Amendment Number	Description	Pages Affected	Date	Approval
1	List of Supplements and List of Effective Pages updated. Section 2: Completely re-issued to include 12 mm polyester load tapes. Pages 2-19 and 2-20 added. Section 4: 4.1.6 and Cylinder Torque values deleted (moved to Supplement 7.52) 4.1.7 and 4.1.8 renumbered accordingly. Section 6: Periodic testing of cylinders moved to Supplement 7.52. Cylinder rejection limits revised. Pages 6-23 and 6-24 deleted. Section 8 Page 8-2, 12mm tape description updated. Appendix 4, 12mm loadtape introduced, Typographical errors for O Types and Colt A Types corrected. Introduction of Supplement 7.51 Introduction of Supplement 7.52	i-iii, i-iv, i-v, i-vii to ix 2-1 to 2-20 4-2, 4-3, 6-1, 6-13 to 6-22, 8-2 A4-1 to A4-3	05/10/07	The technical content of this document is approved under the authority of EASA.21J.140 (C485)

Note: Any new or amended text in the revised page will be indicated by a black vertical line in the right hand margin, and the Amendment Number and the date will be shown at the bottom of the page.

The supplements ticked 'Applicable' to this balloon are inserted into this manual in Section 7.

Supplements associated with the base flight manual

Supplement Number	Description	Issue	Date	Applicable
7.12	Out of Production Envelope Types			
7.13	Duo Airchair MKII			
7.14	Cloudhopper Millenium			
7.15	Wheelchair Baskets			
7.19	Double, Triple and Quad Demountable Burners			
7.20	Basket Towing Plates			
7.25	Shadow Single and Shadow Mini Removeable burner			
7.26	Stealth/Shadow Electric Burner			
7.30	Envelope Laser Display System			
7.32	Out of Production Hoppers			

Supplements

Supplement Number	Description	Issue	Date	Applicable
7.51	Stealth/Shadow Burner - Valve Seal Replacement			
7.52	Periodic inspection of Fuel Cylinders			

Section	Page	Date of Issue	Section	Page	Date of Issue	Section	Page	Date of Issue
0	i-i	10 April 2006	4 (cont.)	4-7	10 April 2006	6 (cont.)	6-15	05 October 2007
	i-ii	10 April 2006		4-8	10 April 2006		6-16	05 October 2007
	i-iii	05 October 2007		4-9	10 April 2006		6-17	05 October 2007
	i-iv	05 October 2007		4-10	10 April 2006		6-18	05 October 2007
	i-v	05 October 2007		4-11	10 April 2006		6-19	05 October 2007
	i-vi	10 April 2006		4-12	10 April 2006		6-20	05 October 2007
	i-vii	05 October 2007		4-13	10 April 2006		6-21	05 October 2007
	i-viii	05 October 2007		4-14	10 April 2006		6-22	05 October 2007
	i-ix	05 October 2007		4-15	10 April 2006		6-23	Deleted
	i-x	10 April 2006		4-16	10 April 2006		6-24	Deleted
	i-xi	10 April 2006		4-17	10 April 2006			
	i-xii	10 April 2006		4-18	10 April 2006	7	7-1	10 April 2006
				4-19	10 April 2006		7-2	10 April 2006
1	1-1	10 April 2006		4-20	10 April 2006			
	1-2	10 April 2006		4-21	10 April 2006	8	8-1	10 April 2006
				4-22	10 April 2006		8-2	05 October 2007
2	2-1	05 October 2007		4-23	10 April 2006		8-3	10 April 2006
	2-2	05 October 2007		4-24	10 April 2006		8-4	10 April 2006
	2-3	05 October 2007		4-25	10 April 2006		8-5	10 April 2006
	2-4	05 October 2007		4-26	10 April 2006		8-6	10 April 2006
	2-5	05 October 2007		4-27	10 April 2006		8-7	10 April 2006
	2-6	05 October 2007		4-28	10 April 2006		8-8	10 April 2006
	2-7	05 October 2007		4-29	10 April 2006			
	2-8	05 October 2007		4-30	10 April 2006	A	A1-1	10 April 2006
	2-9	05 October 2007		4-31	10 April 2006		A1-2	10 April 2006
	2-10	05 October 2007		4-32	10 April 2006		A2-1	10 April 2006
	2-11	05 October 2007					A2-2	10 April 2006
	2-12	05 October 2007	5	5-1	10 April 2006		A2-3	10 April 2006
	2-13	05 October 2007		5-2	10 April 2006		A2-4	10 April 2006
	2-14	05 October 2007					A3-1	10 April 2006
	2-15	05 October 2007	6	6-1	05 October 2007		A3-2	10 April 2006
	2-16	05 October 2007		6-2	10 April 2006		A4-1	05 October 2007
				6-3	10 April 2006		A4-2	05 October 2007
3	3-1	10 April 2006		6-4	10 April 2006		A4-3	05 October 2007
	3-2	10 April 2006		6-5	10 April 2006		A4-4	10 April 2006
	3-3	10 April 2006		6-6	10 April 2006		A5-1	10 April 2006
	3-4	10 April 2006		6-7	10 April 2006		A5-2	10 April 2006
				6-8	10 April 2006			
4	4-1	10 April 2006		6-9	10 April 2006			
	4-2	05 October 2007		6-10	10 April 2006			
	4-3	05 October 2007		6-11	10 April 2006			
	4-4	10 April 2006		6-12	10 April 2006			
	4-5	10 April 2006		6-13	05 October 2007			
	4-6	10 April 2006		6-14	05 October 2007			

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SECTION 4 - FUEL SYSTEM REPAIRS

2.1 GENERAL

The general arrangement of balloon envelopes and systems are shown in the Cameron Balloons Flight Manual Issue 10, Section 6.

2.1.1 Sewing Machines

A lock stitch must be used (chain stitching is not permitted for envelope repairs). The needle size used is 110 (18 Singer System). The stitch length should be set to give between 5 and 8 stitches per 25 mm (inch). Where a twin needle machine is used the preferred needle spacing is 8 mm (5/16"), alternatively a needle spacing of 9.5 mm (3/8") may be used.

2.1.2 Envelope Thread

A three strand, metric 40 (210 denier) nylon or polyester thread must be used, ideally of a contrasting colour to the fabric. The envelope is manufactured using nylon thread. The scoop or skirt is manufactured using a similar thread made from Nomex.

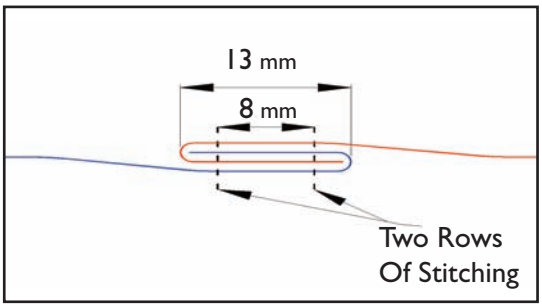
Nylon thread is available as 'Universally Bonded', 'Usual' (S or left-twist) wound and 'Reverse' (Z or right twist) wound. These thread types are interchangeable although certain types of sewing machine may require specific threads (refer to sewing machine manual).

Note: If 'Usual' and 'Reverse' wound thread is used on twin needle sewing machines, the 'Usual' thread should be used on the outermost needle.

2.1.3 Balloon Seam

The seam used in manufacture is known as a balloon seam (French Fell seam). To produce this seam correctly it is essential that the folded-over edge of fabric is penetrated by both rows of stitching.

The ends of stitch lines must be locked by 'back-tacking' (10 mm to 30 mm) or by overlapping the stitching by a minimum of 150 mm (e.g. when a bobbin is changed) to prevent the seam from pulling apart.



▲ Balloon Seam Cross Section

2.1.4 Limitations

2.1.4.1 Replacement Panels

Pre-cut panels or pre-sewn assemblies must be used where more than 10% of the envelope fabric panels are to be replaced at any one time.

Pre-cut panels or pre-sewn assemblies must be used for all panel replacements above the equator of the envelope.

Pre-cut and pre-sewn components must be manufactured by Cameron Balloons Ltd., or by any organisation holding a written approval from Cameron Balloons Ltd. for this purpose.

2.1.4.2 Adhesive Repairs

Adhesive repairs are less satisfactory than sewn repairs, which have the same strength as the original construction of the balloon. Repairs may be in the form of circular or oval patches over holes, or strips for straight tears. The extent to which these may be used depends on the location in the envelope.

The limitations for each type of repair (adhesive patch or strip) are given in the appropriate sub-sections of this manual.

If a panel is damaged beyond the limits laid out for adhesive repairs, a sewn patch should be used or the panel should be replaced.

2.1.4.3 Hyperlast Fabric

Other than complete panel replacement, Hyperlast fabric may only be repaired using the methods given in Sections 2.3 and 2.4.2.

2.1.4.4 Kevron Load Tapes

Repairs involving the unpicking or re-sewing of seams or joints incorporating Kevron load tapes may only be made by repair facilities with written authorisation to do so from Cameron Balloons Limited.

2.2 PANEL REPLACEMENT

1. Unpick all the stitching around the damaged panel. If a seam is covered by a horizontal load tape, this should be unpicked to reveal the panel seam. Vertical tapes are sewn on at the same time as the vertical seams are made. Using a seam ripper, break apart every 3rd or 4th stitch and carefully pull the seam apart. Remove all traces of thread from the area unpicked. For ease of sewing, unpicking should extend at least 100 mm beyond the panel limits.

2. The replacement panel may be copied from an existing panel (within the limitations of Section 2.1.4.1). Remove an identical undamaged panel from the envelope and draw around its edge to transfer its profile onto the new fabric.

Note: Ensure the warp and weft of the fabric in the replacement panel are in the same direction as the original panel.

3. If the replacement panel is too large or too small for the aperture in the envelope, no part of the panel or envelope should be cut to make it fit. The edge which is too long should be sewn with a row of twin needle stitching. The thread tension should be set high enough to shrink the edge as required. Load tapes that are too long should also be shortened using this method.

4. The new panel should be stitched into the envelope using a balloon seam (Section 2.1.3). Start at the intersections with the horizontal seams. When stitching the vertical seams, begin and end 150 mm beyond where the seams were originally unpicked.

Note: Where seams are attached to load tapes, the seam should be sewn first. The completed seam should then be sewn to the load tape.

2.3 SEWN PATCH REPAIRS

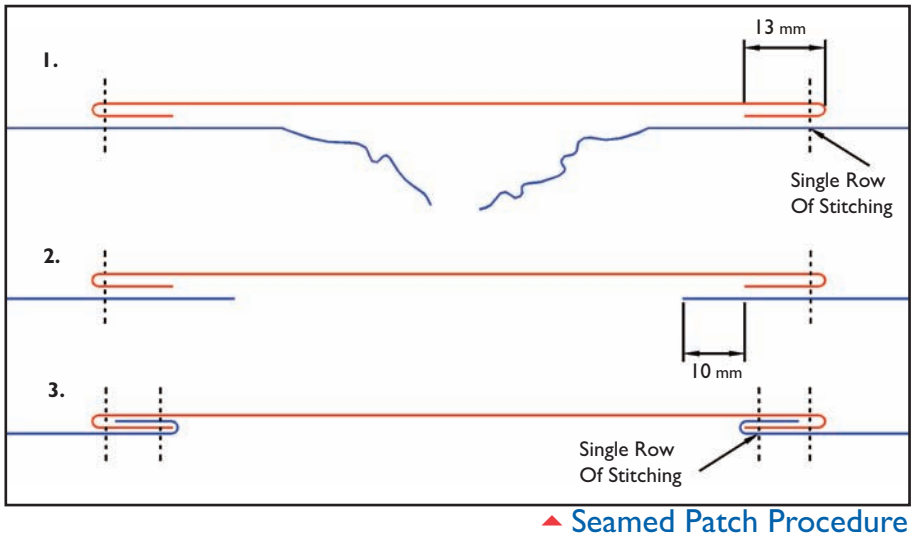
Patches may be used to make repairs to panels and should be made as follows-

2.3.1 Seamed Method

1. Cut patch to shape, fold edges over 13 mm and sew to the damaged area of the envelope.

2. Cut out the damaged area leaving 10 mm excess as shown.

3. Fold the excess under and sew as shown.



Seamed Patch Procedure

These seams are not true balloon seams because the outer row of stitches penetrates only three layers of fabric.

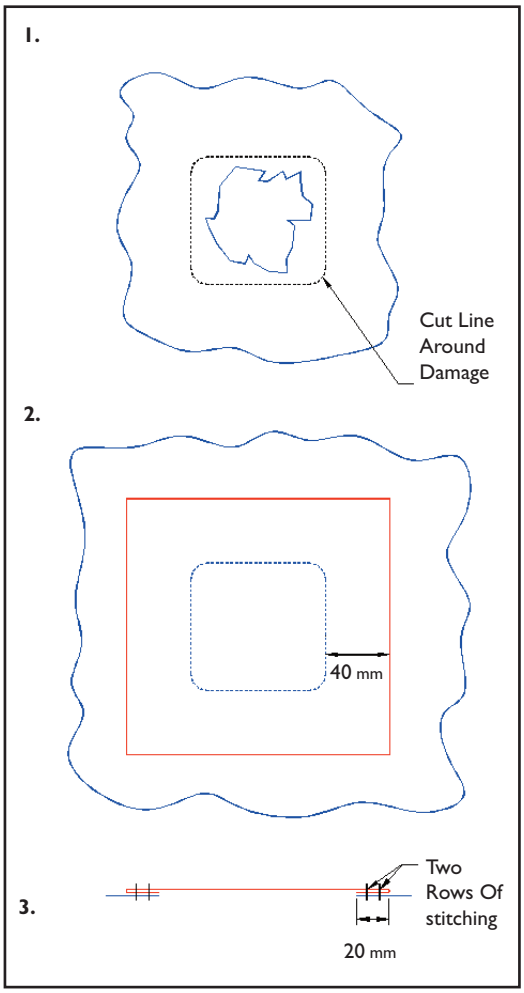
If the damage extends to within 25 mm of a seam, the seam should be unpicked and the patch continued to the panel edge. The seam at the panel edge should be re-sewn using a balloon seam.

2.3.2 Hot Cut and Overlay Method

1. Place a flat piece of wood inside the envelope, under the damaged panel. Remove the damaged area with a hot knife (this will seal the edges of the fabric). Cut a rectangular aperture with radiused corners.

2. Cut an oversize patch, adding a 40 mm seam allowance in each direction.

3. Sew the patch to the panel with a 20 mm folded hem as shown.



▲ 'Hot Cut And Overlay' Procedure

2.4 ADHESIVE PATCH REPAIRS

2.4.1 Limitations

Holes and tears in ripstop envelope fabric, less than 75 mm in any dimension, may be repaired by using an adhesive patch. There must be at least 100 mm between each patch.

Holes and tears in Hyperlast fabric where the diameter of the hole is less than 25 mm diameter or the length of the tear is less than 50 mm in length may be repaired using an adhesive patch. There must be at least 100 mm between each patch.

If the damaged fabric is within 25 mm of a seam or load tape the adhesive patch technique should not be used.

The maximum number of repairs within these limitations in the lower half of the envelope (defined as the area below the widest horizontal seam between two vertical load tapes) is 12 per panel.

The maximum number of repairs within these limitations in the upper half of the envelope (defined as the area above the widest horizontal seam between two vertical load tapes) is 12 in total.

2.4.2 Procedure

Adhesive patches may be made either from envelope fabric applied using a neoprene contact adhesive or from Cameron repair tape.

The patch should be cut with radiused corners and should overlap the damage by a minimum of 25 mm in each direction.

Two patches must be used, one on each of the inner and outer surfaces of the envelope.

Adhesive patch repairs to Hyperlast fabric must have two rows of stitching around the periphery of the patch

Note: A stronger repair to ripstop envelope fabric can be achieved by sewing round the periphery of the adhesive patch with a single row of stitching.

2.5 ADHESIVE STRIP REPAIRS WITH STITCHING

2.5.1 Limitations

Tears in the envelope fabric up to 1.5 m long may be repaired by using strips of balloon fabric applied using a neoprene contact adhesive or with Cameron repair tape.

If the damaged fabric is within 25 mm of a seam or load tape, the adhesive strip technique may not be used and a sewn patch must be fitted.

Below the first horizontal load tape (Cameron Envelopes) or the first 4 m (Thunder & Colt Envelopes) above the Nomex in the lower section of the envelope, repairs of this type can be used with no restriction.

Above this line in the lower half of the envelope (defined as the area below the widest horizontal seam between two vertical load tapes), strip repairs may be used for single linear tears up to 1.5 m in length. The maximum total length of strip repairs is 6 m.

Strip repairs in the upper half of the envelope are not permitted.

2.5.2 Procedure

The edge of the strip must overlap the original fabric by 25 mm, and two rows of stitching must be sewn around the edges of the strip.

2.6 LOAD TAPE REPAIRS

2.6.1 General

Warning: The envelope load tapes are an essential part of the balloon's structure, and the balloon must not be flown if any of them are damaged. Correct specifications for load tapes are given in Appendix 4 and all repairs must be made using tape of the same specification as the original.

Cut tape ends must be melted with a flame or hot knife to prevent fraying. Joints must be made to the same specification as the original joints at the ends of the load tape.

Joints or turnbacks in the load tapes are specified by a measured length before sewing (allowing for shrinkage during sewing) and a minimum finished length.

Special-shaped envelopes may use alternative specifications of horizontal load tape and Cameron Balloons must be contacted for advice when repairing these envelopes.

2.6.2 Horizontal Load Tapes

Horizontal load tapes, with the exception of the base tape and parachute aperture edge tape, on conventional shaped balloon envelopes are either 12 mm or 20 mm polyester tape or 25 mm nylon tape (see Appendix 4). In normal flight these tapes carry no load, and are fitted as rip-stoppers.

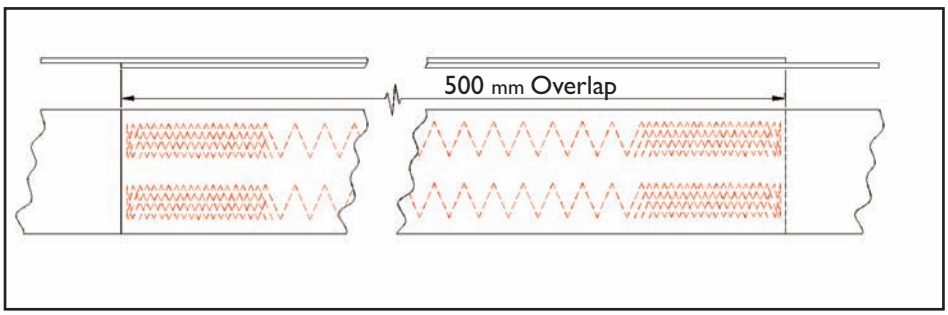
The standard horizontal load tape joint (20 or 25 mm tape) has a measured length 610 mm and a finished length of 600 mm. Where 12 mm tape is used, the measured length is 385mm and the finished length is 350mm. Both joints are secured with two rows of parallel stitching where each row of stitching must extend beyond each end of the joint for a minimum of 150 mm.

Nylon and polyester tapes must not be used together on the same horizontal load tape. Repairs must be made using the same specification of tape as is already fitted. If a complete horizontal is being replaced either 20 mm polyester or 25 mm nylon tape to the correct specification may be used.

2.6.3 Vertical Load Tapes

The standard vertical load tape joint (20, 25 and 45 mm tape) has a measured length 500 mm and a minimum finished length of 470 mm.

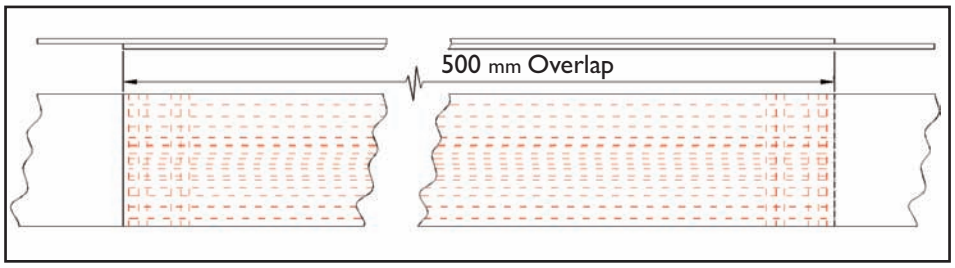
Where 12 mm tape is used, the measured length is 275mm and the finished length is 250mm.



▲ Standard Zig-Zag Stitched Tape Joint Detail

The standard joint is, one (12 mm tape), two (20 mm and 25 mm tape) or four (45 mm tape) parallel row(s) of 3-step zigzag stitching along the length of the joint or turnback. The stitching is secured by back-tacking with four passes of stitching for 30 mm at the ends of each row.

Care should be taken to ensure that the stitching does not run over the ends of the joint.



▲ Alternative Parallel Stitched Tape Joint Detail

Alternatively, if a zigzag sewing machine is not available, the joint can be secured with a number of rows of parallel stitching along its length (using either single or double needle machine).

In addition a number of rows of stitching are sewn across each end of the joint;

20 mm polyester tape-	8 rows of parallel stitching, 3 across each end.
25 mm nylon tape-	8 rows of parallel stitching, 3 across each end.
25 mm polyester tape-	14 rows of parallel stitching, 3 across each end.
45 mm polyester tape-	16 rows of parallel stitching, 24 across each end.

Warning: Parallel stitched joints are not permitted on 12 mm polyester tape

To avoid excessive puncturing of the envelope fabric, the joint should be completely sewn on the tape alone. The tape is then sewn to the fabric with two rows of stitching.

Note: If a tape is damaged near to an extremity, it is better to replace the entire Section from the damaged area to the end of the tape.

2.6.4. Base and Parachute Aperture Edge Tapes

If any section of the envelope base tape requires replacement, the joints must be identical to the vertical load tapes.

Joints in the parachute aperture edge tape must have a minimum finished length of 150 mm with 4 rows of parallel stitching where 20 mm and 25 mm tapes are used and a minimum finished length of 255 mm overlap with 6 rows of parallel stitching where 45 mm tape is used. The end of each row should be back-tacked, overlapping the ends of the joint.

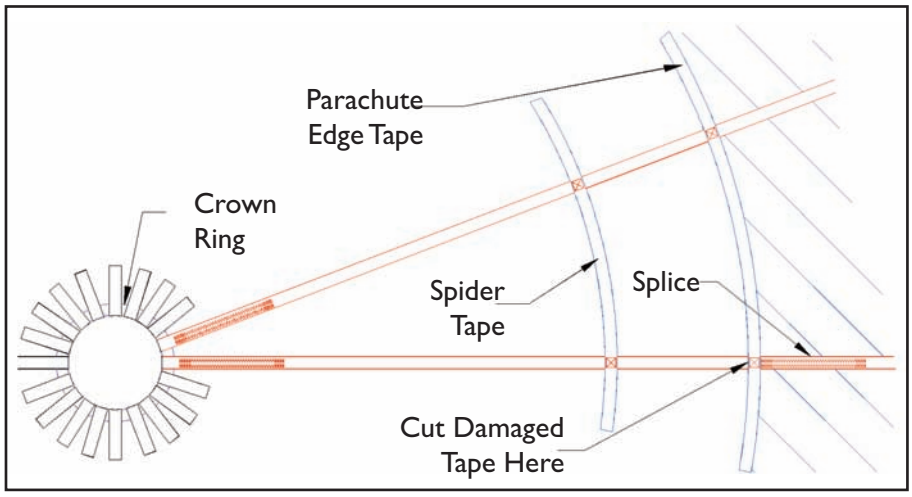
2.6.5 Repairs to Crown Tapes

Repairs to the load tapes between the edge of the parachute aperture and crown ring (crown tapes) are repaired as detailed in the following sub-sections.

2.6.5.1 Cameron Envelopes with Parachute Valves, Lock Tops or Velcro Rip Panels

1. Cut the damaged tape at the point where it crosses the parachute aperture edge tape and unpick the turnback from the crown ring.

2. If the envelope is fitted with any spider tapes, mark these tapes at the point at which they cross the damaged tape and unpick them from the tape.



▲ Cameron Parachute Crown Tape Repair

3. Cut a length of replacement tape which is 500 mm longer than the measured length of the damaged tape.

Note: It is good practice to measure an adjacent tape as a control.

4. Stitch the replacement tape onto the original tape at the parachute aperture edge, using the joint method specified in Section 2.6.3.

5. Mark the tape at 500 mm and 580 mm from the free end on the outside of the tape. If spider tapes are fitted, mark their positions on the new crown tape, as measured from an adjacent crown tape.

6. Thread the new tape 'under' (between the spider and parachute) any spider tapes and wrap round the crown ring noting the correct direction from adjacent tapes. Make sure the tape is not twisted, press the two marks together and sew the turnback.

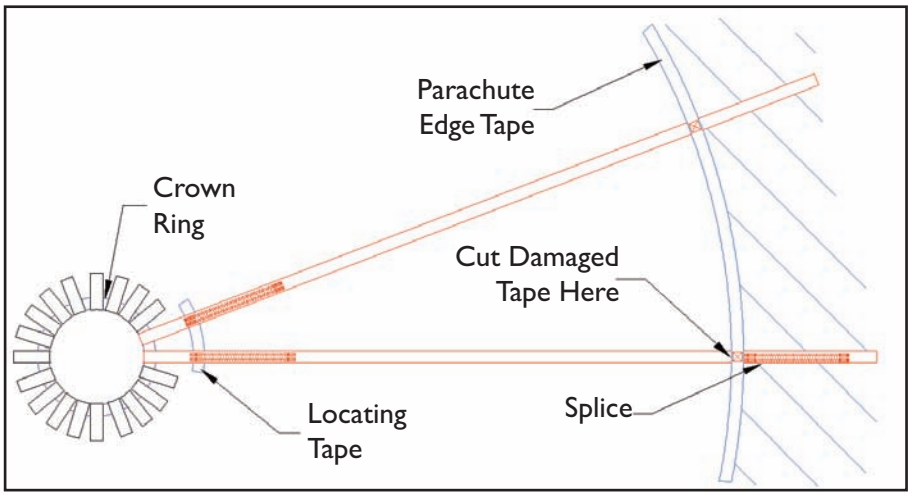
7. Measure the repaired crown tape against an adjacent tape, there should be no more than 10 mm difference between the lengths of the two tapes.

8. Sew the spider tapes to the crown tape using the same stitch pattern as an adjacent spider tape joint.

2.6.5.2 Thunder & Colt Envelopes with Parachute Valves or Combination Rip Panel / Parachute Valves

The method is similar to one described in Section 2.6.5.1 above, but Thunder & Colt envelopes have a radial locating tape adjacent to the crown ring.

1. Cut the damaged tape at the point where it crosses the parachute aperture edge tape and unpick the turn-back from the locating tape and the crown ring.



Thunder & Colt Parachute Crown Tape Repair

2. Cut a length of replacement tape which is 500 mm longer than the measured length of the removed tape.

Note: It is good practice to measure an adjacent tape as a control.

3. Stitch the replacement tape onto the original tape at the parachute aperture edge, using the joint method specified in Section 2.6.3.

4. Mark the tape at 500 mm and 630 mm from the free end on the outside of the tape.

5. Wrap the replacement tape round the crown ring, sandwiching the locating tape between the two marks before sewing the turnback.

6. Measure the repaired crown tape against an adjacent tape, there should be no more than a 10 mm difference between the lengths of the two tapes.

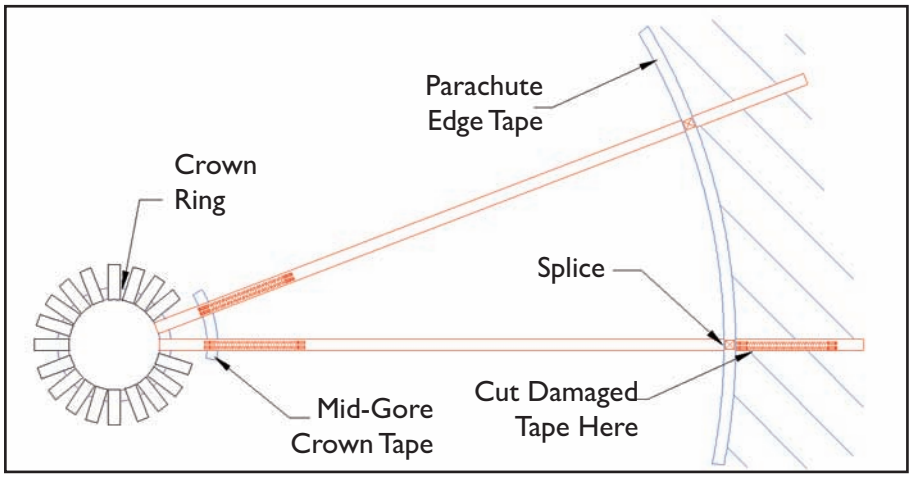
Note: For the combination rip / parachute valve there are two different lengths of crown tape.

2.6.5.3 Envelopes with RDS And Smart Vent Deflation Systems

The RDS and Smart Vent deflation systems have additional mid-gore crown tapes. These tapes are either attached directly to the crown ring(s) or to an adjacent spider tape.

When measuring lengths for replacement tapes, care must be taken to compare the new tape length with the correct corresponding tape (main or mid-gore).

Main crown tapes are re-paired in accordance with Section 2.6.5.1.



▲ RDS / Smart Vent Crown Tape Repair

Mid-gore crown tapes that attach directly to a single crown ring are repaired in accordance with Section 2.6.5.1 but the replacement tape is marked 250 mm and 330 mm from the free end on the outside of the tape (Step 5.).

Mid-gore crown tapes that attach directly to double crown rings are repaired in accordance with Section 2.6.5.1 but the replacement tape is marked 250 mm and 650 mm from the free end on the outside of the tape (Step 5.).

Mid-gore crown tapes that attach directly to the spider tape are repaired in accordance with Section 2.6.5.1 but the replacement tape should be marked at 270 mm from the free end (Step 5.). This mark is placed against the spider and the replacement tape wrapped round it. The end of the turnback should be sewn through the spider tape.

Note: The RDS deflation system has stainless steel rings running along some of the mid-gore tapes. If one of these tapes is being replaced it is important to ensure that the ring is threaded onto the new tape before sewing the turnback.

2.6.5.4 Envelopes with Trivent Deflation Systems

Contact Cameron Balloons Ltd. giving the envelope Construction Number for details.

2.6.5.5 Envelopes with 12 mm Polyester Vertical Tapes

The method is similar to the one described in Section 2.6.5.2 above, but the vertical load tape round crown ring is protected by 'loop protector' made from a length of 14 mm tubular webbing.

1. Mark both sides of the locating tape at the position were it crosses the vertical load tape.

2. Cut the damaged tape at the point where it crosses the parachute edge tape and unpick the turnback from the locating tape and the crown ring.

3. Cut a length of replacement tape which is 275mm longer than the measured length of the removed tape, and cut a 230mm length 14mm tubular webbing

Note: It is good practice to measure an adjacent tape as a control.

4. Stitch the replacement tape onto the original tape at the parachute edge, using the joint method specified in section 2.6.3.

5. Mark the tape at 205mm and 435mm from the free end.

6. Thread the 'loop protector' onto the replacement tape, then slide it up the tape so it sits between the two marks and pin in position.

7. Thread the replacement tape between the two tapes of the locating tape, round the crown ring and then back between the two tapes of the locating tape. Place the two ends of the 'loop protector' together and then sew a vertical tape turnback.

8. Measure the repaired crown tape against an adjacent tape, there should be no more than a 10mm difference between the lengths of the two tapes.

9. Sew the locating tape back together with using a Zigzag stitch. Making sure to line up marks on the locating tape with the ends of the loop protector.

2.6.6 Vertical Load Tape to Flying Cable Turnback

There are two different repairs that involve this joint.

2.6.6.1 Replacing Flying Cables

Note: An alternative method of flying cable replacement which dose not require any sewing is given in Section 2.8.1

1. Unpick the protector and any scoop D-rings.

2. Unpick the base tape from the Nomex for 100 mm either side of the vertical tape.

3. Unpick the Nomex from the vertical tape over a distance of 100 mm beyond vertical tape joint.

4. Unpick the vertical tape turnback and remove the cable.

5. Inspect the vertical tape for wear or damage, including any caused by unpicking

6. Thread on the new cable and re-sew the vertical tape turnback.

7. Thread the cable and vertical tape between the nomex and the bottom tape and sew the vertical tape to the nomex with two rows of stitching.

8. Re-sew the base tape, making sure the vertical tape is secured to the base tape with a single needle box, or back-tacked across the junction with 12 rows of single needle stitching.

9. Re-sew the protector and any scoop D-rings.

2.6.6.2 Damage to the Tape Loop Holding the Flying Cable

1. The unpicking is the same as steps 1 to 4 from Section 2.6.6.1.

2. Cut the tape at the level of the bottom tape and heat seal the raw end.

3. Cut a length of replacement tape which is 1070 mm long.

4. Thread this tape through the eye of the cable.

5. Make a turnback by sandwiching the original tape between the replacement tape leaving a 30 mm loop

6. Complete the repair as steps 7 to 9 from Section 2.6.6.

2.6.6.3 Envelopes with 12mm Polyester Vertical Tapes

Apart from the alternative method of flying cable replacement given in Section 2.8.1 all repairs that involve unpicking the flying cable turnback use the method detailed below. As is 2.6.5.5 the vertical tape through the eye of the cable is protected with by a 'loop protector' made from a length of 14mm tubular webbing.

1. Unpick the protector and any scoop D-rings.

2. Unpick the base tape from the Nomex for 100mm either side of the vertical tape.

3. Unpick the 1st horizontal tape at the top of the Nomex from the envelope for 100mm either side of the vertical tape.

4. Unpick the vertical tape from the envelope to a point 600mm into the first nylon envelope panel.

5. Cut the tape leaving a 400mm tail hanging free from the envelope and heat seal the raw end.

6. Join a 1500mm length of vertical load tape to the free end with a vertical tape joint.

7. Thread the tape between the 1st Horizontal tape and the Nomex and sew to the envelope with two rows of stitching. Stop sewing 300 mm from the bottom of the Nomex.

8. Re-sew the 1st Horizontal to the Nomex back-tack across the junction with 6 rows of single needle stitching

9. Measure the free end of the tape against the Nomex and add on 335 mm, then cut and heat seal the raw end.

10. Mark the vertical load tape 275 mm and 375 mm from the free end.

11. Cut a 100 mm length of 14 mm tubular webbing for the 'loop protector'. Thread the 'loop protector' onto the vertical load tape, then slide it up the tape so it sits between the two marks and pin in position.

12. Thread the replacement tape through the eye of the cable. Place the two ends of the 'loop protector' together and then sew a vertical tape turnback.

13. Thread the cable and vertical tape between the Nomex and bottom tape and sew the vertical tape to the Nomex with two rows of stitching.

14. Re-sew the base tape make sure that the vertical tape is secured to the base tape by 6 rows of single needle stitching.

15. Re-sew the protector and any scoop D-rings.

2.7 CONTROL LINES

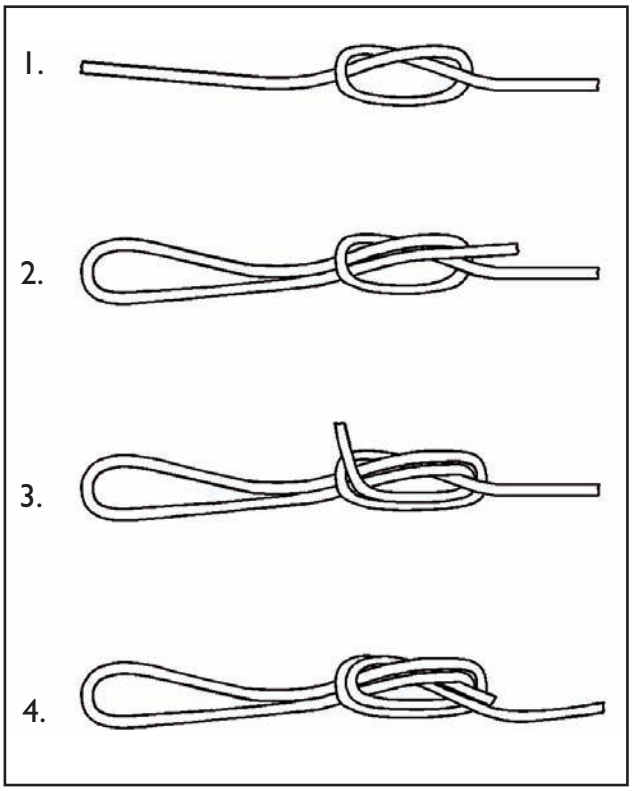
2.7.1 General

All control lines must be replaced with line identical to the original.

All control lines are installed using the 'Cameron' knot. When two lines are to be joined, the interlocking loops at the end of each line should be made using the 'Cameron' knot.

The free ends of polyester line should be cut with a hot knife or heat sealed with a flame.

The ends of Kevlar-cored lines should be finished off by pulling the outer covering back by 20 or 30 mm, cutting off the protruding Kevlar core and heat sealing the outer cover over the end.



▲ Tying The 'Cameron' Knot

The free ends of Kevlar line should be taped or knotted and covered in heat-shrinkable tubing (heat-shrink) to prevent fraying.

The following control line knots should have 14 mm heat-shrink fitted over the 'tail' of the knot to prevent entanglement with other control lines-

RDS And Smart Vent Deflation Systems-

i. Crown line: Upper end of the crown line adjacent to the Crown Ring.
ii. Ripline (red): Upper end of the Ripline At the joint with the centralising lines.

Lock Top Deflation System-

i. Arming Line (black and yellow)- At the joint of the lower Section and the 3 mm line.

If any of these knots have become loose or have been undone, the heat-shrink must be replaced. If the heat-shrink has become damaged, the knot 'tail' can be wrapped with 3M-365 tape until the damaged heat-shrink can be replaced.

The overall length of the control lines must not be reduced. Some excess is required in the lines in order to accommodate envelope distortion and operational needs.

Replacement control lines should be installed whilst removing the original line. Tie the replacement line to one end of the original control line. Pull the other end of the original line through the envelope, untying and retying the knot between the replacement and original line at each pulley, allowing the rope ends to pass through. This will ensure that the replacement line follows the routing of the original control line.

2.7.2 Crown Line

Crown lines are attached to the crown ring by a tape strap and a karabiner. This is to allow the removal and separate packing of the line should it have become wet during inflation or after landing.

The crown line may be repaired by knotting. Knots should not be put in the first 7 m of the line adjacent to the crown ring as the knot may interfere with the normal working of the deflation system. The crown line should be long enough to attach to the burner frame when the balloon is inflated.

2.7.3 Parachute Centralising and shroud lines

If damaged, the line may either be replaced or the damaged Section may be cut out and a new Section knotted in. The length of the line should be checked against a similar line.

2.7.4 RDS and Smart Vent shroud / centralising lines

If the line is damaged within 600 mm of the bottom pulley, the damaged Section can be cut out and a new Section of line knotted in. If the line is damaged elsewhere then the line must be replaced. The length of the line should be checked against an adjacent line. Pre-shrunk line should be used for the replacement lines.

2.7.5 Turning Vent Lines

The 3 mm polyester lines between the vent and the control line may be replaced or repaired by knotting in a new length of line.

The Kevlar-cored control line consists of two Sections of different diameter line knotted together. This knot is protected by a nylon bullet. If the upper line is damaged within 2.5 m of either end of the line then a new Section may be knotted into the vent end of the line. If the lower Section is damaged then it should be replaced.

To replace this Section-

1. Unscrew the protective nylon bullet.
2. Untie the lower line from the upper line.
3. Thread the new line through the bullet.
4. Knot in the new Section of line.
5. Screw the nylon bullet together and tighten.

Older envelopes (pre-Mod C421) are fitted with a continuous line. If this line is damaged near one end a new Section of line may be knotted in, allowing the damaged Section to be removed. Any knots must be within 2.5m of either end of the control line.

2.7.6 RDS, Smart Vent and Trivent Riplines, Trivent Venting Lines

If an RDS, Smart Vent or Trivent ripline is damaged it should be replaced. If a Trivent venting line is damaged then it should be replaced.

2.7.7 Internal Loops and Control Line Pulleys

When replacing loops, pulleys etc., copy the attachment method from an original feature, noting especially the position of any heavy back-tacks on the tape. If a pulley is being replaced then it should be replaced by one of an identical type.

Warning: Pulleys not supplied by Cameron Balloons must not be used.

2.7.8 Control Line Specifications and Usage

2.7.8.1 Specifications

Envelope control line specifications are listed in Appendix 5.

2.7.8.2 Usage

2.7.8.2.1 Cameron Envelopes / Thunder & Colt Envelopes, CN3001 to 4999, CN10000 and Subsequent

Parachute Valves

The Centralising lines and Shroud lines are 3 mm Kevlar line. The operating line is red and white 8 mm Kevlar-cored line.

Note: The operating line may be red 8 mm Kevlar-cored line.

Lock-Top Parachute Valves

The Centralising lines and Shroud lines are 3 mm Kevlar line. The operating line is red and white 8 mm Kevlar-cored line. The lower part of the arming line is yellow and black 8 mm Kevlar-cored line, the upper part is 3 mm polyester line.

Note: The operating line may be red 8 mm Kevlar-cored line.

Rapid Deflation System (RDS) and Smart Vent

The shroud/centralising lines are 3 mm polyester line. The Ripline is red 8 mm Kevlar-cored line and the vent line is red and white 8 mm Kevlar-cored line. All the other rigging lines for RDS or Smart Vent are 3 mm polyester line.

Velcro Rip Panel

Both the upper and lower Sections of the rip line are red 8 mm Kevlar-cored line.

Combination Rip Panel / Parachute Valve

Both the upper and lower Sections of the rip line are red 8 mm Kevlar-cored line. The Centralising lines and Shroud lines are 3 mm Kevlar line and the parachute operating line is red and white 8 mm Kevlar-cored line.

Turning Vents

For clockwise rotation (turning the balloon to the pilots right) the lower Section of the control line is green 6 mm Kevlar-cored line, the upper Section is green 3.5 mm Kevlar-cored line.

For anticlockwise rotation (turning the balloon to the pilots left) the lower Section of the control line is black 6 mm Kevlar-cored line, the upper Section is white 3.5 mm Kevlar-cored line.

The lines between the vent and the control line are 3 mm polyester line.

Note- The control lines may be continuous green or black 6 mm Kevlar-cored line.

Trivent

The ripline is red 8 mm Kevlar-cored line and the vent line is red and white 8 mm.

2.7.8.2.2 Thunder & Colt Envelopes CN 3000 and Previous

Parachute Valves

The Centralising lines are 3 mm Kevlar line, Shroud lines are 3 mm polyester line. The operating line is red 8 mm Kevlar-cored line.

Note: The original operating line may be 6 mm red polyester with a taped wire end. If a red 8 mm Kevlar-cored line is to be fitted, the control line pulleys must be changed.

Combination Rip Panel / Parachute Valve

The Centralising lines are 3 mm Kevlar line, Shroud lines are 3 mm polyester line. The rip line is red 8 mm Kevlar-cored line and the parachute operating line is red and white 8 mm Kevlar-cored line.

Note: The original parachute operating line may be 6 mm white polyester and the original ripline may be 6 mm red polyester, each with a taped wire end. To fit the 8 mm Kevlar-cored lines the control line pulleys must be changed.

Velcro Rip Panel

The ripline is red 8 mm Kevlar-cored line.

Note: The original operating line may be 6 mm red polyester with a taped wire end. If a red 8 mm Kevlar-cored line is to be fitted, the control line pulleys must be changed.

Turning Vents

The control lines are 3.5 mm either green or white and the lines between the vent and the control line are 3 mm polyester line.

Note: The original control lines were white and black. The green line replaces the black line.

2.8 FLYING CABLES

2.8.1 Stainless Steel Flying Cables

Warning: Replacement flying cables may only be supplied by Cameron Balloons Ltd.

Damaged flying cables should be replaced by unpicking and re-sewing the Vertical load tape to flying cable turnback as detailed in Section 2.6.5.

Alternatively, a special short cable may be ordered from Cameron Balloons and attached to the load tape loop(s) using a 'Quick-link' link. The screw gate of the Quick-link must be fixed in the closed position using Loctite 270 Studlock.

Note: Some flying cables are arranged as a pair of cables connected to a single thimble. If one of the pair of cables is damaged then the entire assembly must be replaced.

Some envelopes have a single flying cable attached to two adjacent loops of load tape. It is essential that any replacement is threaded through both loops in the same configuration.

Cameron and Thunder & Colt envelopes with a CN greater than 3000 use "standard length" flying cables, nominal length of 2557 mm, with the following exceptions;

- Envelopes with volumes of less than 56,000 cu.ft may use cables with a nominal length of 2020 mm.

- Envelopes with a CN greater than 10210 and with a volume greater than 250,000 cu.ft, excluding the Cameron Z-600, may use cables of two different lengths, nominally 2557 mm and 2280 mm.

- The Cameron Z-600 uses eight different lengths of cables, nominally between 2930 mm and 3520 mm.

Thunder & Colt envelopes CN 001 to CN 3000 use cables "sets" where the cables are of differing lengths. When replacing cables on these envelopes, the length of the replacement cable must be compared with the original. In the case of an assembly with a pair of cables connected to a single thimble, both cable lengths must be verified. If the 'Quick link' method is being used, the replacement cable is nominally 37 mm shorter than the original cable.

2.8.2 Kevlar Flying Cables

Kevlar flying cables are designed for simple replacement without tools.

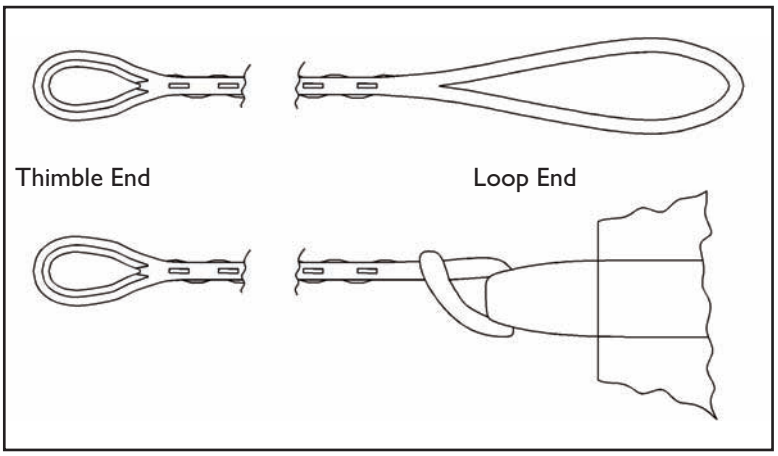
The Kevlar flying cable has a 90 mm loop spliced into the envelope end of the cable and a metal thimble spliced into the other. The metal thimble end attaches to a karabiner at the load frame.

Remove the existing flying cable by loosening the cable where it passes back through its end loop at the mouth of the envelope.

1. Insert the loop end of the new flying cable through the vertical load tape loop(s).

2. Pass the thimble end of the cable through the loop End and pull tight.

3. Arrange the vertical load tape loop(s) and Kevlar cable so that load is evenly spread through the joint. Pass the thimble end of the cable through the webbing protector.



▲ Installation Of Kevlar Flying Cables

2.9 PARACHUTE REPLACEMENT

Parachutes may only be replaced by Cameron Balloons Ltd. or at approved repair facilities. For further information please contact the manufacturer.

2.10 ENVELOPE CLEANING

The envelope may be cleaned by hand with warm water (40°C max.). For heavy soiling a pure soap or a mild non-biological detergent solution may be used. It is important that any cleaners used do not contain bleaching agents. The envelope should be rinsed with plenty of water after washing. Avoid vigorous rubbing or scrubbing as this may damage the fabric coating.

Do not attempt to wash the balloon in any type of washing machine.

When cleaning is complete the envelope should be allowed to dry naturally out of direct sunlight, then once the fabric is dry the balloon should be hot inflated to dry out the load tapes.

Caution: Drying the envelope fabric by hot inflation may damage the fabric coating.

2.11 VELCRO CLEANING

The performance of Velcro joints is improved by regular cleaning. Carefully remove all trapped materials and debris (e.g. grass, thread etc.) trapped in both halves of the Velcro joint.

Balloons with Velcro rip panels are best packed with the Velcro closed, as the 'hook' side of the Velcro is abrasive and may damage adjacent stitching etc.

2.12 VELCRO REPLACEMENT

When replacing Velcro, copy the size, sense (hook or loop) and colour from the original.

Carefully unpick the old Velcro and re-sew a new piece copying the original features.

Note: It is permissible to sew new Velcro over old Velcro without removing the original but it must be ensured that the patch does not become too stiff. If the old Velcro is not removed, it should be noted in the aircraft logbook.

2.13 TEST INFLATION AFTER REPAIR

If any repair has required the alteration or re-rigging of any of the envelope control systems, the envelope should be test inflated (refer to Section 6.22.4).

4.1 GENERAL

WARNING: It is essential that any fuel system or burner maintenance is carried out in clean conditions as the presence of dirt may impair the function of seals or cause blockage of the jets. Burners must be dis connected from all fuel supplies and vented of pressure prior to any maintenance/repair work.

Any maintenance/repair work carried out on the fuel system/burner(s) must be followed by a complete functional check (Section 6.17.3) before the item is returned to service.

4.1.1 Spare Parts

Use only genuine Cameron Balloons spare parts when maintaining or repairing fuel system and burner components. Commercially available equivalents, although appearing similar, may have been manufactured to different specifications.

Descriptions of spare parts can be found in Section 8.4 of this Manual.

4.2 STANDARD PRACTICES

4.2.1 'O'-rings and Seals

Seals manufactured from elastomers (nitrile rubber etc.) are not given a finite service life although it is good practice to replace them on a regular basis.

When units are disassembled, 'O'-rings and Seals should be inspected and, where possible, replaced.

Inspection should consist of a detailed visual inspection for deformation, cuts, cracks and gouges. The 'O'-ring or seal should be rejected if any defect is found.

'O'-rings should be assembled with the greatest of care. The 'O'-ring and mating component should be lubricated prior to assembly. The type of lubrication is specified for each application in the relevant Section.

4.2.2 PTFE Tape

Always ensure that the threads are clean and free from old tape. Use a wire brush and cleaning spray.

Hold the roll of tape in the palm of the hand. Lay the end of the tape onto the male thread close to the free end of thread without covering the last turn of the thread.

Wrap the thread with three layers of sealing tape in the direction of inclination of the thread (for right hand threads this is in a clockwise direction viewed from the free end of the thread). Apply the tape with an even, firm pull so that the tape seats into the thread.

Tear the tape by pulling in the same direction as you were winding until it separates. Smooth the torn end into the thread by running your fingers over it in the same direction it was applied. The tape will adhere to itself.

Caution: There should be no tape covering or overhanging the first external thread adjacent to the end of the fitting. This could detach during tightening and contaminate the fuel system.

4.2.3 PTFE Paste

Where PTFE Paste is specified as a sealing medium for male tapered threads in propane cylinders, the following standard practices apply.

Always ensure that the threads are clean and free from old sealant. Use a wire brush and solvent based cleaning spray. Remove any debris from the cylinder.

Lightly smear the paste into the male thread in the cylinder fitting prior to assembly.

4.2.4 Leak Detection

Leak detection should be carried out using the leak detector spray.

The spray should be applied to the joint requiring testing. Any leaks will be shown by the presence of bubbles.

Excess fluid can be removed with a lint free cloth.

4.2.5 Cleaning of Liquid Pilot Light Regulators

If the liquid pilot light regulator housing and/or piston are heavily soiled, the following generic cleaners may be used-

i. Chlorinated solvents e.g., trichloroethane (ICI 'Triklone').

ii. Hydrocarbon solvents e.g. petroleum fractions, or citrus based oil.

iii. Water based detergents.

4.2.6 Burner Hose Replacement

Burner hoses with tapered NPT fittings (Shadow, Stealth and Sirocco burners) should be assembled with PTFE tape.

Burner hoses with parallel BSP fittings (Stratus burner) should be fitted with the appropriate sized 'Dowty' type bonded sealing washers.

4.2.7 Torque Settings

The maximum recommended torque values should not be exceeded when replacing the following components.

BURNER FUEL HOSES

Fitting	Thread Form	Max. Torque (Nm)
Shadow/Stealth Burner Liquid Hose	1/4"NPT	20
Shadow/Stealth Burner Vapour Hose	1/4"NPT	20
Sirocco Burner Liquid Hose	1/4"NPT	20
Stratus Burner Liquid Hose	3/8"BSP	20
Stratus Burner Liquid Hose	1/4"NPT	15

Note: 1 Nm = 0.737 lb ft = 8.85 lb in.

4.3 CONSUMABLE ITEMS

Consumable items required to complete the fuel system maintenance actions described in this manual are listed in Section 8.4.2

Use only the lubricants specified in each operation and referenced above. In general KSP125 (which is a specially formulated PFPE lubricant) is specified for applications where the components are actually immersed in liquid propane, and silicone based lubricants are specified for all other areas.

WARNING: Graphite based 'dry film' lubricants must not be used to lubricate any part of the fuel system.

6.1 GENERAL

This is the manufacturer's recommended inspection schedule for all Cameron, Thunder & Colt and Sky hot air balloons.

The following pages can be copied and used as a check list for performing the inspections. The inspector should fill in the boxes at the bottom of each page as a record of the inspection.

If they are to be used for a specific inspection of an aircraft, insert the details at the bottom of each page.

6.2 SCHEDULED INSPECTIONS

This is the manufacturer's recommended inspection schedule for all Cameron, Thunder & Colt and Sky hot air balloons.

At intervals of 100 flight hours or one calendar year, whichever occurs the sooner, perform the inspections / checks prescribed in Sections 6.4 - 6.16 utilising the inspection criteria prescribed in Sections 6.17 - 6.23.

Fuel Cylinders require a 10 year periodic inspection in accordance with the requirements of Supplement 7.52 to this manual.

6.3 UNSCHEDULED INSPECTIONS

Unscheduled inspections are those inspections, other then the Scheduled Inspections prescribed in Section 6.2, which must be performed as conditions dictate. They are-

1. Pre-flight Inspections (Section 6.22.1)
2. Envelope Overheat Inspections (Section 6.22.2)
3. Powerline Contact Inspections (Section 6.22.3)
4. Test Inflation After Repair (Section 6.22.4)

6.4 DOCUMENTATION

1.	The Aircraft Logbook (logbook), Certificate of Airworthiness (C of A) and Flight Manual must be present at the time of inspection.	
2.	Check that the correct component serial numbers are entered in the logbook (e.g. basket, burner and fuel cylinders).	
3.	Check the applicability of the Flight Manual to all the major components.	
4.	Where components are made by another manufacturer, check for the available supplementary operational and maintenance instructions	
5.	Check the applicability of services bulletins, AD's and other mandatory continued airworthiness requirements	

6.5 ENVELOPE

1.	Check the condition of the crown ring and crown line.	
2.	Check the joints of the vertical load tapes with the crown ring.	
3.	Check the stitching of the joints between the vertical tapes and the overlying tapes across the parachute or rip panel aperture.	
4.	Check the stitching of the joints between the vertical tapes and the top edge of the envelope.	
5.	Check that the temperature streamer and melting link are fitted and securely attached (load tape 2, near the top of the envelope).	
6.	Inspect the Tempilabel (load tape 3, near top of the envelope and parachute edge). Record the maximum temperature indicated by the label in the logbook. If overheating is indicated (over 121°C) perform an envelope overheat inspection (Section 6.22.2).	
7.	If the envelope has flown more than 250 hours, is suspected of having been overheated, or at the inspector's discretion, perform a grab test (Section 6.20).	
8.	If substantial fabric porosity is suspected then a flight test should be performed, but only after a grab test has demonstrated the balloon is safe to fly (Sections 6.20 and 6.21).	

Note: If there are any doubts about the parachute seal then the balloon should be inflated and the parachute seal inspected.

CN	Inspection Date	Inspectors Signature

Cylinder straps: Check the straps for any wear or damage. Buckles and rivets should be free from corrosion. Check leather straps for excessive mould or dryness. The leather must not crack when flexed, especially near buckle holes. Check webbing straps for UV degradation (UV degradation usually manifests itself as fading of the webbing).

Pilot restraint harness anchor: Check load tape anchors for wear or damage. Check the basket stakes that the anchor is attached to for security and freedom from fracture. For U-bolt anchors, check the U-bolt for deformation check the condition and security of the nuts and the condition of the floor around the fitting. On under batten anchors check the condition of the batten and the D-ring.

6.17.5 Ancillary Equipment (If fitted)

Launch restraint: Check the physical condition of the latch mechanism. Inspect for signs of distortion or wear. Check the operation of the latch. Inspect the webbing strap (if fitted) for signs of wear, cuts, heat damage and UV degradation (UV degradation usually manifests itself as fading of the webbing). If the webbing has any defects it should be replaced. Check the condition of the restraint rope for wear or damage.

Pilot restraint harness and strap: Check the condition and function of buckles and fittings. Check the condition of the webbing as for a launch restraint.

Instruments: Check altimeter against reference altitude (e.g. site elevation). Check Variometer for initial needle deflection when switched on/off.

6.18 FUEL CYLINDERS

If there is any doubt over the nature of any defects found during the inspection of fuel cylinders, the cylinders must be referred to Cameron Balloons for further inspection.

If a cylinder has been deemed unsuitable for further service, it is deemed unsuitable for use in balloons AND unsuitable for the safe storage of liquefied gases.

Note: These requirements do not exempt the owner from any other regulations or legal obligations regarding propane cylinders.

Inspection frequency-

Annual: Functional test & external visual inspection.

Periodic: 10 years from the date of manufacture and every 10 years thereafter. (Annual inspection, internal inspection and proof pressure test)

6.18.1 External Visual Inspection

Remove the cylinder cover and inspect the cylinder body for external damage or corrosion. Give special attention to areas where water can be trapped (e.g. the junction between the cylindrical shell and the footring). Check the integrity of all permanent attachments including the data plate.

Section 6.18.5 gives definitions of cylinder damage and guidance on rejection limits.

All stainless steel and Titanium cylinders must be fitted with a padded cover.

Offtake bosses: The offtake bosses may become damaged by an impact on the valves or by careless valve replacement. Ensure that the valves are vertical, that the bosses do not appear to have been pushed into the cylinders and that the welds around the bosses are undamaged.

6.18.2 Pressure Relief Valve (PRV)

CAUTION: Always wear eye protection when examining relief valves under pressure. Never look directly into a relief valve under pressure.

Check that the PRV (or the vapour offtake valve in which it is fitted) will not be more than 10 years old at the date of the next annual inspection (refer to Appendix 3).

Where the PRV is separate, remove the pipeaway (if fitted) and dust cover and inspect the valve for contamination or corrosion. If the PRV is integral in the vapour valve, check that the seal has not been broken. Wear eye protection while inspecting the valve.

If there is any evidence of leakage, corrosion or contamination the valve must be replaced.

Cylinders should only be fitted with a single PRV.

6.18.3 Functional Check

Note: All leak checks specified in this Section are visual checks using leak detector.

Vapour Valve (if fitted): Open the vapour valve and check function of the self-seal (with the valve open and no coupling connected no vapour should escape). Check for leaks around the valve base and the valve stem.

Connect a vapour hose and ignite the pilot light. Check the joint at the quick connect coupling for leaks. If the regulator is of the adjustable type, check the regulator adjustment over a range of pressures. Turn off the vapour valve with the pilot light valve open to check that the vapour valve shuts off fully.

Liquid Valve: Remove the liquid valve dust cover (if fitted). Open the cylinder valve and check the function of the self-seal (with the valve open and no coupling connected no liquid or vapour should escape - do not look directly into the outlet). Check for leaks around the valve base and the valve stem. Shut the liquid valve and connect to a burner.

Open the cylinder valve and check leaks at the coupling.

Check that the fuel pressure is in the normal operating range of the burner (normally the green sector of the pressure gauge).

Operate the main burner for a minimum of 10 seconds and ensure the fuel pressure does not drop once the blast valve has been opened. Shut off the cylinder valve and open the blast valve to ensure the valve shuts off completely (it may take some time for the residual flame to die away). Disconnect the hose and recheck the function of the self-seal valve.

Fixed level liquid gauge (FLLG or Bleed Valve): Check for leaks around the base of the valve and the valve outlet. Open and close the valve to check for correct operation.

In addition, if the FLLG is fitted with a "Fuelsafe" system, check for leaks at the quick release coupling with the vent hose connected.

Contents Gauge: The freedom of movement of the contents gauge may be checked by leaning the cylinder forwards and backwards relative to the orientation of the gauge. This should cause the reading on the cylinder gauge to change.

Leak check: check all pressure holding joints with leak detector. This includes all threads into the cylinder, all joints between valves / regulators / connectors, valve stems (open & close the valve during this test), the seal around contents gauges and the welds around the bosses.

6.18.4 Periodic Inspection

Periodic inspection is detailed in Supplement 7.52. to this manual.

6.18.5 Annual Inspection of Fuel Cylinders- Definition of Cylinder Damage and Guidance on Rejection Limits

Note 1: Consideration of appearance, location and number of defects also play a part in the evaluation of damage. See especially Section 6.18.1, 'Offtake bosses'.

Note 2: Stainless steel and Titanium cylinders vary in thickness from 1.4 - 2 mm. The most highly stressed part of the cylinder is in the cylindrical wrapper section. Particular care should be taken when inspecting this area. The thinnest wall sections are in the hemispherical ends. Worthington aluminium cylinders have a minimum wall thickness of 3.5 mm.

As a general rule, if the cut or gouge can be felt with a thumbnail, its depth is in excess of 0.1 mm to 0.2 mm (approximately 10% of the wall thickness at the thinnest point).

Note 3: Damage to the upper and lower guard ring is acceptable providing that the distortion has not affected the cylinder body, and that the guard rings continue provide protection to the cylinder body and fittings.

Corrosion: Any cylinder exhibiting corrosion should be referred to the manufacturer. Corrosion can be identified as areas of discolouration (rust colour), isolated pits or chains of pits (which are normally black in colour). Particular attention should be paid to the areas around the welds and to the bottom centre of the cylinder base.

Table 6.1: Guidance on Rejection Limits relating to Physical and Material Defects in the cylinder shell.

Defect	Definition	Rejection Limits
Bulge	Visible Local Swelling of the Cylinder	All
Dent	A depression in the cylinder that has neither penetrated or removed metal, and its width at any point is greater than 2% of the external cylinder diameter	When the depth of the dent exceeds 25% of its width at any point. See Note 1
Visible damage on welds	Any combination of dent, cut, gouge or other damage on welded joints	All
Cut or Gouge (Cylinders where the wall thickness is known)	A sharp impression where metal has been removed or redistributed	When the depth of penetration exceeds 5% of the original minimum wall thickness. See Note 2
Cut or Gouge (Cylinders where the wall thickness is not known)	A sharp impression where metal has been removed or redistributed	All
Dent Containing Cut or Gouge	A depression in the cylinder within which there is a cut or gouge	Where the size of the dent or gouge approaches the dimension for rejection on an individual defect
Crack	A split or rift in the cylinder shell	All

6.19 CROWN TAPE DIMENSIONS - VELCRO RIPS

This check ensures that the crown tapes are shorter than the radius of the Velcro rip panel. If the tapes were longer than the rip panel radius, the Velcro would be stressed and would be likely to open in flight.

6.19.1 Circular Velcro rips

1. Mark the centre point of the circular patch in the centre of the rip panel.

2. From the centre point in the direction of each load tape, mark out the radius 'R' using the appropriate value from Table 2. These points should be permanently marked with a felt tip pen or other means.

3. With the Velcro correctly in place ask an assistant to hold each load tape on the envelope side of the Velcro. Ensure that the relative lengths of the Velcro panel and the free tapes are not distorted.

4. Hold the free load tape and the panel straight together, with no slack, but no excessive tension. The inside edge of the crown ring should match the radius mark in step 2. Repeat for each load tape.

5. If the free tape is too long by more than 10% of 'R' it must be unstitched and resewn. Free load tapes which are too short present no danger, although amounts greater than 0.5 'R' would merit investigation.

Table 6.2- Velcro Rip Crown Tape Dimensions

Type	Radius 'R'	
	cm	inch
O-31	20	8
O-42	22	8.5
O-56	24	9.5
O-65	28	11
O-77	30	12
O-84	30	12
O-105	33	13
O-120	33	13
O-160	37	14.5
A-105	33	13
A-120	33	13
A-140	37	14.5
A-160	36	14
A-180	33	13
A-210	36	14
A-250	36	14
A-300	36	14

6.19.2 Rectangular and Triangular Velcro Rips

Rectangular and triangular rip panels are normally only fitted to special shape balloons.

The length of the load tape should be checked against the corresponding fabric length. The load tape must be shorter than the corresponding fabric by at least 5 % (load tape length $\leqslant$ 0.95 fabric length). If the load tapes are too long they must be shortened.

Free load tapes that are too short present no danger although lengths $\leqslant$ 0.8 fabric lengths should be investigated.

Note: On triangular and rectangular Velcro rips the Velcro should be replaced every 100 hours.

6.20 GRAB TEST

The grab test should be performed on each colour of fabric near the top of the envelope. If the envelope is partially manufactured with a long-life fabric (e.g., Hyperlast), both the long life fabric and the standard fabric should be grab tested.

On Cameron Balloons and on Bristol built T&C balloons (CN 3445 and subsequent) the outer area of the parachute panel between the edge of the panel and the Velcro tabs needs only to be grab tested to 21 lb (9.5 kg) for the parachute to be fully airworthy.

The fabric must be gripped with the jaw edges carefully aligned so that the same fibres are being pulled from each end.

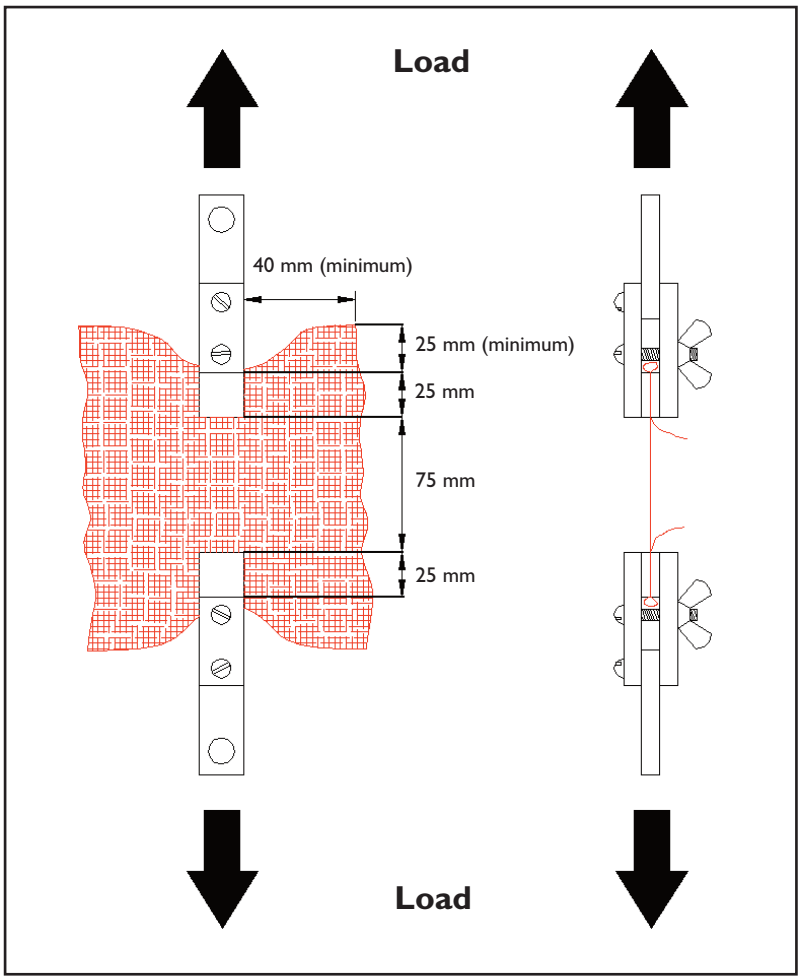
The clamp edges must be parallel so that the fibres are loaded evenly. The clamp should be tightened so that the fabric does not move in the jaws.

If the fabric withstands a 30 lb (13.6 kg) pull it is fully airworthy

If the fabric fails between 21 lb and 30 lb (9.5 and 13.6 kg) fabric may be passed as airworthy with the following limitations-

1. Balloon size not to exceed 105,000 cu.ft (3000 cu.m).
2. Balloon not to be used for the carriage of fare paying passengers.
3. Max loading 14 lb / 1000 cu.ft.
4. Grab test to be repeated annually or every 50 flying hours, whichever is more frequent.

If the fabric fails below 21 lb (9.5 kg) then all the weak fabric must be replaced and the envelope reinspected.



Grab Test Procedure

8.1 GENERAL

This Section provides a list of design definitions of the replacement parts and materials used in the maintenance of the balloon and its ancillary equipment.

All parts and materials are available from Cameron Balloons Ltd. or approved suppliers.

8.2 ENVELOPE

8.2.1 General

When ordering replacement envelope parts it is essential to state the Brand (e.g. Cameron or Thunder & Colt), the type / variant (e.g. O-160), the constructors number and approximate date of manufacture.

8.2.2 Consumable Items

Part Number	Description
CE-1000-0000	Repair Tape, Adhesive Backed
CE-4300-0001	Envelope Thread, Metric 40 (210 Denier) ('usual' or 'unusual' wound) - Reel
CE-4300-0002	Envelope Thread, Metric 40 (210 Denier) - Barbobs G Bobbins
CE-4300-0003	Envelope Thread, Metric 40 (210 Denier) - Nomex
CE-4300-1001	Envelope Thread, Metric 40 (210 Denier) - Oxley universally bonded
CE-3020-0001	Velcro, 20 mm (twin metre)
CE-3025-1000	Velcro, 25mm, Super Hook
CE-3025-2000	Velcro, 25mm, Loop
CE-3050-0002	Velcro, 50 mm (twin metre)

8.2.3 Envelope Fabric

Part Number	Description
CE-5133-XXXX*	Ripstop Nylon Envelope Fabric
CE-5134-XXXX*	Ripstop Nylon Envelope Fabric (Alternative)
CE-3390-XXXX*	Hyperlast Envelope Fabric
CE-2389-XXXX*	Hyperlast Envelope Fabric (Alternative)
CE-1123-XXXX*	Nomex Envelope Fabric

For details of lightweight fabrics and special fabrics (e.g. gold and silver), contact Cameron Balloons Limited.

Note: * The last four digits of fabric part numbers denote the fabric colour, e.g. CE-5133-5198 = Ripstop Nylon Envelope Fabric-Royal Blue.

8.2.4 Envelope Load Tape

Part Number	Description
CE-2013-1000	12mm polyester, minimum strength 300kg (661lbs), white
CE-2013-1001	12mm polyester, minimum strength 300kg (661lbs), black
CE-2020-2101	20mm polyester, minimum strength 1021kg (2250 lbs), white
CE-2020-1101	20mm polyester, minimum strength 1021kg (2250 lbs), black
CE-2020-5001	20mm polyester, minimum strength 680 kg (1500 lbs), white
CE-2020-5011	20mm polyester, minimum strength 680 kg (1500 lbs), black
CE-2025-1001	25mm nylon, minimum strength 680 kg (1500 lbs), white
CE-2025-2001	25mm nylon, minimum strength 680 kg (1500 lbs), black
CE-2025-1101	25mm polyester, minimum strength 1814 kg (4000 lbs), white
CE-2025-2103	25mm polyester, minimum strength 1814 kg (4000 lbs), black
CE-2025-3001	25mm polyester, minimum strength 3000 kg (6614 lbs), white
CE-2025-3002	25mm polyester, minimum strength 3000 kg (6614 lbs), black
CE-2045-1001	45mm polyester, minimum strength 2722 kg (6000 lbs), white
CE-2045-1002	45mm polyester, minimum strength 2722 kg (6000 lbs), black
CE-2100-1001	50mm Tape, Turnback Protectors, White
CE-2100-2001	50mm Tape, Turnback Protectors, White

8.2.5 Envelope Hardware

Part Number	Description
CB-0734-0001	Turnback Protector
CE-4000-0001	Tempilabel (121°C)
CE-4000-0002	Pulley Block, Single, Tufnol (8mm max. diameter rope)
CE-4000-0003	Pulley Block, Single, Tufnol, With Becket (8mm max. diameter rope)
CE-4000-0004	Pulley Block, Double, Tufnol, With Becket (8mm max. diameter rope)
CE-4103-0002	Heat Shrink Caps, Parachute Line
CE-4103-0005	Maillon Rapide Quick Link, 5mm, Oval
CE-4260-0001	Temperature Flag with Solder Link
CE-4260-0002	Temperature Flag Solder Link
CE-4260-0003	Temperature Flag
CE-4300-0007	Spring Hook (Control Line lower end)
CE-4300-0008	Scoop Shackle, Standard
CE-4300-0009	'D' Ring, Aluminium (25mm)
CE-4300-0010	Riplock Hook
CE-4300-0023	Flying Cable Vee Ring, Large
CE-4300-0024	Karabiner, Crown Line (Top)
CE-4300-0025	Karabiner, Crown Line (Bottom)
CE-4300-0026	'D' Ring, Stainless Steel (22mm wide)
CE-4300-0027	Scoop Shackle, Large
CE-4300-0100	Swivel
CG-1000-1021	Scoop Hook (Fixed Eye Boat Snap), 82mm
CG-1000-1022	Scoop Hook (Fixed Eye Boat Snap), 98mm

A4.1 All Cameron Envelopes and Thunder & Colt Envelopes, CN3001 and Subsequent

The base tape is either 25 mm polyester of minimum strength 1814 kg (4000 lbs) or 45mm polyester of minimum strength 2722 kg (6000 lbs)

The parachute aperture edge tape for Cameron types is normally of the same specification as the vertical load tape except where the envelope has 12 mm polyester vertical loadtapes where the edge tape is 20 mm polyester (minimum strength 1020kg (2250 lbs)).

The parachute aperture edge tape for Thunder & Colt types is 25 mm polyester of minimum strength 1815 kg (4000 lbs).

All other horizontal tapes are 12 mm polyester (minimum strength 300 kg (660 lbs)), 20 mm flat polyester (minimum strength 680 kg (1500 lbs)) or 25 mm flat nylon (minimum strength 680 kg (1500 lbs)).

The additional mid-gore crown tapes fitted to RDS or Smart Vent are 20 mm polyester of minimum strength 1020 kg (2250 lbs)

For Vertical load tape specifications, refer to Table **A4.1**

A4.2 Thunder & Colt Envelopes CN0001 to CN3000

The base tape is 50 mm polyester of minimum strength 2000kg (4400 lbs). This tape is also used for the rip aperture edge tape on combination rip / parachute deflation systems.

The parachute aperture edge tape is 25 mm polyester of minimum strength 1815 kg (4000 lbs).

All other horizontal tapes are 20 mm polyester of minimum strength 680 kg (1500 lbs)

For Vertical load tape specifications, refer to Table **A4.2**

Note: In both tables, two different load tape specifications have been listed for some envelopes. For these envelopes it is not permitted to mix tape specifications. (i.e. All the vertical tapes shall be to the same specification)

Table - A4.1 Vertical Load Tape Specifications-Current

Envelope Type	Envelope Size Range	Vertical Load Tape Specification
A-Type	105 to 160	20 mm polyester of minimum strength 1020kg (2250 lbs)
	180 to 340	25 mm polyester of minimum strength 1815 kg (4000 lbs)
	340 HL to 375	45 mm polyester of minimum strength 2722 kg (6000 lbs) or 25 mm polyester of minimum strength 3000 kg (6614 lbs)
	400 to 530	45 mm polyester of minimum strength 2722 kg (6000 lbs)
Concept	60	20 mm polyester of minimum strength 680 kg (1500 lbs) or 25 mm nylon of minimum strength 680 kg (1500 lbs)
	70 to 100	20 mm polyester of minimum strength 1020kg (2250 lbs)
GP-Type	65, 70	20 mm polyester of minimum strength 680 kg (1500 lbs)
H-Type	20 to 34	20 mm polyester of minimum strength 680 kg (1500 lbs) or 25 mm nylon of minimum strength 680 kg (1500 lbs)
N-Type	31 to 210	20 mm polyester of minimum strength 1020 kg (2250 lbs)
O-Type	31 to 90	20 mm polyester of minimum strength 1020 kg (2250 lbs)
	105 to 160	25 mm polyester of minimum strength 1815 kg (4000 lbs)
TR-Type	60, 70	20 mm polyester of minimum strength 680 kg (1500 lbs)
Viva	31 to 65	20 mm polyester of minimum strength 1020 kg (2250 lbs)
	77 to 90	25 mm polyester of minimum strength 1815 kg (4000 lbs)
Z-Type & Colt A Type	25 to 31	12 mm polyester of minimum strength 300 kg (660 lbs)
	42	20 mm polyester of minimum strength 680 kg (1500 lbs)
	56 to 210	20 mm polyester of minimum strength 1020 kg (2250 lbs)
	225 to 425 LW	25 mm polyester of minimum strength 1815 kg (4000 lbs).
	450 to 600	25 mm polyester of minimum strength 3000 kg (6614 lbs)
Thunder Series S1	AX5-42S1 to AX8-84S1	20 mm polyester of minimum strength 1020 kg (2250 lbs)
	AX8-90S1 to AX10-180S1	25 mm polyester of minimum strength 1815 kg (4000 lbs).
Thunder Series S2	AX8-90S2 to AX9-140S2	20 mm polyester of minimum strength 1020 kg (2250 lbs)
	AX10-160S2 to AX11-250S2	25 mm polyester of minimum strength 1815 kg (4000 lbs).
Colt Bullet	56B to 90B	20 mm polyester of minimum strength 1020 kg (2250 lbs)

Table A4.2 - Vertical Load Tape Specifications-Obsolete

Envelope Type	Envelope Size Range	Vertical Load Tape Specification
Colt A	25A to 56A	20 mm polyester of minimum strength 680 kg (1500 lbs)
	69A to 210A	20 mm polyester of minimum strength 1020kg (2250 lbs)
	240A to 315A	25 mm polyester of minimum strength 1815 kg (4000 lbs)
Thunder Series S1	AX5-42S1 to AX8-84S1	20 mm polyester of minimum strength 1020kg (2250 lbs)
	AX8-90S1 to AX10-180S1	25 mm polyester of minimum strength 1815 kg (4000 lbs)
Thunder Series S2	AX8-90S2 to AX9-140S2	20 mm polyester of minimum strength 1020kg (2250 lbs)
	AX10-160S2 to AX11-250S2	25 mm polyester of minimum strength 1815 kg (4000 lbs)
Colt Bullet	56B to 90B	20 mm polyester of minimum strength 1020 kg (2250 lbs)

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