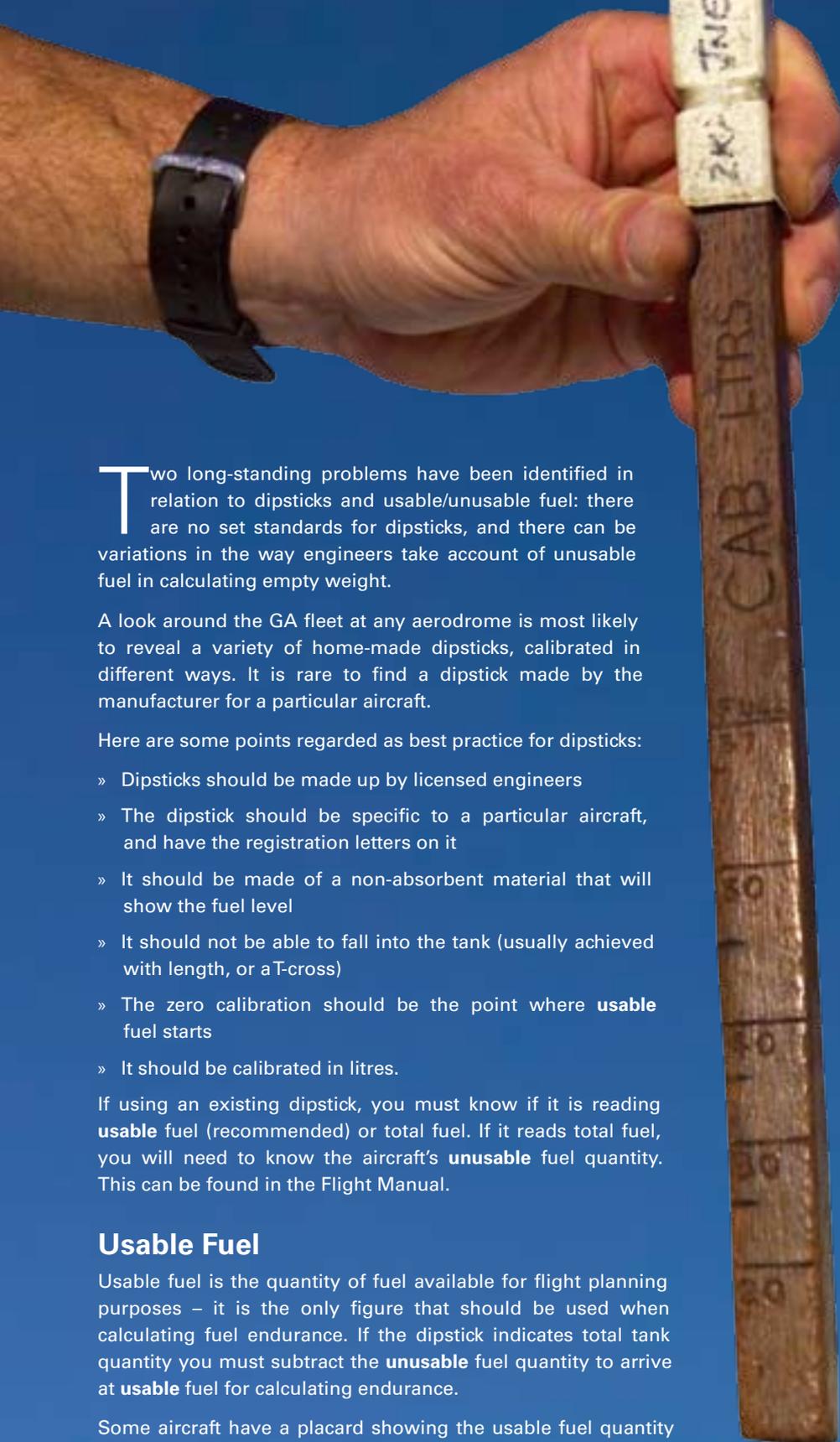


# Dipsticks



The fuel dipstick is a very reliable way to measure the amount of fuel in your aircraft tanks, but it is often a misunderstood tool.

Two long-standing problems have been identified in relation to dipsticks and usable/unusable fuel: there are no set standards for dipsticks, and there can be variations in the way engineers take account of unusable fuel in calculating empty weight.

A look around the GA fleet at any aerodrome is most likely to reveal a variety of home-made dipsticks, calibrated in different ways. It is rare to find a dipstick made by the manufacturer for a particular aircraft.

Here are some points regarded as best practice for dipsticks:

- » Dipsticks should be made up by licensed engineers
- » The dipstick should be specific to a particular aircraft, and have the registration letters on it
- » It should be made of a non-absorbent material that will show the fuel level
- » It should not be able to fall into the tank (usually achieved with length, or a T-cross)
- » The zero calibration should be the point where **usable** fuel starts
- » It should be calibrated in litres.

If using an existing dipstick, you must know if it is reading **usable** fuel (recommended) or total fuel. If it reads total fuel, you will need to know the aircraft's **unusable** fuel quantity. This can be found in the Flight Manual.

## Usable Fuel

Usable fuel is the quantity of fuel available for flight planning purposes – it is the only figure that should be used when calculating fuel endurance. If the dipstick indicates total tank quantity you must subtract the **unusable** fuel quantity to arrive at **usable** fuel for calculating endurance.

Some aircraft have a placard showing the usable fuel quantity near the filler cap.

## Unusable Fuel

The quantity of unusable fuel is determined during the original aircraft certification process. Usually, this involves a test to find out how much fuel remains in the tanks at the point at which the engine fuel supply is interrupted. Federal Aviation Regulation 23.959(a) says that the unusable fuel supply for each tank must be established as not less than the quantity at which the first evidence of malfunctioning occurs under the most adverse fuel feed condition occurring under each intended operation and flight manoeuvre. For conventional aircraft with a forward mounted engine, this is usually nose up at best angle of climb attitude.

The amount of unusable fuel can vary considerably from aircraft to aircraft. There is a big difference between Piper and Cessna aircraft, for example.

The Flight Manual should show the unusable fuel quantity.

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## Aircraft Empty Weight

Empty weight is the weight of an aircraft, including airframe, powerplant(s), all fixed equipment, full oil tank(s), and **unusable** fuel. The empty weight figure is found in the form CAA2173 located in the Flight Manual and can be expressed in pounds or kilograms. On the back of the form is listed all the equipment fitted at the time the aircraft was weighed.

Engineers preparing the CAA2173 form need to adhere to the manufacturers' procedure for determining unusable fuel. This varies from type to type. For example, some manufacturers will use a method that runs the engine until it stops, and then add a specified quantity, whereas other manufacturers may say to drain the tanks entirely, and add a specified amount. The resulting level may be above the fuel outlet port to allow for the manoeuvres described above (see diagram).

For more information see our booklet, *Weight and Balance*, and Advisory Circular AC43-2 *Aircraft weight and balance control – forms CAA2102 and CAA2173*.

## Role of the Fuel Gauges

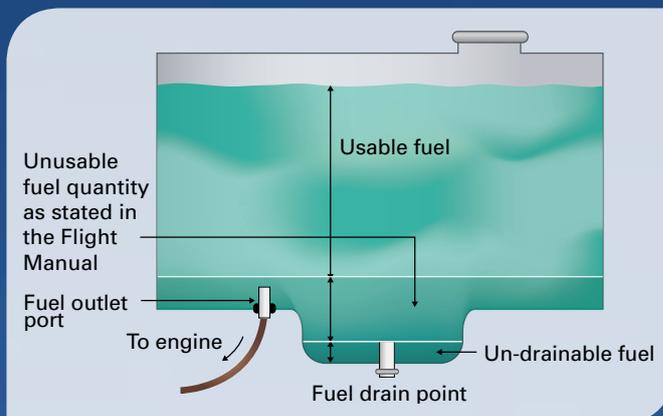
Contrary to some opinion, most fuel gauges do read reasonably accurately. After dipping the tanks, check the gauges and compare the readings – you will then know if the gauges are reading accurately. If they don't, they need to be repaired.

The fuel gauges should be an integral part of your fuel management. Monitor levels during flight, and compare with your calculations. Fuel loss in flight can happen – through fuel venting, for instance, or a leaking fuel drain. This may not be visible, especially in a low-wing aircraft, so the fuel gauges may be your only clue that fuel is being used at a greater rate than planned.

## Tips for Dipping Your Tanks

Here are some points that should be kept in mind when dipping a fuel tank:

- » The aircraft should be parked on level ground. If this is not possible, dip each tank, turn the aircraft through 180 degrees, dip each tank again, and take the average of the two values. This may not be totally accurate, but it will be better than either of the two single readings.
- » Cross-feeding during refuelling, or at any other time, can be prevented in most single-engine aircraft by selecting either the LEFT or RIGHT tank only. The trap here is that when you are refuelling the aircraft with the fuel selector set to BOTH, the tank that you are filling can be cross-feeding to the other tank. Although not large, this could result in a quantity of fuel less than was originally intended in the first tank by the time you have finishing filling the second tank, and this could be a problem if the flight requires both tanks to be full.



Cross-section of an aircraft fuel tank (not to scale)

- » Fuel tanks should always be dipped after refuelling to establish the exact amount of fuel on board – even when adding a known quantity of fuel.
- » The dipstick should be inserted in the filler neck perpendicular to the wing surface, unless there is another method specified in the Flight Manual. Some aircraft fuel tanks must be dipped on an angle because the main spar is directly below the filler neck.
- » Always take a fuel sample from each drain point after refuelling, to check for correct fuel grade and any impurities.

For more information, see our booklet *Fuel Management*. You can get a free copy by emailing [info@caa.govt.nz](mailto:info@caa.govt.nz). ■

