

# PD Series Ram-Air Reserve Parachute Owner's Manual



**PD**  
**RESERVE**

Performance Designs, Inc.  
1300 E. International Speedway Blvd.  
DeLand, FL 32724 Tel: (386) 738-2224 Fax: (386) 734-8297  
[www.performancedesigns.com](http://www.performancedesigns.com)





Dear Customer

We'd like to thank you for your purchase of a new Performance Designs, Inc. reserve parachute. We're confident you'll be pleased with it in every way. You'll like its light weight and small pack volume. If you deploy it, you'll be pleased with its quick reliable openings, good flight characteristics and great landings that Performance Designs canopies are known for.

We urge you and your rigger to carefully inspect your new reserve to completely familiarize yourselves with its features and quality workmanship.

Again, thank you for choosing a Performance Designs canopy. With proper care, it should provide many years of service.

Sincerely

Bill J. Coe  
President



READ THIS MANUAL CAREFULLY BEFORE ASSEMBLING, PACKING OR USING YOUR PERFORMANCE DESIGNS RESERVE PARACHUTE.



## W A R N I N G

Each time you use this parachute you risk bodily injury and death.

You can substantially reduce this risk by: **(1)** assuring every component of the parachute system has been assembled and packed in strict accordance with the manufacturer’s instructions. **(2)** by obtaining proper instruction in the use of this canopy and the rest of the equipment, and **(3)** by operating each component of the system in strict compliance with the owner’s manual and safe parachuting practices.

However, parachute systems sometimes fail to operate properly - even when properly assembled, packed and operated - so you risk serious injury and death each time you use the system.

### STATEMENT OF COMPLIANCE

The policies contained herein comply with the Federal Aviation Regulations, Part 21.

### REVISION LIST

This manual may be revised at any time by Performance Designs, Inc (PD). The only way to be sure this manual is current for your canopy is to check periodically with PD or check [www.performancedesigns.com](http://www.performancedesigns.com). PD welcomes suggestions of ways to improve this publication. If you feel parts are incomplete or hard to understand, please let us know by writing or emailing PD. This is the Fourth (4th) printing of the PD Reserve Owners Manual. All changes up to the printed date have been incorporated.

Copyright 2002, Performance Designs, Inc.

### DISCLAIMER NO WARRANTY

Because of the unavoidable danger associated with the use of this parachute, the manufacturer makes no warranty, either expressed or implied. It is sold with all faults and without any warranty of fitness for any purpose. The manufacturer also disclaims any liability in tort for damages, direct or consequential, including personal injuries resulting from a defect in design, material, workmanship or manufacturing whether caused by negligence on the part of the manufacturer or otherwise. **By using this parachute assembly, or allowing it to be used by others, the user waives any liability of the manufacturer for personal injuries or other damages arising from such use.**

If the buyer declines to waive liability on the part of the manufacturer, buyer may obtain a full refund of the purchase price by returning the parachute before it is used to the manufacturer within 15 days from the date of the original purchase with a letter stating why it is returned.



PD Reserve Size: PD _____  PD Serial No: R _____  Date of Manufacture: _____
--



## SYSTEM INFORMATION CARD

**All Performance Designs parachutes come with a system information card. This card makes important information about the system available to the user.** Without this information the user may not be able to determine if the system is suitable for their weight, experience level, opening and landing conditions. Much of this information is placarded in locations where it is unavailable to the user when the rig is packed so this is the primary means of the user being able to assess their ability to use this equipment. This is part of the TSO required placarding on Performance Designs Reserves. The system information card should be kept in the packing data card pocket or in a designated location for operating limitations that is readily available to the user. For Performance Designs canopies the information needed to fill it out can be obtained from the data panels (warning labels) or from the Performance Designs Inc. web site. If other manufacturers products are used you may need to consult with the manufacturer for this information

## CANOPY PACKING / DEPLOYMENT LOG

**As any conventional ram air reserve is repeatedly handled and repacked, the fabric permeability will increase. This increased permeability will affect opening, flight and/or landing characteristics.** To monitor this important issue, we have incorporated a tracking and inspection program into our reserve canopies. Compliance with this program is mandatory. Each time the reserve is inspected and packed, a single diagonal line \ is to be placed in the next open box on the label. In the event of an actual deployment, an **X** is to be placed in the next available box.

**The warning label should accurately reflect the repacks and uses on that reserve canopy.** In the event a rigger encounters a discrepancy between the packing data card and the warning label, the label should be brought into compliance, just as the rigger would do with any other piece of equipment. The owner of the reserve should be informed that the rigger is simply complying with Performance Designs' requirement for the label to accurately reflect the repacks and/or uses on that canopy.

After 40 repacks or 25 deployments have been reached, the reserve must have its permeability tested. (In most countries, 40 repacks are usually performed over a 10 to 20 year period.) The testing is performed to insure that the fabric permeability has not reached a point where the openings and landing performance would be unacceptable. Subsequent to passing this testing, an additional label is affixed and the canopy is then returned into service. The label will contain additional boxes, the specific number being chosen according to the results of the test.

### CONVENTIONS USED



Information about FreeFlying



Important information



Tips and hints



Warning information

# TABLE OF CONTENTS

# PAGE

LETTER FROM THE PRESIDENT . . . . .	1
WARNING / REVISION LIST / CANOPY DATA . . . . .	2
SYSTEM INFORMATION CARD, CONVENTIONS & DEPLOYMENT LOG . . . . .	3
<b>SECTION 1 - GENERAL INFORMATION . . . . .</b>	<b>6</b>
GENERAL INFORMATION ABOUT THIS MANUAL . . . . .	7
READ THE MANUAL BEFORE ASSEMBLY OR USE . . . . .	7
<b>SECTION 2 - CANOPY CHOICE . . . . .</b>	<b>8</b>
CHOOSING THE CORRECT CANOPY . . . . .	9
WING LOADING, CANOPY SIZE & SKILL LEVELS . . . . .	10
HIGH TEMPERATURE AND FIELD ELEVATIONS . . . . .	11
WING LOADING DESCRIPTIONS . . . . .	11
FLIGHT CHARACTERISTICS . . . . .	13
BASIC INSTRUCTIONS FOR LOW WING LOADINGS . . . . .	13
TIPS ON FLYING AT HIGH WING LOADINGS . . . . .	14
<b>SECTION 3 - OPERATING LIMITATIONS . . . . .</b>	<b>16</b>
DEPLOYMENT BODY POSITION AND AIRSPEED . . . . .	17
DEPLOYMENT SPEED . . . . .	17
FREE FLYERS . . . . .	17
MINIMUM DEPLOYMENT ALTITUDES . . . . .	18
EFFECTS OF ALTITUDE ON AIRSPEED . . . . .	18
TEMPERATURE AND AIRSPEED . . . . .	18
IN SUMMARY . . . . .	19
MAXIMUM CERTIFICATED WEIGHTS AND SPEEDS . . . . .	19
UNDERSTANDING THE BASICS OF TSO C23 . . . . .	19
SAFE OPERATING GUIDELINES AND COMMON SENSE . . . . .	19
<b>SECTION 4 - CANOPY MAINTENANCE . . . . .</b>	<b>22</b>
CANOPY CARE AND CONDITION . . . . .	23
DEGRADATION FROM USE . . . . .	23
INSPECTION INSTRUCTIONS . . . . .	23
VISUAL INSPECTION . . . . .	24
FABRIC TESTING . . . . .	25
STRENGTH TESTS . . . . .	25
PERMEABILITY CHECKS . . . . .	26
MAINTENANCE AND REPAIRS . . . . .	26
MINOR REPAIRS . . . . .	26
MAJOR REPAIRS . . . . .	26
FACTORY REPAIRS . . . . .	26
WET CANOPIES . . . . .	27

# TABLE OF CONTENTS

# PAGE

<b>SECTION 5 - CONFIGURATION AND ASSEMBLY</b> . . . . .	<b>28</b>
SIDE AND FRONT VIEWS . . . . .	29
DEPLOYMENT SYSTEMS . . . . .	30
REPACK CYCLES . . . . .	30
SERVICE LIFE . . . . .	30
COMPATIBILITY CHECK . . . . .	30
ATTACHING THE RESERVE TO RISERS . . . . .	30
CONNECTOR LINKS . . . . .	31
STAINLESS LINKS . . . . .	31
SLINKS . . . . .	33
ATTACHING STEERING LINES TO TOGGLES . . . . .	32
TOGGLE ATTACHMENT: MICROLINE WITH FACTORY MADE LOOP . . . . .	34
TOGGLE ATTACHMENT: MICROLINE . . . . .	35
TOGGLE ATTACHMENT: POLYESTER LINES . . . . .	36
 <b>SECTION 6 - PACKING INSTRUCTIONS</b> . . . . .	 <b>38</b>
FLAT PACKING INSTRUCTIONS . . . . .	38
PRO PACKING INSTRUCTIONS . . . . .	49
 <b>CHARTS</b> . . . . .	 <b>57</b>

# SECTION 1

## GENERAL INFORMATION

- GENERAL INFORMATION ABOUT THE MANUAL
- IMPORTANT INFORMATION TO READ PRIOR TO USE



## GENERAL INFORMATION ABOUT THIS MANUAL



**To reduce the risk of serious injury or death, you must obtain instruction in the use of this parachute from a competent and appropriately rated instructor before using this parachute for the first time.** It is beyond the scope of this manual to teach you how to deploy, fly, land or maintain this parachute. This manual is only a general guide about this canopy. It does not replace or substitute for proper training and instruction. If there is anything that you do not fully understand, you must get help from a properly rated instructor. Parachute associations around the world, including the United States Parachute Association, publish recommended procedures on learning to skydive and on using skydiving equipment. We urge you to learn and follow these procedures. Jumping this parachute without first receiving thorough and personal instruction increases the risk of serious injury or death.



**Sport parachuting technology and procedures continue to advance rapidly.** Although a great deal of care has been taken in the preparation of this manual, Performance Designs cautions that it may contain information that may not be correct or behind the current state of the art of parachute use.

For these reasons, you must use qualified experts - riggers and instructors - to help you inspect, assemble, pack, use and maintain this parachute. Performance Designs recommends that you stay abreast of current techniques and procedures. One such way of keeping updated is to log onto [www.performancedesigns.com](http://www.performancedesigns.com).

### READ BEFORE ASSEMBLY OR USE



**Since parachutes are manufactured and inspected by people, there is always a possibility this parachute contains defects as a result of human error.** Therefore, the entire parachute system - main and reserve canopies, harness, container and other components - must be thoroughly inspected before their first use and before each subsequent use.

**Parachutes get weaker through time for a number of reasons. They are subject to wear during packing, deployment and landing. Exposure to many agents, including sunlight, heat and household chemicals, significantly weaken parachutes.** The damage may or may not be obvious. To help minimize the risk of parachute failure and possible serious injury or death, the entire parachute system should be thoroughly inspected at least every year. Parachute associations around the world have laws regarding repack and inspection cycles. Make sure that you are aware of the laws pertaining to you. Inspections must be done by a certificated rigger who has previous experience with this type of parachute.

**Your parachute should be immediately inspected if at any time it is exposed to a degrading element.** Remember that some chemicals will continue to degrade the parachute long after initial exposure. Regular and thorough inspections are necessary to maintain the structural integrity, reliability, and flight characteristics of the parachute.


Always know the entire life history of every part of your parachute system. That way you will know that no part has been exposed to an agent that may seriously weaken or damage it.

# SECTION 2

## CANOPY CHOICE

- **CHOOSING THE CORRECT CANOPY**
- **WING LOADING, CANOPY SIZE AND SKILLS LEVEL**
- **HIGH TEMPERATURES AND FIELD ELEVATIONS**
- **WING LOADING DESCRIPTIONS**
  - **Less than 0.45**
  - **Between 0.45 and 0.7**
  - **Between 0.7 and 1.0**
  - **Between 1.0 and 1.4**
  - **1.4 and Higher**
- **FLIGHT CHARACTERISTICS**
- **BASIC INSTRUCTION FOR LOW WING LOADINGS**
- **TIPS FOR FLYING AT HIGHER WING LOADINGS**

## CHOOSING THE CORRECT CANOPY

It is important for your safety and enjoyment that you match your canopy with your ability and weight. Performance Designs reserve canopies are built in several models and sizes that span a wide range of canopy sizes and operating limits. **There is a specific reserve to match almost any combination of deployment altitudes, weights, skill levels, and landing elevations.** You should read this section very carefully to ensure that this is the correct canopy chosen. 

Any canopy's descent rate and forward speed increases as the weight it is carrying, the so called suspended weight, increases. **The canopy also becomes more responsive and reacts more radically when it is stalled or turned.** Penetration into the wind increases, but glide ratio decreases. Because of these aerodynamic facts, it is unsafe to put too much weight under any particular canopy.

If a canopy is too small for you, safe and comfortable landings will be difficult to obtain, even for experienced jumpers under ideal conditions. Less experienced jumpers should be more conservative on canopy size.

The explanations about canopy flight characteristics below are based on landing elevations at sea level. **If you're landing at elevations more than 2000 feet above sea level, you should consider getting a canopy at least one size larger than what you would normally jump at sea level.**

Determining the wing loading of the parachute you intend to jump or buy is a good guide to matching your weight to a particular canopy. **Wing loading is easily calculated by dividing a total suspended weight in pounds by the surface area of the parachute in square feet.** Total suspended weight is the weight of the jumper plus all his clothing and gear, including all components of the parachute system.

The size of Performance Designs canopies is printed on the data panel on the centre cell top surface near the tail. **(Be sure to actually check the data panel; canopies of different sizes may look the same.)**

A typical ready-to-jump sport parachute system (rig and both canopies) weighs 15 lbs (14.5kg) to 30 lbs (29.5kg). Add this, plus the weight of your jumpsuit, clothing and accessories to your body weight to get the total suspended weight.

For example, a jumper who weights 165 lbs (74.8kg) with his jumpsuit on and who jumps a packed rig that weighs 25 lbs (11.35kg) would have a suspended weight of 190 lbs (86.1kg).

Here's an example of how to calculate wing loading of a 210 square foot canopy and the jumper used in the example above:

$$\frac{190 \text{ lbs}}{210 \text{ sq.ft}} = 0.9 \text{ lb./sq.ft.}$$

Now calculate the wing loading for the main and reserve canopies you intend to jump. Compare the wing loadings of your main and reserve parachutes. Generally, if the wing loadings are similar and the canopies are both of reasonably similar design, the speeds and skill level requirements will be close enough for most experienced jumpers to handle. If they are very different the canopies will fly very differently.

A very important factor is what wing loadings you are used to, so compare the wing loading to the canopies you were previously jumping. **If the change in wing loading is more than 15%, the canopy**

**will seem very fast, have a high rate of descent, and be tricky to flare.** This situation can be very dangerous, therefore we recommend restricting the change to less than 15%.

You should particularly avoid having a higher wing loading main parachute than you are used to, and a reserve that has an even higher wing loading. Keep in mind that at high wing loadings you have very little time to figure out how to land the canopy even if you open up high. Also consider that when you open your reserve you will probably be at a lower altitude than you are normally open on your main. There is a good chance that you will not make it to your intended landing area. Do you really want to be trying to figure out how to land the smallest, fastest, highest rate of descent canopy you have ever jumped, while landing in an undesirable location?

## WING LOADING, CANOPY SIZE AND SKILL LEVEL

We no longer publish one single value for “maximum exit weight”, but rather a table including maximum exit weight limits in pounds and kilograms according to canopy pilot skill level. An example of this table follows:

MODEL	MINIMUM	STUDENT	NOVICE	INTERMEDIATE	ADVANCED	EXPERT	MAXIMUM
PD 143R	VLC	N/R	122 lb (55 kg)	143 lb (65 kg)	165 lb (75 kg)	200 lb (91 kg)	254 lb (115 kg)

VLC = Varies with landing conditions. N/R = Not recommended

**How are the different categories defined?** Although a skill level category system with rigid definitions for each level is not possible, we can say that the range starts from the STUDENT level (first skydive) and goes beyond EXPERT (some of the best pilots in the world), of which there are only a handful. Numbers of jumps is one factor, but not necessarily the dominant one. The type of equipment being used on those jumps is an important factor, as is how frequently these jumps are being made. **An important rule to consider is to limit any change to a smaller canopy size to no more than a 15% size reduction from what you are used to.** In the final evaluation, it is the type and quality of canopy experience that really determines a person’s preparedness for a given canopy.

One way to use this chart is to find where you are on the chart, and ask yourself if you should be in that category. For example, if you have a PD143-R and have an exit weight of 195 lbs, we feel you should be an expert. If you consider yourself a novice, then this canopy is probably not suitable for you. You should check this with your main canopy as well. It is important to note that the weights listed under each category are only a maximum for each category, and not a requirement. Many expert skydivers prefer to jump at lower wing loadings than the level shown on the chart, for a variety of reasons.

## HIGH TEMPERATURE AND FIELD ELEVATIONS

**Landing performance degrades with increasing temperature and altitude.** To help compensate for this we recommend that you lower all published weights (except any minimum weights) by 2% for each 1000 feet your landing area is above sea level. In addition you should lower all published weights (except minimum weights) by an additional 1% for each 5 degrees F (3 degrees C) above standard day conditions. Standard day conditions are 59 deg F (15 deg C) at sea level and reduce approximately 3.5 deg F (2 deg C) per thousand feet. It is usually not very practical to reduce your landing weight so you really need to consider this at the time you are selecting a parachute to buy or use. **This is an excellent reason to give yourself a little more margin when purchasing a canopy.** Landing performance also degrades with increasing temperature and altitude.

## WING LOADING DESCRIPTIONS

This section describes how canopies typically perform at various wing loadings. **Since your recent experience will affect your frame of reference, this section is only a general guide.** It is still preferable to compare the wing loading of your new reserve to the canopy you have been jumping.

### WING LOADINGS LESS THAN 0.45 LB/SQ.FT:

The parachute is too large for you. The canopy will fly very slow, and may not have sufficient penetration, even in light winds. Turbulence will have a greater influence on the canopy. Light turbulence or wind gusts that canopies with higher wing loadings fly through easily may be sufficient to stall or collapse your canopy. We recommend that you do not use this canopy if the wing loading is below 0.45.

### WING LOADINGS BETWEEN 0.45 AND 0.7 LB/SQ.FT:

This is a lightly to moderately loaded parachute. This is a good area for students and low experience level jumpers, and for pilot emergency bailout parachute systems when used by a pilot with very little training. The canopy will be relatively slow and docile. It will be easy to land and will not require the very precise flare timing and technique that canopies at higher wing loadings require to get an acceptable landing. However, proper instruction in the use of this canopy is required. When jumping at this wing loading, you will be more limited as to wind speed, wind gusts, and turbulence than jumpers using canopies at higher wing loadings. Even if other jumpers are jumping, the conditions may not be safe for you to jump.

### WING LOADING BETWEEN 0.7 AND 1.0 LB/SQ.FT:

This is moderately loaded canopy. If this is a higher wing loading than you are used to, the canopy will fly fast and turn fast. It will require more skill to land well. Small errors in flaring technique that were unnoticeable on a larger canopy will cause noticeable errors on this one. It will also be more difficult to land in confined landing areas. Be sure your skill level is up to the demands of this situation.

**WING LOADINGS BETWEEN 1.0 AND 1.4 LB/SQ.FT:**

This is a highly to very highly loaded canopy. A high experience level is required to get an acceptable landing, even under ideal landing conditions. If this is a higher wing loading than you are used to, the canopy will fly and turn very fast. A precisely timed dynamic flare will be required to get the rate of descent to an acceptable level. Your forward speed may be high when you actually land. Stalls will occur at relatively high flight speeds. It will be difficult to land this parachute in confined areas or at high altitudes.



**Also keep in mind that if you are rendered unconscious and an AAD opens your reserve, you may still suffer severe injuries or death due to uncontrollable landing.**

Performance Designs recommends a minimum of 300 jumps on ram-air canopies, and at least 50 jumps on a canopy no more than 15% larger than this reserve, before using a reserve in this wing loading. If you choose a canopy at or above these wing loadings, you must realize and accept the additional risks involved in use of the canopy.

**WING LOADINGS ABOVE 1.4 LBS/SQ.FT, AND BELOW THE MAXIMUM SUSPENDED WEIGHT:**

This is a very high wing loading. **Turn rates, forward speed and rates of descent will all be very high.** A very high experience level is required to get an acceptable landing, even under ideal landing conditions. Control range may be very short, with stalls happening very abruptly, with little warning. This situation can be very dangerous. Performance Designs advises all jumpers, regardless of experience, that it is safer to choose a lower wing loading than this level. However, Performance Designs recognizes that there are a few individuals that have a great deal of experience and skill flying a main parachutes in this wing loading, and are determined to use reserves in the same wing loading. **While this is legal (if the conditions below are met), it is very hazardous.** There are relatively few jumpers that are capable of handling this situation. **At a minimum, jumpers must meet the follow requirements:**

- ✓ At least 500 ram-air canopy jumps and at least 100 jumps on a ram-air canopy that is no more than 15% larger than the reserve parachute
- or-
- ✓ Have an endorsement in their log book from an instructor who has the proper ratings issued to them by their countries governing association stating that:
  - The jumper has been given instruction in high wing loading canopies.
  - The maximum wing loading the individual has demonstrated that they can safely handle.
  - The wing loading for the reserve parachute must not exceed the maximum demonstrated wing loading



**These are both FAA (USA) and Performance Designs requirements that must be met for you to be legal.** Other countries throughout the world may also enforce these limitations. Even if you meet the level requirements this is a very dangerous situation. The landing conditions, weather, or your skill level may make this even more dangerous. **Severe injury or death may result.** Also keep in mind that if you are rendered unconscious and an AAD opens your reserve, it is very likely that you may suffer severe injuries or death due to an uncontrolled landing. For these reasons, we recommend that you get a canopy with a lower wing loading.

**The absolute maximum suspended weight for the canopy is the absolute legal limit. There are no situations where it is permissible to exceed the maximum suspended weight for the parachute. Structural failure may occur if you exceed these limits. By exceeding the absolute maximum suspended weight you risk serious injury, death, equipment failure, and FAA violations or fines.**

## FLIGHT CHARACTERISTICS

This section is intended to give you some hints on how to fly your reserve. This is not a substitute for proper training. **Performance Designs recommends that you obtain proper instruction on the use of your parachute system before using this canopy.** In the U.S.A. you should use a United States Parachute Association rated instructor. Other countries have similar associations for approving instructors.

Even if you are familiar with ram-air parachutes, including Performance Designs canopies, your new reserve parachute may handle differently. **Like most 7 cell main canopies, the PD 7 cell reserves generally have a higher rate of descent and a lower glide ratio than most 9 cell main parachutes at smaller wing loadings.**



## BASIC INSTRUCTION FOR LOW WING LOADINGS



**The following is intended to be a supplement to proper instruction on the use of this parachute from a qualified and appropriately rated instructor. This is not a course of instruction.**

In the event of the deployment of your ram-air reserve, check your altitude. If there is sufficient altitude, prepare your canopy for flight as follows:

- ☐ Release the brakes. On most systems this is accomplished by pulling down on the toggles. Note that if only one brake releases, the canopy will enter a turn. Depending on the size and wing loading the turn can be quite fast. In the rare event that there is difficulty releasing one of the brakes, the turn should be stopped by continuing to pull down the side that released until the turn stopped.
- ☐ If necessary at this point, the slider may be pumped down by pulling both toggles down to your waist and holding them there for few seconds and then raising them back up. If any cells are closed, this action should open them. You may have to repeat this action two or three times. Again, perform the above procedures only if there is sufficient altitude. It is better to make a smooth flared landing with collapsed end cells than to land while pumping the toggles to clear them
- ☐ Next look for the best landing area you are sure you can reach. Keep in mind that your reserve may not glide as far as your main parachute. Your opening altitude will probably be lower than normal under your reserve. The sooner you look for a landing area the more places you will have to choose from. Immediately turn toward your intended landing area.
- ☐ If there is enough extra altitude after reaching the landing area, try some practice flares in the air. Note the control range and how the canopy stalls. If you flare too much you may stall the canopy and hit the ground unusually hard.
- ☐ Always fly a conservative approach for a first-time landing on any canopy. Set up your final approach to landing higher than normal. Avoid turns close to the ground. Remember this canopy probably flies very differently than the one you are used to. It may lose a lot more altitude in a turn than you

expect. Try to land into the wind. However, it is more important to not be turning on landing. It is recommended that all turns be completed by 200 feet above ground level.

## TIPS FOR FLYING AT HIGHER WING LOADINGS

**These are some highlights to help you be better prepared before you receive instruction on the use of this parachute.**

Since flying at high wing loadings is advisable only for highly experienced jumpers, this section will cover only those areas often overlooked by experienced jumpers. Chances are that finding yourself under your reserve will come as a bit of a surprise. It is important fly toward your landing area while attempting to become accustomed to the canopy as soon as possible.

**The smaller reserves may have a shorter control range and a sharper stall than you are used to.** Therefore several practice flares should be performed, altitude permitting. This will give you a good idea of how long the control range is, and how far you may pull the toggles without stalling the canopy. How much altitude is required depends on your experience, but a practice flare should be possible if you executed your emergency procedures at the advisable altitude. **Remember that you are losing altitude, so do a practice flare early in the canopy flight.**

It is not advisable to do a steep turning approach. Even though you may be used to this on your main canopy, this canopy will handle different. Therefore, it is best to fly a straight in approach with plenty of airspeed, if possible. Avoid even small toggle inputs for the last ten seconds before landing, as they can have the effect of slowing the approach, which will reduce the potential flaring power. If you do turning approaches on your main, it is a good idea to stay current on straight in approaches.

Flare the canopy as you did during the practice flares that gave the best results. If you didn't do the practice flares, then you'll have to do your best guess on the real thing. Planning ahead will avoid this problem on the next time...





# SECTION 3

## OPERATING LIMITATIONS

- **DEPLOYMENT BODY POSTION AND AIRSPEED**
- **DEPLOYMENT SPEED**
  - **FREEFLYERS**
  - **MINIMUM DEPLOYMENTY ALTITUDES**
  - **THE EFFECTS OF ALTITUDE ON AIRSPEED**
  - **THE EFFECTS TEMPERATURE HAS ON AIRSPEED**
  - **SUMMARY**
- **MAXIMUM WEIGHTS AND SPEEDS**
- **UNDERSTANDING TSOC23**
- **OPERATING GUIDLINES**

## DEPLOYMENT BODY POSITION AND AIRSPEED

Although it is not always possible in emergency situations, it is desirable to have a good body position for deployment of any parachute canopy. It is usually best to be sitting up head high with shoulders level on deployment. Other body positions may increase the possibility of parachute damage, malfunction, high opening shocks, or excessively slow deployments. However, while good body position is desirable, it is unwise to waste altitude to get into a good body position. To reduce the risk of serious injury or death, proper training in how to control your body position during deployment is required.

Deploying your reserve with one shoulder low may increase the possibility of line twists. It may take considerable time and altitude to untwist the lines, particularly at high wing loadings with the associated high descent rate.

## DEPLOYMENT SPEED

**It is important to understand the deployment speed limitations of your parachutes and stay within their placarded limits. Failure to do so may result in failure of the parachute, serious injury or death.** Your deployment speed is affected by three factors:



- ▣ ***Basic body position and body type***
- ▣ ***Deployment altitude***
- ▣ ***Temperature during deployment***

### FREEFLYERS



Some body positions such as head down, stand up and long dives, may enable the user to reach speeds and attitudes, beyond those for which your equipment has been designed and tested. **Premature or unintentional deployments in these body positions, even if you are below the maximum placarded deployment speed, are extremely dangerous.**

Your parachute system was designed to operate within specific weight and speed parameters, while oriented in a body position ranging from “belly to earth” to a slightly “head high” attitude.

Deployments outside of these limits could cause any/all of the following:

- Extremely hard openings resulting in equipment failure
- Severe bodily injury
- Possible harness failure or ejection from the harness
- Canopy damage, malfunction or death

Do not exceed the operational speed or weight limits of your parachute system. You should avoid deploying in an attitude that your equipment was not designed for. The maximum operating limitations of your system are the lowest weight limit and lowest airspeed limit of any of the system components. You need to check the reserve parachute, main parachute and harness/container to determine the operating limitations.

## MINIMUM DEPLOYMENT ALTITUDES

Though it is best to slow down from a high speed dive before deploying, the overriding factor must be to deploy above your minimum safe altitude, regardless of your airspeed. For more information on minimum opening altitudes, consult your country's national organization that governs skydiving activities.

You must deploy your main canopy high enough to allow for sufficient altitude for a safe reserve deployment. **When determining a minimum safe altitude you must also consider AAD activation altitude. You must deploy your main parachute at a sufficient high altitude that you will be able to recognise a malfunction on your main parachute and be able to deal with it appropriately before getting to the AAD activation altitude.**

## THE EFFECTS OF ALTITUDE ON AIRSPEED

**True airspeed (the speed you are actually going) increases by about 2% per thousand feet of altitude above sea level.** At 10,000 feet you will be going about 20% faster than what the airspeed indicator in the aircraft indicates. This means that your typical sea level freefall speed of 110kts will actually be about 135kts. At 20,000 feet there is a 40% increase in airspeed. Therefore a flat and stable body position may be over 150kts.

**Though typical jump aircraft are in the 80 kts – 100 kts jump speed range, exit speeds can be 125kts or more.** If the aircraft airspeed indicator is indicating over 125kts at 10 000 feet, you are going faster than the 150kts maximum certified airspeed of most reserves. An aircraft with an indicated airspeed of greater than 107kts at 20,000 feet will also put you over 150kts true airspeed on exit, which is over the maximum operating speed of most parachutes.

The maximum deployment speed listed on the warning label is based on standard day conditions at sea level. Deploying your parachute at higher altitudes and temperatures greatly affects the true airspeed you are actually going whether in an aircraft or in freefall. These effects may make it relatively easy to exceed the airspeed limitations of most reserves in certain conditions. **The average free fall speed near sea level is approximately 90 - 100 kts, though speeds of up to 110kts are not uncommon.** This higher speed is common with people having less body surface area, heavier in weight or with smaller, slicker jumpsuits. Even if you do not fit into this category, it will only take a slight dive to reach 110 kts.

## THE EFFECTS TEMPERATURE HAS ON AIRSPEED

Additionally, air temperature also affects airspeed. All placard speed limits and the above examples assume standard day conditions of 59 deg F (15 Deg C) at sea level. Standard temperature decreases by about 3.5 deg F (2 deg C) per thousand feet. Your true airspeed will be about 1% higher for each 5 deg F (3 deg C) above the standard temperature at deployment altitude.

**From the above information, you can see that it is very possible to exceed the airspeed limitation of your reserve, especially at high altitudes and variances in temperatures.** With head down, sit flying, tumbling, or other body positions you can exceed the maximum speeds of most reserves quite easily.

**Even if your parachute survives a high-speed opening you may not. Parachutes tend to open faster with increases in airspeed and increases in altitude.** Faster openings mean higher G loads on your body. Excessive G loadings from high-speed deployments have caused severe injuries and death. Lower weight is a major disadvantage in this situation. Lower weights will decelerate faster for a given canopy

deceleration force so the G loading (and your risk) will go up as weight goes down. The TSO requires the canopy to open in relatively low distances to increase the survivability of low altitude deployments. However, this feature also exposes you to high G loadings from high airspeed and/or high altitude deployments.

**Premature deployments may result in deployments above the maximum speed.** Many of the newest container systems have much better protection against premature deployment. We recommend that you only use modern equipment designed for your specific uses.

## IN SUMMARY

- ☐ Plan your opening altitudes and body positions so that you stay within the operating limits of your parachute.
- ☐ If you are going fast, make sure you spend enough time slowing down before deploying your parachute, altitude permitting.
- ☐ Each component is marked with its individual operating limits. The user must check each component to be sure they are inside the operating limits of all the components.

## MAXIMUM CERTIFICATED WEIGHTS & SPEEDS

The charts at the end of the manual shows the recommended maximum suspended weights and the absolute maximum suspended weights. **Exceeding the recommended maximum suspended weight may result in serious injury or death due to landing injuries. Exceeding the absolute maximum suspended weight is illegal, a violation of the Federal Aviation Regulations, and may result in serious injury or death due to structural failure as well as landing injuries.**



**Do not exceed the maximum suspended weight!**



## UNDERSTANDING THE BASICS OF TSO C23

These parachutes have been tested and approved under TSO C23c category B or TSO C23d using the full weights and speeds required by the appropriate TSO. **However, for landing safety, the FAA has given Performance Designs the authority to lower the legal weight limits from those listed in the TSO.** While the TSO allows for testing at weights as low as 264 lbs (119.5 kg), all Performance Designs reserve parachutes have been tested with weights in excess of 300 lbs (135.9 kg) and airspeeds 180 kts or greater.

The term TSO is a FAA mnemonic for Technical Standards Order. A TSO is a FAA production approval for certain aviation related products. TSO C23 is specifically for personal parachutes. To produce a TSO'd product the item must have passed a FAA approved test program and the manufacturer must maintain FAA approved manufacturing and quality control systems. Each time the FAA makes significant changes to the testing equipments the revision letter is incremented. Currently, most personal parachutes are manufactured under TSO's C23b, C23c or C23d.

TSO C23b was based on testing a military C9 round canopy, which at the time was considered a state of the art canopy. **Standard category equipment had to demonstrate the ability to withstand a 5000 lb shock load with no damage. No specific speed or weight was required for structural testing.** This testing was adequate for most skydiving applications when all canopies were round and were built out of relatively high permeability fabric and high elongation Nylon lines.

With new technologies such as low permeability fabric and new canopy designs like ram-air canopies, this standard was no longer adequate. Some canopies could generate the 5000 lb shock loads at relatively low weights and speeds while others would not generate 5000 lbs at speeds and weights far higher than what was required with a C9.

**Parachute equipment produced under TSO C23b has no required placarded maximum weight or speed.** However, this is very misleading. All parachute equipment has a maximum weight and speed combination above which failure is likely. Unfortunately, **TSO C23b did not provide a means for determining a maximum certified weight or speed so these values are unknown. It is worth noting that most equipment recertified in more recent TSO's had to be structurally upgraded in order to pass the newer TSO.** In most cases it is significantly easier to pass the 5000 lb shock load of C23b than to pass the minimum testing requirements of TSO C23C or TSO C23D.

The next revision of the TSO, TSO C23c, provided a solution to the lack of specific weight and speed testing and placarded limits. **However, TSO C23c had a major limitation in that it only provided for certifying equipment up to 254 lbs exit weight. This meant that anyone over about 230 lbs could not legally use this equipment.**

**TSO C23d fixed this limitation by providing a means for certifying at higher weights and higher airspeeds.**

## SAFE OPERATING GUIDELINES AND COMMON SENSE



**Reserve parachutes are tested at weights and speeds significantly higher than the placarding limits to give a reasonable safety margin.** However, only new parachutes are tested and usually no more than three high speed/heavy weight tests are performed on a single canopy and a specific deployment system. **Different deployment systems may affect opening loads.** There are some variations inherent in materials and manufacturing. Different temperatures and humidity may significantly affect material strengths. Further, parachute materials get weaker through age, use, UV light exposure, dust, sand, and chemical exposure (including things as simple as human body sweat).



Parachute equipment has historically had a relatively low failure rate. However, a large part of this low failure rate is due to relatively conservative operational use. **Few canopies are deployed much above 110 kts or close to their maximum operating weight. As with any other device, the higher you load it, the higher the possibility for failure.** With all these variables, there is a possibility that your reserve parachute will fail at lower airspeed/weight combinations than the test canopies. Larger margins between the placard limits and your operational use will give you a greater safety factor. We strongly recommend that you do not plan on operating at or near the placarded maximum speed or weight.



# SECTION 4

## CANOPY MAINTENANCE

- CANOPY CARE AND CONDITION
- CANOPY DEGRADATION FROM USE
- INSPECTION INSTRUCTIONS
  - VISUAL INSPECTION
- FABRIC TESTING
  - STRENGTH TESTING
  - PERMEABILITY CHECK
- MAINTENANCE AND REPAIRS
  - MINOR REPAIRS
  - MAJOR REPAIRS
  - FACTORY REPAIRS
- WET CANOPIES



## CANOPY CARE AND CONDITION

- ▣ Avoid dragging any part of the canopy across the ground.
- ▣ Do not leave the canopy exposed to the sun any longer than is absolutely necessary.
- ▣ Avoid washing your canopy. Doing so will reduce the performance of the parachute, possibly to the point of making the canopy un-airworthy and voiding the TSO. Local areas that are soiled or stained should be cleaned with mild soap and water. Do not use harsh detergents or products containing bleach.
- ▣ Have your Performance Designs reserve inspected and maintained by a licensed rigger in compliance with FAR Part 105.43 or the standards for your country.
- ▣ Store your parachute in a cool, dry place in a container through which light will not pass. This will prevent the permanent and difficult-to-detect damage caused by ultraviolet light. Light from many artificial light sources, as well as sunlight contains ultraviolet light.
- ▣ Nylon degrades rapidly with acids. Acids from bug spots or food can seriously degrade the parachute. These should be cleaned as soon as possible. Acids from batteries will destroy parachutes. Never allow the parachute to come in contact with Lead acid (automotive and aircraft) batteries or be stored in the same environment. Acid contamination may take a long time to degrade the canopy enough to make it structurally unsafe. The affected area may have no visible signs of damage. If there is reason to suspect significant acid contamination the equipment should be permanently removed from service and destroyed.

## DEGRADATION FROM USE

This canopy is designed for reserve or emergency use only. It is not intended to be jumped on a regular basis, or to accrue a large number of jumps. In an effort to build the most reliable reserve parachute possible, materials were chosen mainly for reliability and strength, rather than maximum durability over a large number of jumps. **The fabric permeability increases with use, even more so from packing and handling and packing, causing the canopy to take more time and altitude to open.** A canopy with a lot of jumps will not open as quick, land as well or be as reliable as a new one. It is very important that your reserve be in close to new condition. **A reserve with fabric over the permeability limits may take too long to open at routine cut-away altitudes, could possibly result in bodily injury or your death.** If you are in doubt about the condition of your reserve, have it thoroughly inspected and have the fabric permeability tested.

## INSPECTION INSTRUCTIONS

Your Performance Designs reserve must be inspected thoroughly before it is packed the first time and at each repack. This inspection should be performed with even more care and attention when first assembled and after a deployment. A certificated rigger must inspect your new Performance Designs reserve and determine its compatibility with your rig.

This inspection should be done in a clean, well-lit area with enough room to spread out the reserve canopy.

Here is the Performance Designs recommended procedure for inspecting your reserve canopy. Consult the owner's manual for your rig and other components for instructions on inspecting them.

## **VISUAL INSPECTION**

We recommend starting at the top of the canopy and working down to the risers as described below:

- ▣ **TOP SURFACE:**  
Spread the canopy out on its bottom surface and inspect the top surface starting at the front of the left end cell. Check half of the cell from nose to tail. Then check the other half cell going tail to nose. Repeat this pattern until all the cells top surfaces are inspected. Look for rips, stains, snags, burns, abrasions or failed seams.
  
- ▣ **BOTTOM SURFACE:**  
Turn the canopy over and spread it out to inspect the bottom surface. Again use the procedure of inspecting half cells as on the top surface. Check for rips, stains and failed seams. Look very closely at the line attachments. Even slight damage is cause for rejection in these areas. Line attachments must be completely free of any damage or defects. Check under the ends of the line tabs.
  
- ▣ **RIBS:**  
Inspect each rib from leading edge to the trailing edge by looking inside each cell. Pay extra attention to the line attachment points.
  
- ▣ **LAY THE CANOPY OUT NEATLY ON ONE SIDE:**  
Stacking each loaded rib on top of the others. Check that all lines in each line group are the same length and that the trim differential between each line group is correct for this reserve. Check the condition of the stabilizers and slider stops on the stabilizer.
  
- ▣ **SUSPENSION LINES:**  
Check the full length of each line for damage and wear. Look for fraying at all cascades and where each line attaches to the connector link. Check that all lines are sewn and that the stitching is good. Check the continuity and routing of each line.
  
- ▣ **SLIDER:**  
Be sure the fabric isn't torn, that the grommets are undamaged and have no sharp edges, and that they are securely attached to the slider. Be sure every suspension line and both steering lines pass through the proper grommet on the slider.
  
- ▣ **CONNECTOR LINKS:**  
Visually check the link and its condition. If the link is not bent or damaged, the link is ok for continued service. If SLinks are used, check for proper installation and for cuts or wear. There should be no visible damage to the links.
  
- ▣ **SLIDER STOPS:**  
Insure that the slider stops located on the connector links are the correct ones, are positioned correctly, and are properly tacked to the links. No substitutes are authorized for Performance Designs slider stops.
  
- ▣ **TOGGLES:**  
The toggles must be installed correctly and must match the guide ring and the hook and loop

fastener on the risers. Performance Designs canopies come with brake settings and toggle tie-on marks set for PIA standard riser/brake dimensions. This standard calls for 4 inches (10.2 cm) from the top of the riser to the top of the brake-setting ring. If the risers are more than 1 inch or (2.5 cm) different from this standard the canopy must be modified. This modification may only be done by a master rigger and must be reported to Performance Designs, Inc. In addition, any changes must be marked on the canopy's data panel. Some special purpose or pilot emergency system canopies may be set up for a different toggle system. It is the riggers responsibility to insure that the components are compatible.

**THE REST OF THE ASSEMBLY:**

Follow the instructions in the rig manufacturers owners manual to inspect the rest of your parachute system

**FABRIC TESTING**

**STRENGTH**

Fabric testing should be done annually (at the appropriate repack cycle), however it is not necessary to test the fabric before the first pack job if the parachute is within one year of the date of manufacture.

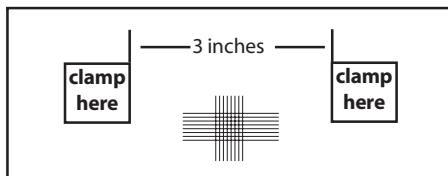
**When the fabric is tested, note this on the packing data card.** Use commercially available 1 inch (2.54 cm) wide fabric testing clamps with rubber faced jaws and appropriate scale. The scale should be calibrated at least once per year and be accurate within 1.0 lbs (0.4535 kg).

**A total of three fabric strength tests should be performed on each canopy:**

- one on the left end cell top surface
- one on the right end cell top surface
- one on the centre top surface near trailing edge

This test should never be done where any part of the fabric involved in the test is within 3 inches (7.62cm) of any seam or the data panel. The test should be done chord-wise. An additional test must be performed on any stained or discolored areas.

- 1 Attach the locking fabric clamps to the ripstop fabric. The distance between the clamps should be 3 inches (7.62 cm) and the clamps should be aligned so that the ripstop pattern is parallel to the edge of the jaw.
- 2 Lock the clamps securely to avoid slippage. Pass a short length of suspension line through the eye of one clamp and secure to the packing table or other object which will allow a 30 lbs (13.62kg) load without movement.
- 3 Pass the hook from the spring scale through the other eye and apply a 30 lbs (13.62 Kg) load for 3 seconds.



APPLY TENSION PARALLEL TO WARP OR FILL (NOT ON THE BIAS)

## PERMEABILITY CHECK

The permeability of the fabric is very important. **As the permeability increases, the canopy will open more slowly and flight performance will deteriorate. The rate of descent will increase and the forward speed will decrease. The ability of the canopy to flare to a soft landing will decrease.**

To help insure opening, flight and landing performance maintained to a satisfactory level, **Performance Designs has established an average permeability limit of 8.0 cfm for the top and bottom fabric surfaces.**

Fabric permeability does not change while the canopy is packed; **it changes as a result of use, packing and handling.** That's why it is important to maintain a complete history of the parachute.

### **Fabric permeability must be tested if any of the following events occur:**

The canopy is completely submerged in water.

- ▣ 25 jumps have been made on the canopy since it was new or last certified.
- ▣ The canopy has been repacked 40 times since it was new.
- ▣ The canopy has an unknown number of jumps, repacks, or there is reason to believe that jumps or repacks were not properly logged.
- ▣ Flight performance appears to be substandard.
- ▣ There are other reasons to believe the fabric permeability may exceed specifications.

The Performance Designs factory is equipped to perform permeability testing. It is recommended that any canopy needing such testing be returned to the factory.

## MAINTENANCE AND REPAIRS

### **Repairs are broken into three categories:**

- ▣ **Minor repairs:** These may be done by a senior rigger or your country's equivalent.
- ▣ **Major repairs:** These require a Master Rigger or your country's equivalent.
- ▣ **Factory repairs:** These repairs may be performed only by the Performance Designs factory. These include all repairs that are not specifically listed as minor or major repairs. Small snags and holes smaller than 1/8 inch square (one ripstop box) located further than 10 inches (25.4cm) from the closest line attachment may be left unrepaired as long as there are no more than one in any 10-inch (25.4cm) circle. A maximum of three such snags per cell are allowed. Ripstop tape is not authorized for use on Performance Designs reserves. If the damage is enough to warrant a repair, a sewn repair must be done.

Any hole or tear up to 10 inches (25.4cm) in length may be repaired by a senior rigger as long as the closest area of the completed repair is at least 1 inch (2.54 cm) from the nearest seam and at least 5 inches (12,7cm) from the nearest tape or line attachment. These are minor repairs.

Any line, tape or webbing damage is a major repair. Lines may be replaced by a master rigger. However, it is recommended that these repairs be done at the factory.

Master Riggers may perform repairs that do not involve taking apart any bartacks on the canopy. Special bartack patterns are used that are not normally found in the field. In addition, removal and replacement of these stitch patterns usually weakens the fabric to the point that it is necessary to replace portions of panels. The original templates are needed to complete this correctly.


All replacement materials and thread must come from the Performance Designs factory and:

- ⊙ must have been purchased within 2 years
- ⊙ have been stored properly
- ⊙ show no signs of discoloration.

Under strength thread and fabric is frequently found in the field. The only way to be sure your materials are up to Performance Designs standards is to purchase them directly from Performance Designs.

## WET CANOPIES

This reserve canopy must be completely dry and free of all contaminants before it is packed. **If it gets wet, the source of the water will determine what needs to be done.**

- ⊙ Fresh water that is known to be clean, such as rain or dew will only require air drying.
- ⊙ Swimming pool water usually contains chlorine or other chemicals that will degrade the Nylon fabric. It is very important that your canopy be thoroughly rinsed with fresh water as soon as possible.
- ⊙ Salt water must also be thoroughly rinsed out as soon as possible. If you get salt water on the canopy, keep it wet until you can rinse it off. Keeping canopy wet will prevent salt crystals from damaging the fabric and make it easier to rinse out all the salt water.
- ⊙ When rinsing out a canopy, avoid agitating the canopy any more than necessary. **Agitating the fabric, especially when wet, causes the fabric permeability to increase. Do not use a washing machine.** 
- ⊙ To dry the canopy, first hang the canopy inverted, and then drape the canopy across a tight clothes line, or fly the canopy in a gentle breeze. Never hang the canopy in a manner that will cause the canopy to dry in a distorted shape or dry at different rates along the canopy. **Do not use any heat sources to assist in drying the canopy. Do not put the canopy in a clothes dryer.**

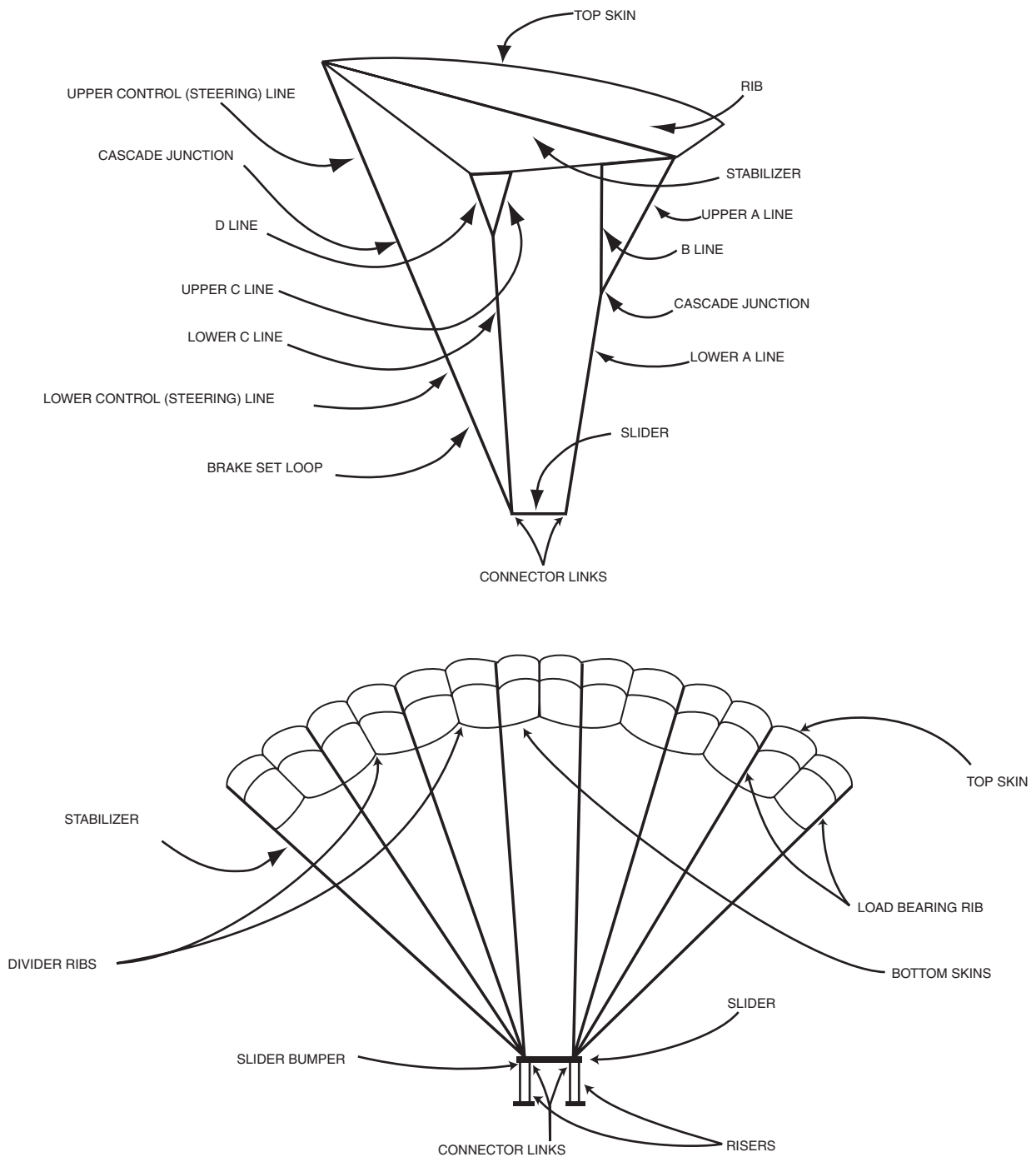
If the canopy fabric has been agitated or moved around much while wet, the fabric must be tested for permeability, before it is returned to service.

# SECTION 5

## CONFIGURATION AND ASSEMBLY

- **SIDE AND FRONTAL VIEWS**
- **DEPLOYMENT SYSTEMS**
- **REPACK CYCLES**
- **SERVICE LIFE**
- **COMPATIBILITY CHECK**
- **ATTACHING THE RESERVE TO RISERS**
- **CONNECTOR LINKS**
  - **STAINLESS LINKS**
  - **SLINKS**
- **ATTACHING STEERING LINES TO TOGGLES**
  - **INSTRUCTION FOR MICROLINES**
  - **INSTRUCTION FOR POLYESTER LINES**

# SIDE AND FRONT VIEW



## DEPLOYMENT SYSTEMS

This parachute has been tested for reserve use using a free bag deployment system which incorporates the bungee stow closing system. No other deployment system has been tested or approved by Performance Designs for reserve or emergency use with this parachute. Even if a pilot chute attachment exists, you cannot attach a pilot chute if the canopy is being used as a reserve. To do so voids the TSO.

## REPACK CYCLES

**Currently, up to one-year repack cycles are authorized for Performance Designs reserve canopies when cared for properly.** Proper care includes keeping the entire system clean, dry, limited exposure to UV light, not overheating, and no exposure to degrading elements. **Performance Designs reserves the right to extend or reduce repack intervals based on continued research and field experience.**

You must use the shortest repack cycle of the your country's applicable legal requirements, harness/container manufacturer's requirements, and AAD manufacturer's requirements.

Your new Performance Designs reserve canopy must be assembled, inspected and packed into your parachute system by a certificated rigger. Even if you live in a country where it is legal for you to assemble and maintain your reserve, you should let an experienced and appropriately rated person that is familiar with this reserve, your harness/container and all other components of the parachute system perform the assembly and repack.



**If your reserve parachute is improperly assembled or packed, you risk serious injury or death!**

## SERVICE LIFE

No specific maximum service life has been determined for this parachute. There are many factors that will effect the ultimate service life of this parachute such as where it is stored and how it is used. For civilian applications, service life is usually based on condition.

## COMPATIBILITY CHECK

**Before you begin, be sure the risers, toggles, free bag, pilot chute, harness, container and other items are compatible with your Performance Designs reserve canopy and each other.** Even if the container is specifically approved for this canopy, they may not be compatible. All components must fit and function properly. Sometimes reserves are too loose or too tight for a particular container, even though they are supposed to be compatible. If any of the components do not fit or function properly, they are not compatible, and that makes it illegal to assemble the system.

## ATTACHING THE RESERVE TO THE RISERS

When assembling a Performance Designs canopy onto risers it is important that the directions are followed precisely. The first time you perform an installation, it should be under supervision. If these directions are followed correctly, and only parts supplied by Performance Designs are used, these links will provide excellent service.



## CONNECTOR LINKS

The connector links supplied by Performance Designs for use with their reserve canopies are of the highest quality, and are carefully inspected and tested. Other links may look similar, or even identical, to those supplied by Performance Designs but any substitute could be considerably weaker than the real thing. **To insure that the links you use are not substandard make sure that any replacement links come directly from Performance Designs. No substitutes or alternative sources are authorized.**

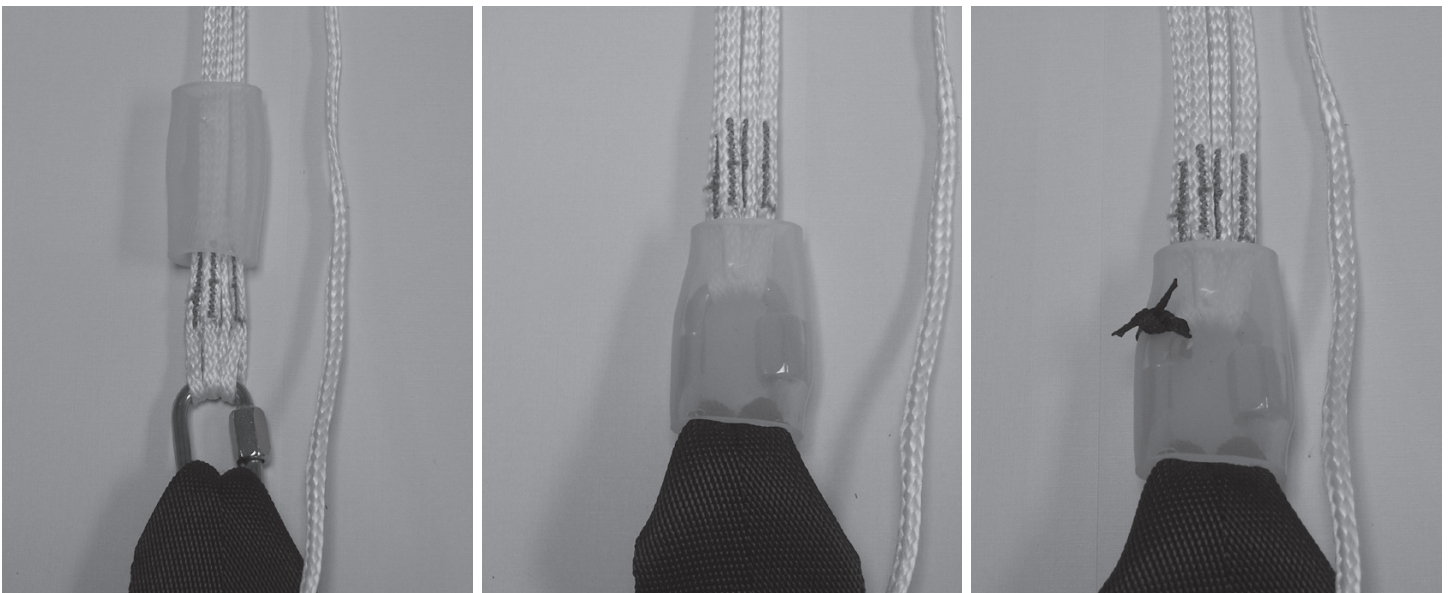
There are three different types of links available from Performance Designs for use on reserves. They are number 4 and number 5 stainless links and the Slink. Number 4 links were originally used for minimum pack volume and weight. In cases where the riser volume is too large to fit properly on a number 4 link, number 5 links should be used. **The Slinks are a soft link that reduces pack volume and weight. They also eliminate any previous discomforts on your back such as lumps or bumps in the container. When properly installed, they are stronger than the stainless steel links they replace.** The SR type link is TSO'd for use on our PR type reserves. There are other non-TSO'd type slinks available, so be sure to verify that the correct slinks are installed. Be sure to use the correct link bumpers. The number 4 link bumpers will not work on number 5 links. All links on a canopy should be the same size. It is not necessary to use bumpers on reserves fitted with SR1 Slinks. **Do not mix different size links on a canopy.**

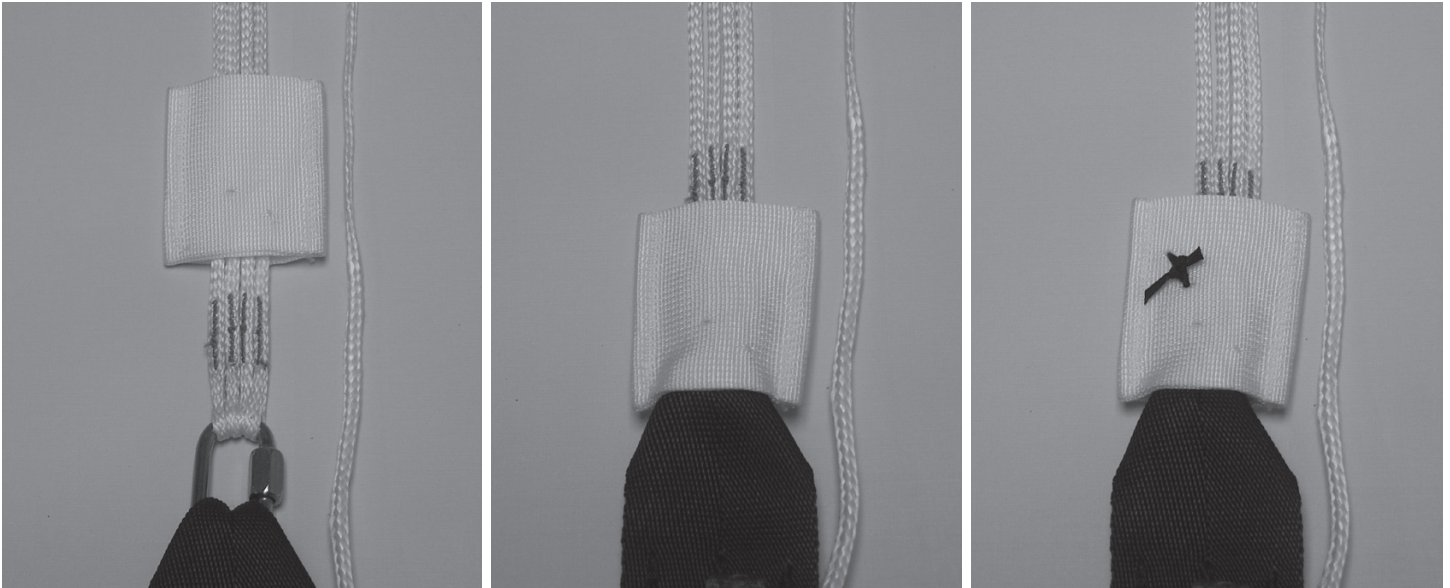


If the links are in good condition and properly assembled they are much stronger than necessary. However if they are substandard, damaged or improperly installed they may fail at less than 250 lbs (113.5kg).

## STAINLESS LINKS

- ❑ Remove all grease and dirt from links, using a solvent that will leave no residue. Trichlorethylene or electrical contact cleaner is recommended.
- ❑ Inspect the links carefully. Check for nicks, burrs and any sign of bending or stress. Check to be sure the barrel will screw down at least 2-3/4 turns from first engagement with no resistance.





- If the bumpers are not already installed, slide them over the links and onto the lines. You can use a pull up cord to assist you in doing this.
- Attach the connector links onto the risers and tighten the links - finger tight.



- **Perform a thorough line continuity check at this point, making absolutely sure that the canopy is rigged correctly.**
- Immediately tighten finger tight, and torque to 20 inch / lbs (1.22927 N.m). To accurately gauge this, place a 5 lb. (2.27 kg) weight on a wrench, 6 inches (15.2 cm) from the link. When the wrench is horizontal and the barrel no longer turns, the link is fully tightened. Do not tighten more than 30 inch / lbs (1.8439 N.m). Clean off any excess thread lock with a clean, dry rag. Do not use water or solvents.

## SLINKS

Instructions on installing Slinks, see page 35 - overleaf.

## ATTACHING STEERING LINES TO TOGGLES

A mark is provided on the canopy control line which is the best location for the toggle. If the toggles are above the mark the canopy will not have the forward speed it should and may not land well.

**Attach the steering toggles according to the rig manufacturer's instructions, if they are compatible with the type of steering line used.** Make sure that the instructions are compatible for the type of steering line. **Microline usually requires a different method than Polyester or Dacron line.** Knots that hold fine in Polyester or Dacron line may slip out of Microline. Also be sure that the knot cannot get caught on the riser guide ring. Make sure the installation is safe.

If no conflicting instructions are given by the rig manufacturer we recommend the following methods. The methods shown work well for most popular toggles. If your toggles are different, make sure that the method you use will work properly. (Instructions follow on page 36)

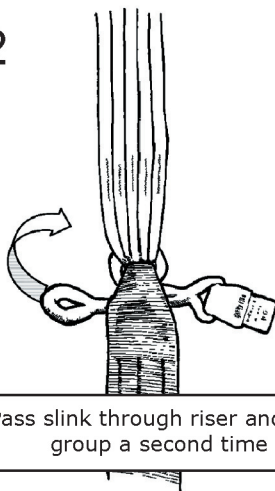
SLINK INSTRUCTIONS

1



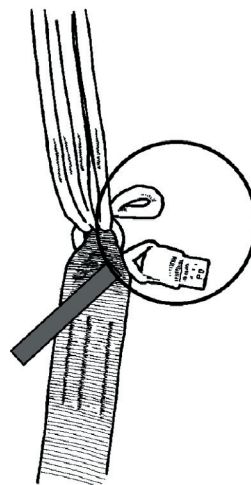
Pass slink through riser & lines

2

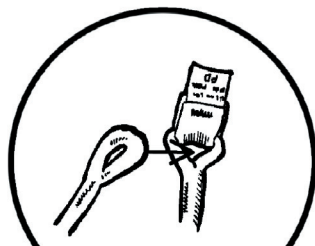


Pass slink through riser and line group a second time

3

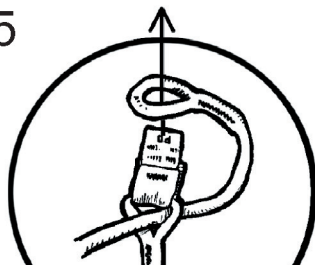


4



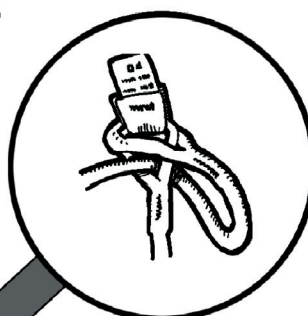
Pass loop end through under tab

5



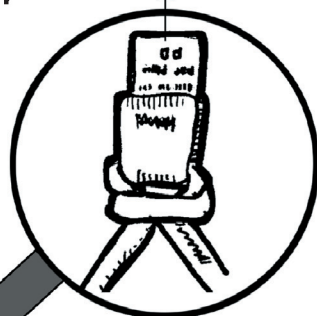
Feed tab back through loop

6



Pull Tight

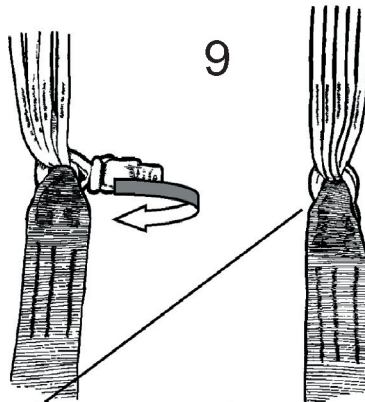
7



8



9



Tuck tab away



The first 15-20 deployments will cause the Slink to take a more permanent "set". It is important to ensure that the tab is located between the risers during this period so as to insure this set occurs with the tab in the proper position. Once this has occurred, the Slink will have a tendency to remain in this position. If this procedure is not followed, the tab may rotate out of position. Allowing the tab to remain outside of the risers during deployment and flight will result in excessive wear of the Slink, potentially leading to structural failure.

**Note: Should you find that the tab does not remain in place, PD recommends tacking the tab to insure it stays locked between the risers.**



**NOTE:** Prior to hooking up the steering toggles, insure that the steering line passes through the grommet on the slider as shown.

***THIS STEP MUST BE FOLLOWED PRIOR TO ATTACHING THE TOGGLES TO STEERING LINES, REGARDLESS OF THE TYPE OF STEERING LINE BEING USED.***

## TOGGLE ATTACHMENT: MICROLINE STEERING LINE WITH FACTORY MADE LOOP

If your Performance Designs reserve has factory made loops on the steering lines, follow these instructions:

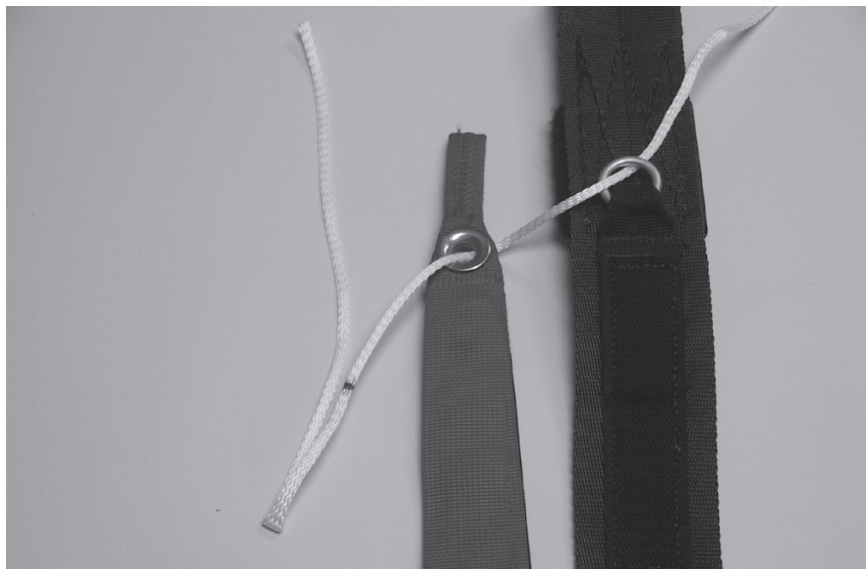
1. Once the steering line is routed through the guide ring on the riser, continue by routing the steering line through the grommet on the steering toggle. Always start routing from the hook and loop fastener side. **Figure 1**
2. Now slide the loop over the **lower end** of the steering toggle and pull the steering line through. **Figure 2**
3. Finally, the loop should be tight around the toggle and centered on the grommet. **Figure 3**



## TOGGLE ATTACHMENT: MICROLINE STEERING LINE

1) Once you have routed the steering line through the guide ring on the riser, continue by routing the steering line through the grommet in the toggle as shown. Always start routing from the hook and loop fastener side. Create a loop  $2 \frac{3}{16}$ " (5.6 cm) long.

**Note: The loop length may need to be adjusted, depending on the particular toggle.**



2) Now make an overhand knot with the loop you created. Pull the knot tight, while keeping the knot just below the toggle mark.



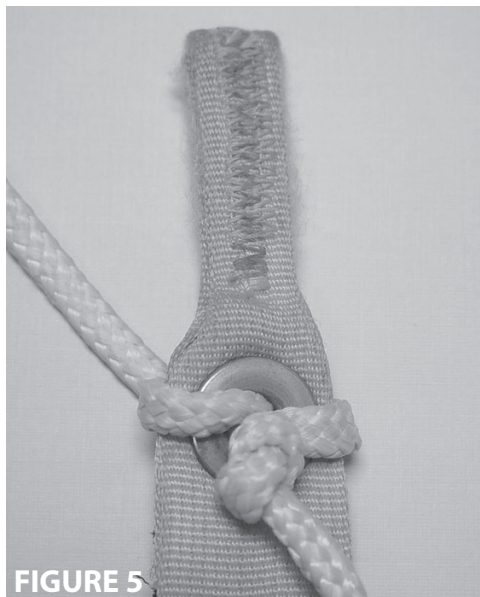
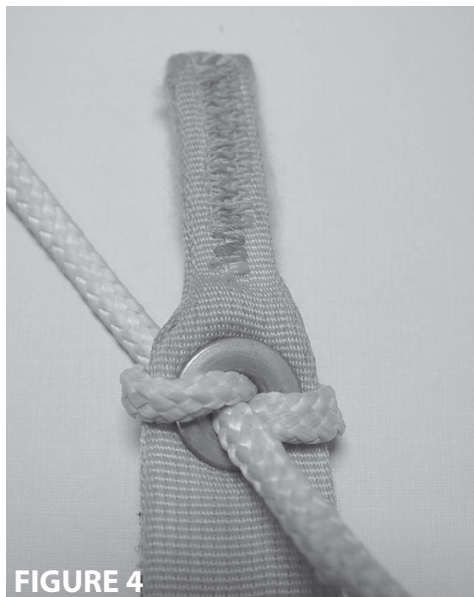
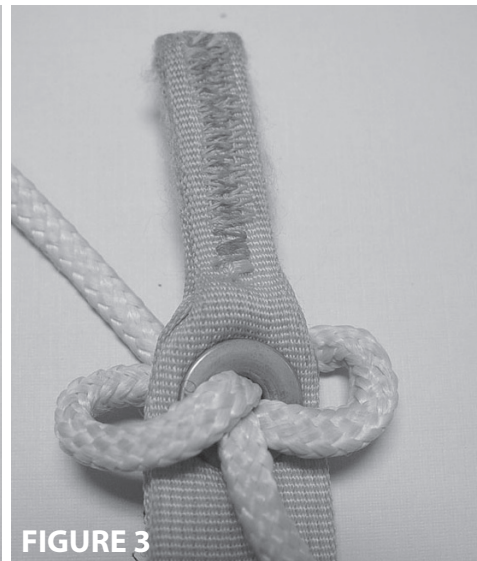
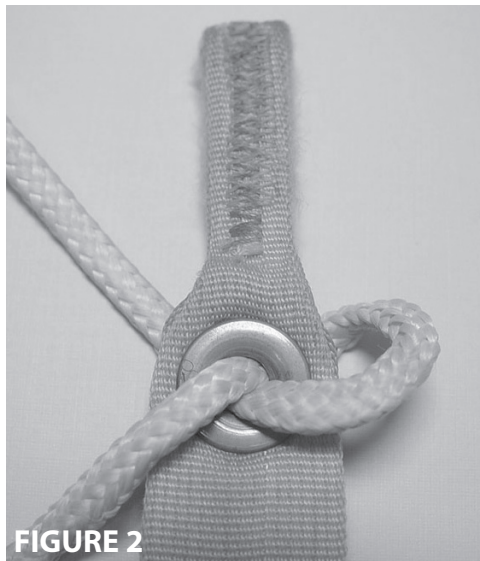
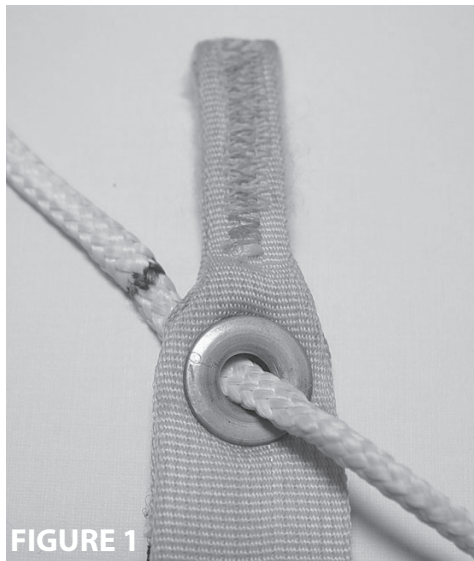
3) Now slide the loop over the toggle, starting at the lower end of the steering toggle. The loop should be tight around the toggle when the loop is centered on the grommet.

**PD recommends that the excess line be finger trapped as shown in the diagram.**



## TOGGLE ATTACHMENT: DACRON / POLYESTER STEERING LINES

1. Once you have routed the steering line through the guide ring located on the riser continue to route it through the grommet in the toggle, starting from the hook and loop fastener side. **Figure 1**
2. Then route the steering line around the toggle on the right side and then back through the grommet. **Figure 2**
3. Now route the steering line around the toggle on the left side and then back through the grommet. **Figure 3**
4. Adjust the line so that the toggle mark is on the line exiting the grommet going to the canopy, at the base of the grommet, on the hook and loop fastener side of the toggle. Pull out all the slack while maintaining the toggle mark position. **Figure 4.**
5. Tie an overhand knot in the steering line and cinch it against the toggle. **Figure 5**
6. **Figure 6** shows the toggle mark at the base of the grommet after completion.





# SECTION 6

## FLAT PACKING INSTRUCTIONS

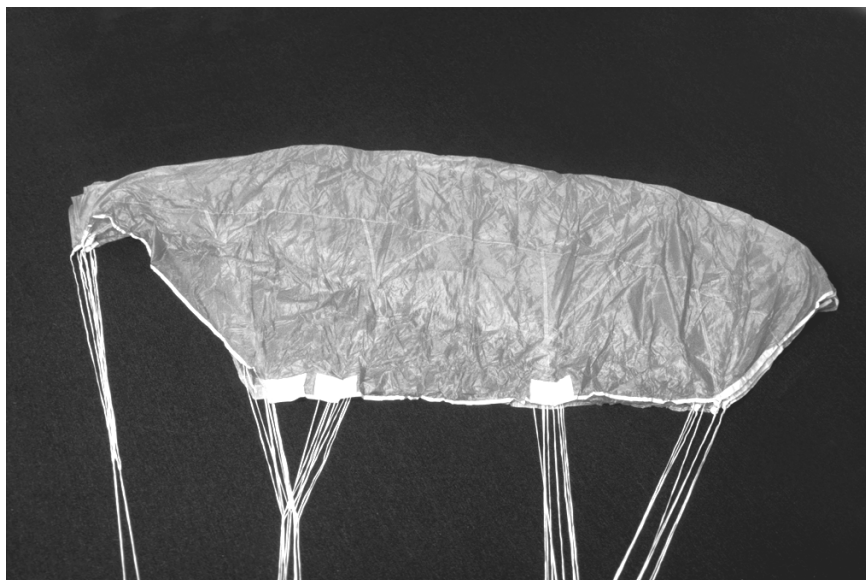
If the rig manufacturer specifies a packing method other than the one shown, and the rig manufacturer specifically authorizes its use for this parachute you may decide which instructions to follow. Otherwise you must follow these instructions. These reserves have been tested and found to work well using both this method and a specific, neatly organized, Pro Pack method for reserves.



- Make reference to the Section 5 on Deployment systems and Compatibility prior to packing the reserve.
- Take note of the Repack cycles as discussed in Section 5



**1.** Flake out the canopy until all seven T seams (where the non-loaded ribs meet the top skins) are straight from leading edge to trailing edge.



**2.** Be sure the canopy is flaked and straight. Grasp the seven T seams at the leading edge in your left hand. Grasp the seven T seams directly above the A lines with your right hand. Pull tension against the rig to be sure the A lines are straight, and then fold the leading edge back under the canopy so the A-line path is on the far left as you look from canopy top toward the rig.



**3.** Hold down the canopy at the A-line path, find the seven T seams directly above the B-line path and fold to the left, placing the B lines on the top of the A lines.





**4.** The material between the A and B should now be in fold to your right of the A and B line paths.

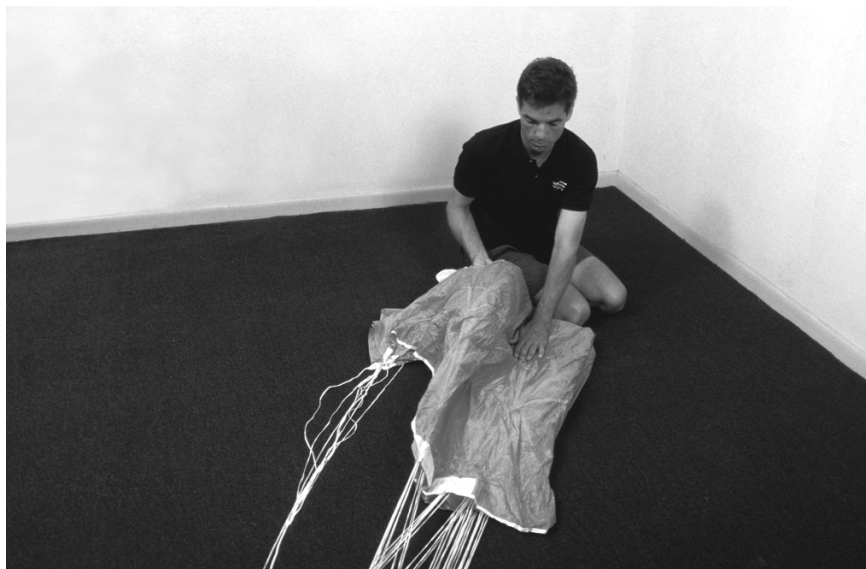


**5.** Hold down the canopy at the B-line path and grab the seven T seams directly on top of the C-line path. Fold the C lines to the left, past the B-line path as far as possible, then bring them back and lay the C lines on top of the B lines. This results in the canopy fabric between the B and C lines being folded on the left side of the canopy and the C lines are directly on top of the B lines. Straighten this fold as necessary



**6.** Clear the stabilizers while ensuring tension on the line groups.

**7.** Grab the seven T seams directly above the D-line path and fold to the left placing the D lines on top of the C-line path. The material between the C and D lines should be folded to the right of the lines.



**8.** Hold down the canopy at the D-line path and grasp the tail with your right hand. Hold the steering lines to the left past the D-line path and then back so that the canopy fabric between the D and steering lines is folded on the left side of the canopy and the steering lines are directly on top of the D lines. Make the second half of this fold on an angle so that there is enough slack in the steering lines to set the brakes. The D lines should stay taut.



**9.** Straighten this fold as necessary after setting the brakes. Be sure none of the lines are wrapped around a slider stop.





**10.** Set the deployment brakes according to the harness and container manufacturer's instructions.



**11.** Split the tail so there are five folds on each side from the bottom up. Lay the center cell of tail on top. It should be spread out to the same width as the rest of the folded canopy.



**12.** Clear the stabilizers A to B, B to C, and C to D so that they are on each side of the line path and do not cross the center. Look up the lines to all the line attachment points. All lines should go up to the attachment points with no canopy fabric between them



**13.** Pull up the slider by grabbing the tapes around its center and walking from the connector links to the base of the folded canopy



**14.** Grasp the tail at each edge of the center cell and pull down until even with the lower edge of the folded canopy. Raise the center cell of the tail 6 inches and inspect the D lines and steering lines. Make sure all lines are taut.

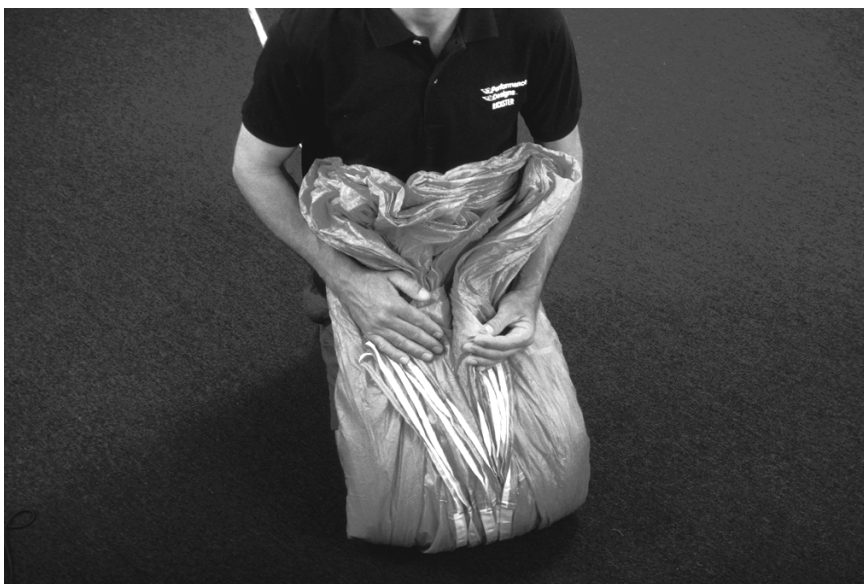




**15.** Dress the center of the tail by spreading out the top center panel to the width of the rest of the canopy underneath



**16.** Tuck the center tail panel around the canopy, working from bottom to top and making sure not to cover the leading edge.



**17.** Kneeling on the lower tail, pull the top of the folded reserve up onto your lap. Make sure the seven leading edge opening are exposed and that the tail is not wrapped in front of the openings.

Lay the canopy back down and redress in preparation for inserting it in its free bag.

## FOLDING THE CANOPY TO PUT IT IN THE BAG

There are several different types of bags used by various harness and container manufacturers. Performance Designs, Inc. recommends three different folding techniques to prepare the canopy for placement in these bags.

**If the rig manufacturer specified a different method of organizing the canopy before placing it in the bag, follow their instructions. However, you must make sure that the rig manufacturer's instructions are valid and proper for this canopy.**

**1.** For one and two pin containers with closing loops on a vertical center line of the container:

**A)** Fold the bottom of the folded reserve back and on top of itself making approximately a 6-inch S-fold. (*top illustration*).

**B)** Kneeling on this fold, carefully part the top half of the canopy into two halves. Starting from bottom to top and using a kneading motion, mold the halves into two equal ears.





C) In the case of a two-pin center-line configuration, a dimple should also be made between the left and right line groups below the slider.

**Follow the harness and container manufacturer's instructions for putting the canopy into the bag, and completing the pack job.**



**2. For one and two-pin containers that require S-folding the canopy into the bag:**

Starting at the bottom of the canopy and working toward the top using a kneading motion, fold the canopy into a tight, narrow roll and redress the tail around so that the data panel is on top and the canopy is the width of the data panel. Be sure not to cover up the seven leading edge openings by repeating Step 15 above. Put the canopy into the bag on its side.

**Follow the harness and container manufacturer's instructions for putting the canopy into the bag, and completing the pack job.**





**3. For two pin containers with the closing loops side by side:**

**A)** Fold the bottom of the reserve canopy back onto itself making approximately a 6- inch fold.



**B)** Make a second S fold on top of the previous fold.

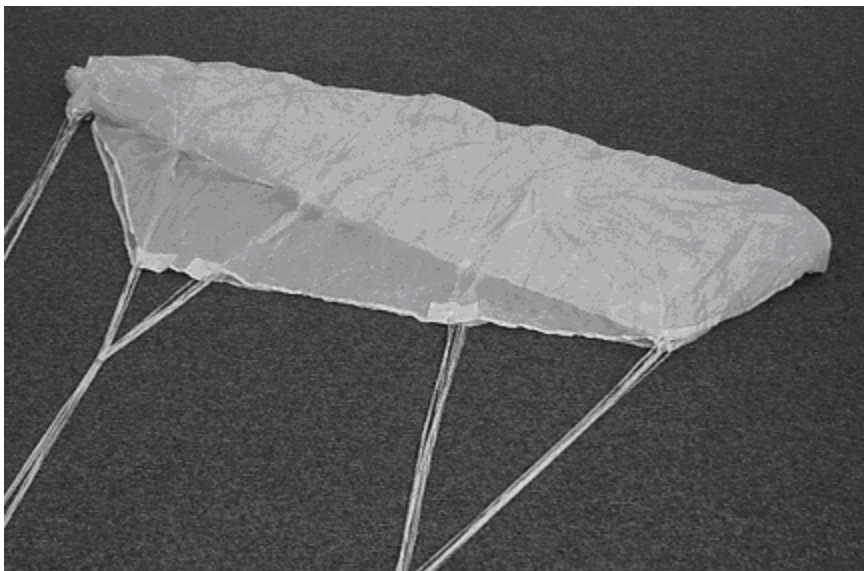
**C)** Kneeling on this fold and using a choking motion, make a side to side dimple in the canopy so that the proper amount of bulk is above and below the dimples. Performance Designs does not recommend the use of a strap to aid in this step. However, if you must use a strap, be extra sure to remove the strap before closing the bag.

**Follow the harness and container manufacturer's instructions for putting the canopy into the bag, and completing the pack job.**

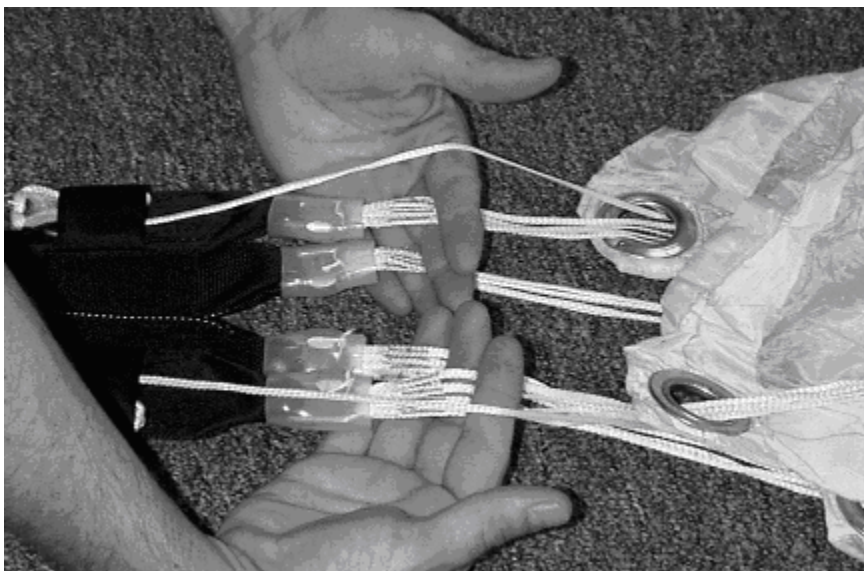
# PRO PACKING INSTRUCTIONS

If the rig manufacturer specifies a packing method other than the ones shown, and the rig manufacturer authorizes its use for this specific parachute, you may decide which instructions to follow. Otherwise you must follow PD's instructions. These reserves have been tested and found to work well using both the PRO Pack method shown here, and the Flat Pack method shown in the PD Reserve Owner's Manual. It is recommended that you follow the instructions for the packing method with which you are most familiar

**Inspect the canopy thoroughly before starting to pack it, following the inspection instructions described in section 4 of the PD Reserve Owner's Manual.** Check the line continuity, and ensure the canopy has been assembled on the rig correctly.



**1)** Flake the canopy out on its side until all seven T seams (where the non-loaded ribs meet the top skins) are straight from leading edge to trailing edge as shown. Set the deployment brakes according to the rig manufacturer's instructions.



**2)** Crouch next to the risers and face the canopy. Be sure there are no twists in the risers. Slip the fingers of your left hand between each left hand riser and between the left hand steering line and the risers. Do the same with your right hand. Slide your fingers up onto the lines as shown, grasping the lines below the slider



**3)** Start moving up the lines, allowing them to slide between your fingers. Push the slider ahead of you until you reach the bottom of the canopy. Carefully lift the canopy off of the ground. Make sure the lines are not twisted and the canopy is facing the correct direction. The nose openings should be facing the rig, and the tail should be farthest from the rig.

Step outside of the lines and transfer the lines to one hand so that the left and right sides of the canopy hang at the same height.

**4)** Starting with the end cell nearest your legs, begin flaking the nose of the canopy. Pull each cell completely out, and keep it in your hand. Then, pick up the next, taking care not to miss any until all seven cells are in your hand.

When you have the entire nose flaked, tuck it between your knees and hold it there

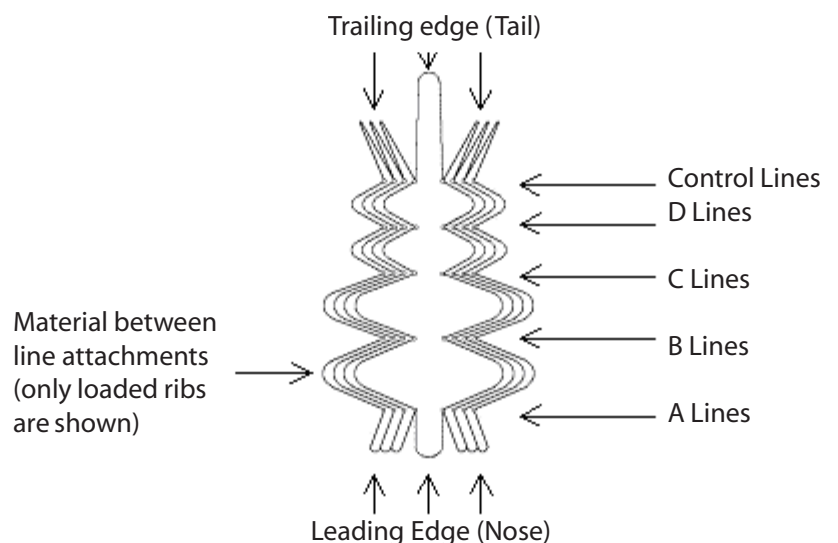


**5)** Clear the stabilizers. Flake the material between each line group out toward the stabilizers, keeping the line groups stacked together in the middle of the pack job. Clear the tail, flaking the material between each steering line toward the outside of the pack job.



The diagram at right shows the correct organization of the canopy after step 5 is completed. The leading edge will be closest to your body, and the trailing edge will be farthest away from you. When looking straight down into the canopy from above, it should resemble this diagram.

Note: to improve clarity, the slider is not shown.





**6)** Hold the canopy parallel to the floor with the nose facing down as shown. Continue to hold the lines in one hand while using your free arm to support the canopy fabric. While maintaining even tension on the lines, gently place the canopy back down on the floor or packing table with the nose facing down.

**7)** Starting on the right side of the canopy, carefully lift the folds of material back towards the center of the pack job until the nose is exposed. Clear the three cells to the right of the center cell and flake this section of the nose toward the outside of the pack job.

Note: references to the right and left sides are from the canopy pilot's point of view.

**8)** Flake the material between the A and B lines away from the line channel in the center of the pack job. Be sure that all three T seams to the right of the center cell are neatly flaked.



**9)** Find the four bottom seams to the right of the center cell and flake them out toward the stabilizer. The bottom seams are where the loaded ribs meet the bottom skins.

Make sure the right side B lines are grouped together and stacked neatly on top of the A lines.



**10)** Smooth out the fold between the A and B lines.

Repeat steps 8 through 10 to flake the material between the B and C lines.

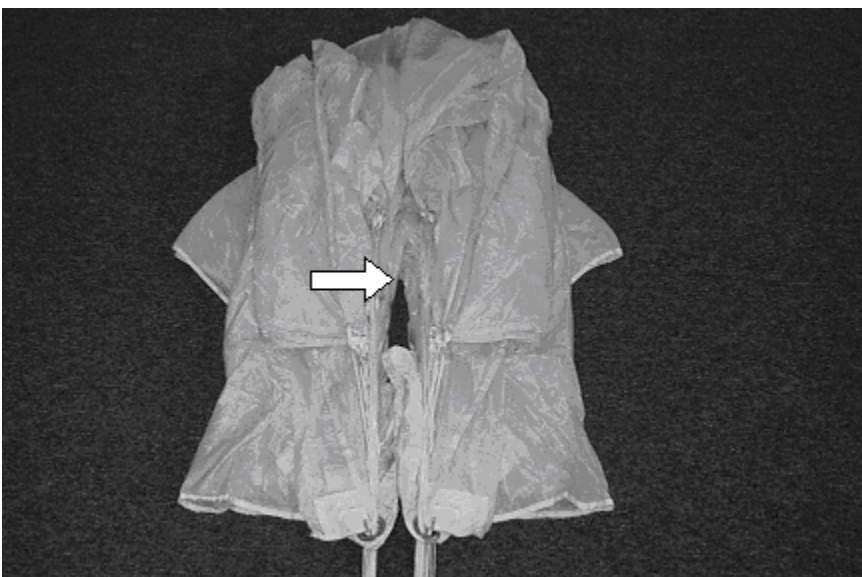




**11)** Flake the material between the C and D lines away from the line channel in the center of the pack job. Make sure the D lines are grouped together and stacked neatly on top of the A, B, and C lines. It is important to keep even tension on all the line groups throughout the remainder of the pack job. Pulling on the T seams directly above the line attachment points will help keep the lines straight and maintain the folds in the material.



**12)** Flake the material between the upper control lines toward the outside of the pack job, leaving the control lines stacked neatly on top of the A, B, C, and D lines.



**13)** Repeat steps 7 through 12 to flake the left side of the canopy. Make sure the line channel in the center of the pack job is clear, as indicated by the arrow in the picture at right.



**14)** Quarter the slider, dividing the material evenly between the slider grommets. Make sure the slider grommets are seated against the slider stops sewn into the stabilizers.

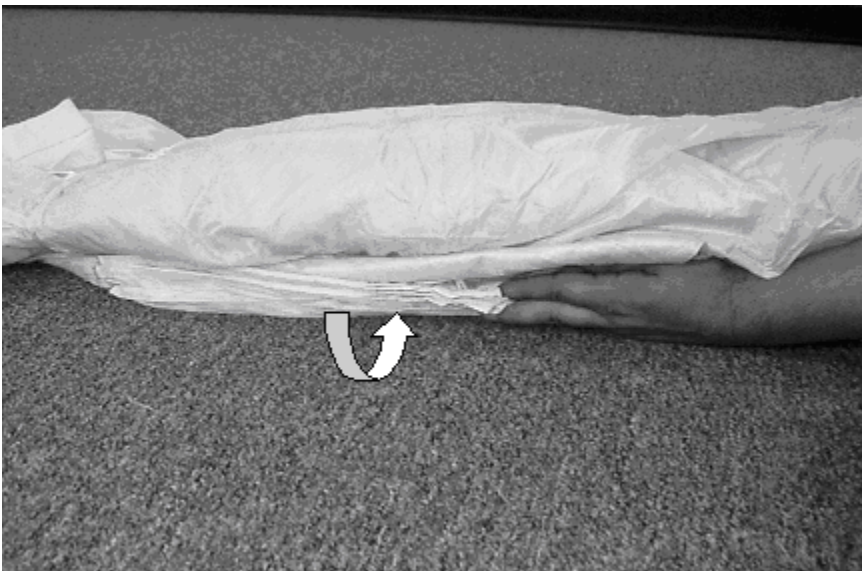


**15)** Dress the center of the tail by spreading out the top center panel to the width of the canopy underneath.



**16)** Dress the canopy to the width of the bag. Tuck the center tail panel around the canopy, working from the slider end up and making sure not to cover the leading edge.





**17)** Carefully S-fold the nose under the canopy, making sure the leading edge remains exposed, but does not extend past the edges of the folded canopy.

Proceed to step 14, "pulling down the center cell" of the Flat Packing instructions on page 45 in the PD Reserve Owner's Manual.

# PD RESERVE OWNER'S MANUAL

## PD SERIES SPECIFICATIONS

MODEL	PD-99R	PD-106R	PD-113R	PD-126R	PD-143R
Size (sq ft)	99	106	113	126	143
Chord (ft)	6.86	7.1	7.3	7.75	8.25
Span (ft)	14.42	14.92	15.4	16.27	17.33
Aspect Ratio	2.1:1	2.1:1	2.1:1	2.1:1	2.1:1
Weight Polyester/Dacron (lb)*	4.4	4.5	4.6	5.3	6
Weight Microline (lb)*	3.9	4	4.1	4.6	5.3
Pack Volume Polyester/Dacron (cu in)*	246	270	305	314	358
Pack Volume Microline (cu in)*	235	249	288	296	338
Max suspended weight (lb)	119	128	136	151	171
Max suspended weight (TSO) (lb)	220	220	220	254	254
TSO/Category	C23d	C23d	C23d	C23c(b)	C23c(b)
Max Deployment Speed (kts)	150	150	150	150	150

## TRIM DIFFERENTIALS BETWEEN LINE GROUPS (inches)

A-B	2.35	2.43	2.39	2.27	2.78
A-C	8.93	9.21	9.4	9.13	10.54
A-D	15.79	16.3	16.77	17.59	18.84
A-Tail, Brakes Set	7.39	9.4	7.87	8.91	7.49

\*Variations of 10% or more are common due to temperature, humidity, material tolerances, and packing techniques.

# PD RESERVE OWNER'S MANUAL

## PD SERIES SPECIFICATIONS

MODEL	PD-160R	PD-176R	PD-193R	PD-218R	PD-235R	PD-253R	PD-281R
Size (sq ft)	160	176	193	218	235	253	281
Chord (ft)	8.73	9.15	9.59	10.19	10.58	10.98	11.57
Span (ft)	18.33	19.22	20.13	21.4	22.21	23.05	24.29
Aspect Ratio	2.1:1	2.1:1	2.1:1	2.1:1	2.1:1	2.1:1	2.1:1
Weight Polyester/Dacron (lb)*	6.5	7	7.7	8.4	8.8	9.1	9.6
Weight Microline (lb)*	5.7	6.2	6.9	7.6	8	8.3	8.5
Pack Volume Polyester/Dacron (cu in)*	385	413	468	509	553	597	749
Pack Volume Microline (cu in)*	364	390	442	481	522	563	697
Max suspended weight (lb)	192	211	232	254	254	254	300
Max suspended weight (TSO) (lb)	254	254	254	254	254	254	300
TSO/Category	C23c(b)	C23c(b)	C23c(b)	C23c(b)	C23c(b)	C23c(b)	C23d
Max Deployment Speed (kts)	150	150	150	150	150	150	150

## TRIM DIFFERENTIALS BETWEEN LINE GROUPS (inches)

A-B	3.02	3.12	3.21	3.56	3.72	3.88	3.13
A-C	11.16	11.79	12.26	13.08	13.63	14.1	14.93
A-D	19.98	21.04	21.86	23.39	24.29	25.19	26.44
A-Tail, Brakes Set	8.44	9.78	10.1	10.82	11.21	11.77	12.05

\* Variations of 10% or more are common due to temperature, humidity, material tolerances, and packing technique.

T R S E R I E S S P E C I F I C A T I O N S

MODEL	TR	TR	TR	TR	TR	TR	TR	TR
Size (sq.ft. )	193	218	235	253	281	305	335	375
Chord (ft )	9.59	10.19	10.58	10.98	11.57	12.05	12.63	13.36
Span (ft )	20.13	21.40	22.21	23.05	24.29	25.31	26.52	28.06
Aspect Ratio	2.1:1	2.1:1	2.1:1	2.1:1	2.1:1	2.1:1	2.1:1	2.1:1
Weight Polyester / Dacron (lb )*	8.68	9.22	9.57	9.74	10.3	11.1	12.0	13.3
Pack Volume Polyester / Dacron (cu.in. )	531.6	564.4	586.7	613.8	749	813	893	1000
Max Suspended Weight (lb. )	270	335	335	335	340**	370**	407**	425
TSO / Category	C23d	C23d	C23d	C23d	C23d	C23d	C23d	C23d
Maz Deployment Speed (kts )*	200	200	200	200	200	170	170	170

T R I M D I F F E R E N T I A L S B E T W E E N L I N E G R O U P S ( i n c h e s )

A - B	3 3/8"	3 1/2"	3 3/4"	3 7/8"	4	4.17	4.37	4.62
A - C	12 3/8"	13 1/8"	13 5/8"	14 1/8"	15	15.63	16.38	17.33
A - D	22 1/4"	23 1/2"	24 3/8"	25 1/4"	26.7	27.82	29.15	30.84
A-Tail, Brakes Set	14 3/8"	15"	15 3/8"	15 3/4"	12.39	13.07	13.93	15.08

\*Variations of 10% or more are common due to temperature, humidity, material tolerances, and packing techniques.

\*\*Higher operating limitations are authorised in certain situations. Contact Performance Designs for details.

# P D R E S E R V E O W N E R ' S M A N U A L

## O P T I M U M S E R I E S S P E C I F I C A T I O N S

MODEL	OP-99	OP-106	OP-113	OP-126	OP-143
Size (sq.ft)	99	106	113	126	143
Chord (ft)	6.87	7.1	7.3	7.75	8.25
Span (ft)	14.42	14.92	15.4	16.27	17.33
Aspect Ratio	2.1 : 1	2.1 : 1	2.1 : 1	2.1 : 1	2.1 : 1
Weight Microline (lb.)*	3.6	3.63	3.66	3.72	3.8
Pack Volume Microline (cu.in)*	228	239	250	271	298
Max. suspended weight (TSO) (lb)	220	220	254	254	254
TSO / Category	C23d	C23d	C23d	C23d	C23d
Max. Deployment Speed (Kts)*	150	150	150	150	150

## T R I M D I F F E R E N T I A L S B E T W E E N L I N E G R O U P S ( i n c h e s )

A - B	2.35	2.43	2.51	2.78	2.78
A - C	8.93	9.24	9.54	10.07	10.54
A - D	15.79	16.34	16.87	17.81	18.84
A - Tail, Brakes Set	8.07	7.98	7.89	7.71	7.49

## S K I L L A N D O P E R A T I N G L I M I T S ( S T D D A Y T E M P , A T S E A L E V E L )

MODEL	OP-99	OP-106	OP-113	OP-126	OP-143
Minimum Weight	VLC**	VLC**	VLC**	VLC**	VLC**
Student	NR***	NR***	NR***	NR***	NR***
Novice	NR***	NR***	NR***	NR***	122
Intermediate	NR***	NR***	113	126	143
Advanced	119	127	130	145	165
Expert	149	159	169	176	200
Maximum Weight	220	220	254	254	254

\* Variations of 10% or more are common due to temperature, humidity, material tolerances, and packing technique.

\*\* Varies with weather/landing conditions

\*\*\* Not recommended

# PD RESERVE OWNER'S MANUAL

## OPTIMUM SERIES SPECIFICATIONS

MODEL	OP-160	OP-176	OP-193	OP-218	OP-235	OP-253
Size (sq ft)	160	176	193	218	235	253
Chord (ft)	8.73	9.15	9.59	10.19	10.58	10.98
Span (ft)	18.33	19.23	20.13	21.4	22.21	23.05
Aspect Ratio	2.1:1	2.1:1	2.1:1	2.1:1	2.1:1	2.1:1
Weight Microline (lb)*	5.15	5.5	5.9	6.45	6.9	7.4
Pack Volume Microline (cu in)*	331	355	402	438	475	512
Max suspended weight (TSO) (lb)	300	300	300	300	300	300
TSO/Category	C23d	C23d	C23d	C23d	C23d	C23d
Max Deployment Speed (kts)	150	150	150	150	150	150

## TRIM DIFFERENTIALS BETWEEN LINE GROUPS (inches)

A-B	2.85	2.98	3.12	3.3	3.43	3.55
A-C	10.23	10.75	11.28	12.01	12.48	12.97
A-D	20.67	21.74	22.83	24.34	25.32	26.32
A-Tail, Brakes Set	7.42	8.02	8.64	9.5	10.05	10.62

## SKILLS AND OPERATING LIMITS (STD DAY TEMP, AT SEA LEVEL)

MODEL	OP-160	OP-176	OP-193	OP-218	OP-235	OP-253
Minimum Weight	VLC**	VLC**	VLC**	VLC**	VLC**	VLC**
Student	NR***	NR***	185	210	235	255
Novice	165	185	200	225	245	265
Intermediate	170	195	210	235	255	275
Advanced	200	220	245	260	275	290
Expert	235	255	270	280	290	300
Maximum Weight	300	300	300	300	300	300

\* Variations of 10% or more are common due to temperature, humidity, material tolerances, and packing technique.

\*\* Varies with weather/landing conditions

\*\*\* Not recommended