

Revision ~~1~~**2**

~~11 February 2011~~

**18 January 2023x**

### 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 (**EWCG**), 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**Revision 2 corrects outdated references, makes stylistic changes in line with current ACs and adds a Version History.** ~~Revision 1 adds instructions for helicopters requiring recording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.~~

**Version History**

## History Log

Revision No.	Effective Date	Summary of Changes
0	25 December 1997	Initial issue
1	11 February 2011	<ul style="list-style-type: none"><li>Added instructions for helicopters requiring recording of a lateral centre of gravity (C of G), and instructions on the inclusion and establishing of unusable fuel.</li><li>Amended the title to better reflect purpose of AC.</li></ul>
2	18 January 2023	Corrects outdated references.  Makes stylistic changes in line with current ACs and adds a Version History.

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## General

Rule 91.109 requires that an aircraft be operated in accordance with its aircraft flight manual (AFM). To comply with this requirement, and to operate an aircraft within the weight and C of G 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 C of G centre-of-gravity for the aircraft, from information contained in the form CAA 2173 - *Weight and Balance Data* supplement of the AFM 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 exception to this is set out under rule 21.191(9), which states that the aircraft will not be required to be weighed where the Director is satisfied that the aircraft has been weighed within the last five years, and the empty weight and EWCG have been given accurately within the last five years [Refer rule 21.191(9)] by:

- a Weight and Balance Report issued by the manufacturer, or
- the competent National Airworthiness Authority (NAA) of the State from which the aircraft was exported.

When filling in the equipment list of the form CAA 2173 list is to be prepared, listing all removable items of fixed location included in the empty weight. Remove 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 the empty weight and EWCG 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 C of G. Examples of this include, may be but are 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 **Instructions for Continuing Airworthiness (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 **four** seats or more, where this has not been carried out on the aircraft in the preceding 10 years, **as prescribed in** —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 **EWCG 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 **(C of G)** of an aircraft in its empty weight condition.

### **Unusable Fuel**

~~Unusable fuel is~~ **T**he 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~~ **NAAs** 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.**

~~Undrainable fuel is~~ **T**he 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 **AFM flight manual** may need to be referred to for details of any unusable fuel or undrainable fuel and the quantity prescribed.

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

- FAA AC AC120-27**F** (Latest revision **available here**)
- UK Civil Aviation Authority CAP 562, **Civil Aircraft Airworthiness Information and Procedures**, Leaflet **8-10, Weight and Balance of Aircraft** ~~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 ~~transmitting~~ **transmitting** devices (e.g. 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  $\pm 2$  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~~, **Calibration of tools and test equipment for maintenance of aircraft**.

## 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 **(RTS)** 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~~ **must have** previous experience of aircraft weighing and weight and balance calculation under supervision of an appropriately qualified and experienced engineer, **as outlined** ~~referred to~~ in rule 66.57.

On completion of the form CAA 2102 **an RTS** ~~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~~ **must** 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 **form** CAA 2173 has been completed, **and**
- ensure the new **form** CAA 2173 is inserted in the **AFM** 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 website, <http://www.caa.govt.nz/Forms/Forms.htm> **under the 'Forms' tab.**

## Aircraft Configurations – Use of more than one form CAA 2173

**It is acceptable to carry more than one copy of form CAA 2173 in cases where** where an aircraft / helicopter is ~~utilised~~ **used** 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 t~~ The **relevant** forms are **must be** 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 manufacturer's instructions and recorded on the forms **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 needs to be considered,** in the case where the manufacturer requires this data to be recorded.