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### Airworthiness Certification Requirements- Manned Free Balloons

#### 1. APPLICATION

1.1 The following AIC serves to sensitize the industry about the requirements for Airworthiness Certification for the Manned Free Balloon operating commercially in Botswana for the purposes of Civil Aviation (Airworthiness) and (Approved Maintenance Organizations) Regulations, 2012.

#### 2. DEFINITIONS

**'Hot-air airship'** means a power driven lighter-than-air aircraft where buoyancy is provided by hot air.

**'Time-in-service'** means the time-in-service of the balloon or balloon component from initiation of burner operation prior to flight until cessation of burner operation at the completion of flight.

**'Major repair'** means the repair of damage which involves the replacement of more than one panel in the upper half of the envelope or more than three adjacent panels in the lower half of the envelope or load tape repairs or replacement. In addition, the making of any repair to the suspension system or any repair to the burner system other than seal replacement or the cleaning of jets constitutes a major repair.

**'Manned balloon'** means a non-power-driven lighter-than-air aircraft capable of carrying one or more persons and equipped with controls to permit the pilot to control the altitude of the aircraft.

A manned balloon consists of three components:

- Envelope
- Burner system
- Basket.

A Certificate of Airworthiness can only be issued for the complete balloon not for the individual components.

Only approved combinations of the three components (envelope, burner system and basket) may be fitted to a balloon.

Baskets and burners may be interchanged in accordance with approved specifications without requiring the reissue of the Certificate of Airworthiness. However, the interchange of the basket and/or burner on a FOT (First Of Type) / FOM (First Of Model) balloon must be approved by CAAB.

If the envelope is interchanged, the balloon is regarded as a new aircraft and consequently, the Certificate of Airworthiness must be reissued.

### **3. DESIGN STANDARDS**

#### **3.1 Special conditions:**

If Civil Aviation Authority of Botswana (CAAB) finds that the design standards specified in this subsection do not provide adequate or appropriate safeguards against particular features or characteristics of a balloon, CAAB may issue such special conditions which add to or vary the design standards for that aircraft as it finds necessary to restore a level of safety equivalent to that otherwise established in the design standards.

#### **3.2 Basic requirements and equivalent safety:**

(a) The design standards which follow shall be complied with, as applicable, unless CAAB has determined on the basis of evidence submitted that any item not complied with is compensated for by factors which provide an equivalent level of safety;

(b) Balloons:

(i) For manned free balloons against which compliance was required for original type certification by the competent authority in the State of manufacture; and

(ii) Those requirements specified in paragraphs 4.1 and subsequent of this section;

***Note: An intending purchaser of an imported balloon for which original type certification was to standards other than the Transport Canada, European Aviation Safety Agency or Federal Aviation Administration should consult CAAB as to the acceptability of those other standards.***

(ii) Those requirements specified in paragraph 4.1 and subsequent of this subsection.

***Note 1: Airworthiness Directives must be complied with before a certificate of airworthiness will be issued for an individual balloon.***

(c) Balloon Inspection

(i) The balloon must be inspected in its complete state.

If no test inflation has been entered / certified in the balloon's log book, the inspection must include a hot inflation to ensure that the control cords are installed correctly and there are no obvious flaws in the balloon.

(ii) The inspection for issue of a Certificate of Airworthiness should include the presence/fitment of the thermal indicator.

#### 4. HEATER

##### 4.1 Heater endurance test:

(a) The heater system (including the burner unit, controls, fuel lines, fuel cells, regulators, control valves and other related elements) must be substantiated by an endurance test designed to reflect the limiting conditions likely to be encountered in service, both in kind and duration. The endurance test proposed by the manufacturer must be approved by CAAB. In performance of the test, each element of the system must be installed and tested so as to simulate the actual balloon installation; and

- (b) The test must also include at least 3 flameouts and restarts; and
- (c) Each element of the system must be serviceable at the end of the test; and
- (d) The pilot light (or other means of ignition) must be shown to operate reliably in typical gusts and rain, must be readily accessible for relighting and must be easily relit.

***Note 1: Appendix I to this section describes an acceptable means of demonstrating compliance with the requirements of this paragraph.***

## **5. SYSTEMS**

### **5.1 Instruments:**

The balloon shall be provided with the following instruments installed in such a manner that they are clearly legible by the crew:

- (a) All balloons:
  - (i) Sensitive altimeter with barometric scale calibrated in mill bars in increments of not more than 2 mill bars; and
  - (ii) Vertical speed indicator;
- (b) Hot air balloons:
  - (i) Fuel quantity gauge or other means (such as isolated tanks which can be used in sequence) which enable the pilot to know the quantity of fuel remaining. The gauge or gauges must be calibrated in appropriate units or in percent of fuel cell capacity over a range from empty to at least 30% of capacity; and
  - (ii) Envelope temperature indicator which may be of the continuous reading type or a type which gives a warning signal; and
  - (iii) Outside air temperature thermometer.

## **6. DESIGN AND CONSTRUCTION**

6.1 The manufacturer's identification data is usually engraved on the crown ring of the balloon.

6.2 A fire-proof metal plate must be attached to the envelope.

6.3 Basket:

The basket shall be provided with a sufficient number of hand-holds to provide at least 1 for each occupant. The hand-holds shall be so located that the risk of injury to the occupants using them is minimized.

The basket must be provided with drain holes which minimize the risk of accumulation of fuel within the basket.

***Note: The basket and equipment carried therein should, as far as is practicable, be manufactured from non-magnetic materials.***

## 7. DOCUMENTS

7.1 General:

The CAAB shall be supplied with a copy of each of the documents and data listed in paragraphs 7.2 to 7.4 inclusive. They shall be in the English language and in document form acceptable to the Authority.

***Note: Design data contained in manufacturers' documents will be treated as confidential information and will not be communicated to other persons without the written permission of the manufacturer concerned.***

7.2 Design data:

The required design data for an imported aircraft is listed here:

(a) Summary report providing statements of the means of compliance with the requirement paragraphs of this section including, where applicable, a reference to other documents in which compliance is substantiated; and

(b) Reports substantiating compliance with the requirement paragraphs of this section; and

(c) Type certificate and type certificate data sheet or equivalent documents issued by the competent authority in the State of manufacture; and

(d) Ground and flight type inspection reports or, where these do not exist, such other reports which summarize compliance of the aircraft by inspection and flight assessment, approved by the above competent authority; and

(e) A specimen flight manual for the balloon model, approved by the competent authority; and

**Note: An acceptable flight manual format is detailed at Appendix II.**

(f) List of type design data, including reports, required by, or submitted to, the competent authority in respect of the balloon, basket and heater system — some of these data may be required by CAAB; and

(g) Details of any additional requirements, including special conditions, and exemptions, exceptions, equivalent safety findings and any other deviations required or approved by the competent authority; and

(h) Type record or reports which summarize the design basic loads and the acceptability of the balloon against the structural design standards approved by the competent authority; and

(i) All general assembly drawings and station diagrams for the balloon; drawings of all major structural elements and assemblies, and of all essential systems and services including heater systems; and

(j) Complete drawing list.

### 7.3 Service documents:

All current field service documents and advice to operators which contain modifications or changes, or which establish or change inspections in respect of the envelope, basket, basket suspension system or heater system, together with statements from the manufacturers in which undertakings are given to supply CAAB copies of all subsequent documents of that type.

### 7.4 Manuals:

(a) Manufacturer's manuals dealing with airworthiness limitations as well as schedules and procedures for inspection, maintenance, overhaul and repair of the balloon, including its envelope, heater system, basket and its equipment, and basket suspension system; and

(b) Manufacturer's manual detailing procedures for flight operation; and

(c) Illustrated parts catalogues for the balloon including its envelope, basket, basket suspension system, heater system and its equipment; and

(d) Manufacturer's documents detailing any additional or special operating characteristics and functional test procedures for services, systems and equipment, including equipment manufactured to commercial specifications.

## **8. BALLOON MAINTENANCE**

### **8.1 Purpose**

This section addresses the maintenance requirements for manned balloons and hot-air airships operated commercially in Botswana.

### **8.2 - Maintenance Requirements**

All balloons, by virtue of being classified as Lighter than air-aircraft, are required by Civil Aviation (Airworthiness) Regulations, 2012 to have maintenance program developed by the Certificate of Registration holder and approved by the Authority. When the program has been developed it must be entered on the balloon's Log Book Statement, a copy of which is to be forwarded to the airworthiness office having administrative control over that balloon's records. Furthermore, the aforementioned regulations specify that all maintenance that is performed on aircraft (in this case balloon) must be performed by appropriate persons. Major repairs shall only be performed by the holder of an appropriate Certificate of Approval.

The appropriate persons to perform and certify for maintenance are as follows, to the extent indicated:

(a) The pilot-in-command, other than a student pilot and other than a pilot acting in the course of employment with an employer, to perform and certify for maintenance limited to:

(i) Post assembly, daily or pre take-off inspections;

(ii) Repairs which are not major repairs;

(b) The holder of a valid appropriate maintenance authority, other than a person acting in the course of employment with an employer, to perform and certify for maintenance other than major repairs; and

(c) The holder of a valid certificate of approval, to perform and certify for maintenance covered by that certificate.

8.3 Persons acting in the course of employment would be performing and certifying for the maintenance on the behalf of their employers.

8.4 The certifications for periodic inspections can only be made by:

(a) The holder of a valid appropriate certificate of approval, this certification is made, on behalf of the certificate of approval holder, by the holder of a valid appropriate maintenance authority, employed by that certificate holder.

8.5 As inflation and propulsion engines are required for the safe operation of hot-air airships their maintenance is also required to be carried out by an appropriate person. The appropriate person to perform this maintenance is the holder of a valid maintenance authority endorsed for that type engine and installation or the holder of an appropriate certificate of approval.

8.6 If the Certificate of Registration holder is developing a system of maintenance for approval by the Authority, then that system should ensure that the balloon is required to be inspected at the following periods:

(a) Post assembly;

(b) Daily or pre-take off inspection, before each flight;

(c) Periodic inspection; and

(d) Hard landing inspection, when-ever a landing has been made while the balloon was experiencing an excessive rate of descent.

8.7 Periodic inspections required by paragraph 8.6 should be complied with at the following periods:

(a) For private balloons, every 100 hours time-in-service or 12 months, whichever is the earlier; or

(b) For commercial balloons:

(i) Where no mixing of the balloon's components with those of another balloon has occurred, every 100 hours time-in-service or 12 months, whichever is the earlier; or



(ii) Where mixing of the balloon's components approved for interchanging with those of another balloon has occurred, every 100 hours time-in-service for the envelope and suspension system and every 6 months for the components.

8.8 As an Airworthiness Directive is a direction under Civil Aviation (Airworthiness) Regulations, 2012, any additional special inspection, test, check or modification requirements that are contained in an Airworthiness Directive must be observed.

8.9 As the log book also performs the function of the maintenance release, any maintenance, other than post assembly and pre-take-off inspections, that will be required to be performed on the balloon between each periodic inspection, is required to be entered in the log book by the person certifying for the completion of the periodic inspection.

## **9. CERTIFICATION**

9.1 A certification is required for all maintenance that is performed on the balloon to ensure a continuous airworthiness history. These certifications are required by Civil Aviation (Airworthiness) Regulations, 2012.

9.2 The regulations direct that all maintenance is to be certified. When any of the following maintenance has been completed an entry and certification is required in the balloon's log book to record that maintenance:

(a) Periodic inspections;

(b) Hard landing inspections;

(c) Defect rectifications;

(d) Repairs;

(e) Modifications;

(f) Component replacements; or

(g) Special inspections, tests, checks or modifications specified as a requirement in an airworthiness directive.

9.3 The entries and certifications need to include a complete and detailed description of the maintenance that has been performed.

## **10. MAINTENANCE RECORDS**

10.1 A balloon, for the purpose of record keeping, means the envelope and suspension system. The basket and burner are considered as major components of that balloon.

10.2 The balloon requires a log book to record its airworthiness and maintenance history and maintenance certifications. The approved log book is one approved by the CAAB and it will be retained by the Certificate of Registration holder, as specified in the Civil Aviation (Airworthiness) Regulations 2012, for at least 12 months after the balloon has been permanently withdrawn from service.

## **11. LOG BOOK ENDORSEMENTS**

The balloon operator is responsible for recording the approved interchange of components in the appropriate maintenance record (Log Book).

The holder of an appropriate Maintenance Authority for the maintenance of balloons must certify the entry.

11.1 The log book is to be made available to the pilot-in-command prior to and at the completion of each flight. The pilot-in-command is to record the time-in-service, both daily and cumulative, in the log book, as soon as practicable after each flight.

11.2 An endorsement needs to be made in the log book to identify damage or defects that if not corrected could compromise the safe operation of the balloon. This endorsement will also state that the balloon is unairworthy, and will need to be signed and dated by the person making the endorsement.

11.3 Where a balloon has become unairworthy the reason will be entered in the log book and the balloon will not be flown until there is an entry in the log book certifying that the maintenance necessary to rectify or repair that defect has been completed.

11.4 Provided the damage or defect mentioned in the endorsement does not render the balloon unairworthy, that endorsement may be cancelled by making a further endorsement cancelling the original endorsement. This further endorsement may only be made by:

- (a) The holder of a valid appropriate maintenance authority;
- (b) The holder of a valid appropriate certificate of approval; or
- (c) The pilot-in-command, being other than a student pilot.

11.5 It is an offence under the BCARs for a person to cancel an endorsement if the damage or defect compromises the continued safe operation of the balloon.

## APPENDIX I

### HOT AIR BALLOONS — HEATER ENDURANCE TEST

#### 1. HEATER AND ASSOCIATED EQUIPMENT

##### 1.1 General

(a) This Appendix describes an acceptable means of demonstrating compliance with the requirement of subparagraph 3.1 of this section in the case of heaters which are provided with controls which have a means of modulating power output. The test will need to be modified for heaters with other types of controls.

(b) The test shall be conducted such that the complete heater system including the burner unit, controls, fuel lines, fuel cells, regulators, control valves and other related equipment are substantiated. Each element of the system must be installed and tested so as to simulate the actual balloon installation. The system shall complete the prescribed test without failure or malfunction

##### 1.2 Heater System Test

(a) The test is to be so conducted such that the block of cycles in (b) is repeated 10 times.

(b) Each block is to consist of the following spectrum:

Segment	Power Setting (% maximum design output)	Number of cycles (seconds)	Duration of cycles
1	100	80	5
2	50	200	10
3	30	300	10
4	20	360	10
5	100	1	900

Note 1: Each segment is to be conducted in the sequence tabulated above.

Note 2: The test may be interrupted if necessary.

Note 3: Each cycle of each segment is to be repeated at the following intervals:

(a) Power setting of 100% — not less than 100 seconds after the completion of the preceding cycle;

(b) Power setting of less than 100% — not less than 50 seconds after the completion of the preceding cycle.

Note 4: Each block of test cycles, i.e., the spectrum defined in (b), is to be commenced at an interval of not less than 1 hour from the completion of the previous block.

Note 5: The burner is to be inspected for defects at the conclusion of each of the 10 blocks. Evidence of any defect or malfunction is to be regarded as a failure.

## APPENDIX II

### FLIGHT MANUAL

#### 1. INTRODUCTION

1.1 This Appendix describes an acceptable method for presenting the data for the flight manual.

1.2 The content of the manual shall be based on data determined in accordance with the requirements of this section, on manufacturer's specifications and procedures and on such other data as are specified or approved by CAAB.

1.3 The manual shall be in the English language.

1.4 If a flight manual is to be prepared specially for use in Australia, the data it contains should, where practicable, be presented in the following units:

weights	kilograms
balloon dimensions	millimetres
distance (e.g., landing)	metres
fluid quantities (e.g., liquids: fuel and oil)	litres
speeds	knots
altitudes and vertical distances	feet
rates of climb	feet/minute
pressure	kilopascals
temperatures	degrees Celsius

1.4.1 If a quantity expressed as a unit on the face of an aircraft instrument is to be presented in the flight manual for a balloon, it must be presented using the same system of unit as on the instrument.

1.5 The manual shall have a protective cover and shall be in such a form as can be readily amended.

1.6 The manual shall be specifically identified and this identification shall appear on each page of the manual together with the date of issue of that page. Each page shall be marked or otherwise identified as being approved by CAAB, except section 7, the contents of which are separately approved by a weight control officer or other authorized person.

1.7 The flight manual may form part of another manual.

## **2. CONTENTS OF FLIGHT MANUAL**

2.1 The manual shall comprise the following distinct sections and each section shall be clearly identified and separated from each other section.

**Section 1 — General**

**Section 2 — Limitations**

**Section 3 — Normal procedures**

**Section 4 — Emergency procedures**

**Section 5 — Mandatory equipment list**

**Section 6 — Radio systems**

**Section 7 — Weight and balance**

**Section 8 — Supplements.**

2.2 **Section 1 — General** — shall contain the following:

- (a) An approval page which shall include:
  - (i) Name of the manufacturer; and
  - (ii) Balloon type and model; and

- (iii) Balloon serial number; and
  - (iv) Nationality and registration markings of the balloon; and
  - (v) Airworthiness certification category; and
  - (vi) Number of the associated certificate of airworthiness; and
  - (vii) Provision for the signature of a delegate of CAAB signifying his or her approval of the manual, together with the date of his approval;
- (b) A table of contents which shall clearly indicate those parts of the manual which are approved;
  - (c) Pages for the recording of both general and particular amendments including a description of the amendment system;
  - (d) An introduction page specifying the applicability of the manual, the requirement for its carriage in the balloon and the manner of issue of amendments;
  - (e) Definitions of the following terms:
    - (i) Airfield pressure altitude;
    - (ii) any other term used in the manual which may not be readily understood;
  - (f) General data appertaining to the balloon which shall include the following:
    - (i) Approved fuel types and grades;
    - (ii) Total and usable capacity of each fuel cell.

2.3 **Section 2 — Limitations** — shall contain the following limitations together with any other item established as being a limitation on the operation of the balloon:

- (a) The maximum weight of the balloon determined in accordance with the manufacture's requirements, as applicable;
- (b) The empty weight of the balloon determined in accordance with the manufacture's requirements, as applicable;
- (c) The rate of climb of the balloon determined in accordance with the manufacture's requirements, as applicable;



(d) The maximum vertical velocity of descent of the balloon, the altitude loss required to attain that velocity and the altitude loss required to recover from a descent at that velocity, when determined in accordance with the manufacture's requirements, as applicable;

(e) Miscellaneous:

(i) Minimum flight crew;

(ii) Maximum permissible number of occupants;

(iii) A statement of any restriction on smoking in the balloon;

(iv) Maximum permissible operating altitude;

(v) Maximum permissible envelope temperature;

(vi) Maximum certificated weight;

(vii) a statement of the inscription on, and the location of, each placard which is required to be displayed, together with an explanation of the significance of any instrument colour markings.

2.4 **Section 3 — Normal Procedures** — shall contain recommended procedures and information necessary for the safe operation of the balloon, and shall include at least the following:

(a) Check lists as appropriate to the operation of the balloon;

(b) Procedures and limitations in the use of all balloon systems.

2.5 **Section 4 — Emergency procedures** — shall contain those operating procedures for flight and system emergency conditions which are essential for the continued safe operation of the balloon. The procedures shall be presented as briefly as possible commensurate with maximum clarity.

2.6 **Section 5 — Mandatory equipment list** — The instruments and indicators which must be installed and serviceable to ensure compliance with the basis of airworthiness certification of the balloon shall be listed.

2.7 **Section 6 — Radio systems** — shall provide for listing radio communication and navigation systems installed in the balloon, together with their maximum altitude limitations applicable to the types of operation for which the balloon radio system is approved.

2.8 **Section 7 — Weight and balance** — shall contain the following:

(a) Information necessary to ensure loading of the balloon within the limitations specified in section 2 of the manual, including:

(i) A load data sheet; and

(ii) An equipment list; and

(iii) Where appropriate, a loading system including such instructions as are necessary to ensure correct use of the system;

(b) Where a loading system is not required, the flight manual shall contain a statement to this effect;

(c) Where the loading system takes the form of a placard in the crew compartment, the flight manual shall contain a statement of the inscription on and the location of the placard.

***Note 1: Flight manual loading data approved by a weight control officer should not bear additional indication of CAAB approval***

2.9 **Section 8 — Supplements** — shall contain in the form of supplements, information applicable to any installed equipment or operation of the balloon not covered by the body of the manual. Each supplement shall describe the equipment or operation of the balloon to which it is related and shall list any additions to or revisions of the limitations and procedures of the basic manual.