DOCUMENT
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DOCUMENT TITLE

GENERAL OPERATIONS, FLIGHT PLANNING AND PERFORMANCE

CHAPTER 1 – WEIGHT

Version 1.0
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WEIGHT CONTROL

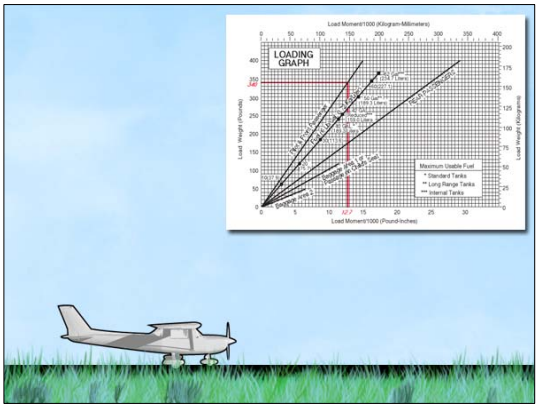
INTRODUCTION TO WEIGHT AND BALANCE

There are many factors that lead to efficient and safe operation of aircraft. Among these vital factors is proper weight and balance control. The weight and balance system commonly employed among aircraft consists of three equally important elements:

- The weighing of the aircraft,
- The maintaining of the weight and balance records, and
- The proper loading of the aircraft.

An inaccuracy in any one of these elements nullifies the purpose of the whole system. The final loading calculations will be meaningless if either the aircraft has been improperly weighed or the records contain an error.

Improper loading cuts down the efficiency of an aircraft from the standpoint of altitude, manoeuvrability, rate of climb, and speed. It may even be the cause of failure to complete the flight, or for that matter, failure to start the flight. Because of abnormal stresses placed upon the structure of an improperly loaded aircraft, or because of changed flying characteristics of the aircraft, loss of life and destruction of valuable equipment may result.



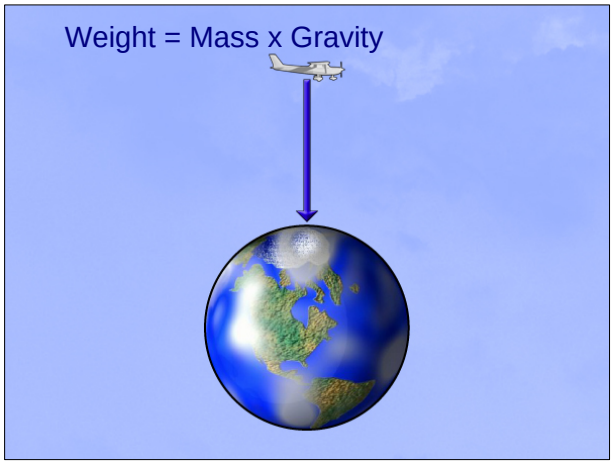
Compliance with weight and balance limits of any aircraft is therefore critical to flight safety. Operating an aircraft above the maximum weight limitation compromises the structural integrity of the aircraft and adversely affects its performance. Operation with the centre of gravity (CG) outside the approved limits may result in control difficulty.

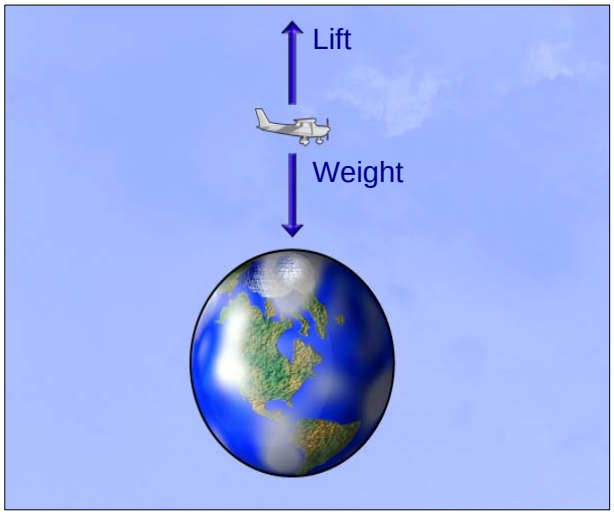
The pilot-in-command of the aircraft has the responsibility on every flight to know the maximum allowable weight of the aircraft and its CG limits. This allows the pilot to determine on the pre-flight inspection that the aircraft is loaded in such a way that the CG is within the allowable limits.

WEIGHT

Weight is the force with which gravity attracts a body toward the centre of the Earth. It is a product of the mass of a body and the acceleration acting on the body. Weight is a major factor in aircraft construction and operation, and demands respect from all pilots.

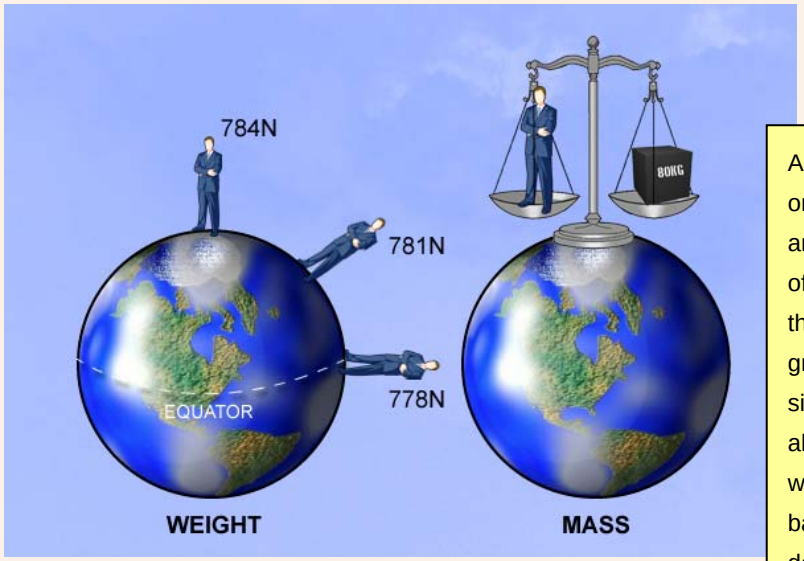
Excessive weight reduces the efficiency of an aircraft and the safety margin available if an emergency condition should arise.





The force of gravity continually attempts to pull the aircraft down toward Earth. The force of lift is the only force that counteracts weight and sustains the aircraft in flight. However, the amount of lift produced by an aerofoil is limited by the aerofoil design, angle of attack, airspeed, and air density. Therefore, to assure that the lift generated is sufficient to counteract weight, loading the aircraft beyond the manufacturer's recommended weight must be avoided. If the weight is greater than the lift generated, the aircraft may be incapable of flight.

Difference between Weight and Mass?



A balance scale balances the force of one object's weight against the force of another object's weight. The two sides of a blance scale are close enough that the objects experience similar gravitational fields. Hence, if they have similar masses then their weights will also be similar. The scale, by comparing weight, also compares masses. The balance scale is one of the oldest known devices for measuring mass.

EFFECTS OF WEIGHT

Any item aboard the aircraft that increases the total weight is undesirable as far as performance is concerned. Manufacturers attempt to make the aircraft as light as possible without sacrificing strength or safety.

Important! Most modern aircraft are so designed that if all seats are occupied, all baggage allowed by the baggage compartment is carried, and all of the fuel tanks are full, the aircraft will be grossly overloaded. This type of design requires the pilot to give great consideration to the requirements of the trip. If maximum range is required, occupants or baggage must be left behind, or if the maximum load must be carried, the range, dictated by the amount of fuel on board, must be reduced.

The pilot of an aircraft should always be aware of the consequences of overloading. An overloaded aircraft may not be able to leave the ground, or if it does become airborne, it may exhibit unexpected and unusually poor flight characteristics. If an aircraft is not properly loaded, the initial indication of poor performance usually takes place during take-off.

Excessive weight reduces the flight performance of an aircraft in almost every respect. The most important performance deficiencies of the overloaded aircraft are:

- Higher take-off speed, which requires a
- Longer take-off run
- Reduced rate and angle of climb
- Lower maximum altitude
- Shorter range
- Reduced cruising speed
- Reduced manoeuvrability
- Higher stalling speed
- Higher approach and landing speed
- Longer landing roll
- Excessive weight on the nose wheel or tail wheel

The pilot must be knowledgeable in the effect of weight on the performance of the particular aircraft being flown. Pre-flight planning should include a check of performance charts to determine if the aircraft's weight may contribute to hazardous flight operations. Excessive weight in itself reduces the safety margins available to the pilot, and becomes even more hazardous when other performance-reducing factors are combined with overweight. The pilot must also consider the consequences of an overweight aircraft if an emergency condition arises. If an engine fails on take-off or airframe ice forms at low altitude, it is usually too late to reduce the aircraft's weight to keep it in the air.

WEIGHT CHANGES

The maximum allowable weight for an aircraft is determined by design considerations. However, the maximum operational weight may be less than the maximum allowable weight due to such considerations as high-density altitude or high-drag airfield conditions caused by wet grass or water on the runway. The maximum operational weight may also be limited by the departure or arrival airport's runway length.

One important pre-flight consideration is the distribution of the load in the aircraft. Loading the aircraft so the gross weight is less than the maximum allowable is not enough. This weight must be distributed to keep the CG within the specified limits:

If the CG is too far aft, passenger weight or baggage can be shifted forward.

If the CG is too far forward, a heavy passenger can be moved to one of the rear seats or baggage can be shifted from a forward baggage compartment to a rear compartment.

The fuel load should be balanced laterally: the pilot should pay special attention to the POH regarding the operation of the fuel system, in order to keep the aircraft balanced in flight.

The weight of the aircraft can also be changed by altering the fuel load. Fuel has considerable weight (2.7 kg per US Gal)) 30 gallons may weigh more than one passenger. But it must be remembered that if weight is lowered by reducing fuel, the range of the aircraft is decreased. During flight, fuel burn is normally the only weight change that takes place. As fuel is used, the aircraft becomes lighter and performance is improved.

Repairs or modifications may also affect the weight of the aircraft. Changes of fixed equipment have a major effect upon the weight of the aircraft. An aircraft can be overloaded by the installation of extra radios or instruments. Fortunately, the replacement of older, heavy electronic equipment with newer, lighter types results in a weight reduction. This weight change, however helpful, will probably cause the CG to shift and this must be computed and annotated in the weight and balance record.

It is the responsibility of the pilot-in-command to use the most current weight and balance data when operating the aircraft.

WEIGHT AND BALANCE RECORD

Part A - Weight and Balance Maintenance Data (to be completed by a Weight and Balance Control Officer (WBCO))

REF OSW243	Weight and Balance Report Ref: Flight Manual Sect 6 iss 4		Revision and Re - Issue Required 7/11/2007			
	Centre of Gravity Position (CG) is LONGITUDINAL / LATERAL (delete as appropriate)	Configuration	Empty Weight and Empty Weight CG (Weighing or Validation dated 7-Nov-07	Weight:kg 773.8	Arm: mm 1002.0709	Index 775402.5
	measured...AFT...of datum	Four Seater		MTOW=		1150
	Aircraft Longitudinal / Lateral Datum		Max. and Min Empty weight &Empty weight CG.			
P .OSMOND A162909 Approval Stamp	Forward Face of Firewall		Revision and Reissue by WBCO is required when running totals are	Weight:kg 779.55 768.05	Arm: mm 1007.0709 997.07095	more than less than

Part B - Record of Empty Weight and Balance Changes (the person so endorsing maintenance shall ensure that Part B is calculated and recorded in accordance with CAO100.7)

Date	Description of Alteration	Moment Arm from Datum (mm)	Weight and Balance Change Added (+) Weight:kg	Added (+) Index	Removed (-) Weight:kg	Removed (-) Index	Running Total of Empty Weight & Empty Weight CG Weight:kg	Arm: mm	Index
7-Nov-07							773.8	1002.07	775402.5
13-Jan-09	ELT Installation	3430			0.255	874.65	**773.545**	**1001.27**	**774527.9**
	Remove ELT200 Install Kannad 406								

Organisation:	Flight Training Adelaide	Aircraft Type	Socata TB10	VH- YTQ	PAGE 1