澳門特別行政區 REGIÃO ADMINISTRATIVA ESPECIAL DE MACAU





AERONAUTICAL CIRCULAR CIVIL AVIATION AUTHORITY – MACAO, CHINA

SUBJECT:

Weight and Balance of Aircraft

EFFECTIVE DATE:

01 March 2015

CANCELLATION:

Nil

GENERAL:

The President of Civil Aviation Authority – Macao, China, in exercise of his power under Article 35 of the Statutes of Civil Aviation Authority approved by the Decree-Law 10/91/M and paragraph 89 of the Air Navigation Regulation of Macao (ANRM) establishes this Aeronautical Circular (AC).

1. Introduction

- 1.1. ANRM Part III Paragraph 16 (1) specifies that every aircraft in respect of which a Certificate of Airworthiness issued or rendered valid under that Regulation is in force shall be weighed, and the position of its centre of gravity determined, at such times and in such manner as the Civil Aviation Authority may require in the case of that aircraft.
- 1.2. ANRM Part III Paragraph 16 (2) requires the operator of the aircraft to prepare a Weight Schedule.
- 1.3. This AC prescribes the detailed requirements for weighing Macao registered aircraft, the determination of the centre-of-gravity of such aircraft and preparation of Basic Weight Schedules and Weight and Balance Reports from which the loading for flight can be correctly determined.

2. Definitions

2.1. Basic Weight

Basic Weight is the weight of the aircraft and all its basic equipment, plus that of the declared quantity of unusable fuel and unusable oil. In the case of turbineengined aircraft the Maximum Total Weight Authorised of which does not exceed 5700 kg, it may also include the weight of usable oil.

2.2. Basic Equipment

Basic Equipment is the unconsumable fluids, and the equipment which is common to all roles for which the operator intends to use the aircraft.

2.3. Variable Load

Variable Load is the weight of the crew, of items such as the crew's baggage, removable units, and other equipment the carriage of which depends upon the role for which the operator intends to use the aircraft for the particular flight.

2.4. Aircraft Prepared for Service, or Operating Weight

The sum of the Basic Weight and the total Variable Load required for the particular role in which the operator intends to use the aircraft.

2.5. Disposable Load

Disposable Load is the weight of all persons and items of load, including fuel and other consumable fluids, carried in the aircraft, other than the Basic Equipment and Variable Load.

Note: To obtain the total loaded weight it is necessary to add to the Basic Weight the weights of those Variable and Disposable Load items which are to be carried for the particular role for which the aircraft is to be used.

3. Weighing Requirements

3.1. All aircraft shall be weighed prior to the initial issue of a Macao Certificate of Airworthiness. Alternatively the weighing of the aircraft can be done overseas prior to their importation if any subsequent changes in weight have been computed and recorded, providing that all the necessary weight and balance data for the aircraft are furnished to the Authority and such data are found to be accurate and adequate.

- 3.2. Aircraft shall be re-weighed within two years after the date of manufacture and thereafter at intervals not exceeding five years, and at such other times as the Authority may require. Aircraft weighing shall be conducted in accordance with procedures acceptable to the Authority. Essential aspects of the conduct of weighing are given in Appendix 3.
- 3.3. 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 Basic Equipment list associated with the Basic Weight Schedule (see paragraph 4). Otherwise, in determining the Basic Weight and the corresponding centre of gravity position, corrections will have to be made for items that have been weighed but that are not Basic Equipment items, and for Basic Equipment items not installed in the aircraft during the weighing.
- 3.4. Weighing results and related calculations shall be recorded in a weighing report which shall be retained by the operator. When the aircraft is again weighed the previous weighing records must be retained with the aircraft records.
- 3.5. The operator shall maintain records of all known weight and centre of gravity changes which occur after the aircraft has been weighed and such records shall be retained by the operator.

4. Basic Weight Schedule

- 4.1. A Basic Weight Schedule shall be provided for each aircraft. Each Schedule shall be identified by the aircraft type and model number, the nationality and registration marks and the aircraft serial number. The date of issue and the reference number of the Schedule shall be given and the Schedule shall be signed by a person suitably qualified and acceptable to the Authority. A statement shall be included stating that the Schedule supersedes all earlier issues.
- 4.2. The Schedule shall present the derivation of the Basic Weight and the centre of gravity from the most recent weighing report or Basic Weight Schedule or other acceptable information. The Schedule shall indicate the landing gear positions (retracted or extended) to which the derived centre of gravity position is related. The Schedule shall also include the current Basic Equipment list showing the weight and lever arm of each item or make reference to the document in which such a list is included.

- 4.3. The date and reference number of the most recent weighing report, Basic Weight Schedule or other acceptable information, upon which the Schedule is based, shall be given.
- 4.4. The Basic Weight Schedule may be in the form given in Appendix 2 to this AC. Variations in presentation are permitted, but must be acceptable to the Authority. In the case of helicopters, it may be necessary to present lever arms and moments about more than one axis, depending on the centre of gravity limits specified in the flight manual.
- 4.5. The datum which is defined in the Basic Weight Schedule may be different from the datum defined in the Certificate of Airworthiness or flight manual to which the centre of gravity limits relate. When a different datum is used it shall be adequately defined, its precise relationship to the datum in the Certificate of Airworthiness or flight manual shall be given, and any lever arms and moments which appear in any part of the Schedule shall be consistent with the datum so declared.
- 4.6. The Schedule shall be retained by the operator and where the Schedule has been revised the previous issue must be retained with the aircraft records.
- 4.7. Operators shall revise the Basic Weight Schedule when the weight and centre of gravity are known to have undergone changes in excess of a maximum figure, which has been agreed by the Authority as applicable to a particular aircraft type.

Note: The following changes in basic weight or centre of gravity position are considered significant and must be reported to the Authority:

- (a) Aeroplanes whose empty weight has changed by more than 0.5% of the maximum total weight authorised or whose basic centre of gravity position has changed by more than 0.5% of the mean aerodynamic chord.
- (b) Helicopters whose empty weight has changed by more than 1% of the maximum total weight authorised or whose basic centre of gravity position has changed by more than 0.5 inch or 10% of the maximum permissible centre of gravity range whichever is the lesser.

5. Weight and Balance Report

- 5.1. A Weight and Balance Report shall be produced for each Macao registered aircraft. A copy of each report shall be supplied to the Authority.
- 5.2. The Weight and Balance Report is intended to record the essential loading data to enable the particular aircraft to be correctly loaded and to include sufficient

information for an operator to produce written loading instructions in accordance with the requirements of the ANRM.

- 5.3. The Weight and Balance Report shall include the following items:
 - (a) Reference number and date of issue.
 - (b) Type and model number of the aircraft and its nationality and registration mark.
 - (c) Basic Weight

The Basic Weight and centre of gravity of the aircraft as derived from the Basic Weight Schedule shall be presented. A copy of the Basic Weight Schedule, including the Basic Equipment list, and any referenced weighing report, shall be attached to the Report.

(d) <u>Datum definition</u>

A diagram or a description of the datums (e.g. in relation to the fuselage frame numbering system or other identifiable points) shall be included. See also paragraph 4.5.

(e) Variable Load

Information on the weight and lever arms appropriate to Variable Load items may be detailed for as many roles as the operator wishes and for every role the total weight and moment change shall be given. Weights of crew members may be assumed at not less than the weight shown in the ANRM, provided the aircraft has a total seating capacity of 12 or more persons. Otherwise the weight of each person must be found by weighing.

(f) Loading Information

This shall include all relevant information so that, knowing the disposable load which is intended to be carried, the weight and the position of the centre of gravity of the aircraft can be calculated. At least the following shall be given:

- (1) The lever arm of the centre of gravity of an occupant of each seat.
- (2) The lever arm of each compartment or area in the aircraft where disposable load, such as luggage or freight, may be placed.

- (3) Any significant change in the centre of gravity of the aircraft (change in moment) which will result from a change in configuration, such as the retraction and extension of the landing gear.
- (4) The lever arm of the centre of gravity of fuel and oil in each tank including the variation of the lever arm with the quantity loaded if this variation is significant.
- (5) The maximum total usable capacities of the fuel and oil tanks and the weight of fuel and oil when the tanks are filled to their capacities assuming typical densities of these fluids.
- (g) A statement shall be given in the Schedule to the effect that pursuant to the ANRM the pilot-in-command shall satisfy himself before take-off that the load is of such weight, and is so distributed and secured that it may safely be carried on the intended flight.
- (h) A statement that the Report supersedes all earlier issues.
- 5.4. The weights, distances, moments and quantities may be given in any units provided that these are used consistently and agree with the markings and placards on the aircraft.
- 5.5. A copy of the Report shall be included in the flight manual of all aircraft not exceeding 5 700 kg MTWA. If a flight manual is not applicable, the Report shall be displayed or retained in the aircraft in a suitably identified stowage.
- 5.6. Operators shall revise the Weight and Balance Report when there is a change to any of the items in paragraph 5.3.
- 5.7. The Weight and Balance Report may be in the form given in Appendix 1 to this AC. Variations in presentation are permitted, but must be acceptable to the Authority.

- END -

Page 6 of 6

Appendix 1 – Example of A Weight and Balance Report			
SPECIMEN WEIGHT AND BALANCE REPORT			
Reference	:	NAL/WBR/123	
Date of Issue	:	1 January 1989	
Produced by	:	New Aviation Ltd	
Aircraft Type and Model	:	Flynow 2E	
Nationality and Registration Marks Manufacturer	:	B-MZZ F.L.Y. Co. Ltd.	
Manufacturer's Serial Number	:	853	
Maximum Total Weight Authorised Centre-of-Gravity Limits	:	3320 kg Refer to flight manual reference number FM/946	
Part A Basic Weight			
NAL/BWS/246 dated 31 December 1988	3 is	: 2500 KG	
The c.g. of the aircraft in the same condition at this weight and with the landing gear extended is		: 127 in aft of datum	
The total moment about the datum in this condition in kg in/100 is		: 3175	
Note:			
(1) The datum is at fuselage station 0 situated 114 inches forward of the wing leading edge. This is the datum defined in the flight manual. All lever arms are distances in inches aft of datum.			
(2) The basic weight includes the weight of 11 kg unusable fuel and 2.2 kg unusable oil.			

8.2

Part B Variable Load

The weight, lever arms and moments of items of Variable Load are shown below. The Variable Load depends upon the equipment carried for the particular role.

Item	Weight	Lever Arm	Moment
	(kg)	(in)	(100 kg-in)
Pilot (one)	-	108	-
De-icing fluid 1.5 gal	5.5	140	8
Life-jackets (7)	6.4	135	9
Row 1 passenger seats (two)	27.2	173	47
Row 2 passenger seats (two)	27.2	215	59
Row 3 passenger seats (two)	27.2	248	68
Table	3.6	256	9
One stretcher and attachments (in place of seat rows 2 and 3)	20.5	223	46
Medical stores	6.8	250	17

Part C Loading Information (Disposable Load)

The total moment change when the landing gear is retracted in kg-in/100 is:

The appropriate lever arms are:

Item	Weight	Lever Arm (in)	Capacity (imp.gal)
Fuel in tanks 1 and 2	620 ¹	145	190
Engine Oil	23^{1}	70	5.5
Forward baggage		21	
Rear baggage		261	
Passengers in Row 1 seats		171	
Passengers in Row 2 seats		213	
Passengers in Row 3 seats		246	
Patient in stretcher		223	

1. Densities – Petrol 7.2 lb Imp. gal; Kerosone 8.1 Ib Imp. gal; Oil 9.0 Ib Imp. gal.

Note: To obtain the total loaded weight of aircraft, add to the Basic Weight the weights of the items of Variable and Disposable Load to be carried for the particular role.

AC No. : AC/AW/028R00 Date : 15 September 2014

In accordance with ANRM, it is a requirement that the pilot-in-command satisfies himself before take-off that the load is of such a weight, and is so distributed and secured, that it may safely be carried on the intended flight.

This Report was prepared (date) and supersedes all previous issues.

Name and Designation
Signed
on behalf of

- END -

Appendix 2 - Example of a Basic Weight Schedule

SPECIMEN BASIC WEIGHT SCHEDULE

Reference	:	NAL/BWS/246
Date of Issue	:	31 December 1988
Aircraft Type and Model	:	Flynow 2E
Nationality and Registration Marks	:	B-MZZ
Manufacturer's Serial Number	:	853

COMPUTATION OF BASIC WEIGHT AND CENTRE-OF-GRAVITY POSITION

Description	Weight (kg)	Arm (in)	Moment (kg-in)
Aircraft weight as per weighing report WR/789 dated 30 December 1988	2475	126	311850
Total of items weighed but not part of Basic Equipment (listed to be given)	-25	-	-650
Total of Basic Equipment items not weighed (list to be given)	+50	-	+5000
Basic Weight	2500	127	317500

Or

Description	Weight (kg)	Arm (in)	MOMENT (kg-in)
Aircraft basic weight as per Basic Weight Schedule NAL/BWS/245 dated 20 June 1988	2475	126	311850
Total of Basic Equipment items removed (listed to be given)	-25	-	-650
Total of Basic Equipment items added (list to be given)	+50	-	+5000
New Basic Weight	2500	127	317500

Note: The datum is at fuselage station O situated 114 inches forward of the wing leading edge. This is the datum defined in the flight manual. All lever arms are distances in inches aft of datum.

Current Basic Equipment List (may be given on separate sheets and attached to Schedule):

Item	Weight (kg)	Arm (in)
Two Marzell propeller type BL – H3Z30	57.6 each	76
Two engine driven 100 ampere alternative type GE- 361	12.2 each	117
One 13 AH Ni-Cd battery CB-7	14	153
Etc	etc	etc

This Schedule was prepared (date) and supersedes all previous issues.

Name and Designation Signed on behalf of

- END -

Appendix 3 – Conduct of Weighing

- 1 The following aspects should be adhered to and included in company weighing procedures:
 - (a) All weighings shall be supervised by a suitably qualified person.
 - (b) Weighing equipment should be suitable for the purpose. Evidence should be available, if necessary, to show that the equipment is regularly inspected and calibrated and its errors are within the tolerances specified by the equipment manufacturer or local weights and measure authority.
 - (c) The staff are trained and handling equipment is adequate to permit weighings to be made accurately and safely.
 - (d) Unless otherwise agreed to by the Authority a weighing shall consist of two independent weighings made with the aircraft longitudinal datum horizontal. The load must be removed from the weighing equipment between the weighings. Any discrepancy in the weighings shall not exceed 0.2 per cent of the gross weight or 25 lbs whichever is greater. If this tolerance is exceeded further weighings should be performed until the results between two consecutive weighings agree within the tolerance.
 - (e) A weighing report should be produced to provide a record of all measurements and calculations pertinent to the weighing. The report should include a list of equipment installed on the aircraft at the time of weighing.

- END -