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GENERAL OPERATIONS, FLIGHT PLANNING AND PERFORMANCE

CHAPTER 17
FACTORS AFFECTING APPROACH AND LANDING PERFORMANCE

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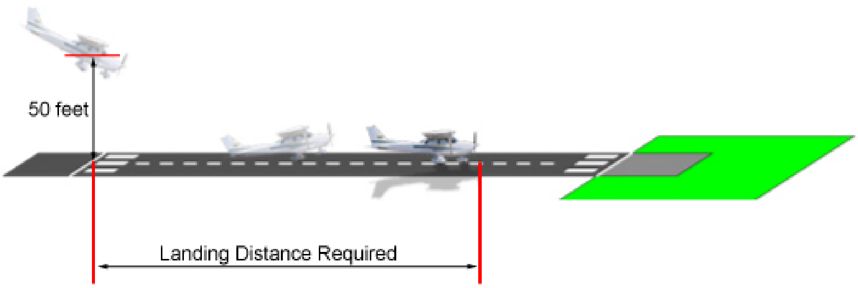
FACTORS AFFECTING APPROACH AND LANDING PERFORMANCE

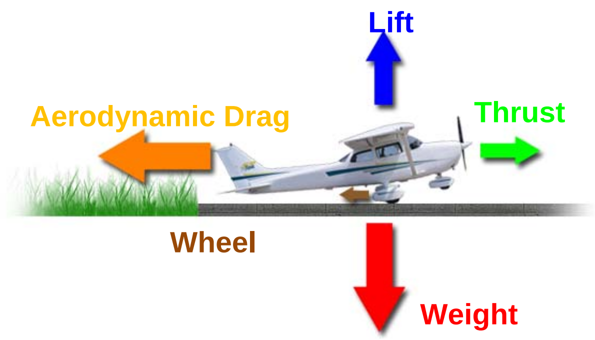
INTRODUCTION

Planning for the landing phase begins with landing weight and climb weight calculations, the latter ensuring that a safe climb out can be made in the event of go-around.

The Landing Distance Required (LDR) begins at 50 feet above the threshold and ends with a full stop. It assumes maximum braking, whilst avoiding excessive use which could result in damage to brake systems and/or blown tyres.



When planning for the landing a number of factors need to be considered



To obtain minimum landing distance at the specified landing speed, the forces that act on the aircraft must provide maximum deceleration during the landing roll. The forces acting on the aircraft during the landing roll may require various procedures to maintain landing deceleration at the peak value.

A distinction should be made between the procedures for minimum landing distance and an ordinary landing roll with considerable excess runway available. Minimum landing distance will be obtained by creating a continuous peak deceleration of the aircraft; that is, extensive use of the brakes for maximum deceleration.

On the other hand, an ordinary landing roll with considerable excess runway may allow extensive use of aerodynamic drag to minimise wear and tear on the tyres and brakes. If aerodynamic drag is sufficient to cause deceleration of the aircraft, it can be used in deference to the brakes in the early stages of the landing roll; i.e., brakes and tyres suffer from continuous hard use, but aircraft aerodynamic drag is free and does not wear out with use.

Note: The use of aerodynamic drag is applicable only for deceleration to 60 or 70 % of the touchdown speed. At speeds less than 60 to 70 % of the touchdown speed, aerodynamic drag is so slight as to be of little use, and braking must be utilised to produce continued deceleration of the aircraft. Since the objective during the landing roll is to decelerate, the power plant thrust should be the smallest possible positive value (or largest possible negative value in the case of thrust reversers).

In addition to the important factors of proper procedures, many other variables affect the landing performance. Any item that alters the landing speed or deceleration rate during the landing roll will affect the landing distance.

The most critical conditions of landing performance are the result of some combination of high gross weight, high density altitude, and unfavourable wind. These conditions produce the greatest landing distance and provide critical levels of energy dissipation required of the brakes. In all cases, it is necessary to make an accurate prediction of minimum landing distance to compare with the available runway. A polished, professional landing procedure is necessary because the landing phase of flight accounts for more pilot-caused aircraft accidents than any other single phase of flight.

LANDING DISTANCE — FLAPS LOWERED TO 40 ° - POWER OFF, HARD SURFACE RUNWAY - ZERO WIND

GROSS WEIGHT LB	APPROACH SPEED IAS, MPH	AT SEA LEVEL & 59 °F		AT 2500 FT & 50 °F		AT 5000 FT & 41 °F		AT 7500 FT & 32 °F	
		GROUND ROLL	TOTAL TO CLEAR 50 FT OBS	GROUND ROLL	TOTAL TO CLEAR 50 FT OBS	GROUND ROLL	TOTAL TO CLEAR 50 FT OBS	GROUND ROLL	TOTAL TO CLEAR 50 FT OBS
1600	60	445	1075	470	1135	495	1195	520	1255

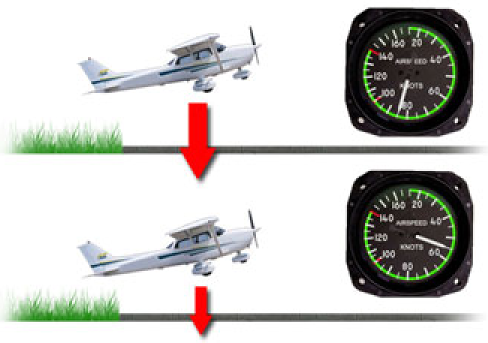
NOTES:
1. Decrease the distances shown by 10% for each 4 knots of headwind.
2. Increase the distance by 10% for each 60 °F temperature increase above standard.
3. For operation on a dry, grass runway, increase distances (both "ground roll" and "total to clear 50 ft obstacle") by 20% of the "total to clear 50 ft obstacle" figure.

In the prediction of minimum landing distance from the AFM/POH data, the following considerations must be given :

- Pressure altitude and temperature - to define the effect of density altitude.
- Gross weight - which defines the CAS for landing.
- Wind - a large effect due to wind or wind component along the runway.
- Runway slope and condition - relatively small correction for ordinary values of runway slope, but a significant effect of snow, ice, or soft ground.

FACTORS AFFECTING LANDING DISTANCE

Effect of Gross Weight



The effect of gross weight on landing distance is one of the principal items determining the landing distance. One effect of an increased gross weight is that a greater speed will be required to support the aircraft at the landing angle of attack and lift coefficient.

For an example of the effect of a change in gross weight, a 21 % increase in landing weight will require a 10 % increase in landing speed to support the greater weight.

When minimum landing distances are considered, braking friction forces predominate during the landing roll and, for the majority of aircraft configurations, braking friction is the main source of deceleration.

The minimum landing distance will vary in direct proportion to the gross weight. For example, a 10 % increase in gross weight at landing would cause a:

- 5 % increase in landing velocity and
- 10 % increase in landing distance.

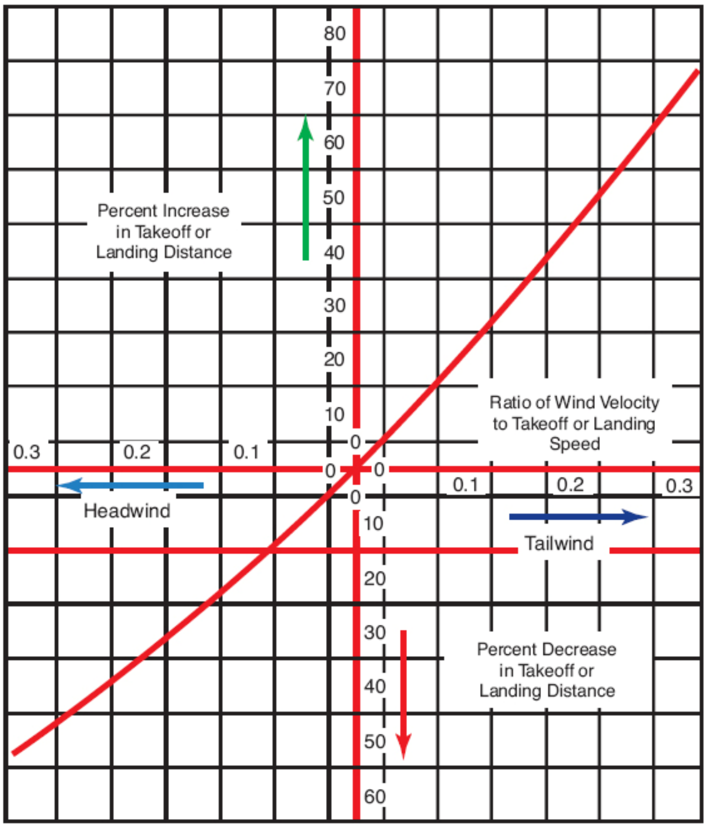
Important !!!
Remember that maximum structural landing weight is a limitation that is imposed by the manufacture and must not be exceeded under any circumstances, otherwise structural damage may occur

EFFECT OF WIND

A head-wind during final approach will steepen the approach path whereas a tail-wind will make the approach path more shallow and increase the risk of overshooting the intended touch down point.

A head-wind will reduce the groundspeed during the landing and will reduce the landing distance. The landing run which is the distance taken for the aircraft to stop from the point of touch down will be significantly reduced by a head-wind.

For example a head-wind of 10% of the touch down speed will reduce the landing run by approximately 20%.

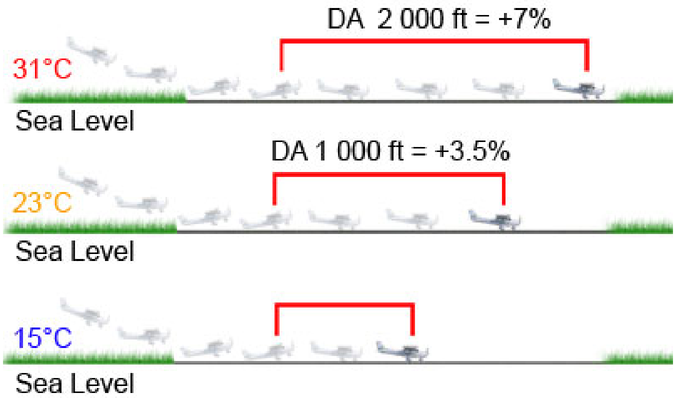


It should noted that under Australian regulations during pre-flight planning the forecast winds at the destination are not used in calculations. Ambient conditions observed at or received inbound to the destination circuit area, can be used for landing decisions but in pre-flight planning, the pilot cannot assume that the forecast winds will remain unchanged during the flight. Nil winds are used at the planning stage when checking the maximum landing weight as a possible restriction on take-off weight.

The graph illustrates this general effect.

EFFECT OF PRESSURE ALTITUDE AND AMBIENT TEMPERATURE

The effect of pressure altitude and ambient temperature is to define density altitude and its effect on landing performance. An increase in density altitude will increase the landing speed but will not alter the net retarding force. Thus, the aircraft at altitude will land at the same indicated airspeed as at sea level but, because of the reduced density, the true airspeed (TAS) will be greater.

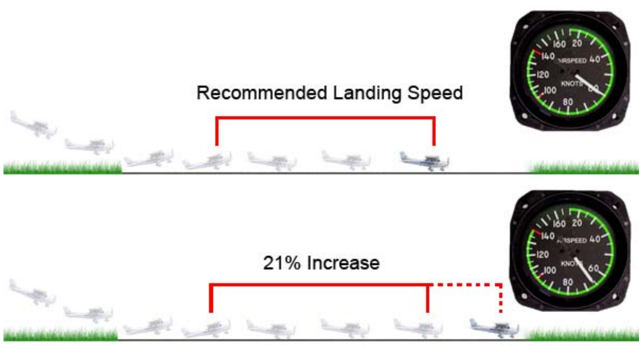


Since the aircraft lands at altitude with the same weight and dynamic pressure, the drag and braking friction throughout the landing roll have the same values as at sea level. As long as the condition is within the capability of the brakes, the net retarding force is unchanged, and the deceleration is the same as with the landing at sea level. Since an increase in altitude does not alter deceleration, the effect of density altitude on landing distance would actually be due to the greater TAS.

The minimum landing distance at 5 000 ft would be 16 % greater than the minimum landing distance at sea level. The approximate increase in landing distance with altitude is approximately 3.5 % for each 1 000 ft of altitude. Proper accounting of density altitude is necessary to accurately predict landing distance.

EFFECT OF LANDING SPEED

The effect of proper landing speed is important when runway lengths and landing distances are critical. The landing speeds specified in the AFM/POH is generally the minimum safe speeds at which the aircraft can be landed. Any attempt to land at below the specified speed may mean that the aircraft may stall, be difficult to control, or develop high rates of descent. On the other hand, an excessive speed at landing may improve the controllability slightly (especially in crosswinds), but will cause an undesirable increase in landing distance.

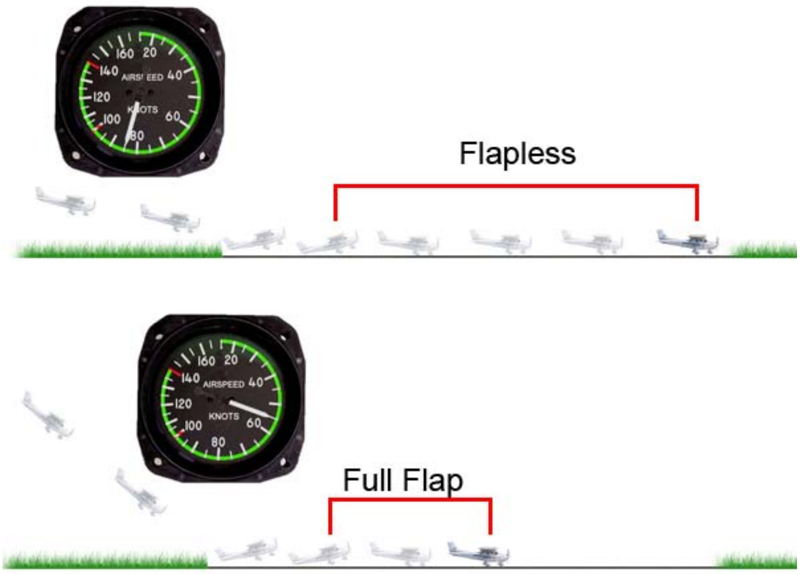


A 10 % excess landing speed would cause at least a 21 % increase in landing distance.

The excess speed places a greater working load on the brakes because of the additional kinetic energy to be dissipated. Also, the additional speed causes increased drag and lift in the normal ground attitude, and the increased lift will reduce the normal force on the braking surfaces. The deceleration during this range of speed immediately after touchdown may suffer, and it will be more likely that a tyre can be blown out from braking at this point.

EFFECT OF FLAPS

Flaps decrease the stalling speed and thus allow a lower touchdown speed and a reduced landing run. There is less strain on the landing gear and the attitude of the aircraft with flaps lowered allows a better view along the descent path to the touch down area.



However when winds are strong and gusty, it may be advisable to land with reduced flap settings to improve controllability, assuming the landing distance is sufficient to cope with the higher landing speed.

EFFECT OF RUNWAY SURFACE

The nature of the surface affects the rolling friction and more importantly the effectiveness of the braking system. Landing for example on a slush covered surface results in greater rolling friction but the brakes may be ineffective, especially at higher speeds. Generally the landing distance required is increased when landing on surfaces other than dry concrete or bitumen.

EFFECT OF RUNWAY SLOPE

The landing distance required on an up-sloping runway is less than on a level runway. It should be noted however that the effect is relatively minor and it is very unlikely that an up-slope would justify landing on a shorter runway or on a runway on which there is a tail-wind component.