



Advisory Circular

AC43-2

Revision 1

11 February 2011

Aircraft Empty Weight and Empty Weight Centre of Gravity—Forms CAA 2102 and CAA 2173

General

Civil Aviation Authority (CAA) advisory circulars (ACs) contain information about standards, practices, and procedures that the Director has found to be an **Acceptable Means of Compliance (AMC)** with the associated rule.

consideration will be given to other methods of compliance that may be presented to the Director. When new standards, practices, or procedures are found to be acceptable they will be added to the appropriate AC.

Purpose

This AC describes an acceptable means of compliance with standards for the establishment and the calculation of an aircraft empty weight and empty weight centre of gravity, by the use of CAA Form 2102 - *Aircraft Weight and Balance Report* and CAA Form 2173 - *Weight and Balance Data*.

Related Rules

This AC relates specifically to Civil Aviation Rule Part 43 - General Maintenance Rules and Part 91- General Operating and Flight Rules.

Change Notice

Revision 1 adds instructions for helicopters requiring recording of a lateral centre of gravity, and instructions on the inclusion and establishing of unusable fuel.

This revision also amends the Title to better reflect the purpose of this AC.

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General

Rule 91.109 requires that an aircraft be operated in accordance with its flight manual. To comply with this requirement, and to operate an aircraft within the weight and centre of gravity limitations of the flight manual, an accurate record is required of the aircraft's empty weight and empty weight centre of gravity (EWCG).

The objective of this AC is to enable a flight crew member to determine the correct weight and centre of gravity for the aircraft, from information contained in the Form CAA 2173 - *Weight and Balance Data* supplement of the aircraft flight manual.

All aircraft, whether new or used, will normally be required to be weighed to determine the empty weight and EWCG before issue of an airworthiness certificate. The aircraft will not be required to be weighed where the Director is satisfied that the empty weight and EWCG are given accurately within the last 5 years [*Refer rule 21.191(9)*] by:

- A Weight and Balance Report issued by the manufacturer.
- The competent authority of the State from which the aircraft was exported.

The equipment list of the Form CAA 2173 is to be prepared, listing all removable items of fixed location included in the empty weight. Other removable items are to be removed before weighing.

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.

Any change of empty weight and EWCG is to be recorded by the certifying engineer in the aircraft logbook and a new Form CAA 2173 completed.

For major modifications and repairs the calculation of the change in weight and EWCG is to be included, or indicated as required post installation, on the Form CAA 337 or its accompanying data package.

If changes in empty weight conditions arise from work certified by the holder of an avionic licence, who is not licence rated or approved to certify EWCG changes, the licensed avionic engineer shall ensure that an engineer authorised to certify weight and balance takes the necessary actions for the calculation or reweighing and completion of a new Form CAA 2173.

Aircraft reweighing and recalculation of empty weight and centre of gravity will be required when:

- 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.
- The operator has reason to believe the current data is not accurate.
- The aircraft manufacturer has specific requirements detailed in the ICA's for the aircraft. For example; Robinson Helicopters 2200 hour/12 year overhaul inspection.

- For powered aircraft with a certificated maximum seating capacity of 4 seats or more where this has not been carried out on the aircraft in the preceding 10 years. *Refer rule 91.605(e)(10).*

NOTE: Air transport operators are required to have procedures in their operator's exposition detailing aircraft weighing to establish the empty weight and calculation of the empty weight centre of gravity.

Definitions:

For the purpose of this AC the following definitions apply:

Empty Weight.

Has the same meaning assigned to it as in CAR Part 1

Empty Weight Centre of Gravity (EWCG).

The EWCG is the centre of gravity of an aircraft in its empty weight condition.

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. For example; aircraft TCDS for a FAR 23/27 light aircraft of US origin).

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).

Weighing Procedures

Weighing procedures to be followed are that specified in the aircraft manufacturer's Instructions for Continuing Airworthiness (ICAs). However, the flight manual may need to be referred to for details of any unusable fuel or un-drainable fuel and the quantity prescribed.

If no specific procedure is specified for the aircraft type, the procedures to be used are specified in:

- FAA AC AC120-27 (Latest revision)
- UK Civil Aviation Authority CAP 562 Leaflet 1-4
- Military documents relating to the specific aircraft type and configuration.

Weighing Equipment

Weighing equipment is to be of a type suitable for the purpose and is to be in good condition. When using electronic scales, care must be taken to ensure that there is no interference from other electronic transiting devices; (eg: mobile phones) that may affect the accuracy of the scales.

Weighing equipment is to have been tested and certified, within the previous 12 months by an accredited testing authority as meeting the following requirements:

- **Accuracy:** $\pm 0.2\%$ of the applied load or ± 2 kg, whichever is the greater, over the temperature range for which the equipment is designed.
- **Repeatability:** Deviation from the mean by not more than 0.05% of the applied load.

NOTE: Calibration of equipment is detailed in AC AC43-13.

Forms 2102 and 2173

Form CAA 2102 – Aircraft Weight and Balance Report

Weighing of aircraft must be supervised by a person certifying a release-to-service in accordance with rule 43.101.

The details of the weighing, including any calculations, are to be recorded on Form CAA 2102 - Aircraft Weight and Balance Report.

Despite the above paragraph, every person supervising weighing of an aircraft and certifying the Form CAA 2102 is to have previous experience of aircraft weighing and weight and balance calculation under supervision of an appropriately qualified and experienced engineer referred to in rule 66.57.

On completion of the Form CAA 2102 a release-to-service statement is to be certified in the report by a person authorised under Part 43, and the report inserted in the aircraft logbook. In addition, Section 8 of the Empty Weight Change Record of the Form CAA 1464-Aircraft Airworthiness Directives, Aircraft Modifications, Engine and Propeller Installation logbook is to be updated.

Certifying engineers are to ensure that the Form CAA 2173 has been completed in accordance with this AC.

Form CAA 2173–Weight and Balance Data

When a new empty weight or EWCG has been established, either by reweighing or by calculation, certifying persons are to:

- Ensure the CAA 2173 has been completed
- Ensure the new CAA 2173 is inserted in the aircraft Flight Manual.

Replacement Forms CAA 2102 and CAA 2173

Replacement copies of the Forms CAA 2102 and CAA 2173 are available in Word and pdf format, from the CAA web site: <http://www.caa.govt.nz/Forms/Forms.htm>

Aircraft Configurations–Use Of More Than One Form CAA 2173

Where an aircraft / helicopter is utilised for multiple roles; i.e. in a standard configuration and for example with seats removed for cargo transport, or spray gear fitted in an agricultural role, it is permissible to carry more than one copy of a Form CAA 2173 provided the forms are clearly identified to show the configuration of the aircraft to which they relate.

Helicopters EWCG-Lateral Balance

Helicopter manufacturers may require that the helicopter be weighed to take into account lateral balance EWCG. Where this is the case lateral C of G is to be calculated in accordance with the manufacturers' instructions and recorded on the Form CAA 2102 and CAA 2173.

Where changes have been made to the helicopter that could affect the EWCG, consideration is to be given to the Lateral C of G component in the case where the manufacturer requires this data to be recorded.