HOT AIR BALLOON FLIGHT MANUAL

This manual forms part of EASA Type Certificates EASA.BA.012 and EASA.BA.013 first approved on 29 August 2005 and 02 August 2005 respectively.
Approved by EASA under Approval Number EASA.BA.A.01000 on 10 April 2006.

This Manual is specific to the following balloon-

Model _____ Constructor's Number _____

Registration _____ Year Of Construction _____

Applicable MTOM _____ kg

This balloon is to be operated in compliance with the information and limitations contained herein.

I hereby certify that this Flight Manual, incorporating the Supplements indicated in Section 8 and issued for the above balloon, conforms to EASA Type Certificate EASA.BA.012 or EASA.BA.013, and that the Type Certificate is correct and current at the time of issue of the Certificate of Airworthiness.

Signed _____ Name _____ Date _____

For Cameron Balloons Limited. EASA DOA No. EASA.21J.140

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Record Of MTOM Amendments

Applicable MTOM	Date Of Change	Signature

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Record of Amendments

Amendment Number	Description	Pages Affected	Date	Approval
1	Record of Amendment, List of Effective pages, Contents and List of Supplements Updated. Page 2-2: Permitted Damage increased. Page 4-2: Cylinder Orientation guidance added. Page 5-6: "Total" boxes added to tables. Page 6-10; Caution regarding vapour regulators at low ambient temperature added. 45 was 60. Pages 7-1, 7-2 revised, 7-3 and 7-4 added. Supplement 8.1: Addition of Turtle-120 Special Shape, Colt Sugar Box 90, Buddy-90, Head One-105, Lightbulb-110, Bierkrug-90, Condom -105, Apple-90, RX-105, Tiger 90 and Cup-110. Supplement 8.6: Addition of Record of Amendments, T&C and Cameron burners and burner frame information. Supplement 8.8: Introduction of basket maximum pay-loads and minimum burner requirements in accor-dance with EASA.BA.016. Extension to include T&C envelopes. Supplement 8.9: Kubíček Bottom Ends with Cameron and T&C Envelopes. Supplement 8.12: Addition of Cameron H20, H24, H34, Colt 17A, 21A and Thunder AX6-56S1. Supplement 8.15: Addition of Basket List. Supplement 8.19: Demountable double, triple and quad burners. Supplement 8.21: Deletion of A1 category (moved to type specific supplements), Addition of Basket CB3394, CB3006, CB3027, CB3120, CB3448 and CB3449, added. Type 3 cylinders added to CB950 and CB3175. Supplement 8.22: Addition of Paragraph 22.6.3.10.1. Burner Assemblies CB2051, CB2065, CB2081, CB2089, CB2095, CB2096, CB2097, CB2130, CB2145, CB2298, CB2299 added. Supplement 8.32: Out of Production Hoppers. Supplement 8.33: Sky Bottom Ends with Cameron and Thunder & Colt Envelopes.	i-iii, i-vii, i-viii, i-ix, i-xiv, ixv, i-xvi, 2-2, 2-3, 4-2, 5-6, 6-10, 6-11, 7-1 to 7-4, Supplement 8.1: All, Supplement 8.6: All, Supplement 8.8: All, Supplement 8.9: New Supplement, Supplement 8.12: All, Supplement 8.15: All, Supplement 8.19: New Supplement, Supplement 8.21: All, Supplement 8.22: All, Supplement 8.32: New Supplement, Supplement 8.33: New Supplement,	17:12:2007	Approved by EASA under Approval Number EASA.BA.C.01128
2	Supplement 8.10: Chaize Baskets.	Supplement 8.10: New Supplement,	21:12:2007	Approved by EASA under Approval Number EASA.BA.A.01013

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.

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List of Supplements

The supplements ticked 'Applicable' to this balloon are inserted into this manual in Section 8.

Number	Description	Issue	Approval Date	Applicable
8.1	Special Shapes	9	17 December 2007	
8.2	Balloons On German Register	-	-	-
8.3	Balloons On French Register	-	-	-
8.4	Balloon Works Bottom Ends with Cameron Envelopes	-	-	-
8.5	Raven Aerostar Bottom Ends with Cameron Envelopes	1	10 April 2006	
8.6	Lindstrand Bottom Ends with Cameron and T&C Envelopes	2	18 April 2007	
8.7	Ultramagic Bottom Ends with Cameron Envelopes	1	10 April 2006	
8.8	Schröder Fire Bottom Ends with Cameron and T&C Envelopes	2	15 August 2007	
8.9	Kubícek Bottom Ends with Cameron and T&C Envelopes	1	17 December 2007	
8.10	Chaize Baskets	1	21 December 2007	
8.11	Lindstrand Cloudhopper with Cameron Envelopes	1	10 April 2006	
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8.17	Special Needs Passenger Seat	-	-	
8.18	Removable Partition Basket	1	10 April 2006	
8.19	Demountable double, triple and quad burners	1	30 November 2006	
8.20	Basket Towing Plates	1	10 April 2006	
8.21	Special Baskets	4	17 December 2007	
8.22	Out of Production Burner Models	2	18 April 2007	
8.23	Sirocco Burner - Remote Control Operating System	1	10 April 2006	
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8.25	Removable Burner	1	10 April 2006	
8.26	Shadow / Stealth Electric Burner	1	10 April 2006	
8.27	Launching Hang Gliders	1	10 April 2006	
8.28	Night Flying	1	10 April 2006	
8.29	Dropping Parachutists	1	10 April 2006	
8.30	Envelope Laser Display System	1	10 April 2006	
8.31	-	-	-	
8.32	Out of Production Hoppers	1	18 April 2007	
8.33	Sky Bottom Ends with Cameron and T&C Envelopes	1	10 April 2006	
	Canadian - Specific Addendum Type			

Number	Description	Issue	Approval Date	Applicable

SECTION 3 - EMERGENCY PROCEDURES

SECTION 4 - NORMAL PROCEDURES

1.1 INTRODUCTION

This balloon flight manual has been prepared to provide pilots and instructors with information for the safe operation of all Cameron free hot air balloons.

Revisions to this Manual are published on the Cameron Balloons Limited website at www.cameronballoons.co.uk.

Email notification of revisions can be received by subscribing to the Technical Update Service on this website.

1.2 CERTIFICATION BASIS

The types of balloon for which this manual is applicable have been approved by EASA, under the following Type Certificates-

EASA.BA.013: Cameron 'A' types
Cameron 'C' types
Cameron 'GP' types
Cameron 'N' types
Cameron 'O' types
Cameron 'TR' types
Cameron 'V' types
Cameron 'Z' types
Cameron 'Colt A' types
Cameron 'Thunder Series I' (SI) types
Cameron 'Thunder Series II' (SII) types

EASA.BA.012: Cameron 'Special' types

1.3 DEFINITIONS

Checklists are given in blue text, while important information is given in **bold text**.

The following definitions apply to warnings, cautions and notes used in this flight manual.

WARNING- Means the non-observation of the corresponding procedure leads to an immediate or important degradation of flight safety.

CAUTION- Means the non-observation of the corresponding procedure leads to a minor long-term degradation of flight safety.

Note- Draws attention to any special item not directly related to safety, but which is important or unusual.

The Maximum take-off Mass (MTOM) is the maximum permissible total weight of the balloon and all its equipment at take-off, including fuel, instruments, passengers and crew.

The Minimum Landing Mass (MLM) is the minimum permissible total weight of the balloon and all its equipment at landing, including fuel, instruments, passengers and crew.

Throughout this manual, the terms 'mass' and 'weight' are interchangeable and have an identical meaning.

1.4 DESCRIPTION

Envelopes are of sewn construction. Envelopes are made from high tenacity nylon fabric and polyester load-bearing tapes.

The main heat source for balloon flight is a high-output burner fuelled by liquid propane (LPG).

The fuel is carried in liquid form under pressure in metal cylinders.

Occupants are carried in a basket of traditional wickerwork construction.

A full description of the balloons and their systems is given in Section 6.

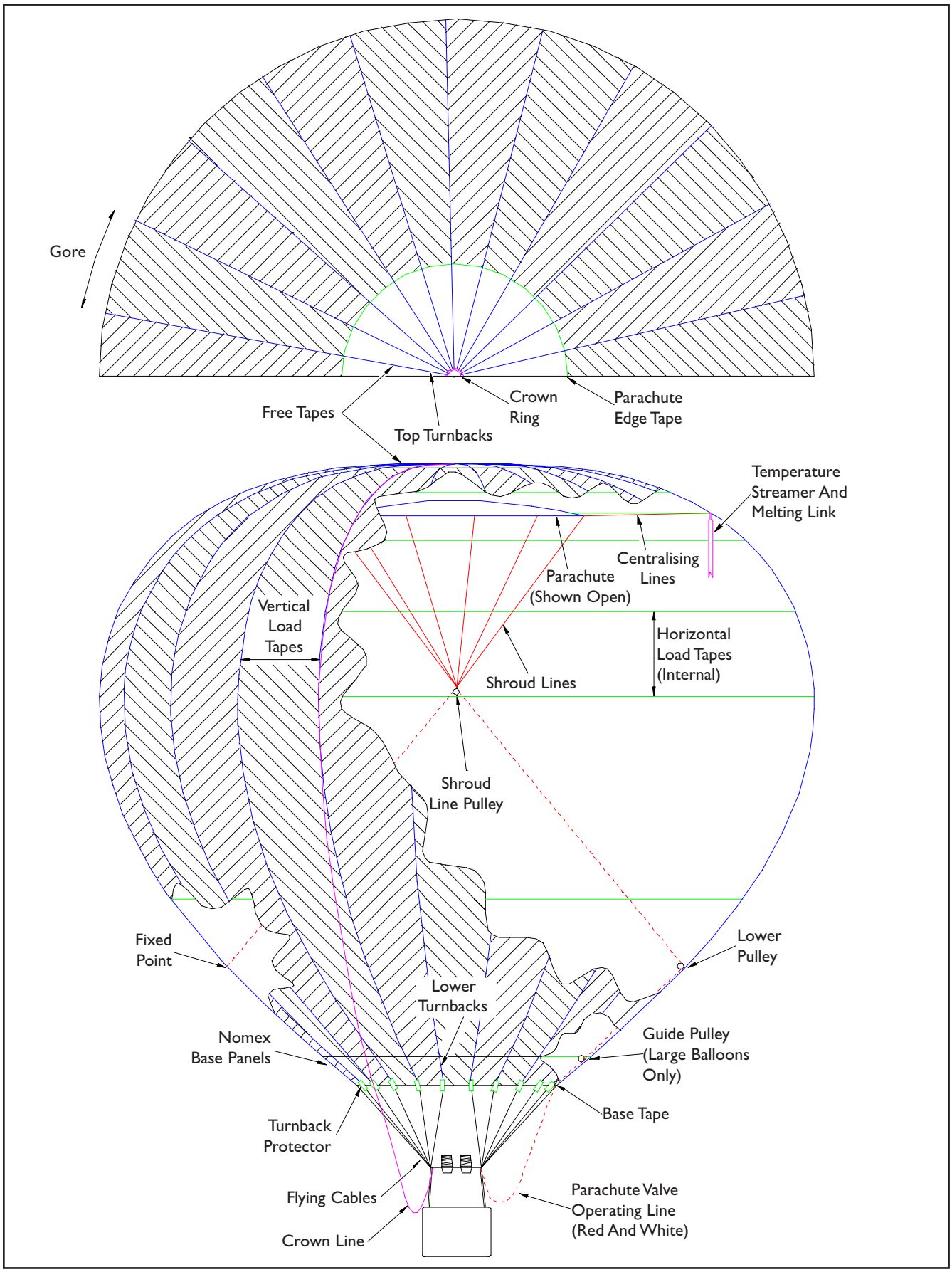
1.5 USE OF OLDER TYPES OF EQUIPMENT

Older types of baskets and burners not listed in this Flight Manual may be used with new balloon envelopes provided the appropriate Flight Manual supplement is used.

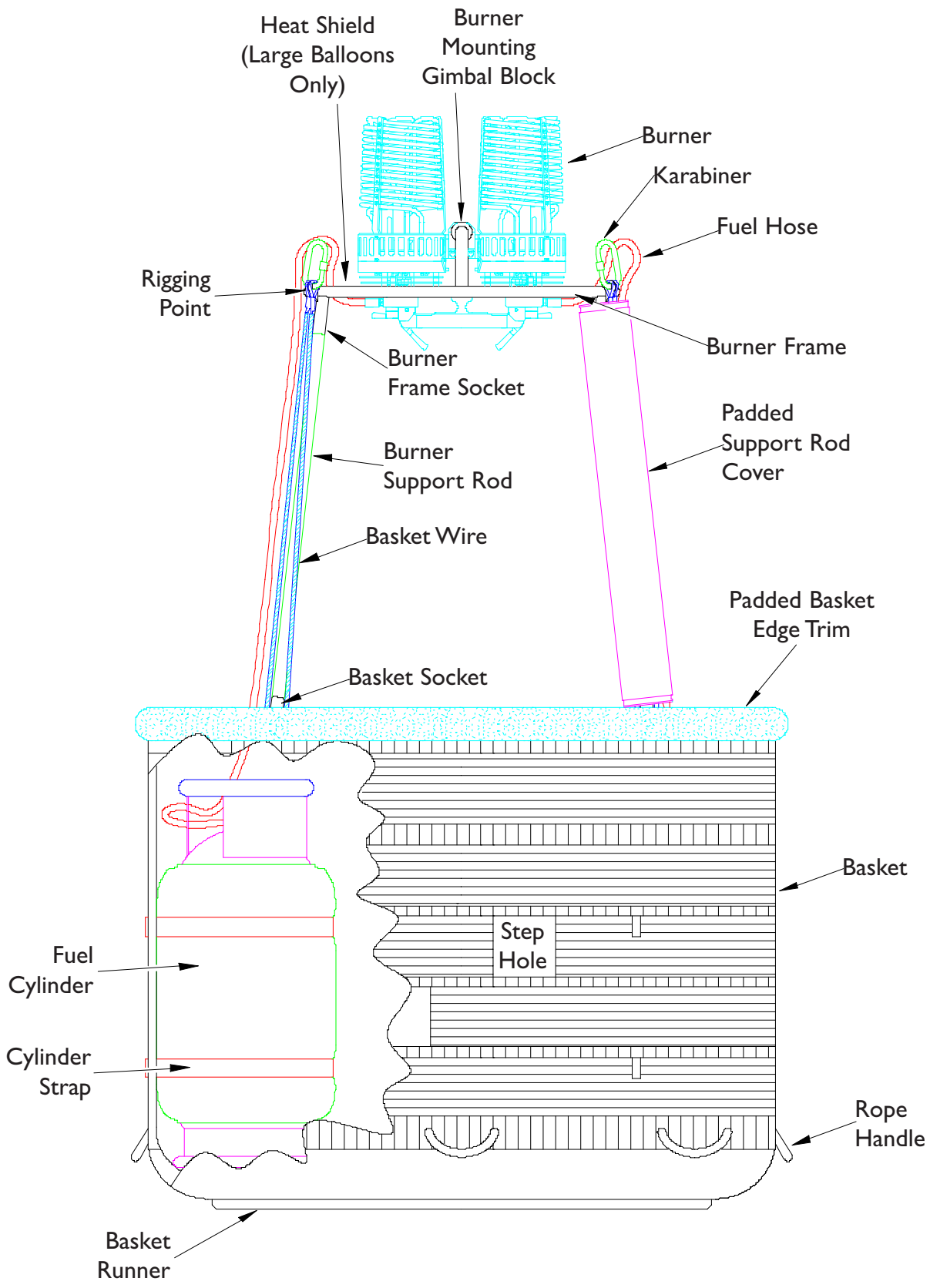
The weights of the basket and burner must be recorded in the Component Weight Record of this manual (Table 4, Section 5) and the appropriate Section of the aircraft logbook. These weights are listed in the log book of the balloon the items were originally supplied with, or determined by weighing.

The limitations and procedures given in Sections 2 to 5 of this Flight Manual and supplements apply to all Cameron burner and basket types.

The inspection schedule given in Section 6 of the Cameron Balloons Maintenance Manual Issue 10 applies to all Cameron envelope, burner, cylinder and basket types.



▲ Typical Envelope Description



Typical 'Bottom End' Description ▲

2.1 INTRODUCTION

Section 2 details the operating limitations for the balloon and its standard equipment.

The limitations included in this Section and in Section 8 have been approved by EASA.

WARNING: The balloon must not be flown into contact with powerlines.

2.2 WEATHER

1. Balloons must not be flown free in surface winds greater than 15 knots (7.7m/sec).

2. The balloon must not be flown in meteorological conditions which could give rise to erratic winds and gusts of 10 knots (5.1m/sec) above the mean wind speed.

3. The balloon must not be flown if there is extensive thermal activity or any cumulonimbus (thunderstorm) activity.

2.3 FUEL

1. The fuel pressure must never exceed the system safe working pressure of 15 bar (218psi).

2. The fuel for the burner is LPG. Propane is the preferred fuel, but some content of other hydrocarbons is permissible, provided that minimum fuel pressures are maintained throughout the flight.

3. The minimum fuel pressure is 3 bar (44psi) for balloons smaller than 340,000cu.ft (9630m^3).

   CAUTION: Care should be exercised if the fuel pressure is below 5.5bar (80psi).

4. The minimum fuel pressure is 7 bar (102psi) for balloons of 340,000cu.ft (9630m^3). and larger, unless Shadow, Sirocco or Stratus burners are used, when the minimum fuel pressure is 5.5 bar (80psi),

5. Burners must not be operated on a vapour fuel supply.

6. With the exception of single occupancy balloons, a minimum of two independent cylinders with provision to supply pilot lights (double burner) are required, three such cylinders for a triple burner, four for a quadruple burner. Extra cylinders may be used.

2.4 MINIMUM BURNER REQUIREMENTS

1. A single burner may only be used in balloons of less than 105,000cu ft (2975m^3).

2. A double burner may only be used in balloons of 56,000cu ft (1585m^3) to 210,000cu ft (5950m^3).

3. A triple burner may only be used in balloons of 140,000cu ft (3970m^3) to 315,000cu ft (8920m^3).

4. A quad burner may only be used in balloons of 180,000cu ft (5100m^3) to 600,000cu ft (16992m^3).

2.5 PERMITTED DAMAGE

1. No damage is permitted to load tapes or any load bearing part of the suspension system.

2. No damage is permitted to the burner or fuel system.

3. Damage to the fabric below the first horizontal load tape above the Nomex (Cameron) or within 4 m of the Nomex (Thunder & Colt) is limited to holes or tears smaller than 1 m (39") in any direction.

4. Damage to the fabric higher than that specified above is limited to holes or tears smaller than 12 mm (½") in any direction. The distance between two adjacent holes shall not be less than 50mm (2"). The maximum number of holes or tears permitted is 12. If there is any damage in the upper half of the envelope (defined as the area above the widest horizontal seam between two vertical load tapes), it must be repaired within 10 flying hours.

5. Any damage outside these limitations must be repaired in accordance with the instructions contained in the Maintenance Manual.

2.6 SAFETY EQUIPMENT (MINIMUM EQUIPMENT)

The following minimum equipment must be carried:

1. Protective gloves must be available to the pilot.

2. Matches or other independent means of ignition in addition to any igniters built into the burner.

3. A Halon 1211 or powder fire extinguisher of minimum size 1kg and conforming to EN3.

4. An Altimeter with an indicating range sufficient for the operation range of the balloon.

5. A rate of climb and descent indicator (variometer).

6. An envelope temperature indicator which may either be of the continuous reading type or a type which gives a warning signal.

7. Each fuel cylinder shall be fitted with a fuel quantity gauge.

8. A time piece.

All minimum equipment must be functional.

2.7 CREW

1. The minimum crew is one pilot.

2. The pilot must be suitably qualified to conduct the flight.

3. The maximum number of occupants (consisting of crew and passengers) is determined by Sections 2.8, 2.9 and 2.15 below.

2.8 ENVELOPE TEMPERATURE AND LOADING

1. The envelope temperature must not exceed 120°C, (250°F).

2. The envelope temperature must be controlled either by use of the envelope thermometer, or by loading according to the loading chart in Section 5.

2.9 WEIGHT RANGE

1. The take-off Mass (TOM) of the balloon must never exceed the Maximum TOM (MTOM) shown in table 1. The applicability of the MTOM, either Standard or Reduced is given on page i-i.

2. If it is desired, for operational or insurance reasons, to alter the MTOM of the balloon, either the Standard or Reduced MTOM, appropriate to the balloon model, may be selected. These permitted MTOM values are shown in Section 2 Table 1. The MTOM in use must be entered as an amendment on page i.i and used for loading calculations.

3. For balloons of 105,000 cu. ft(2975 m^3) and above, the Minimum Landing Mass (MLM) for normal operation must not be less than 50% of the Standard MTOM. For special flights, record attempts etc., with only necessary crew on board, lower masses may be used at the pilot's discretion.

2.10 RATES OF CLIMB AND DESCENT

1. With the exception of 'TR' Type balloons, the maximum rate of climb and descent for conventional shaped balloons smaller than 340,000 cu.ft (9630m^3) is 1000 ft/min (5 m/sec).

2. The maximum rate of climb and descent for 'TR' Type balloons is 1700 ft/min (8.5m/sec), except where the RDS is fitted, when the maximum rates of climb and descent are limited to 1000 ft/min (5 m/sec).

3. The maximum rate of climb and descent for conventional shaped balloons between 340,000 and 600,000 cu.ft is 800 ft/min (4m/sec).

2.11 PARACHUTE VALVE

1. The parachute valve must not be held open for periods longer than 3 seconds during flight. The envelope must be allowed to re-inflate fully and the envelope mouth must be seen to be fully open before subsequent operations of the vent.

2. 'TR' Type balloons must not have the parachute valve opened at rates of descent greater than 500ft/min (2.5m/sec).

2.12 RAPID DEFLATION SYSTEMS

1. The parachute valve of the rapid deflation system, when used for the controlled release of hot air during flight, must not be held open for periods longer than 3 seconds. The envelope must be allowed to re-inflate fully between operations of the vent.

2. Use of the rip line is not permitted at heights greater than 2m (6ft) above ground level, except in an emergency.

2.13 VELCRO RIP PANEL

1. Opening of the Velcro rip panel is not permitted at heights greater then 2m (6ft) above ground level, except in an emergency.

2.14 TETHERED FLIGHT

1. Balloons smaller than 340,000 cu.ft (9630m^3) must not be tethered in surface winds greater than 15 knots (7.7 m/sec).

2. Balloons of 340,000 cu.ft (9630m^3) and larger must not be tethered in surface winds greater than 10 knots (5.1 m/sec).

3. The balloon must not be tethered with passengers in surface winds greater than 10 knots (5.1m/sec).

4. When tethering with passengers the balloons Take-Off Mass is limited to 75% of the standard MTOM.

5. The maximum height for tethered flight is 30m (100ft) from the ground to the underside of the basket.

2.15 BASKETS

1. Each compartment must not contain more than six persons.

2. Reasonable space must be provided for each occupant, with regard to both comfort during the flight and to safety during the landing (Refer to Appendix 4).

3. The must be at least one restraint, e.g. hand hold, for each basket occupant.

4. Woven floor baskets must be fitted with load spreading boards when fitted with cylinders with a useable volume greater than 45 litres.

5. Where the ratio of length to width of the basket is greater than 1.4:1 the balloon must be equipped with envelope turning vents to allow the basket to be correctly orientated for landing.

2.16 CYLINDERS

1. All stainless steel, duplex stainless steel and titanium cylinders shall be equipped with an outer, water resistant protective layer at least 25mm thick made from structural cellular foam or similar material.

2. Each cylinder must be secured by a minimum of two cylinder straps. The straps must be of an approved design. Leather straps should not be used to secure cylinders with a useable volume greater than 60 litres.

2.17 ENVELOPE RIGGING

1. The following envelope types must be rigged using 4 tonne karabiners; Z-375, Z-400 and Z-450.

TABLE 1 - ENVELOPE WEIGHT LIMITS AND VOLUMES

Model		Volume		Standard MTOM		Reduced MTOM		FAI Class
		cu. ft	cu. m	kg	lb	kg	lb	AX
Z-25	25A	25000	708	227	500	227	500	4
V-31	O-31	31450	890	285	629	285	629	4
N-31	Z-31							
	31A							
V-42	O-42	42000	1190	381	840	381	840	5
N-42	Z-42							
	42A							
V-56	O-56	56000	1586	508	1120	499	1100	6
N-56	Z-56							
	56A							
TR-60	C-60	60000	1700	544	1200	499	1100	7
V-65	O-65	65000	1841	590	1300	499	1100	7
N-65	Z-65							
GP-65	65A							
	65-SI							
Z-69	69A	69000	1954	626	1380	499	1100	7
C-70	N-70	70000	1982	635	1400	499	1100	7
GP-70	TR-70							
V-77	O-77	77500	2195	703	1550	499	1100	7
N-77	Z-77							
77A	77-SI							
	C-80	80000	2266	726	1600	499	1100	8
	O-84	84000	2379	762	1680	499	1100	8
C-90	V-90	90000	2549	816	1800	499	1100	8
O-90	N-90							
Z-90	90-SII							
90-A	90-SI							
C-100	N-100	100000	2832	907	2000	907	2000	8
O-105	N-105	105000	2974	952	2100	952	2100	8
A-105	Z-105							
105-SII	105A							
	105-SI							
O-120	N-120	120000	3398	1088	2400	999	2200	9
A-120	Z-120							
120SII	120A							
	120-SI							

Note- Table 1 lists the complete range of envelopes produced by Cameron Balloons Limited.

The applicable envelope data in Table 1 corresponds to the specific envelope Type and Variant given on page i-i and in Table 4.

For details of Type Approval, reference should be made to the appropriate Type Certificate.

Table 1 - Envelope Weight Limits And Volumes (continued)

Model		Volume		Standard MTOM		Reduced MTOM		FAI Class
		cu. ft	cu. m	kg	lb	kg	lb	AX
N-133	Z-133	133000	3767	1206	2660	999	2203	9
O-140	A-140	140000	3965	1270	2800	999	2203	9
Z-140	140-SII							
140A	140-SI							
N-145	Z-145	145000	4106	1315	2900	999	2203	10
Z-150	150-SII	150000	4248	1361	3000	999	2203	10
	150A							
O-160	N-160	160000	4531	1451	3200	999	2203	10
A-160	Z-160							
160-SII	160A							
	160-SI							
N-180	A-180	180000	5098	1633	3600	999	2203	10
Z-180	180-SI							
180-SII	180A							
	A-200	200000	5664	1814	4000	999	2203	10
N-210	A-210	210000	5947	1905	4200	1905	4200	10
Z-210	210-SII							
	210A							
Z-225	225-SII	225000	6372	2041	4500	2041	4500	11
	225A							
	240A	240000	6797	2177	4800	2177	4800	11
A-250	Z-250	250000	7080	2268	5000	2268	5000	11
250-SII	250A							
	260A	260000	7363	2358	5200	2358	5200	11
A-275	Z-275	275000	7788	2494	5500	2494	5500	11
	275A							
	A-300	300000	8496	2721	6000	2699	5951	11
A-315	Z-315	315000	8920	2857	6300	2699	5951	11
	315A							
	A-340	340000	9629	2857	6300	2699	5951	12
	A-340 HL			3084	6800	2699	5951	12
Z-350	350A	350000	9912	3175	7000	2699	5951	12
A-375	Z-375	375000	10620	3401	7500	2699	5951	12
	375A							
A-400	Z-400	400000	11328	3628	8000	2699	5951	12
	400A							
	A-415	415000	11753	3764	8300	2699	5951	12
	Z-425LW	425000	12036	3662	8075	2699	5951	13
Z-450	450A	450000	12744	4082	9000	2699	5951	13
	A-530	530000	15010	4807	10600	2699	5951	13
	Z-600	600000	16992	5089	11215	5089	11215	13

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3.1 INTRODUCTION

Section 3 provides checklists and amplified procedures for coping with emergencies that may occur.

3.2 AVOIDANCE OF DANGEROUS OBSTACLES AT LOW LEVEL

The pilot must decide whether to climb or to make an emergency landing.

3.2.1 Emergency Climb

Single Burners-

Emergency climbs should be made by operating one main burner valve and one whisper burner valve. The main burner valve and whisper burner valve used must be fed from independent fuel supplies.

Double, Triple and Quad Burners-

Emergency climbs should be made by operating the main burner valve on each burner unit simultaneously.

Note- The operation of two burners from a single fuel supply using the crossflow valve will not give maximum burner power.

3.2.2 Emergency Landing

Emergency landings can be made by partially opening the parachute valve, Rapid Deflation System or Velcro rip panel at heights of 15m (50 ft) or less.

3.3 CONTACT WITH ELECTRIC POWER LINES

Contact with electric power wires is extremely dangerous and can result in serious or fatal injuries. It should be avoided at all costs.

If contact with power wires cannot be avoided, initiate a rapid descent so that contact with the wires will be made by the envelope instead of the basket assembly.

Shut off all the fuel supplies at the cylinder valves and vent the fuel hoses before contact.

If the balloon is caught in the power wires, do not touch any metallic parts.

If the basket is not in contact with the ground remain in it, if possible, until the electrical power is shut off.

If it is necessary to leave the basket, do not place the body in contact with the ground and any part of the balloon at the same time.

Do not attempt to recover the balloon until the electricity authority has been contacted, and has indicated that it is safe to do so.

3.4 FIRE - IN THE AIR

Shut off the fuel supply at the cylinder valve.

Put out fire with extinguisher.

Identify the cause of the fire and decide if it is possible to relight the burner. If not, the procedure for a hard landing (Section 3.8) must be followed.

3.5 FIRE - ON THE GROUND

Shut off the fuel supply at the cylinder valve and send all persons not directly fighting the fire to a safe distance.

Put out fire with extinguisher.

WARNING- If the fire is not extinguished immediately, ensure that all remaining persons retreat to a safe distance, as an explosion will occur if the fire continues and causes the cylinders to rupture.

If the balloon is inflated the pilot must pull the parachute operating / rip line to prevent the balloon becoming airborne while the passengers exit. The pilot should exit the balloon last with the parachute operating / rip line in hand to ensure that the balloon does not become airborne.

Note- If a dry powder fire extinguisher has been used, it is very important that all traces of the powder residue are removed from the balloon and associated equipment. The powder becomes extremely corrosive once it has been used on a fire or exposed to the atmosphere, and can cause damage.

3.6 DAMAGE TO ENVELOPE IN FLIGHT

Heat to replace lost lift while maintaining a steady rate of descent.

Remain at very low altitude and land as soon as possible.

Do not burn if the air loss from the balloon is sufficient to cause the mouth to close, as damage to suspension tapes could cause a catastrophic failure.

If the rate of descent cannot be controlled, consider jettisoning all disposable ballast, including fuel cylinders which are not in use, if it is possible to do so without endangering people or property on the ground.

3.7 ACCIDENTAL OPERATION OF THE RAPID DEFLATION SYSTEM

If the rip line is accidentally pulled in flight the vent will start to operate. The pilot will be warned by the difference in feel as the panel starts to open.

The rip line should immediately be released, and the panel closed by pulling on the venting line. The burner must be operated to replace lost heat.

WARNING- The panel will not automatically re-close on release of the rip line.

3.8 PREPARATION FOR A HARD LANDING

There are two possible hard landing situations. A burner or envelope failure results in a 'heavy' landing where the speed is mostly vertical, whereas a weather emergency may cause a 'fast' landing where the speed is mostly horizontal.

In a heavy landing the occupants should brace against vertical compression, with their knees only slightly bent. The rope handles or cylinder rims should be firmly held.

In a fast landing the basket may tip forward violently on impact, tending to throw the occupants out. The occupants should adopt a low down position (knees well bent) with their back or shoulder pressed against the leading edge of the basket, head level with the basket edge and rope handles or cylinder rims firmly held.

Remind passengers not to leave the basket until told to do so.

Extinguish the pilot light(s), shut the fuel off at all cylinders in use and empty the hoses if time permits.

The parachute operating / rip line should be firmly gripped before touchdown.

3.9 ENVELOPE OVER TEMPERATURE

Descend to the minimum practical altitude and keep to low rates of climb and descent. If the temperature remains too high, land as soon as possible.

Note- If the balloon is not overloaded for the altitude and ambient temperature it is extremely unlikely that the envelope temperature limits will be exceeded in normal flight.

3.10 BURNER FAILURE

Burner Unit Malfunction-

Transfer control to another burner unit or to the other fuel supply (single burner).

Shut off the fuel supply to the defective burner unit at the cylinder valve.

Vent fuel from the defective burner unit and supply hose.

Land as soon as possible.

Note- If the blast valve fails in the open position, its flow can be controlled by opening and closing the cylinder valve (liquid offtake).

Crossflow Valve Leak (Stealth, Shadow and Stratus burners only)-

Close the two blast valves connected by the crossflow valve.

Transfer control to the whisper burners or burners not connected by the crossflow valve. Land as soon as possible.

Note- Crossflow valve leaks are only evident with the main burner operating.

If a fuel leak cannot be controlled, shut off all fuel including the pilot light and brief passengers for a hard landing (Section 3.8).

Note- If the main fuel hoses are removed from the support rod covers they are long enough to reach fuel cylinders at the opposite end of the basket.

CAUTION- Care should be taken when operating with the fuel hoses outside of the support rod covers, as the liquid fuel pressure can cause the hose to deflect when the blast or whisper valve is operated. This may change the direction of the burner and flame.

3.11 PILOT LIGHT FAILURE

If a pilot light is extinguished for any reason, it should be relit.

Each burner unit is fitted with a pilot light, single burners having two independent pilot lights. All burners will operate with one failed pilot light. The failed pilot light should be turned off and a landing made as soon as possible.

On double burners or pairs of burners the crossflow valve, if fitted, should be opened to ensure reliable ignition of both burners from the remaining pilot light. If the pilot light fails on the single unit of a triple burner then control should be maintained on another burner.

If all pilot lights fail the following procedure should be adopted-

1. Shut off all fuel supplies at the cylinder valve.

2. Lock one whisper burner valve (Shadow, Stealth and Sirocco burners) fully open or lock one main burner valve open using the blast valve latch (Stratus Burner).

3. Partially open the fuel supply to this burner at the cylinder valve, to permit a small amount of fuel to enter the burner.

4. Light the burner with a match or other igniter.

WARNING- do not use the igniter built into the burner, as it will not ignite the fuel

5. Fully open the fuel supply to the burner, using the cylinder liquid valve to control the flight of the balloon.

6. Partially close the cylinder liquid valve to a fractional setting, regulating the burner to maintain a pilot setting.

7. Land as soon as possible.

Note- Do not leave one cylinder providing the pilot setting, with main fuel taken from another, because prolonged restricted flow of liquid will cause freezing of the valves.

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4.1 INTRODUCTION

Section 4 provides checklists and amplified procedures for the conduct of normal operation. Normal procedures associated with optional systems can be found in Section 9.

4.2 FLIGHT PLANNING AND WEATHER

Before starting to prepare the balloon for flight the pilot should consider the balloon loading, the weather and the flight area to determine their suitability for the flight.

4.2.1 Loading

The balloon should be loaded in accordance with limitations given in Sections 2.8 and 2.9. The effect of temperature on fuel pressure (Section 4.6.1) should also be considered.

4.2.2 Weather

In addition to the weather limitations in Section 2.2, the following should be considered-

Severe Weather A balloon flight should never be attempted around thunderstorm activity, ahead of approaching frontal systems or near severe weather of any kind.

Thermal Activity Balloons are significantly affected by air turbulence. Balloon flights are typically made in the first 2-3 hours after sunrise or the last 2 hours before sunset when thermal activity is at a minimum.

Sea Breezes The influence of sea breezes should be considered before flights near large bodies of water.

Wind Direction The wind direction should not carry the balloon into controlled airspace unless the class of the airspace is known and appropriate equipment is carried (e.g transponder, VHF radio), or into areas unsuitable for landing (mountains, lakes or large built-up areas) unless sufficient fuel is carried to overfly such areas safely.

The pilot should visually assess the weather both before take-off and during the flight and be prepared to modify flight plans accordingly.

Flight Planning Checks

Weather	Expected to be suitable throughout the flight.
Turbulence	Minimal expected during flight.
Wind Direction And Speed	Predicted flightpath - airspace restrictions.
Flight Duration	Passenger weight and fuel contents appropriate (see Section 5).

4.3 PREPARATION AND RIGGING

4.3.1 Site

The site should be chosen so that the downwind path that the balloon will take is clear of powerlines or high obstacles. There should be no powerlines or obstructions in any direction that the balloon could touch should it move during the inflation. The area for laying out the balloon should ideally be a smooth grass surface. Surfaces covered with rocks, sticks or other objects likely to cause fabric damage should be avoided.

The take-off point chosen for inflation should be towards the upwind side of the site and, if possible, at a point that gives some shelter from the prevailing wind.

4.3.2 Basket rigging

Unload the basket at the take-off point; place the envelope, in its bag, about 5m downwind of the basket.

A non-partitioned basket should be positioned with the step hole on the upwind side.

A T-partition basket should be positioned with the pilot compartment on the right, looking from the basket towards the envelope.

Double T-partition baskets should be positioned with either long side facing towards the envelope.

Note: The orientation of Double -T baskets should be alternated periodically to minimise any permanent distortion.

Strap the cylinders as required into the basket. Check the contents and ensure that the master cylinders (if used) are on the downwind (envelope) side of the basket.

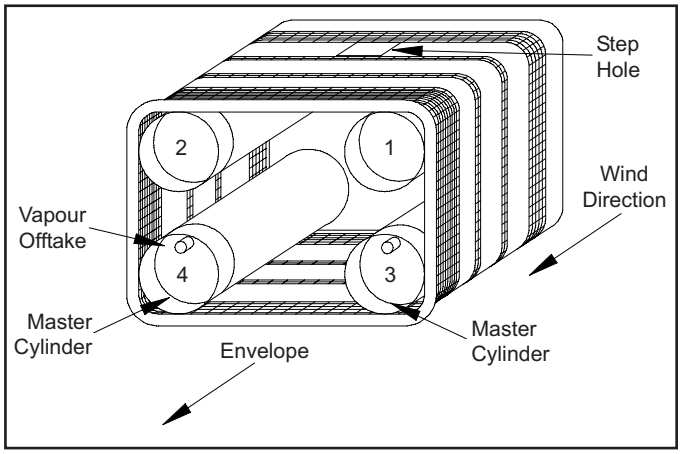
The orientation of the cylinders should ensure that:

1) Cylinders that are required to supply liquid during inflation are positioned so that the liquid valve is in the lower half of the cylinder when the basket is on its side.

2) Cylinders that are required to supply vapour during inflation are positioned so that the vapour valve is uppermost when the cylinder is on its side.

3) All cylinders should be positioned so that the liquid off-takes and hoses cannot be struck by the pilot or passengers during landing.

WARNING: Incorrect positioning of cylinders used for vapour offtake can result in pilot light failure.



▲ Correct Positioning Of Master Cylinders

4.3.3 Burner Rigging

The burner frame should be orientated so that the burner pressure gauges are legible when the basket is laid down for inflation. The burner frame is rigged to the basket using karabiners of which there are three standards detailed in Table 1. The 2.5 and 3 tonne karabiners may be regarded as direct alternatives, although the 2.5 tonne is the preferred standard as it causes less flattening of the wires due to its symmetric oval shape

Table 1. - Karabiner Specifications

Part No.	Rating	Identification Markings
CU-9820-0003	2.5 Tonne	STUBAI SYMOVAL2500 UIAA
CU-9820-0001	3 Tonne	STUBAI SYMOVAL3000 UIAA
CU-9825-0001	4 Tonne	STUBAI SYMOVAL4000 UIAA

The 2.5 Tonne karabiners are used in all basket-envelope rigging, not including tethering, except in the following applications where 4 tonne karabiners are recommended;

- where the burner frame has only 4 attachment points and the envelope volume is of 210,000 cu.ft (5947 m^3) and greater;

and,

- where the burner frame has 8 attachment points and the envelope volume is of 340,000 cu.ft (9629 m^3) or larger.

If a launch restraint is to be attached to these karabiners, it is essential that they are orientated so that restraint karabiners must load the solid, not the screwgate side of the envelope karabiners.

4.3.3.1 Flexible Corner Socket Burner Frames

Insert the support rods into the basket sockets, then lift the burner up and locate the burner frame corner sockets onto the top of the support rods.

4.3.3.2 Fixed Corner Socket Burner Frames

Insert the support rods into the burner frame corner sockets, lift up the burner and rods and locate the lower end of the rods into the basket sockets.

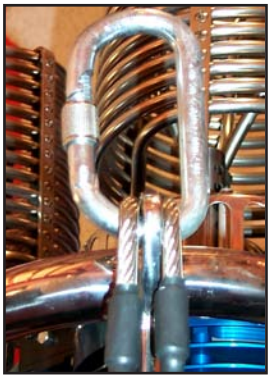
For T-partition baskets the burner is offset towards the pilot compartment.

4.3.3.3 Adjustable Height Burner Frames

Where an adjustable height burner frame is used, the gas strut must be below the burner during inflation and the burner must be in the upper half of its height range. On larger baskets the gas strut is positioned to the side of the burner, and care must be taken not to overheat the strut.

4.3.3.4 Rigging of Basket Wires to Burner Frame (All Burner Frames)

The correct attachment of the basket wires depends on the number of wires and the burner frame type.



Rigging Of Frame Type 'A'

For frame type 'A', the wires go either side of the rigging point, and a karabiner is passed through the wires and rigging point as shown.

For frame type 'B', the wire goes inside the rigging point and the karabiner is passed through the rigging point and wire as shown.

For frame type 'C', one wire goes inside the rigging point, and one wire goes on one side of the rigging point. The karabiner is passed through the rigging point and wires as shown.

For frame type 'D', each wire fits inside a rigging point. Each karabiner is passed through one rigging point and wire as shown.

Rigging Of Frame Type 'B'

Fit the padded support rod covers, enclosing the hoses within them. Start the zips at the top and close downwards. It is important that there is sufficient slack hose at the top to allow the burner to gimbal, but not so much that the hose is affected by radiant heat from the burner.

On non-partitioned baskets the liquid hoses are enclosed in the upwind support rod covers. Vapour hoses (if used) are enclosed in the downwind support rod covers.

On T-partitioned baskets all the hoses fit into the two covers at the pilot's compartment end of the basket.

Rigging Of Frame Type 'C'

When double burners are fitted to a double T-partition basket the hoses are arranged identically to the hoses in an open basket. If a triple or quad burner is fitted the hose(s) of each burner follow the adjacent rod. Double T baskets can use two additional padded covers containing only the fuel hoses, suspended from the burner frame and connected inside the pilot compartment.

Check that all burner and cylinder valves are closed and connect the fuel hoses to the cylinders. If cylinder manifolds are used they must be connected as described in Section 4.6.3.1. Fuel hoses should be filled with fuel to check that there are no leaks. The burner test may be performed now or when the balloon is inflated (see Pre-Take-off checklist). Close the cylinder valves and burn the fuel from the hoses.

Rigging Of Frame Type 'D'

Manoeuvre the basket onto its side with the burner facing the envelope.

4.3.4 Pre-Flight Check Of Suspension Wires

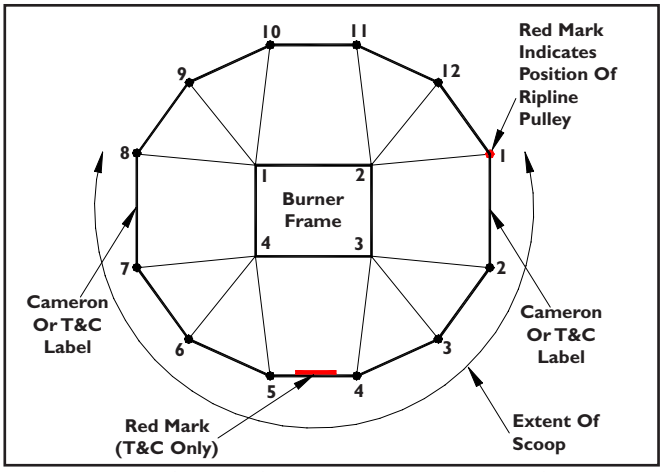
Solid floor baskets must have no damage to the rawhide wire protectors sufficient to expose the suspension wires. Check also for wire damage where the wires are visible between the protectors and the skids.

Any such damage must be inspected by a qualified inspector and repaired if necessary before flight (Maintenance Manual Section 6.17.4).

4.3.5 Envelope Preparation

Pull the base of the envelope out of the bag, and connect the appropriate flying cables to each karabiner on the burner frame (see diagrams). Take care that cables are not crossed and that the scoop is outside all of the cables.

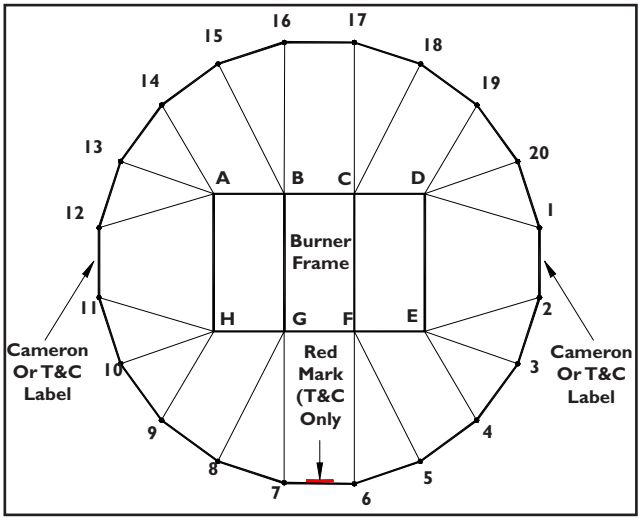
Where 8, 12, 16 and 32 envelope flying cables are fitted, they should be distributed evenly amongst the attachment points. Envelopes with 20 cables are rigged as shown except when using a four rod, eight karabiner system were the inner and outer corners are combined (A to B, C to D, E to F and G to H)



▲ Flying Cable Connections Viewed from the 4 Rod Basket (12 Cable Rigging Shown)

Where an envelope with 24 cables is rigged to an 8 rod basket, the balloon is rigged as shown for 20 cable rigging, with the extra 4 flying cables attached to the burner frame at rigging points B,C,F and G. Where a similar envelope is rigged to a 4 rod basket, the flying cables will be collected together either using 'V' wires or forged rings. The balloon can then be rigged as shown for 12 cable rigging.

Where an envelope is equipped with 28 cables, the balloon is rigged as for 20 cable rigging but with one additional cable added to each rigging point of the burner frame.



▲ Flying Cable Connections Viewed From The Basket (20 Cable, 8 Rod Rigging Shown)

Envelope cables may be left permanently attached to a second set of karabiners, which are connected to the burner frame karabiners during rigging. This arrangement causes a 90° twist, which can be avoided by connecting a forged tether ring between the karabiners.

Close all karabiner screwgates and connect the control lines to the appropriate points on the burner frame or basket.

The parachute operating line should be attached to either of the karabiners on the pilot's right or inside the pilot compartment of partitioned baskets.

Connect the launch restraint e.g. Bonanno Quick Release (Section 4.5.3).

Pull the envelope from the carrying bag by taking hold of the bag handles and walking away down-wind. Stow the envelope bag in the basket or attach it to a support rod taking care not to trap any of the fuel hoses.

4.3.6 Pre-flight check Of Kevlar flying cables

Prior to each inflation each Kevlar flying cable (if fitted) must be inspected.

The cables must be replaced if the creamy yellow core is exposed or damaged, or if the flexibility of the polyester cover is noticeably reduced.

Any cable that is damaged during the inflation must be replaced before take-off. Instructions for replacing Kevlar cables are given in the Maintenance Manual, Section 2.7.2.

4.3.7 Preparation Of Lock-Top, Velcro Rip Panel And Rapid Deflation System

Preparation and use of the Lock-Top, Velcro Rip Panel and Rapid Deflation System are described in Sections 4.8 to 4.10 respectively.

4.4 INFLATION

4.4.1 Cold Inflation

The crew members should be briefed before the inflation procedure is started. Passengers may be briefed either before inflation begins, or once they are in the basket after inflation. Passengers should be shown how to correctly get into the basket before inflation starts.

CAUTION- The most important instruction for all crew members is to let go immediately if they are lifted off the ground.

Two crew members should be used to control the mouth during the inflation.

Mouth Crew Briefing

1. Clothing of natural or heat-resisting fibre should be worn. Ensure that arms and legs are covered, and that leather or fire-resistant gloves are worn.

2. One crew member should control the fan. The airflow should be directed towards the centre of the mouth as the balloon is inflated. On receiving the pilot's signal the fan should be turned off and moved clear of the basket.

3. Hold the mouth of the envelope so that the Nomex base panels give the crew member protection from the heat of the flame. The crew should keep the mouth opening as near circular as possible and to keep the flying cables taut to avoid them hanging in the burner flame. This should be done without stepping inside any of the flying cables. The crew member on the pilot's right hand side may need to hold the control lines to prevent them hanging in the burner flame.

4. As the envelope fills with hot air the mouth will rise, and it will be necessary to change grip around the mouth towards the bottom edge. Do not hold on by the scoop, but as the envelope finally rises catch the scoop attachment hooks and clip them onto the karabiners.

One strong person is sufficient for the crown line of a balloon of 90,000cu ft (2550m³) or less in good conditions. More may be required for larger balloons. It is important for a safe, smooth inflation that the crown crew is well briefed and understands the job.

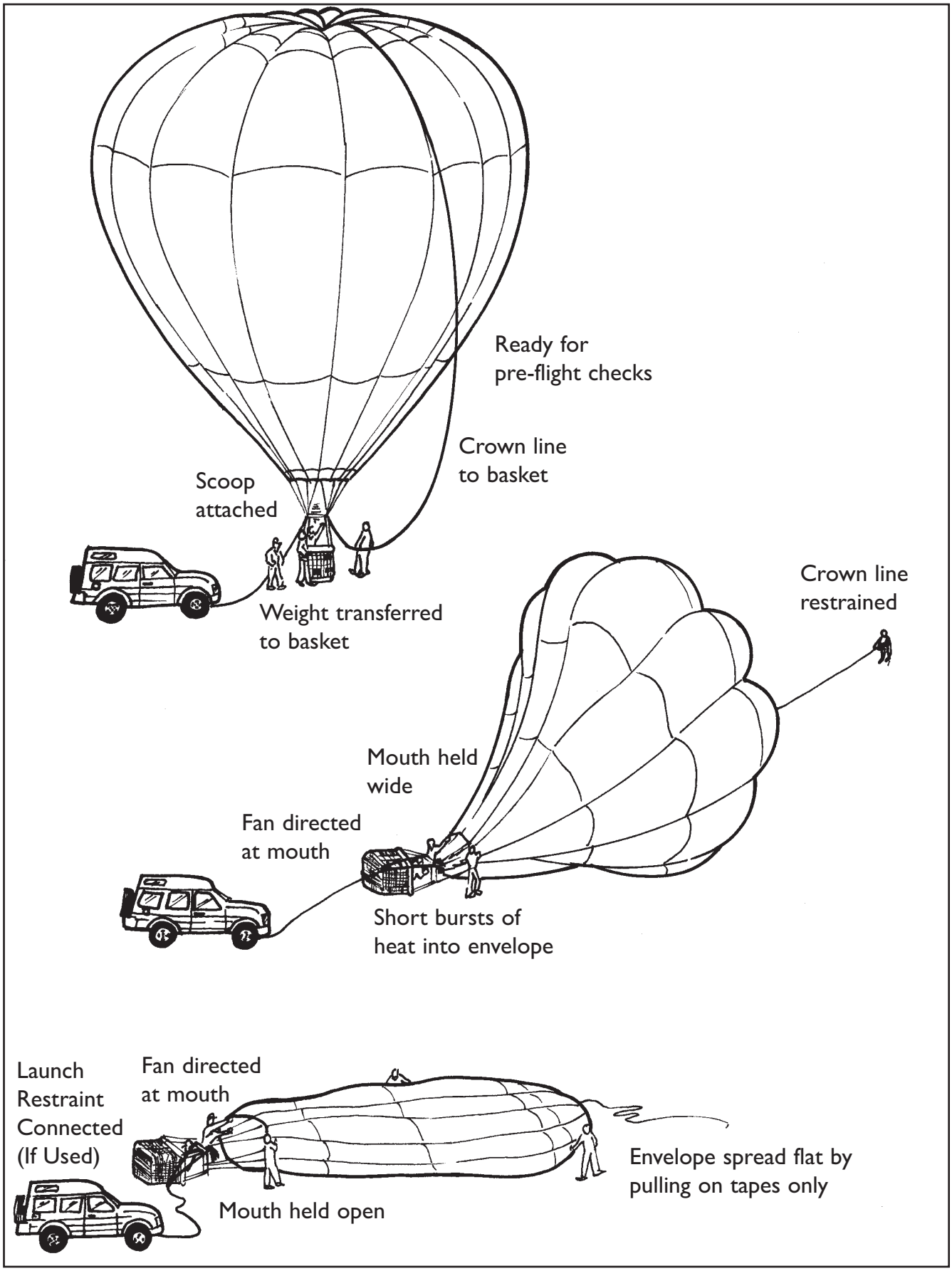
Crown Crew Briefing

1. Strong gloves and footwear should be worn.
2. Refuse all offers of help pulling on the crown line from onlookers.
3. Inform the pilot if anything looks unusual at the top of the envelope.
4. Always stay at the end of the line - do not attempt to feed out the line.
5. Do not loop or tie the crown line around your body, your arm or any object.
6. The object is to prevent the envelope from swaying excessively, and to prevent it rising until it is full and sufficiently buoyant. Apply only moderate tension on the crown line until the parachute panel is seen to be pressing against the crown tapes, then apply maximum force until the balloon is upright. Do not try to fight the wind, but keep the envelope downwind wherever possible.
7. On the pilot's instruction clip the end of the line to a karabiner on the burner frame.

Any additional crew should be briefed to hold the basket down as the balloon comes upright. This is particularly useful on larger balloons.

Pre-Inflation Checks

Rigging	Basket and envelope cables correctly attached and checked for damage. Karabiner screwgates closed. Control lines attached. Kevlar flying cables checked (Section 4.3.6).
Fuel	Cylinders securely strapped in the appropriate positions. Contents checked. Hose connections tight.
Weather	Suitable for flight.
Instruments	Switched on. Set.
Launch Restraint	Connected to fixed point.
Ground Crew	Briefed. Gloves issued. Keys in retrieve vehicle.



▲ Inflation Procedure

With the crew in position, start the inflator fan and set it at part-throttle to introduce enough air into the envelope to free the parachute and parachute operating line.

Untangle the control lines and feed any slack into the mouth of the balloon. Additional control lines should be attached to any suitable karabiner or to the attachment points provided in the pilot compartment of partitioned baskets.

If the parachute has become tangled-

Follow two adjacent shroud lines from the envelope to the parachute, then work around the edge of the parachute untangling the lines.

Tab the parachute valve into position, matching the numbers or colours near the Velcro tabs on the parachute and envelope. Make sure that there are no folds of fabric lying on the parachute operating line which could open the parachute during the inflation.

Complete the cold inflation with an appropriate fan throttle setting (normally full throttle).

4.4.2 Hot Inflation

When the envelope is fully inflated with cold air, check that all the crew are ready and warn them that hot inflation is about to begin. Take up position behind the burner and check that all the burner valves are closed. Only one burner should be used for inflation and only one liquid fuel supply should be switched on.

When vapour pilot lights are fitted, the master cylinders supplying vapour should not be used for inflation. This allows these cylinders to be correctly aligned for vapour supply during inflation.

Open the cylinder valve at the cylinder to be used for inflation, and check that there are no fuel leaks at the cylinder and burner. Turn on the pilot light fuel supply and ignite the pilot light.

Handwheel type cylinder valves supplying liquid propane should be opened by 1½ - 2 turns in order to ensure full fuel flow to the burner. Quick shut off valves should be opened fully. Vapour supply valves need only be opened by half a turn.

Ensure that the mouth crew are holding the mouth wide open, and that all the flying cables are out of the way of the flame. Aim the burner at the lower half of the opening and give a short burst of flame. Continue, always with short bursts, and the balloon will slowly fill.

As the lift in the balloon increases it will start to rise. If the balloon is allowed to rise too rapidly the momentum of the rising balloon may lift the basket temporarily off the ground. Never allow too many people on the crown line as this would allow excessive lift to build up, and could lead to the basket leaving the ground in an uncontrolled manner.

As the balloon rises to the vertical position, step backwards into the basket, and continue heating to fully inflate the balloon.

While completing the inflation, the additional fuel systems may be turned on and additional burners checked (see Pre-Take-off checklist).

Check the parachute function by pulling on the parachute operating line until the Velcro untabs. Release the line and check the appearance of the panel after it has closed.

The passengers should now be loaded. The pilot should ensure that they have sufficient space, and that each passenger has a handhold available. Normal clothing for the prevailing weather is suitable for ballooning. Flat-soled shoes should be worn.

When passengers are aboard, they should be briefed.

Passenger Briefing - Open Baskets

1. Do not hold on to hoses, valves or control lines.

2. Hold on to rope handles, cylinder rims or (except when landing) burner support rods.

3. Before landing, stow all loose items, cameras etc.

4. On landing stand sideways to the direction of travel, at the front edge of the basket. Knees should be together and slightly bent. Hands must remain inside the basket. Hold on to rope handles or cylinder rims. Watch the progress of the landing and brace for the touchdown. After touchdown the basket may fall on its side and drag along the ground.

5. After landing do not leave the basket without the pilot's permission.

Passenger Briefing - Partitioned Baskets

1. Do not hold on to hoses, valves or control lines.

2. Hold on to rope handles or (except when landing) burner support rods.

3. Before landing, stow all loose items, cameras etc.

4. On landing face away from the direction of travel. Knees should be together and slightly bent. Push backwards against the leading edge of the passenger compartment. Hold on to the rope handles in front of you with both hands. After touchdown the basket may fall on its side and drag along the ground.

5. After landing do not leave the basket without the pilot's permission.

The passenger's landing position may be rehearsed before take-off to ensure that they are taking up the correct position. It is important that the passenger's knees are only slightly bent, and that they are not squatting or sitting on their heels.

4.5 TAKE-OFF

Pre-Take-Off Checks

Envelope	General condition - free of damage, other than permitted base damage - load tapes free of damage without sign of undue strain - flying cables correctly connected - karabiner screwgates closed and karabiners loaded lengthwise. Parachute valve - test operation - appearance normal - operating line attached to load frame -Lock-Top/Rapid Deflation System - tested and functioning correctly.
Pilot Lights	Burning satisfactorily, normal appearance and sound. No freezing at cylinder vapour offtake and vapour valve open (vapour pilot light only).
Burner Test	Note pressure from cylinder in use and consider the effect on balloon performance. Test also the additional fuel systems and burners. All fuel cylinders should be connected and tested, to ensure adequate fuel pressure and uncontaminated fuel delivery.
Fuel	Contents of all cylinders checked. Remember which cylinder is in use.
Equipment	Matches, or strikers; maps, with up-to-date information on airspace restrictions and sensitive areas - instruments and radio (if used), switched on and set - envelope bag attached to basket.
Loading	Passengers aboard and briefed. Weight calculations checked (or monitor envelope temperature as lift builds up to take-off).
Pilot Restraint	Belt worn and strap connected (if used).

4.5.1 Take-Off- Calm Conditions

take-off by building up lift with intermittent burning, all crew standing clear of the basket. The balloon will lift off and burning can stop a short distance above the ground.

Be ready to burn again at the top of the climb to prevent a descent.

4.5.2 Take-Off- Windy Conditions, Sheltered Site

An apparent loss of lift can occur as the balloon first encounters faster moving air just above the surface during windy conditions. When the balloon is static on the ground, the faster moving air above it creates an area of low pressure which creates lift in the same way as an aeroplane wing.

As the balloon takes-off, this effect diminishes causing the balloon to descend unless more heat is added. The burner flame will also be deflected which may prevent heating to replace the lost lift.

In windy conditions build up excess lift before leaving the ground either by using crew in a 'hands on' and 'hands off' drill, or a restraining device. Burn while ascending and use the angle control on the burner to counteract the deflection of the flame by the wind. The balloon should be launched with the open side of the scoop (if fitted) facing upwind.

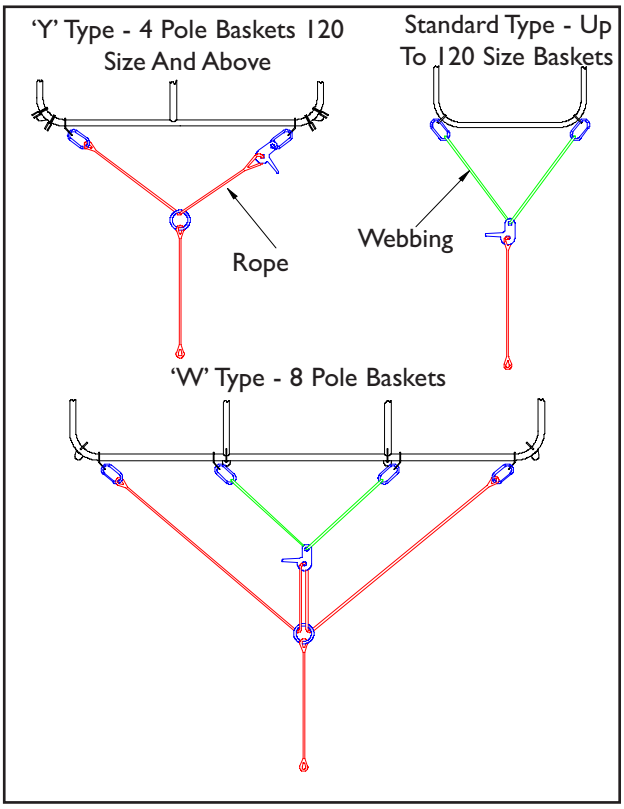
4.5.3 Bonanno Quick Release

The ends of the webbing yoke should be connected to the restraint lugs on the upwind side of the burner frame. If restraint lugs are not fitted, the yoke should be connected to the two uppermost karabiners during inflation. A short tether line is best for maximum control, and is looped through the jaws of the latch.

When take-off is imminent, the securing pin is withdrawn ready for the final release. The final release should be performed by the pilot. The latch should be held firmly by the handle, and the pilot should be ready to prevent the latch from recoiling or falling towards the occupants of the basket. For this reason, the final release should be made when the quick release is as lightly loaded as possible.

If the basket is fitted with strong points (Modification C438), the balloon may be restrained from these points using the quick release in the 'Y' configuration.

WARNING - To prevent unintentional entanglement, If the basket is fitted with strong points on both sides it is important that no rigging is left attached to the strong points on the upwind side of the basket when they are not in use.



▲ Quick Release Systems

4.6 CONTROL IN FLIGHT

4.6.1 Burner Control

The flight path of the balloon is controlled by the use of the burner, which is either full on or full off. When the atmosphere is stable and the pilot is sufficiently practiced, the height can be controlled to an accuracy of a few centimetres.

The characteristics of the balloon will vary with temperature and loading. As the take-off mass of the balloon increases, more burning will be required to maintain level flight. Temperature affects the burner power by its effect on fuel pressure. At low ambient temperatures the vapour pressure of propane falls, significantly reducing burner power.

In winter conditions the low ambient temperatures allow the balloon to be loaded to near its maximum weight, while fuel pressures may fall to the minimum permitted for flight. In such conditions it may take much longer than usual to stop a descent.

4.6.2 Parachute Valve

The parachute valve, whether fitted as the only means of deflation or as part of a rapid deflation system, provides a very powerful means of reducing lift, and care must be taken to avoid unintentional descents.

When using large amounts of parachute opening in flight, always watch the envelope to observe the amount of deflation occurring. Parachute opening in flight must not exceed the limitations in Section 2.11.

Under very lightly loaded conditions it is possible that the parachute will not reclose automatically, but it will do so if the burner is operated - this requires a visual check.

Additionally, where turning vents are fitted it is possible to vent hot air by simultaneous operation of both the turning vents.

4.6.3 Fuel Management

In flight one fuel cylinder is connected to each burner fuel supply. Two cylinders will be connected for a single or a double burner, three cylinders for a triple burner and four cylinders for a quad. These cylinders should be tested immediately before take-off and remain turned on during flight.

Note- Tema 3810 connectors have a latching locking ring below the main release ring. When the locking ring is 'up' (towards the connection), the main release ring cannot be operated to release or make the connection.

One fuel supply should be used preferentially during flight to ensure that two fuel systems are never exhausted simultaneously.

Master cylinders (if a vapour pilot light is fitted) should normally be used last. Occasionally, in very cold conditions, or where a long flight is planned the master cylinders should be used first, as the withdrawal of vapour to fuel the pilot lights reduces cylinder pressure over time. Sufficient fuel should be left in the cylinder to fuel the pilot lights- 3% of cylinder contents per hour of flight is sufficient to fuel a vapour pilot light.

The last cylinder available to each fuel supply must not be used to below 25% full. This ensures that multiple fuel supplies remain at all times and that full burner power is available in an emergency.

The recommended fuel pressure range for all burners is 3 to 10 Bar (44 to 145 psi), which is indicated by the green range on the burner pressure gauge.

CAUTION- The main burners are designed to operate on liquid propane. If they are operated on propane vapour the burner will overheat and may be permanently damaged.

Causes of the burner receiving vapour are-

Inflating from a fuel cylinder which is only partially full;

Inflating with the fuel cylinder incorrectly positioned in the basket;

Inflating with the basket facing down hill;

Operating a burner on an empty cylinder.

When a burner is operated on vapour, the flame becomes shorter, the sound changes and the indicated fuel pressure on the burner gauge falls.

If it is desired to burn as much fuel as possible from a cylinder, then the last 5% of the contents should be burned with the whisper burner, where the liquid fuel can be clearly seen emerging from the whisper jet. Once liquid fuel stops emerging, discontinue the use of that cylinder as the vapour flame will not provide sufficient heat to maintain height.

Cylinder Change Procedure

1. Check function of an alternative burner or fuel supply.
2. Check safe flight path.
3. Shut off the empty cylinder at the cylinder valve.
4. Operate the burner valve to empty the fuel hose.
5. Disconnect the fuel hose from the empty cylinder and reconnect to a full cylinder.
6. Check secure connection.
7. Open the full cylinder, relight the pilot light if necessary.
8. Check function of burner.

4.6.3.1 Use Of cylinder manifolds

WARNING – Only manifolds supplied by Cameron Balloons Ltd. may be used.

Cylinder manifolds may be used to connect several fuel cylinders to one burner fuel supply.

The manifold must not be used to connect two or more burner fuel supplies together as this will reduce the number of independent fuel supplies to the burner and make any fuel system failure more serious.

A manifold must not be used in such a way as to leave a bare cylinder connector (e.g. only two cylinders on a three-cylinder manifold).

Only one cylinder at a time should be open to each burner. This simplifies fuel management and enables fuel to be turned off more quickly in the event of a fire. Having more than one cylinder open on a manifold may also result in fuel flowing between cylinders. This may leave one cylinder with insufficient vapour space to cope with fuel expansion at the end of a flight.

Fuel manifolds do not eliminate the need for careful fuel management. The pilot must remain aware of which cylinder is in use and of the overall fuel situation.

4.6.4 Climbing

A climb is initiated by burning more than is required for level flight.

During rapid climbs a crosswind will be felt at the basket due to the airflow passing around the balloon. Care should be taken to not overheat the envelope.

4.6.5 Descending

A descent is initiated by burning less than is required for level flight.

Rapid descents from high altitude may be made without burning (a cold descent). The rate of descent will vary with loading and atmospheric conditions. The balloon may swing or rotate a little and light buffeting may be experienced. If the mouth of the envelope shows any tendency to close a short burn should be made, sufficient to reopen it.

Recovery from cold descents should be initiated at least 2000ft, (600m) above the ground and should be achieved with a number of short burns rather than a single long burn, which could overheat the balloon.

4.6.6 Flight At Higher Altitudes

When flights are being made to a considerable altitude (greater than 3000ft [900m] above take-off level) the weight calculations should be rechecked in the light of the actual temperature encountered at altitude. It is therefore necessary to have a loading chart, an altimeter and a thermometer in the basket.

Alternatively, if an envelope temperature gauge is fitted, it may be used to monitor envelope temperature during the climb.

Oxygen should be carried for flights above 10,000ft (3000m).

4.6.7 Gusts And Crosswinds

When wind is felt in flight it means that the balloon has entered an airflow of a new speed or direction. This relative wind will act on the balloon until it has taken up the velocity of the new airflow. Gusts tend to cause the balloon to lose lift by forcing some of the hot air out of the envelope and prevent its replacement by diverting the heat of the flame. When a gust is experienced, the burner should be operated immediately, angling the burner to counteract the deflection of the flame by the wind.

Gusts and crosswinds are to be expected during thermic conditions, after take-off from shelter and near ground features such as hills, woods or buildings.

4.6.8 Flight in Thermic Conditions

Thermic conditions make control of the balloon difficult and they should be avoided. Thermals have a rising core of warm air surrounded by a mass of sinking air which produces strong horizontal gusts. Thermal activity will cause the balloon to change course and altitude unpredictably.

When flying in thermic conditions the balloon should be kept a minimum of 500ft AGL (150m) except when landing. Landing approaches should be made with great care and must not bring the balloon near power wires or other obstacles.

Flight near to cumulonimbus or thunderstorm clouds must be rigorously avoided. Although cumulonimbus clouds often generate areas which are deceptively calm at ground level, the clouds may contain turbulence sufficient to destroy the balloon or to carry the balloon to such altitudes that the occupants die of oxygen starvation or exposure.

4.7 LANDING

Pre-Landing Checks

Powerlines	Well clear of approach path and overshoot.
Passenger Briefing	Silence during landing. Repeat landing part of passenger briefing.
Pilot Restraint	Belt worn and strap connected (if used).
Fuel	Enough fuel in cylinder(s) in use for landing and overshoot.
Loose Items	Instruments, cameras, radios, etc., securely stowed.
Rip line	Parachute operating line or rip line in hand during approach.
Arming Line	Pulled and indicator flag visible (Lock Top only).
Venting Line	Available and free to pull out of bag (Rapid Deflation System only).
Liquid Fuel Supply	Check contents of cylinders in use.
Pilot Lights	Should be turned off when the pilot is satisfied that no further burner operation will be required.

4.7.1 Approach to Land

For landing, a field must be chosen in the line of flight, containing a sufficiently large clear area in which to land the balloon. The intended landing area should be free of animals, crops, telephone wires and power cables, and there should be no high obstacles in the approach or overshoot. A larger landing area will be needed in stronger winds.

4.7.2 Touchdown

The balloon is flown towards the selected landing field using the burner and venting to control the rate of descent. Plenty of clearance should be allowed when flying over obstacles. As the ground is approached a final burn is made to slow the descent. If the wind speed is high, or the landing field poses a fire risk, the pilot lights should be turned off immediately prior to touch-down and the main fuel supply turned off, if time allows. On all landings, as soon as the pilot decides that no further burner operation is required, the pilot lights and all fuel supplies should be shut off and the lines vented.

The parachute should be opened immediately prior to touchdown. If winds are light and it is intended to keep the balloon upright then the parachute operating line may be released once the balloon is stationary. In stronger winds the parachute operating line should be pulled and held in order to deflate the balloon completely.

4.7.3 Landing Large Balloons - Use of turning vents

Large balloons, especially those using partitioned baskets, require particular care in landing. The size and shape of the basket makes it unsafe to touch down on a corner or short end in any appreciable wind. This can be prevented by the use of turning vents to correctly orientate the basket during the approach to land.

Pulling on the green line will rotate the balloon to the pilot's right. Pulling on the black line will rotate the balloon to the pilot's left.

4.7.4 Action after Landing

Turn off and empty any fuel hoses not already shut down and switch off instruments.

Empty the envelope of air by folding it into a long line, starting from the base and kneeling on it to expel the air towards the crown. On wet or dirty ground a cleaner but less effective method is to stand astride the envelope at the Nomex base panels and gather it in the arms, then walk to the crown squeezing with the arms and legs.

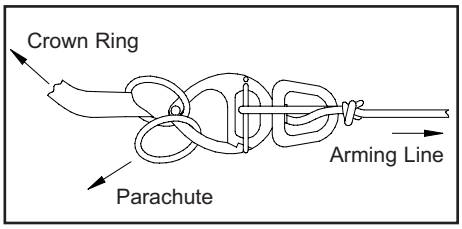
Pack the envelope into the bag starting at the crown. Do not detach the envelope from the burner frame until at least half of it is in the bag.

Enter the flight in the aircraft's and pilot's logbooks.

4.8 LOCK-TOP

4.8.1 Preparation of the Envelope

Tab the parachute panel into position (Section 4.4.1) Pull the quick release shackle up to the crown ring (it will be found adjacent to the guide ring 1.5m (5ft) from the crown ring on load tape no.1). Join the stainless steel rings attached to the parachute panel (at the edge of the crown patch) and the crown ring together with the shackle as shown.



▲ Release Shackle Assembly

Attach the end of the arming line (yellow and black spiral) to the burner frame. Follow up the arming line to the lower tie-off point inside the envelope and secure it in position using the Velcro tab.

4.8.2 Pre-Take-Off checks

Check the operation of the parachute valve. Check that the arming line is attached to the load frame, that the tie-off is not broken and that the lock-top indicator flag is not hanging inside the envelope (it can normally be seen sitting on top of the parachute panel).

4.8.3 Landing

Landing a balloon with a Lock-top is similar to landing a balloon fitted with a conventional parachute valve, but the system must be armed prior to touchdown. The arming line, which unlocks the parachute from the crown ring, should only be pulled when a final landing is imminent.

The indicator flag becomes visible inside the envelope when the system is armed.

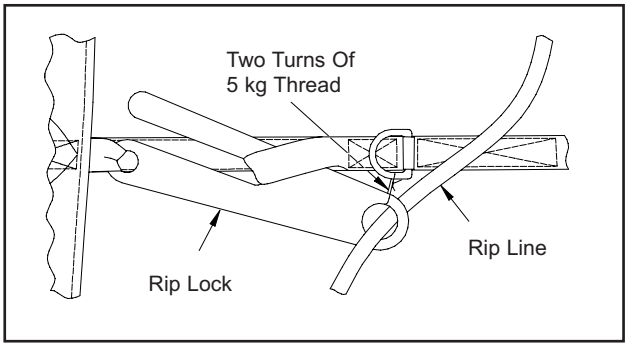
WARNING- In the unlocked state an extended pull on the parachute operating line beyond the limits in Section 2.11 may cause the parachute to 'stall'. The parachute will then not re-close.

Note- When the take-off mass of the balloon exceeds half of the standard MTOM, it is no longer necessary to arm the vent prior to use. It is therefore not necessary to rig the arming line after the parachute has been tabbed into place. Great care must be taken however not to stall the parachute when the arming line is not used.

4.9 VELCRO RIP PANEL

4.9.1 Preparation Of The Envelope

The panel needs to be carefully closed before inflating the envelope. The strength of the seal is very dependent on how firmly the Velcro is pressed together, so the seal must be well pressed down. It is also very important to ensure the Velcro is dry and free from grass etc.



▲ Riplock Rigging

To close the panel the ends of each straight Section should be correctly aligned and the Section pulled taut from each end, allowing the seal to be closed neatly.

This procedure should be repeated for each Section of the panel edge.

Nylon thread or knitting wool of about 5kg (10lb) strength should be used to fasten the breaking points.

The rip locks should be tied off after the velcro panel has been sealed closed. Open a 60cm (2ft) length of Velcro starting about 30cm (1ft) from the lock. This allows easy access to tie off the rip locks from outside the balloon. Using two turns of thread closely tie the rip lock hooks to the adjacent D-rings.

It is necessary to enter the bottom of the balloon to tie off off the lower Section of rip line to the bottom pulley. The steel ring at the top of the lower Section of the rip line should be tied off to the becket of the lower pulley either by using the Velcro tie off, or four turns of thread as above.

Be sure to pull enough slack red rip line into the top of the envelope to prevent the weight of the line opening the end rip lock during inflation.

4.9.2 Pre-Take-Off checks

Care must be taken to ensure that the rip line has not passed inside the slot of any of the rip lock hooks, and this should be rechecked from the basket before flight.

Note- For combination rip Velcro parachute valves, the Velcro rip should be secured as above and the parachute then prepared as Section 4.4.1. It is particularly important to ensure the rip locks are properly secured, as use of the parachute could open the Velcro rip panel if they are not.

4.10 RAPID DEFLATION SYSTEM (RDS)

4.10.1 Preparation of the Envelope

Attach the rip line (red rope) to the burner frame and the venting line (red and white rope) to the ring on the Rapid Deflation System bag installed in the basket.

Tab the parachute panel into position. Care should be taken to ensure that no lines are wrapped around the Velcro tabs, crown line, or any of the rings or pulleys.

4.10.2 Pre-Take-Off Checks

Test the venting action of the system and ensure that all the Velcro tabs are detached.

Ensure that the balloon is hot and then test the deflation action of the system. Pull on the rip line to collapse the parachute into the centre of the balloon. As soon as the parachute has collapsed, pull on the venting line to re-inflate the parachute panel. A second operation of the venting line may be needed to obtain a good seal.

The excess venting line should be placed loosely into the top of the Rapid Deflation System bag to prevent any possibility of it becoming entangled.

4.10.3 In-Flight Release of Hot Air

To release hot air during flight the venting line should be pulled. Venting should not exceed the limitations in Section 2.12.

4.10.4 Landing and Final Deflation

The rip line may be pulled immediately before touchdown. For final deflation the panel should be pulled fully open. If the balloon is to be kept inflated, the panel may be opened and then closed by pulling on the venting line once sufficient air has been released.

In light winds it is possible to deflate the balloon by using the venting action, however deflation will be slower than with a conventional parachute.

4.11 PILOT RESTRAINT HARNESS

The pilot restraint harness (if required) should be worn during any period of low level flight and may be worn throughout the flight.

The harness is a simple waist belt fitted with either a parachute buckle or a seat belt type buckle - either of which will allow rapid release in an emergency. A strap of adjustable length is clipped between a metal D-ring on the belt and an anchor point fitted on or near the floor of the basket.

A pouch is fitted to the wall of the basket to store the belt and strap when not in use.

During the landing approach the pilot should take up a secure landing position in the basket, then tighten the strap by pulling on the sewn handle. It is vital that the strap is pulled sufficiently short to prevent the pilot from falling over the side of the basket.

The pilot restraint harness should be used in addition to, not instead of, good pilot positioning and holding on to handles or cylinder rims during the landing.

4.12 TETHER OPERATION

See Section 2.14 for limitations.

4.12.1 Site

Tethering requires an open site free from overhead wires or nearby obstacles. It must be sufficiently large to allow the inflation of the balloon and the installation of the tether lines. The site must also have some provision for crowd control. The area downwind of the site should also be free from obstacles, in case the balloon breaks free of the tether and goes into free flight.

4.12.2 Rigging

The most suitable arrangement of tether lines is a low tripod arrangement with the balloon at its apex. If higher tethers are required then the dimensions of the tripod base should be increased in order to keep the angle of the ropes to the ground the same as with a low tether. As the wind speed increases the tripod should be made flatter either by increasing the distances between the tether points or by decreasing the rope length.

Ropes used for tethering should have a minimum strength of 4000kg (8800lb), and should be inspected before each flight. Where karabiners are required in the tether system (not the balloon rigging), 5000kg (11000lb) karabiners must be used.

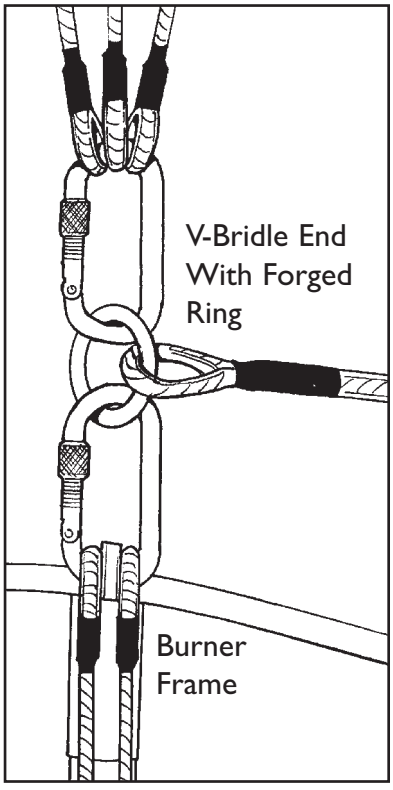
Anchors for tether points should be capable of withstanding a 4000kg (8800lb) loading.

Two tether ropes should be deployed upwind to provide the main resistance to movement. The angle between them should be between 60° and 120°.

Forged tether rings must be used to attach the V-bridles to the balloon. Burner frame restraint lugs must not be used.

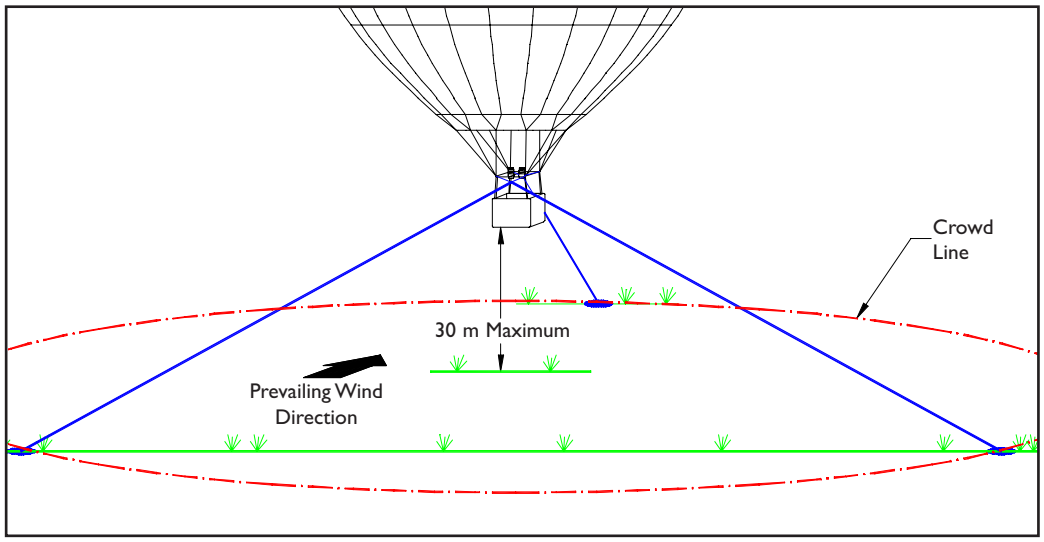
The ropes should be attached to a V-bridle connected to two forged tether rings on the side of the load frame opposite the scoop. A third rope should be attached to a V-bridle connected to the two tether rings on the downwind side of the burner frame. This rope should be attached to a third, downwind, anchor point.

While rigging it must be ensured that karabiners are loaded only in their long axis. Transverse loads, especially across the screwgate, can cause the karabiner to fail far below its rated strength.



▲ V-Bridle Rigging

WARNING- Webbing V-bridles used for inflation restraints must not be used for tethering.



▲ Correct Tethering Site Layout

4.12.3 During Tethered Flight

If the wind speed increases above 15knots (6m/sec), or sufficiently to make control of the balloon difficult, or if the wind becomes gusty the balloon must be deflated.

In windy conditions the amount of jerking of the balloon on the tether ropes must be minimised. This is usually achieved by adjusting the length of the tether ropes so that all three ropes are taut when the balloon is just above ground level. If a vehicle is used as an anchor point for the down-wind tether line it may be moved backwards and forwards in order to vary the maximum height of the balloon.

While tethering it is important to keep spectators away from basket, tether lines and vehicles used as anchors for tether ropes.

4.12.4 Tethering Weak Link (Optional)

The weak link is a calibrated 'fuse piece', which, if fitted, provides an early warning of excessive loads in the tether system. The link is fitted between two tether rings and bypassed by a steel rope. The weak link is fitted to the apex of the upwind V-bridle. If tether loads exceed 500kg (1100lb) the fuse piece will break, transferring loads into the steel wire. If the link fails the balloon should be deflated immediately.

4.13 REFUELLING

4.13.1 Precautions When Dealing With Propane

Propane vapour is flammable and heavier than air.

Do not refuel cylinders in the basket (unless an external venting kit is fitted).

Do not refuel cylinders in enclosed spaces.

Do not refuel cylinders near hollows or drains in which the vapour could accumulate.

There must be no potential sources of ignition in the refuelling area (e.g., naked lights, smoking, live electrical / electronic equipment or radio equipment (e.g. VHF radios or mobile telephones)).

Avoid performing activities that might create a spark (e.g. moving steel fuel cylinders).

The fuel cylinders and supply cylinder must be electrically earthed during the filling process.

Protective gloves must be worn.

A fire extinguisher must be available.

The danger of flammable vapour accumulation can be minimised by refuelling only one cylinder at a time.

4.13.2 Filling from a Bulk Tank with Pump

WARNING- If a cylinder is to be refuelled from a high pressure pump (e.g., At an automotive or commercial filling station), suitable precautions must be taken to ensure that cylinder pressure does not exceed the safe working pressure of 15bar (218psi).

Procedure

1. Connect the filling hose to the liquid outlet of the flight cylinder.
2. Open the fixed liquid level gauge (bleed valve) on the flight cylinder just enough to hear gas escaping.
3. Open the liquid valve on the cylinder.
4. Open the supply valve on the bulk tank.
5. Start the pump.

6. When the flow from the fixed liquid level gauge changes from vapour to liquid stop the pump immediately and close all the valves in reverse order of steps **2.** to **4.** above.

7. Disconnect the supply hose.

8. Vent the cylinder connector by depressing the centre spigot of the self-seal connector. On Rego type valves this should be done with a smooth object such as the blunt end of a pencil or the cylindrical projection on the connector dust cap. This prevents liquid propane from being trapped between the valve and the self seal in the connector, potentially causing damage.

4.13.3 Filling from a Transportable Bulk Cylinder

Industrial transportable gas cylinders may be fitted with either a liquid outlet, a vapour outlet or both. It is preferable to use a cylinder with a liquid outlet, but if a cylinder with a vapour outlet is used it must be partially inverted to supply liquid propane.

These cylinders often contain an accumulation of dirt and water. To minimise the amount of debris that gets into the flight cylinders, the cylinder should be positioned valve down at an angle of about 45°. This will trap any dirt and water in the 'shoulder' of the cylinder.

Pilots regularly refuelling from these cylinders should ensure that a suitable fuel filter (e.g., Bonanno fuel filter) is included in their refuelling hose, especially if a Stealth or Sirocco burner is used.

Procedure

1. Connect the outlet of the transportable gas cylinder to the liquid outlet of the flight cylinder via a suitable refuelling hose.

2. Partially invert the transportable gas cylinder (if vapour withdrawal outlet is being used).

3. Open the fixed liquid level gauge (bleed valve) on the flight cylinder just enough to hear gas escaping.

4. Open the valves on the flight cylinder and commercial cylinder.

5. When the flow from the fixed liquid level gauge changes from vapour to liquid close all the valves.

6. Disconnect the refuelling hose.

7. Vent the self seal on the cylinder connector.

These procedures fill the cylinder to 80% of total volume. The vapour space provides sufficient volume for thermal expansion of the liquid propane. Cylinders should not be overfilled as the liquid fuel may expand and completely fill the vapour space. If this occurs the pressure relief valve will open and release propane. The relief valve is set to open at a pressure of approximately 26bar (375psi).

If overfilling is suspected the fixed liquid level gauge should be opened in a safe and controlled area until liquid propane comes out only in spurts, rather than as a continuous stream. Alternatively, the excess can be transferred to another cylinder using a suitable hose.

4.13.4 Use Of Fuel Safe

The Fuel Safe system is an extension fitted to the fixed liquid level gauge to vent propane vapour via a hose away from the vicinity of the cylinder. This enables the safe refuelling of cylinders in a basket or trailer.

The system operates in the same way as a conventional bleed valve. When the cylinder is full, liquid appears in the hose adjacent to the fixed liquid level gauge.

CAUTION- The precautions detailed in Section 4.13.1 must be observed when using the Fuelsafe System.

4.13.5 Emptying Fuel Cylinders

If it is necessary to completely empty a cylinder for transport or maintenance, the remaining fuel should be burnt off by intermittent use of the whisper burner.

4.14 FUEL PRESSURISATION

WARNING- Pressurisation must never be carried out with air or oxygen, as an explosive mix would occur within the cylinder

In order to provide increased fuel pressure during cold conditions fuel cylinders may be pressurised with nitrogen.

The nitrogen used must be from a regulated supply, providing a pressure of between 0 and 10 bar (0 - 145 psi) to the fuel cylinder, and this nitrogen supply must be operated in accordance with the suppliers instructions.

Nitrogen is added to the cylinder through its liquid feed valve until the desired pressure level is reached.

CAUTION- The maximum cylinder pressure must not exceed 10bar (145psi).

CAUTION- The maximum cylinder pressure must not exceed 7bar (100psi) if the cylinder is to be stored in a pressurised state.

If vapour pilot lights are used, sufficient master cylinders must remain nitrogen-free and be easily identifiable for operation.

CAUTION- A cylinder that has been pressurised with nitrogen becomes unusable for vapour withdrawal, as the nitrogen occupies the vapour space at the top of the fuel cylinder.

When fuel cylinders which have been pressurised with nitrogen are warmed, the fuel pressure will rise much more rapidly than that of an unpressurised cylinder. Care must be taken to ensure that the cylinder maximum safe working pressure is never exceeded. This may be achieved either by pressurising cylinders to a maximum of 7 bar(100psi) if they are to be stored, or by pressurising cylinders to 10 bar(145psi) immediately before a flight and venting the nitrogen from any unused or partially used cylinders as soon as is practical after landing.

It is highly recommended that any cylinder which has been pressurised with nitrogen is labelled as such, and extra care is taken with the use and storage of the cylinder.

Nitrogen is vented from a fuel cylinder by opening the fixed liquid level gauge and allowing vapour to vent for a minimum of 10 minutes. This will allow a considerable amount of nitrogen and propane vapour to escape, markedly reducing the internal pressure of the cylinder.

When using this procedure, the same precautions must be taken as when filling the cylinders.

If a master cylinder is to be returned to use supplying a vapour pilot light after having being nitrogen pressurised, empty the cylinder then refill normally. Extra care should be taken during the first pre flight burner test to ensure the pilot light operates correctly and provides a stable flame.

It is important that the use of high pressure nitrogen cylinders is carried out with reference to the safety, handling and storage guidelines in place for these cylinders. Local and national regulations concerning the use of these cylinders must also be complied with. The supplier of the cylinders will be able to provide the necessary information.

4.15 USE OF A MINI VAPOUR CYLINDER

WARNING – It is important to check that the mini vapour cylinder valve is open before flight as residual vapour in the hose from the burner test may give the impression, for a period of time, that the system is fully functional even when the valve is closed.

The mini vapour cylinder should be strapped into a suitable location in the basket. It should be oriented so that it is vertical at all times that vapour is being withdrawn.

If only one vapour hose is to be connected the other vapour outlet may be left bare. If two vapour hoses are to be connected then an extension hose may be required.

Care must be taken to ensure that two independent pilot light fuel supplies remain to keep the redundancy of the fuel and burner system.

The mini vapour cylinder contains sufficient fuel to supply one pilot light for approximately ten hours or two pilot lights for approximately five hours.

Note: Some mini vapour cylinders incorporate a dip tube which allows vapour to be drawn off with the cylinder in the horizontal position when the outlet is oriented downwards.

4.15.1 Refuelling A Mini Vapour Cylinder

The vapour regulator and connecting hose should be removed from the cylinder by unscrewing the 'Rego' connector. Once the vapour regulator is removed, the refuelling procedure is identical to a flight cylinder.

If the cylinder is fitted with a fixed liquid level gauge (rather than a fill stop valve), the level gauge is incorporated in the cylinder valve. Care is required not to overfill the mini cylinder if a pump is being used for refuelling, but care must also be taken to ensure the cylinder is full.

The fixed liquid level gauge is in the flow of liquid during refuelling causing a small amount of leakage from the fixed liquid level gauge during filling. The cylinder is not full until there is a constant liquid flow from the fixed liquid level gauge.

5.1 INTRODUCTION

This Section gives the procedure to calculate the weight range within which the balloon may safely be operated.

5.2 LOADING CHART

Before each flight the take-off mass must be calculated, and a check made to ensure that this does not exceed the available lift, otherwise the envelope can easily be overheated.

The load which can be carried safely depends on-

1. The temperature of the surrounding air (ambient temperature).

2. The expected flight altitude.

The available lift may also be calculated using the information given in Appendix 2

5.2.1 Instruction For Use Of The Chart

1. Find the 'Lift (lb) per 1000 cu ft' for the expected flight altitude and temperature, using the chart.

2. Use Section 5, Table 2 or 3 to find total permitted lift for the size of balloon, interpolating if necessary.

3. Disposable lift is the total permitted lift minus the balloon empty weight.

4. Ensure that the combined weight of passengers and fuel cylinders does not exceed the disposable lift.

Notes

1. The dotted lines show typical temperature variations with height (I.S.A. is the International Standard Atmosphere). These are an approximation, and can be used to estimate the ambient temperature (and therefore the lift) at another altitude when the ambient temperature at one altitude is known. For flights to altitudes high above take-off altitude see Section 4.6.6.

2. The loading chart is based on static lift with an 100°C internal temperature, thus allowing for moderate rates of climb within the temperature limitation.

3. The applicable Maximum take-off Mass of the balloon must not be exceeded. (See Section 2, Table 1).

4. Empty weight includes the envelope, carrying bag, burner, karabiners and basket including poles, pole covers and fire extinguisher. (Not included are cylinders, accessories or occupants). The main component weights are listed in Section 5, Table 4 and the balloon's log book.

5. Fuel cylinder weights are given in Section 5, Table 4 or Table 9 in Appendix III.

5.3 INVERSION CONDITIONS

When the temperature of the atmosphere increases with height, loading according to the temperature of the cool ground layer can lead to overheating after the initial climb.

On cool early morning flights, either use the expected midday temperatures for the calculations, or leave a good margin below the calculated maximum permitted weight.

5.4 SAMPLE CALCULATIONS

Dotted lines showing the sample calculations are marked on the chart.

Example 1- Ambient temperature at maximum altitude known.

The balloon is to be flown to a maximum altitude of 3000 ft and the forecast temperature at that altitude is 11°C.

Start with the ambient temperature at the maximum altitude on the horizontal scale. Follow up vertically to intersect the 3000ft curve. This point will show the lift at 3000ft on the vertical scale (16.7 lb per 1000 cu ft).

Example 2- Ambient temperature at maximum altitude not known

The balloon is to be flown to a maximum altitude of 10000ft from a take-off altitude of 3000ft The ambient temperature at take-off is 8°C.

Start with the ambient temperature at take-off on the horizontal scale. Follow up vertically to intersect the 3000 ft curve. This point will show the lift at 3000 ft on the vertical scale (17.4 lb per 1000cu ft).

To allow for the effect of altitude follow parallel to the ISA curves until the 10000 ft curve is reached. This point shows the theoretical ambient temperature at 10000ft (-7°C) on the horizontal scale and the lift at 10000ft (16.3 lb per 1000 cu ft) on the vertical scale.

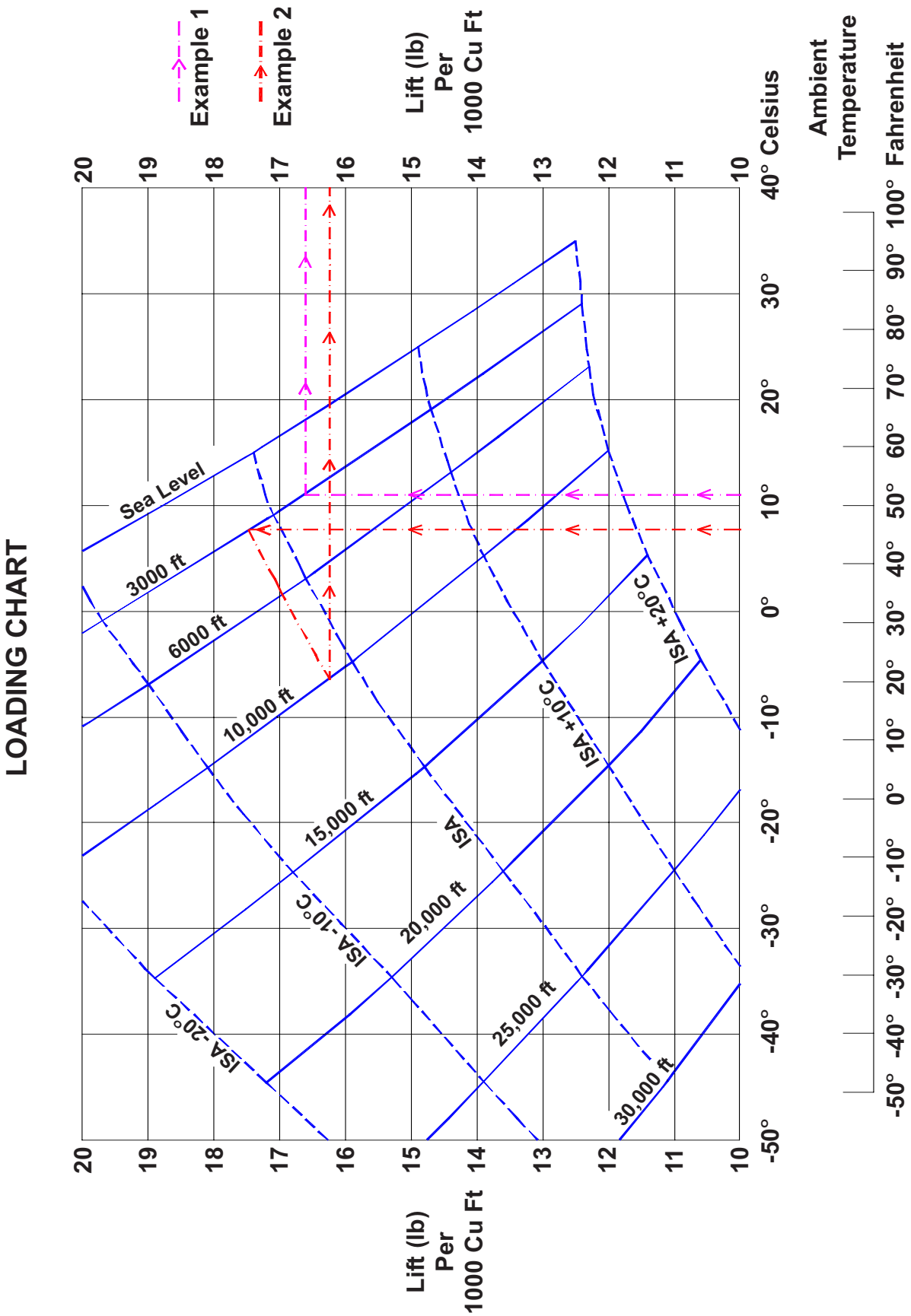

LOADING CHART
Example 1
Example 2
Lift (lb) Per 1000 Cu Ft
Ambient Temperature
40° Celsius
Fahrenheit
Sea Level
3000 ft
6000 ft
10,000 ft
15,000 ft
20,000 ft
25,000 ft
30,000 ft
ISA -20°C
ISA -10°C
ISA
ISA +10°C
ISA +20°C

Table 2 - Total Permitted Lift (kg)

Balloon Size	Lift (lb) Per 1000 cu.ft.										
	10	11	12	13	14	15	16	17	18	19	20
25	113	125	136	147	159	170	181	193	204	215	227
31	143	157	171	185	200	214	228	243	257	271	285
42	191	210	229	248	267	286	305	324	343	362	381
56	254	279	305	330	356	381	406	432	457	483	508
60	272	299	327	354	381	408	435	463	490	517	544
65	295	324	354	383	413	442	472	501	531	560	590
69	313	344	376	407	438	469	501	532	563	595	626
70	317	349	381	413	444	476	508	540	571	603	635
77	352	387	422	457	492	527	562	597	633	668	703
80	363	399	435	472	508	544	580	617	653	689	726
84	381	419	457	495	533	572	610	648	686	724	762
90	408	449	490	531	571	612	653	694	735	776	816
100	454	499	544	590	635	680	726	771	816	862	907
105	476	524	572	619	667	714	762	810	857	905	952
120	544	599	653	707	762	816	871	925	980	1034	1088
133	603	663	724	784	844	905	965	1025	1086	1146	1206
140	635	699	762	826	889	953	1016	1080	1143	1207	1270
145	658	723	789	855	921	987	1052	1118	1184	1250	1315
150	680	748	816	884	952	1020	1088	1156	1224	1293	1361
160	726	798	871	943	1016	1088	1161	1234	1306	1379	1451
180	816	898	980	1061	1143	1225	1306	1388	1470	1551	1633
200	907	998	1088	1179	1270	1361	1451	1542	1633	1723	1814
210	952	1047	1143	1238	1334	1429	1524	1619	1715	1810	1905
225	1020	1122	1224	1327	1429	1531	1633	1735	1837	1939	2041
240	1089	1197	1306	1415	1524	1633	1742	1851	1960	2068	2177
250	1134	1247	1361	1474	1588	1701	1814	1928	2041	2155	2268
260	1179	1297	1415	1533	1651	1769	1887	2005	2123	2241	2359
275	1247	1372	1497	1621	1746	1871	1995	2120	2245	2370	2494
300	1361	1497	1633	1679	1905	2041	2177	2313	2449	2585	2721
315	1429	1571	1714	1857	2000	2143	2286	2429	2571	2714	2857
340	1542	1696	1850	2005	2159	2313	2467	2621	2776	2857	2857
340HL	1542	1696	1850	2005	2159	2313	2467	2621	2776	2930	3084
350	1587	1746	1905	2063	2222	2381	2540	2698	2857	3016	3175
375	1701	1871	2041	2211	2381	2551	2722	2892	3062	3232	3401
400	1814	1995	2177	2358	2540	2721	2902	3084	3265	3447	3628
415	1882	2070	2259	2447	2635	2823	3011	3200	3388	3576	3764
425LW	1927	2120	2313	2506	2698	2891	3084	3277	3469	3662	3662
450	2041	2245	2449	2653	2857	3061	3265	3469	3673	3878	4082
530	2404	2644	2884	3125	3365	3605	3846	4086	4327	4567	4807
600	2721	2993	3265	3537	3810	4082	4354	4626	4898	5089	5089

Table 3 - Total Permitted Lift (lb)

Balloon Size	Lift (lb) Per 1000 cu.ft.										
	10	11	12	13	14	15	16	17	18	19	20
25	250	275	300	325	350	375	400	425	450	475	500
31	315	346	378	409	441	472	504	535	567	598	620
42	420	462	504	546	588	630	672	714	756	798	840
56	560	616	672	728	784	840	896	952	1008	1064	1120
60	600	660	720	780	840	900	960	1020	1080	1140	1200
65	650	715	780	845	910	975	1040	1105	1170	1235	1300
69	690	759	828	897	966	1035	1104	1173	1242	1311	1380
70	700	770	840	910	980	1050	1120	1190	1260	1330	1400
77	775	852	930	1007	1085	1162	1240	1317	1395	1472	1540
80	800	880	960	1040	1120	1200	1280	1360	1440	1520	1600
84	840	924	1008	1092	1176	1260	1344	1428	1512	1596	1640
90	900	990	1080	1170	1260	1350	1440	1530	1620	1710	1800
100	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000
105	1050	1155	1260	1365	1470	1575	1680	1785	1890	1995	2100
120	1200	1320	1440	1560	1680	1800	1920	2040	2160	2280	2400
133	1330	1463	1596	1729	1862	1995	2128	2261	2394	2527	2660
140	1400	1540	1680	1820	1960	2100	2240	2380	2520	2660	2800
145	1450	1595	1740	1885	2030	2175	2320	2465	2610	2755	2900
150	1500	1650	1800	1950	2100	2250	2400	2550	2700	2850	3000
160	1600	1760	1920	2080	2240	2400	2560	2720	2880	3040	3200
180	1800	1980	2160	2340	2520	2700	2880	3060	3240	3420	3600
200	2000	2200	2400	2600	2800	3000	3200	3400	3600	3800	4000
210	2100	2310	2520	2730	2940	3150	3360	3570	3780	3990	4200
225	2250	2475	2700	2925	3150	3375	3600	3825	4050	4275	4500
240	2400	2640	2880	3120	3360	3600	3840	4080	4320	4560	4800
250	2500	2750	3000	3250	3500	3750	4000	4250	4500	4750	5000
260	2600	2860	3120	3380	3640	3900	4160	4420	4680	4940	5200
275	2750	3025	3300	3575	3850	4125	4400	4675	4950	5225	5500
300	3000	3300	3600	3900	4200	4500	4800	5100	5400	5700	6000
315	3150	3465	3780	4095	4410	4725	5040	5355	5670	5985	6300
340	3400	3740	4080	4420	4760	5100	5440	5780	6120	6300	6300
340HL	3400	3740	4080	4420	4760	5100	5440	5780	6120	6460	6800
350	3500	3850	4200	4550	4900	5250	5600	5950	6300	6650	7000
375	3750	4125	4500	4875	5250	5625	6000	6375	6750	7125	7500
400	4000	4400	4800	5200	5600	6000	6400	6800	7200	7600	8000
415	4150	4565	4980	5395	5810	6225	6640	7055	7470	7885	8300
425LW	4250	4675	5100	5525	5950	6375	6800	7225	7650	8075	8075
450	4500	4950	5400	5850	6300	6750	7200	7650	8100	8550	9000
530	5300	5830	6360	6890	7420	7950	8480	9010	9540	10070	10600
600	6000	6600	7200	7800	8400	9000	9600	10200	10800	11215	11215

Table 4 - Balloon Component Weight Record

Registration	
Year Of Construction	
Constructors Number	
Balloon Type	

Component	Drawing Number	Serial Number	Weight (kg)
Envelope			
Burner			
Basket			
		Total	

Cylinder	Drawing Number	Serial Number	Weight (kg)	
			Empty	Full
Cylinder 1				
Cylinder 2				
Cylinder 3				
Cylinder 4				
Cylinder 5				
Cylinder 6				
		Total		

Total Fuel Weight _____ kg

6.1 INTRODUCTION

Section 6 provides a description of the standard component parts and assemblies that make up the balloon system.

Optional equipment is described in Section 8.

6.2 ENVELOPE

Envelopes are of sewn construction, and are made of high tenacity nylon fabric. The fabric is coated to make it airtight and to protect it from the effects of sunlight. All the main loads on the envelopes are carried by nylon or polyester load tapes and the designs use high factors of safety.

Horizontal tapes act as rip stoppers so that any damage to the envelope will be limited in extent.

The base panels of the balloon are made from Nomex heat resistant fabric so that the nylon is kept at a sufficient distance from the flame to prevent heat damage. The lower ends of the load tapes are formed into rigging loops to which stainless steel or Kevlar cables, called flying cables, are attached.

Envelopes are fitted as standard with a 'Parachute' deflation system in sizes of up to 150,000 cu.ft (4250m^3) and a 'Lock-Top' deflation system in larger sizes. The Rapid Deflation System is available as an option on most models.

The base of the balloon may be fitted with a Scoop. This improves the performance of the balloon when taking off or tethering in wind, and during flight in turbulent conditions.

There are seven standard types of envelope, all of which are of the conventional 'inverted teardrop' shape.

6.2.1 Cameron 'V' Type

The Viva has eight bulbous gores. Sizes range from 31,000 to 90,000cu.ft (890 to 2550m^3). There are eight flying cables.

6.2.2 Cameron 'C' Type

The Concept is a 12-gore vertically cut envelope of 60,000 to 100,000cu.ft (1700 to 2832m^3) designed for economy of construction. There are twelve flying cables.

6.2.3 Cameron 'O' Type And Thunder Series I

The Cameron 'O' Type and Thunder Series I have twelve semi-bulbous gores. Sizes range from 65,000 to 160,000cu.ft (1840 to 4530m³). There are twelve flying cables.

6.2.4 Cameron 'A' Type And Thunder Series II

The Cameron 'A' Type and Thunder Series II envelopes are designs for larger balloons not requiring a smooth surface. Standard sizes range from 90,000 to 530,000 cu.ft (2549 to 15,010m³). There are twenty flying cables.

6.2.5 Cameron 'N' Type

The Cameron 'N' Type envelope has closely spaced load tapes and narrow gores of vertically cut panels to give a near-smooth surface. Sizes range from 31,000 to 210,000cu.ft (890 to 5947m³). There are twelve or sixteen flying cables dependent on envelope size.

6.2.6 Cameron 'Z' Type And Colt 'A' Type

The Cameron 'Z' Type and Colt 'A' type envelopes have closely spaced load tapes and narrow gores of horizontally cut panels to give a near-smooth surface. Sizes range from 25,000 to 600,000cu.ft (708 to 16992m³). There are eight, twelve, twenty-four, twenty-eight or thirty two flying cables dependent on envelope size.

6.2.7 Cameron 'GP' Type

The 'GP' type balloon is specially designed for competition flying. The envelope shape allows the balloon to be more manoeuvrable and safer during demanding competition flying. The envelope can be fitted with Turbulators which aid stability during rapid climbs or descents. Sizes range from 65,000 to 70,000cu.ft (1841 to 1982m³). There are twelve flying cables.

6.2.8 Cameron 'TR' Type

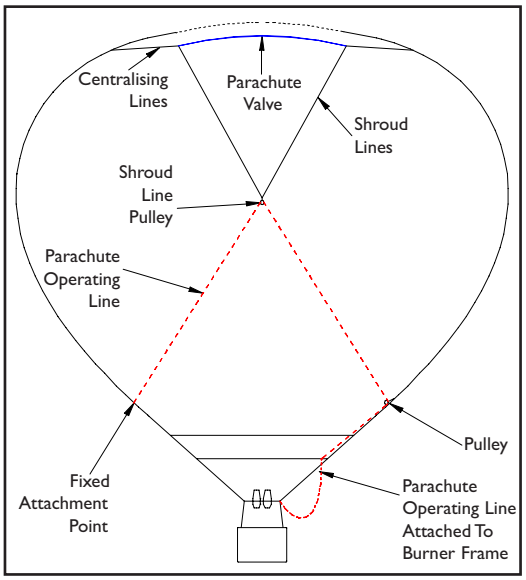
The 'TR' type balloon is specially designed for competition flying. The envelope shape allows the balloon to safely achieve high rates of climb and descent. Sizes range from 60,000 to 70,000cu.ft (1700 to 1982m³). There are twelve flying cables.

6.2.9 Parachute Valve

The parachute valve allows the controlled release of hot air (venting) and the complete deflation of the envelope. It takes the form of a circular parachute-style panel sealing a circular opening in the top of the envelope.

The parachute is held in position by the internal pressure of the hot air and by centralising lines which join its edge to the inside surface of the balloon.

The parachute valve is opened by pulling the red and white operating line attached, via a pulley, to the shroud lines of the parachute. The operating line passes through a second pulley to give a greater mechanical advantage. Larger envelopes may be fitted with a third or fourth pulley to increase the mechanical advantage.



▲ Parachute Internal Arrangement

For in-flight venting the parachute panel is opened for a few seconds, whereas for deflation it is held open until the envelope deflates.

6.2.10 Lock-Top

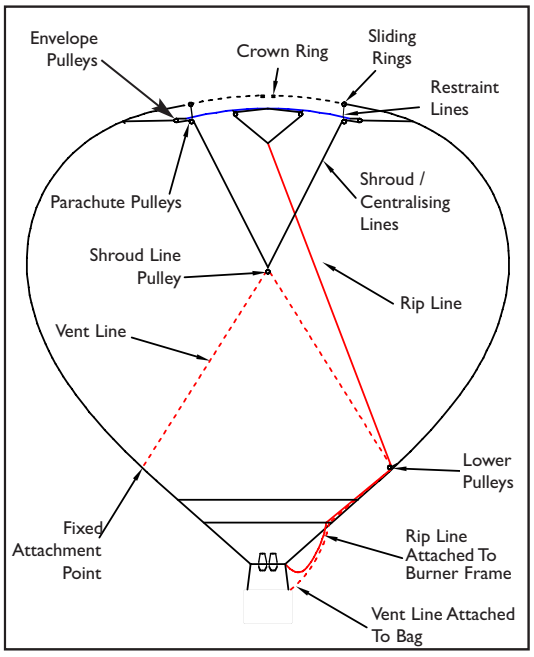
The Lock-Top is a modified form of the parachute valve fitted as standard equipment to larger envelopes. The parachute panel is fitted with longer centralising lines, allowing it to be pulled clear of the circular opening in the top of the envelope. This results in a faster final deflation.

The centre of the parachute is attached to the crown ring by a snap shackle which ensures that the parachute cannot be 'stalled' as a result of over-venting. On the final approach to landing the shackle is opened by pulling the yellow and black arming line. A flag appears inside the envelope once the system has been armed.

6.2.11 Rapid Deflation System (RDS)

The Rapid Deflation System is similar in appearance to a parachute valve. However, the centralising and shroud lines are replaced by a single length of line running through pulleys.

Pulling the red line gathers the parachute panel into a column in the centre of the circular opening for final deflation.



▲ Rapid Deflation System Internal Arrangement

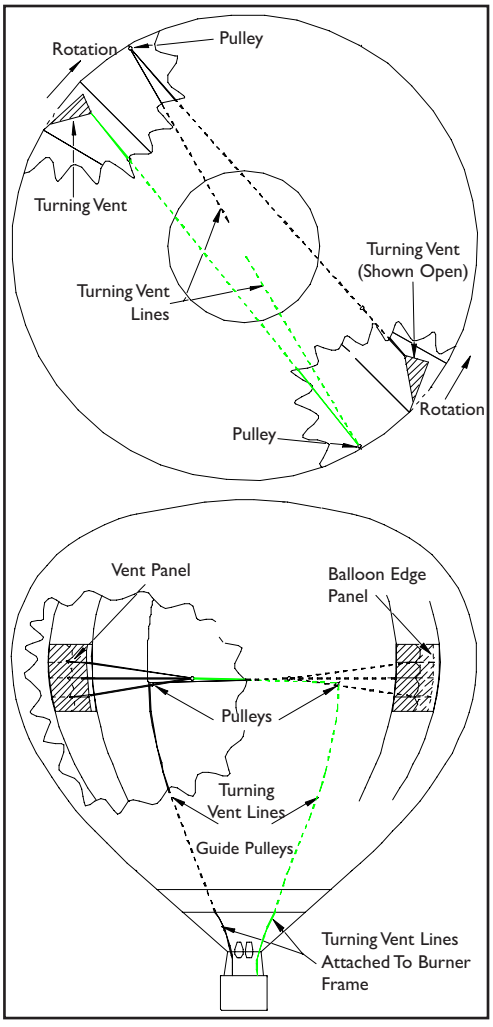
The action of the red line can be reversed by pulling the red and white venting line.

Pulling the red and white venting line opens the parachute in a similar way to a parachute valve for in-flight venting of hot air.

6.2.12 Velcro Rip Panel

The Velcro rip is a panel in the top of the envelope, held in place around part of its edge by Velcro. Pulling the red rip line breaks the Velcro seal allowing the envelope to deflate. The Velcro rip panel will not re-close once operated, and must not be used until the balloon is committed to a landing.

Rip locks are fitted at intervals around the panel's edge. These prevent loads in the panel from inadvertently opening the Velcro. Both the locks and the rip line are held in place with ties, which must be broken by pulling the red rip line before the panel can be deployed.



Turning Vent Internal Arrangement

Envelopes fitted with a Velcro rip panel may be fitted with a separate vent for the controlled release of hot air in flight. Either turning vents are fitted which may be opened simultaneously, or a separate 'side-dump' vent is fitted (red and white control line).

6.2.13 Combination Rip Panel / Parachute Valve

The combination top is a deflation system in which a parachute is fitted in the centre of a circular Velcro rip panel. This system is used mainly for larger balloons.

The parachute is used for in-flight venting and for deflation in light winds. In stronger winds a rapid deflation may be achieved by using the Velcro rip panel.

Note- Velcro rip panels should be stored closed to prevent envelope thread damage from the 'hook' side of the Velcro.

6.2.14 Turning Vent

Turning vents may be fitted, which allow the balloon to be rotated about its vertical axis while airborne. These can be used to align the basket into the safest position for landing and can assist the effective display of advertising. The black line will rotate the balloon to the pilot's left, the green line to the pilot's right.

6.2.15 Temperature Streamer

A melting link attached to a streamer is fitted to all envelopes, usually near the top of load tape no. 2. If the envelope is overheated the streamer will fall through the mouth of the envelope warning the pilot. The streamer will fall out at 127°C (261°F) and may be of any colour contrasting with the envelope.

6.2.16 Tempilabel

One tempilabel is sewn into all envelopes near the top of load tape 3, and one into the parachute edge near tape 3. These labels have temperature sensitive areas which permanently change colour at different temperatures between 90° to 150°C (200° to 300°F). This provides a permanent record of the maximum temperature the fabric has reached.

6.3 BURNER

6.3.1 General

The main heat source for balloon flight is a high-output burner fuelled with liquid propane.

Burners are available in single, double, triple and quad configurations.

The burner valve controls are colour coded to aid recognition.

6.3.2 Main Burner

The fuel passes through a vaporising coil (burner coil) and jet system prior to combustion.
Fuel flow is controlled by an on/off valve referred to as the blast valve. The blast valve control is coloured red.

6.3.3 Whisper Burner

The Whisper burner ('Liquid Fire' or 'Cow Burner') feeds liquid fuel directly to a multi-hole jet producing a quieter and less powerful flame. Fuel flow is controlled by a rotary valve or toggle valve which can vary the output of the burner. The whisper burner control is coloured blue.

The Whisper burner is designed for occasional use. Excessive use may cause discolouration of the envelope.

The Whisper burner should not be operated continuously with the valve partially open as this may lead to droplets of propane being produced at the nozzle. Liquid fuel may then collect in the base of the burner and present a fire risk.

6.3.4 Pilot Light

Burner ignition is provided by a pilot light. Pilot lights may be fuelled by liquid propane taken from the main fuel supply or from a separate regulated vapour supply. The pilot light is controlled by a rotary action shut off valve. Each pilot light has its own piezo igniter (except the Shadow Single burner which shares one igniter between two pilot lights). The pilot light control obscures the igniter push button when in the closed position. The pilot light control is coloured gold.

Note- During initial use, some 'bedding down' of the pilot light and whisper burner valves may occur necessitating a simple adjustment to ensure the valves shut off correctly (Maintenance Manual Sections 4.5.1 and 4.6.1).

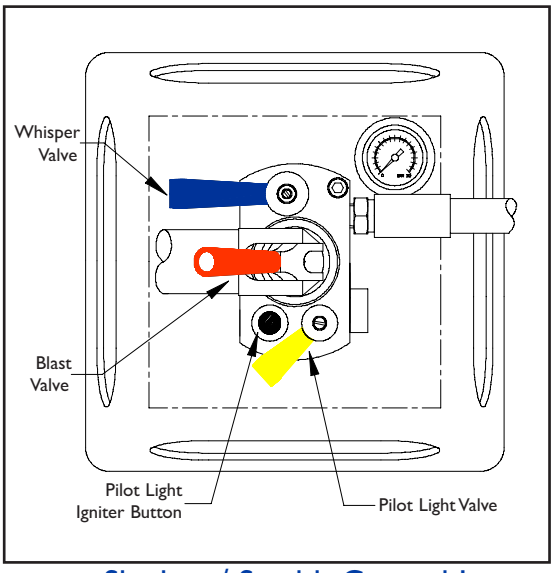
6.3.5 Pressure Gauge

A pressure gauge is fitted to each liquid fuel supply. The pressure gauge displays the fuel pressure at the burner.

6.3.6 Fuel Supplies

A minimum of two separate fuel supplies is always fitted. In a single burner these both feed, via independent valves, to the same burner coil. In double, triple or quad burners, each burner unit has its own independent fuel supply.

The fuel hoses on triple and quad burners are marked with a coloured band at each end so that the hose couplings can be matched with their burner unit.



▲Shadow / Stealth Control Layout

6.3.7 Simultaneous Multiple Burner Operation

In multiple burners, pairs of burners are linked by either 'dual action handles' or by a crossflow valve. The dual action handle allows the operation of two main blast valves, via separate fuel supplies, with one hand. The crossflow valve allows the routing of single fuel supply from one blast valve to two burner coils. Maximum power will not be achieved using the crossflow as both the burners are being fed from one fuel hose.

6.3.8 Shadow and Stealth Burners

The Shadow burner uses a jet ring incorporating multi-hole jets producing a powerful slim high speed flame.

Shadow Single Burner

The Stealth burner uses a sophisticated foil jet ring system to achieve a considerable reduction in noise output. The Stealth has a 'soft start - soft finish' burn, with a gradual build up and decay of burner noise.

The lower flame speed produced results in a 'softer' flame which is more easily deflected by wind or turbulence. Radiant heat is also slightly increased.

Cleaning of the Stealth jet ring may be required after using dirty propane (Maintenance Manual Section 4.5.6). If dirty propane is suspected a fuel filter should be incorporated into the refuelling hose.

Shadow and Stealth burners are fitted with a liquid pilot light. A vapour pilot light is available as an option. Both types of pilot lights are fitted with filters which require periodic cleaning (Maintenance Manual Section 4.5.2).

6.3.8.1 Shadow Single Burner

The Shadow single burner consists of a single burner coil with a dual feed manifold block. The manifold block has two independent fuel supplies each with its own blast valve, whisper valve and pilot light.

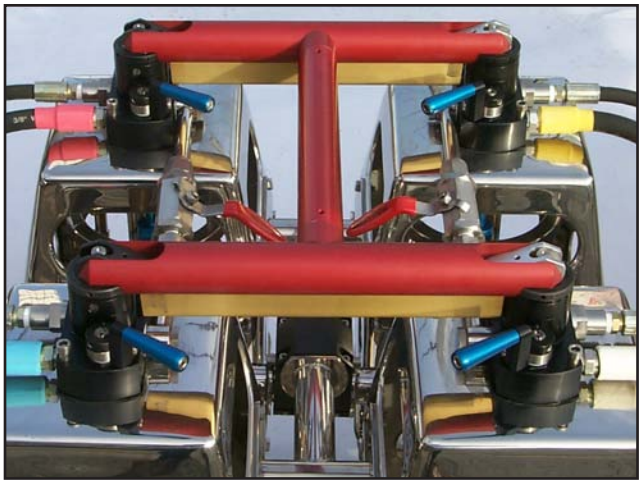
6.3.8.2 Shadow And Shadow / Stealth Combination Burners

Shadow and Shadow/Stealth combination burners are available as double, triple and quad burners.

The Shadow and Stealth burners share the same manifold block and control layout, and differ only in the main burner jet ring and coil arrangement.

The Stealth burner is only fitted in combination with Shadow units to create double, triple or quad combination burners.

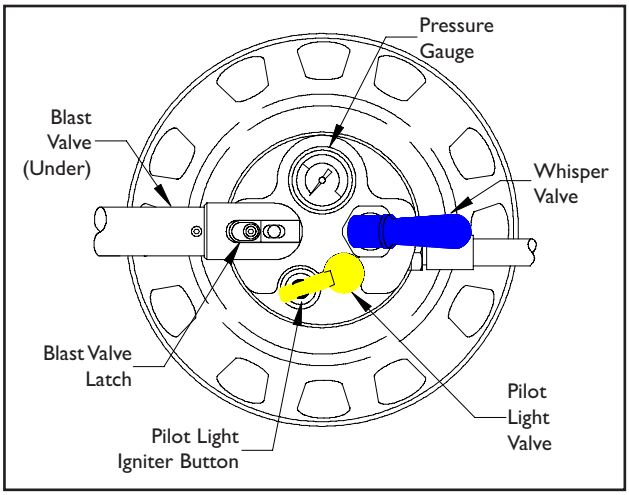
Double burners are fitted with crossflow valves. Triple and quad burners can be fitted with crossflow valves or dual action handles ('squeeze bar action') between paired burner units.



Stealth / Shadow Quad Burner

6.3.9 Stratus Burner

The Stratus Burner is available as a single, double, triple or quad burner.



▲ Stratus Control Layout

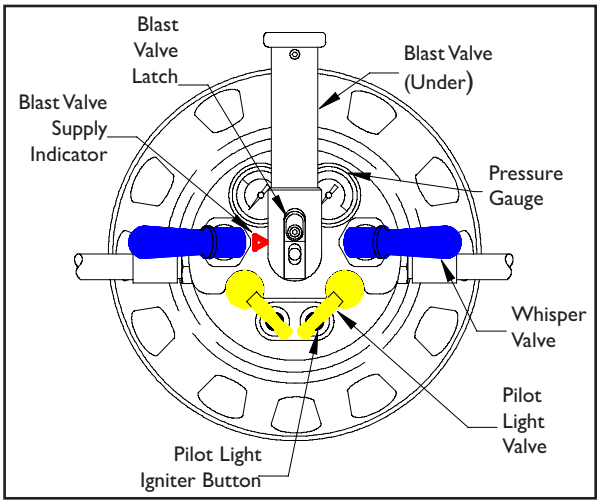
The main burners are fitted with squeeze action blast valves which are operated by squeezing the control lever towards the hand grip. Each handle has a latch fitted on its underside to allow the valve to be locked on in an emergency (Section 3.11). The blast valve handles are arranged so that pairs of burners be operated simultaneously with one hand.

The Whisper burner is operated by a toggle valve, which may be rotated to give a convenient operating position.

The Stratus burner is fitted with a liquid pilot light. A vapour pilot light is available as an option. Both types of pilot lights are fitted with filters which require periodic cleaning (Maintenance Manual Section 4.7.2).

6.3.9.1 Stratus Single Burner

The Stratus single burner has two independent fuel supplies. Each fuel supply feeds a pilot and whisper burners. One main blast valve is fitted and its fuel supply is denoted by a red arrow on the block. The Stratus single burner has two igniters.



▲ Stratus Single Control Layout

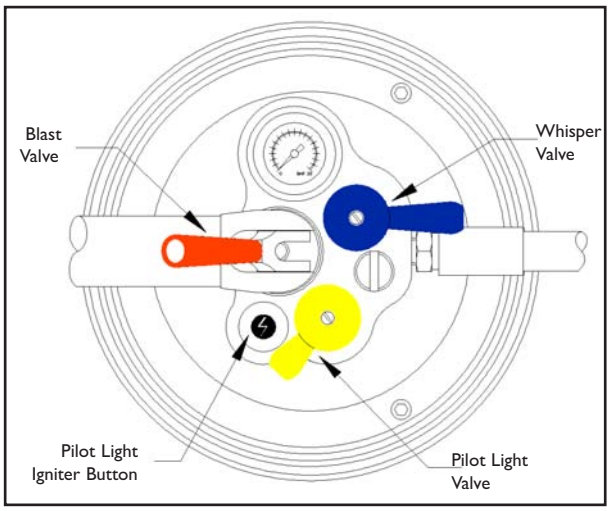
6.3.9.2 Stratus Double, Triple And Quad Burners

Triple and quad burners can be fitted with crossflow valves between adjacent burners. When a crossflow valve is open, two burners can be operated from one burner valve. This enables all the burners to be operated with one hand.

6.3.10 Sirocco Burner

The Sirocco burner is available as a double, triple or quad burner.

The Sirocco burner has the ability to perform over a wide range of fuel pressures without the use of nitrogen (N_2) pressurisation, and gives a slim, powerful flame with low radiant heat output.



▲Sirocco Control Layout

The burner coil operates at a relatively low temperature which reduces thermic cycling extending burner life.

A dual action handle is fitted to allow the operation of a pair of burner units simultaneously with one hand.

The Whisper valve and pilot valve are operated by rotary action handles which are marked to show their sense of operation.

The Sirocco manifold block enables quick disassembly for ease of maintenance.

The Sirocco is only available with a regulated liquid pilot light system.

Sirocco burners are not fitted with crossflow valves.

6.3.11 Sirocco E.P. Remote Control Burner

The Sirocco burner is available with a solenoid actuated remote control system. The burner may be operated normally or from a hand held remote control. The remote control system actuates either burner of a double burner or both burners simultaneously. The System can also be fitted to one pair of burners in a triple burner system or one pair of burners in a quad burner system.


▲Sirocco Manifold Block

6.3.12 Fixed Height Burner Frame

The burner assembly is mounted on a gimbal in the burner frame. The burner frame has a socket in each corner to accept a nylon support rod. In addition, there are rigging points at each corner through which karabiners are hooked to join the basket wires to the envelope flying cables. Larger frames are fitted with four additional sockets and rigging points. Heat shields may be fitted to larger burner frames to reduce radiant heat.

6.3.13 Adjustable Height Burner Frame

The adjustable height burner frame allows the burner to be raised and lowered relative to the basket floor. This adjustment can be safely carried out in flight. The adjustable burner frame is only available for use with single and double burners.


▲Adjustable Burner Frame

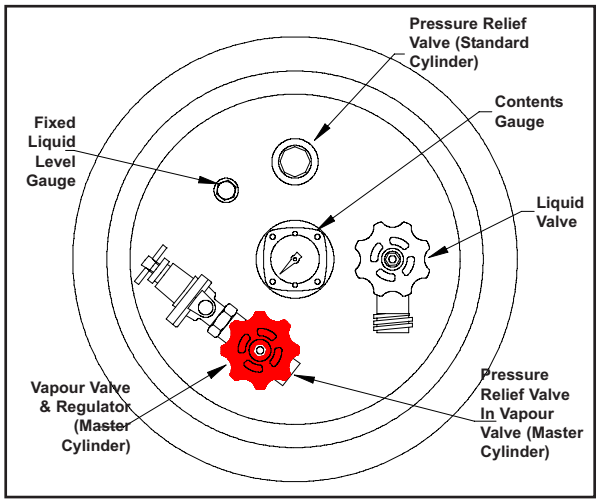
6.4 FUEL CYLINDERS

The fuel cylinders contain the liquid propane fuel under pressure. The cylinders are supplied in two configurations.

'Standard' cylinders - supplying liquid fuel feed only.
'Master' cylinders - supplying liquid fuel feed with an additional pressure regulated vapour supply for vapour pilot lights.

The liquid fuel is drawn from the bottom of the cylinder via an internal dip tube. The liquid supply is controlled by an external valve, either a handwheel type valve with a Rego type (screw-on) hose connector or a 'quick shutoff' lever-operated valve. The quick shutoff valve may be fitted with either a Rego type screw-on connector or a Tema push-on connector.

The regulated vapour pilot light supply (master cylinders only) is taken directly from the top of the cylinder through a handwheel type valve and an adjustable regulator. The vapour hose is connected using a quick release coupling.



▲ Fuel Cylinder Valve Layout - Master Stainless Steel Cylinder Shown

Caution: The Vapour Regulator requires an internal cylinder vapour pressure of 0.5 Bar (7 p.s.i) before it operates correctly. Care must be taken at low ambient temperatures when using fuel which is predominantly butane.

All fuel cylinders are fitted with-

A contents gauge which indicates from approximately 33% of capacity until the cylinder is empty.

A fixed liquid level gauge (bleed valve) which indicates when the cylinder is full.

A pressure relief valve (PRV) which protects the cylinder against excessive internal pressure.

A padded cover with integral map pocket. The padded cover must be used at all times.

The cylinders are strapped vertically inside the basket. Load spreading boards must be fitted to the internal runners of woven floor baskets if cylinders with a useable volume greater than 45 litres are used.

6.4.1 Cameron Stainless Steel Fuel Cylinders

Cameron stainless steel fuel cylinders have usable volumes of between 42 and 71 litres and have straight dip tubes.

6.4.2 Cameron Duplex Stainless Steel Fuel Cylinders

A range of duplex stainless steel cylinders is available. These have usable volumes of between 45 and 72 litres. Cameron duplex stainless steel fuel cylinders have curved dip tubes.

6.4.3 Cameron Titanium Fuel Cylinders

Titanium fuel cylinders provide the best fuel to cylinder weight ratio. They are externally similar to the stainless steel cylinders, but have an empty weight of approximately 10kg less per cylinder (see table 11). Cameron Titanium fuel cylinders have straight dip tubes.

6.4.4 Mini Vapour Cylinder

The Mini Vapour Cylinder is a 5 litre Worthington aluminium fuel cylinder, fitted with a vapour outlet, pressure regulator and connections for two pilot light hoses.

Use of a Mini Vapour Cylinder allows the main master cylinders to be pressurised with nitrogen (N_2) or carbon dioxide (CO_2) to increase burner power in cold conditions, or in cases of low gas pressure (e.g. when using butane).

6.4.5 Fuel Manifolds

Approved fuel manifolds may be used to join the outlets of several fuel cylinders to one burner fuel hose.

WARNING- Accidents have been caused by the use of non-approved fuel manifolds. In particular it is important that rigid refuelling adapters are not used to allow the combination of Rego outlet cylinders with Tema connectors or vice-versa.

6.5 BASKET

Baskets are of traditional wickerwork construction. The basket floors are either woven or solid plywood. The structural load is taken by stainless steel wires forming a continuous sling from the burner frame underneath the basket floor.

The baskets are strengthened by aluminium 'U'-tubes or a stainless steel frame.

The top of the basket is padded with foam, which is then trimmed with leather or suede. The bottom edge is covered with rawhide which protects the basket from damage during landings and transit. Openings are woven into the basket for cylinders straps and step holes.

The basket cables, burner support rods and fuel hoses are contained within zip-up padded covers.

Side or end wall cushions and cushion floors may be added inside the basket to increase the levels of passenger comfort.

A fire extinguisher must be fitted inside the basket.

▲ Aristocrat Basket

6.5.1 Concept Basket

The Concept basket is available in two sizes to match the Concept 60 - 70 and 80 - 100 envelopes. The baskets are of lightweight construction and have a flat top.

6.5.2 Aristocrat And Classic Baskets

The Aristocrat and Classic ranges of baskets carry between one and six occupants. The baskets are usually made with the top of the basket upswept at each end but flat top baskets can be specified.

6.5.3 Partitioned Baskets

Larger baskets have internal partitions woven into the walls and floor of the basket. These partitions provide greater structural integrity and separation between groups of passengers The pilot and fuel cylinders occupy a separate compartment from the passengers.

Larger partitioned baskets use two rigging points on each corner of the load frame for increased strength. The largest partitioned baskets have provision for eight burner support rods, each with its own rigging points.

Padded hose covers can be used to bring fuel hoses from the centre of the burner frame to the centre of the pilot compartment.

Turning vents should be fitted to envelopes used with partitioned baskets. This allows the basket to be rotated so that the long side faces the direction of travel during landing.


▲Double 'T' Partition Basket

6.5.4 Pilot Restraint Harness

The pilot restraint harness prevents the pilot being thrown from the basket during a heavy or fast landing. The harness fastens around the pilot's waist, and is attached securely either to or close to the basket floor. A quick release buckle is fitted to allow the pilot to leave the basket in an emergency.

6.5.5 Bonanno Quick Release

The quick release is designed to restrain the balloon during inflation and heating up for take-off, but must not be used for tethered flight. A locking pin is fitted to prevent accidental release.

Use of the quick release is recommended to ensure that the balloon does not drag during inflation or leave the ground prematurely.

Note- Care should be taken to protect all webbing and rope items from the effects of sunlight. Ultraviolet radiation causes degradation of the rope or webbing, considerably reducing its strength. This applies especially to the launch restraint and equipment for tethered flight. Regular checks should be made to the launch restraint and equipment for tethered flight for wear and loss of strength.

6.6 FLIGHT INSTRUMENTS

Flight instruments used in ballooning are an altimeter (for altitude measurement), a variometer (to display climb and descent rate), a time piece (to record flight times, sunset times etc.) and an envelope temperature gauge (to indicate envelope internal temperature).

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7.1 INTRODUCTION

This Section contains the recommended procedures for proper ground handling and servicing of the balloon.

7.2 INSPECTION PERIODS

Details of the required inspection periods are given in Cameron Balloons Maintenance Manual Issue 10, Section 6.

7.3 ALTERATIONS OR REPAIRS

It is essential that the responsible airworthiness authority is contacted prior to any alterations being made to the balloon to ensure that the airworthiness of the balloon is not compromised.

For repair procedures, reference should be made to Cameron Balloons Maintenance Manual Issue 10.

7.4 TRANSPORTATION

The following Sections apply to road transportation. If the balloon is to be transported by rail, sea or air, the operator of the service should be contacted prior to travel to find out what requirements they have in respect of fans, propane cylinders etc. Extra protection may be required when shipping by these methods.

7.4.1 Envelope

When the balloon is to be transported, the envelope must be carried in its storage bag, and should be protected from weather.

7.4.2 Burners

The burners must be vented of propane, and the fuel hoses disconnected from the cylinders before transport.

The burners should not be rigged to the basket. Transporting a basket and burner in this manner leads to greatly increased wear to the structure, and there is a chance of the burner striking low bridges.

Burners fitted with a crossflow valve should be transported with the crossflow valve in the open position.

Sirocco, Shadow and Stealth burners are fitted with 'squeeze action' valve controls mounted below the hand grip. The burner should be transported and stored with the control lever moved through approximately 150° so that it is parallel with the hand grip.

Burners with liquid pilot lights should be transported and stored with the burner vertical and coils uppermost, to prevent any 'heavy ends' in the fuel interfering with the liquid pilot light regulator.

7.4.3 Cylinders

Fuel cylinders must only be transported or stored vertically with the valves uppermost, as the pressure relief valves are designed to vent only vapour.

The cylinders must be firmly secured inside the basket or other form of protection within the transportation unit.

Cylinders which have been pressurised with nitrogen must be checked to ensure the internal vapour pressure is not greater than 7 bar (100 psi) prior to transportation.

If the cylinder pressure exceeds 7bar, the cylinder must be vented (Section 4.14) until the cylinder pressure is below 7bar.

7.4.4 Baskets

WARNING: Great care must be taken when transporting solid floor baskets to ensure that damage is not caused to the wires on the underside of the basket floor. If damage is evident or suspected, the wires must be inspected as per Cameron Balloons Maintenance Manual Issue 10 Section 6.17.4 before flight.

Baskets should be protected from the elements during transportation by use of a suitable cover.

When using ratchet straps to secure baskets to trailers, care must be taken not to over tighten these straps as permanent distortion to the basket can occur (especially when the basket is new or wet).

Baskets can be loaded longitudinally or transversely. Solid floor baskets must not be loaded or unloaded over the side of a vehicle or trailer unless wire protectors (CB 3351) are fitted. This is due to the high risk of wire damage from the edge of the vehicle or trailer. Before loading, check that all these protectors are in place and secure. Woven floor baskets must be protected from areas of the trailer that could cause damage to the wires or wicker. If the basket is to be winched lengthways onto a vehicle or trailer, only approved basket towing plates and bridles should be used. The winch cable must not be attached to the rope handles, or any other part of the basket, or serious damage could be caused to the basket structure.

When unloading baskets from trailers, great care must be taken not to drop the basket onto the ground without cushioning the impact (especially larger baskets with full fuel cylinders) as damage to the structure can occur.

7.5 STORAGE

The balloon should be stored in a clean dry place.

The envelope should not be stored damp or wet for more than a few days, as residual moisture can result in fabric deterioration due to mould or mildew. A wet envelope should be gently dried by keeping it cold inflated with a fan, rolling the envelope over if necessary. Hot inflating a wet envelope may cause damage to the fabric.

The basket should not be stored wet or with a covering of mud, as this will trap moisture next to the hide and wicker, leading to deterioration of the basket. The basket should be cleaned using fresh water and allowed to dry. If the basket is secured to a trailer using ratchet straps during storage, the straps should be loosened to prevent any permanent distortion.

Salt contamination of any part of the balloon and its equipment must be avoided. If any of the balloon's components become contaminated with sea water they should be washed with plenty of fresh water. Salt will cause corrosion in metal components (including stainless steel), accelerate decay in wickerwork, and adversely affect the envelope fabric and tapes.

For full cleaning instructions, reference should be made to Cameron Balloons Maintenance Manual Issue 10.

Cylinders must be stored in a well-ventilated area with no sources of ignition or excessive heat. Cylinders must not be stored near drains or cellars, where any leaked propane could collect.

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8.1 INTRODUCTION

This Section contains the appropriate supplements necessary to safely and efficiently operate the balloon when equipped with various optional systems and equipment not included in the main manual.

The balloon shall be operated in accordance with the applicable supplement when appropriate, but the content of the base Flight Manual will also apply.

Where a conflict arises between the information given in a Supplement and the information given in the base Flight Manual, the information given in a supplement takes precedence.

A list of applicable supplements is provided at the beginning of this manual.

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9.1 INTRODUCTION

This Section lists the major components which may be combined with each envelope to make a complete balloon.

9.2 EQUIPMENT LIST

Tables 5, 6, 7 and 8 list the envelopes, baskets, fuel cylinders, burners and burner frames which are compatible.

Table 5 - Envelopes

Envelope Type	Drawing Number	Applicable Burners	Applicable Baskets
A-105	CB115	B	B, C, D, E, F, G, H, I, J, K
A-120	CB617	B	C, D, E, F, G, H, I, J, K, L
A-140	CB105	B	D, E, F, G, H, I, J, K, L, M
A-160	CB653	B, C	D, E, F, G, H, I, J, K, L, M, N
A-180	CB692	B, C, D	E, F, G, H, I, J, K, L, M, N, O
A-200	CB1199	B, C, D	G, H, I, J, K, L, M, N, O, P, Q
A-210	CB199	B, C, D	G, H, I, J, K, L, M, N, O, P, Q
A-250	CB463	C, D	H, I, J, K, L, M, N, O, P, Q
A-275	CB1147	C, D	I, J, K, L, M, N, O, P, Q
A-300	CB603	C, D	K, L, M, N, O, P, Q
A-315	CB1028	C, D	K, L, M, N, O, P, Q
A-340	CB1166	D	L, M, N, O, P, Q
A-340HL	CB1148	D	L, M, N, O, P, Q
A-375	CB761	D	M, N, O, P, Q
A-400	CB1248	D	N, O, P, Q
A-415	CB1311	D	N, O, P, Q
A-530	CB197	D	N, O, P, Q
C-60	CB996	A, B	A, B, C, D, E, F, G
C-70	CB1256	A, B	A, B, C, D, E, F, G, H
C-80	CB1025	A, B	A, B, C, D, E, F, G, H, I
C-90	CB1460	A, B	A, B, C, D, E, F, G, H, I, J
C-100	CB1048	A, B	B, C, D, E, F, G, H, I, J, K
GP-65	CB1397	A, B	A, B, C, D, E, F, G, H
GP-70	CB1498	A, B	A, B, C, D, E, F, G, H

Table 5 - Envelopes (continued)

Envelope Type	Drawing Number	Applicable Burners	Applicable Baskets
N-31	CB476	A	A, B, C, D
N-42	CB476	A	A, B, C, D, E
N-56	CB476	A, B	A, B, C, D, E, F, G
N-65	CB476	A, B	A, B, C, D, E, F, G, H
N-70	CB476	A, B	A, B, C, D, E, F, G, H
N-77	CB476	A, B	A, B, C, D, E, F, G, H, I
N-90	CB476	A, B	A, B, C, D, E, F, G, H, I, J
N-100	CB476	A, B	B, C, D, E, F, G, H, I, J, K
N-105	CB476	B	B, C, D, E, F, G, H, I, J, K
N-120	CB476	B	C, D, E, F, G, H, I, J, K, L
N-133	CB476	B	C, D, E, F, G, H, I, J, K, L
N-145	CB476	B, C	D, E, F, G, H, I, J, K, L, M
N-160	CB476	B, C	E, F, G, H, I, J, K, L, M, N
N-180	CB476	B, C, D	E, F, G, H, I, J, K, L, M, N, O
N-210	CB476	B, C, D	G, H, I, J, K, L, M, N, O, P, Q
O-31	CB110	A	A, B, C, D
O-42	CB101	A	A, B, C, D, E
O-56	CB45	A, B	A, B, C, D, E, F, G
O-65	CB54	A, B	A, B, C, D, E, F, G, H
O-77	CB112	A, B	A, B, C, D, E, F, G, H, I
O-84	CB49	A, B	A, B, C, D, E, F, G, H, I
O-90	CB658	A, B	A, B, C, D, E, F, G, H, I, J
O-105	CB167	B	B, C, D, E, F, G, H, I, J, K
O-120	CB505	B	C, D, E, F, G, H, I, J, K, L
O-140	CB772	B, C	D, E, F, G, H, I, J, K, L, M
O-160	CB368	B, C	D, E, F, G, H, I, J, K, L, M, N
TR-60	CB1520	A, B	A, B, C, D, E, F, G
TR-70	CB1519	A, B	A, B, C, D, E, F, G, H
V-31	CB149	A	A, B, C, D
V-42	CB369	A	A, B, C, D, E
V-56	CB134	A, B	A, B, C, D, E, F, G
V-65	CB166	A, B	A, B, C, D, E, F, G, H
V-77	CB170	A, B	A, B, C, D, E, F, G, H, I
V-90	CB817	A, B	A, B, C, D, E, F, G, H, I, J
Z-25	CB1461	A	A, B, C
Z-31	CB1462	A	A, B, C, D
Z-42	CB1463	A	A, B, C, D, E
Z-56	CB1464	A, B	A, B, C, D, E, F, G
Z-65	CB1346	A, B	A, B, C, D, E, F, G, H
Z-69	CB1465	A, B	A, B, C, D, E, F, G, H
Z-77	CB1342	A, B	A, B, C, D, E, F, G, H, I
Z-90	CB1340	A, B	A, B, C, D, E, F, G, H, I, J
Z-105	CB1345	B	B, C, D, E, F, G, H, I, J, K

Table 5 - Envelopes (continued)

Envelope Type	Drawing Number	Applicable Burners	Applicable Baskets
Z-120	CB1348	B	C, D, E, F, G, H, I, J, K, L
Z-133	CB1349	B	C, D, E, F, G, H, I, J, K, L
Z-140	CB1477	B, C	D, E, F, G, H, I, J, K, L, M
Z-145	CB1350	B, C	D, E, F, G, H, I, J, K, L, M
Z-150	CB1473	B, C	D, E, F, G, H, I, J, K, L, M
Z-160	CB1351	B, C	D, E, F, G, H, I, J, K, L, M, N
Z-180	CB1352	B, C, D	E, F, G, H, I, J, K, L, M, N, O
Z-210	CB1353	B, C, D	G, H, I, J, K, L, M, N, O, P, Q
Z-225	CB1466	C, D	G, H, I, J, K, L, M, N, O, P, Q
Z-250	CB1459	C, D	H, I, J, K, L, M, N, O, P, Q
Z-275	CB1467	C, D	I, J, K, L, M, N, O, P, Q
Z-315	CB1468	C, D	K, L, M, N, O, P, Q
Z-350	CB1469	D	L, M, N, O, P, Q
Z-375*	CB1470	D	M, N, O, P, Q
Z-400*	CB1471	D	N, O, P, Q
Z-425LW	CB1502	D	N, O, P, Q
Z-450*	CB1472	D	N, O, P, Q
Z-600	CB1565	D	N, O, P, Q
Thunder 65 S1	CB1136	A, B	A, B, C, D, E, F, G, H
Thunder 77 S1	CB1080	A, B	A, B, C, D, E, F, G, H, I
Thunder 90 S1	CB1113	A, B	A, B, C, D, E, F, G, H, I, J
Thunder 105 S1	CB1107	B	B, C, D, E, F, G, H, I, J, K
Thunder 120 S1	CB1137	B	C, D, E, F, G, H, I, J, K, L
Thunder 140 S1	CB1214	B, C	D, E, F, G, H, I, J, K, L, M
Thunder 160 S1	CB1138	B, C	D, E, F, G, H, I, J, K, L, M, N
Thunder 180 S1	CB1139	B, C, D	E, F, G, H, I, J, K, L, M, N, O
Thunder 90 S2	CB1082	A, B	A, B, C, D, E, F, G, H, I, J
Thunder 105 S2	CB1089	B	B, C, D, E, F, G, H, I, J, K
Thunder 120 S2	CB1105	B	C, D, E, F, G, H, I, J, K, L
Thunder 140 S2	CB1079	B, C	D, E, F, G, H, I, J, K, L, M
Thunder 150 S2	CB1334	B, C	D, E, F, G, H, I, J, K, L, M
Thunder 160 S2	CB1140	B, C	D, E, F, G, H, I, J, K, L, M, N
Thunder 180 S2	CB1141	B, C, D	E, F, G, H, I, J, K, L, M, N, O
Thunder 210 S2	CB1142	B, C, D	G, H, I, J, K, L, M, N, O, P, Q
Thunder 225 S2	CB1200	C, D	G, H, I, J, K, L, M, N, O, P, Q
Thunder 250 S2	CB1194	C, D	H, I, J, K, L, M, N, O, P, Q

* These envelopes must be rigged using 4 tonne karabiners (Stubai 982501 Karabiners (marked 'SYM OVAL 4000 UIAA').

Table 5 - Envelopes (continued)

Envelope Type	Drawing Number	Applicable Burners	Applicable Baskets
Colt 25A	CB1461	A	A, B, C
Colt 31A	CB1462	A	A, B, C, D
Colt 42A	CB1463	A	A, B, C, D, E
Colt 56A	CB1464	A, B	A, B, C, D, E, F, G
Colt 65A	CB1346	A, B	A, B, C, D, E, F, G, H
Colt 69A	CB1465	A, B	A, B, C, D, E, F, G, H
Colt 77A	CB1342	A, B	A, B, C, D, E, F, G, H, I
Colt 90A	CB1340	A, B	A, B, C, D, E, F, G, H, I, J
Colt 105A	CB1345	B	B, C, D, E, F, G, H, I, J, K
Colt 120A	CB1348	B	C, D, E, F, G, H, I, J, K, L
Colt 133A	CB1349	B	C, D, E, F, G, H, I, J, K, L
Colt 140A	CB1477	B, C	D, E, F, G, H, I, J, K, L, M
Colt 150A	CB1473	B, C	D, E, F, G, H, I, J, K, L, M
Colt 160A	CB1351	B, C	D, E, F, G, H, I, J, K, L, M
Colt 180A	CB1352	B, C, D	D, E, F, G, H, I, J, K, L, M, N
Colt 210A	CB1353	B, C, D	E, F, G, H, I, J, K, L, M, N, O
Colt 225A	CB1466	C, D	G, H, I, J, K, L, M, N, O, P, Q
Colt 240A	CB1128	C, D	G, H, I, J, K, L, M, N, O, P, Q
Colt 250A	CB1459	C, D	H, I, J, K, L, M, N, O, P, Q
Colt 260A	CB1129	C, D	I, J, K, L, M, N, O, P, Q
Colt 275A	CB1467	C, D	K, L, M, N, O, P, Q
Colt 315A	CB1468	C, D	L, M, N, O, P, Q
Colt 350A	CB1469	D	M, N, O, P, Q
Colt 375A	CB1470	D	N, O, P, Q
Colt 400A	CB1471	D	N, O, P, Q
Colt 450A	CB1472	D	N, O, P, Q

Table 6 - Baskets

Basket Category	Drawing Number	Basket Description*	Applicable Cylinders	Applicable Burner Frames
A	CB8320	HOPPER	1, 2, 3	-
A	CB8310	SINGLE AIRCHAIR	4	SINGLE AIRCHAIR
B	CB8340	DUO AIRCHAIR	5	DUO AIRCHAIR
B	CB3116	VOYAGER 11	1, 2	CB2235, CB2358, CB2533
B	CB3037	LITE	1	CB2356
B	CB310-1A	31 - 42 O	1a, 1, 2	CB2598, CB2224, CB2203, CB2231, CB2874, CB2226, CB871
C	CB300-2A	56 - 65 O	1a, 1, 2	CB2598, CB2224, CB2203, CB2231, CB2874, CB2226, CB871
C	CB310-2A	56 - 65 O	1a, 1, 2	CB2598, CB2224, CB2203, CB2231, CB2874, CB2226, CB871
C	CB3050-2	56 - 65 O	1a, 1, 2	CB2598, CB2224, CB2203, CB2231, CB2874, CB2226
C	CB3115-2	56 - 65 O	1a, 1, 2	CB2598, CB2224, CB2203, CB2231, CB2874, CB2226
C	CB3011-2A	56 - 65 H O	1a, 1, 2, 3	CB2598, CB2224, CB2203, CB2231, CB2874, CB2226, CB925
C	CB3023-2	56 - 65 H O	1a, 1, 2, 3	CB2598, CB2224, CB2203, CB2231, CB2874, CB2226, CB925
C	CB3011-2B	56 - 65 H O	1a, 1, 2, 3	CB2598, CB2224, CB2203, CB2231, CB2874, CB2226, CB925
C	CB3051	C 60 / 70 O	1a, 1, 2	CB2203, CB2598, CB2562, CB2224, CB2560, CB2231, CB2874, CB2226
D	CB300-3A	77 - 84 O	1a, 1, 2	CB2598, CB2224, CB2203, CB2231, CB2874, CB2226, CB871
D	CB310-3A	77 - 84 O	1a, 1, 2	CB2598, CB2224, CB2203, CB2231, CB2874, CB2226, CB871
D	CB3050-3	77 - 84 O	1a, 1, 2	CB2598, CB2224, CB2203, CB2231, CB2874, CB2226
D	CB3115-3	77 - 84 O	1a, 1, 2	CB2598, CB2224, CB2203, CB2231, CB2874, CB2226
D	CB3011-3A	77 - 84 H O	1a, 1, 2, 3	CB2598, CB2224, CB2203, CB2231, CB2874, CB2226
D	CB3023-3	77 - 84 H O	1a, 1, 2, 3	CB2598, CB2224, CB2203, CB2231, CB2874, CB2226
D	CB3011-3B	77 - 84 H O	1a, 1, 2, 3	CB2598, CB2224, CB2203, CB2231, CB2874, CB2226
D	CB3052	C 80 / 90 O	1a, 1, 2	CB2598, CB2224, CB2203, CB2231, CB2874, CB2226
D	CB8012	65 - 77 O	1a, 1, 2	CB8810, CB8811, CB8020, CB8021, CB8902, CB8903, CB8894, CB8821
D	CB8017	65 - 77 H O	1a, 1, 2, 3	CB8810, CB8811, CB8020, CB8021, CB8902, CB8903, CB8894, CB8821
D	CB8001	65 - 77 O	1a, 1, 2	CB8810, CB8811, CB8020, CB8021, CB8902, CB8903, CB8894, CB8821
D	CB8006	65 - 77 H O	1a, 1, 2, 3	CB8810, CB8811, CB8020, CB8021, CB8902, CB8903, CB8894, CB8821
D	CB8013	77 - 90 O	1a, 1, 2	CB8810, CB8811, CB8020, CB8021, CB8902, CB8903, CB8894, CB8821
D	CB8018	77 - 90 H O	1a, 1, 2, 3	CB8810, CB8811, CB8020, CB8021, CB8902, CB8903, CB8894, CB8821
D	CB8002	77 - 90 O	1a, 1, 2	CB8810, CB8811, CB8020, CB8021, CB8902, CB8903, CB8894, CB8821
D	CB8007	77 - 90 H O	1a, 1, 2, 3	CB8810, CB8811, CB8020, CB8021, CB8902, CB8903, CB8894, CB8821
E	CB300-4A	90 - 105 O	1a, 1, 2	CB2598, CB2224, CB2203, CB2231, CB2874, CB2226, CB871
E	CB310-4A	90 - 105 O	1a, 1, 2	CB2598, CB2224, CB2203, CB2231, CB2874, CB2226, CB871
E	CB3050-4	90 - 105 O	1a, 1, 2	CB2598, CB2224, CB2203, CB2231, CB2874, CB2226
E	CB3115-4	90 - 105 O	1a, 1, 2	CB2598, CB2224, CB2203, CB2231, CB2874, CB2226
E	CB3011-4A	90 - 105 H O	1a, 1, 2, 3	CB2598, CB2224, CB2203, CB2231, CB2874, CB2226, CB925
E	CB3023-4	90 - 105 H O	1a, 1, 2, 3	CB2598, CB2224, CB2203, CB2231, CB2874, CB2226, CB925
E	CB3011-4B	90 - 105 H O	1a, 1, 2, 3	CB2598, CB2224, CB2203, CB2231, CB2874, CB2226, CB925
E	CB8014	90 - 105 O	1a, 1, 2	CB8810, CB8811, CB8020, CB8021, CB8902, CB8903, CB8894, CB8821
E	CB8019	90 - 105 H O	1a, 1, 2, 3	CB8810, CB8811, CB8020, CB8021, CB8902, CB8903, CB8894, CB8821
E	CB8003	90 - 105 O	1a, 1, 2	CB8810, CB8811, CB8020, CB8021, CB8902, CB8903, CB8894, CB8821
E	CB8008	90 - 105 H O	1a, 1, 2, 3	CB8810, CB8811, CB8020, CB8021, CB8902, CB8903, CB8894, CB8821
F	CB3320	105 - 120 P W	1a, 1, 2	CB3321, CB3322
F	CB8015	105 - 120 O	1a, 1, 2	CB8822, CB8823, CB8824, CB8825, CB8830, CB8831
F	CB8020	105 - 120 H O	1a, 1, 2, 3	CB8822, CB8823, CB8824, CB8825, CB8830, CB8831
F	CB8004	105 - 120 O	1a, 1, 2	CB8822, CB8823, CB8824, CB8825, CB8830, CB8831
F	CB8009	105 - 120 H O	1a, 1, 2, 3	CB8822, CB8823, CB8824, CB8825, CB8830, CB8831
F	CB8200	105 - 120 T	1a, 1, 2, 3	CB8822, CB8823, CB8824, CB8825, CB8830, CB8831

* For key see page 9-6

Table 6 - Baskets (continued)

Basket Category	Drawing Number	Basket Description*	Applicable Cylinders	Applicable Burner Frames
G	CB303	20 - 133 O	1a, 1, 2, 3	CB2309, CB2312
G	CB3238	120 - 133 P	1a, 1, 2, 3	CB2470, CB2468
G	CB3233	120 - 133 T	1a, 1, 2, 3	CB2470, CB2468
H	CB991	140 T	1a, 1, 2, 3	CB2264, CB2263
H	CB3060	140 T W	1a, 1, 2, 3	CB2266, CB2265
H	CB3376	140 T	1a, 1, 2, 3	CB2264, CB2263
H	CB8266	120 - 160 T	1a, 1, 2, 3	CB8822, CB8823, CB8824, CB8825, CB8830, CB8831
I	CB3310	160 -180 T	1a, 1, 2, 3	CB2590, CB2591
I	CB8206	160 - 210 TT	1a, 1, 2, 3	CB8826, CB8827, CB8832, CB8833, CB8840, CB8841, CB8829, CB8828, CB8835, CB8836
J	CB754	180 - 210 TT	1a, 1, 2, 3	CB2420, CB2411, CB2261
K	CB3164	210 TT Os	1a, 1, 2, 3	CB2250, CB2303
L	CB3314	210 - 250 T	1a, 1, 2, 3	CB2505, CB2592
L	CB3081	210 - 250 TT W	1a, 1, 2, 3	CB2260, CB2304
M	CB3004	250 TT	1a, 1, 2, 3	CB2250, CB2303
M	CB971	250 TT D	1a, 1, 2, 3	CB2260, CB2304
M	CB3387	250TT	1a, 1, 2, 3	CB2613, CB2614
N	CB3200	275 TT Os	1a, 1, 2, 3	CB2427, CB2447
O	CB3042	300 TT	1a, 1, 2, 3	CB2270, CB2258
O	CB3040	300 TT D	1a, 1, 2, 3	CB2271, CB2259
O	CB3049	300 TT S	1a, 1, 2, 3	CB2272, CB2269
O	CB3235	300 TT	1a, 1, 2, 3	CB2390
O	CB3223	300 TT S	1a, 1, 2, 3	CB2427, CB2447
O	CB8250	350 TT	1a, 1, 2, 3	CB8842, CB8843
O	CB3360	350 TT	1a, 1, 2, 3	CB2418
P	CB3205	400 TT S	1a, 1, 2, 3	CB2418
Q	CB3288	400 - 410 TT S	1a, 1, 2, 3	CB2418
R	CB3370	600 TT S	1a, 1, 2, 3	CB2376

*** Key-** O = Open; P= single partition; T = T partition; TT = double T partition; Os = offset; D = designed for use in Germany; S = Designed for use on African Safaris; W = wheelchair access.

Table 7 - Fuel Cylinders

Cylinder Category	Drawing Number	Cylinder Material	Cylinder Description
1a	CB901	ALUMINIUM	MINI WORTHINGTON
1	CB250	ALUMINIUM	WORTHINGTON
2	CB426	STAINLESS STEEL	60
2	CB497	STAINLESS STEEL	40
2	CB599	STAINLESS STEEL	40
3	CB959	STAINLESS STEEL	80
3	CB2088	STAINLESS STEEL	T60
2	CB2900	DUPLEX STAINLESS STEEL	45
2	CB2901	DUPLEX STAINLESS STEEL	60
3	CB2902	DUPLEX STAINLESS STEEL	54
3	CB2903	DUPLEX STAINLESS STEEL	72
2	V20-100-00	STAINLESS STEEL	T&C V20
2	V30-100-00	STAINLESS STEEL	T&C V30
3	V40-100-00	STAINLESS STEEL	T&C V40
2	CB2380S	TITANIUM	60
3	CB2383S	TITANIUM	80
2	CB2385S	TITANIUM	40
3	CB2387S	TITANIUM	T60
2	A0/V30	STAINLESS STEEL	SKY V30
3	A0/V40	STAINLESS STEEL	SKY V40
4	CB8414	STAINLESS STEEL	H30
5	CB8424	STAINLESS STEEL	H40

Table 8 - Burners

Shadow, Stealth and Stratus burners have their pilot light configuration denoted, with the following drawing numbers being appended with -1 for vapour, -2 for liquid or -3 for mixed vapour and liquid.

Table 8 - Burners (continued)

Burner Category	Drawing Number	Burner Description
A	CB2245	Single Shadow, Fixed Frame
A	CB2246	Single Shadow, Adjustable Height Frame
A	CB2512	Single Shadow, Fixed Frame Removable Burner
A	CB2233	Single Shadow Mini, Fixed Frame
A	CB2538	Single Shadow Mini, Removable Burner
A	CB8710	Single Stratus, Liquid Pilot Light
A	CB8712	Single Stratus, Vapour Pilot Light
B	CB2222	Double Shadow, Fixed Frame
B	CB2433	Double Shadow Solenoid Valve, Fixed Frame
B	CB2215	Double Shadow, Adjustable Height Frame
B	CB2243	Double Shadow / Stealth, Fixed Frame
B	CB2251	Double Shadow Solenoid Valve / Stealth Solenoid Valve, Fixed Frame
B	CB2244	Double Shadow / Stealth, Adjustable Height Frame
B	CB2694	Double Sirocco, Fixed Frame
B	CB2691	Double Sirocco E.P., Fixed Frame
B	CB2695	Double Sirocco, Adjustable Height Frame
B	CB8720	Double Stratus, Liquid Pilot Light
B	CB8721	Double Stratus, Vapour Pilot Light
C	CB2255	Triple Shadow
C	CB2520	Triple Shadow, Squeeze Bar Action, with Crossflow
C	CB2301	Triple Stealth (double) / Shadow (single)
C	CB2289	Triple Shadow (double) / Stealth (single)
C	CB2446	Triple Shadow / Stealth (double) ‘ Shadow (single)
C	CB2459	Triple Stealth (double) / Shadow (single), Squeeze bar Action
C	CB2467	Triple Shadow (double) / Stealth (single), Squeeze bar Action
C	CB2469	Triple Shadow / Stealth (double) / Shadow (single), Squeeze bar Action
C	CB2696	Triple Sirocco
C	CB2692	Triple Sirocco E.P.
C	CB8730	Triple Stratus, Liquid Pilot Light.
C	CB8731	Triple Stratus, Liquid Pilot Light, ‘T’ Baskets
C	CB8732	Triple Stratus, Liquid Pilot Light, ‘TT’ Baskets
C	CB8733	Triple Stratus, Vapour Pilot Light
C	CB8734	Triple Stratus, Vapour Pilot Light, ‘T’ Baskets
C	CB8735	Triple Stratus, Vapour Pilot Light, ‘TT’ Baskets
D	CB2256	Quad Shadow
D	CB2351	Quad Shadow, Dual Squeeze Bar
D	CB2305	Quad Shadow (double) / Stealth (double)
D	CB2342	Quad Shadow (double) / Stealth (double), Dual Squeeze Bar
D	CB2395	Quad Shadow / Stealth (double) / Shadow / Stealth (double)
D	CB2697	Quad Sirocco
D	CB2693	Quad Sirocco E.P.
D	CB8740	Quad Stratus, Liquid Pilot Light
D	CB8741	Quad Stratus, Liquid Pilot Light, Crossflow
D	CB8742	Quad Stratus, Vapour Pilot Light
D	CB8743	Quad Stratus, Vapour Pilot Light, Crossflow

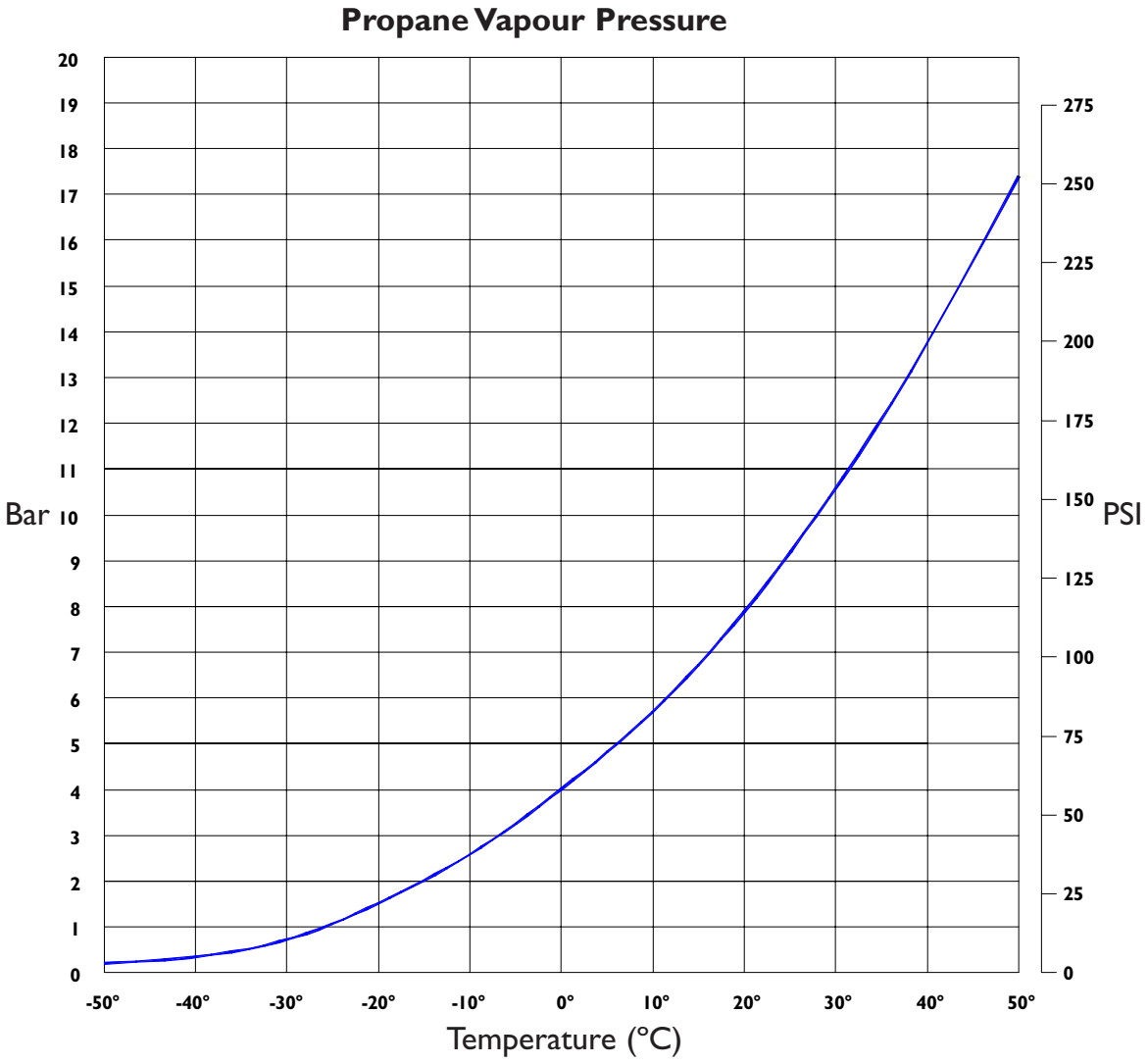
Appendix 1 - Notes On Propane Fuel

Propane is a petroleum hydrocarbon, chemical formula C_3H_8. At normal temperatures and pressures it is a vapour, but it is stored as a liquid under pressure.

Propane is in its pure state colourless and odourless, and is heavier than air (1.5 times as dense). To reduce the risk of a propane leak going undetected a sulphur compound is added to give it a noticeable smell.

The requirements for commercial propane vary from country to country. Propane may contain 'heavy ends' which are long-chain hydrocarbons (oils and greases) or water. Special care is required when using commercial cylinders for the supply of propane as these are generally used for vapour supply, allowing heavy ends and water to collect in the bottom of the cylinder. Heavy ends may contaminate the fuel system (especially the vapour side) necessitating stripping and cleaning. Water may freeze in the cylinders and obstruct the liquid fuel flow.

Commercial propane will also contain some amount of butane (C_4H_{10}). Butane is also deliberately added to propane, particularly in hot countries, in order to reduce the vapour pressure. Butane has similar properties to propane, differing mainly in its vapour pressure which is substantially lower.



A small proportion of butane in the fuel is acceptable, provided that the fuel pressure does not drop below the minimum required for flight.

The storage of the fuel under pressure is an advantage as it allows the operation of a very high output burner without a pump, but since burner power is directly related to the fuel pressure, lower burner power is obtained in winter.

Liquid propane expands rapidly with increasing temperature, making it essential to never completely fill a storage cylinder. The fixed liquid level gauge (bleed valve) is set to release liquid when the cylinder is approximately 80% full leaving sufficient vapour space to allow for normal levels of fuel expansion.

Further protection from high temperatures and overfilling is provided by a pressure relief valve in the cylinder. This valve is set to open at approximately 26bar (375psi).

Large amounts of heat are required to change propane from a liquid to a gas. This is the reason the burner uses liquid fuel, drawn from the bottom of a cylinder via a dip tube. If vapour were drawn off at the high rates required then the cylinder would rapidly cool and lose pressure.

A vapour pilot light draws propane vapour from the top of the cylinder via a pressure regulator. Occasionally when the cylinder is on its side during inflation liquid propane will enter the regulator. The evaporation of propane inside the regulator will cause frost to form on the outside and the regulator may perform erratically or leak slightly.

Appendix 2 - Lift Calculations For Balloons

The lift of a hot air balloon may be calculated as follows-

$$T_a = T_g - (0.0065 \times H)$$

$$P = 1013.25 \times \left[1 - \frac{0.0065 \times H}{273.16 + T_g} \right]^{5.256}$$

$$L = 0.3484 \times V \times P \times \left[\frac{1}{T_a + 273.16} - \frac{1}{T_i + 273.16} \right]$$

where L = total lift of the balloon in kg
V = envelope volume in m^3
P = air pressure in hPa / mB
H = planned flight altitude in m
T_i = average internal envelope temperature in °C (Maximum of 100 °C)
T_a = ambient temperature at flight altitude in °C
T_g = ambient temperature at ground level in °C

ISA standard atmosphere is assumed.

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Table 9 - Fuel Cylinder Weights And Volumes

Cylinder Material	Cylinder Type	Volume (Litres)		Configuration	(Including Cover & Straps)			
					Empty Weight		Full Weight	
		Total	Usable		kg	lb	kg	lb
Aluminium	Worthington	47	38	Master	15	33	34	75
				Standard	14	31	33	73
Stainless Steel	'40' CB599	51	41	Master	20	44	41	90
				Standard	19	42	40	88
	'T60' CB2088	65	52	Master	23	50	50	110
				Standard	22	48	49	108
	'60' CB426	69	55	Master	22	48	51	112
				Standard	21	46	50	110
	'80' CB959	88	70	Master	26	57	62	137
				Standard	25	55	61	135
Duplex Stainless Steel	'45' CB2900	56	45	Master	21	46	44	96
				Standard	20	44	43	94
	'60' CB2901	75	60	Master	23	51	53	117
				Standard	22	49	52	115
	'54' CB2902	68	54	Master	24	53	51	113
				Standard	23	51	50	132
	'72' CB2903	90	72	Master	27	60	63	139
				Standard	26	57	62	137
Titanium	'40' CB2385	51	41	Master	11	24	34	75
				Standard	10	22	33	73
	'T60' CB2387	65	52	Master	14	31	41	90
				Standard	13	29	40	88
	'60' CB2380	70	56	Master	14	31	43	95
				Standard	13	29	42	93
	'80' CB2383	88	70	Master	15	33	52	114
				Standard	14	31	51	112

Table 10 - Burner Weights

Burner (Including Karabiners)		kg	lb
[1] Single	(Shadow / Stratus)	17	37
[1] Double	(Shadow / Stealth / Sirocco / Stratus)	24	53
[2] Triple	(Shadow / Stealth / Sirocco / Stratus)	44	97
[2] Quad	(Shadow / Stealth / Sirocco / Stratus)	52	115

[1] In adjustable height frame add 3kg / 7lb

[2] If metal heat shields are fitted add 7kg / 15lb

Note- The component weights given in table 11, and table 12 are approximate and for guidance purposes only. For pre-flight weight calculations, the actual component weights given in Table 4 and the aircraft log book should be used.

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Introduction

In addition to the limitations in Section 2 and Section 5, the following factors should be considered when determining how many occupants a particular basket can carry for a particular flight. The guidance below assumes that a standard occupant is an adult of 77kg mass.

The pilot should also take into account the relative masses and sizes of the passengers when loading partitioned baskets to evenly distribute the payload.

Maximum Occupancy

For all baskets, a minimum 0.25m^2, floor area should be allowed for each standard occupant.

When calculating the number of occupants, the area used by items of other equipment (e.g. fuel cylinders) must be subtracted from the total area.

For the purposes of these calculations the floor area taken up by single fuel cylinders can be taken as 0.1m^2 for "large" diameter cylinders (e.g. CB2901) and 0.09 m^2 small diameter cylinders (e.g. CB2900).

Example

If we consider the following example;

Envelope; Z-140,

Basket; CB303,

Double Burner; CB2694,

Fuel for 1 hour flight with reserve; CB2901x2 and CB2900 x1

Limitation on occupancy by floor area;

Floor area of basket (to frame tube centre-lines) = 1.1x1.78 = 1.96 m^2

Floor area of equipment = [0.1x2] +0.09 = 0.29 m^2

Available floor area for occupants = 1.96 – 0.29 m^2 = 1.67 m^2

Total maximum number of occupants = 1.67 / 0.25 = 6.68 = 6 standard occupants

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