Ram-Air Parachute Training Guide

2018

A Comprehensive Guide to the USFS Smokejumper Ram-Air Parachute System

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RAM-AIR PARACHUTE TRAINING GUIDE

February

2018

The intent of this guide is to standardize the training of USFS students on the ram-air parachute system.

UNITED STATES FOREST SERVICE SMOKEJUMPER PROGRAM

Suggestions for all modifications of the USFS Ram-Air Parachute Training Guide (RATG) are submitted to the USFS Ram-Air Parachute System Training Specialist. All procedure and terminology changes will be approved and catalogued through the Ram-Air Change Management Action Team (RACMAT) and appropriate committees. All proposed changes and revisions must be submitted by January 1st so that they can be forwarded to receive the appropriate approvals and be finalized by February 1st on an annual basis.

The USFS Ram-Air Parachute Training Guide (RATG) is Appendix 11.3 to the Forest Service Section of the Interagency Smokejumper Operations Guide (ISMOG).

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REVIEW SIGNATURES

This 2018 update of the Ram-Air Parachute Training Guide (RATG) for the USFS Smokejumper Program was reviewed by the following:

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Revision and Amendment Log

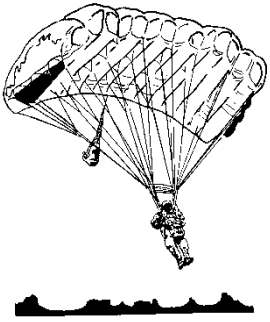
The following chart summarizes revisions and amendments made to the Ram-Air Parachute Training Guide for 2018. Editorial changes such as formatting and grammatical changes that do not affect meaning are not included in this list. Mid-season changes are meant to be written into each RATG in the field and adhered to for the remaining duration of the season once official approval is obtained.

1. Tracking number.
2. Section number where the revision or amendment was made.
3. Brief description of the revision or amendment

Tracking No.	Section No.	Brief Description
1.0	Chapter 2 Lesson 2-2 Page 36	Add in a step before step 1. 1. You are jumping a _____. (jumper gives positive response)
2.0	Chapter 1 Lesson 1-6 Page 19 and Chapter 3 Lesson 3-1 Page 50	Spotter no longer uses command to "Activate your AAD". Spotter will give information that the aircraft has made it to jump altitude and this is the jumper's que to Activate their AAD.

INTRODUCTION

This comprehensive Ram-Air Parachute Training Guide is designed to present in-depth information about training procedures used by the United States Forest Service (USFS) Smokejumper Program. It is a **guide** for trainers who will be teaching USFS Smokejumpers the proper use of the ram-air parachute system. It is also a reference for course work, terminology, equipment, procedures, and historical background as it relates to the Smokejumper Ram-Air Parachute Training Program.



Course Layout

The guide is divided into chapters focused on specific elements. Each chapter is further divided into lessons. Each lesson includes objectives to be completed in the normal sequence of training. A separate Instructor Supplement provides additional information and resources for instructors.

Course Objectives

Upon completion of this training program, student(s) must demonstrate competency in the application of learned knowledge outlined in each of the chapter's objectives. Student(s) must perform satisfactorily in all areas of Ram-Air Smokejumper Training.

Chapter and Lesson Objectives

Objectives appear at the beginning of each chapter and lesson. These objectives define what student(s) will be required to do at the completion of the chapter or lesson.

Acronyms

Acronyms used in the Ram-Air Parachute Training Guide include the following:

Table 1: List of Acronyms

Acronym	Meaning
AAD	Automatic Activation Device
AGL	Above Ground Level
DIT	Drogue-in-Tow
DZ	Drop Zone
FPS	Feet Per Second
IC	Incident Commander
ISMOG	Interagency Smokejumper Operations Guide
JIC	Jumper-in-Charge
MPH	Miles Per Hour
PG	Personal Gear
RACMAT	Ram-Air Change Management Action Team
RATG	Ram-Air Parachute Training Guide
RSL	Reserve Static Line
SMJ	Smokejumper
USFS	United States Forest Service

CHAPTER 1 JUMP EQUIPMENT

RAM-AIR PARACHUTE TRAINING GUIDE

USFS SMOKEJUMPER PROGRAM

CHAPTER 1 – Jump Equipment

Student(s) will be issued ram-air jump gear and become familiar with the parachute and harness components. The equipment will be fitted, and the use of each component will be described. The parachute deployment sequence will be shown, and proper use and care of the components will be demonstrated.

Chapter 1 Objectives

At the completion of Chapter 1, student(s) must be able to accurately:

- ☐ Identify the main components of the current smokejumper main ram-air parachute.
- ☐ Identify the main components of the current smokejumper ram-air harness.
- ☐ Identify the main components of the current smokejumper drogue parachute.
- ☐ Identify the main components of the current smokejumper ram-air reserve parachute.
- ☐ Identify the main components and function of the SMJ CYPRES AAD.
- ☐ Explain the deployment sequence of the current smokejumper ram-air parachute system.
- ☐ Demonstrate both physically and verbally the proper procedures for attaching a main ram-air parachute to a ram-air harness.
- ☐ Demonstrate the proper procedures for stowing the reserve parachute when not in use and the harness when not attached to a main parachute.
- ☐ Identify at least three routine wear and tear items to jumper gear that can be expected in the field.

Lesson 1-1 – Issue of Jump and Fire Line Gear

Students will be issued and introduced to a complete set of serviceable jump and fire line gear.

Lesson Objectives

At the completion of this lesson, student(s) will:

- ☐ Possess a complete set of serviceable jump and fire line gear.

Lesson 1-2 – Main Parachute Nomenclature

This lesson introduces student(s) to the smokejumper ram-air main parachute.

Lesson Objectives

At the completion of this lesson, student(s) will be able to accurately:

- ☐ Verbally identify the components of the current smokejumper ram-air main parachute.

Introduction

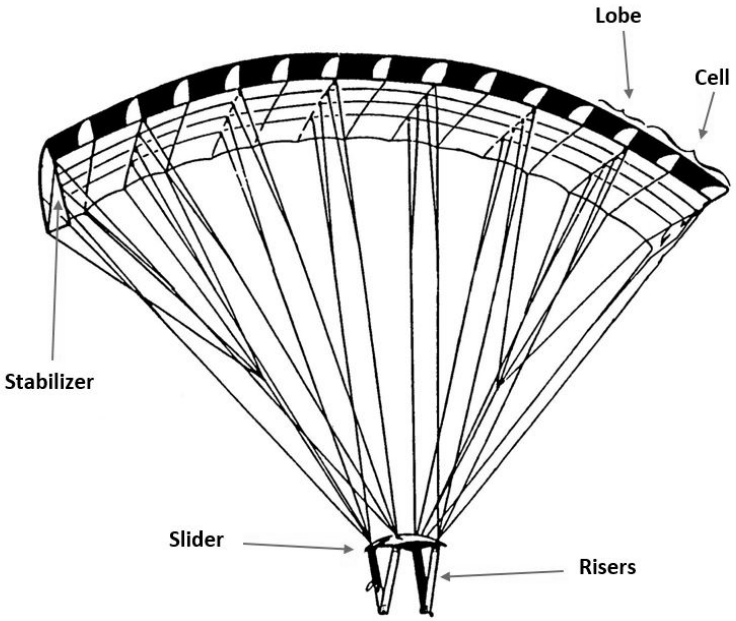
The primary ram-air main canopies utilized by the USFS are Paraflite's DC-7 and Performance Design's CR-360. These seven-cell ram-air canopies are 375 sq. ft. and 360 sq. ft. respectively and are span and chord-wise constructed. They feature a max airspeed of about 20 to 25 mph.

Parachute Parts

Key components of the parachute include the following:

- ☐ Three rings.
- ☐ Risers.
- ☐ Soft loop.
- ☐ French links.
- ☐ Crosstie.
- ☐ Steering toggles.
- ☐ Control lines.
- ☐ Slider.
- ☐ A lines.
- ☐ B lines.
- ☐ C lines.
- ☐ D lines.
- ☐ Cascade lines.
- ☐ Sundt or cat's eye.
- ☐ Leading edge (nose).
- ☐ Trailing edge (tail).
- ☐ Stabilizer.
- ☐ Lower surface (bottom skin).
- ☐ Upper surface (top skin).
- ☐ Ribs.
- ☐ Crossports.
- ☐ Cell.
- ☐ Lobe.
- ☐ Kill line ring.
- ☐ Packing tabs.

Figure 1: Ram-Air Canopy



STABILIZER – Canopy material extending below the bottom skin on each side of the canopy designed to provide stability while flying in a deep brake setting.

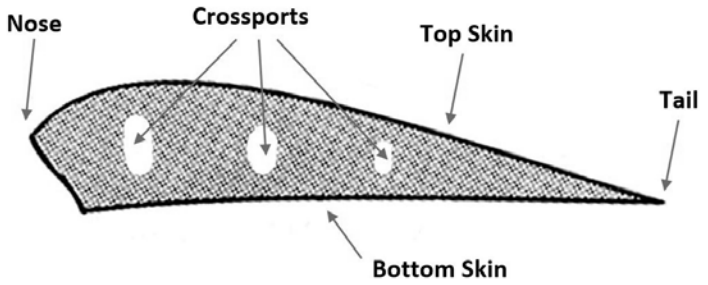
SLIDER – A reefing device used to slow the opening of the canopy to prevent excessive opening shock.

RISERS – Webbing assemblies used primarily to transfer the load of the suspension lines to the parachute harness incorporating a 3-ring attachment/release mechanism and Velcro to stow the steering control toggles.

CELL – A chamber formed between the fabric of two load bearing ribs and the top and bottom skin of the ram-air canopy. Each cell is divided by one or more non-load bearing ribs forming lobes.

LOBE – One half of a ram-air cell.

Figure 2: Ram-Air Rib Profile



NOSE – The open leading edge or front of the ram-air canopy.

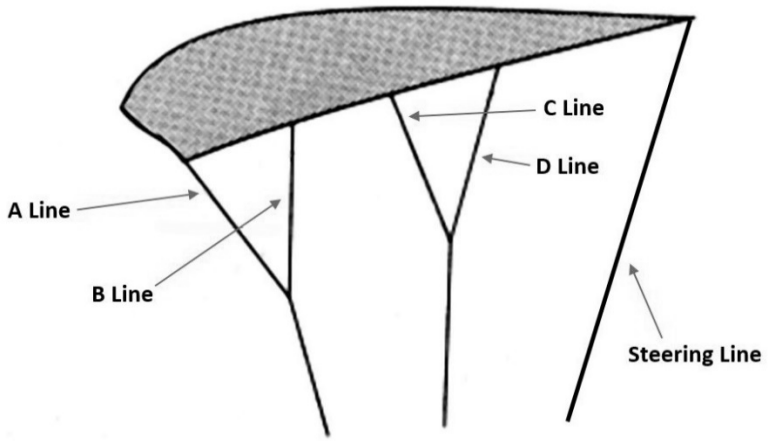
CROSSPORT – Small holes cut in the rib sections to balance the air pressure within the cells across the full span of the canopy and aids in inflation.

TAIL – Also known as the trailing edge refers to the rear of the ram-air canopy where the cascaded control lines are attached.

TOP SKIN – The top surface of the ram-air canopy.

BOTTOM SKIN – The lower surface of the ram-air canopy.

Figure 3: Ram-Air Lines



A, B, C, D LINES – (Suspension lines) The lines attaching the canopy to the connector links, transfers the load from the bottom skin of the parachute to the risers.

STEERING LINE – (Control lines, Brake lines) Attached to the trailing edge of the canopy in distinct left and right groups, the control lines are cascaded in the upper section joined to a single line attached to a steering toggle in the lower section. The lines used to steer and modulate the forward speed of the parachute.

Lesson 1-3 – Harness Nomenclature

This lesson introduces student(s) to the current smokejumper ram-air harness.

Lesson Objectives

At the completion of this lesson, student(s) will be able to accurately:

- ☐ Verbally identify the components of the current smokejumper ram-air harness.

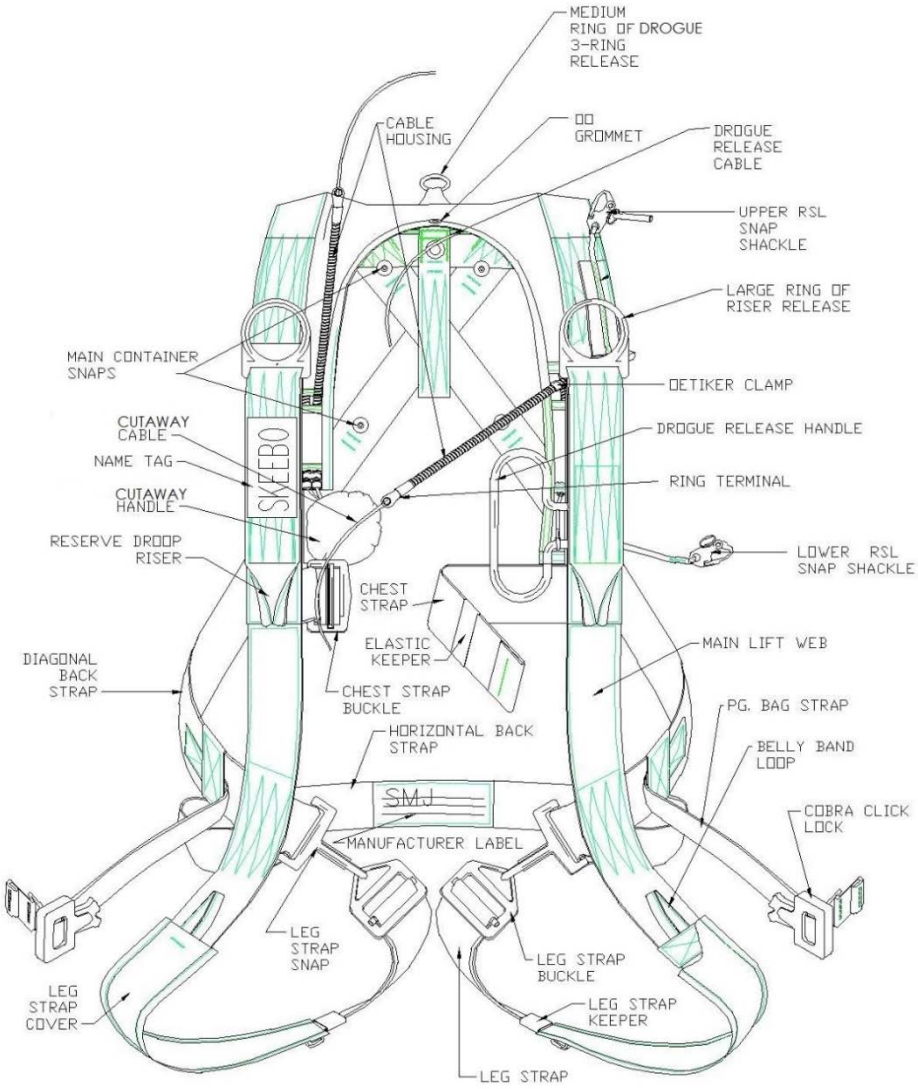
Harness Parts

The ram-air harness is fitted especially for the components of the smokejumper system.

Components include the following:

- ☐ Leg strap snap
- ☐ Leg strap buckle
- ☐ Leg strap
- ☐ Leg strap keeper
- ☐ Leg strap cover
- ☐ Belly band loop
- ☐ PG bag strap
- ☐ Cobra click lock
- ☐ Horizontal back strap
- ☐ Harness log
- ☐ Diagonal back strap
- ☐ Main lift web
- ☐ Chest strap
- ☐ Chest strap buckle
- ☐ Reserve droop riser
- ☐ Drogue release handle
- ☐ Housing cover
- ☐ Name tag
- ☐ Drogue release cable
- ☐ Cutaway handle
- ☐ Cutaway cable
- ☐ Snap shackle
- ☐ Reserve static line (RSL)
- ☐ Large ring of riser 3-ring release
- ☐ Cable housing
- ☐ Ring terminal
- ☐ Rubber band and grommet
- ☐ Yoke
- ☐ Medium ring of drogue 3-ring release
- ☐ Small ring of drogue 3-ring release
- ☐ Main container snap
- ☐ Soft loop of drogue 3-ring release (Not in diagram below)
- ☐ Oetiker cable clamp

Figure 4: Ram-Air Harness, Model 8801 Ver C



Lesson 1-4 – Drogue Parachute Nomenclature

This lesson introduces student(s) to the current smokejumper drogue parachute.

Lesson Objectives

At the completion of this lesson, student(s) will be able to accurately:

- ☐ Verbally identify the components of the current smokejumper drogue parachute.

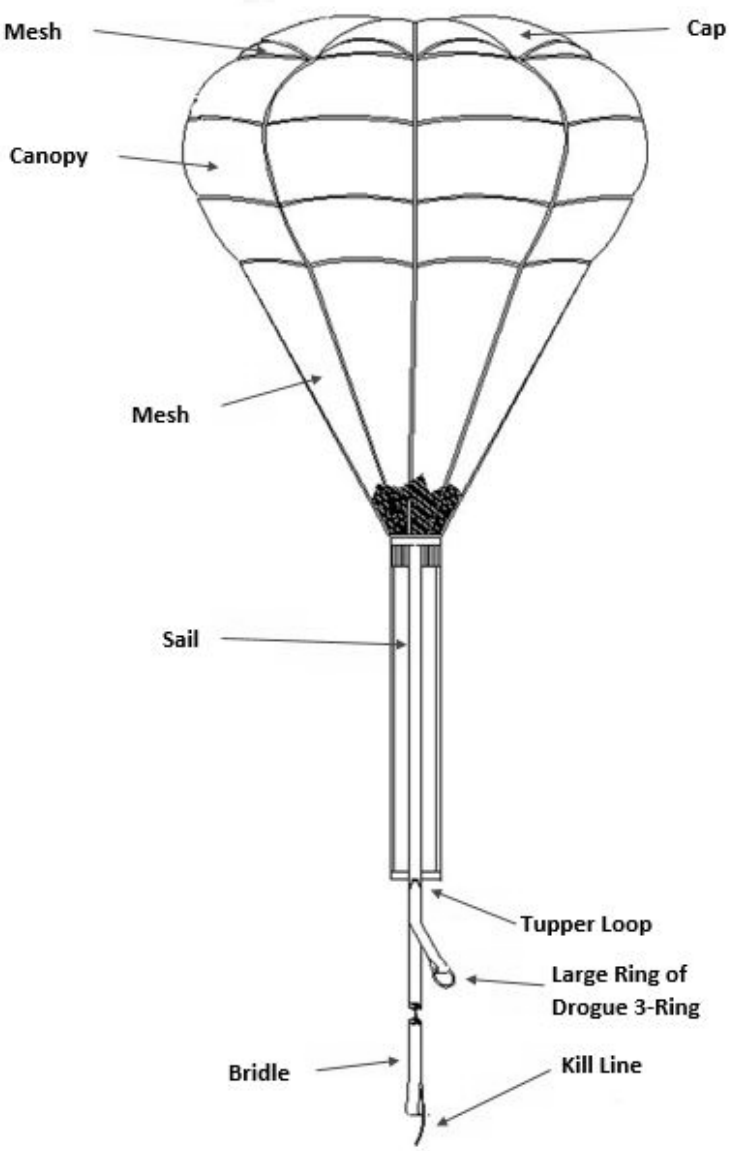
Function

The drogue parachute has two primary functions. First, the drogue serves to stabilize the jumper after exit while providing for good body position prior to deployment of the main parachute. Second, the drogue serves as a pilot chute for the main canopy after the jumper manually releases it from the harness.

Background

Soviet Union smokejumpers used a drogue deployment system for their round canopies during the 1970s. This concept was adopted by Jim Veitch and Ron Lund in 1979 for deploying ram-air canopies. Various versions were experimented with throughout the 1980s with the basic design coming into use in 1986. Zero porosity (ZP) fabric was used on the cap and/or main body from 1998 to 2000. Investigative work following the Liston fatality indicated that ZP drogues exhibited greater oscillations than drogues constructed with F-111 material. The increased oscillations were identified as an undesirable characteristic and may have been a contributing factor to the accident. ZP drogues were removed from service.

Figure 5: Drogue Parachute Parts



Lesson 1-5 – Reserve Parachute Nomenclature

This lesson introduces student(s) to the current ram-air smokejumper reserve parachute.

Lesson Objectives

At the completion of this lesson, student(s) will be able to accurately:

- ☐ Verbally identify the components of the current smokejumper ram-air reserve parachute.

Background

MT-1S: 270 sq. ft., 5-cell, ram-air canopy, max airspeed about 25 mph. This model was originally used as a main parachute during the early development of the ram-air system, circa 1981-1984. Flight characteristics are similar to the DC-7 and CR-360, but the smaller size results in increased forward speeds and a faster descent rate. Designed and manufactured by Paraflite, Inc., prior to April 2007. Purchased and currently manufactured by Airborne Systems.

The attachment of the reserve to the ram-air harness using "droop risers" allows the parachute to ride in a similar position as the main when deployed.

Figure 6: Droop Risers

Lesson 1-6 – SMJ CYPRES AAD Nomenclature and Function

This lesson introduces student(s) to the current smokejumper Automatic Activation Device (AAD).

Lesson Objectives

At the completion of this lesson, student(s) will be able to accurately:

- ☐ Identify the main components and function of the SMJ CYPRES AAD.

Smokejumper CYPRES AAD Overview

The Smokejumper CYPRES 2 is an Automatic Activation Device (AAD) mounted on the reserve. The CYPRES determines vertical speed and altitude by measuring barometric pressure and will activate the reserve if vertical speed and altitude criteria are met. All intentional jumping on the USFS ram-air system requires the use of an active (AAD).

Hardware

The Smokejumper CYPRES 2 consists of a control unit, processing unit, and release unit.

Figure 7: Smokejumper CYPRES 2 Control Unit

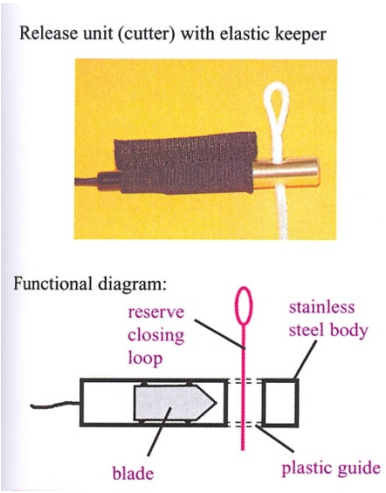
Figure 8: Smokejumper CYPRES 2 Processing Unit

Figure 9: Smokejumper CYPRES 2 Release Unit (Cutter)

Activation Mechanism

The CYPRES activates the reserves by severing the reserve closing loops. The reserve closing loops are threaded through holes in the release units and are severed by a blade that is fired via a propellant should the processing unit give the signal to activate. It is important to note that the CYPRES is secondary to the reserve's primary means of activation: manual deployment via pulling the reserve handle.

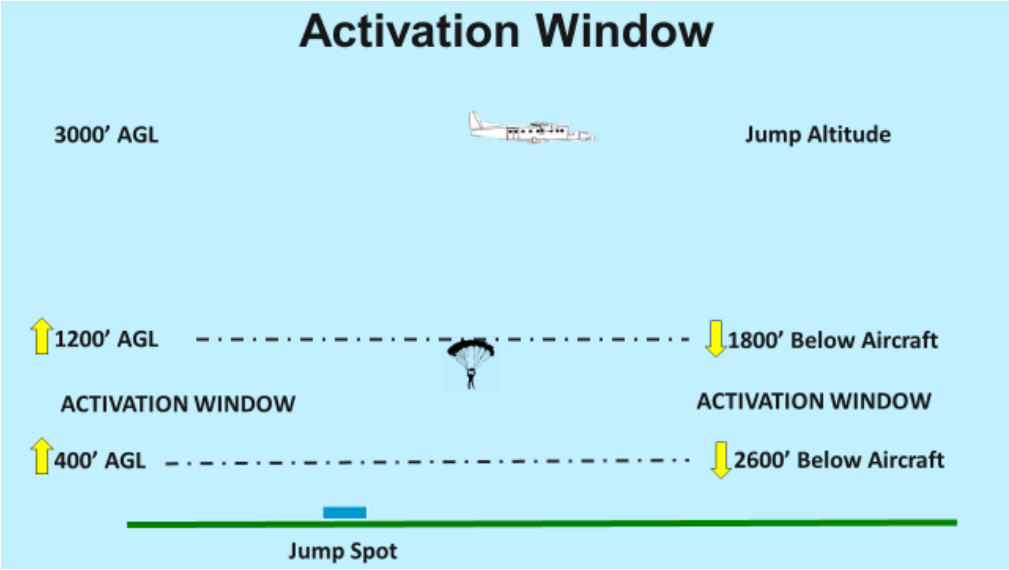
Figure 10: CYPRES AAD Activation Mechanism



Activation Criteria

The CYPRES will automatically activate the reserve if the jumper has a vertical speed exceeding 78 mph within the activation window. The activation window is determined by the altitude at which the unit is turned on. The activation window is 1800 feet below the altitude at which the unit is turned on and extends to 2600 feet below the altitude at which the unit was turned on. For a normal operational jump with an exit at 3000 feet above ground level (AGL) this would result in an activation window of 1200 feet AGL to 400 feet AGL.

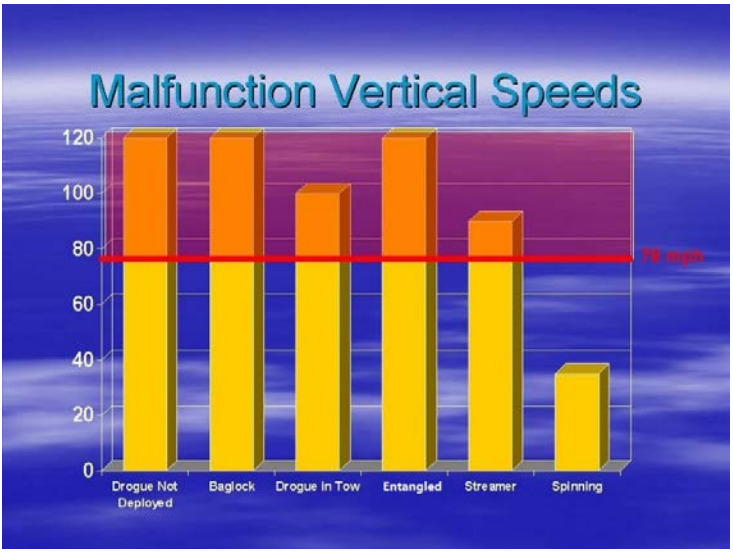
Figure 11: CYPRES AAD Activation Window



Malfunction Vertical Speeds

Some but not all malfunctions result in high enough vertical speeds to meet the CYPRES criteria. Vertical speeds in excess of 78 mph are expected in all malfunction types where the main canopy fails to partially or fully deploy. Examples include drogue-in-tow, drogue not deployed, bag-lock, and horseshoe types. Malfunctions with a partially deployed main canopy such as a streamer may or may not result in enough vertical speed to meet activation criteria. Malfunctions with a fully deployed but uncontrollable canopy such as a spinning type will almost certainly not result in a high enough vertical speed to activate the CYPRES.

Figure 12: Malfunction Vertical Speeds



Functioning Test of Unit (Self-Test)

The functioning test (self-test) serves to verify that the CYPRES is in proper working order. It should be performed each day that the potential exists for the unit to be used on a jump.

The procedure for performing a self-test is to push the orange button on the control head four times with short clicks. The red LED light will illuminate after the first push. Subsequent pushes must immediately follow illumination of the light. After a total of four clicks, the CYPRES will go into a self-test mode. If the buttons are pushed too fast or too slow, the CYPRES will ignore the switch-on attempt.

The control head display will show the number "10" at the beginning of the self-test and countdown to "1." A pause will occur and the display will show the actual air pressure in hPa (millibars), then show "0" and shut off.

Figure 13: Smokejumper CYPRES 2 Functioning Test

The self-test should only be done on the ground or while the aircraft is flying straight and level.

A successful self-test will be indicated by the "0" at the end of the countdown and the display will then go blank.

Turning Unit On and Off

The spotter issues the activation command at jump altitude, before the command to get in the door: **"We are at 3000 feet; activate your AAD."** All jumpers designated to jump on the load will activate their CYPRES on the initial command. It is critical that the CYPRES is not activated prior to the spotter command. The CYPRES computes the activation window based on the altitude at time of arming and an incorrect arming altitude could result in the jumper exiting within the activation window.

The arming switch on the side of the reserve is used to turn the CYPRES on and off. The unit is turned on by pulling the arming tab up while guarding the front of the reserve. Red tape on the switch signifies the switch is in the armed position. **The control head will display a "0" verifying that the unit is on and ready for jump operations.**

The unit is turned off by pulling the arming tab down. The control head will turn blank verifying that the unit is off.

Figure 14: CYPRES AAD "On" or "Armed"

Error Codes

An error code will be displayed on the control head if the unit detects a problem during the functioning test (self-test).

Table 2: CYPRES AAD Error Codes

Error Code	Meaning
"1111" or "2222"	Indicates that one or both attached release units are not correctly connected. This could be due to a cable break, a disconnected cutter plug, or when the cutters have been activated.
"3333"	Indicates that excessive variations in ambient air pressure have been measured during the functioning test period. This could occur if the functioning test was performed in a flying aircraft. It is most likely to occur during a self-test in the plane while climbing or descending. If this error occurs, make sure the aircraft is straight and level and repeat the self-test.
"Month/Year"	If the unit enters six months before maintenance due date, the maintenance date (next maint. in month / year) will automatically be shown at each self-test. Six months after the due date, the display will change to: 'next maint. now."

- If the error message occurs during a functioning test performed on the ground, the reserve will be switched-out with a properly functioning reserve. The malfunctioning CYPRES reserve will be returned to one of the ram-air lofts immediately.
- If an error message occurs in the aircraft, the reserve will be switched-out with the spare reserve. The spotter will be notified immediately and the reserve will be returned to a ram-air loft as soon as possible.

Watch-Outs

- Misfire potential is extremely low, but reserves should always be securely guarded in aircraft when jump door or rear ramp is open.
- Units are not waterproof. Exercise diligent care to prevent wet reserves.
- Do NOT jump with a CYPRES that fails to turn on. No risk of a misfire exists with a unit that fails to turn on, but the loft needs to get it back in a timely fashion to determine cause of problem.

Lesson 1-7 – Deployment Sequence

This lesson introduces student(s) to the deployment sequence of the current ram-air smokejumper parachute system.

Lesson Objectives

At the completion of this lesson, student(s) will be able to accurately:

- ☐ Verbally explain the main and reserve deployment sequences for the current ram-air smokejumper parachute system.

Main Deployment Sequence

The ram-air main follows this sequence when opening:

1. Static line opens drogue.
2. Drogue stabilizes the jumper. (See Figure 15.)
3. Released drogue pulls main deployment bag off jumper's back.
4. Lines deploy (locking stows keep canopy from opening before line stretch). (See Figure 16.)
5. Main deployment bag is pulled off canopy.
6. Canopy begins to inflate. (See Figure 17.)
7. Slider descends lines.
8. Canopy fully inflates. (See Figure 18.)

Figure 15: Main Deployment Sequence 1

Figure 16: Main Deployment Sequence 2

Figure 17: Main Deployment Sequence 3

Figure 18: Main Deployment Sequence 4

Ram-Air Reserve Deployment Sequence

1. Reserve static line (RSL) or jumper pulls reserve handle.
2. Pilot chute deploys.
3. Pilot chute pulls bridle from container.
4. Deployment bag (free bag) is released from container after full bridle extension.
5. Lines deploy (Locking stows keep canopy from opening before line stretch).
6. Deployment bag is pulled off canopy.
7. Canopy begins to inflate.
8. Droop risers break tacking placing risers in upper configuration.
9. Slider descends line.
10. Canopy fully inflates.

Lesson 1-8 – Gear Care

This lesson introduces student(s) to the proper maintenance of and care given to ram-air smokejumper equipment.

Lesson Objectives

At the completion of this lesson, student(s) will be able to accurately:

- ☐ Demonstrate both physically and/or verbally the proper procedures for stowing harness when not attached to a main parachute.
- ☐ Identify verbally at least three routine "wear and tear" items to be expected in the field.
- ☐ Demonstrate verbally or physically how to properly stow reserve parachute when not in use.

EACH PERSON IS REPONSIBLE FOR THEIR OWN GEAR!

Lesson 1-9 – Parachute Hook-Up

This lesson introduces student(s) to the proper procedures for attaching a main parachute to a ram-air harness.

Lesson Objectives

At the completion of this lesson, student(s) will be able to accurately:

- ☐ Demonstrate both physically and verbally the proper procedures for attaching a main parachute to a ram-air harness.

Three-Ring Release System

Introduction

The 3-ring release system was invented by the Relative Workshop in 1976. It was the first practical release that allowed parachutists to jettison their mains by pulling a single handle.

Not only is the 3-ring easier to operate than previous canopy release systems, it is also more reliable. Failures of a properly built and assembled 3-ring system are virtually unknown.

Once the main is jettisoned, the only things left on the harness are two smooth rings that cannot snag a deploying reserve. Some other popular release systems can interfere with reserve deployment.

Modifying the 3-Ring Release

The great reliability of the 3-ring system results from the proper functioning of each of its individual components. Therefore, the user should not modify the system in any way or replace genuine 3-ring parts with others.

These modifications (among others) will cause the system not to work properly:

- Not using a cutaway handle that has special yellow-coated cable. This Teflon-impregnated coating is important; other plastic coatings may cause the cables to bind in the housings or loops, making it difficult or impossible to jettison the risers.
- Using a cutaway handle with cables of the wrong length. The length of the cables ensures that the risers release in the proper order.

Getting to Know the 3-Ring System

Knowing how the 3-ring release works will help you assemble and inspect it properly.

Begin by peeling the cutaway handle from the Velcro on the harness. Look behind the risers near the harness and observe the movement of the yellow cable as you pull the handle. When the cable clears the white loop, the release is initiated.

Now slowly pull one of the risers off the harness. As you pull, you'll notice that the white loop gets pulled through the grommet by the action of the smallest ring.

Because of the mechanical advantage provided by the 3-ring design, a force of only one pound on the top ring can keep the release together.

That is why it is important to keep foreign matter like bits of grass and sticks out of the 3-ring assembly. A small stick in the soft loop could prevent a riser from releasing.

It's also important to understand one of the properties of the nylon components of the system. When nylon stays in the same position for a long time, it begins to conform to that position, or take a "set." If the 3-ring release system stays assembled for too long, the nylon can become so stiff that the low drag from a malfunction (such as a streamer) won't pull the riser off the ring.

Three-Ring Release Precautions

Proper Alignment

Proper alignment of the three rings ensures proper function. The large ring of the drogue release 3-ring mechanism can be moved out of optimum position for opening. This situation has not been demonstrated to lock the 3-ring under expected drogue loads, but may contribute to a hesitation of release. For the large ring to be in the proper position it must be upright in a parallel plane with the other two rings. It must not lay down over either of the other two rings where it might momentarily bind. Correctly attached riser 3-rings cannot enter improper alignment. However, this situation can arise with a correctly manufactured and assembled drogue 3-ring assembly due to incidental movement as the jumper wears the equipment in the airplane.

The rubber band keeper of the harness acts to ensure correct alignment. The large ring of the drogue 3-ring is held in an upright position by the rubber band keeper attached to the jumper’s harness. The keeper is of light holding capability, just enough to maintain the large ring in position. The keeper releases with light load and does not interfere with the functioning of the drogue 3-ring mechanism while releasing. The keeper allows the jumper to quickly and easily position the drogue large ring correctly when attaching the parachute to the harness. The keeper maintains the drogue large ring in proper position during normal jostling in the aircraft. The keeper is visually checked for correct drogue large ring position during pre-jump equipment checks.

Absence of Debris

Three-rings need to be free from debris for proper function. Because of the mechanical advantage provided by the 3-ring design, a force of only one pound on the small ring keeps the release together. That's why it is important to keep foreign matter like bits of grass and sticks out of the 3-ring assembly. A small stick in the white loop could prevent a riser from releasing. Smokejumper operations subject

gear to foreign matter. It is essential that any foreign matter be removed prior to jumping. Visual inspection for debris must occur during parachute hook-up and subsequent equipment checks.

Supple Loop

The nylon components, especially the soft loop, of the 3-ring assembly must be flexible. The nylon components of the system may become stiff if frozen or if the nylon stays in the same position for a long time. Below freezing temperatures have the potential for causing release hesitation or failure if the nylon was wet prior to being subjected to these conditions. Dry soft loops are unaffected by below freezing conditions, and wet loops in above freezing conditions do not have a negative effect on releases. However, it is important to remember that air temperature decreases with altitude. Near freezing conditions at ground level likely indicates below freezing conditions at jump altitude. As you ascend through the atmosphere the average rate of temperature change is 3.5 degrees per 1000 feet. The rate for unsaturated air is 5.4 degrees per 1000 feet. A jump spot temperature of 48 degrees could result in below freezing conditions at a jump altitude of 3000 feet AGL.

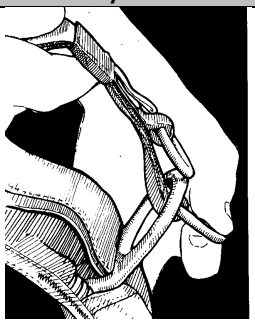
Inspection of the 3-ring assemblies for moisture must occur during parachute hook-up and subsequent equipment checks. Any possibility of encountering below freezing conditions with wet components must be avoided. The best option is to ensure all components of 3-ring assemblies are dry prior to jumping.

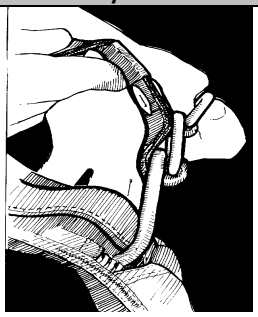
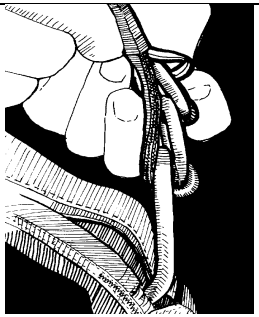
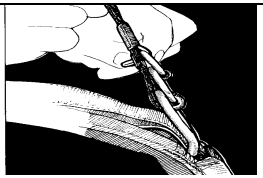
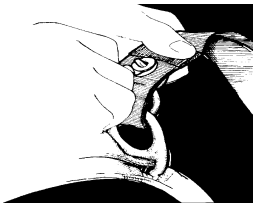
Assembly

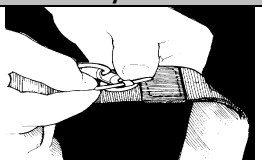
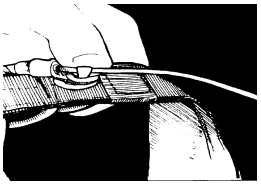
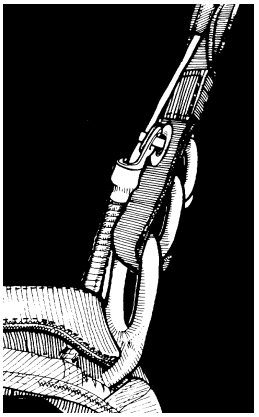
Before assembling the 3-ring release, make sure the risers are not twisted or reversed.

Inspect nylon components for excessive dirt or debris. Flex and twist rings and loop to ensure supple movement of 3-ring assembly.

Table 3: Three-Ring Release System Assembly Steps

Assembly Illustration	Three-Ring Release Assembly Instructions
	1. Thread each cable into its housing and mate the handle to the harness. The handle should be positioned as close to the end of the housing as possible so that no cable is exposed. 2. With the rings of the riser facing toward the floor, pass the medium ring on the end of the riser through the large harness ring from above. Fold it back toward the canopy and riser.

Assembly Illustration	Three-Ring Release Assembly Instructions
	3. Thread the small ring through the medium ring the same way, but make sure it doesn't pass through the large ring.
	4. Bring the soft loop through the small ring only, and then through the riser grommet so it pokes out the back of the riser.
 	5. Continue threading the soft loop through the ring terminal on the end of the cable housing. The flat side of the housing grommet should be against the riser.

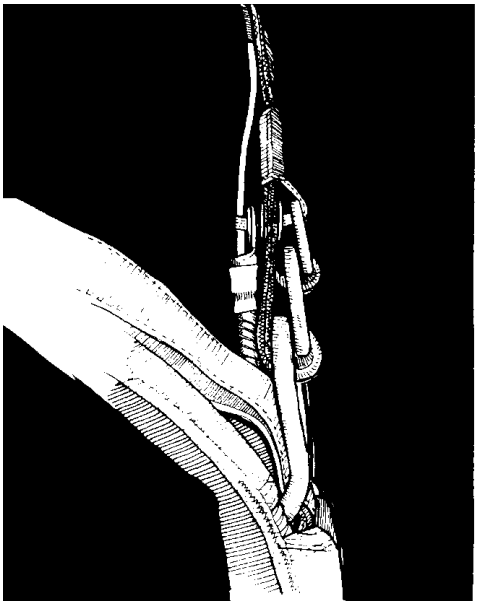
Assembly Illustration	Three-Ring Release Assembly Instructions
  	6. Thread the yellow cable through the soft loop, making sure the loop isn't twisted. Be careful with the cable so you don't bend it too sharply or kink it. Insert the free end of the cable into the stow on the back of the riser. 7. Repeat the above steps with the other riser and drogue release.

Pre-Jump Inspection

After hooking up your gear, check the 3-ring release system for the following:

1. Each ring passes through only one other ring.
2. The soft loop passes through only the small ring.
3. The soft loop passes through the grommet on the riser then through the ring terminal without twisting.
4. Nothing passes through the soft loop except the yellow cable.
5. The cutaway handle is securely seated to the harness, the drogue release is seated, and no cables are visible between the handle and cable housings.

Figure 19: Three-Ring Release System Assembly



Past Mistakes Made in Hooking Up 3-Rings

The following mistakes have occurred in the past during 3-ring hook-up:

1. Passing more than one ring through another ring.
2. Not passing the soft loop through the ring terminal or not passing the yellow cable through the soft loop. This will cause a riser to release when the main is deployed. If it is done on the drogue release 3-ring, it will cause the main to deploy immediately after exit.
3. Drogue cable hooked up to a rear riser and a riser hooked up to the drogue. This will cause a drogue-in-tow. (Occurred on early version of BLM harness that featured long cable housings for both riser and drogue 3-rings. Not possible to do on current harness.)
4. Routing cable housing under harness.

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CHAPTER 2 EQUIPMENT CHECKS

RAM-AIR PARACHUTE TRAINING GUIDE

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CHAPTER 2 – Equipment Checks

In this chapter, student(s) will be introduced to equipment checks and suit-up procedures. This chapter is divided into three lessons: Suit-Ups, Equipment Checks, and Secondary Equipment Checks.

Chapter 2 Objectives

At the completion of Chapter 2, student(s) must be able to:

- ☐ Flawlessly suit-up in their jump gear in two minutes or less with all gear correctly in place.
- ☐ Accurately perform an equipment check (Buddy Check). This includes verbally and physically identifying any irregularities in a fully suited-up jumper and performing proper corrective actions to the equipment.
- ☐ Accurately perform a secondary equipment check (pin check). This will include verbally and physically identifying any irregularities in a fully suited-up jumper and performing proper corrective actions to the equipment.

Lesson 2-1 – Suit-Up

Student(s) will be taught techniques for suiting up in jump gear and will be tested on their ability to perform the procedure.

Lesson Objectives

At the completion of this lesson, student(s) must be able to flawlessly:

- ☐ Suit-up in their jump suit, harness with main container / live main, reserve attached, and helmet, gloves, and PG bag in hand in two minutes or less with all gear correctly in place.

Lesson 2-2 – Equipment Check

An instructor will demonstrate the proper procedures for checking the equipment of a fellow smokejumper fully suited-up and ready to board the aircraft. Student(s) will then perform the proper procedures and demonstrate competency with checks.

Lesson Objectives

At the completion of this lesson, student(s) must be able to:

- ☐ Demonstrate the steps taken in giving a fellow smokejumper an equipment check (buddy check).
- ☐ Identify irregularities in a fully suited-up jumper and perform proper corrective actions to the equipment.

Equipment Check List

Begin by asking the jumper if he/she is ready for a check. Then start at the bottom and work up, touching each item as you go. If you find a mistake, fix it, then return to the previous item and begin again.

1. You are jumping a _____. (jumper gives positive response)
2. Jump pant stirrups under boot.
3. Zippers on jumpsuit pants down.
4. Leg pockets cinched with no excess cargo hanging out.
5. Harness leg straps over crotch protector, untwisted, and snapped, metal to metal.
6. All three Personal Gear (PG) bag straps clear and routed correctly.
7. Main container belly bands routed through belly band loops, attachment hardware snapped into reserve.
8. Good due date on reserve.
9. Reserve handle properly seated.
10. Curved reserve locking pins properly seated and sealed.
11. Lower RSL properly routed from locking pins to lower snap shackle and closed.
12. Upper RSL properly routed to upper snap shackle and closed.

13. AAD is off. (switch)(VIGIL: No Switch)
14. Did you do a self-test? (AAD)(VIGIL: Jumper will confirm AAD is ON)
15. Did you check your reserve knife? (Snapped in place facing away from jumper).
16. Carabiner through harness droop risers, barrels fully closed with light pressure.
17. Chest strap properly routed through buckle and seated on Velcro if equipped, otherwise chest strap is routed through elastic keeper.
18. Drogue release handle properly seated.
19. Cutaway handle properly seated.
20. Left and right 3-ring release assemblies properly attached to parachute risers. Lightly pull cable housing to verify proper connection and routing. *(Inboard, medium ring through large ring, small ring through medium ring, soft loop through small ring, through grommet, through ring terminal, cable through soft loop and stowed.)* Verify assemblies are free from any debris and are not wet.
21. Drogue release 3-ring assembly properly attached to drogue bridle. *Large ring up, medium ring through large ring, small ring through medium ring, soft loop through small ring, thru grommet, cable thru soft loop and stowed.* Verify assembly is free from any debris and is not wet.
22. Rubber band keeper is connected correctly to drogue bridle and drogue 3-ring assembly is in proper alignment.
23. Pull-the-dot snaps attaching main container to harness are connected and routed correctly.
24. Curved locking pin properly seated on main container.
25. Drogue bridle below pin extends to bottom of pin cover flap.
26. Static line in good condition.
27. Static line weak link in good condition.
28. Static line clip is functional.
29. Give static line clip to jumper; ask if he or she has the following items: helmet, gloves, and letdown rope.

Lesson 2-3 – Secondary Equipment Check

Student(s) will demonstrate the proper procedures for performing a secondary check of the equipment of a fellow smokejumper fully suited-up and ready to exit the aircraft.

Lesson Objectives

At the completion of this lesson, student(s) must:

- ☐ Flawlessly and in the proper order, demonstrate the steps taken in giving a fellow smokejumper a secondary equipment check (pin check).
- ☐ Identify irregularities in a fully suited jumper and perform proper corrective actions to the equipment.

Background

The secondary check (pin check) was formally established following the Liston fatality. The foremost reason was to ensure that the PG bag attachment and strap routing was checked prior to exit. This had not commonly occurred during the equipment check as it was not typical for a jumper to be wearing the PG bag until immediately prior to exit.

> **Always be conscious of your reserve handle and get in the habit of guarding it. In the airplane, it becomes of greater importance and a necessity. The checks are in confined and close quarters and sometimes require utilizing both hands. Practice the proper procedure and get in the habit of keeping awareness levels high during the checks.**

Secondary Equipment Check List

Start at the bottom and work up, touching each item as you go. If you find a mistake, fix it, then return to the previous item and begin again.

1. PG bag straps routed correctly and hardware connected.
2. Main container belly band through belly band loops, attachment hardware snapped into reserve.
3. Left and right 3-ring release assemblies properly attached to parachute risers. Lightly pull cable housing to verify proper connection and routing. *(Inboard, medium ring through large ring, small ring through medium ring, soft loop through small ring, through grommet, through ring terminal, cable through soft loop and stowed.)* Verify assemblies are free from

any debris and are not wet.

4. Drogue release 3-ring assembly properly attached to drogue bridle, large ring up. (*Large ring up, medium ring through large ring, small ring through medium ring, soft loop through small ring, through grommet, cable through soft loop and stowed.)* Verify assembly is free from any debris and is not wet.
5. Rubber band keeper of the harness is connected correctly to drogue bridle and drogue 3-ring assembly is in proper alignment.
6. Curved locking pin properly seated on main container.
7. Drogue bridle below pin extends to bottom of pin cover flap.

Notes

There may be times when jumpers may not have their PG bags hooked up for the secondary equipment check. (Example: jumpers toward the front of the plane may wait for the first stick to exit.) In this case, do the pin portion of the check and be mindful to complete the PG bag portion of the check when the PG bag is put on. It is each jumper's responsibility to complete the check in a timely manner as not to hold up jump operations.

Jump partners need to be aware of one another prior to getting in the door. Look each other over to make sure everyone is clean and ready. See that your jump partner has nothing hanging out of his/her leg pockets and top of PG bag is flat with no loose straps. In general, just be conscious of each other and look for anything out of the ordinary. Things can happen between the buddy checks, watching the streamers, hooking up, and getting in the door.

Table 4: Equipment Check Items with Consequences of Failure

Equipment Check Item	Consequences of Failure
Jump pant stirrups under boot.	• Crotch-strap of jump pants would be rendered ineffective, severe groin injury is likely to occur.
Zippers on jumpsuit pants down.	• Potential for stirrups to become dislodged from boot soles rendering the crotch-strap of jump pants ineffective thus likely causing a severe groin injury. • Increased potential to interfere with a clean exit.
Leg pockets cinched with no excess cargo hanging out.	• Potential to interfere with clean exit greatly increases. A career-ending injury resulted in the early 1980s when a leg pocket drawstring caught in the step during exit. • Potential for an entangled drogue malfunction or other interference when parachute deployment occurs. A letdown rope fell out of a leg pocket during exit in the mid-1990s. The rope was in close proximity to the deploying main canopy.
Harness leg straps over crotch protector, untwisted, and snapped, metal to metal.	• Routing of leg strap under crotch protector would likely result in severe groin injury. • Material interfering with snap and buckle could result in snap coming open prematurely. A leg strap became unsnapped during a fire jump in the mid-1990s. The jumper successfully completed the jump but handle placement and harness location was significantly altered.
All three PG bag straps clear and routed correctly.	• Straps must be routed inboard of belly bands to prevent PG bag from riding up over the reserve. Incorrect strap routing in conjunction with a failure of lower attachment point could interfere with jumper performance of procedures, cause an inadvertent reserve opening, or interfere with a purposeful reserve opening.
PG bag attachment hardware connected (Secondary Check).	• An incorrect or lack of connection would increase potential for loss of PG bag and possibly interfere with the jumper's ability to execute procedures.

Equipment Check Item	Consequences of Failure
Main container belly bands routed through belly band loops on leg straps, attachment hardware snapped into reserve.	• Failure to route the main container belly bands through the belly band loops could cause the main container to interfere with the operation of the drogue 3-ring by allowing the main container to shift upward. • Failure to snap belly bands to reserve would likely result in reserve interfering with jumper's ability to execute procedures, cause problems with reserve deployment, and/or cause main container to interfere with drogue 3-ring.
Good due date on reserve.	• FAA regulations require that reserve parachutes be repacked by a licensed rigger every 180 days.
Reserve handle properly seated.	• Improper seating of reserve handle would increase potential for inadvertent reserve activation.
Curved reserve locking pins properly seated and sealed.	• Improper seating of reserve locking pins would increase potential for inadvertent reserve activation. • FAA regulations require that reserve parachutes be sealed by the rigger.
Lower RSL properly routed from locking pins to lower snap shackle and closed.	• Routing of lower RSL through reserve carabiner could possibly prevent a malfunctioning main canopy from being jettisoned which could interfere with deployment of reserve canopy. • Failure to close snap shackle would render RSL ineffective. Reserve opening altitude would be decreased due to necessity of manual activation.
Upper RSL properly routed to upper snap shackle and closed.	• Routing of upper RSL over riser 3-ring could possibly prevent a malfunctioning main canopy from being jettisoned by interfering with the 3-ring mechanism. • Failure to close snap shackle would render RSL ineffective. Reserve opening altitude would be decreased due to necessity of manual activation.
Your AAD is off. **Did you do a self-test? (AAD)**	• The AAD needs to be in the off position in order to properly arm when turned on at jump altitude. • Without a self-test, the unit may not be working properly.

Equipment Check Item	Consequences of Failure
Reserve knife blade good, snapped in place facing away from jumper.	• Blades may become worn due to flexing of knife in container. Severely worn blades do not cut effectively.
Carabiners through harness droop risers, barrels fully closed with light pressure.	• Reserve performance would be degraded if only hooked up to one droop riser, performance would be irrelevant if not hooked up to either droop riser. • Over-tightening of barrels can cause significant problems when taking off reserve. This could cause serious problems if a letdown was necessary.
Chest strap properly routed through buckle and seated on Velcro if equipped, otherwise chest strap is routed through elastic keeper.	• A chest strap improperly routed would render it ineffective thereby creating a situation where the jumper could fall out the harness upon opening shock. • Unseated Velcro increases the potential for the chest strap to loosen and displace the drogue release handle increasing the likelihood of a "Lost Handle" malfunction.
Drogue release handle properly seated.	• An improperly seated handle would greatly increase the potential for a "Lost Handle" malfunction.
Cutaway handle properly seated.	• An improperly seated handle would greatly increase the potential for an inadvertent main cutaway. An inadvertent main cutaway occurred during a training jump in 2000 when the cutaway handle became unseated and released the main.

Equipment Check Item	Consequences of Failure
Left and right 3-ring release assemblies properly attached to parachute risers; lightly pull cable housing to verify proper connection and routing. Verify assemblies are free from any debris and not wet.	• Improperly connected 3-rings could result in riser failure and/or an inability to cut away a malfunctioning main. • Improperly routed cables could interfere with function of riser 3-rings resulting in an inability to cut away a malfunctioning main • Improperly routed cables could put excessive force on terminal end of cable during main deployment. A failure of the terminal end could result in a riser release and necessitate the emergency procedure. • Pulling on the cable with excessive force could cause the terminal end to come off the cable. A failure of the terminal end could result in a riser release and necessitate the emergency procedure. • Debris in the 3-ring assembly could result in riser failure and/or an inability to cut away a malfunctioning main. • It is possible for wet components of the 3-ring assembly to freeze which could retard or prevent a release of the mechanism.
Drogue release 3-ring assembly properly attached to drogue bridle, large ring up. Verify assembly is free from any debris and is not wet.	• Improperly connected 3-rings could result in assembly failure and/or an inability to release the drogue. • Debris in the 3-ring assembly could result in assembly failure and/or an inability to release the drogue. • It is possible for wet components of the 3-ring assembly to freeze which could retard or prevent a release of the mechanism.
Rubber band keeper is connected correctly to drogue bridle and drogue 3-ring assembly is in proper alignment.	• An unconnected rubber band keeper allows the drogue 3-rings to come out of alignment. Proper alignment ensures consistent and immediate release of the 3-ring mechanism.
Pull-the-dot snaps attaching main container to harness are connected and routed correctly.	• Unattached or misrouted pull-the-dot snaps would allow the main container to rise up and block the drogue 3-ring assembly, increasing the potential for a “drogue-in-tow” malfunction.

Equipment Check Item	Consequences of Failure
Curved locking pin properly seated on main container.	• An improperly seated pin could release the main deployment bag from the container prematurely. Premature release of main deployment bag could result in a horseshoe malfunction or other deployment problem.
Drogue bridle below pin extends to bottom of pin cover flap.	• Potential would exist for drogue bridle to be pinched between the container and top closing flap causing a hesitation in the deployment of the main canopy.
Static line.	• A damaged static line could break upon exit and fail to deploy the drogue resulting in a high-speed malfunction.
Static line weak link in good condition.	• A damaged weak link could break upon exit and fail to deploy the drogue resulting in a high-speed malfunction.
Static line clip.	• A nonfunctional static line clip could prevent a jumper from hooking up in the aircraft or prevent the spotter from removing the clip after exit
Give static line clip to jumper, confirm that jumper has helmet, gloves, and letdown rope.	• Lack of equipment would preclude jumper from exiting aircraft.

CHAPTER 3 AIRCRAFT PROCEDURES

RAM-AIR PARACHUTE TRAINING GUIDE

USFS SMOKEJUMPER PROGRAM

CHAPTER 3 – Aircraft Procedures

In this chapter, student(s) will be introduced to general aircraft safety, in-flight emergency procedures, and duties of the spotter. They will also be asked to demonstrate the proper procedures for hooking up their static lines, the four-point check, exiting the aircraft, jump count, and opening checks. This chapter is divided into three lessons: General Aircraft Safety, Standard Aircraft Briefing, and the Mock-Up.

Chapter 3 Objectives

At the completion of Chapter 3, student(s) must be able to accurately:

- ☐ Demonstrate verbally and physically the safety procedures involved with aircraft propellers, approaching or leaving an aircraft, fueling operations, and take-offs and landings.
- ☐ Demonstrate verbally and physically the proper safety procedures for given in-flight emergencies that are jumper and aircraft related.
- ☐ Demonstrate verbally and physically the proper safety procedures used during normal jumper operations including boarding the aircraft, the flight to the incident, the dropping of jumpers, and the dropping of cargo.
- ☐ Demonstrate verbally and physically the proper safety procedures for emergency exits from the aircraft both on a main and reserve parachute.
- ☐ Demonstrate verbally and physically proper reactions to given commands by a spotter during simulated jumper operations.
- ☐ Demonstrate verbally and physically the proper aircraft and exit procedures from a simulated jump-ship. These procedures will include all aspects of general aircraft safety, in-flight emergency procedures, a proper hook-up, four-point check, exit, jump count and opening checks.
- ☐ Demonstrate the proper reactions to commands during simulated jump sequences.

Lesson 3-1 – General Aircraft Safety

Students will be introduced to various aspects of aircraft safety and smokejumper operations relating to aircraft.

Lesson Objectives

At the completion of this lesson, student(s) must be able to accurately:

- ☐ Demonstrate verbally and physically the safety procedures involved with aircraft propellers, approaching or leaving an aircraft, fueling operations, and take-offs and landings.
- ☐ Demonstrate verbally and physically the proper safety procedures for given in-flight emergencies that are jumper related and aircraft related.
- ☐ Demonstrate verbally and physically the proper safety procedures used during normal jumper operations including boarding the aircraft, the flight to the incident, the dropping of jumpers, and the dropping of cargo.
- ☐ Demonstrate verbally and physically the proper safety procedures for emergency exits from the aircraft both on a main and reserve parachute.

General Aircraft Safety

Propellers

1. Always avoid the aircraft propellers, even when they are motionless. Treat them as if they are always in motion.
2. Maintain propeller awareness. Know where they are and keep a safe distance away from them.

Approaching or Leaving Aircraft

1. Always approach or leave aircraft on a path that avoids the propellers.
2. Do not take shortcuts close to the nose or under the wings of an aircraft.
3. Approach rear-loading aircraft from the rear.
4. Approach forward-loading aircraft from the front. Do not approach or attempt to leave until the props on the loading door side stop spinning.

Fueling Operations

1. No smoking is allowed within 50 feet of the aircraft or within 50 feet of fuel tanks at any time.
2. No one is allowed on board the aircraft during fueling operations.

Boarding Order

1. Rear-loading aircraft: load in reverse order, i.e., last jumper first.
2. Front-loading aircraft: load in actual jump order.

Take-Off/Landing/Low Level

1. Wear seat belts and secure all personal gear.
2. Jumpers must wear a jump suit, gloves, and helmet with mask down on take-offs and landings and during low-level cargo drops.
3. Do not move around inside the aircraft during take-offs, landings, or low-level patterns. Changes in the center of gravity can make the aircraft hard for the pilot to control.

Flight to Fire

1. Avoid unnecessary movement.
2. Know the location of airsick bags and use them if needed.
3. Know the location of the emergency exits and fire extinguishers.
4. Exercise caution near aircraft windows. Avoid putting pressure on them with boots, helmets, or other gear.
5. Stay away from an open door unless the spotter has given approval and static line is hooked up.
6. Guard your reserve. Be especially aware of your reserve handle and prevent it from getting snagged or caught.
7. Jumpers will be instructed to perform an equipment check, in flight, 20 minutes from a fire. Each jumper will give and receive an equipment check (buddy check).
8. Five minutes out from a fire, the spotter will instruct jumpers to perform a secondary equipment check (pin check).
9. Enroute to the fire, the spotter will hand a note back to the jumpers. Everyone should read it. The note will include some or all of the following information:

- Reported fire size, coordinates, district or zone, suppression response area.
- Ground contacts, other aircraft and/or suppression forces enroute.
- Frequencies for dispatch, air-to-ground, tactical resources.
- Incident Commander (IC) or Jumper-in-Charge (JIC) and trainees.
- Charge code.

Over the Fire – Dropping Jumpers

1. The spotter selects the jump spot (the IC may be involved in selection) and determines wind drift. During observation and streamer passes, pay particular attention to jump spot location and relationship to fire location, ground hazards, terrain features, water sources, and fire behavior.

   The spotter may give additional information to the designated IC or JIC, including:

   - Suppression strategy.
   - Radio frequencies.
   - Other aircraft in the area or responding to fire.
   - Best route to the fire from the jump site.
   - Ground contacts (if already staffed).
   - Escape routes in case of a blow up.
   - Potential de-mob routes.
   - Maps of the area.

2. Watch the streamers (and other jumpers dropped before you) to get an indication of wind direction and amount of drift. Do not bunch up at the rear of the aircraft.
3. The spotter will tell what size stick will be dropped. The first jumper in the stick will check that all jumpers in the stick are ready to jump, prior to being asked by the spotter.
4. The spotter will ask the first jumper in the stick "Are you ready?" (Jumper will have on helmet, gloves, PG bag, reserve belly bands and PG bag straps tight, and static line clip in hand). The first jumper will answer for the whole stick.
5. The spotter will then ask "Are you tight?" to make sure the jumpers have tightened their leg straps. Again, the first jumper will answer for the whole stick.
6. The spotter will then tell the designated stick to hook up. The jumper will hook up and show the connected snap to the spotter who will check to see that the static line snap is hooked up

correctly. **It is the jumper's responsibility to hook up and to maintain control of his/her static line until it is at the aft end of the overhead cable, or until the static line clip has been handed to the spotter or assistant.**

7. Static line awareness must be maintained until you are sitting in the door ready for exit.
8. The spotter will give each stick a pre-jump briefing. *(All jumpers in the stick should move within hearing distance and make eye contact).*

   The pre-jump briefing will include:

   - Location of the jump spot and exit point.
   - Jump spot elevation.
   - Streamer drift and wind direction.
   - Ground hazards.
   - Type of pattern flown.

   The spotter will end the briefing by asking jumpers if they have any questions. Jumpers need to actively seek any needed clarifications.
9. "We are at 3000 feet AGL" this command prompts ram-air jumpers to arm or verify the AAD is armed (The spotter, before giving this command, will confirm with the pilot that the aircraft has leveled off at 3,000 feet AGL.) This command will always be given prior to the jumper getting in the door. The spotter will verify ram-air jumpers have armed their AAD's prior to getting in the door.
10. The spotter will tell the first jumper to get in the door. This is the signal for all jumpers in the stick to do a four-point check.
11. All jumpers must protect their reserve handles when moving towards the door.
12. The spotter/assistant spotter will make a final visual check on each jumper prior to the exit. On final, the spotter will confirm the jump altitude and tell each jumper that his/her static line is clear. The spotter will say "Get ready" about three seconds from exit.
13. Jumpers exit the aircraft only when slapped on the shoulder by the spotter. If spotter discovers a safety problem and the pass is aborted, the spotter will block the door with his/her arm at face level and tell the jumper not to exit.
14. Upon conclusion of jump operations, the spotter will prompt any remaining jumpers to deactivate their AADs, "Turn your AADs off." Jumpers will deactivate their AADs and verify that their jump partner has deactivated their AAD.

Cargo Dropping

1. Jumpers must wear helmets, gloves, and seat belts during cargo drops.
2. Avoid unnecessary movement.
3. Do not assist the spotter or assistant spotter unless asked. Stay out of the way. A fully suited jumper moving cargo for the spotter stands a much better chance of accidentally deploying his/her reserve in the plane.

In-Flight Emergencies

Jumper-related emergencies include:

1. Inadvertent deployment of reserve inside aircraft.
    - Try to cover immediately--do anything necessary to prevent reserve pilot chute from exiting aircraft.
    - If reserve pilot chute leaves the aircraft, follow it very quickly.
2. Jumper-in-tow.
    - If possible, place both hands on helmet, indicating that you are okay.
    - Be ready to be cut away by the spotter; as soon as the spotter sees that you can pull your reserve you will probably be cut away.
    - When cut away, pull reserve.
    - **Do not pull your reserve until you are cut free of the plane.**

Aircraft- related emergencies include:

1. Noncritical (landing gear stuck, electrical problems, etc.)
    - Pilot determines if bailout is necessary and confers with spotter.
    - Remain seated; await instructions.
    - Will probably go as normal jump.
2. Critical (engine fire, hydraulic problem, etc.)
    - When possible, the pilot will initiate emergency procedures through the spotter.
    - Remain seated until told otherwise.
    - The spotter may indicate which chute to use.
    - When the spotter tells you to, move to the door and exit.

- In an urgent situation, do not take the time to put on helmet, gloves, or PG bag.

The main and reserve open in about the same amount of time. Both canopies need an absolute minimum of 400 feet AGL to open. Therefore, in a critical emergency, the parachute you have on or can get on the quickest is the one with which you should exit.

Emergency Exits

1. Emergency exit on main parachute:
    - Move to the rear of the aircraft.
    - Follow “normal" procedures for the aircraft you are in and clip static line to the extender if you have time.
    - Two static lines can be clipped to the same extender in an emergency.
    - In an emergency bailout, clip your static line to the overhead cable. **The point clipped into must allow the jumper to clear the door before the drogue starts to inflate.**
    - Look at drogue release handle while exiting.
    - Pull drogue release handle when clear of door (a quick pull minimizes the chance of a tumbling body interfering with chute deployment).
    - Pulling the drogue release handle before leaving the aircraft would interfere with the normal staged deployment of the ram-air main and may lead to entanglement in the lines.
2. Emergency exit on reserve:
    - Do not hook up static line.
    - Look at handle when in the door.
    - Look at handle while exiting.
    - Pull handle when clear of aircraft.
3. Regrouping after bailout:
    - Steer to a safe landing.
    - Maintain good airspace awareness.
    - Establish communications.
    - Walk towards the last jumper and /or the aircraft.

Crash Procedures

- Helmets and gloves on.
- If time, secure any loose cargo.
- Restrict movement.
- Wear your seat belt.
- Keep to rear of cargo if possible.
- Get out of plane quickly and help anyone who is injured.

Lesson 3-2 – Standard Aircraft Briefing

Students will be introduced to the commands that will be given to each jumper during jumper operation and proper procedures to be followed during the jumping sequence.

Lesson Objectives

At the completion of this lesson, student(s) must accurately:

- ☐ Demonstrate verbally and physically proper reactions to given commands by a spotter during simulated jumper operations.

Standard Aircraft Briefing

1. Spotter tells jumpers the size of the stick.
2. Spotter asks first jumper in the stick: "Are you ready?"
3. First jumper answers for entire stick: "Ready."
4. Spotter asks first jumper in the stick: "Are you tight?"
5. First jumper answers for the entire stick: "Yes."
6. Spotter: "Hook up."
7. All in the stick hook up.
8. Spotter briefs jumpers on jump spot, winds, flight pattern, and hazards. All jumpers guard their reserves while this takes place.
9. Spotter informs jumpers when aircraft reaches jump altitude. At jump altitude, all jumpers designated to jump will activate their AADs while guarding their reserve.
10. Spotter: "Get in the door."
11. Using both hands, the first jumper gets in the door while the other jumpers in the stick perform a four-point check:
    - “Drogue release.”
    - “Cutaway.”
    - “Reserve.”
    - “Lower RSL.”

12. First jumper does his/her four-point check, then guards his/her reserve and leans back to give spotter room to look out the door. Other jumpers in the stick move to ready position.
13. Spotter tells the jumpers they are turning final, 3000 feet AGL.
14. Spotter checks that jumpers are clear. Spotter: "You are clear."
15. Spotter aligns aircraft.
16. Three seconds from exit, spotter pulls back out of the door. Spotter: "Get ready."
17. Jumper cocks into position and waits for the slap.
18. Spotter slaps jumper on shoulder.
19. Jumper exits and performs jump count (while shuffling away from mock-up to allow other jumpers room to exit):
    - Jump thousand.
    - Look thousand.
    - Reach thousand.
    - Wait thousand.
    - Pull thousand.
20. Chute opens and jumpers perform opening checks.
    - "Check my canopy."
    - "Check my airspace."
    - Canopy control check: "Right turn, Left turn, Stall."
21. Spotter will issue command to deactivate AAD prior to aircraft descent for any remaining jumpers. "Turn your AADs off." Cue to deactivate your AAD and verify that your jump partner has done the same.

Lesson 3-3 – Aircraft Mock-Up

Students will be asked to perform actual jumper operations from boarding the aircraft to properly exiting and completing their opening checks from a simulated aircraft.

Lesson Objectives

At the completion of this lesson, student(s) must be able to:

- ☐ Demonstrate verbally and physically the proper aircraft and exit procedures from a simulated jump-ship. These procedures will include all aspects of general aircraft safety, in-flight emergency procedures, a proper hook-up, four-point check, exit, jump count, and opening checks.
- ☐ Demonstrate physically the proper reaction to given commands during simulated jump sequences.

CHAPTER 4 EXITS AND OPENING CHECKS

RAM-AIR PARACHUTE TRAINING GUIDE

USFS SMOKEJUMPER PROGRAM

CHAPTER 4 – Exits and Opening Checks

This chapter will introduce student(s) to proper exits, the jump count, and after-canopy-opening checks. This chapter is divided into two lessons: Ram-Air Exits and Opening Checks.

Chapter 4 Objectives

At the completion of Chapter 4, student(s) must be able to:

- ☐ Demonstrate verbally and physically the four-point check and describe when it must be performed.
- ☐ Demonstrate verbally and with proper timing the ram-air jump count.
- ☐ Demonstrate physically proper exit techniques.
- ☐ Identify the three components of the opening checks.
- ☐ Identify and explain the purpose of the “Check my canopy” component.
- ☐ Identify and explain the purpose of the “Check my airspace” component.
- ☐ Identify and explain the purpose of the Control check component.
- ☐ Demonstrate the opening checks.

Lesson 4-1 – Ram-Air Exits

Students will be introduced to proper ram-air exits. This chapter includes instruction on the Four-Point Check, Jump Count, Exiting the Aircraft, and Opening Checks.

Lesson Objectives

At the completion of this lesson, student(s) must be able to:

- ☐ Demonstrate and verbalize the four-point check and describe when it must be performed.
- ☐ Demonstrate and verbalize with proper timing the ram-air jump count.
- ☐ Demonstrate and verbalize the opening checks.

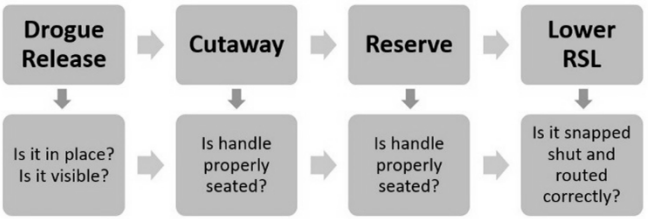
Four-Point Check

Prior to jumping, each jumper must complete a "four-point check" of his/her equipment. The first jumper in a stick will complete the check after getting in the door. The remainder of the stick will complete the check when the spotter gives the “Get in the door” command. The check is made in the same order every time. The jumper should touch each item being checked as he/she looks at it. The purpose of the check is to verify that all handles are in the correct location and that the lower RSL is connected.

Table 5: Four-Point Check

Step	Equipment	Check
1	**Drogue Release**	Is it in place? Is it visible?
2	**Cutaway Handle**	Is handle properly seated?
3	**Reserve Handle**	Is handle properly seated?
4	**Lower RSL**	Is it snapped shut and routed correctly?

Figure 20: Four-Point Check



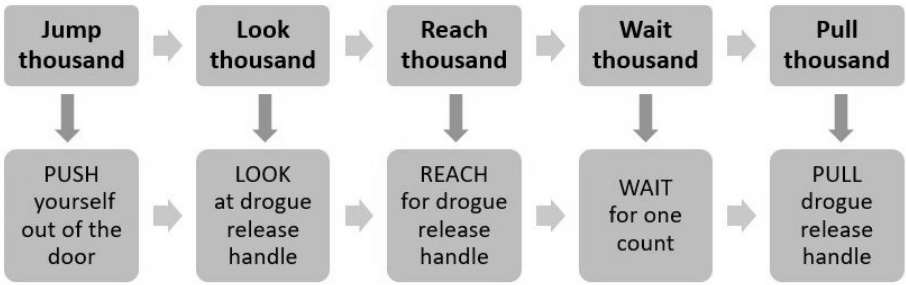
Jump Count

The primary purpose of the jump count is to give the jumper a time reference. The count should last five seconds, a time frame that allows the jumper to clear the airplane and be fully stable under the drogue when deploying the main. The jump-count is initiated after the spotter gives the slap.

Table 6: Jump Count

Count	Action
Jump thousand.	Push yourself out the door.
Look thousand.	Look at drogue release handle.
Reach thousand.	Reach for drogue release handle.
Wait thousand.	Wait for one count.
Pull thousand.	Pull drogue release handle.

Figure 21: Jump Count



Exiting the Aircraft

Ram-air jumpers exit all jump-ships from a seated position, with the static line hooked to an extender which is connected to an overhead cable. A good exit from the aircraft will minimize the risk of a malfunction by providing clean air for the deploying drogue and ensures good body position for the deployment of the main.

Key elements to performing good exits include:

- **Prior to the slap, be square in the door.**

  Reason: The relative wind acts to push the jumper to the aft side of the door unless the jumper makes a conscious effort to prevent it. Exiting the aircraft from the aft position usually results in a quick left rotation which places the deploying

drogue sail/bridle in contact with the helmet or shoulders, resulting in an increased potential for an entangled drogue malfunction. Additionally, deployment of the drogue will be slowed as a result of the jumper's burble.

Tips: Placing the left hand in the lower aft corner prior to slap helps to prevent getting pushed to the aft side.

- **Prior to the slap, keep legs tight against the step or aircraft fuselage.**

  Reason: The relative wind acts to push the jumper's legs downwind. When a jumper exits in this position, the legs will be in the vicinity of the deploying drogue. The deploying drogue sail/bridle will often be in contact with the helmet or shoulders, resulting in an increased potential for an entangled drogue malfunction. Additionally, the jumper will often rock back and forth underneath the deployed drogue longer than desirable.

  Tips: Make a conscious effort to keep legs firmly planted against step or aircraft as soon as you get in the door. This is relatively easy when exiting a Twin Otter, but increases in difficulty at higher aircraft exit speeds.

- **Upon slap, push off with both arms equally.**

  Reason: Pushing off stronger with one arm usually results in the jumper rotating immediately upon exit. This will cause problems similar to not being square in the door.

  Tips: Being square in the door makes this relatively easy. Jumpers with short arms can utilize the side of the door for hand placement but most jumpers achieve better results when using the corners or the floor. Most problems are caused by not pushing off strongly enough with the left arm.

- **Upon slap, focus on leaving the aircraft with an emphasis on a head-down angle of approximately 45-degrees.**

  Reason: This forward lean allows the best angle for the air flow to cleanly inflate the drogue, and assists the jumper in remaining tucked in a tight body position.

  Tips: Pivot or rotate out of the aircraft keeping the same body position as you were sitting in the door, but emphasize tipping forward to obtain more of a face-down angle.

- **Upon slap, focus on keeping legs tight against the aircraft as you exit**.

  Reason: Even a momentary lapse in leg strength will result in the legs being blown downwind by the windblast. Legs in the downwind position are the most common cause of poor exits. Problems include the drogue sail/bridle contacting the shoulder and/or helmet, increased potential for an entangled drogue malfunction, and increased rocking underneath drogue.

- **After slap, keep legs tucked up**.

  Reason: Keeping legs tucked up accomplishes two things. First, it reduces the size of the jumper's burble. A smaller size burble will result in quicker drogue inflation and better stability under the drogue. Second, rocking underneath the drogue will be minimized which may result in better body position upon opening.

- **After slap, hands go to butt and keep legs together.**

  Reason: Minimizes potential for an entangled drogue malfunction and spinning while under drogue.

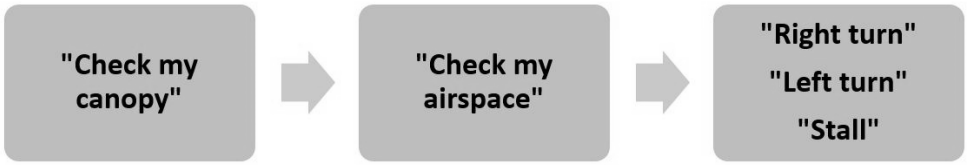
Opening Checks

Refer to Lesson 4-2 for detailed information on opening checks.

Assuming that a malfunction has not occurred, the jumper now completes the after-canopy-opening checks:

1. **"Check my canopy"** – Does it look right? Is it flying? The jumper's hands should go to the rear risers while looking at the canopy.
2. **"Check my airspace"** – The jumper looks in front and to the sides. Is another jumper approaching? If so, pull on the right rear riser (or anything on the right side) to turn away.
3. **Canopy control check** – The jumper will confirm that the parachute is capable of being safely controlled. The jumper will verbalize "Right turn," "Left turn," and "Stall" while performing these maneuvers. If the canopy cannot be safely controlled, then malfunction procedures will be immediately initiated.

Figure 22: Opening Checks



Discussion Points

- A canopy must clearly pass the opening checks. If not, cut away and get a canopy overhead that you can safely land. When in doubt, cut it away. Making the decision early is critical to ensure the reserve has plenty of time to open and to allow you to land softly and accurately.

Lesson 4-2 – Opening Checks

This lesson explains the proper procedures to perform after completing the jump count and deployment of the main canopy.

Lesson Objectives

At the completion of this lesson, student(s) will be able to:

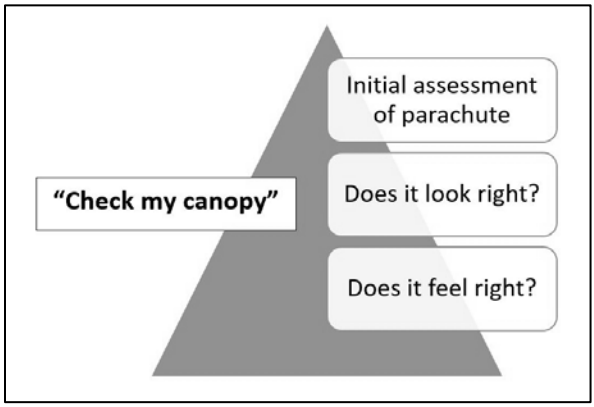
- ☐ Identify the three components of the Opening Checks.
- ☐ Identify and explain the purpose of the "Check my canopy" component.
- ☐ Identify and explain the purpose of the "Check my airspace" component.
- ☐ Identify and explain the purpose of the Control Check component.
- ☐ Demonstrate the Opening Checks.

Opening Checks

Opening Checks are performed to ensure that the main canopy is safe to land and the immediate airspace is clear of other jumpers. The process requires the jumper to make assessments, make decisions, and take appropriate actions.

Check My Canopy

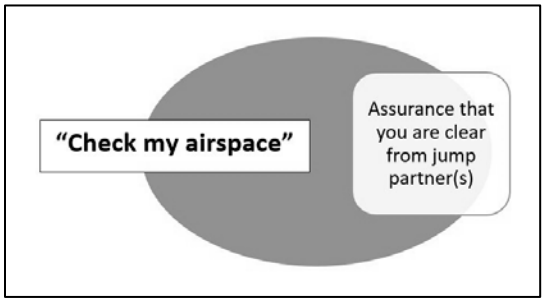
Figure 23: Opening Checks – Check My Canopy



"Check my canopy" is the first step in the process. This is the initial assessment of the parachute. The canopy should look right and feel right to the jumper. Many types of malfunctions will be immediately obvious, but some are more subtle. In cases where the canopy is fully deployed and inflated, it is easy for the jumper to rush through this step. Inspecting both brake lines is a good way to ensure that the entire canopy is viewed in an appropriate time frame. This step should take no longer than three seconds. If the canopy looks right and feels right, the jumper can proceed to the next check. If the canopy is bad or absent, the appropriate malfunction procedures must be performed.

"Check My Airspace"

Figure 24: Opening Checks – Check My Airspace

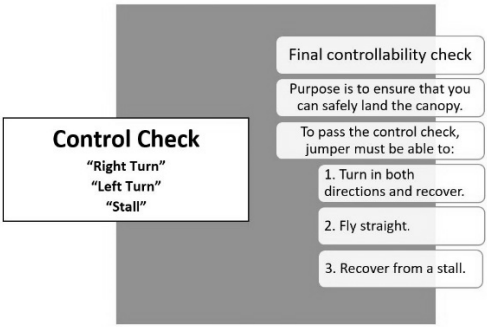


A clear airspace is critical due to the extremely bad outcomes associated with canopy collisions. The airspace in front of the main canopy's direction of flight is most critical. With good airspace, the

jumper can proceed to the control check. With bad airspace, the jumper needs to take evasive action to avoid a canopy collision prior to performing a control check.

Control Check ("Right Turn, Left Turn, Stall")

Figure 25: Opening Checks – Control Check



The control check is the final check of the canopy. Its purpose is to prove that you can safely land the canopy. For the canopy to pass the control check, the jumper must be able to:

1. Turn in both directions and recover.
2. Fly straight.
3. Recover from a stall.

If the canopy passes the control check, the jumper can confidently fly to the ground. If the canopy fails the control check, the jumper performs malfunction procedures once. This is the one and only attempt to clear. If the malfunction procedure fails to correct the problem or if the jumper believes the canopy is unsafe to land, the emergency procedure must be initiated immediately. If the problem is corrected, passes the control checks, and is determined safe to land, then continue with the jump. A subsequent control check failure mandates immediate initiation of the emergency procedure.

Figure 26: Opening Checks

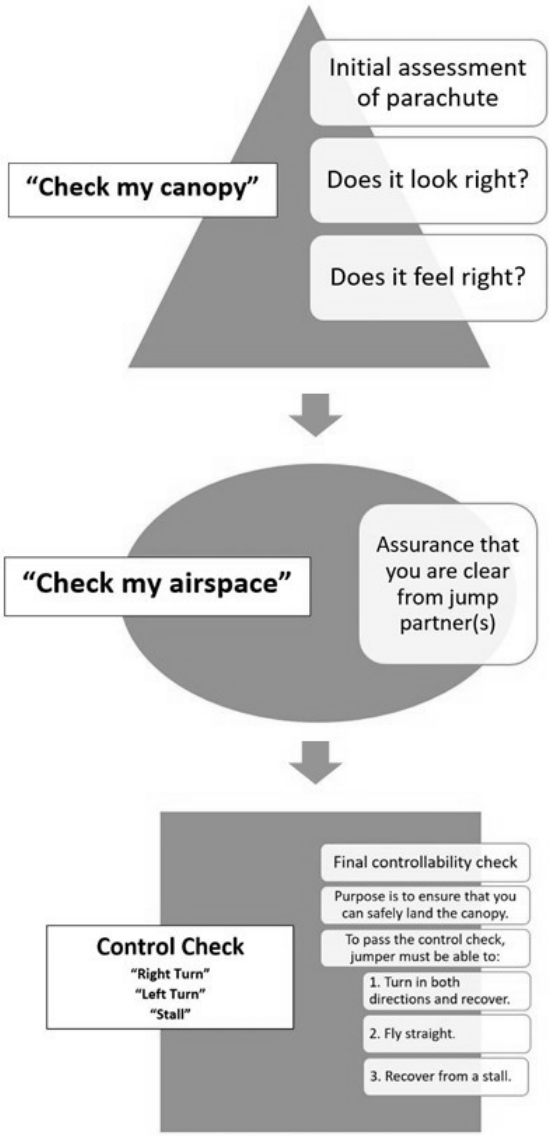
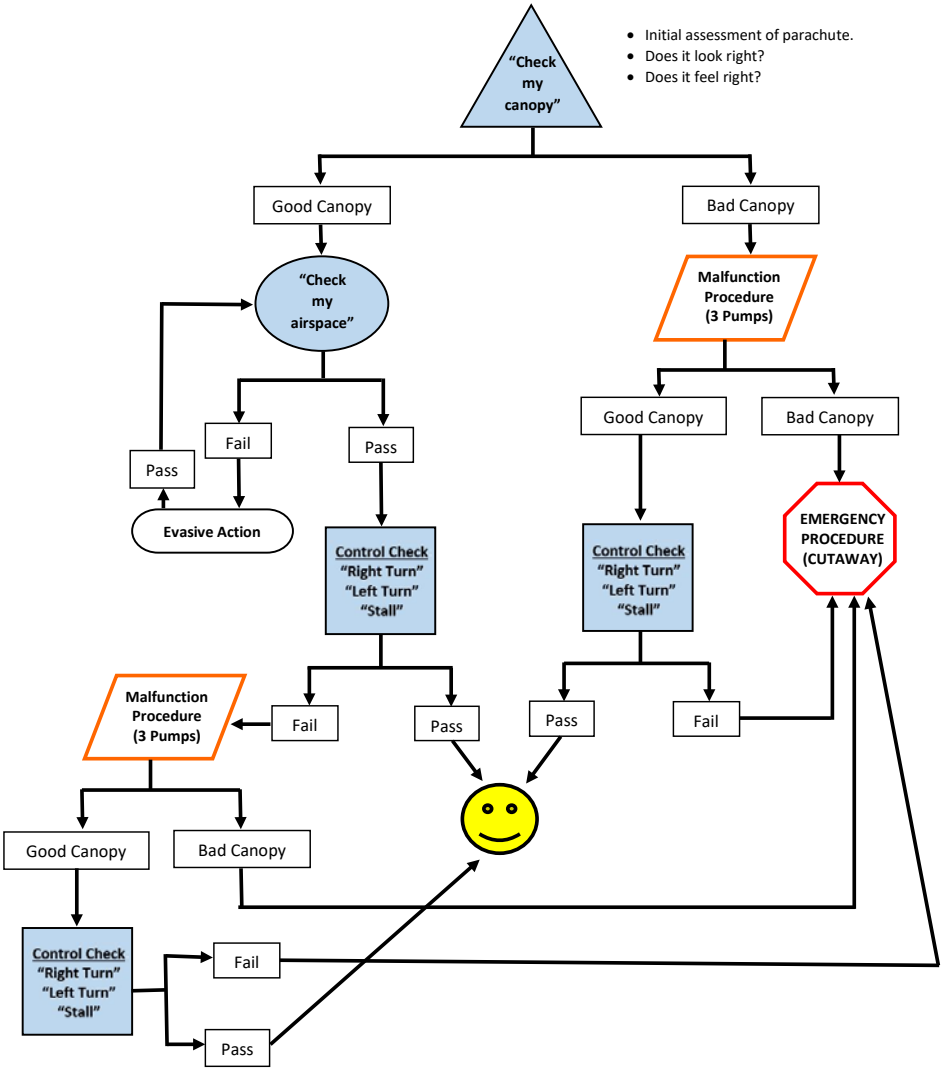


Figure 27: Opening Checks Flowchart



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CHAPTER 5
MALFUNCTIONS

RAM-AIR PARACHUTE
TRAINING GUIDE

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CHAPTER 5 – Malfunctions

This chapter introduces student(s) to possible malfunctions and the proper emergency procedure. This chapter is divided into six lessons: Ram-Air Malfunction Procedures, Types of Malfunctions, Malfunction Television (MTV) Training, Jump Tower Performance Standard, Tower Introduction, and Tower Jumps.

Chapter 5 Objectives

At the completion of Chapter 5, student(s) must be able to:

- ☐ Demonstrate verbally and physically the four-point check and describe when it must be performed.
- ☐ Demonstrate verbally and physically with proper timing the ram-air jump count.
- ☐ Demonstrate verbally and physically the opening checks.
- ☐ Demonstrate verbally and physically the proper emergency procedure in the case of a malfunction that cannot be cleared.
- ☐ Identify and describe verbally the three primary ram-air malfunction procedures as given or as shown on video.
- ☐ Demonstrate verbally and physically the appropriate corrective action needed for any given primary malfunction.
- ☐ Identify and describe verbally the special situations that may occur during a jump. These may be given or shown on video.
- ☐ Describe verbally the appropriate corrective action needed for any given special situation.
- ☐ Accurately, and without hesitation, recognize and identify all malfunctions given (or shown), and accurately describe and perform the appropriate malfunction procedures.
- ☐ Accurately list verbally the three categories of the jump tower evaluation criteria and identify the instructor responses associated with each evaluation.
- ☐ Satisfactorily perform at least four actual training tower jumps. This will include the performance of proper aircraft, exit, malfunction, and emergency procedures.

Lesson 5-1 – Ram-Air Emergency Procedure

Lesson Objectives

At the completion of this lesson, student(s) must be able to accurately:

- ☐ Demonstrate verbally and physically the proper emergency procedure in the case of a malfunction that cannot be cleared.

Every jumper should review malfunction procedures often, at least before every jump.

The jumper should go through his/her jump count, look up at an imaginary canopy, envision a malfunction, and then run through the appropriate responses to the malfunction. Each malfunction scenario should be reviewed this way, as should the procedures for checking a good canopy. This exercise requires concentration and diligence; it should not be just a cursory afterthought.

Emergency Procedure

This procedure is the same for every malfunction that cannot be cleared.

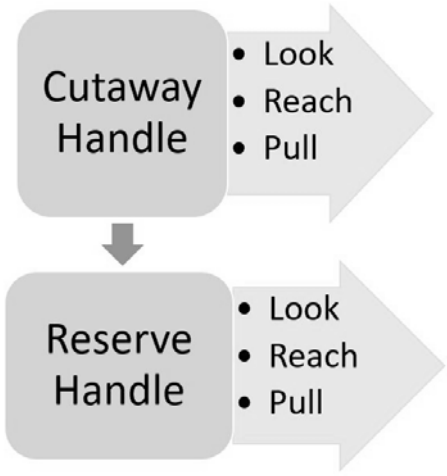
THROW AWAY DROGUE HANDLE VIGOROUSLY, LEFT HAND ON BUTT, FEET TOGETHER, HEAD DOWN.

1. **LOOK** AT CUTAWAY HANDLE.
2. **REACH** AND GRAB CUTAWAY HANDLE.
3. **PULL** CUTAWAY HANDLE, THROW IT AWAY.
4. **LOOK** AT RESERVE HANDLE.
5. **REACH** AND GRAB RESERVE HANDLE.
6. **PULL** RESERVE HANDLE, THROW IT AWAY.

Another way to think of the emergency procedure is by the three-step process, **LOOK, REACH, PULL.** When the decision has been made to cut away a malfunctioning main, the jumper must **LOOK** at the cutaway handle, **REACH** for it, then **PULL** it. The jumper then must **LOOK** at the reserve handle, **REACH**

for it, and **PULL** it.

Figure 28: Look, Reach, Pull Emergency Procedure



The same emergency procedure is used for all the malfunctions we may encounter.

Once the decision to go to the emergency procedure has been made, attention should be focused on the chest/reserve area, where all the handles are located.

Lesson 5-2 – Types of Malfunction Procedures

Students will be introduced to possible ram-air parachute malfunctions. They will also be shown the video on Ram-Air Parachute Malfunction and Emergency Procedures.

Lesson Objectives

At the completion of this lesson, student(s) must be able to accurately:

- ☐ Describe verbally the three primary ram-air malfunction procedures.
- ☐ Demonstrate verbally and physically the appropriate corrective action needed for any given primary malfunction.
- ☐ Describe verbally the special situations that may occur during a jump.
- ☐ Describe verbally the appropriate corrective action needed for any given special situation.

Primary Malfunctions

There are three primary malfunction procedures:

1. Check-With-Vigor.
2. Three-Pumps.
3. Entangled.

Check-With-Vigor Malfunction Procedure

The "Check-With-Vigor" malfunction procedure encompasses everything from drogue-in-tow to no drogue deployment to parachute bag-lock.

Drogue-in-Tow

Drogue deployed but did not release. Possible causes include:

- Three-rings not hooked up correctly.
- Swedge came loose on drogue release handle.
- Drogue bridle broke.
- Improper alignment of drogue 3-ring.
- Freezing of wet components of drogue 3-ring assembly.

- Debris in drogue 3-ring assembly.

Corrective Action:

Initiate a vigorous check for canopy, "Check-With-Vigor." A vigorous look back bumps the drogue 3-ring with the back of the helmet and changes the geometry of the harness near the drogue 3-ring. If the drogue does not release following the "Check-With-Vigor," the emergency procedure is initiated.

Drogue Did Not Deploy

Possible causes include:

- Jumper forgot to hook up.
- Cable broke.
- Weak link broke.

Corrective Action:

Initiate a vigorous check for canopy, "Check-With-Vigor." A vigorous look back bumps the drogue 3-ring with the back of the helmet and changes the geometry of the harness near the drogue 3-ring if the drogue is present. If the drogue does not release following the "Check-With-Vigor," the emergency procedure is initiated.

Note this corrective action would be ineffective for this type of drogue-in-tow (DIT) malfunction, but would still allow sufficient altitude for reserve deployment. The corrective action is specified for this type of DIT malfunction to keep procedures consistent for all DIT malfunctions. Consistent procedures reduce malfunction identification decision points and result in better performance in high stress situations.

Bag-Lock

Lines deployed, but canopy remains in deployment bag. Possible causes include:

- Rigging error.

Corrective Action:

Initiate a vigorous check for canopy, "Check-With-Vigor." If the bag-lock does not release following the "Check-With-Vigor," the emergency procedure is initiated.

Note this corrective action would likely be ineffective for this type of DIT malfunction but would still allow sufficient altitude for reserve deployment. The corrective action is specified for this type of DIT malfunction to keep procedures consistent for all DIT malfunctions. Consistent procedures reduce malfunction identification decision points and result in better performance in high stress situations.

Three-Pumps Malfunction Procedure

You will use this malfunction procedure when you have risers deployed and some parachute material trying to inflate, such as a spinning canopy, a hung slider, a line over, or a streamer.

Streamer Malfunction

The drogue has been released; canopy is above the jumper, but will not inflate. Possible causes include:

- Hung slider.
- Tangled lines.
- Line-over.
- Opening damage.
- Material failure.

Corrective Action:

Grab the toggles and pump them deliberately three times all the way down. This should inflate the canopy. If not, initiate the emergency procedure.

Spinning Malfunctions

A spinning malfunction is a partially or fully open canopy that goes into a turn after opening. For a spinning malfunction caused by broken lines, it is important that you evaluate whether the canopy can be controlled before you cut away the main. If the main canopy is not controllable (does not pass the control check), it is time to get rid of it and deploy a parachute you can land.

Rapid Spinning

Rapid turn rate with a rapid descent rate. Possible causes include:

- Lines tangled.
- Broken lines.

Corrective Action:

Grab the toggles and pump three times all the way down. If the spin does not stop; initiate emergency procedures.

Broken Brake Line

Canopy will be in a slow turn. Possible causes include:

- Brake line broke on opening.

Corrective Action:

Release the other brake line, let it up, and then steer with your risers. Turn with your front or rear risers, flare with your rear risers.

Released Brake Line

Possible causes include:

- Brakes stowed incorrectly.
- Hard opening.

Corrective Action:

Stop the spin by releasing the other brake. Steer with the brake lines or rear risers. If you can't reach the toggles, steer with your risers.

Entangled Drogue Malfunction Procedure

An entangled drogue malfunction would occur if the drogue deployed and either the drogue or the bridle got caught on part of your body.

Drogue or Drogue Bridle Entanglement

Possible causes include:

- Poor exit.

Corrective Action:

1. Jump count is initiated ("Jump Thousand, Look Thousand…").
2. Entangled drogue is identified ("Entangled").
3. Three attempts to clear ("Clear Thousand, Clear Thousand, Clear Thousand").
4. If drogue clears – pull drogue release handle ("Pull Thousand").
5. If drogue does not clear – initiate the emergency procedure ("Look, Reach, Pull – Look, Reach, Pull"). *(It is acceptable to use both hands to clear the entanglement. If it clears, return left hand to hip; if it does not clear, it may be necessary to use the left hand to hold fabric clear of handles and the deploying reserve.)*

Special Situations

Several special situations can occur that, although rare, you need to be prepared to deal with. These include horseshoe malfunctions, lost handles, collisions, two canopies, released 3-rings, line twists, end-cell closure, drogue over the nose, twisted risers, and canopy damage.

Horseshoe Malfunction Procedure

This malfunction can occur if the curved locking pin is not properly seated on the main container and prematurely dislodges from the closing loop. The horseshoe could also occur if something interferes with the deployment sequence, allowing the drogue to catch on some part of your body. When a parachute deploys, but remains attached to the jumper by the risers and at least one other point, the resulting mess would resemble a horseshoe shape.

Horseshoed Canopy

Possible causes include:

- Improperly seated curved locking pin on main container.
- Loose body position or loose equipment.

Corrective Action:

Throw your drogue release handle, slap (or brush) at the drogue three times to try to clear the drogue from your body. If it doesn't clear, initiate the emergency procedure.

Lost Handle

A lost handle malfunction would occur if the jumper was unable to locate the drogue release handle after exiting the aircraft. Possible causes include:

- Loose or unhooked leg strap.
- Jacket material covering handle.
- Handle came out of keeper and is floating.
- Jumper focuses on another part of harness.

Corrective Action:

Continue count to a total of three "pull thousands," making three attempts to find and pull your drogue release handle. With each additional "pull thousand," look for and attempt to pull the drogue release handle, beginning your search by following the chest strap across your body from right to left toward the drogue release handle and broadening your search until the third “pull thousand”. If you cannot find it by the third "pull thousand," initiate emergency procedure.

Collisions

One of the most dangerous situations a jumper can encounter is a midair collision with another jumper. A collision between jumpers can result in both jumpers becoming entangled, loss of steering control, and possible collapse of canopies. Prevent this by always being aware of your airspace and knowing where other jumpers are at all times.

Table 7: Corrective Action for Collisions

Scenario	Possible Causes	Corrective Action
Jumpers opening up close to one another	• Spotter error. • Jumper in latter stick has a malfunction.	Check airspace and initiate a right turn. Yell to other jumper to make sure he/she knows your location. One jumper gains vertical separation.
Jumpers are facing each other and closing	• Unawareness of airspace. • Canopies open facing one another.	Make a right turn by grabbing anything on the right side that will turn you: a steering toggle, a front riser, or a rear riser. Establish verbal communication.
Inevitable collision	• Jumper error.	Extend your arms and legs to avoid passing through lines. Communicate with your jump partner. If there is sufficient altitude, the lower jumper could cut away by pulling the cutaway handle and then pulling the reserve handle. At lower altitudes, cutting away is not an option. Don't do anything that will worsen the situation. Do the best PLF you have ever done.

Two Canopies

The main and reserve are both deployed.

Table 8: Corrective Action for Two Canopies

Scenario	Possible Causes	Corrective Action
Main and reserve are fully inflated.	• Inadvertent reserve opening. • Out of sequence emergency procedure. • Pulling the RSL lanyard and the drogue release handle simultaneously.	Ensure parachutes are not tangled, disconnect upper RSL then cut away the main canopy by pulling the cutaway handle. You must be positive that the canopies are clear, if there is any doubt; fly both canopies to the ground. It is better to land two canopies than to risk entanglement. If the canopies are tangled gently steer with your rear risers using the inside riser of each canopy.
Main inflated, reserve starting to deploy.	• Inadvertent reserve opening.	Stop deployment by grabbing the free bag; stop the deployment and stow it in a manner to ensure that it will not entangle you if it starts to inflate. If the reserve is partially inflated, you can aid the deployment by shaking the risers.

Released 3-Ring

The inadvertent release of a riser 3-ring parachute attachment would put the canopy in an uncontrollable spin. Possible causes include:

- Improper hookup of the 3-ring.
- Broken soft loop.

Corrective Action:

Initiate the emergency procedure.

Line Twists

The main canopy is open, but the lines are twisted together. Possible causes include:

- Drogue release pulled before jumper is stable.
- Rigger error.

Corrective Action:

Do not release the brakes until untwisted.

- Kick feet, grab the risers, and pull them apart.
- Yell to jump partner to inform him/her of your twists.
- A jumper can be twisted so much it can be considered a malfunction.
- See how well the canopy is inflated. If the slider is below the cascade points, the canopy can be landed safely, but steering will be impossible until the canopy untwists.
- If the slider is below the cascade points, it is highly unlikely that the canopy would be twisted enough to be considered a malfunction.

End Cell Closure

The canopy is inflated except for the end cells. The canopy will fly just fine in this condition. Possible causes include:

- "Things happen."
- Turbulence.

Corrective Action:

- Not a malfunction. Simply pump the toggles to re-inflate.
- Turbulence may induce end cell closures. Fly at 1/2 brakes to overcome this problem.

Drogue Over the Nose

Occasionally the drogue will drape itself over the nose of the canopy. Possible causes include:

- Prolonged stall.

Corrective Action:

Confirm that the drogue is not affecting control and then ignore it.

Twisted Risers

The canopy is fully inflated and oriented correctly. One or both risers have a full twist in them. Possible causes include:

- Rigger error.

- Jumper hooked up canopy with risers twisted.

Corrective Action:

Confirm that the twist(s) is not affecting control. There will be more pressure on the toggles but steering should not be a problem.

Rips and Tears

Some of the canopy nylon has been damaged on opening. The ram-air can sustain significant damage and still be controllable. Possible causes include:

- Rigger error.
- Hard opening.

Corrective Action:

Determine canopy controllability. If the canopy cannot be landed safely, initiate the emergency procedure. If the canopy can be landed safely avoid radical maneuvers, and land at 1/2 brakes.

Summary

The same emergency procedure is used for all of the malfunctions that may be encountered. The decision to get rid of a canopy you cannot land should be made promptly. If you have doubts about the airworthiness of your main canopy, you should opt to get a good parachute above you: the reserve. Once the decision to go to the emergency procedure has been made, **focus attention on the chest/reserve area and carry out the emergency procedure.**

Lesson 5-3 – Malfunction Television (MTV) Training

The Malfunction Television (MTV) is used to reinforce malfunction identification and execution of the proper emergency procedure.

Lesson Objectives

At the completion of this lesson, student(s) must accurately:

- ☐ Recognize and identify all malfunctions given (or shown) without hesitation.
- ☐ Describe and perform the appropriate procedures.

The MTV involves one-on-one interactive video, with the student responding to a variety of malfunctions as an instructor evaluates student responses.

Lesson 5-4 – Explanation of Units Training

Students will be introduced to the Units Training.

Lesson Objectives

At the completion of this lesson, student(s) must be able to:

- ☐ Identify verbally the safety concerns and proper procedures at the Units Training.

Lesson 5-5 – Tower Training

Students will perform training tower jumps. Students will be evaluated on their ability to identify malfunctions and execute proper malfunction and emergency procedures.

Tower training reinforces what student(s) have already learned about proper aircraft procedures, exits, and malfunction procedures. The tower stresses a student much like an actual jump. Students **must** demonstrate competence in all aspects of tower training before graduating to actual jump training.

Lesson Objectives

At the completion of this lesson, student(s) must:

- ☐ Perform at least four actual training tower jumps with a satisfactory evaluation. This will include the performance of proper aircraft, exit, and malfunction procedures.

CHAPTER 6
LETDOWNS

RAM-AIR PARACHUTE TRAINING GUIDE

USFS SMOKEJUMPER PROGRAM

CHAPTER 6 – Letdowns

In this chapter, student(s) will be introduced to smokejumper letdown training. This training teaches students to perform a standard letdown from a ram-air canopy.

Chapter 6 Objectives

At the completion of Chapter 6, student(s) must:

- ☐ Perform a flawless tape and carabiner letdown in less than 3 minutes 15 seconds.

Letdowns from Trees

While it is generally better to land on the ground, tree landings are not usually dangerous. If you have miscalculated your approach, hold what you've got. A low hook-turn to make the primary jump spot is more dangerous than a tree landing. If a tree landing is eminent, slow down your airspeed. Attempt to hit the tree solidly so as to bag or cap the tree. Avoid hardwoods, snags, and larch trees.

Tree Landings

1. Avoid hardwoods and snags; they are brittle and tend to break.
2. Always approach into the wind.
3. Pick a specific tree to land in. Steer for it just like you would for a spot on the ground. Smaller trees are generally better.
4. Approach the tree at 1/2 brakes.
5. Aim about 6 to 10 feet below the top of the tree so the canopy will cap the tree.
6. Ease into the tree with some forward speed.
7. Keep hands and arms close to the body until you have stopped falling to avoid snagging on limbs.
8. Visually check how well you're hung up but do not bounce to test.

If the canopy is not secure in the tree (slipping), then try to ensure a solid anchor point. For example, pull yourself into the trunk of the tree and tie off to it before proceeding with the letdown.

Letdown Equipment Standards

- Service life of tape/rope will be 10 years or 10 letdowns/uses.
- Lowering cargo with letdown tape/rope constitutes one use.

- Tape/rope will be inspected after each letdown/use and replaced if necessary.

Students **must** perform a flawless letdown in the specified time frame before graduating from the Units Training. Students will talk their way through the letdowns so instructors can hear that no steps are missed and to help students memorize the procedure.

Lesson 6-1 – Tape and Carabiner Letdowns

Lesson Objectives

At the completion of this lesson, student(s) must:

- ☐ Perform without error a smokejumper letdown in 3 minutes 15 seconds or less from a letdown training apparatus.

Letdown Procedures – Tape and Carabiner

1. Make sure the parachute is securely hung in the tree. If it isn't hung up securely, try to pull yourself over to the tree and begin the letdown procedure from the trunk or a branch.
2. Place drogue release handle in left leg pocket.
3. Feel around your neck, head, arms, and legs for suspension lines. Tie loose lines off, away from your body. This is to prevent you from getting hung up in any lines during your letdown.
4. Unfasten right side of reserve, PG bag, and lower PG bag attachment and allow them to hang on the left side.
5. Pull the O-rings out of your jump pants and straighten them. Make sure your carabiner is on the right ring assembly, with the gate facing away from your body.
6. Remove 4 to 6 feet of letdown tape and pass it up under your right leg. Leave the remainder of the letdown tape in your leg pocket.
7. Pass the letdown tape through your O-rings twice from right to left. Check for play.
8. Tie off to the tight side riser:
    a. Starting inboard, thread tape between the V formed on the tight riser (inside to outside).
    b. Wrap tape around back of riser, around front of riser, and thread through the V from outside to inside.
    c. Tie off with three half hitches leaving 6 to 12 inches of tail.
    d. Tuck the tail back into the V of the riser.
    e. Now is a good time to pull the cutaway cables from the keepers.

f. **NOTE:** If possible, always tie to the bole or a healthy limb greater than 3 inches in diameter. Route the tape through the tight riser, then wrap the tape around the bole of the tree or branch and tie off with three half hitches. Leave 6 to 12 inches of tail.

9. Pass the tape through the carabiner. Be sure the carabiner is away from your body, with the O-ring of your jump pants between you and the carabiner.

10. Take up the slack in the tape between the riser and O-rings:

    a. Grasp the tight riser with one hand and the tape below the O-rings with the other.

    b. Simultaneously do a one-arm pull-up on the riser and take up all the slack with the other hand. Your entire weight should now be supported by the letdown tape.

    c. Transfer weight to carabiner.

    d. Pinch letdown tape on carabiner with left hand and tie off letdown tape on carabiner using a slip knot. The loop of the knot should be at least 8 inches long.

    e. Tie a safety hitch onto the 8-inch loop of the slip knot

11. Keep the coiled tape or tape bag in your leg pocket.

12. Now do a **FIVE-POINT CHECK:**

    a. Make sure the RSL is disconnected.

    b. Tape tied to riser/fixed object with three half-hitches.

    c. Tape through O-rings.

    d. Tape under right thigh.

    e. Tape through carabiner, tied off and secured with a safety hitch.

> **Caution:** *If you skip the 5-point check and forget to do b, c, or d above, you will probably fall.*

13. Release the risers:

    a. Place your loose side hand in the V on the loose side riser.

    b. Holding your weight on the loose side riser, slowly pull the loose cutaway cable with the other hand until the 3-ring releases.

    c. GENTLY EASE DOWN FROM RISER.

    d. Place your tight side hand in the V on the tight side riser.

    e. Holding your weight on the tight side riser, slowly pull the cutaway handle with the other hand until the 3-ring releases.

f. GENTLY EASE DOWN FROM RISER.

14. Check again for suspension lines.
15. Remove safety hitch.
16. Pinch letdown tape on carabiner with left hand and pull the slip knot free with your right hand (palm facing up). You can use your left hand to clear limbs and maneuver on your way down, while braking with your right hand. The right hand will provide sufficient stopping force by simply squeezing the tape and dropping your hand to outer right thigh.
17. Let the tape slide slowly through your hands and make a smooth descent. The rate of descent can be controlled by braking.
    - Avoid sudden stops since this could dislodge the canopy from the tree.
    - Keep your hands out and away from the O-rings and carabiner to prevent your gloves and sleeves from tangling. If any material gets sucked into the O-rings you will be unable to continue rappelling as the rings will be jammed.

Reserve Letdown Procedures – Tape and Carabiner

Procedures for the reserve letdown are almost the same as for a standard letdown with a few modifications. Because the reserve is not able to release from the harness in the same manner as the main, the jumper must climb out of his/her harness to descend.

1. Make sure the parachute is securely hung in the tree. If it isn't hung up securely, try to pull yourself over to the tree and begin the letdown procedure from the trunk or a branch.
2. Feel around your neck, head, arms, and legs for suspension lines. Tie loose lines off, away from your body. This prevents you from getting hung up in any lines during your letdown.
3. Put radio and reserve knife in left leg pocket. Unfasten both PG bag and reserve container; let them fall to the ground.
4. Pull the O-rings out of your jump pants and straighten them. Make sure your carabiner is on the right ring assembly, with the gate facing away from your body.
5. Remove 4 to 6 feet of letdown tape, passing it under your right leg. Leave the remainder of the letdown tape in your leg pocket.
6. Pass the letdown tape through your O-rings twice from right to left. Check for play.
7. Tie off to the non-gated side of the carabiner on the tight side riser. Wrap the tape around the carabiner twice, and tie off with three tight half hitches leaving 6 to 12 inches of tail.

   NOTE: If possible, always tie to the bole or a healthy limb greater than 3 inches in diameter. Route the tape through the tight side riser carabiner, then wrap the tape around the bole of the tree or branch and tie off with three half hitches. Leave 6 to 12

inches of tail.

8. Pass the letdown tape through your carabiner. Be sure the carabiner gate is facing away from the body, with the O-ring of your jump pants between you and the carabiner.
9. Take up the slack in the tape between the riser and O-rings:
    a. Your entire weight should now be supported by your letdown tape.
    b. Grasp the tight riser with one hand and the tape below the O-ring with the other. Simultaneously do a one arm pull up on the riser and take up all the slack with the other hand. **NOTE:** Make sure tape is clear of leg strap before pulling the slack out. If this is not done it may interfere with the removal of the leg strap in later steps. Your entire weight should now be supported by your letdown tape.
    c. Transfer weight to carabiner.
    d. Pinch letdown tape on carabiner with left hand and tie off letdown tape on carabiner using a slip knot. The loop of the knot should be at least 8 inches long.
    e. Tie a safety hitch onto the 8-inch loop of the slip knot.
10. Keep the coiled tape or tape bag in your leg pocket.
11. **Now do a FOUR-POINT CHECK: (there's no need to worry about the RSL)**
    a. Tape tied to carabiner/fixed object with three half hitches.
    b. Tape through O-rings.
    c. Tape under right thigh.
    d. Tape tied off to carabiner with slip knot and secured with a safety hitch.

> ***Caution:*** *If you skip the Four-Point Check and forget to do a, b, or c above, you will probably fall.*

12. Climb out of your harness:
    a. Undo your chest strap.
    b. Loosen your leg straps.
    c. Release the leg strap on the left side.
    d. Pull your left arm out of the harness.
    e. Release the leg strap on your right side.
    f. Pull you right arm out of the harness; you should now be out of your harness.
13. Check again for suspension lines.

14. Remove safety hitch.
15. Pinch letdown tape on carabiner with left hand and pull the slip knot free with your right hand (palm facing up). You can use your left hand to clear limbs and maneuver on your way down while braking with your right hand. The right hand will provide sufficient stopping force by simply squeezing the tape and dropping your hand to outer right thigh.
16. Let the tape slide slowly through your hands and make a smooth descent. The rate of descent can be controlled by braking.
    - Avoid sudden stops since this could dislodge the canopy from the tree.
    - Keep your hands out and away from the O-rings to prevent your gloves and sleeves from tangling. If any material gets caught in the O-rings you will be unable to continue rappelling as the rings will be jammed.

Two-Tape Letdown Procedures – Tape and Carabiner

The two-tape letdown is exactly the same as the standard letdown until the end of the letdown tape is reached.

1. With about 10 to 15 feet of tape left, the jumper ties off to the carabiner with a slipknot and safety knot.
2. Jumper's jump partner climbs tree to get a second tape to him/her, or throws a tape up, or the jumper in the tree hauls the second tape up with parachute cord.
3. Ends of both tapes are tied together with a simple overhand knot.
4. Jumper releases the slipknot and proceeds with the letdown (overhand knot will pass through the O-rings on jump pants).

Lesson 6-2 – Special Jump Spot Situations

Student(s) will be introduced to special jump spot situations which may occur even though they are not desired. These situations can affect the jumper's flight plan and/or landing zone. Student(s) will be given ways to minimize the risks of injury if these situations present themselves in the field.

Lesson Objectives

At the completion of this lesson, student(s) must:

- ☐ Identify and describe verbally at least four special jump spot situations and accurately describe techniques for minimizing the risk of injury in these situations.

Right of Way

1. The right of way always goes to the lower jumper or to the jumper in the blind.
2. If two jumpers are converging on one another, each should slow down and turn away from the other. This often happens on final when two jumpers approach the spot from different angles. A jumper should never get so fixated on the spot that he/she doesn't know where the other jumpers are. If you are converging on another jumper on final, yell to get his/her attention. Do not assume that the other jumper sees you. Turn away from the spot and land in an alternate spot, if need be. **ALWAYS SACRIFICE ACCURACY FOR SAFETY!**

High Wind Landings

A problem with high wind landings is getting dragged by the parachute once on the ground. If you know it is windy always:

1. Face into the wind.
2. Make sure your RSL has been disconnected
3. Don't perform a full performance flare.
4. Cut away the canopy after you hit the ground.
5. Pull down on one toggle. This will cause the canopy to fly itself into the ground.

Water Landings

If you find yourself coming down over water you should steer for the nearest shore. Don't give up; keep steering for shore for as long as you can. Your jump partner should bring his/her letdown rope to

the nearest point of land to assist you. When a water landing is imminent, you should do the following:

1. Make sure your RSL is released. This will prevent your reserve from deploying when the main canopy is cut away after landing. A reserve deployment in the water will compound problems, especially in moving water.
2. Turn and face into the wind; set up as if you are making a normal landing.
3. Flare the canopy before splash down just as you would for any landing; be prepared to do a PLF. Facing into the wind and flaring on landing will cause the canopy to land behind you rather than on top of you.
4. Execute a PLF upon landing.
5. As soon as you hit the water cut away your canopy by pulling your cutaway handle.
6. Float face up. In swift water, float feet first downstream.
7. Don't panic if canopy is covering you. The facemask provides airspace. Clear the canopy by pulling from overhead toward stomach. Remember your reserve knife in case you need to cut lines.
8. Back paddle to shore.
9. Retrieve parachute only in non-critical situations. If situation is non-critical parachute can be retrieved by tying your letdown rope to a riser and dragging the canopy in with the letdown rope after you've reached the shore. NEVER TIE THE PARACHUTE TO YOURSELF.

Ice Landings

If you find yourself coming down over ice you should steer for the nearest shore. Don't give up; keep steering for shore for as long as you can. Generally, ice is thin during jump season and a jumper will break through it and into the water. Your jump partner should bring his/her letdown rope to the nearest point of land to assist you. When an ice landing is imminent, you should do the following:

1. Do a good PLF. Thick ice is a particularly hard surface.
2. If you break through the ice, crawl up onto the surface as quickly as possible. If the ice is too thin to support your weight while standing, lie flat and crawl.

Jump Partner Responsibilities: If you see your jump partner go into water or ice, you must ensure that he/she makes it safely to shore. There are a few things you should do and be thinking about:

- Grab your letdown rope.
- Throw one end of your letdown rope to your jump partner and try to haul him/her in.
- Stay off the ice.

- If your jump partner goes through the ice or lands in water, build a fire to help him/her get dry; watch for signs of hypothermia.

Power Line Landings

Do whatever you must to keep from landing in power lines, even if it means doing a downwind landing. If collision with a power line is imminent:

1. Bring your arms in tight across your chest.
2. Make sure your feet and knees are together (make yourself as streamlined as possible so you don't bridge on any two lines).
3. Try to zero out your airspeed (but don't stall), so that you come straight down between the power lines.
4. **Do not** grab any power lines.

If you hang up in the power lines, you have the following options:

- Have someone call the power company and have them turn off the power before you do anything.
- If you're not too high off the ground, you may elect to cut away without tying off to your canopy with your letdown rope. Make **sure** your RSL is disconnected. Remove the knife from the reserve container. Release your PG bag and reserve and drop them to lessen the impact when you hit the ground.
- If you do a letdown, **DON'T DROP YOUR LETDOWN ROPE TO THE GROUND; LEAVE IT IN YOUR LEG POCKET.** If your letdown rope falls to the ground, you could be electrocuted.
- **Tape and carabiner procedure**. When you're about ten feet off the ground, stop your descent and perform the tie off procedures. Remove knife from the reserve container. Release your PG bag and reserve and drop them to lessen the impact when you hit the ground. Grab the tape above the O-rings and cut your letdown tape cleanly below your O-rings. Then release tie off, let go of the rope and fall to the ground. Do a good PLF.
- **Friction device and rope procedure.** When you're about 10 feet off the ground, stop your descent and perform the tie-off procedures. Remove: knife from the reserve container. Release your PG bag and reserve and drop them to lessen the impact when you hit the ground. Cut rope 6 inches below the friction device. Grab rope above friction device, release safety knot and let go of rope. Do a good PLF.

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CHAPTER 7 PARACHUTE LANDING FALLS

RAM-AIR PARACHUTE TRAINING GUIDE

USFS SMOKEJUMPER PROGRAM

CHAPTER 7 – Parachute Landing Falls

In this chapter, student(s) will be introduced to the parachute landing fall (PLF). A properly done PLF minimizes the shock of landing by distributing the force of the landing throughout the entire body.

This chapter is divided into three lessons: Parachute Landing Fall Performance Standards, Class Demonstration, and Roll Simulator.

Chapter 7 Objectives

At the completion of Chapter 7 student(s) must:

- ☐ Accurately verbalize the three categories of the PLF evaluation criteria and identify the instructor responses associated with each evaluation.
- ☐ Accurately describe three reasons why doing a good PLF is important.
- ☐ Accurately identify the five points of contact and proper procedures for doing PLFs off the roll simulator.
- ☐ Satisfactorily perform six PLFs, one in each of the six directions: forward (left and right), backwards (left and right), and directly to the right and left sides.

Lesson 7-1 – Parachute Landing Fall Performance Standards

Students will be given the performance criteria used in evaluating their PLFs.

Lesson Objectives

At the completion of this lesson, student(s) must:

- ☐ Verbally list the three categories of the PLF evaluation criteria.
- ☐ Identify the instructor responses associated with each evaluation.

Performance Categories

The following three performance categories are intended to help students understand what is expected of them during PLF simulator training. The categories also serve to identify any trends that are deemed unacceptable and aid the student in correcting any of these problems.

1. **Satisfactory**--Student demonstrates good, tight body position; hits all five points of contact.
2. **Needs improvement**--Student erred in one of the components of the PLF; arm out, feet apart, missing one of the five points of contact.
3. **Unacceptable**--Student consistently makes mistakes; sticking arms out, poor body position, feet constantly apart. A feet, knees, head PLF would be a good example of what instructors would consider unacceptable.

Category Responses

A **Category 2** evaluation would precipitate one-on-one counseling with an instructor, using video review to aid in correcting any mistakes, and a discussion of the error. Students having trouble with PLFs on the simulator would be taken to the ramp and "talked through" the correct technique by an instructor.

A **Category 3** evaluation would be reviewed by the student and at least two instructors. If the student is having difficulty with PLFs, the instructors will concentrate on the basic components of a correct PLF on the ground and work up to the simulator. However, if a student establishes a pattern of unacceptable PLFs and this pattern continues, it would be considered grounds for removal.

Lesson 7-2 – Class Demonstration

Students will be introduced to the proper way to use the Roll Simulator. Proper parachute landing falls (PLFs) in all directions will be demonstrated.

The parachute landing fall minimizes the shock of landing by distributing it throughout the entire body. Students are taught to do a PLF on every jump, no matter what the weather or the jump spot dictates. Emphasis is placed on keeping feet and knees together, getting off the feet quickly, and keeping hands and arms tight against the body.

Lesson Objectives

At the completion of this lesson, student(s) must accurately:

- ☐ Describe three reasons why doing a good PLF is important.
- ☐ Identify the three basic kinds of PLFs.
- ☐ Identify the five points of contact and proper procedures for doing PLFs off the roll simulator.

Parachute Landing Falls (PLFs)

1. **<u>There are three basic kinds of PLFs:</u>**
   - Front (left, right)
   - Side (left, right)
   - Rear (left, right)
2. **<u>Why do a good PLF?</u>**
   - Landing shock is spread throughout entire body.
   - PLFs done correctly can prevent injuries.
   - Doing bad PLFs is a habit that will hurt you eventually.

   A jumper should perform good PLFs instinctively, every time.
3. **<u>Preparation for landing:</u>**
   a. Face into the wind.
   b. Hands at 1/2 brakes.

c. Arms and elbows tucked in at sides.

d. Knees slightly bent.

e. Eyes at 45 degrees (don't look at ground beneath feet).

f. **DON'T TENSE UP.**

Every successful jump ends with an attempt to perform a PLF.

4. **The five points of contact:**

a. Balls of feet.

b. Calves.

c. Thighs.

d. Butt.

e. Lats.

5. **Points to stress:**

- Get over the instinct to stick arms out to break fall.
- Keep feet and knees together.
- Look where you want to roll.
- RELAX TO MAKE THE ROLL FLUID.

Lesson 7-3 – Roll Simulation

Students will perform Parachute Landing Falls. They will be evaluated based on the criteria presented in Lesson 7-1.

Lesson Objectives

At the completion of this lesson, student(s) must:

- ☐ Successfully perform six PLFs, one in each of the six directions.

CHAPTER 8 RAM-AIR FLIGHT THEORY

RAM-AIR PARACHUTE TRAINING GUIDE

USFS SMOKEJUMPER PROGRAM

CHAPTER 8 – Ram-Air Flight Theory

This chapter is divided into seven lessons: Ram-Air Flight Theory; Flight Characteristics, Performance, and Techniques; Patterns; Jump Spot Selection; Fundamentals of Spotting; Jump Spot Weather and Terrain; and High Wind Jumps.

Chapter 8 Objectives

At the completion of Chapter 8, student(s) must:

- ☐ Describe the basic concepts of ram-air aerodynamics.
- ☐ Describe the three primary factors that affect the performance of the ram-air canopy.
- ☐ Describe how the stall point of a canopy is identified and why it is important.
- ☐ Draw glide angles for the full run, 1/4 brake, 1/2 brake, 3/4 brake, and stall brake settings. Identify the optimal glide angle brake setting, acceptable brake settings for landing, and the safety position toggle setting.
- ☐ Describe how the planing maneuver is executed and identify good uses for it during a jump.
- ☐ Describe a canopy's flight characteristics in the full brake setting (mushing, sinking, riding-the-ball) listing toggle position, forward speed, and descent rate.
- ☐ List good uses, common mistakes, and watch-outs for the full brake setting (mushing, sinking, riding the ball).
- ☐ Describe a canopy's flight characteristics during a stall and indicate a good use of the stall.
- ☐ Identify the two types of toggle turns and list the characteristics of each type.
- ☐ Describe front and rear riser turns and good uses for each.
- ☐ Identify the three types of landing maneuvers listing advantages and disadvantages to each.
- ☐ Identify the legs of a traffic pattern and cite suggested altitudes for each leg.
- ☐ List advantages to flying a standard pattern.
- ☐ Contrast standard patterns for high and low wind conditions.
- ☐ Explain how wind variations will alter the standard pattern.
- ☐ List guidelines for using a nonstandard pattern.
- ☐ List nonstandard pattern watch-outs.
- ☐ Identify the four parts to every jump and verbally describe factors influencing proper techniques utilized in each part.

- ☐ Verbally describe techniques that will minimize risks associated with varying jump conditions.
- ☐ Identify and describe verbally desirable and undesirable jump spot characteristics.
- ☐ Identify average wind direction based on landing location of streamers.
- ☐ Determine average wind speed based on landing location of streamers and spotter's estimate of drift.
- ☐ Explain how the presence of up or down air is determined.
- ☐ Explain how wind variations will alter the standard pattern.
- ☐ Identify three types of jump-ship patterns that are used to drop jumpers.
- ☐ Identify and describe verbally at least five special jump spot situations and accurately describe techniques for minimizing the risk of injury in these situations.
- ☐ Identify and describe verbally at least six influential factors that are pertinent to jump spot selection and evaluation.
- ☐ Describe verbally how given weather and topographic conditions can affect a landing on a given jump spot.
- ☐ Accurately identify ground hazards, alleyways, and alternate jump spots on a given slide projection.

Lesson 8-1 – Ram-Air Flight Theory

This lesson introduces student(s) to the basic theory of ram-air parachute flight.

Lesson Objectives

At the completion of this lesson, student(s) will:

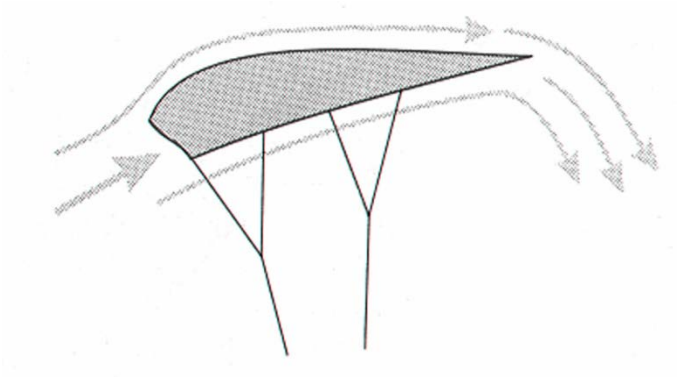
- ☐ Describe the basic concepts of ram-air aerodynamics and the generation of lift.

Ram-Air Flight Theory

The ram-air parachute is an aerodynamically stiffened fabric wing that generates lift as it moves forward through the air. The airfoil's angle of incidence is maintained by the relative lengths of the suspension lines; the leading edge of the wing is slightly lower than the trailing edge.

Thus, the airfoil-shaped canopy is forced to slide or plane through the air, similar to a glider in descending flight. The ram-air wing generates lift in the same manner, relying primarily on the reduced pressure of the air flow over the curved upper surface.

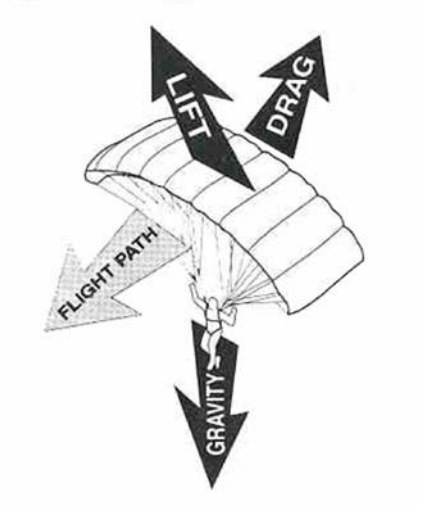
Figure 29: Ram-Air Wing Air Flow



The leading edge of the wing is open or physically missing, forming intakes that inflate the cells. The internal air pressure causes a small amount of stagnant air to be pushed ahead of the airfoil, forming an artificial leading edge. The focal point of this stagnant air acts as a true leading edge, deflecting the relative wind above and below. Drag, which acts in a direction parallel to the relative wind, is the only force tending to retard the forward motion of the wing through the air. Gravity, plus the resultant sum of these aerodynamic forces on the upper surface, acts to "pull" the wing through the air, thus the flat

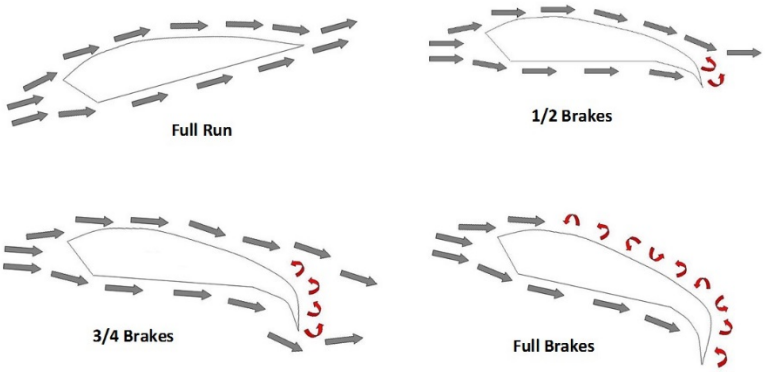
glide angle.

Figure 30: Lift, Drag, Gravity



Application of brakes on the parachute pulls the trailing edge down, creating additional drag and a loss of gliding speed. This also produces a proportionate loss in lift, resulting in a steeper glide angle. As full brakes are reached, the wing ceases to generate lift altogether, the result being a nearly vertical descent angle. Pulling the toggles beyond full brakes will cause the parachute to stall. The following figure illustrates the loss of lift associated with various brake settings.

Figure 31: Application of Brakes



Differential application of brakes (one side only or one side more than the other) produces an unbalanced drag force at the trailing edge, resulting in a yaw turn toward the side with the highest drag.

Because the "slow" side generates less lift, it tends to drop slightly in a shallow banking motion, much like an airplane. This bank angle increases as the difference between toggle pull increases.

Lesson 8-2 – Flight Performance, Characteristics, and Techniques

The ram-air parachute is a flying machine. The jumper must understand flight performance capabilities and master a few techniques to get the most out of the parachute.

Lesson Objectives

At the completion of this lesson, student(s) will:

- ☐ Describe the three primary factors that affect the performance of the ram-air canopy.
- ☐ Describe how the stall point of a canopy is identified and why it is important.
- ☐ Draw glide angles for the full run, 1/4 brake, 1/2 brake, 3/4 brake, and stall brake settings. Identify the optimal glide angle brake setting, acceptable brake settings for landing, and the safety position toggle setting.
- ☐ Describe how the planing maneuver is executed and identify good uses for it during a jump.
- ☐ Describe a canopy's flight characteristics in the full brake setting (mushing, sinking, riding-the-ball) listing toggle position, forward speed, and descent rate.
- ☐ List good uses, common mistakes, and watch-outs for the full brake setting (mushing, sinking, riding the ball).
- ☐ Describe a canopy's flight characteristics during a stall and indicate a good use of the stall.
- ☐ Identify the two types of toggle turns and list the characteristics of each type.
- ☐ Describe front and rear riser turns and good uses for each.
- ☐ Identify the three types of landing maneuvers listing advantages and disadvantages to each.

Canopy Performance Factors

The performance of a ram-air canopy is primarily affected by the weight of the jumper, density-altitude, and movement of the toggles.

Weight of Jumper and Gear

The forward speed and descent rate of the ram-air is affected by the weight of the jumper and his/her equipment. A heavier jumper will have greater forward speed and a higher descent rate than a light jumper. A jumper has some control over how much gear is carried and thus his/her jump weight.

Density-Altitude

Hot temperatures and/or high elevation will result in greater forward speed and descent rate than in cool temperatures and/or low elevation.

Toggle Movement

The ram-air parachute is very responsive to your commands. It will do what you make it do. When you decide to perform a flight maneuver, you make the decision based on what you see and feel. If you are in a steeply banked turn or are swinging under the canopy, it is difficult to make a good flight decision because canopy response lags behind your commands.

In other words, if you fly from an unstable platform or if you over-control, you will not get maximum performance. Slow, gentle toggle movements help a jumper avoid disorientation. And in the case of deep brake flight and stall recovery, are required to avoid hard landings. It is better to fly with the toggles kept fairly close to the body than with outstretched arms. This technique helps reduce arm fatigue, provides more accurate identification of the stall point, and helps prevent outstretched arms when performing PLFs.

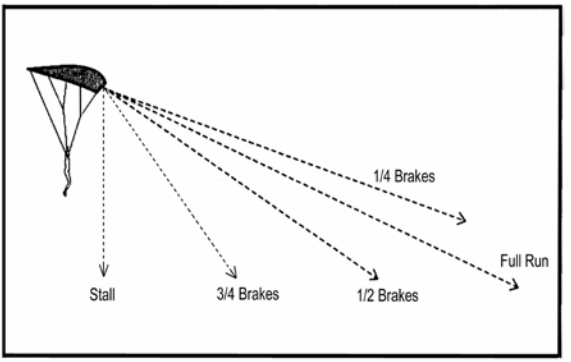
Stall Point

The stall point is the toggle position at which the canopy will cease forward flight and begin to enter a stall. The stall point is typically located with a toggle position near the bottom of the reserve. The location of stall points can vary significantly from canopy to canopy. Minor variances in stall point location can exist on the same canopy depending on density altitude and wing loading. Positive identification of the stall point on every jump is critical for jump safety and performance. The stall point is located by slowly and smoothly lowering the toggles until the canopy ceases flying.

Straight Ahead Maneuvers

The various straight ahead maneuvers are used to affect the glide angle of the canopy. Canopy glide angles can be changed by manipulating either the steering toggles or the risers. The following figure shows the glide angles for a ram-air canopy at the various toggle settings. Note that the 1/4 brake setting provides the flattest glide angle, but not necessarily the most time in the air.

Figure 32: Brake Setting Glide Angles



Full Run

- Toggles are all the way up.
- Greatest forward speed of any toggle setting, 20 to 25 mph.
- Greatest descent rate of any toggle setting aside from sink/stall, 12 to 14 fps.
- Not acceptable toggle position for landing.

Full run is the quickest way to get from point A to point B when retention of altitude is not a concern. If getting blown backwards on final, it will allow a jumper to land closer to the spot than any other toggle setting. Common mistakes include overuse while in the pattern and using too long in the presence of turbulence. The canopy is susceptible to turbulence at this brake setting.

1/4 Brakes

- Toggles are 1/4 of the way between full run and stall point.
- Forward speed is 13 to 17 mph.
- Descent rate is 11 to 12 fps.
- Optimal glide angle for most canopies.
- Not acceptable toggle position for landing.

The 1/4 brake setting provides the optimal glide angle. For example, 1/4 brakes is the best choice if the jumper turned on final too far downwind and is trying to make it back to the jump spot. The 1/4 brake setting is the preferred starting point for a dynamic or staged flare. A jumper will realize most of the benefits of starting a flare from 1/4 brakes without as much risk of the canopy being negatively affected by turbulence.

1/2 Brakes

- Toggle position is halfway between full run and stall point.
- Forward speed is 9 to 12 mph.
- Descent rate is 9 fps.
- Canopy is least susceptible to turbulence.
- Acceptable toggle position for landing.

1/2 brakes is also referred to as the safety position. The canopy is least susceptible to turbulence at this brake setting and both forward speed and descent rates are acceptable for landing. 1/2 brakes also give a jumper the maximum flexibility to adapt to changing wind conditions, especially useful on final. This brake setting is useful as it allows a jumper more time to make decisions and allows for higher margins of error than do 1/4 brakes or full run. A 1/2-brake flare can create a soft landing, since there is still sufficient forward speed to transition to lift.

3/4 Brakes

- Toggle position is 3/4 of the way between full run and stall point.
- Forward speed is 5 to 8 mph.
- Descent rate is 10 fps.
- Acceptable toggle position for landing.
- Watch-out: Brake setting is close to stall point.

3/4 brakes is useful for making a steep descent into a tight spot. It is also useful to minimize overshooting if the 1/2-brake sight picture was misjudged. Jumpers need to be cautious about not drifting into deeper brake settings inadvertently. It is a natural reaction to move the toggles lower when overshooting and this will put the canopy very close to its stall point. Also, remember that canopies in slow flight are more susceptible to turbulence.

Full Brakes, Sinking, Mushing, and "Riding the Ball"

- Toggle setting is exactly on stall point.
- Forward speed is 0 to 5 mph.
- Descent rate is 17 fps.
- Variance between canopies can be significant.
- Extremely unacceptable toggle position for landing.

The full brake setting is an extremely useful tool for making an accurate jump but is dangerous if used

inappropriately. Full brakes are an effective tool for losing altitude on final or making a descent into a tight spot in tall timber. Many jumpers have been injured by using this brake setting at too low of an altitude. DC-7 canopies are prone to surging when coming out of this flight mode too quickly. The canopy can transition unexpectedly into a stall in the presence of turbulence and sustained use can result in canopy transitioning into a stall. Only experienced jumpers should use below 200 feet AGL and the canopy should be flying by 100 feet AGL.

Stall

- Toggles are lower than stall point.
- Forward speed is 0.
- Descent rate is 23 to 38 fps.
- Canopy may have directional instability.
- Recover by smoothly raising both toggles to the 3/4 brake position and hold until the canopy begins to fly.
- Extremely, extremely unacceptable brake position for landing.

The stall maneuver is an effective tool for losing altitude. It is best used prior to entering the pattern or during the downwind leg. Riding the ball or sinking is usually the better choice for losing altitude during the base and final legs. The stall maneuver should not be utilized lower than 300 feet AGL. It is extremely likely that a landing in this mode will result in a serious injury. Transitioning out of the stall maneuver should be done by smoothly raising both toggles and holding until canopy begins flying again. Snapping the toggles up or raising toggles to a very high setting can result in an extreme surge causing a rapid dive and high forward speed.

Planing

- Front risers are pulled down as to increase descent rate without using brakes, allowing the jumper to get to the ground faster without getting blown backwards by using brakes.
- Descent rate increases, 16 feet per second.
- Mating Velcro on toggles and risers reduce difficulty in retrieving toggles, however, holding on to the toggles does not significantly affect the canopy's ability to plane.

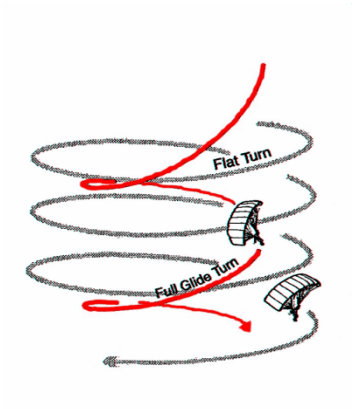
Planing is an effective tool for holding into the wind, when the wind speed exceeds the forward speed of the canopy at full run. Planing increases the decent rate, this in turn minimizes your exposure time in high winds, without compromising the forward speed of your canopy. This maneuver should not be used lower than 200 feet AGL, as the canopy is susceptible to turbulence in this flight mode. It is important to remember to allow transition time from front risers back to toggles for landing.

Turn Types

Toggle Turns (Two Types)

Full Glide Turns

Figure 33: Full Glide Turns

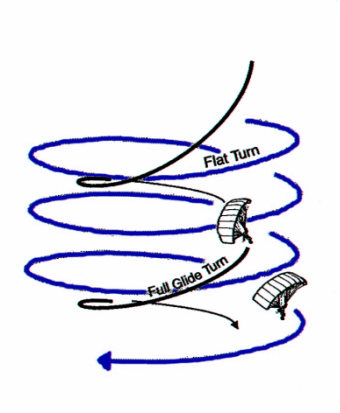


- Toggle is pulled all the way down on the side you want to turn while the other toggle is left at full run.
- Canopy banks similar to an aircraft.
- Canopy takes 4 to 6 seconds for first turn.
- Turn rate, degree of bank, and descent rate will increase with time.
- Turns held beyond a full revolution are called spiral turns.
- The jumper will feel increased pressure in the harness and airspeed increasing.
- Because of the increased descent rate, never make full glide turns below 300 feet AGL.

Full glide turns are an effective tool for turning but subjects the jumper to more banking than off-hand turns. Sustained full glide turns (spiral turns) are an effective maneuver to lose altitude, but not as effective as front riser bomb turns. Common mistakes made while employing the spiral turn include losing track of altitude and coming out of the turn in the wrong direction. This maneuver can often result in a jumper becoming dizzy and disoriented. It is extremely important to ensure that the airspace is clear below and downwind of the jumper prior to executing the turn.

Off-Hand Turns

Figure 34: Off-Hand Turns



- Initiated while flying in a partially braked mode.
- Toggle is raised on opposite side from desired turn direction.
- Canopy banks much less compared to a full glide turn.
- Turn speed is quicker, especially at low speeds.
- Canopy pivots on its axis.

The reduced banking associated with off-hand turns makes it the preferred type of turn for many parts of the jump. Using off-hand turns while turning between legs of the pattern helps to minimize turn times. Utilizing off-hand turns for making corrections on final will result in a better sight picture. Also, gentle off-hand turns can be safely utilized to avoid obstacles near or on the ground. Off-hand turns are generally preferred over full glide turns.

Front Riser Turns

- Toggles should be put in full run position.
- Initiated by pulling down either riser on side of desired turn.
- Can use dive loop on riser or grab any upper part of front riser.
- Canopy will bank significantly.
- Turn rate, descent rate, and speed will be very high and increase over time.
- Turns held beyond a full revolution are called bomb turns.

Sustained front riser turns are an effective tool for gaining vertical separation early in a jump. "Bomb turn" is the term used to refer to a sustained front-riser turn. The same watch-outs listed under full glide turns apply to sustained front-riser turns. Bomb turns are an effective maneuver to lose altitude. Common mistakes made while employing the bomb turn include losing track of altitude and coming out of the turn in the wrong direction. This maneuver can often result in a jumper becoming disoriented. It is extremely important to ensure that the airspace is clear below and downwind of the jumper prior to executing the turn. Front riser turns are also effective to make steering corrections while planing.

Rear Riser Turns

- Leave toggles stowed if used in case of imminent collision after opening.
- Release toggles from stows if used in the case of a broken brake line.
- Initiated by pulling either rear riser down on side of desired turn.
- Grab the upper part of rear riser.
- Turns are effective but require more force than pulling down a toggle.

Rear riser turns are not commonly employed during normal jumps; however, they are very valuable in certain situations. If a jumper is faced with an imminent canopy collision after opening, a right riser turn will result in a quicker turn than unstowing the brakes and making a toggle turn. The second situation demanding rear riser turns would occur in the case of a broken brake line or detached toggle. In this case, it is preferable to steer with rear risers than to make turns with the sole functioning steering line. Rear riser turns are similar to toggle turns in that they deflect the rear sections of the canopy. They require more force to execute since the jumper is pulling down a larger area of the canopy. Pulling down a rear riser will pull all the C and D lines on that side compared with just the trailing edge for a toggle turn.

Landing Maneuvers

1/2 Brake Landing

- The 1/2 brake setting provides for an acceptable landing due to the low descent rate and moderate forward speed.
- Allows for the greatest accuracy.
- Best defense against turbulence.

Half-brake landings are often the best choice for jump spots that require a high degree of accuracy and/or have turbulence present. Virtually no timing is required so it is an easy maneuver to execute. Accuracy is increased due to the ease of maintaining a consistent sight picture. The canopy is least susceptible to turbulence at the 1/2 brake setting so oscillations will be minimized.

A somewhat lighter landing can be obtained by flaring from the 1/2 brake setting. About 5 to 10 feet off the ground slowly depress both toggles to the stall point coinciding with touchdown.

Staged Flare

- Converts forward speed of the canopy into lift.
- Toggles are moved from full run or 1/4 brake setting to stall point in incremental steps with pauses at 1/2 brake and 3/4 brake settings.
- Allows jumper to hold safe brake setting if timing is off or turbulence is encountered.

Staged flares are a good compromise between 1/2 brake landings and dynamic flares. Landings can be lighter than with a 1/2 brake landing and a staged flare has two significant advantages over a dynamic flare. First, the staged flare doesn't require as much precision to execute. Second, the staged flare can be terminated and a safe brake setting can be held if timing is off and/or turbulence is encountered. Additionally, staged flares help a jumper develop their timing for executing a dynamic flare. Proper altitudes to initiate are very dependent on density altitude with high density altitudes requiring the jumper to initiate at a higher altitude than at low density altitudes. See the following section on dynamic flares for further details.

Dynamic Flare

- Converts forward speed of the canopy into lift.
- Toggles are moved from full run or 1/4 brake setting to stall point in a smooth continuous manner just before landing.
- At completion of maneuver, forward speed will be 0-5 mph and descent rate will be 0 fps for a short duration (1 to 2 seconds). Descent rate will increase dramatically to that of a full stall, 20 to 26 fps, with severe oscillations if the flare is initiated and completed too soon in the landing approach.

Dynamic flares provide the opportunity for the lightest possible landing. However, there are significant drawbacks compared to the staged flare or 1/2 brake landing. A high degree of timing is required, jump accuracy is reduced, and the canopy is more susceptible to turbulence. A poorly executed dynamic flare will result in the jumper landing with an extreme amount of forward speed, a very high descent rate, or both. Dynamic flares are best used when the jump spot doesn't require great accuracy and is free from turbulence.

Beginning the flare from 1/4 brakes or less instead of full run offers two advantages. First, the canopy will surge less if the final was flown at the 1/2 brake or lower setting. Second, the canopy is less susceptible to turbulence at the 1/4 brake setting than the full run setting. There is not a hard and fast rule as to what height a jumper should begin initiating the flare as many factors come into play. The general rule of thumb is to time the flare so the toggles are reaching the stall point simultaneously with the feet hitting the ground. This doesn't allow the canopy time to transfer all of the possible lift, but it is better to be too late than too early.

Regardless of the flare technique, the primary factor in any given landing is density altitude, but jumper weight and canopy type also need to be taken into consideration. Low density altitudes mandate a lower initiation point than high density altitudes; also, heavier jumpers need to initiate the flare slightly earlier than lighter jumpers.

Lesson 8-3 – Patterns

This lesson describes the terminology and nuances of standard and nonstandard patterns. It also explains how wind variations will alter a standard pattern.

Lesson Objectives

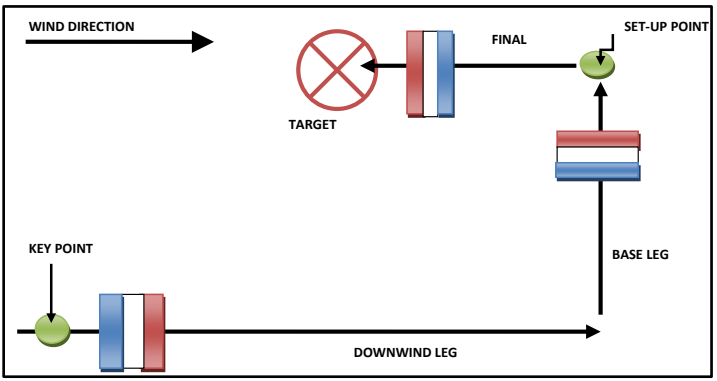
At the completion of this lesson, student(s) will:

- ☐ Identify the legs of a traffic pattern and cite suggested altitudes for each leg.
- ☐ List advantages to flying a standard pattern.
- ☐ Contrast standard patterns for high and low wind conditions.
- ☐ Explain how wind variations will alter the standard pattern.
- ☐ List guidelines for using a nonstandard pattern.
- ☐ List nonstandard pattern watch-outs.

Standard Pattern

Flight patterns used under canopy fit into two categories: 1) Standard Pattern and 2) Nonstandard Pattern. The appropriate choice for a particular jump depends primarily on wind speed. It is generally preferable to use the standard pattern when wind speeds are 15 mph or less, in other words, when the drift streamers show 500 yards or less.

Figure 35: Standard Pattern



The standard pattern is based on the traffic pattern used by aircraft prior to landing. The pattern can be left or right hand, defined by the direction of turns used in the pattern. For example, a jumper flying a left-hand pattern would be making left hand turns when turning between the legs of the pattern. The standard pattern offers many advantages to the jumper in the areas of accuracy and safety. The standard pattern allows for a good inspection of the jump spot and makes it easy to monitor changes in wind direction or speed during the jump. It also lends itself well to making adjustments for changing conditions. Most importantly, it provides an orderly landing sequence for multiple jumpers in the air. Components of the pattern include: Key Point, Downwind Leg, Base Leg, Set-Up Point, and Final.

Key Point

- Point at which the jumper enters the pattern.
- Approximately 1500 feet AGL.
- Cue to release upper RSL snap shackle.

Downwind Leg

- Begins at Key Point, approximately 1500 feet AGL.
- Ends with turn onto Base Leg approximately 1000 feet AGL.

Base Leg

- Begins at end of downwind leg, approximately 1000 feet AGL.
- Ends at Set-Up Point, approximately 300 to 500 feet AGL.

Set-Up Point

- Situated between Base Leg and Final Leg.
- Point at which the jumper refines sight picture for landing.
- Approximately 300 to 500 feet AGL.

Final Leg

- Begins at Set-up Point.
- Ends with landing.

Guidelines for Using Pattern

- Standard pattern is effective in winds up to 15 mph.
- Minimize flight over hazards
- Ideal to fly at 1/2 brake setting. The 1/2 brake setting allows jumper to speed up or

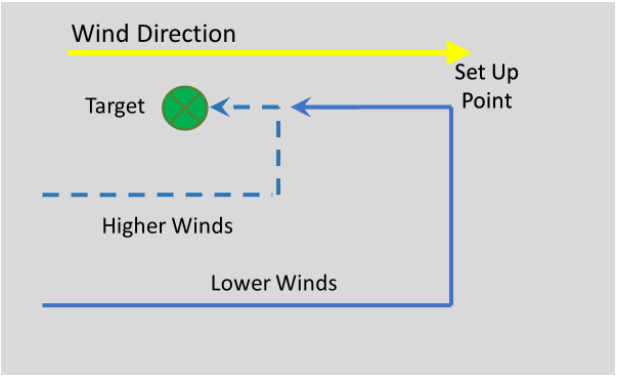
slow down as needed. Also, it is easier to make good decisions at slow airspeeds.

- Generally better to err too high on altitudes than too low. Can use sink to lose altitude but it's difficult to get gravity to take you back up.

High and Low Wind Patterns

Tighten pattern as wind speed increases, downwind leg should be closer to wind line and the set-up point will move closer to jump spot.

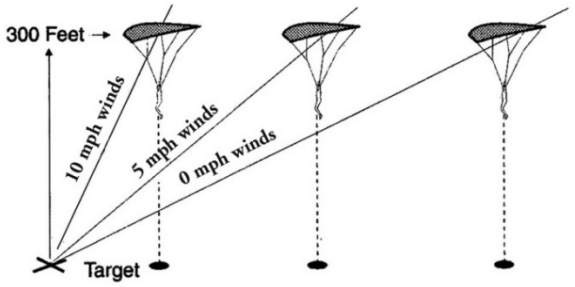
Figure 36: High and Low Wind Patterns



Set-Up Point

The proper set-up point downwind of the jump spot will vary according to wind speed. The distance downwind decreases with an increase in wind speed. It is ideal to fly from set-up point to jump spot at 1/2 brakes. In high wind situations, it is possible for the set-up point to be directly above the jump spot or even upwind. The figure below shows approximate glide angles for a final flown at the 1/2 brake setting.

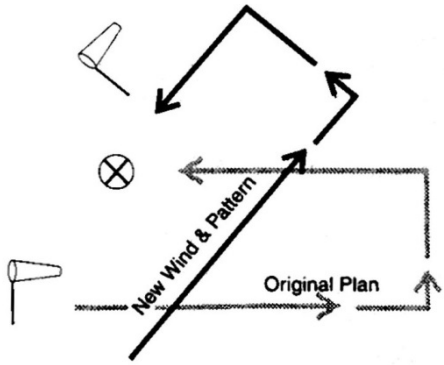
Figure 37: Approximate Glide Angles at 1/2 Brake Setting



Adjusting for Changes in Wind Direction

It is not uncommon for the wind to change during jump operations. Most changes are minor and can be corrected for by slight adjustments on final. If the change in wind direction is significant AND it is recognized prior to entering the pattern, it may be preferable to shift the entire pattern. Shifting the pattern will increase the potential for landing directly into the wind but jumpers should be cautious to avoid chasing the windsock with light and variable wind conditions.

Figure 38: Adjusting for Changes in Wind Direction



Adjusting for Changes in Wind Velocity

When winds increase during the jump it is important to recognize the change and make the necessary adjustments. Most adjustments are fairly straightforward and entail reducing the distance traveled on the downwind leg or "cutting corners" of the base leg. Adjusting for a decrease in winds doesn't always require changing the pattern. Sinking or mushing from the original set-up point will usually result in an acceptable sight picture. Extending the base leg is acceptable if you are the last jumper in the stick, but the potential for airspace conflicts increases.

Figure 39: Adjusting for Increased Winds on Downwind

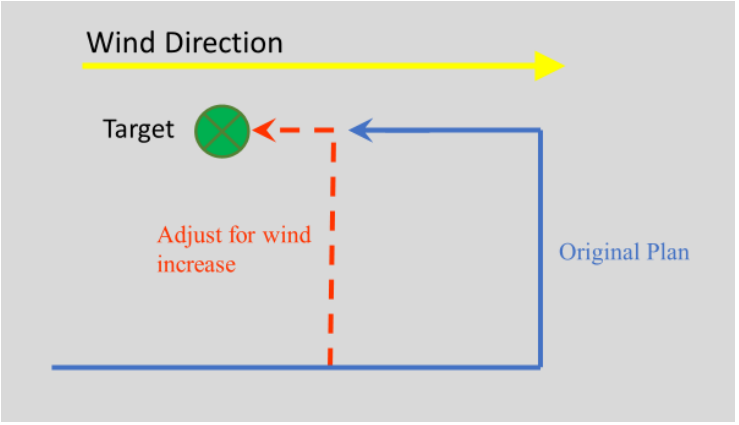


Figure 40: Adjusting for Decreased Winds by Extending Base

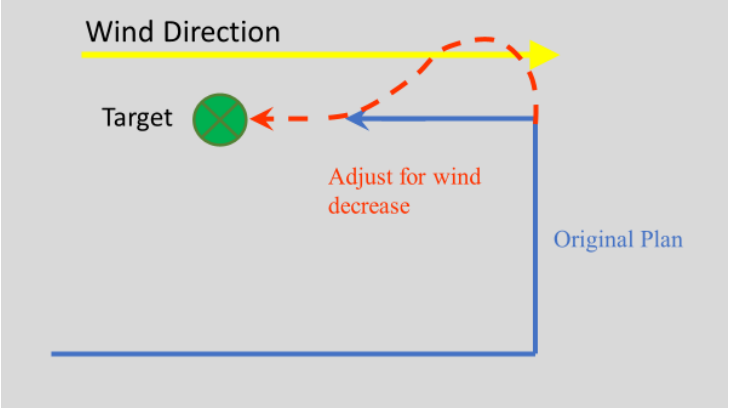
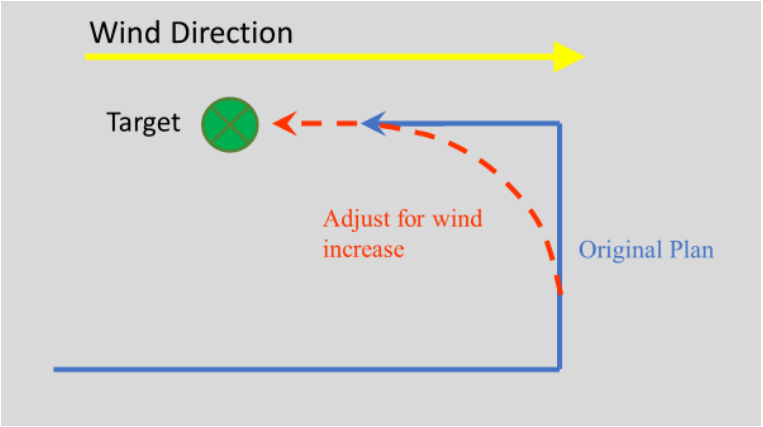


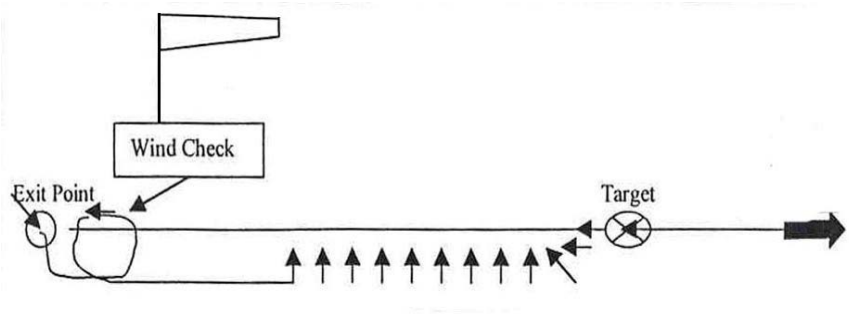
Figure 41: Adjusting for Increased Winds on Base



Nonstandard Patterns

Nonstandard patterns are most commonly used during high wind jumps (15 mph or greater or 500 yards drift or greater) but can also be used when hazards or terrain features would prevent a safe and accurate standard pattern jump. Nonstandard patterns are characterized by minimal or no flight downwind of the jump spot, minimal or no flight in downwind direction, and the majority of flight occurs close to the wind line.

Figure 42: Nonstandard Pattern



Guidelines for Using a Nonstandard Pattern

- Make it part of your plan
- First jumper in stick should get vertical separation early. If using bomb turns, be careful not to come out of turns facing downwind.

- Be extra careful maintaining airspace awareness. Second jumper will likely have difficulty maintaining a visual on jump partner while backing in.
- Crabbing is generally better than backing in as it allows quicker reaction to wind changes.

Nonstandard Pattern Common Mistakes

- Lack of vertical separation in lower part of jump.
- Not being prepared to adjust to changes in wind velocity down low.

Nonstandard Pattern Watch-Outs

- Harder to predict where your jump partner will be.
- Lighter jumpers will be able to use in lower winds than heavier jumpers.
- Second jumper will often have more difficulty maintaining sight of jump partner.

Lesson 8-4 – Jump Spot Selection

Students will be introduced to preferred conditions and "rules of thumb" for selecting a place to land a ram-air parachute.

Lesson Objectives

At the completion of this lesson, student(s) must:

- ☐ Identify desirable features for a jump spot.
- ☐ Identify hazardous features for a jump spot.

Role of Jumper

The spotter is responsible for selecting the jump spot but the jumper has input into the selection process. A jumper has veto authority over the spot selected if the jumper doesn't believe he/she can safely jump the spot.

Desirable Jump Spot Features

- Low turbulence.
- Clean landing area.
- Safe from fire.
- Unlikely to damage parachutes.
- Natural or easily cleared helispot.
- Close to anchor point.
- Close to work area.
- Close to water sources.
- Close to road for briefing incoming forces or demobilization.

Jump Spot Hazards

- Lee side of anything.
- Rising terrain.
- Tall timber.

- Snags.
- Hardwoods.
- Power lines.
- Fences.
- Deadfall.
- Ice.
- Water.
- Old helispots or fire lines.
- Yucca.
- Rocks.

Jump spots are selected by the spotter to maximize the potential for operational effectiveness while minimizing risk. A jumper needs to be cognizant of the different factors inherent to any jump spot so that the intent is realized. A jumper has veto authority over the spot selected if the jumper doesn't believe he/she can safely jump the spot.

Table 9: Desired Jump Spot Features

Desired Jump Spot Features[1]	Jump Risk	Operation Effectiveness
Clean Landing Area	▼ Fewer ground obstacles lessens chance of injury upon landing. ▼ Greater flexibility—you don't have to be exact as to where you land in the jump spot. ▼ Parachute.	▲ Stronger jumper work force. ▲ Quick cargo retrieval time—no need to hack at trees and brush to untangle lines. ▲ An undamaged chute allows field rigging and reuse of chute, especially if called to an area where there are no replacements chutes available.

1 The jumper's point of view is mainly from the plane; however, there is some mention where the jump spot perspective is in regard to firefighting.

Desired Jump Spot Features[1]	Jump Risk	Operation Effectiveness
Safe from Fire	▼ Choose a jump spot near the flank or tail or where natural barriers exist. This enables jumpers to more easily reach a safety zone. Consider the fire activity and measure it against the last few fires you've jumped. Also, think about time of year, like early June when fire behavior is usually moderate, which allows you to land closer.	▲ Unthreatened gear does not take time away from fire or the jump-ship having to return to resupply the fire.
Close to Anchor Point	▼ Allow jumpers to secure the fire sooner and establish a safety zone.	▲ Extended retardant from the anchor point helps to secure gear.
Close to Work Area	▼ Less unburned fuel distance between the fire and the jump spot. ▼ Safety zone easily accessible.	▲ Shorter travel time and reduces opportunities of injury when hiking through difficult terrain. ▲ Quick access to gear and additional personnel when they arrive on the fire.
Close to Water Source	▼ Being close to water allows the jumper to get to the safety zone quickly. Water's edge a good place to store jump gear and equipment.	▲ Jump-ship can stagger drops of pump and hose for a quick progressive trunk line. ▲ Helicopter dip-site for buckets.
Close to Road	▼ Possible boundaries and barriers for initial or extended attack.	▼ Serves as a good check-in area to brief incoming forces. ▲ Not dependent on helicopters if on a road system. Quick de-mob possible.

Key:

▼ Minimizes

▲ Maximizes

Table 10: Undesired Jump Spot Features

Desired Jump Spot Features	Jump Risk	Operation Effectiveness
Rising Terrain	▲ Landing into the hill could cause injury.	▼ Cargo drops could take more time due to treacherous terrain. Cargo can also be delayed when thermal updrafts keep jumpers in the air longer.
Tall Timber	▲ High probability of a lengthy letdown. ▲ Falling out of a tree might cause serious injuries. ▲ Turbulence near treetops could make it difficult to land safely in jump spots.	▼ Cargo drop will likely be delayed if a jumper trees-up. Possible problems retrieving cargo as well. ▼ Damaged chutes could not be field rigged, so the other fire was not jumped near the one from which you just de-mobed—Dillingham.
Side Hill Landings	▲ Hill's steepness could be a safety problem if a jumper doesn't contour the hill. ▲ Possibility of spot fires if debris rolls below the jumper. Though ease of movement (least desirable being uphill) to escape routes and safety zones. The ease of movement is a big advantage for suppression activities as well.	▼ Cargo will most likely roll downhill.
Snags	▲ Snags have been known to fall over if landed in, which could also snap tops, increasing likelihood of injury.	▼ Disruption of jumps operations. Jump-ship might have to return if climbing gear is not on board.
Hard-Woods	▲ Brittle and possible injury when landing in them	▼ Cargo could hang-up in a dense tree canopy. Time would most likely be added until cargo was remedied.

Desired Jump Spot Features	Jump Risk	Operation Effectiveness
Power Lines	▲ Could be hard to see—more so in fading light. Greater risk for serious injury.	▼ Higher probability that jump operations will need to be adjusted so one-man sticks can be accomplished safely.
Fences	▲ Blends in with landscape and presents a hazard.	▼ One man sticks possibly.
Deadfall	▲ High risk of extremities catching as the chute carries jumper forward on landing. ▲ Fuel loading covering stumps is difficult to measure and often revealed too late.	▼ Higher probability that the parachute will catch and tear and rendered unusable. ▼ Fire could threaten cargo and personal chutes during the lengthy processes it takes to retrieve the gear.
Ice	▲ Higher probability of injury occurring if a jumper busts through ice. The situation will likely be more serious if bodies of water went undetected due to snowy landscape.	▼ Possibility more jumpers needed to help assist with medical attention, or warming fire.
Water	▲ Greater risk of landing in water and a rescue required. ▲ More jumpers needed.	▼ More time setting up nonstandard jump operation pattern (crosswind) or adjustments so one-man sticks can be accomplished safely. ▼ Cargo could land in water.
Old Helispots or Fire Lines	▲ Punjies are not apparent until too late. Sharp stobs could puncture jumpsuit and body. ▲ High slash around the perimeter can be hazardous. ▲ Minimal work needed to improve helispot.	▼ In the event that gear needs to be centrally located, it could take a while if you have to climb over a lot of brush to move the gear.

Desired Jump Spot Features	Jump Risk	Operation Effectiveness
Yucca	▲ The ground will most likely be hard and rocky. ▲ Sword-shaped leaves and other pointy vegetation can be hazardous. ▲ And can shred parachutes.	▼ Plants could puncture water cubies and the fire would need to be resupplied. ▼ Medical attention might be needed. ▼ Field rigging may not be possible.
Rocks	▲ Smaller rocks are better than big boulders. Have plenty of alternates. ▲ Rocks can be disguised by brush—more so with Lower 48 clear-cuts. ▲ Large outcroppings can be notorious for blocking wind. Do a good roll.	▼ In regards to fire operations rocks can save time as anchor points, and or to connect the dots. ▼ Possibility of more jumpers needed to assist with medical attention.

Key:

▼ Minimizes

▲ Maximizes

Lesson 8-5 – Fundamentals of Spotting

This lesson explains the basic procedures that a spotter employs to safely drop jumpers. Knowledge of these procedures will assist a jumper in making a valid jump plan.

Lesson Objectives

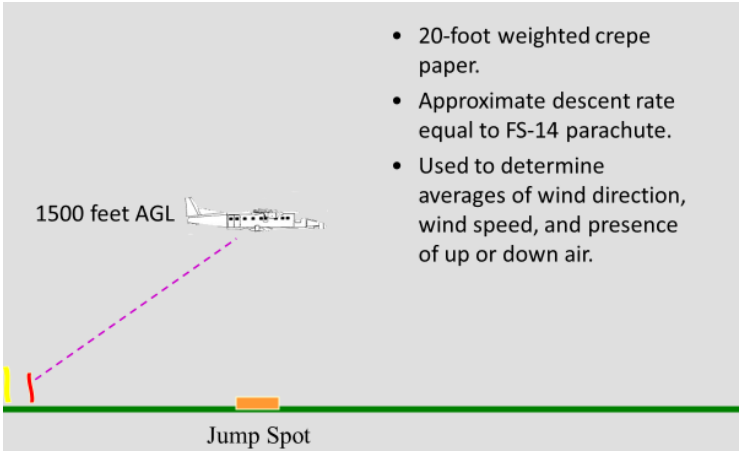
At the completion of this lesson, student(s) will:

- ☐ Identify average wind direction based on landing location of streamers.
- ☐ Determine average wind speed based on landing location of streamers and spotters estimate of drift.
- ☐ Explain how the presence of up or down air is determined.
- ☐ Explain how wind variations will alter the standard pattern.
- ☐ Identify three types of jump-ship patterns that are used to drop jumpers.

Streamers

Streamers are 20-foot pieces of colored crepe paper that a spotter uses to determine wind information. The streamers are weighted to have a descent rate approximately equal to the round parachutes used by the Forest Service. Dropped prior to each jump, a spotter can determine information on wind direction, wind speed and the presence of up or down air based on the streamer's flight, landing location, and time of descent.

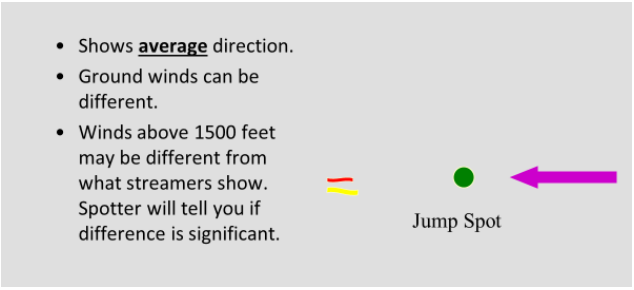
Figure 43: Streamers



Wind Direction

Streamers drift with the wind. By knowing the point that the streamers are released from the aircraft and their landing location it is possible to determine the average direction of the wind. The wind at any particular altitude may be different than what the streamers showed but knowing the average direction will give a jumper the information needed to begin forming a jump plan.

Figure 44: Wind Direction

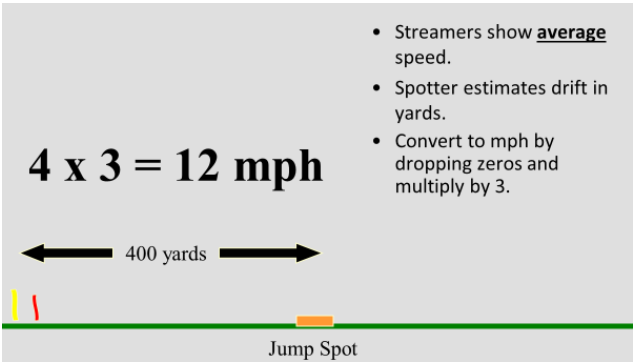


Wind Speed

The distance between the streamer's release point and their landing location shows the average wind speed. The greater the distance, the greater the average wind speed. Spotters will estimate the drift in yards and this estimate will be part of the pre-jump briefing given to a jumper prior to exiting. For

example, “the streamers showed 400 yards of drift.” Some jumpers prefer to think in terms of mph. Yards of drift can be converted to mph through a simple formula. Convert to mph by dropping the zeros in yards of drift and multiplying by 3. For example, 400 yards of drift equates to a 12-mph wind speed.

Figure 45: Wind Speed



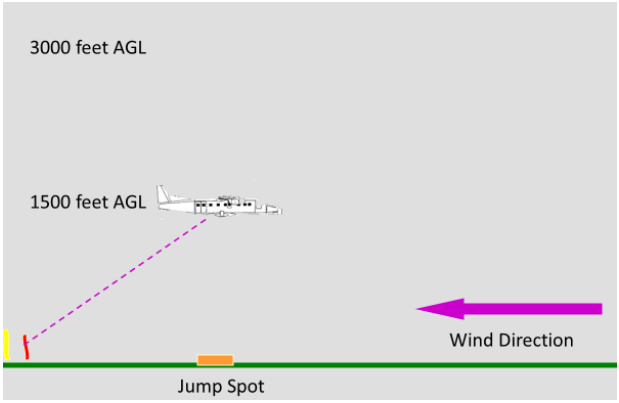
Up or Down Air

The presence of up or down air can be determined by timing how long it takes the streamers to descend. In vertically calm air at sea level streamers will take 70 to 75 seconds to fall 1500 feet. Usually, the spotter will feel comfortable with anything over 60 seconds. The time of the last check set of streamers is more important than earlier sets as they are passing through the same body of air that the jumper will.

First Set of Streamers

The first set of streamers is dropped over the jump spot from 1500 feet AGL. The spotter guides the pilot over the spot to ensure that the streamers are released directly over the jump spot. The spotter watches the streamers during their descent, notes their landing location, and times their descent rate.

Figure 46: First Set of Streamers



Check Streamers and Exit Points

Check streamers are dropped from 1500 feet AGL to determine the proper exit point. Check streamers landing in the jump spot or immediate vicinity confirm the proper release point for round jumpers. Square jumpers are normally dropped from 3000 feet AGL so the square exit point is further upwind than the round exit point. Taking into account the loss of 400 feet in altitude prior to main canopy deployment, the theoretical perfect square exit point is 1.73 times further than the round exit point. The actual exit point used is determined by the spotter taking a variety of factors into consideration. Typical square exit points range from 1.5 to 2 times the round exit points. Typically, the first jumper in a stick is dropped “short” and the last is dropped “long.” A spotter may drop streamers from 3000 feet AGL when there is evidence of significant differences in wind direction or speed from 1500 to 3000 feet AGL.

Figure 47: Check Set of Streamers

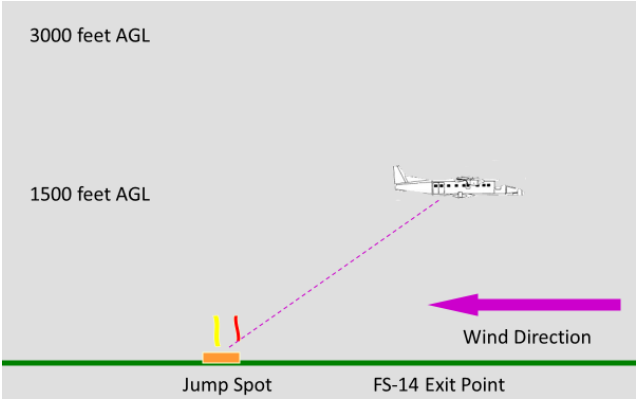
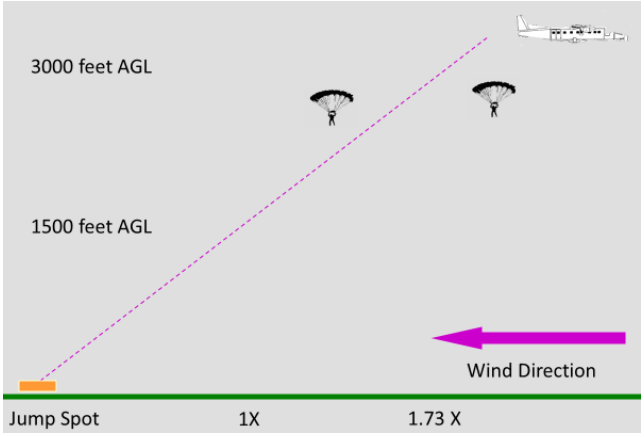


Figure 48: Two Ram-Air Jumpers



Watching the Streamers

Seeing the streamers can be challenging. The limited number of windows, maneuvering of the jump-ship, and poor visibility can and will make streamer observation difficult. Tenacity is usually rewarded, so don't give up. The spotter provides information on what the streamers showed during the pre-jump briefing, but it is better if the jumper also saw the streamers.

Reading the Streamers

Watching the streamers is important because they provide information helpful in making a jump plan and executing a safe jump. The last 500 feet of their descent is probably the most important as this will indicate what the winds will be when on final. Turbulence may be indicated when streamer tails fold over or wave erratically. Streamers that pile up when they hit the ground indicate no wind on the ground. Streamers that "lay out" when they hit indicate high wind on the ground.

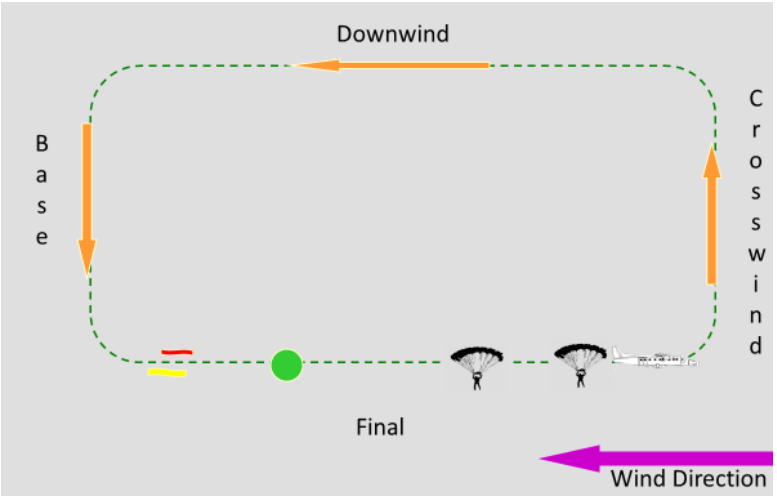
Jump-Ship Patterns

Jump-ship patterns are designated by how the final heading's direction compares to the wind direction indicated by the drift streamers. Typically, the same pattern is used throughout a mission. The three types of patterns are: (1) Standard, (2) Crosswind, and (3) Downwind. Patterns are comprised of crosswind, downwind, base, and final legs.

Standard Pattern (Into the Wind)

Standard patterns are the most common due to their simplicity and ease of execution. The pattern is identical to the normal landing approach for aircraft and square parachutes with final being directly into the wind. The resulting minimal ground speed makes it relatively easy for the spotter to correctly line up the aircraft over the exit point. Because pilots and jumpers are accustomed to it, briefings are simplified and the potential for miscommunication decreases. Perhaps the biggest disadvantage to the standard pattern is the fact that it becomes such a habit for everyone that it is used in situations when other patterns would be better.

Figure 49: Standard Pattern with Jumpers



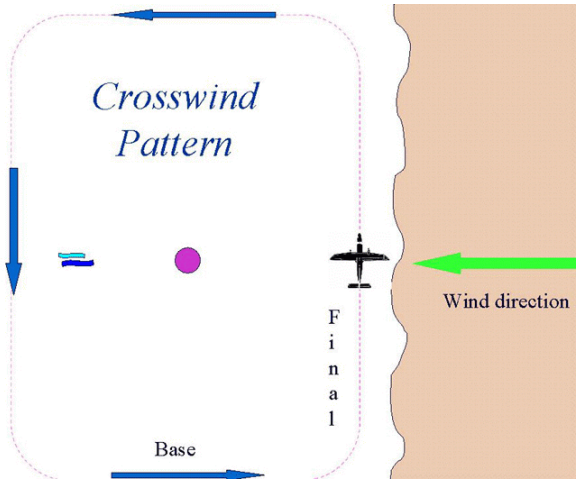
Crosswind Pattern

Crosswind patterns are most frequently used when some hazard or a rising terrain feature upwind of the jump spot precludes an upwind final. Typical hazards include large bodies of water or smoke columns.

There are some inherent advantages to crosswind patterns. A final crosswind heading with the jump spot to the left of the aircraft provides both spotter and jumpers with the best view of a jump spot. All jumpers exit the aircraft about the same distance upwind. Also, there is a reduced potential for dropping jumpers on preceding sticks.

Disadvantages include jumpers being let out off the wind line, increased difficulty in lining up jump-ship on final, tendency for jump-ship to drift toward jump spot on final, and the potential for need of more elaborate briefings.

Figure 50: Crosswind Pattern

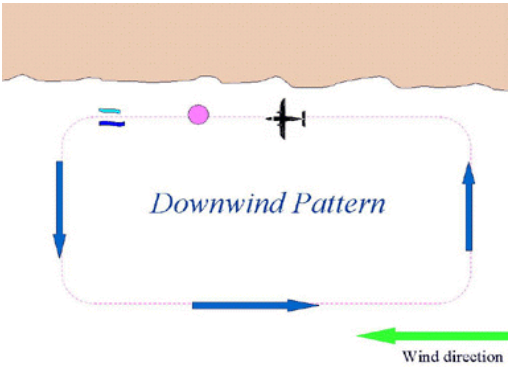


Downwind Pattern

Downwind patterns are rarely used. Typically, a downwind pattern is used only when a standard or crosswind pattern is not possible because of terrain and/or other hazards.

Downwind patterns feature the final leg being flown with the wind. This increases the likelihood of a spotter releasing the jumpers closer to the jump spot than desired. Also, the first jumper exiting the aircraft will be further from the jump spot than subsequent jumpers. Both factors should be taken into account when formulating a jump plan.

Figure 51: Downwind Pattern



Lesson 8-6 – Jump Spot Weather and Terrain

Influential factors such as terrain, ground hazards, and weather conditions will be discussed as they relate to jump spot selection and evaluation.

Students will examine hypothetical terrain situations commonly found in smokejumper operations. Successful jumps into rugged terrain require jumpers to identify set-up areas that best mitigate the situational hazards.

Lesson Objectives

At the completion of this lesson, student(s) must:

- ☐ Identify and describe at least six influential factors that are pertinent to jump spot selection and evaluation.
- ☐ Describe how weather and topographic conditions can affect a landing on a given jump spot.
- ☐ Accurately identify ground hazards, alleyways, and alternate jump spots on a given scenario.
- ☐ Identify areas of probable clean air and turbulent air.
- ☐ Identify set-up areas that minimize potential for landing into rising terrain and maximize potential for landing in areas of clean air.

Lesson 8-7 – High Wind Jumps

Students will be introduced to high wind jump techniques. Good techniques to utilize in high wind situations will be explored as well as common mistakes.

Lesson Objectives

At the completion of this lesson, student(s) must:

- ☐ Identify good techniques to utilize in high wind situations.
- ☐ Identify set-up areas that maximize accuracy and safety in high wind situations.
- ☐ Identify common mistakes that occur in high wind situations.

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CHAPTER 9 TRAINING JUMPS

RAM-AIR PARACHUTE TRAINING GUIDE

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CHAPTER 9 – Training Jumps

Lesson 9-1 – Parachute Performance Standards

The following is a guide to help define parachute handling performance. Emphasis will be placed on providing extra instruction to those individuals exhibiting marginal or sub-par performance. It will also serve to identify trends in unacceptable performances and help prevent injuries caused by a lack of technical skill.

Lesson Objectives

At the completion of this lesson, student(s) must verbally:

- ☐ List the five training jump ratings.

Training Jump Ratings

During training jumps and simulated jumps, training cadre will evaluate exit, pattern, and landing using these five ratings:

Table 11: Training Jump Ratings

Rating	Description
A	**Superior:** The exit, pattern and landing are performed in a flawless manner exceeding set performance standards. Accuracy is excellent and jump objectives are met.
B	**Successful:** The exit, pattern and landing are performed in a manner that meet performance standards. Accuracy is good and jump objectives are met.
C	**Satisfactory:** The exit, pattern and landing are performed in a manner that barely meet performance standards. Accuracy is acceptable and jump objectives are met. The individual needs improvement in some elements of the jump.
D	**Unsatisfactory (needs improvement):** The exit, pattern and landing are performed in a manner that does not meet performance standards. Accuracy is unacceptable and jump objectives are not met. The individual needs improvement in multiple elements of the jump.

Rating	Description
F	**Unsatisfactory:** Standard procedures disobeyed which resulted in a serious problem or potential problem. For example: collision or near collision with jump partner; failed the emergency procedure during malfunction; severe downwind landing; landing so far off the spot that it becomes a hazard; low radical turns; forced or intended stand-up landing, stall or sink during landing.

Jump Scoring Criteria

Jump scoring will be assessed using an average of the scores received in the three categories identified on a standard jump critique form. The exit, pattern and landing are the three areas evaluated. Scores will be given and averaged for a jump. This overall average letter grade will be the final jump score given. However, if a score of an F (unsatisfactory) is given in any category the entire jump score will be lowered to this level so that corrective action can be taken.

Category	Corrective Action
A, B, C	A Category **A, B, or C** evaluation will indicate satisfactory parachuting skills. Some elements of the parachute jump may require additional action.
D	A Category **D** jump would precipitate one-on-one "counseling" with the individual and parachute trainer/lead trainer. Using video review or discussion of the error, the individual would receive information on how to improve in an honest, non-confrontational setting.
F	A Category **F** jump would be reviewed by the individual and more than one parachute trainer and the incident would be documented. A case history will be established. If a trend toward unacceptable jumping develops, or if one event was catastrophic enough, it could be grounds for removal from the program.

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APPENDICES

RAM-AIR PARACHUTE TRAINING GUIDE

USFS SMOKEJUMPER PROGRAM

APPENDIX A – Jump Currency Protocol

The following explains USFS annual jump training and currency requirements.

Refresher Training

Every smokejumper will complete a successful refresher training course once every year prior to being placed on the active fire jump list. This training includes successful performance in the following areas: Classroom training, Units Training outside the classroom, and four jumps minimum in mixed terrain.

The parachute trainers maintain documentation of performance standards. Document showing completion of refresher training is filed.

Currency

Jump proficiency requirements are to assure that every jumper is current on jump techniques and malfunction procedures following a period of jump inactivity. These recommendations should be used as guidelines, on a case-by-case basis, taking into account the jumper's previous experience and performance. Performance standards for proficiency jumps should follow guidelines outlined in the Ram-Air Parachute Training Guide (RATG).

Time Frames for Currency Jumps

Table 12: Currency Requirements and Recommendations

Time Frame	Currency Requirement and Recommendations
0 to 14 days	Jumper will review exit techniques, opening checks, malfunction procedures, and basic flight techniques on their own prior to jumping. Live currency jump is made with jump critique provided when appropriate.
15 to 45 days	All of the above, plus: • Spotter or Senior Trainer provides interactive briefing covering proper exit and basic flight techniques. Jumper must demonstrate knowledge of proper techniques during this briefing. • Jumper will demonstrate proper technique for malfunction and emergency procedures for all 3 malfunction types during a "circle-up." "Malfunction Procedures" video and/or malfunction simulator will be utilized if jumper cannot demonstrate correct procedures. Practice will continue until malfunction procedures corrected.

Time Frame	Currency Requirement and Recommendations
46 to 60 days	All of the above, plus: • Review of "Malfunction Procedures" video recommended. • Malfunction simulator required if any mistakes on malfunction procedures not corrected.
61+ days	All of the above, plus: • Demonstrate proper "Equipment Checks" procedure recommended. • Malfunction simulator practice recommended. • "Jump Techniques" video recommended.

APPENDIX B – Smokejumper Ram-Air Fatalities

Billy Martin: http://www.wlfalwaysremember.org/images/incidents/documents/1991-05-31-william-martin-osha-nffe-1993.pdf

David Liston: http://www.wlfalwaysremember.org/images/incidents/documents/2000-04-29-david-liston-report.pdf

Mark Urban: http://www.wlfalwaysremember.org/images/incidents/documents/2013-09-27-mark-urban-sai-factual-report.pdf

APPENDIX C – MARS Reporting

Malfunction Abnormality Reporting System (MARS) - A database to report all malfunctions and abnormalities, to track trends and prevent injuries.

Forest Service employees should report all MARS only in the USFS MARS system. Currently, both agencies are working toward a shared database and in the future, this link may be broken. In that event, please contact your Loft Foreman for the current database link. The Forest Service MARS can only be accessed with a FS login username and password while connected to the Forest Service Intranet at this time.

USFS: https://apps.fs.usda.gov/mars/ (This is the 2nd generation version)

BLM: http://www.smokejumpermasteraction.org/ma2/

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GLOSSARY

RAM-AIR PARACHUTE TRAINING GUIDE

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GLOSSARY

ABOVE GROUND LEVEL (AGL) – A height measured with respect to the underlying ground surface. The unit of measure most commonly used when speaking about the jump pattern.

AIRFOIL - A structure consisting of a curved surface on top and a flat surface on bottom designed to generate lift due to the difference in the pressure of the air flowing over the two surfaces.

AIR SPEED - The horizontal speed the parachute is traveling through an air mass; in jumper jargon, same as forward speed.

ALLEYWAY - A gap or series of openings in timber leading to the jump spot.

ALTERNATE SPOT - Another place to land if conditions or parachute technique cause the jumper to miss the designated primary jump spot.

ANGLE OF INCIDENCE - The air foil's angle set by the relative length of the suspension lines manufactured into the canopy.

ARE YOU READY - A question the spotter will ask the first person in the stick prior to hooking up the static line requiring an answer for all jumpers in that stick. Followed by, "Are your leg straps tight?"

AUTOMATIC ACTIVATION DEVICE (AAD) - A device designed to automatically activate a parachute.

BASE LEG - The part of the formal landing pattern in which the jumper is flying cross wind in preparation to making the turn for final approach to landing.

BLEEDING OFF ALTITUDE - Losing altitude utilizing techniques such as the S-turn, stall or sink in order to establish the proper sight picture for descending to the spot.

BOMB TURNS – Term used to refer to a sustained front-riser turn, an effective maneuver to lose altitude.

BODY POSITION - The posture assumed by the jumper at the moment of exit from the aircraft and held until the canopy begins deployment.

BOTTOM SKIN - The lower surface of the ram-air canopy.

BOW TIE TURNS - A maneuver in which the jumper weaves back and forth in order to bleed off altitude to avoid overshooting the jump spot; similar to S-turns, but slightly more radical as the jumper turns farther into the S, turning away from the jump spot.

BRAKE LINES - See Control Lines (also known as Steering Lines).

BRIDLE - The material connecting the drogue parachute to the main parachute deployment bag.

BROKEN LINES - A malfunction involving separation of suspension lines between the risers and the canopy during the deployment, likely to induce a turn or spin.

BURBLE - A disturbed air mass occurring on the lee side of an object.

BUZZARDING – A flight technique error where a jumper is high over the landing zone and appears to have no distinguishable jump plan, leading to unpredictability amongst jump partners.

CANOPY SURGE - The momentary acceleration and descent of the canopy as it comes out of a stall or when the control lines are quickly brought to full run position from a deep brake setting, will cause the jumper to oscillate as the canopy centers itself.

CASCADE LINES - Suspension lines that merge with other lines below the canopy and above the connector links designed to distribute the line load.

CELL - A chamber formed between the fabric of two load bearing ribs and the top and bottom skin of the ram-air canopy. Each cell is divided by one or more non-load bearing ribs forming lobes.

CHASING THE WIND LINE - Also known as Chasing the Wind Sock, a flight technique mistake of changing direction of the final approach too low to the ground based on slight fluctuations of ground wind.

CHECK MY CANOPY - The opening check procedure of visually inspecting the condition of your parachute canopy immediately after deployment.

CHECK MY AIRSPACE - The opening check procedure of scanning the area in your immediate path to verify safe maneuvering space; the continuing awareness of location of all other jumpers during descent to the ground.

CONTROL CHECK - The procedure of verifying that your canopy is functioning properly after opening. It involves pulling a full right turn, left turn, and stall.

CHORD - The measured distance from the canopy nose to the canopy tail.

COLLISION - Entanglement of two or more canopies while in the air caused by inattentive jumper(s).

COLLISION AVOIDANCE - A quick maneuver to avoid a canopy collision, usually involving one or both jumpers making a right turn when approaching head on.

COMING UP SHORT - A flight technique error occurring on final when the jumper misjudges the sight picture and is unable to penetrate the existing wind or make it back to the desired jump spot due to traveling too far on the downwind leg.

CONNECTOR LINKS - Oval metal attachment rings also called French links joining the suspension lines to the risers.

CONTROL LINES - Control lines (Also known as Steering Lines or Brake Lines) are used to steer and modulate the forward speed of the parachute; attached to the trailing edge of the canopy in distinct left and right groups, the control lines are cascaded in the upper section joined to a single line attached to a steering toggle in the lower section.

CONTROL TOGGLES - See Steering Toggles.

CRABBING - A flight technique used in higher wind situations to move sideways in a vector by pointing the nose of the canopy off of the wind line.

CRABBING FINAL - A non-conventional pattern involving making a final approach in higher wind where the jumper moves sideways by vectoring the canopy off the wind line; useful when the jump spot is a ridge perpendicular to the wind line, allowing the jumper to avoid going downwind of the jump spot due to the hazard of the lee slope.

CRACK THE WHIP - A flight technique error occurring when a jumper following another jumper does not allow for descent rate and goes too far downwind while mimicking the perceived pattern.

CROSS-PORTS - Small holes cut in the rib sections to balance the air pressure within the cells across the full span of the canopy.

CROSS WIND - Refers to flying the canopy at approximately 90 degrees to wind line; also refers to wind blowing at right angles to final approach.

CROSS WIND LANDING - Landing the parachute at right angles to the wind, usually to take advantage of the longest part of the opening of the jump spot.

CUTAWAY HANDLE – Also known as Main Release handle. The orange handle located on the right side of the harness attached to cables routed to the 3-ring assemblies of the main parachute risers and harness; when pulled, the handle removes the cables from the nylon soft loops, allowing the 3-ring assemblies to release.

DEEP BRAKES - Pulling down the control lines to a point where the canopy is in a slow flight mode and minimally flying forward.

DEPLOYMENT - The sequence of events occurring as the parachute is extracted from a packed container until it is fully open.

DEPLOYMENT BAG - The bag which holds the folded parachute inside the container to facilitate the deployment of the suspension lines and the canopy in the proper, predetermined sequence. Frequently abbreviated as D-bag.

DESCENT RATE - The vertical speed at which the jumper approaches the ground while descending during the parachute jump.

DIVE LOOPS - Webbing handles sewn on the front parachute risers when pulled allow the jumper to bring the nose of the canopy down.

DOWN AIR - A mass of air that is moving down due to atmospheric instability or terrain features, considered to be a hazard to aircraft and parachutes when occurring near the ground.

DOWN WIND - Refers to any point down wind of the designated jump spot.

DOWN WIND LANDING - A flight technique mistake of landing while running with the wind.

DOWN WIND LEG - During the parachute descent, the part of the formal pattern where the jumper is

traveling (running) with the wind to a distance far enough to allow the proper angle for descent to the jump spot after turning to the base leg and the final approach.

DRIFT - Also known as Wind Drift, refers to a wind speed measurement as determined by the horizontal distance traveled by drift streamers to assist the jumpers in making a plan about the jump; drift is expressed in estimated yards by the spotter to the jumpers before exit.

DRIFT STREAMER - Lengths of weighted crepe paper used to determine the wind speed (drift) and wind direction (wind line) in the area of the jump spot; also can be hand-held by the first jumpers to indicate local ground winds to jumpers that proceed to land after them.

DROGUE - A small parachute designed to stabilize the body position of a jumper during the exit from the aircraft and then to act as a pilot chute to extract the main from the container when the drogue release handle is pulled.

DROGUE-IN-TOW - A deployment malfunction occurring when the drogue parachute fails to properly deploy or release, thus preventing the main canopy from being extracted from the container.

DROGUE KILL LINE - A line routed inside the bridle, connecting the top of the main canopy to the apex of the drogue chute, used to deflate the drogue during the main parachute deployment.

DROGUE OVER THE NOSE - Usually caused by holding a prolonged stall, the drogue is draped over the nose of the canopy.

DROGUE RELEASE - The stage in the deployment sequence when the drogue release handle is pulled allowing the 3-ring attachment holding the inflated drogue to release, allowing the drogue to feed out the remaining bridle to pull the locking pin on the parachute container.

DROGUE RELEASE HANDLE - The green handle located on the left side of the harness attached to a cable routed to the 3-ring assembly of the drogue parachute bridle and harness; when pulled, the handle removes the cable from the nylon soft loop allowing the 3-ring assembly to release.

DYNAMIC FLARE - A flight technique involving converting the forward speed of the ram-air parachute into lift for the purpose of gaining a momentary reduction of descent rate; used to effect a soft landing by moving the steering toggles from full run or quarter-brakes to a full brake position using proper timing and technique to allow aerodynamics to have full effect.

EASE THE TOGGLES UP - A flight technique involving slowly raising the steering toggles in order to gain sufficient forward speed to regain safe flight but without inducing a surge or oscillation associated with radical toggle movements.

EDDY - Same as Rotor, the swirling air of turbulence associated with conditions found on the leeward side of an obstruction.

EMERGENCY PROCEDURE - Refers to a standard procedure for a jumper to employ after experiencing an uncontrollable malfunction involving the proper technique and sequence for deploying the reserve parachute; after identifying the need to deploy the reserve, the jumper throws away the drogue release handle, places left hand on butt, pulls the cutaway handle, (look, reach pull), throws away

cutaway handle, pulls the reserve handle (look, reach, pull).

END CELL CLOSURE - A term to describe a cell or number of cells not fully inflated in the ram-air canopy.

ENTANGLED DROGUE - Refers to a drogue parachute or bridle assembly that becomes entangled with the jumper during the exit from the aircraft.

EXIT POINT - The point at which the spotter signals the jumper to exit the aircraft; the point located directly on a line upwind from the jump spot calculated by the spotter to be the same distance traveled downwind by the drift streamers when released over the jump spot.

EXTENDING THE BASE LEG - A flight technique of flying a longer base leg to bleed off altitude in order to gain a better sight picture for final approach.

F-111 - Trade name for the 1.11 ounce per square yard no-porosity rip stop nylon used in most ram-air canopy construction.

FALL OFF - The backward oscillation and rapid descent rate of the parachute when the transition is made from a forward flying condition to a stall.

FEEL FOR THE CANOPY - A term for the subjective analysis of the aerodynamic forces acting on the canopy; the ability of the jumper to anticipate the flight performance of the parachute as commands are given through the control lines.

FINAL APPROACH - The part of the formal pattern in which the jumper has completed all major changes in direction of the canopy and makes the descent to landing, faced into the wind.

FLARE - The process of pulling down both control lines simultaneously, changing the angle of attack of the canopy and thereby transforming any available forward speed into lift. (See Dynamic Flare.)

FLARE WITH RISERS - A technique for flaring the canopy involving pulling down simultaneously on the rear parachute risers.

FLARES - Sections of fabric on the bottom skin used as suspension line attachment points to distribute line loads along the length of the load bearing rib.

FLOAT - The lift and change in glide angle occurring when pulling down the steering toggles from full run.

FLOATING HANDLE - A term for a deployment handle which is loose from its pouch on the harness and thereby "floating" during the exit from the aircraft.

FORMAL PATTERN - The route of the parachute jump made in relation to the direction of the wind, consisting of a downwind leg, base leg and final approach.

FORWARD SPEED - Same as Air Speed, the horizontal speed the parachute is moving ahead in an air mass.

FOUR-POINT CHECK - The equipment check done by the jumper when the spotter says "Get in the Door."

FREE BAG - A parachute deployment bag, bridle and pilot chute system used on the ram-air reserve parachute that is not connected to the canopy and floats free when the canopy is deployed.

FRENCH LINKS - Oval metal connectors used to join parachute components. (See Connector Links.)

FULL RUN - The setting of the trailing edge of the canopy with the steering toggles in the full up position; also known as Full Glide.

GLIDE ANGLE - The angle of descent, i.e., the ratio of forward speed to vertical descent.

GOOD CANOPY - A reference to a properly deployed and properly functioning parachute.

GROUND SPEED - The horizontal speed the jumper is traveling relative to the ground while under canopy.

HALF-BRAKES - A flight technique involving lowering the control lines to the half-way point where the canopy forward speed and angle of attack is reduced by half and the glide angle is deemed most efficient; the control line setting used when encountering turbulence, impending tree landing, and other situations requiring caution.

HALF-BRAKE LANDING - A flight technique of holding a 1/2-brake control line setting during the landing of the parachute.

HARD OPENING - A subjective term for a faster than normal parachute deployment which induces greater opening shock associated with greater line loading.

HAZARDS - Refers to any physical object or local weather condition in the vicinity of the jump spot which would make for an unsafe parachute landing.

HIGH FINAL – A flight technique useful in tight timber spots where the jumper will be at their set-up point higher than 500 feet AGL.

HOLDING INTO THE WIND - A flight technique involving facing the canopy into the wind, thus subtracting the wind speed from the forward speed of the canopy to reduce ground speed; the desired position of the jumper for final approach and landing.

HOLDING THE SINK - A technique for maintaining the canopy in a deep brake "sink" mode for an extended time in order to bleed off altitude and adjust the angle of descent for final approach.

HOLDING WHAT YOU'VE GOT - Similar to a 1/2-brake landing, a flight technique rule of thumb to maintain a safe brake setting of the control lines in order to keep the canopy flying, i.e., avoid a stalled landing, and to reduce pilot error resulting from radical toggle movements near the ground.

HOOK TURN - A radical turn made by rapidly pulling down one control line which induces a rapid spiral and rate of descent; a dangerous flight technique error when made low to the ground, associated with a jumper who is attempting to salvage an attempt to land in the jump spot after overshooting.

HORSESHOE - A malfunction where a parachute deploys, but remains attached to the jumper by the risers and at least one other point. The resulting mess would resemble a horseshoe shape.

HUNG SLIDER - A condition where the slider has not fully descended down the suspension lines.

JALBERT, DOMINA - French kite and parachute designer, "inventor" of the ram-air parachute.

JUMP COUNT - The procedural count the jumper uses when exiting the aircraft to ensure the proper time frame for drogue deployment and reinforce the mechanics of looking for and pulling the drogue release handle; the count is : Jump thousand, look thousand, reach thousand, wait thousand, pull thousand.

JUMP SPOT - The primary location selected for landing the parachute.

JUMP SPOT FIXATION - A flight technique error involving a jumper's fixating on the primary jump spot, losing awareness of airspace, brake settings, and alternate jump spots.

JUMP SPOT WEATHER - Local atmospheric conditions in the vicinity of the jump spot which affect the aerodynamics and performance of the parachute and influence the planning and flight techniques used to make the jump.

KEY POINT – The point at which the jumper enters the pattern.

LANDING ROLL - The mandatory procedural landing where the jumper distributes the shock of landing by getting off the feet and rolling along the side of the body; also known as the PLF or parachute landing fall.

LEADING EDGE - The front or nose of the ram-air canopy.

LEE SIDE - The downwind side of an area that is blocked by a terrain feature or other obstacle, usually associated with turbulent air.

LEE SLOPE - The downwind or back side of a ridge that is blocked by the rising terrain of the ridge line and likely containing a hazard of turbulent air.

LET-DOWN - The procedure for rappelling from a tree or other obstacle in the event of a landing where the parachute is snagged leaving the jumper off the ground.

LET-IT-FLY – A reminder to jumpers, usually emphatically shouted by trainers, to maintain sufficient airspeed near the ground to avoid a stalled canopy.

LINE OVER - A specific type of malfunction occurring on deployment where a suspension line or lines are misrouted over the canopy, likely to induce a turn or spin.

LINE STRETCH - The point in the parachute deployment sequence where the suspension lines and canopy have been extracted from the deployment bag but the canopy has not begun to inflate.

LOAD BEARING RIBS - A rib of the ram-air canopy where the suspension lines are attached.

LOBE - A part of a ram-air cell enclosed by at least one non-load bearing rib.

LOOKING A TURN - A flight technique error where the jumper perceives a turn has been made by inadvertently turning the head.

LOOK, REACH, PULL - The procedural mechanics of the steps involved anytime you pull a handle on the ram-air system.

LOST HANDLE - A malfunction involving the jumper not being able to locate the drogue release handle after exiting the aircraft.

LOW FLARE - Misjudging a flare by initiating too close to the ground for the full flare dynamics to take effect.

LOW PATTERN - A flight technique error involving a jumper who flies a conventional landing pattern too low, has to hurry through each leg of the pattern and doesn't have time to make adjustments to the sight picture on final approach.

LOW SPEED FLARE - A flight technique error in flaring (i.e., punching out) from a deep brake setting with little forward speed available to convert into lift, usually precipitating a hard landing.

MAIN RELEASE HANDLE – Also known as Cutaway Handle. The orange handle located on the right side of the harness attached to cables routed to the 3-ring assemblies of the main parachute risers and harness; when pulled, the handle removes the cables from the nylon soft loops, allowing the 3-ring assemblies to release.

MALFUNCTION - Any problem involving the proper deployment of the parachute.

MUSHING THE CANOPY - Also known as Riding the Ball, a flight technique term for a deep brake setting where the canopy is held in transition between slow flight, sink and stall; a controlled way to bleed off altitude on final without turning away from the jump spot.

NO-MAN'S LAND - A flight technique error where the jumper is directly over the jump spot but is still too high to safely land in the spot due to the forward momentum required for landing a ram-air parachute.

NO WIND DAY - A situation where there is little or no ground wind blowing in the vicinity of the jump spot, thus making it more difficult to slow the canopy horizontally for landing.

NON-LOAD BEARING RIB - A rib in the canopy where no suspension lines are attached.

NOSE - The open leading edge or front of the ram-air canopy.

OFF-HAND TURNS - A flight technique of inducing a smooth and stable turn while flying the canopy in a partially braked mode by letting up the steering toggle on the side opposite you wish to turn.

OPENING CHECKS - The procedural sequence of checks required of jumpers immediately upon full deployment of the parachute.

ORIENT TO THE SPOT - A flight technique of locating and steering the parachute toward the jump spot after the opening checks in order to stay in the ball park while beginning to gauge the wind during

descent to the ground.

OSCILLATION - Rocking the parachute (and the jumper) side to side or back and forth caused by radical toggle movements or air turbulence.

OVERCONTROL - Excessively quick or deep steering toggle movements made before the canopy has had a chance to react to a prior command.

OVERSHOOTING - A flight technique problem where the jumper has too much altitude, is already flying over the primary jump spot and has forward momentum likely to carry the jumper to another location.

PATTERN - A formal plan of guiding the parachute to a landing where the jumper takes into account the direction of the wind and flies in a sequence of downwind leg, base leg and final approach in order to have the proper angle of descent and be faced into the wind on landing.

PENETRATING - A flight technique term that applies to the degree that the jumper is able to move forward relative to the ground while facing into the wind.

PITCH OSCILLATION - The back and forth movement of a jumper under canopy associated with an induced stall or radical toggle movements.

PLAN B - An optional plan for steering and landing the parachute the jumper should make in the airplane and be ready to implement if wind conditions, hazards or the flight of jump partners change.

PLANING - A flight technique involving pulling down the front risers to increase descent rate and forward speed. Planing is an effective tool for holding into the wind, when the wind speed exceeds the forward speed of the canopy at full run. This in turn minimizes your exposure time in high winds, without compromising the forward speed of your canopy.

PLF - Parachute Landing Fall, same as a Landing Roll, a method of distributing the force of landing along the length of the body.

PRE-JUMP PLAN - A plan made while in the airplane with all members of the stick to identify the jump spot, hazards, alternate spots, location of the pattern, who is to go low and any other pertinent factors regarding the jump.

PRESSURE KNOT - A tangle or knot held together by tension on the suspension lines during deployment which would likely result in a turn or a spinning malfunction.

PULL THOUSAND, PULL THOUSAND, PULL THOUSAND - The procedural sequence involving three attempts to locate and pull a lost drogue release handle during exit.

PUMPING THE TOGGLES - Refers to rapidly extending the steering toggles in order to facilitate inflation of the canopy; also refers to minor up and down steering toggle movements used while in deep brakes to keep the canopy from falling off into a stall.

PUNCHING OUT - A flight technique term for quickly bringing the steering toggles all the way down for the purpose of transferring any remaining forward speed into lift for a softer landing.

QUARTER-BRAKES - A flight technique term for pulling down the steering toggles one-quarter of the distance from full run.

QUARTERING - Also known as Crabbing, a technique of pointing the nose of the canopy off of the wind line for purpose of vectoring the canopy.

RADICAL TOGGLE MOVEMENTS - Any rapid movement of the steering toggles that induces the canopy to turn, surge, oscillate or descend rapidly; a flight technique error if associated with late decision-making while on final approach.

RAM-AIR PARACHUTE - A parachute inflated by air "rammed" into the leading edge of joined cells forming a rigid, pressurized airfoil with flight characteristics associated with a winged surface.

RELEASED THREE-RING - Refers to a malfunction where the 3-ring attachment assembly has inadvertently released a main parachute riser during deployment.

RESERVE HANDLE - The red handle located on the front of the reserve container; when pulled, the reserve parachute begins the deployment sequence.

REVERSE FLIGHT - A flight technique of holding the canopy in a prolonged stall until the canopy is moving backward and with a high rate of descent.

RIBS - Sections of fabric attached to the top and bottom skin of the canopy running from nose to tail of canopy to form the cell structure and establish the airfoil shape of the canopy.

RIDING THE BALL - Also known as Mushing the Canopy, a flight technique maneuver involving keeping the canopy in a stable condition while being on the verge of slow flight, sink or stall.

RIGHT TURN, LEFT TURN, STALL - The control check made during the opening check procedure for verifying a good canopy after deployment.

RIPS AND TEARS - Refers to a parachute malfunction involving separated fabric damage sustained to a canopy during the opening sequence.

RISERS - Webbing assemblies used primarily to transfer the load of the suspension lines to the parachute harness, incorporating a 3-ring attachment/release mechanism and Velcro to stow the steering control toggles.

ROTOR - The same as Eddy, refers to turbulence or down air associated with wind swirling on the lee side of an obstacle.

RESERVE STATIC LINE (RSL) - A 94-inch line attached from the riser of the main parachute to the handle of the reserve parachute. Designed to deploy the reserve automatically if the main jettisoned during a malfunction.

RUNNING WITH THE WIND - A flight technique for pointing the canopy in the same direction of the wind thus adding the wind speed to the forward speed (air speed) of the canopy and increasing ground speed.

SAIL BRIDLE - The part of the drogue bridle attached at the base of the drogue canopy sewn with material to act as a sail to facilitate clearance from the jumper during deployment.

SET-UP POINT - The optimum position to begin the final approach for landing, this position in the pattern begins after the last directional turn of the base leg. In a formal pattern this point would be at the junction of the base and final.

SIGHT PICTURE - A flight technique referring to the judgement by the jumper of the forward speed and descent rate at a fixed brake setting while on final approach for landing; estimation of the glide angle to the jump spot.

SINK - A flight technique of using deep brakes to induce a stable vertical descent without appreciably moving horizontally, can be used to bleed off altitude while on final approach to obtain the desired sight picture; a sink should be considered the initial stage of a stall, with rate of descent likely to increase the longer the sink is held; a dangerous flight technique error if used near the ground, the jumper should ease the toggles up with sufficient altitude to gain safe flying speed for landing, the longer the sink being held, the higher the steering toggles will need to be raised and they must be eased up slowly to prevent a severe oscillation.

SLIDER - Also known as Sail Slider, a reefing device used on the ram-air parachute used to slow the opening of the canopy to prevent excessive opening shock.

SLOW FLIGHT - A flight technique term involving the general philosophy of slowing the canopy down during the parachute jump by performing maneuvers at 1/2 brakes or more to be able to make decisions and adjustments with more thought and foresight than someone zooming around at full run.

SNIVEL - Jargon for a slower-than-normal deployment of the parachute.

SOFT LOOP - The nylon loop used in the 3-ring attachment system that secures the third ring in place by use of mechanical advantage; held in place by cables from the drogue release handle and the cutaway handle.

SPAN - The width of the canopy, measured from the one side to the other side.

SPECIAL SITUATIONS - A term for malfunctions or other conditions of the parachute which are sometimes encountered during the parachute jump.

SPINNING - Refers to a malfunction involving a partially or fully open canopy that goes into a rapid, uncontrollable turn immediately upon deployment.

SPOTTER – The individual in-charge of gathering and disseminating information about the jump, monitoring procedures and directing the jumping operation from the aircraft.

SPOTTING - Refers primarily to spotter responsibilities to find the fire, select a jump spot, recognize and avoid jump spot hazards, analyze the wind speed, direction and line and generally see to it the jumpers are properly briefed, prepared and released from the aircraft to facilitate a successful descent by parachute.

S-TURNS - A flight technique maneuver in which the jumper weaves back and forth in order to bleed off altitude.

STABILIZER - Canopy material extending below the bottom skin on each side of the canopy designed to provide stability while flying in a deep brake setting.

STAGED FLARE - Refers to a flight technique of stopping or slowing the pulling of the steering toggles at 1/2 brakes during a flared landing, allowing most of the forward speed to be converted to lift for soft landing and also maintain safe flying speed to avoid a stall.

STAIR-STEPPING - Over controlling the canopy by moving the steering toggles up or down abruptly with the resulting commands to accelerate and decelerate causing a series of floating and sinking while on final approach.

STALL - A flight technique involving slowing the air speed of the canopy to where it is no longer flying; accomplished by pulling the steering toggles to a 100% brake setting thus lowering the tail, increasing the drag on the airfoil to the point where it overcomes the lift, causing a rapid descent rate; can be a useful method for maneuvering when performed at high altitude but is extremely dangerous if done close to the ground.

STALL CHECK - An opening check procedure to quickly determine the controllability of the canopy. A flight technique involving slowly lowering the steering toggles to gauge the point at which the canopy will fall off into a stall for the primary purpose of avoiding a stalled landing and for the secondary purpose of being able to use the sink or stall as a maneuvering technique on final approach.

STALLING OUT - Flight technique error of inducing a stall and impacting the ground.

STALL POINT - Refers to the distance needed to pull down the steering toggles to the point where the canopy will cease forward flight and begin to go into a stall.

STEERING LINES - See Control Lines (also known as Brake Lines).

STEERING TOGGLES - Also known as Control Toggles, the webbing loops attached to the end of the control lines for the purpose of holding while making maneuvers.

STEERING WITH RISERS - A flight technique involving maneuvering the canopy by pulling down on parachute risers and thereby moving entire suspension line groups; used in the event of a broken control line.

STICK - Jump partners who will exit the aircraft on the same pass and generally descend to the jump spot as a team.

STREAMER - Refers to a malfunction involving a parachute where the lines have stretched out but the canopy has not inflated, with the jumper streaming to the earth at a fast rate and the canopy material flapping in the windstream.

SUSPENSION LINES - The lines attaching the canopy to the connector links transferring the load from the bottom skin of the parachute to the risers.

TAIL - Also known as the trailing edge; refers to the rear of the ram-air canopy where the cascaded control lines are attached.

TAIL WIND - Refers to the wind blowing in the same direction of the horizontal travel of the jumper (see Running with the Wind).

THERMAL - Upward rising air caused by heating of the earth surface.

THREE PUMPS AND A DUMP - The procedure for a spinning malfunction, or streamer, of fully extending the steering toggles three times then pulling the cutaway handle to jettison the main parachute if the malfunction does not clear.

THREE-RING ATTACHMENT SYSTEM - A system of three overlapping metal rings held in place by a nylon ring soft loop that employs mechanical advantage to securely attach the parachute risers and the drogue attachment and also allow for easy disconnection when released.

THROW AWAY THE HANDLE - The step in the emergency procedure to follow during a malfunction before pulling the next handle in sequence.

THROWING YOUR HANDS UP - Refers to rapidly moving the steering toggles upward from a deep brake setting to full run causing the canopy to momentarily surge forward and rapidly descend.

TIGHT BODY POSITION - Body posture used during exit from the aircraft with hands on butt, feet and legs held together, bent at the waist at a 45-degree angle.

TOGGLE JERKS - Refers to abrupt steering toggle movements which lead to over control of the canopy.

TOP SKIN - The top surface of the ram-air canopy.

TUPPER LOOP – Named after a smokejumper, the loop found below the sail on the drogue. This is tied to the Tupper loop on the drogue deployment bag. Serves the purpose of staging the deployment sequence.

TURBULENCE - Unstable air mass caused by atmospheric conditions or terrain obstacles requiring ram-air jumpers to assume a 1/2-brake setting of the control lines.

TURNING FINAL - The jump technique term for the last leg of the flight pattern; making the last major turn to descend toward the jump spot, facing the canopy into the wind.

TWISTS - Refers to a canopy that has opened but there are twists in the suspension lines, caused by the deployment bag or jumper spinning or uneven suspension line tension during deployment.

TWO CANOPIES - Refers to a malfunction where the main and reserve parachute have both deployed.

UNDERSHOOTING - See Coming Up Short.

UNITS TRAINING – Practical training outside the classroom on the jump tower, letdown tower, parachute landing simulator, and/or low trolley.

UNSTOWING THE BRAKES – The initial action whereas the jumper pulls the stowed toggles down,

releasing the steering lines from the rigged 1/2 brake setting.

UPWIND - Refers to any point upwind of the designated jump spot.

VERTICAL SEPARATION - Elevation difference established and maintained between jump partners to give all jumpers safe maneuvering room close to the ground.

WEAK LINK - Material sewn into a static line assembly to allow disconnection in the event of extreme loading due to a parachute opening but not separating from the aircraft.

WHIPPING A 360 - Improper flight technique for a jumper making a 360-degree turn while on final approach to avoid overshooting the jump spot.

WIND CHECK - The jump technique procedure of facing the canopy into the wind at or before the mid-point of the jump in order to estimate the velocity and verify the direction of the wind likely to be encountered on final approach.

WIND DRIFT - See Drift.

WIND SHEAR - The turbulent area between two air masses moving at different speeds or in different directions.

WIND LINE - An imaginary line that runs parallel to the direction the wind is blowing; the wind line intersecting the jump spot is of importance to the jumper for determining the approach to landing.

WIND BREAK - Refers to a blockage of the wind or wind shadow occurring due to timber obstacles on the edge of a jump spot, usually associated with increased ground speed as the jumper encounters less wind or a tail wind below the tree line.

WIND SPEED - The velocity of the wind.

WINDS ALOFT - A term for wind conditions measured at varying distances above ground level.

WINDWARD SIDE - The area on the upwind side of an obstacle or terrain feature associated with conditions allowing for a smooth, laminar flow of air or reduced turbulence.

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