity level for each member of the formation.

Examples of actual issues that occur: Variability in dimensions (line lengths & aspect ratio). A world-class team competition CF Triathlon has much shorter lines than the traditional freefall version. It also has differences in nose design, bridle retraction system, trim, and tail pocket. The PD lightning has shorter lines than most off the shelf Triathlons but they are usually longer than the competition Triathlons. If you put PD Lightnings, competition CF Triathlons, standard Triathlons and other models in the same line of a large formation, it will look extremely uneven. This means that the grips taken by this row will force the canopies below to be distorted which will affect the way individual canopies and the formation flies. It is better to have the same type of canopy and line lengths on the same row. If you have variable aspect ratios and spans, this will affect how the complete formation flies.

### 9.5 DESCENT RATES:

Triathlons have higher descent rates than the Lightning. If you put Lightnings on one side of the formation and Triathlons on the other, one side will float and the other sink. Again, we have distortion and a greater chance of the formation wrapping around. So, we have to balance the descent rates on either side of the formation. It might be better to stick these in lockup slots on the lower and outer sides. If your base has a relatively high descent rate and you put the floatier canopies at the bottom of the formation, they will struggle to get into their slots. Build the base with larger, floatier canopies, and place the smaller ones at the bottom. They have a better

chance of staying in their setup position and then getting to their slot as the formation builds. But you still have to match wing loadings.

## 9.6 DESIGN, ORGANIZATION, & DIVE PLANNING

Experience has taught us a great deal about how larger formations fly. We also have a great deal to learn about them. We can use what we know to alter the design characteristics of particular sections and positions within a formation. This could include factors such as different sized canopies in certain parts of the formation (larger canopies in the base), front riser trim aids for people on wing slots, and faster canopies in the centre of the formation to ensure they keep up with the wings. Don't forget that as soon as you start introducing variation, the formula becomes extremely complex. This is why we should aim for as much compatibility as possible when designing and building larger formations. The complexity only becomes relevant when the size of the formation becomes very big (say bigger than 9 ways). Otherwise, keep it simple. The key to designing larger formations is aerodynamic symmetry.

The basis or foundation structure is the diamond. This is usually made up of a square number of parachutists. Two squared equals four,  $3^2=9$ ,  $4^2=16$ ,  $5^2=25$ ,  $6^2=36$ ,  $7^2=49$ ,  $8^2=64$ ,  $9^2=81$ , and  $10^2=100$ . If we aim for a number between these, we add parachutists on the tail (plane dock on the bottom lockup), and on the lower wings.

Slots, wing loads and canopy size:

The Pilot and row two canopies need to be light. If these canopies are wing loaded average or higher the formation will sink causing wings to be unstable and necessitate holding more trim. They also need speed. Micro-lined canopies with sliders, split or removable sliders are options to be used. In very large formations, normal freefall collapsible pilot chutes are also recommended as opposed to the normal retractable pilot chutes common to canopy formation canopies. Canopies in this section are the biggest in size, but the lowest in wing load because you want the highest glide ratio canopies on top of the formation.

The power for the diamond needs to come from the middle. Canopies used in this section can have the highest wing load for more forward speed compared to the rest. These slots are for the newer (least jumps) midsize canopies, being loaded at a higher wing load.

The outside wings need to be light to medium wing load and slow as well. Best canopies for these slots are old worn-out with almost no lift. Cotton topped canopies can also be used in these positions.

Immediate lockup jumpers can have a slightly higher wing load to help keep positive tension on the wing make the formation more stable.

In general, it is good to have a bigger canopy and use weights to be able to adjust the wing loading if needed. Some "CRW" dogs are known for taking a firm diet to be able to participate in the next big way attempt.

## 9.7 SETUP, APPROACH, & WAITING FOR YOUR SLOT AVAILABILITY (ECHELONS)

There are many canopies moving towards, setting up on, and docking onto the formation. Each person should have had each part of their jump designed for them. Positions include, exit, setup, formation slot, break off and landing. Stick to your designated position unless your safety is compromised. Keep an eye out for other parachutists and do NOT infringe on their area. This is especially relevant while waiting on the side of the formation for your slot to appear. Many people move too far out to the side when they try to readjust their setup position. This moves people on their outside further out.

One of important skills a large formation CF jumper needs while they are waiting for their slot is to be able to maintain their position relative to the formation despite any changes in its movements. This requires experience and knowledge in all primary control inputs (risers and toggles), and combinations thereof.



BPA canopy formation Coaching Manual

Holding in position:

- Get to the right position in the first place in a timely manner.
- Once in position, use control inputs to stay there. Minimize sideways movements such as sashays as you will infringe on other parachutists' space.
- Use opposite control such as one riser and opposite toggle (cross-control).
- You could try a combination stall (rear riser or toggle) / forward surge arrangement. But you lose a little bit of control over your airfoil when doing this.
- Do micro-rotations. These are rotations involving short durations of front risers followed by braking.
- Use the burble of a person in front of you to stay close.
- A deep front riser input will accelerate you down but may not go forward.



- **Braking stab.** If you find yourself diving too fast on the formation, a short, sharp stab of the brakes will stop the forward speed without the corresponding increase in relative height that a longer and slower toggle input will give you.

Unless you are the bottom point of a diamond style formation, never cross the centre line of a formation, stay on your side. If you are locking off a wing, do not get between your wingman and the formation, follow them in.

Never get behind the cameraperson, and you should never get in their way. They should reciprocate by respecting and not entering your space unless previously organized.

## 9.8 DOCKING

It is imperative that you dock in your allotted slot within a reasonable time frame, especially if you are closing/locking off a wing. Have no more than two attempts at your slot. If you don't succeed, get out of the way and allow someone else to take the slot. This is not the preferred option but it is better than leaving the formation un-built or unsymmetrical. For example, when you are closing off a wing.

### Wing

Time is less critical here but is still important. It is more important that you make a smooth dock. Otherwise you will end up coming around the front of the formation and wipe it out. As soon as you have been caught, apply appropriate trim, keep an eye on your canopy relative to the formation, and get ready to catch your lockup.

### Lockup

The ideal way to lock off is to dock smoothly on both legs and have both grips taken up at the same time. Occasionally, one of the catchers may not be ready or aware or you may be slightly off centre with your dock. Hence, you should consider the following techniques.

### Wing lockup (outside)

The wing only has one contact point prior to being locked off. This can act as a pivot or hinge if large forces are imposed on that wing. It can also be pulled down which will distort the formation. The safer method in this case is to dock first on the parachutist that is next to the wing. That person is in a more stable position. You will then be "passed" or "walked" over to the wing to complete your lock off. Make your dock in reasonable time to reduce the workload of the wing. It can be physically demanding and unstable if a wing is left hanging with one grip for long periods of time. If you are locking off the outer wing, centre row of a large diamond, you must get there in reasonable time and it is even more critical that you make a smooth dock. Do not dock with speed; remove any excess speed before you dock on the wing. Do not do a rotation style dock where you approach from a higher position using front risers. You are better off docking from a lower position using a bit of rear riser or toggle to approach. Avoid the outer wing lockup pushing the wing into the front of the formation or pulling it down. Pulling it down may



make the opposite wing float up and visa versa. This dock is usually made at the top or the side of a formation.

### **Inside lockup**

This is the easier lockup slot as both parachutists that you are docking onto are locked in from above. There are no pivot points either, so your targeting is a little less critical. This dock is usually made in the centre or the bottom of the formation.

The formation should be built symmetrically and smoothly. This means that both halves of the formation should build at approximately the same time. There is a balance between getting to your slot quickly and allowing the other side to build. The danger of one side building too quickly is that it will make the formation unsymmetrical, it may cause variable and excessive grip tension, and it may create too many pivot points. It is especially important to allow the Pilot to build first. For example, if you are involved in a 16 way diamond, it should build something like the following sequence:

- Pilot - Pin.
- 3rd.
- 4-way diamond lockup.
- 8-way wedge outer wings.
- way wedge lockup.
- 9 way diamond lockups.
- 16 way outer wings.
- 16 way outer wing lockup.
- 16 way lower inner wing lockups.
- Bottom lockup.

Note that this formation can be built much faster with very experienced parachutists using a technique called merging. This, however, takes precision and timing and is not beneficial on most large formations as there is usually sufficient time to build sequentially.

Make sure after you have docked that the correct grips have been taken and that no lines, equipment, or people are tangled. You don't want to find this out on a quick starburst breakoff. Don't accept other docks until this is under control. Incorrect grips may destabilize and unbalance a formation as it is unsymmetrical.

If a formation is very unstable, it is usually a good idea not to dock onto it until it stabilises. There are exceptions such as a lockup slot on a wing. If in doubt, don't.

## 9.9 CATCHING

- Minimize the movement in your harness. You should try to maintain a stable body position and allow the docker to fly to you. Don't reach for the docker if you can avoid it.
- Do not catch a parachutist that is flying at a great speed by the formation. It will distort the formation.
- If you are a wing, do not catch your lockup until the other grip has been taken.
- As soon as you dock, be aware of the presence of the person who is docking onto you.
- If you have to pass or walk a person to an adjacent grip, try to do so with your feet. This is more important on the wings and less important on central lockup slots where trimming is not required as often.

### Walking

If a person docks off centre, but you do not want to let them go, you can "walk them" into the correct position. This is a better option than passing as you can maintain grips on your toggles and risers while moving them into position. Just be sure to make minimal and symmetrical movements in your harness. Be very aware of lines tangling with your feet. Walking involves moving your feet one by one across the canopy. If you are in the centre cell and you want to go to the right end cell, you would take your right foot out, move across one A line and grip it. Then move your left foot one line across, then your right, repeated until you get to your destination on the end cell.

### Passing

If you are locked off on both your end cells, you are less likely to need to be on your controls all the time. Hence, you could use the passing technique to assist a lock off completion. When a person docks onto you, use both your hands to hold the top surface leading edge. You release your grip on the side where you want to pass the canopy and take another grip behind your back and then move the canopy towards the other grip. Repeat this process until the canopy is locked off on both end cells.

Ensure that you have the correct grip and that there are no entanglements of lines, equipment, and bodies.

## 9.10 FLYING IN FORMATION

The centre of the formation should fly faster than the sides. If the sides fly faster, they eventually have nowhere else to go but to pivot back in towards the centre.

### Pilot

Heading control is very important, as is applying the correct amount of brake in order to control forward speed and descent rate. Any small movements from the Pilot are amplified down the formation. Hence, it is imperative to maintain balance and stability in the harness, and to

dampen all of your control inputs. No sudden movements. All adjustments should be controlled and smooth.

### **Wing**

When you first fly this slot, it can be very unnerving trying to maintain your composure with the slightest movement of your outer wing towards the centre of the formation. Some people counteract this fear with TMT - Too Much Trim. This places excessive load on the outer wing, which translates to distortions throughout the formation. Your canopy will be distorted if you use excessive trim. Because if flies inefficiently in this configuration, it will load the formation. Minimize the amount of trim that you use on wings. Apply some inner brake initially and then some outer front riser if required. If you need more loading, ask your lockup to give some front riser input or other techniques to load up and slow down your wing. You can also increase your lockups wing loading by reducing their inflated canopy area. Do this by compressing or blocking off one of their cells.

The more trim you apply, the more your counterpart on the other side will have to apply. There will come a point where you may be better off leaving the formation. Back to the drawing board if you want another attempt at the jump.

### **Monitoring**

While flying the wing slot, you can monitor the symmetry of the formation by looking at the opposite wing and each of the canopies in between. Ideally, you should all be level. If you can see the outer end cell leading edge of the other wing and the canopy seems to be in front of you and at a higher level than the remainder of the formation, it means it is trying to overtake. This may be due to its own performance or other factors. Check how much trim you are applying. If you are applying excessive trim, you may be anchoring and increasing the affective loading of your side of the formation. You are creating a situation like a bulldozer. One side slows and the other keeps going. In the end, the only place it can end up is back in on itself. Relax your trim. If you can see the top skin of the other wing, it is too low on you and may be the one applying too much trim, add a little to counteract, but not too much. There may also be a number of other inefficiencies in the formation that could lead to these observations. They can include bad docks, affects of turbulence and various other oscillations within the formation.

### **Centre lockup**

People in the centre of the formation should maximize their forward speed. Additional forward speed can be improved by loosening the chest strap and arching forward if possible. Monitor the formation around you at all times. If the wings start moving ahead of the centre of the formation, arch harder.

### **Wing lockup**

Keep a constant eye on your wing. If you feel lift being generated on your side of the formation, you should load the wing up by giving some front riser input. You may see this visually when your canopy rises up past the knees of your wing person, or you may feel it. You can also check your level relative to canopies on the same row as yourself.

## 9.11 BREAK OFF

### **Planned**

This is the preferred option as traffic management is easier and risk is much lower.

### **Unplanned**

Sometimes canopy formation does funnel and at some stage prior to landing. The members of a formation will have to break off.

## 9.12 LARGE FORMATION EMERGENCIES

Refer to the Emergency Section for detailed information about how to deal with particular emergencies. In particular, read about wraps and entanglements. Most of the information relevant to general CF emergencies is relevant to larger formations. The main difference is that there is potential for a higher number of people to be involved in the emergency, which may increase the complexity.

Maintain awareness throughout the jump and ensure you communicate. Communication in a large formation for most people is about LISTENING, not talking, unless required by safety. Discipline is very important, especially when things do not go to plan.

If you are the Pilot and there is a wrap below you, DO NOT LET IT GO unless you are endangered yourself. You must clarify the distinction between endangered and scared. You are not necessarily endangered if you are scared. Dropping a wrap significantly increases the risk to people below you. Attempt to maintain stable, on heading flight for as long as possible.

If there is a cutaway, it's important that a minimum number of people chase the equipment (reserve freebag and main canopy). Maintain traffic awareness around you. Do not catch the main canopy at any time. Only catch the freebag if you are experienced and you know what you are doing. However, it is best to just follow it. Ensure that someone follows the reserve too. You never know what state the parachutist may be in after a scary emergency.

There is a chance that you will land off dropzone in an emergency. While everyone should endeavour to fly back to the designated landing area, if possible, it is also extremely important for people to land in groups and not alone. There is always the chance that someone may be or get injured and need immediate assistance. This is true in all off dropzone landings involving any discipline.

## SECTION 10: DEMONSTRATION CANOPY

A canopy formation Coach 3 must instruct demonstration canopy formation training. The materials contained in this section are for reference and do not replace formal CF demonstration training.

For further information, refer to PIM 1 and PIM 2C.