

Safety elements in aircraft performance

[Environment](#), [Air](#)



Safety Elements in Aircraft Performance Introduction: This paper investigates the various aircraft performance safety elements with specific attention to the take-off and landing stages. The particular performance criteria studied is that of FAR25 with inclusion of conditions, configurations and operating modes. Standard performance conditions under study are atmospheric pressure at sea level, ambient air temperature, percent relative humidity and wind velocity (Diamond 1A, General, 2005). These are varied against parametric values of noise levels, take off engine thrusts, approach velocities, etc. The objective of this exercise is to investigate why, if at all, and by how much, if so, each safety element within the overall aircraft performance criteria affects such safety.

Throughout the paper, performance data presented are based on flight tests and have been corrected for the following flight conditions:

1. engine thrust ratings less installation losses, airbleed and accessory loads;
2. full temperature accountability within the operational limits certified;
3. wind accountability as per FAR 25 provisions;
4. humidity accountability as per FAR 25 provisions;
5. take-off and landing performance based on smooth, dry and surfaced runways;
6. the take-off thrust performance data is based on take-off thrust setting instructions as per Diamond 1A, General, 2005. These have been left out because they are not considered germane to this paper's purpose. (Diamond 1A, General, 2005)

The paper shall now also include the basis on which the operational factors

that have been considered for inclusion of the Diamond 1A, 2005, aircraft performance data, the last having been utilized for the purpose of this paper.

1. The maximum demonstrated crosswind component for takeoff and landing is 25 knots.
2. Winds for which graphical corrections are available are to be taken as the tower winds (10m above the runway).
3. Airplanes under study have been demonstrated to be free of air ingestion up to water depths of 0.75in with the nose tire pressure 120+/-5psi.
4. Performance data has not been determined for wet or icy runway conditions.
5. Use sea level performance and power setting airport pressure altitudes below sea level not exceeding -1000ft.
6. Percentage increases given for landing distances under ABNORMAL PROCEDURES are in respect to flaps landing distance unless otherwise specified. (Diamond 1A, p. 6. 2, 2005)

Takeoff Parameters:

The paper shall now begin its investigation into the safety elements that enhance aircraft performance. First, it shall posit the takeoff parametric elements.

Takeoff Field Length (TFL):

TFL, as determined by the combination of weight, altitude, temperature, wind and runway gradient, has to be taken in maximum in consideration of the following factors:

- a. 115% of all-engine takeoff distance from brake release to a height of 35ft

above runway surface.

b. Accelerate-stop distance.

c. Distance to attain 35ft above the runway surface with an engine failure at . (Diamond 1A, p. 6. 7, 2005)

Note: It is noted that the manual points out that the weight limit charts within its ambit does not specify which of the above factors may limit weight under given operating conditions.

Critical Engine Failure Speed:

The decision speed - the speed (IAS), after engine failure or any other cause, at which the pilot may elect to stop or takeoff - varies with weight, temperature, altitude, wind, runway gradient, takeoff flap setting, anti-skid availability, and takeoff speed schedule. (Diamond 1A, p. 6. 8, 2005)

Rotation Speed:

The IAS at which airplane rotation is initiated assuming a continued takeoff after engine failure . When it is assumed that, under these conditions, the airplane is rotated at nose up body altitude at it will reach a speed of before a height of 35ft is attained the rotation speed will vary with weight, altitude, temperature, takeoff flap setting, and takeoff speed schedule. (Diamond 1A, p. 6. 8, 2005)

Airborne Speed:

The speed at which the aircraft first becomes airborne. (Diamond 1A, p. 6. 8, 2005)

Takeoff Safety Speed:

This is the actual speed attained at 35ft above runway surface with engine failure at and the airplane rotated at and where it is assumed that will

always be at least 1.2 the takeoff safety speed varies with weight, takeoff flap setting and takeoff speed schedule. (Diamond 1A, p. 6. 8, 2005)

Note: The values of V_{LO} , V_{LOF} and V_{LOE} correspond to particular takeoff configurations, runway and ambient conditions. The takeoff speed schedules have been provided based on the following:

a. Flaps takeoff

b. Flaps takeoff

c. Flaps increased takeoff speed schedule up to 9% speed increase when TOFL is not limited by runway length, brake energy or obstacle clearance.

d. Schedules b. and c. of above are combined in the chart presentations.

The capacity of the braking system for absorption of airplane energy has limits imposed in the chart system wherever applicable. (Diamond 1A, p. 6. 8, 2005)

Accelerate-Stop Distance:

This is the distance that is required to accelerate at speed using both engines and then bring the airplane to a complete stop using the ENGINE FAILURE DURING TAKEOFF (below V_{LO}) procedure. (Diamond 1A, p. 6. 9, 2005)

Rejected Takeoff:

This is the same as the accelerate-stop procedure. (Diamond 1A, p. 6. 9, 2005)

Appendix:

List of Abbreviations:

IAS = Indicated airspeed - Airspeed indicator reading.

V_{S} = Stall speed - the minimum speed that results when recovery is initiated at

buffet onset with engines idling. Actual stalling speeds vary with weight, configuration, center of gravity, location, bank angle, g load and power setting.