

HOT AIR BALLOON FLIGHT MANUAL

Approved by EASA under Approval Number EASA.BA.A.01000 on 10 April 2006.

This manual forms part of EASA Type Certificates EASA.BA.012 and EASA.BA.013. Following initial certification as shown above, any subsequent revisions to this manual shall either be directly approved by EASA or be approved under the authority of Cameron Balloons Limited, DOA No. EASA 21J.140.

Any revisions/supplements made by other Approved Organisations must be separately approved

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.

Signed _____ Name _____ Date _____

Authority _____

Manufacturer:

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Record Of MTOM Amendments

Applicable MTOM	Date Of Change	Signature

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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 payloads and minimum burner requirements in accordance 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 AX6-56SI. 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
3	Page 9-6 Burner frame applicabilities corrected, key updated, Page 9-8: Assembly CB2424 added, Supplement 8.8: Cameron Burners Added; Supplement 8.9: Baskets K12/K12A/K15 added, Cameron Burners Added. Supplement 8.21: T&C Burner Frame applicabilities updated, key updated.	i-iii, i-vii, i-ix, 9-6, 9-8, Supplement 8.8: All, Supplement 8.9: All, Supplement 8.21: All	01:02:2008	Revision nr Amendment 3 to AFM ref. HABFM-Issue 10 is approved under the authority of DOA nr EASA.21J.140
4	Section 2: Permitted Damage limits revised, TR-77 Variant added. Section 6: TR-77 added, Section 9: TR-77 added, Supplements 8.1 Issue 10: Satzenburger Bottle 56, Colt Flying Jeans, Cameron Cabin and Box 105 added. Supplement 8.2 "Kevron" Load Tapes added, 8.16 Single Airchair added, Supplement 8.21: Issue 6 Basket CB8280 added. Supplement 8.22: Issue 3 Burner assemblies CB2103, CB2104, CB2119 and CB2242 added.	i-iii, i-vii, i-ix, Page 2-2 to 2-6, 6-2, 9-2, 9-3. Supplement 8.1: All, Supplement 8.2: New Supplement 8.16: New Supplement 8.21: Issue 6 Supplement 8.22: Issue 3	03.03.08	Approved by EASA under Approval Number EASA.BA.C.01145

Amendment Number	Description	Pages Affected	Date	Approval
5	<p>Approval statement revised, Record of Amendments updated, List of effective pages updated, List of supplements removed (now on website).</p> <p>Section 1: Clarification of amendment procedure, Type certificate references now in title only “envelopes” added to Section 1.5.</p> <p>Section 2: Limitations Format revised, 2.17 Z-425LW added, Table 1 now only lists volumes (not variant prefixes).</p> <p>Section 8: Supplement Section revised to allow the use of approved data from old manuals</p> <p>Section 9: Table 8-CB294I added</p> <p>Appendix 2 Load Calculation revised</p> <p>Supplement 1: Egg-120 (new), House-60, Can-60, Newspaper 90, Flying Lager Bottle 2, Tub-80, Club-90 (all approved data) added.</p> <p>Supplement 9: Ignis double and triple burner added</p> <p>Supplement 21: CB310-5A, CB994, CB3380 and CB3482 added, Type 2 Cylinders added to CB3018</p>	<p>i-i, i-iv, i-vii, i-ix, i-x,</p> <p>1-1, 1-2</p> <p>2-1, 2-2, 2.5, 2.6, 2-7</p> <p>8-1</p> <p>A2-1</p> <p>All</p> <p>All</p> <p>All</p>	31:07:2008	<p>Approved by EASA under Approval Number EASA.BA.C.01161</p>

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APPROVAL

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I.1 INTRODUCTION

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

Revisions to this Manual are published on the Cameron Balloons Limited website at www.cameronballoons.co.uk. Mandatory revisions to this manual will be introduced by Service Bulletin.

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

I.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: Conventionally shaped envelopes

EASA.BA.012: Cameron 'Special' shaped envelopes

I.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.

I.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.

I.5 USE OF OLDER TYPES OF EQUIPMENT

Older types of envelopes, baskets and burners not listed in Issue 10 of Flight Manual may be used provided the appropriate approved Cameron Balloons Flight Manual supplement is used.

The weights of the envelope 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.

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 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. Main and whisper burners must not be operated on a vapour fuel supply.
2. 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.

2.3.1 Fuel Pressures

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

	Balloons <340,000 ft ³ (9630m ³)	Balloons >340,000 ft ³	Balloons >340,000 ft ³ using Shadow, Sirocco or Stratus burners
Maximum fuel Pressure	15 Bar (215 psi)	15 Bar	15 Bar
Minimum fuel Pressure	3 Bar (44 psi)	7 Bar (102 psi)	5.5 bar (80 psi)

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

2.4 MINIMUM BURNER REQUIREMENTS

Burner Configuration	Permitted Envelope Volume
Single	17,000 ft ³ (481 m ³) - 105,000 ft ³ (2975 m ³)
Double	56,000 ft ³ (1585m ³) - 210,000 ft ³ (5950 m ³)
Triple	140,000 ft ³ (3970 m ³) - 315,000 ft ³ (8920 m ³)
Quad	180,000 ft ³ (5100 m ³) - 600,000 ft ³ (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 1.5 m (60") in any direction.
4. Damage to fabric in areas above that defined in 3, but below the upper part of the envelope (defined as the area above the widest horizontal seam between two vertical load tapes) is limited to holes or tears smaller than 50 mm (2") in any direction. The distance between two adjacent holes must not be less than four times the maximum dimension of the larger hole. There must be not more than 15 holes in this section of the envelope and no more than 5 in any one panel.
5. Damage to the fabric in the upper part of the envelope is limited to holes or tears smaller than 12 mm (½") in any direction. The distance between two adjacent holes must not be less than 50mm (2"). There must be not more than 15 holes in this section of the envelope and there must not be more than 5 holes in any one panel.
6. Any damage outside these limitations must be repaired in accordance with the instructions contained in the Maintenance Manual. Permitted damage, other than that specified in 3, must be repaired prior to an annual or 100 hour inspection.

Note: If any two or more small holes lie within a circle of the same diameter as a permitted hole, they may be considered as one hole for the purposes of paragraphs 4 and 5.

2.14 TETHERED FLIGHT

Limitations	Balloons <340,000 ft ³ (9630m ³)	Balloons >340,000 ft ³
Maximum Surface wind speed	15 knots (7.7 m/sec)	10 knots (5.1 m/sec)
Maximum Surface wind speed with passengers	10 knots (5.1 m/sec)	
Maximum Height above ground (measured from underside of basket)	30m (100ft)	
Maximum Take-Off Mass	limited to 75% of the standard MTOM.	

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. There 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, Z-425LW and Z-450.

TABLE I - ENVELOPE WEIGHT LIMITS AND VOLUMES

Variant	Volume		Standard MTOM		Reduced MTOM		FAI Class. AX
	ft ³	m ³	kg	lb	kg	lb	
25	25 000	708	227	500	227	500	4
31	31 450	890	285	629	285	629	4
42	42 000	1190	381	840	381	840	5
56	56 000	1586	508	1120	499	1100	6
60	60 000	1700	544	1200	499	1100	7
65	65 000	1841	590	1300	499	1100	7
69	69 000	1954	626	1380	499	1100	7
70	70 000	1982	635	1400	499	1100	7
77	77 500	2195	703	1550	499	1100	7
80	80 000	2266	726	1600	499	1100	8
84	84 000	2379	762	1680	499	1100	8
90	90 000	2549	816	1800	499	1100	8
100	100 000	2832	907	2000	907	2000	8
105	105 000	2974	952	2100	952	2100	8
120	120 000	3398	1088	2400	999	2202	9
133	133 000	3767	1206	2660	999	2202	9
140	140 000	3965	1270	2800	999	2202	9
145	145 000	4106	1315	2900	999	2202	10
150	150 000	4248	1361	3000	999	2202	10
160	160 000	4531	1451	3200	999	2202	10
180	180 000	5098	1633	3600	999	2202	10
200	200 000	5664	1814	4000	999	2202	10
210	210 000	5947	1905	4200	999	2202	10
225	225 000	6372	2041	4500	1999	4406	11
240	240 000	6797	2177	4800	1999	4406	11
250	250 000	7080	2268	5000	1999	4406	11
260	260 000	7363	2358	5200	1999	4406	11
275	275 000	7788	2494	5500	1999	4406	11
300	300 000	8496	2721	6000	2699	5951	11
315	315 000	8920	2857	6300	2699	5951	11
340	340 000	9629	2857	6300	2699	5951	12

Table I - Envelope Weight Limits And Volumes (continued)

Variant	Volume		Standard MTOM		Reduced MTOM		FAI Class. AX
	ft ³	m ³	kg	lb	kg	lb	
340 HL	340 000	9629	3084	6800	2699	5951	12
350	350 000	9912	3175	7000	2699	5951	12
375	375 000	10620	3401	7500	2699	5951	12
400	400 000	11328	3628	8000	2699	5951	12
415	415 000	11753	3764	8300	2699	5951	12
425LVV	425 000	12036	3662	8075	2699	5951	13
450	450 000	12744	4082	9000	2699	5951	13
530	530 000	15010	4807	10600	2699	5951	13
600	600 000	16992	5089	11215	5089	11215	13

Note: Table I lists the complete range of envelopes produced by Cameron Balloons Limited.

The applicable envelope data in Table I 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.

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8.1 INTRODUCTION

This Section contains the appropriate supplements and additional approved data 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 and/or additional approved data 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/or additional approved data and the information given in the base Flight Manual, the information given in a supplement takes precedence.

A complete list of Supplements is available on the Cameron Balloons Limited website.

Note: Supplements are updated independently of the base flight manual. It is not necessary to update supplements issued with a specific balloon unless notified by Service Bulletin.

8.2 LIST OF SUPPLEMENTS INSERTED

Date of Insertion	Doc. Ref	Description

Signed _____ Name _____ Date _____

Authority _____

8.3 ADDITIONAL DATA

When the envelope detailed in the approval section is being used in conjunction with

.....
(insert details of basket/burner)

the following approved data must be used.

.....
(insert document title, section and paragraph reference)

Signed _____ Name _____ Date _____

Authority _____

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	CB2424	Triple Shadow, Crossflow to Single Burner
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	CB2941	Triple Shadow (double) / Stealth (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

The lift of a hot air balloon at a given flight altitude may be calculated as follows:

$$T_a = T_g - [0.0065 \times (A - E_g)]$$

$$P = 1013.25 \times \left[1 - \frac{(0.0065 \times A)}{288.16} \right]^{5.256}$$

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

where

- A = maximum planned flight altitude in m
- E_g = elevation of take-off site above sea level in m
- L = total lift of the balloon in kg
- P = air pressure at maximum planned flight altitude in hPa / mB
- T_a = ambient temperature at flight altitude in °C
- T_g = ambient temperature at take-off site elevation in °C
- T_i = average internal envelope temperature in °C (Maximum of 100 °C)
- V = envelope volume in m³

ISA environmental lapse rate is assumed.

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