

RESERVE PACKING GUIDE

1 INTRODUCTION

The aim of this 'Guide' is not to teach reserve packing (this must be done on a one to one basis) but to cover reserve packing in general. Anyone who wishes to hold a packing certificate for reserve parachutes should follow some simple guide lines. Take your reserve packing seriously, stay current and treat it like the life saving device it is. If in doubt ask! This Guide is an Aid to inspecting and packing reserve parachutes and not a mandatory requirement.

2 PREPARATION

- a) Packing reserves should be done in a clean well lit area away from any sort of contamination.
- b) Round reserves need a long smooth table with the appropriate hardware to stretch the canopy out under tension.
- c) Ram air reserves are best packed on a clean carpeted area.
- d) Select and count all tools to be used and make a note of how many.

3 DEPLOYMENT

- a) On receiving a set of kit for a reserve repack ask the owner (if there) to put it on his/her back and deploy the reserve using the correct cutaway and reserve procedures.
- b) Pulling the ripcord should not require so much force that a skydiver would be thrown unstable.
- c) Make sure the pilot chute adequately clears the container flaps.
- d) Holding the pilot chute walk away from the container to determine if the parachute feeds out of the pack easily and in the proper sequence.
- e) Remove the main canopy and put to one side.
- f) Spray some silicone on a clean cloth and wipe the cutaway cable clean, inspect for damage prior to replacing it back in the container.

4 SAFETY INFORMATION

- a) Check the canopy and container serial numbers to see that the two agree with the information on the packing card and whether any part of the system has been affected by a Safety Notice.

NOTE: It is your job as a reserve packer to be fully conversant with all Safety Notices affecting parachute equipment, (refer to Safety Notices).

- b) A manufacturer's manual for both the reserve canopy and the container should be to hand and the reserve packer must be fully conversant with their contents. (Do not just pack it as the previous packer has, as he/she may not have packed it correctly).
- c) Safety Notices and procedures can change, ensure you keep up to date with them.

5 INSPECTING THE RESERVE

No matter how neatly it is packed a reserve that has not been thoroughly inspected might be a threat to the safety of its user. Also newness is not necessarily an indication that it is in good condition. **THAT'S WHY AN INSPECTION IS CRITICAL**

6 THE PILOT CHUTE

- a) Test the fabric strength by stretching and popping the fabric with the hands.
- b) The cap should be clean and properly stitched.
- c) Check the spring for serviceability.
- d) The base of the spring should be secured to the pilot chute fabric by at least four separate tackings.
- e) Pilot chutes with mesh in them may require a bromocresol and tensile test. (Refer to Index of Safety Notices).
- f) There should be no marginal conditions in the pilot chute such as snags or patches, this part of the assembly has to work perfectly.

7 BRIDLE LINE AND FREEBAG

- a) Inspect for serviceability.
- b) On round reserves the bridle line should be attached to the apex lines of the canopy by an open loop that is tacked, it should not be clinched down tightly around the lines. The loop allows the lines to equalize during pilot chute snatch and canopy inflation.
- c) On freebag systems the mouthlock is usually the safety stow method, most manufacturers have now adopted this method.
- d) Be aware of the size of the safety stow if changing to micro line reserves.

8 THE CANOPY

Check the canopy fabric for snags, tears or other problems, by carefully inspecting it panel by panel, any patches should be checked for proper applications and security. Check the strength of the canopy fabric by pulling on fabric with both hands, (canopies with substrength fabric are easy to tear) this simple but effective test is applied to many areas of the canopy. Any reserves with mesh in have to have a bromocresol test every reserve repack and may also require a tensile test. (Refer to Annex A). Inspect all seams and bartacks, etc, for security. If possible a canopy hoist is to be used as this is an excellent inspection aid.

9 SUSPENSION

Suspension lines are given a continuity check to ensure that each line is in the correct order on the connector link and is attached to the proper riser, also check lines for burnt or snagged spots. If it is rigged incorrectly and you pack it, then it becomes your mistake and someone else's life. Inspect all stitching for security.

10 CONNECTOR LINKS

There are two types of connector links commonly used in conjunction with reserves, firstly separable 'L' links; check that the screws are tight with a screwdriver, remember all connector links and screws are not interchangeable. Secondly maillon rapid links; check they are tightly secured (hand tight and a quarter turn with a small spanner or adjustable) do not over tighten. Check the barrel and replace if cracked, beware of cheap imitations that have no tensile strength marked on them and remember rapide links have no side load bearing strength. Some manufacturers state whether size 5 or 6 links should be used.

11 RISERS

Check for serviceability, also check stitching (any sewing machine stitch can look good on one side and not have any thread on the other side).

12 CROSS CONNECTORS (TIE BARS)

If a tie bar is required it must conform to the BPA's Rigging Manual.

13 HARNESS AND CONTAINER

Thoroughly check the harness and container throughout inspecting grommets, pack tray, webbing for fraying, wear, abrasion, defective stitching, etc (look in hidden areas).

14 RESERVE RIPCORD

Check the ripcord, ripcord housings, ripcord pocket and associated sewing.
FINALLY AIR THE CANOPY BEFORE REPACKING AND SEE TO ALL DOCUMENTATION.

15 COMPATIBILITY

Make sure the canopy you are packing is the right size for the pack tray, also check the freebag is the right size.

16 CLOSURE LOOP LENGTH

- a) A closing loop that is too short could result in a dangerously hard pull. One that is long looks messy, and is susceptible to snagging and possibly premature deployment of the reserve.
- b) Attachment of a quick loop and cap to pilot chutes is important and maybe dangerous if not carried out correctly. It has been found that quick loops and caps have been sewn to pilot chutes in a manner that would damage the pilot chute if they were used.
- c) Quick loops have been pulled down tighter to tidy up pop tops, if this is done, a test pull must be done again to ensure the user can still operate the reserve.

NOTE: This is true with 1 pin 'pop tops' as well, always ensure a pull test is done after readjustment

17 TAKEN FROM TALON OWNERS MANUAL

"NOTE: Under no circumstances is a 'T' Bar closing device to be used in conjunction with packing this system, to do so can result in higher than allowable pull force and also damage to the container."

18 TACKING THREAD

Total malfunctions of the reserve have resulted from the wrong use of tacking cords and the wrong type of cord used. BPA qualified Riggers are allowed to seal reserves if they wish using the BPA approved method.

19 CLEAR CHANNEL FOR THE LOOPS

Inspect the completed pack job from the back and front of the container, make sure that no line, canopy or pilot chute material can hinder the closing loop passage through the container. Take care when packing.

20 RUBBER BANDS

Rubber bands must be in perfect condition. They must be the correct size, if in doubt change them. Rubber bands should not be coupled over lines twice at any time.

21 AAD

Read the AAD manual and abide by the recommendations. Make sure that when the AAD works it removes the pin from the closing loop completely (FXC). Ensure the AAD is within the service date.

22 RESERVE STATIC LINE (RSL)/STEVENS LANYARD

Check the serviceability and correct routing. If routed incorrectly this could cause the canopy to hang up after cutting away.

23 INSPECTION AND PACKING REPORT

An Inspection Report is to be filled in during the inspection and packing process to be given to the owner after packing. Keep a copy and this can be your reserve packing log. A separate Packing Inspection Report is available for Tandem equipment.

NOTE: Both Inspection Check list and Reserve Packing Card/Log are required.

24 PACKING

- a) Pack the reserve as taught and according to the manuals.
- b) Determine as to how tight the closing loop is and perform a pull test. (See Test Pull Procedure below).
- c) Count your tools at this stage, ensuring the number is the same as you started with.
- d) Service the 3 ring release system (see Annex B), and reconnect the main parachute ensuring you perform a line sequence check.

25 TEST PULL PROCEDURE

A test pull should be done by the owner/user with the right hand across the body as this is generally the weakest pull. If the owner/user is not available then a pull test should be done using a pull tester or fish scale, there should be a minimum of 5lbs pull and a maximum of 22lbs (15lbs max. front mounted reserves).

26 SUMMARY

Reserve packers must be inquisitive. If you see someone packing a reserve go and talk to them, watch and ask questions. If you see a write up referring to reserve packing, read and study it. Read all the reserve packing manuals you can get your hands on. Attached at Annex C are some reports that have been collated from various sources, use them for their educational value, and don't make the same mistakes. Be professional and gain the knowledge that will enable you to be "safe".

PARACHUTE CANOPY FABRIC TENSILE TEST, NON-DESTRUCTIVE METHOD**1 BACKGROUND**

The purpose of this test method is to provide a simple, standardized, non-destructive method of verifying the strength of parachute fabric. This method is readily usable in the field and is designed to replace the old "Rigger's Thumb Test". This test was devised in response to the "acid mesh" discovery in the mid 1980's.

2 TOOLS REQUIRED

- a) Locking Fabric Clamps
- b) Spring Scale, 50lb minimum capacity
- c) 6" Rule
- d) Permanent Marking Pen
- e) Bromocresol green indicator solution, 0.04% PH Range, 3.8 (Yellow) to 5.4 (Blue)

3 TEST PROCEDURE

This test has been written on the assumption that the purpose of the test relates to the acid mesh problem. If the test is to be performed for other purposes, the procedure may need to be modified.

- a) Locate the mesh vents in the canopy and determine the fabric areas which are in contact with the mesh when the canopy is packed. These areas are shown (diagonally shaded) in illustration #1 (page 6) for typical trivent canopy.
- b) A total of 4 tests should be performed for each canopy. With a trivent canopy, one test should be performed in the panel adjacent to each mesh vent. At least 2 tests should be performed in each direction, (2 warp and 2 fill).
- c) Attach the locking fabric clamps to the ripstop fabric shown in illustration #2 (page 7). The distance between the clamps should be 3" (7.5cm) and the clamps should be aligned so that the ripstop pattern is parallel to the edge of the jaw. Lock the clamps securely so as to avoid slippage.
- d) 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 40lb (18kg) load without movement. Pass the hook from the spring scale through the other eye and apply a 40lb (18kg) load for 3 seconds.
- e) Before removing the clamps place a dot at each corner of the area of the fabric involved in the test this will encompass an area of 1" x 5" to mark for future reference.
- f) Only one test is required on pilot chutes.

MAINTENANCE OF 3 RING RELEASE**1 THE 3 RING RELEASE**

Knowing how the 3 ring release works will help a skydiver assemble and inspect it properly. Each ring forms a lever with a ten-to-one mechanical advantage as it passes through the other. A force of 1000lbs on the large harness ring exerts a force of only 10lbs on the white loop, (opening shock usually totals about 1000lbs or 500lbs on each riser). Because of the mechanical advantage provided by the 3 ring design, only a force of approximately a pound on the top ring assembly. A small stick in the white loop could prevent a riser from releasing. It is 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 – it takes 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) will not pull the riser off the ring.

2 SERVICING THE 3 RING RELEASE

- a) Closely inspect it for wear and tear.
- b) Check the white locking loops to be sure they are not frayed.
- c) Check the velcro on the breakaway handle and main lift web to be sure it is clean and adequately holds the handle.
- d) Check the cable ends for a smooth tapered finish this prevents the cable from hanging up in the loop, if a burr or hook is present consult a rigger.
- e) Check the stitching including that which holds the large rings to the harness.
- f) Check the band tackings that prevent the housings from sliding through their keeper (this keeper is a loop of narrow webbing located a few inches above the release handle). Pull downwards on the housings they should not move downwards more than ½ inch.
- g) Take each riser and vigorously twist and flex the webbing near where it passes through each ring. The idea is to remove any set or deformation in the webbing. Do the same to the white loops.
- h) Check the housings for dents or other obstructions, use the cable to do this.
- i) Clean and lubricate the release cable with silicone spray or WD40. Put a few drops on a paper towel and firmly wipe the cable a few times, a thin invisible film should remain, too much will attract grit and dirt also the oil could become tacky in cold weather requiring more force to extract the cable during a breakaway.
- j) Inspect the security of the fittings at the end of each housing. If one of these fittings were to come off the housing a riser might release prematurely.
- k) If necessary inform the owner that he/she needs to service it more often.

**VARIOUS PROBLEMS ENCOUNTERED
(MAGAZINE REPORTS, ETC)**

REPORTS

- 1 A security 26 foot lopo was received by an FAA Rigger for repack, as the pins were withdrawn fully the pilot chute merely stood up and fell over, not springing out as it should. It was found that all of the netting of the pilot chute had been stuffed up inside the spring from the bottom along with approximately one inch of the crown fabric. When packed in this manner the pilot chute material is pressed against the container, restricting the spring as it attempts to elongate after the ripcord is pulled. The rigger who reported the incident made the final observation "Know thy Rigger".
(Skydiving Magazine)
- 2 The item of an incorrect reserve repack by an advanced instructor has been requested to be dealt with by the STC the instructor concerned be asked to attend the STC meeting.
(Sport Parachutist)
- 3 A report had been received that a pop top reserve packed by a USPA rigger could not be pulled, the pop top had been seated upside down with the short loop in the bottom and the long loop in the top hole.
(Skydiving Magazine, Sport Parachutist)
- 4 An incident occurred, where after a malfunction the parachutist was unable to cutaway due to incorrectly routing of the cutaway housing.
(Sport Parachutist)
- 5 A skydiver was killed when his reserve failed, investigators found a link had separated because it had no screws in. The rigger forgot, the packer did not check.
(Parachutist)
- 6 A 'Wonderhog' type system was deployed in preparation for a repack the pilot chute was unable to clear the stage deployment loop. On close examination it was seen to have been packed with the bridle cord trapped under the stage deployment loop. If used the reserve would not have been able to deploy.
(Sport Parachutist)
- 7 A repack on a reserve was found to lock the bridle line at the stage deployment on examination it was found that the stage deployment loop was made from type 2 rigging line instead of an elastic loop.
(Parachutist)
- 8 On deploying a round reserve the deployment sequence stopped at the diaper and would not release. The elastic band which passes through the grommet to form a closing loop for the diaper had been wrapped around the lines twice. The tightness of the elastic band around the lines caused the grommet to dig in.
(Parachutist, Letter to BPA Feb.'87)
- 9 Note the routing for an AAD on a main or back mounted reserve:

10. A rigger was killed after he failed to deploy his main, his reserve experienced severe fabric damage, as well as four broken lines and failed upper and lower lateral bands. Investigators found the rigger packed his own reserve incorrectly along with others he had packed. The diaper on his reserve was held shut by two bights – loops of suspension line, all the lines were through, instead of just one side of the lines with the slack stowed in the packtray. Stowing only half the lines in this manner means the lines must be fully extended before the diaper opens to allow the canopy to inflate.
(Skydiving Magazine)

11. Deployment Diapers

Having recently moved from Canada to West Germany, I was surprised to find that a jumper can pack his own reserve here without holding a rigger rating. I like this option, it encourages a jumper to learn more about his reserve, rather than treating it like an unknown object designed to save his life during the rare emergency.

I'm the owner of a round reserve fitted with a deployment diaper. During my first pack job under the supervision of a master rigger, a small argument arose when it came to closing the diaper. I wanted to route only one set of lines through the elastic bands – as recommended by the manufacturer - so the canopy will only open once line stretch is achieved. This configuration avoids an out-of-sequence opening during which the canopy could suffer catastrophic structural failure.

My rigger strongly recommended that I pass both sets of lines through the elastic bands on the diaper, referring to two fatal European accidents in which the suspension lines snagged half way down on the pack tray, preventing full line stretch. Consequently, the diaper failed to unlock and both jumpers towed streamer malfunctions to ground.

My rigger said passing both lines through the elastic bands would give the canopy a chance to open in this situation. I ended up packing my reserve according to the manufacturer's instructions, although both methods seem logical but have claimed human life.

Perhaps you could provide some information on the best way to close deployment diapers.

This one is relatively easy: follow the manufacturer's instructions. There are several types of diapers for round reserves. Some are the "full stowage" type, meaning all the suspension lines are stowed on the diaper (as all the lines of a main canopy are stowed in its bag). Other diapers are held shut by one or two bights of line, but the rest of the line is stowed in the reserve pack tray. The design of the diaper and its location on the canopy dictates how it should be packed. If a diaper is not packed correctly, the canopy may inflate before full line stretch, causing what is called an "out-of-sequence" deployment. Such deployments sometimes result in canopy damage or failure. Following the manufacturer's instructions will insure the packing procedures perfectly match the design of the diaper. Any reserve manufacturer will provide copies of his company's owners manuals on request.
(Skydiving #48)

12. Changes to Vector Bags

The Relative Workshop recommends replacing the four rubber O-rings on early Vector ram-air reserve deployment bags with the Para-Flite Safety Stow closing system. Rubber O-rings were used on early Vectors because they are superior for this purpose than conventional rubber stow bands. They tend to be stronger, more resistant to rotting and melting and have consistent specifications. Para-Flite used O-rings for a while on the ram-air reserves it manufactured, but switched to the safety-stow several years ago.

The Safety-Stow is a continuous loop of bungee cord slipped in a channel along the mouth of a deployment bag. The bungee cord is much stronger than even O-rings, and routing it in a channel insures canopy deployment even if one end hangs up. The bungee's extra strength helps prevent the bag from being pulled off the canopy until the lines are full extended. The Relative Workshop will provide Vector owners with kits that riggers can use to modify those Vector deployment bags with O-rings. Owners should make their requests in writing and include their rig's serial number.
(Skydiving Magazine)

13 Possible Problem

I am writing to inform you of a potential malfunction that I have found on my reserve. My rig is an Invader with a Phantom 24 reserve, and the last time it was repacked the pilot chute failed to leave the container when it was dumped. This was caused by the pilot chute materials being trapped by one of the side flaps (see diagram below) preventing the pilot chute spring from expanding. The flaps were released and in freefall the pilot chute will have deployed, but it was risky. The Invader manual suggests that the material is laid flat around the pilot chute and the sides folded under in wide folds to the centre. It appears that it is safe to fold the material far tighter and closer to the pilot chute to avoid it being trapped by flaps 3 and 4. This leaves more loose material at the top and bottom which can be folded under after closing flaps 3 and 4.

I would be interested to know if anyone else has found this problem on their Invaders, or on any similar rig (Vector, Jaguar,) or whether anyone else has reserve packing suggestions.
 Al Redler C6021 (Sport Parachutist)

- 14 Pioneer Parachute Company, Inc. has recently been made aware of a problem with Pioneer K-Series reserves that use resin treated dacron suspension lines which become excessively stiff after a 120 day repack cycle. This condition could impede inflation and may also be apparent on other canopies with dacron lines, including Pioneer main and reserve ram air parachutes.

The problem is attributable to excessive resin treatment by the cord manufacturer, resulting in stiffness where the line appears to be 'set' (hard to straighten after being packed), as well as a slight tackiness on new lines that may cause them to adhere to each other after being packed for a period of time. Due to the potentially serious nature of this condition, all owners of affected Pioneer parachutes (and dealers with units in stock) are urged to follow the inspection and corrective action detailed in this advisory.

MAIN PARACHUTES

Prior to the next usage, inspect for stiffness or tackiness. If apparent, follow Remedial Instructions provided herein.

RESERVE PARACHUTES

Prior to the next usage, have parachute inspected by a Senior or Master Rigger. If stiffness or tackiness is apparent, Senior or Master Rigger is to follow Remedial Instructions provided herein.

REMEDIAL INSTRUCTIONS FOR STIFF LINES

Repairman – Senior or Master Parachute Rigger (Reserve Chutes).

Materials Required – Clean cloth, warm water and talcum powder.

- Procedure -
1. Place canopy on packing table with risers secured to table.
 2. Soak a clean cloth in warm water and wipe each suspension line from riser to skirt three times.
Wipe each line with a dry cloth.
 3. Allow to dry thoroughly.
 4. Apply talcum powder to a clean dry cloth and wipe each suspension line, from riser to skirt.
 5. Once completed, shake excess talcum powder from suspension lines.
Canopy may now be packed in accordance with manufacturer's instructions.
 6. Corrective action in accordance with this advisory should be noted on the packing data card.
- 15 A reserve was packed in a Wonderhog container the bridle line could not clear the inner flap closing loop as the routing was incorrect and could not under any circumstances have cleared.
(Safety Notice, Oct 86)
- 16 Reserve packed with a too strong ripcord seal thread and could lead to an unacceptable hard pull.
(Safety Notice, Nov 85)
- 17 1989 Fatality Reports
- An experienced skydiver died when he broke away from a CRW entanglement between 300 and 1000 feet, he fell for two or three seconds and deployed his reserve. It took longer than normal to open and he hit the ground prior to full inflation. A manufacturer's recommendation to install a slider that allowed for a faster inflation had not been heeded.
(Parachutist)
- 18 A Florida rigger recently discovered a round reserve with good mesh and substrength fabric. The Phantom 24 passed the bromocresol test but failed the fabric test in five areas at forces of less than 25lbs, good fabric can withstand at least 40lbs of force for 3 seconds.
(Skydiving Magazine)
- 19 Misrouting of an RSL on a pop top container – on cutting away the main was still attached to the container by the reserve static line.
(Riggers meeting, April 91)

