acceptable engine model, and the propeller thrust and power characteristics should be substantiated by wind tunnel testing or equivalent means.

d. Effects of ambient temperature. The flight tests of paragraph 1.2.1.a. above will typically provide data over a broad range of ambient temperatures. Additional data may also be obtained from other flight or ground tests of the same type or series of engine. The objective is to confirm that the propulsion system model accurately reflects the effects of temperature over the range of ambient temperatures for which approval is being sought (operating envelope). Because thrust (or power) data can usually be normalised versus temperature using either dimensionless variables (e.g., theta exponents) or a thermodynamic cycle model, it is usually unnecessary to obtain data over the entire ambient temperature range. There is no need to conduct additional testing if:

i. The data show that the behaviour of thrust and limiting parameters versus ambient temperature can be predicted accurately; and

ii. Analysis based upon the test data shows that the propulsion system will operate at rated thrust without exceeding propulsion system limits.

1.2.2 Extrapolation of propulsion system performance data to 915 m (3,000 feet) above the highest airport altitude tested (up to the maximum takeoff airport altitude to be approved) is acceptable, provided the supporting data, including flight test and propulsion system operations data (e.g., engine and propeller control, limits exceedence, and surge protection devices scheduling), substantiates the proposed extrapolation procedures. Considerations for extrapolation depend upon an applicant's determination, understanding, and substantiation of the critical operating modes of the propulsion system. This understanding includes a determination and quantification of the effects that propulsion system installation and variations in ambient conditions have on these modes.

2 Expansion of Takeoff and Landing Data for a Range of Airport Elevations.

2.1 These guidelines are applicable to expanding aeroplane Flight Manual takeoff and landing data above and below the altitude at which the aeroplane takeoff and landing performance tests are conducted.

2.2 With installed propulsion system performance characteristics that have been adequately defined and verified, aeroplane takeoff and landing performance data obtained at one field elevation may be extrapolated to higher and lower altitudes within the limits of the operating envelope without applying additional performance conservatisms. It should be noted, however, that extrapolation of the propulsion system data used in the determination and validation of propulsion system performance characteristics is typically limited to 915 m (3,000 feet) above the highest altitude at which propulsion system parameters were evaluated for the pertinent power/thrust setting. (See paragraph 1 of this AMC for more information on an acceptable means of establishing and verifying installed propulsion system performance characteristics.)

2.3 Note that certification testing for operation at airports that are above 2438 m (8,000 feet) should also include functional tests of the cabin pressurisation system. Consideration should be given to any other systems whose operation may be sensitive to, or dependent upon airport altitude, such as: engine and APU starting, passenger oxygen, autopilot, autoland, autothrottle system thrust set/operation."

AMC 25.101(g) Go-around

ED Decision 2020/024/R

1. General

CS 25.101(g) requires that procedures must be established for the execution of go-arounds from landing configurations (identified as 'balked landings' in this AMC) and from approach configurations (identified as 'missed approaches' in this AMC) associated with the conditions prescribed in CS 25.119 and CS 25.121(d). Also, as required by CS 25.1587(b)(4), each AFM must contain the procedures established under CS 25.101(g), including any relevant limitations or information. The landing climb gradient determined under the CS 25.119 conditions, the approach climb gradient determined under the CS 25.121(d) conditions, and the additional operating limitations regarding the maximum landing weight established in accordance with CS 25.1533(a)(2) must be consistent with the established balked landing and missed approach procedures (CS 25.101(g)) provided in the aeroplane flight manual (AFM). In order to demonstrate the acceptability of the recommended missed approach and balked landing procedures, the applicant should conduct demonstrations (by flight test or pilot-in-the-loop simulator tests) to include a one engine inoperative go-around at a weight, altitude, temperature (WAT)-limited or simulated WAT-limited thrust or power condition.

The applicant should conduct the demonstrations at WAT-limited conditions that result in the greatest height loss and/or longest horizontal distance to accelerate to the scheduled approach climb speed. Alternatively, the applicant may conduct testing at simulated WAT-limited conditions (with reduced thrust or power on the operating engine) and use the resulting time delays for each crew action in a subsequent off-line simulation/analysis in accordance with the procedures below. Although compliance with CS 25.101(g) and (h) and CS 25.121(d) is not directly linked with the criteria for the approval of weather minima for approach, the minimum decision height for initiating a go-around is dependent upon the weather minima to be approved. In addition, a steeper climb gradient and the associated lower WAT-limited landing weight may be associated with CAT II operations. As such, if CAT II weather minima approval is expected, the applicant should conduct the go-around demonstration and/or analysis consistent with both CAT I and II operations for the associated decision height and WAT-limited thrust or power condition (or a critical combination thereof).

2. Procedures

The go-around demonstration specified in Chapter 1 of this AMC can be conducted at an altitude above the normal decision height/altitude (for test safety), with the height loss in the manoeuvre used to show that ground contact prior to the runway threshold would not occur if the manoeuvre was initiated at the decision height/altitude. Flight testing, simulation and/or analysis at a range of (WAT limit or simulated WAT limit) conditions throughout the approved envelope should be conducted to assess the height loss relative to the decision height/altitude consistent with the criteria for the weather minima to be approved (or higher as constrained by AFM limitations). At least one flight test or pilot-in-the-loop simulator test should be conducted at a WAT-limited condition to assess the OEI go-around procedure and establish the time delays used for any subsequent analysis/simulation.

In addition, the assessment of the go-around procedure should include consideration of the horizontal distance (based upon the minimum go-around trajectory) needed to establish the minimum engine-out climb gradient required by CS 25.121(d) or a steeper gradient as required by specific weather minima operational criteria. It should be shown by flight test, simulation and/or analysis that the aeroplane would remain above the profile illustrated in Figure 1 below when the go-around is evaluated at the critical WAT limit condition (up to the structural maximal landing weight) and flown in accordance with the one-engine-inoperative (OEI) go-around procedure.

This provides a minimum design standard trajectory for a missed approach with one engine inoperative and does not constitute a means to ensure obstacle clearance. It does not preclude additional missed approach procedures that may be developed to satisfy operational requirements, including special or complex missed approach path requirements. The operator should seek approval from their national aviation authority to use the additional procedures and data.

(a) In accordance with CS 25.101(h), the established procedures for executing balked landings and missed approaches must:

(i) be able to be consistently executed in service by crews of average skill,

(ii) use methods or devices that are safe and reliable, and

(iii) include allowance for any time delays in the execution of the procedures that may reasonably be expected in service (including the recovery of full go-around thrust or power if equipped with a reduced go-around (RGA) thrust or power function that requires a manual override), but should not be less than one second between successive flight crew actions, except for movements of the primary flying controls.

(b) The flight test demonstration(s), simulation and/or analysis should be made with:

(i) all engines operating (AEO) and the thrust or power initially set for a 3-degree approach, and the configuration and final approach airspeed consistent with the AEO landing procedure (not more than V_{REF} + 5 kt) in zero wind conditions,

(ii) application of the available go-around thrust or power at the selected go-around height (initially the RGA thrust or power level, if so equipped, followed by either automatic or manual selection of full go-around thrust or power in accordance with the established missed approach and engine failure AFM procedures) with simultaneous failure of the critical engine (or with a simulated engine failure, including the effects on dependent systems), and

(iii) the high-lift system, pitch attitude, engine/propeller controls and airspeed adjusted to achieve the conditions consistent with CS 25.121(d), in accordance with the established missed approach and engine failure AFM procedures. The landing gear should be selected to the 'up' position only after a positive rate of climb is achieved. If the use of automatic features (autopilot, auto-throttle, flight director, etc.) is included in the procedure, these features should be considered during the demonstration.

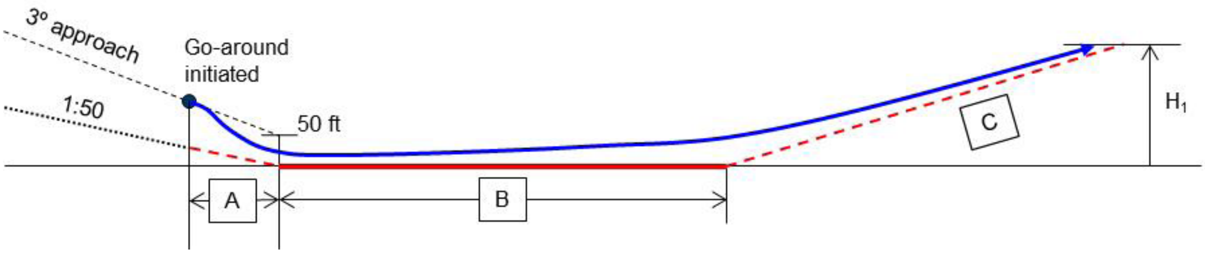


Figure 1. Trajectory Assessment for OEI Go-around

Segment A: From the initiation of go-around at the decision height/altitude to the runway threshold – remain above a 1:50 (2.0 %) plane extended to the runway threshold for clearance of airport obstacles.

Segment B: From the runway threshold plus a distance defined by 40 seconds * V_{T_appr}, not more than the distance indicated in the table below – remain above ground height.

Field Elevation (ft)	**Distance (ft)**
0-3 048 m (0-10 000 ft)	3 048 m (10 000 ft)
>3 048 m (> 10 000 ft)	= Field Elevation

Segment C: A straight line from the end of Segment B at ground height with a gradient defined by CS 25.121(d)(1) or a steeper gradient as required by specific weather minima operational criteria, up to a height, H1 – remain above the line.

Where:

V_{T_appr} is the true airspeed for the normal recommended AEO approach speed in zero wind at the flight condition being assessed (not more than V_{REF} + 9.3 km/h (5 kt) CAS).

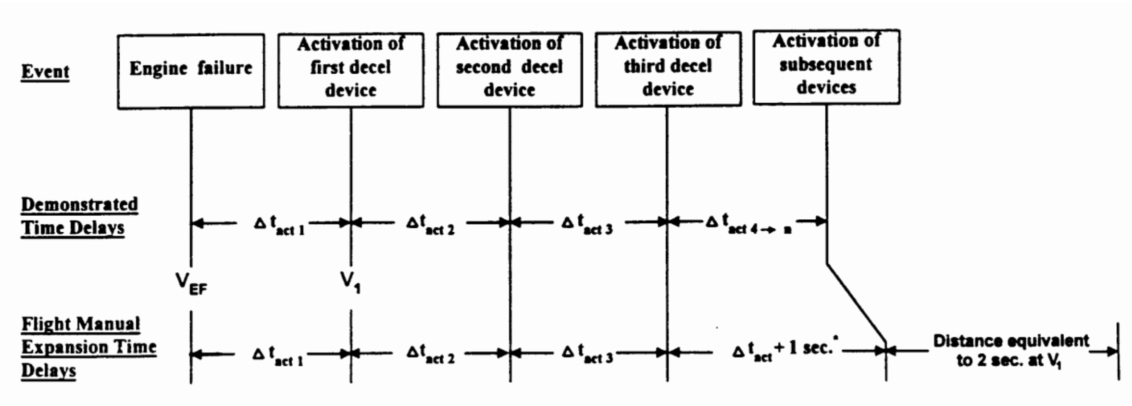
H_1 is the height above the runway elevation where the aeroplane has achieved the approach climb configuration and stabilised on the approach climb speed out of ground effect (1x the wingspan), not less than the height at which the go-around was initiated.

[Amdt 25/13]
[Amdt 25/26]

AMC 25.101(h)(3) General

ED Decision 2003/2/RM

CS 25.109(a) and (b) require the accelerate-stop distance to include a distance equivalent to 2 seconds at V_1 in addition to the demonstrated distance to accelerate to V_1 and then bring the aeroplane to a full stop. This additional distance is not intended to allow extra time for making a decision to stop as the aeroplane passes through V_1, but is to account for operational variability in the time it takes pilots to accomplish the actions necessary to bring the aeroplane to a stop. It allows for the typical requirement for up to three pilot actions (i.e. brakes – throttles – spoilers) without introducing additional time delays to those demonstrated. If the procedures require more than three pilot actions, an allowance for time delays must be made in the scheduled accelerate-stop distance. These delays, which are applied in addition to the demonstrated delays, are to be 1 second (or 2 seconds if a command to another crew member to take the action is required) for each action beyond the third action. This is illustrated in Figure 1.



* 2 sec. where a command to another crew member is required.

FIGURE 1. ACCELERATE-STOP TIME DELAYS

where:–

V_{EF} is the calibrated airspeed selected by the applicant at which the critical engine is assumed to fail. The relationship between V_{EF} and V_1 is defined in CS 25.107.

$\Delta t_{act\ 1}$ = the demonstrated time interval between engine failure and activation of the first deceleration device. This time interval is defined as beginning at the instant the critical engine is failed and ending when the pilot recognises and reacts to the engine failure, as indicated by the pilot's application of the first retarding means during accelerate-stop tests. A sufficient number of demonstrations should be conducted using both applicant and Agency test pilots to assure that the time increment is representative and repeatable. The pilot's feet should be on the rudder pedals, not the brakes, during the tests. For AFM data expansion purposes, in order to provide a recognition time increment that can be executed consistently in service, this time increment should be equal to the demonstrated time or 1 second, whichever is greater. If the aeroplane incorporates an engine failure warning light, the recognition time includes the time increment necessary for the engine to spool down to the point of warning light activation, plus the time increment from light 'on' to pilot action indicating recognition of the engine failure.

$\Delta t_{act\ 2}$ = the demonstrated time interval between activation of the first and second deceleration devices.

$\Delta t_{act\ 3}$ = the demonstrated time interval between activation of the second and third deceleration devices.

$\Delta t_{act\ 4\to n}$ = the demonstrated time interval between activation of the third and fourth (and any subsequent) deceleration devices. For AFM expansion, a 1-second reaction time delay to account for in-service variations should be added to the demonstrated activation time interval between the third and fourth (and any subsequent) deceleration devices. If a command is required for another crew member to actuate a deceleration device, a 2-second delay, in lieu of the 1-second delay, should be applied for each action. For automatic deceleration devices that are approved for performance credit for AFM data expansion, established systems actuation times determined during certification testing may be used without the application of the additional time delays required by this paragraph.

AMC 25.101(i) Performance determination with worn brakes

ED Decision 2003/2/RM

It is not necessary for all the performance testing on the aircraft to be conducted with fully worn brakes. Sufficient data should be available from aircraft or dynamometer rig tests covering the range of wear and energy levels to enable correction of the flight test results to the 100% worn level. The only aircraft test that should be carried out at a specific brake wear state is the maximum kinetic energy rejected take-off test of CS 25.109(i), for which all brakes should have not more than 10% of the allowable brake wear remaining.

CS 25.103 Stall speed

ED Decision 2016/010/R

(See AMC 25.103)

(a) The reference stall speed V_{SR} is a calibrated airspeed defined by the applicant. V_{SR} may not be less than a 1-g stall speed. V_{SR} is expressed as:

$$VSR \geq \frac{V_{CLMAX}}{\sqrt{n_{zw}}}$$

where –

V_{CLMAX} = Calibrated airspeed obtained when the loadfactor-corrected lift coefficient $\left(\frac{n_{zw} W}{qS}\right)$ is first a maximum during the manoeuvre prescribed in sub-paragraph (c) of this paragraph. In addition, when the manoeuvre is limited by a device that abruptly pushes the nose down at a selected angle of attack (e.g. a stick pusher), V_{CLMAX} may not be less than the speed existing at the instant the device operates;

n_{zw} = Load factor normal to the flight path at V_{CLMAX};

W = Aeroplane gross weight;

S= Aerodynamic reference wing area; and

q= Dynamic pressure.

(b) V_{CLMAX} is determined with:

(1) Engines idling, or, if that resultant thrust causes an appreciable decrease in stall speed, not more than zero thrust at the stall speed;

(2) Propeller pitch controls (if applicable) in the take-off position;

(3) The aeroplane in other respects (such as flaps, landing gear, and ice accretions) in the condition existing in the test or performance standard in which V_{SR} is being used;

(4) The weight used when V_{SR} is being used as a factor to determine compliance with a required performance standard;

(5) The centre of gravity position that results in the highest value of reference stall speed; and

(6) The aeroplane trimmed for straight flight at a speed selected by the applicant, but not less than 1.13 V_{SR} and not greater than 1.3 V_{SR}. (See AMC 25.103(b))

(c) Starting from the stabilised trim condition, apply the longitudinal control to decelerate the aeroplane so that the speed reduction does not exceed 0.5 m/s^2 (one knot per second). (See AMC 25.103(b) and (c)).

(d) In addition to the requirements of sub-paragraph (a) of this paragraph, when a device that abruptly pushes the nose down at a selected angle of attack (e.g. a stick pusher) is installed, the reference stall speed, V_{SR}, may not be less than 3,7 km/h (2 kt) or 2%, whichever is greater, above the speed at which the device operates. (See AMC 25.103(d))

[Amdt 25/3]
[Amdt 25/18]

AMC 25.103(b) Stalling speed

ED Decision 2003/2/RM

The airplane should be trimmed for hands-off flight at a speed 13 percent to 30 percent above the anticipated V_{SR} with the engines at idle and the airplane in the configuration for which the stall speed is being determined. Then, using only the primary longitudinal control for speed reduction, a constant deceleration (entry rate) is maintained until the airplane is stalled, as defined in CS 25.201(d). Following the stall, engine thrust may be used as desired to expedite the recovery.

The analysis to determine V_{CLMAX} should disregard any transient or dynamic increases in recorded load factor, such as might be generated by abrupt control inputs, which do not reflect the lift capability of the aeroplane. The load factor normal to the flight path should be nominally 1.0 until V_{CLMAX} is reached.

AMC 25.103(c) Stall speed

ED Decision 2003/2/RM

The stall entry rate is defined as the mean rate of speed reduction (in m/s^2 (knots CAS/second)) in the deceleration to the stall in the particular stall demonstration, from a speed 10% above that stall speed, i.e.

$$Entry\ Rate = \frac{1\cdot 1\, V_{CLMAX} - 1\cdot 0\, V_{CLMAX}}{Time\ to\ decelerate\ from\ 1\cdot 1\, V_{CLMAX}\ to\ V_{CLMAX}}\,(m/s^2(knots\ CAS/sec))$$

AMC 25.103(d) Stall speed

ED Decision 2003/2/RM

In the case where a device that abruptly pushes the nose down at a selected angle of attack (e.g. a stick pusher) operates after C_{LMAX}, the speed at which the device operates, stated in CS 25.103(d), need not be corrected to 1g.

Test procedures should be in accordance with AMC 25.103(b) to ensure that no abnormal or unusual pilot control input is used to obtain an artificially low device activation speed.

CS 25.105 Take-off

ED Decision 2015/008/R

(a) The take-off speeds prescribed by CS 25.107, the accelerate-stop distance prescribed by CS 25.109, the take-off path prescribed by CS 25.111, the take-off distance and take-off run prescribed by CS 25.113, and the net take-off flight path prescribed by CS 25.115, must be determined in the selected configuration for take-off at each weight, altitude, and ambient temperature within the operational limits selected by the applicant -

(1) In non-icing conditions; and

(2) In icing conditions, if in the configuration used to show compliance with CS 25.121(b), and with the most critical of the “Take-off Ice” accretion(s) defined in Appendices C and O, as applicable, in accordance with CS 25.21(g):

(i) The stall speed at maximum take-off weight exceeds that in non-icing conditions by more than the greater of 5.6 km/h (3 knots) CAS or 3% of VSR; or

(ii) The degradation of the gradient of climb determined in accordance with CS 25.121(b) is greater than one-half of the applicable actual-to-net take-off flight path gradient reduction defined in CS 25.115(b).

(b) No take-off made to determine the data required by this paragraph may require exceptional piloting skill or alertness.

(c) The take-off data must be based on:

(1) Smooth, dry and wet, hard-surfaced runways; and

(2) At the option of the applicant, grooved or porous friction course wet, hardsurfaced runways.

(d) The take-off data must include, within the established operational limits of the aeroplane, the following operational correction factors:

(1) Not more than 50% of nominal wind components along the take-off path opposite to the direction of take-off, and not less than 150% of nominal wind components along the take-off path in the direction of take-off.

(2) Effective runway gradients.

[Amdt 25/3]
[Amdt 25/16]

CS 25.107 Take-off speeds

ED Decision 2016/010/R

(a) V_1 must be established in relation to V_{EF} as follows:

(1) V_{EF} is the calibrated airspeed at which the critical engine is assumed to fail. V_{EF} must be selected by the applicant, but may not be less than V_{MCG} determined under CS 25.149(e).

(2) V_1, in terms of calibrated airspeed, is selected by the applicant; however, V_1 may not be less than V_{EF} plus the speed gained with the critical engine inoperative during the time interval between the instant at which the critical engine is failed, and the instant at which the pilot recognises and reacts to the engine failure, as indicated by the pilot’s initiation of the first action (e.g. applying brakes, reducing thrust, deploying speed brakes) to stop the aeroplane during accelerate-stop tests.

(b) V_{2MIN}, in terms of calibrated airspeed, may not be less than –

(1) 1·13 V_{SR} for –

(i) Two-engined and three-engined turbo-propeller powered aeroplanes; and

(ii) Turbojet powered aeroplanes without provisions for obtaining a significant reduction in the one-engineinoperative power-on stall speed;

(2) 1·08 V_{SR} for –

(i) Turbo-propeller powered aeroplanes with more than three engines; and

(ii) Turbojet powered aeroplanes with provisions for obtaining a significant reduction in the one-engine-inoperative power-on stall speed: and

(3) 1·10 times V_{MC} established under CS 25.149.

(c) V_2, in terms of calibrated airspeed, must be selected by the applicant to provide at least the gradient of climb required by CS 25.121(b) but may not be less than –

(1) V_{2MIN};

(2) V_R plus the speed increment attained (in accordance with CS 25.111(c)(2)) before reaching a height of 11 m (35 ft) above the takeoff surface; and

(3) A speed that provides the manoeuvring capability specified in CS 25.143(h).

(d) V_{MU} is the calibrated airspeed at and above which the aeroplane can safely lift off the ground, and continue the take-off. V_{MU} speeds must be selected by the applicant throughout the range of thrust-to-weight ratios to be certificated. These speeds may be established from free air data if these data are verified by ground take-off tests. (See AMC 25.107(d).)

(e) V_R, in terms of calibrated air speed, must be selected in accordance with the conditions of sub-paragraphs (1) to (4) of this paragraph:

(1) V_R may not be less than –

(i) V_1;

(ii) 105% of V_{MC};

(iii) The speed (determined in accordance with CS 25.111(c)(2)) that allows reaching V_2 before reaching a height of 11 m (35 ft) above the take-off surface; or

(iv) A speed that, if the aeroplane is rotated at its maximum practicable rate, will result in a V_{LOF} of not less than -

(A) 110% of V_{MU} in the allengines-operating condition, and 105% of V_{MU} determined at the thrust-to-weight ratio corresponding to the one-engine-inoperative condition; or

(B) If the V_{MU} attitude is limited by the geometry of the aeroplane (i.e., tail contact with the runway), 108% of V_{MU} in the all-engines-operating condition and 104% of V_{MU} determined at the thrust-to-weight ratio corresponding to the one-engine-inoperative condition. (See AMC 25.107(e)(1)(iv).)

(2) For any given set of conditions (such as weight, configuration, and temperature), a single value of V_R, obtained in accordance with this paragraph, must be used to show compliance with both the one-engine-inoperative and the all-engines-operating take-off provisions.

(3) It must be shown that the one-engine-inoperative take-off distance, using a rotation speed of 9.3 km/h (5 knots) less than V_R established in accordance with sub-paragraphs (e)(1) and (2) of this paragraph, does not exceed the corresponding one-engine-inoperative take-off distance using the established V_R. The take-off distances must be determined in accordance with CS 25.113(a)(1). (See AMC 25.107(e)(3).)

(4) Reasonably expected variations in service from the established take-off procedures for the operation of the aeroplane (such as over-rotation of the aeroplane and out-of-trim conditions) may not result in unsafe flight characteristics or in marked increases in the scheduled take-off distances established in accordance with CS 25.113(a). (See AMC No. 1 to CS 25.107(e)(4) and AMC No. 2 to CS 25.107(e)(4).)

(f) V_{LOF} is the calibrated airspeed at which the aeroplane first becomes airborne.

(g) V_{FTO}, in terms of calibrated airspeed, must be selected by the applicant to provide at least the gradient of climb required by CS 25.121(c), but may not be less than –

(1) 1.18 V_{SR}; and

(2) A speed that provides the manoeuvring capability specified in CS 25.143(h).

(h) In determining the take-off speeds V_1, V_R, and V_2 for flight in icing conditions, the values of V_{MCG}, V_{MC}, and V_{MU} determined for non-icing conditions may be used.

[Amdt 25/3]
[Amdt 25/18]

AMC 25.107(d) Take-off speeds

ED Decision 2003/2/RM

1 If cases are encountered where it is not possible to obtain the actual V_{MU} at forward centre of gravity with aeroplanes having limited elevator power (including those aeroplanes which have limited elevator power only over a portion of the take-off weight range), it will be permissible to test with a more aft centre of gravity and/or more than normal nose-up trim to obtain V_{MU}.

1.1 When V_{MU} is obtained in this manner, the values should be corrected to those which would have been attained at forward centre of gravity if sufficient elevator power had been available. The variation of V_{MU} with centre of gravity may be assumed to be the same as the variation of stalling speed in free air with centre of gravity for this correction.

1.2 In such cases where V_{MU} has been measured with a more aft centre of gravity and/or with more than normal nose-up trim, the V_R selected should (in addition to complying with the requirements of CS 25.107(e)) be greater by an adequate margin than the lowest speed at which the nose wheel can be raised from the runway with centre of gravity at its most critical position and with the trim set to the normal take-off setting for the weight and centre of gravity.

NOTE: A margin of 9,3 km/h (5 kt) between the lowest nose-wheel raising speed and V_R would normally be considered to be adequate.

2 Take-offs made to demonstrate V_{MU} should be continued until the aeroplane is out of ground effect. The aeroplane pitch attitude should not be decreased after lift-off.

AMC 25.107(e)(1)(iv) Take-off speeds

ED Decision 2003/2/RM

V_{MU} Testing for Geometry Limited Aeroplanes.

1 For aeroplanes that are geometry limited (i.e., the minimum possible V_{MU} speeds are limited by tail contact with the runway), CS 25.107(e)(1)(iv)(B) allows the V_{MU} to V_{LOF} speed margins to be reduced to 108% and 104% for the all-engines-operating and one-engineinoperative conditions, respectively. The V_{MU} demonstrated must be sound and repeatable.