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**SUBJECT: PERIODIC WEIGHT AND BALANCE PROCEDURES**

**DATE: 24/07/2015**

## 1. PURPOSE

This instruction provides guidance to operators on all matters concerning the weight and centre of gravity of aircraft.

## 2. APPLICABILITY

This instruction is applicable to all Cape Verde registered aircraft.

## 3. REFERENCES

- CV-CAR 5 and 8
- ICAO Doc. 9760 Part III Chapter 7
- Annex 6, Operations of Aircraft,
- Technical Circular CT-33-012 Aircraft Mass And Balance
- AAC Form FS.AER.049 Aircraft Weight and balance Record

## 4. BACKGROUND

The CV-CAR 5 requires that every aircraft for which a Certificate of Airworthiness is in force, shall be weighed and the position of its centre of gravity determined, at such times and in a manner approved by the AAC. Upon the aircraft being weighed, the Operator of the aircraft shall prepare a weight schedule acceptable to the AAC.

## 5. DEFINITIONS

5.1.1 For the purpose of this instruction the following definition shall apply:

- (1) **Empty weight** means the empty weight of an aircraft, including:
- (a) the airframe, engines, propellers, and rotors of the aircraft; and
  - (b) any fixed equipment on the aircraft; and
  - (c) any fixed ballast on the aircraft; and

- (d) any unusable fuel on the aircraft; and
  - (e) full operating fluids required for the normal operation of the aircraft's systems, except potable water, lavatory precharge water, and water intended for injection into the engines of the aircraft; and
  - (f) items specified in the weight and balance section of the flight manual or flight manual and supplement:
- (2) **Empty Weight Centre of Gravity (EWCG):** The EWCG is the centre of gravity of an aircraft in its empty weight condition.
- (3) **Unusable Fuel.** Unusable fuel is the quantity of fuel that cannot be safely used in level flight. This is the quantity of fuel remaining in each tank after the fuel inlet port becomes uncovered in level and balanced flight. (This will often be detailed by aircraft manufacturers in the aircraft flight manual, and/or by National Airworthiness Authorities in data established at the time of type certification of the aircraft.
- (4) **Undrainable Fuel.** Un-drainable fuel is the quantity of fuel that remains in the aircraft fuel tanks and fuel lines after they have been drained. (The undrainable fuel normally only amounts to a small quantity).

## 6. GENERAL REQUIREMENTS

- 6.1.1 The applicant for the issuance or the renewal of a Certificate of Airworthiness is required to provide the current mass and balance report for the aircraft.
- 6.1.2 The Empty Weight and the corresponding C.G position (EWCG) shall be determined and entered in the Weight and Centre of Gravity Report.
- 6.1.3 When an aircraft is weighed, the condition of the aircraft (i.e. the equipment and other items of load such as fluids in tanks) shall be recorded. The equipment Installed should not differ from that included in the declared list of Empty Equipment associated with the Weight and Centre of Gravity Schedule.
- 6.1.4 The mass and balance report is normally obtained by weighing. Nevertheless, if the changes in mass and balance have been duly computed and recorded and if the resulting change is minor (refer to 9.E), the accurate mass may be obtained by calculation from the previous weighing.
- 6.1.5 In making decisions on weighing, the history of the aircraft, its flying performance, and the probable effect on the weight after a major overhaul, or embodiment of a modification, repair, replacement or painting will be considered.
- 6.1.6 If components or items of equipment with a fixed location are added, removed, or repositioned in an aircraft, or if an aircraft is modified or repaired, the change in the empty weight and EWCG is to be calculated, or be established by reweighing.
- 6.1.7 Any change of empty weight and EWCG is to be recorded by an duly qualified and authorised personnel in the aircraft records and a new FS.AER.049 completed.

- 6.1.8 A complete, current, and continuous record of changes in empty mass and empty centre of gravity position should be maintained for each aircraft. This record should contain details of all alterations affecting either the mass or balance of the aircraft.
- 6.1.9 A Weighing Record containing records of the weighing and the calculations involved shall be made available to the AAC and such records shall be retained by the operator. When the aircraft is again weighed, the previous weighing records must be retained with the aircraft records for a period of six months. Operators must maintain records of all known weight and C.G changes which occur after the aircraft has been weighed.

## **7. PERIODIC DETERMINATION OF MASS**

- 7.1.1 The owner or operator of an aircraft in respect of which a standard certificate of airworthiness is issued under CV-CAR 5.D.300 shall be weighed, and the position of the aircraft's center of gravity determined according to the following periodicity:
- (1) When the aircraft is used in commercial operations or aerial work the re-weighed shall be made at intervals not exceeding three (3) years;
  - (2) When used in commercial operations and using an approved weight control program, the time periods determined by the weight management program;
  - (3) When used in general aviation every five (5) years, or
  - (4) For any aircraft, the re-weighed shall be made, if required by AAC.
- 7.1.2 The mass and centre of gravity data, as supplied by the manufacturer in respect of new aircraft, shall be acceptable by AAC.
- 7.1.3 The accumulated effects of modifications and repairs on the mass and balance of the aircraft shall be accounted for and properly documented by the owner or operator.
- 7.1.4 It is the responsibility of the operator of an aircraft to renew the load data sheet if a modification results in a significant change in the empty mass or empty centre of gravity position.
- 7.1.5 Further to the above provisions, if the AAC or the operator is of the opinion that adequate mass control has not been exercised over an aircraft during the modification, the AAC or the operator may require that a new empty mass and empty centre of gravity position should be determined.

## **8. PROCEDURES FOR DETERMINING MASS**

- 8.1.1 Aircraft mass determination should be supervised by appropriately trained and authorised personnel of an approved maintenance organisation or a person suitably qualified acceptable to the AAC.
- 8.1.2 Aircraft should be presented for mass determination in a condition acceptable to the person authorized to supervise the measurements.

- 8.1.3 Two independent determinations should be made and the aircraft longitudinal datum line should be horizontal. The load should be completely removed from the weighing equipment between determinations. The aircraft gross masses as determined by the two measurements should be consistent. If not, the measurements should be repeated until the gross masses, as determined by two consecutive and independent measurements are consistent.
- 8.1.4 Prior to the initial issue of a Certificate of Airworthiness for each aircraft, a list of equipment included in the empty mass should be established. If an operating mass is used, a similar list of removable equipment and disposable load included in the operating mass should also be established. Where a change occurs in the items included in either the empty mass or, if applicable, the operating mass of an aircraft, the appropriate list should be amended by the AMO.
- 8.1.5 Normal precautions, consistent with good practices in the mass determination procedures, should be taken, such as:
- (1) aircraft and equipment should be checked for completeness in accordance with paragraph 6.1 above;
  - (2) Aircraft weighing should be carried out on a level site inside a closed hanger. Aircraft must be dry, free of dew accumulated moisture, dirt and frost.
  - (3) fluids should be properly accounted for; that the aircraft is clean,
  - (4) mass determination should be carried out in an enclosed building, to avoid the effect of wind; and
  - (5) the scales used should be properly calibrated and used in accordance with the manufacturer's instructions. Each scale should be calibrated, either by the manufacturer or by a recognised facility periodically as recommended in the manufacturer's calibration schedule. In the absence of a manufacturer's calibration schedule the AAC will require calibration on an annual basis unless the operator can justify a longer period.
  - (6) Mass readings should be taken when the aircraft is in level configuration in both longitudinal and lateral planes recommended by the manufacturer.
  - (7) When weighing aircraft on jacks, it is important to observe the aircraft jacking procedure, and to fit appropriate jack adapters to the aeroplane jacking points to accommodate the weighing units
  - (8) When using electronic weighing cells, it is recommended that they are switched on 30 minutes (or in accordance with the manufacturer's instructions) before weighing commence in order for the circuits to stabilize.
  - (9) Taking Mass Readings It is recommended that several readings are taken at each reaction point to obtain a reliable average figure.
- 8.1.6 An aircraft mass and balance report should be completed and certified by the person signing the report.
- 8.1.7 Data recorded should be sufficient to enable the empty mass and empty mass centre of gravity position to be accurately determined.

- 8.1.8 The empty mass and empty centre of gravity position should be determined by the owner or operator of the aircraft in accordance with the recorded results of the measurements.
- 8.1.9 The measuring and test equipment used for the determination of mass and centre of gravity must meet the equipment manufacturer calibration standards.

## **9. LOADING DATA**

- 9.1.1 The loading schedule should be kept with the aircraft, forming a part of the aircraft flight manual. It should include instructions on the proper load distribution such as filling of fuel tanks and oil tanks, passenger movement, distribution of cargo, etc. A check should be made to determine if the schedule will allow computation of separate loading conditions when the aircraft is to be loaded in other than the specified conditions shown in the loading schedule.
- 9.1.2 Information on how base records of mass and balance changes to the aircraft may be obtained from the pertinent aircraft specifications, aircraft flight manual and the aircraft mass and balance report. Operators should maintain records of all known mass and centre of gravity changes which occur after the aircraft mass has been determined. A sample of a Form to record the changes to the aircraft mass and CG can be found in the ANNEX B.
- 9.1.3 A mass and centre of gravity schedule should be provided for each aircraft. Each schedule should be identified by the aircraft designation, nationality and registration marks. The date of issue of the schedule should be given and the schedule should be signed by an approved representative of the organization or a person suitably qualified acceptable to the AAC. A statement should be included indicating that the schedule supersedes all earlier issues.

## **10. PREPARATION AND APPROVAL OF LOADING DATA**

- 10.1.1 Loading data prepared in accordance with the provisions of this sub-section should be acceptable to the AAC. Where the applicable flight manual pages are used as the load data sheet and to specify any required loading system, the completed pages should be submitted to the AAC for incorporation in the aircraft flight manual.
- 10.1.2 The operator should be responsible for the preparation of a load data sheet for each aircraft based on the empty mass and empty centre of gravity position.
- 10.1.3 The operator should be responsible for the preparation of a loading system for each aircraft based on the empty mass and empty centre of gravity position, unless it can be shown that the aircraft cannot be loaded so that its centre of gravity falls outside the approved range.

## **11. WEIGHT ALTERATIONS**

- 11.1.1 A complete, current and continuous record of changes in empty weight and empty weight centre of gravity position and, where appropriate, operating weight and operating weight centre of gravity position, shall be maintained for each aircraft and this record shall contain details of all alterations affecting the weight and balance of the aircraft (See ANNEX B).

- 11.1.2 The records should reflect changes in mass and balance and list all modifications affecting the mass or balance of the aircraft. Revised empty mass and CG changes should be identified by the date, aircraft make, model and serial number.
- 11.1.3 If changes to an aircraft's empty weight or operating weight occur due to changes in the aircraft's equipment, the aircraft's equipment list must be amended in accordance with the equipment changes.
- 11.1.4 The record of weight alterations shall be updated after each change (See ANNEX B).
- 11.1.5 In addition to weighing aircraft at specified interval, the mass and balance should be re-established by computing or reweighing whenever the cumulative change to the operating mass exceeds:
- (1)  $\pm 0.5$  % of the maximum landing mass or
  - (2) the cumulative change in the CG position exceeds 0.5 % of the mean aerodynamic chord (MAC).
  - (3) In the case of helicopters, whenever the cumulative change in the CG position exceeds 0.5 % of the total CG range.
- 11.1.6 Aircraft reweighing and recalculation of empty weight and centre of gravity will be required also when:
- (1) Changes have been made to the aircraft that could affect the empty weight and centre of gravity. Examples may be but not limited to; a new built aircraft, a modification being installed, a major repair, or an aircraft being repainted.
  - (2) The operator has reason to believe the current data is not accurate.
  - (3) The aircraft manufacturer has specific requirements detailed in the ICA's for the aircraft or
  - (4) Is required by the AAC.
- 11.1.7 A new record of weight shall be raised after each weighing (See ANNEX A).
- 11.1.8 The revised mass and balance information should be signed by a qualified person. Where mass and balance programme information is generated by a computerized mass and balance control system, the operator should verify the accuracy of the output data.
- 11.1.9 The operator should also ensure that amendments to the input data are validated and incorporated properly into the system. The operator should ensure the overall system is operating properly and the software updates are current.

## **12. WEIGHT AND BALANCE RECORDS**

- 12.1.1 The individual mass and CG position of each aircraft should be confirmed at the specified reweighing periods.

12.1.2 Upon the aircraft being weighed, the owner or operator of the aircraft shall prepare a mass schedule showing-

- (1) The basic mass of the aircraft, namely the mass of the empty aircraft together with the mass of unusable fuel and unusable oil in the aircraft and of such items of equipment as are indicated in the mass schedule, or such other mass as may be approved by the Authority in the case of that aircraft; and
- (2) The position of the centre of gravity of the aircraft when the aircraft contains only the items included in the basic mass or such other position of the centre of gravity as may be approved by the Authority in the case of that aircraft.

12.1.3 The Weight and Balance Report shall apply to the aircraft in the condition in which it is to be delivered to the user.

12.1.4 The mass and balance data shall be recorded on AAC FS.AER.049 (ANNEX A)

12.1.5 The mass and balance report shall include at least the following information:

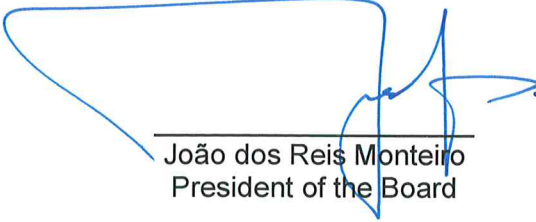
- (1) aircraft nationality and registration letters, make, model and serial number;
- (2) date on which mass was determined and centre of gravity computed;
- (3) datum point used;
- (4) the necessary calculations made;
- (5) reference number of applicable publications used; and
- (6) the signature and licence or approval number of the person who was responsible for establishing the mass and the computing of the centre of gravity; and
- (7) a copy of the mass and balance report including the list of basic equipment and the completed AAC Form FS.AER.49 must be submitted to the AAC

12.1.6 The mass and balance record system should include procedures that allow the air operator to update and maintain a current and continuous record of the mass and CG of the aircraft they operate.

12.1.7 The Weight and Balance Report shall record such loading data as is essential to enable the particular aircraft to be correctly loaded, and shall include sufficient information for an operator to produce written loading information in compliance with the requirements of CV-CAR 8.F.285 and CV-CAR 9.C.180 and the AAC instruction N° 06/DSV/2015 for Aircraft Mass And Balance.

12.1.8 Some large aeroplanes have on-board mass weighing systems. When the aeroplane is on the ground the on-board mass system provides the flight crew with a continuous indication of the aircraft total mass and the location of the CG in per cent of the Mean Aerodynamic Chord (MAC). The operator should seek the approval from the AAC if it wishes to use an on-board mass and balance computerized system as a primary source for dispatch.


12.1.9 The mass schedule shall be preserved by the operator of the aircraft until the expiration of a period of six months following the next occasion on which the aircraft is weighed for the purpose of this regulation.



João dos Reis Monteiro  
President of the Board



**ANNEX A - AIRCRAFT WEIGHT & BALANCE RECORD**

REPÚBLICA DE CABO VERDE  AGÊNCIA DE AVIAÇÃO CIVIL CIVIL AVIATION AUTHORITY	AIRCRAFT WEIGHT & BALANCE RECORD	Ref.: FS.AER.49 Rev.: 0 Data: 21/07/2015	
Aircraft Registration <b>D4-</b>	Aircraft Make and Model:	Serial No.:	W.O No:
The above aircraft was weighed at:		on:	by:
Weighing equipment make and model:	1.	2.	3.
Weighing equipment Serial No's:			
Date last calibrated:			
Reason for weighing: <input type="checkbox"/> Re-weighing of aircraft <input type="checkbox"/> Other, specify _____ <input type="checkbox"/> Equipment changes made to the aircraft		3. Datum Reference:	
Weighing position:		5. Configuration:	
6. The aircraft was weighed in accordance <input type="checkbox"/> Manufacturer's instructions Reference: <input type="checkbox"/> Other Reference:		7. AMO Name:	
		8. AMO Reference:	
<b>EMPTY WEIGHT</b> (see Notes)		Data established by Weighing or Calculation?	
<b>ARM</b>		If established by calculation state when a/c weighed	
<b>MOMENT</b>		Unusable fuel quantity (included in empty weight)	
<b>Longitudinal C of G</b> (state Fwd or Aft of Datum)		A/C Records updated	
<b>Lateral C of G</b> (For Helicopters)			
Performed by – Printed Name	Licence / Authorisation No.	Date	Signature
<b>Notes:</b>			
1. Empty weight includes: unusable fuel, fixed ballast, full operating fluids and items in the Equipment List over page.			
2. Refer to Weight and Balance Section of Flight Manual for further information.			
3. A new form is to be completed whenever revised weight and balance data is established either by weighing or calculation.			
<b>EQUIPMENT LIST</b>			
The following items of removable equipment are included in the empty weight data over page. Refer to Aircraft Logbook for details:			
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**ANNEX B - RECORD OF WEIGHT ALTERATIONS**

Operator Logo	<b>RECORD OF WEIGHT ALTERATIONS</b>							<b>D4-</b>			
Aircraft Make and Model:					Serial No.:						
<i>The onus rests on the owner/operator of this aircraft to ensure that this document is amended and kept up to date.</i>											
<b>CHANGE</b> (Repair/Modification/Equipment change/Other)		<b>EFFECT ON MASS AND CG</b>									
Description	Date	Mass		Cumulative Mass	CG		Cumulative CG	Reweighting or WB recalculation required?	Authorised Person Name/Signature	AMO Number	Date
			%			%		<input type="checkbox"/>			
			Kgs/Lbs			mm/in		<input type="checkbox"/>			
			%			%		<input type="checkbox"/>			
			Kgs/Lbs			mm/in		<input type="checkbox"/>			
			%			%		<input type="checkbox"/>			
			Kgs/Lbs			mm/in		<input type="checkbox"/>			
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			Kgs/Lbs			mm/in		<input type="checkbox"/>			
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			Kgs/Lbs			mm/in		<input type="checkbox"/>			
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