

## Subpart C – Aircraft performance and operating limitations – AMC/GM

### Section 1 – Aeroplanes

#### Chapter 2 - Performance class A

##### AMC1 CAT.POL.A.200 General

###### WET AND CONTAMINATED RUNWAY DATA

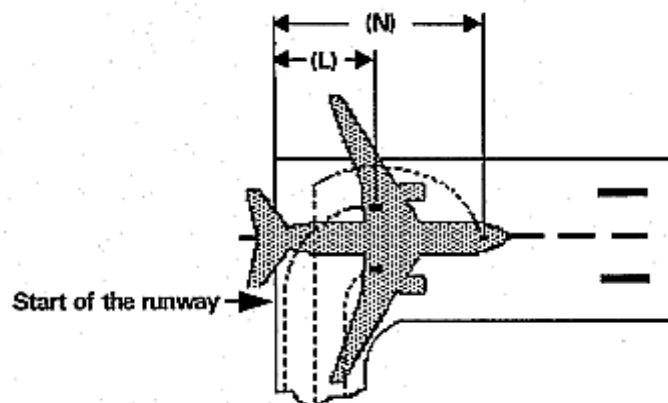
If the performance data have been determined on the basis of a measured runway friction coefficient, the operator should use a procedure correlating the measured runway friction coefficient and the effective braking coefficient of friction of the aeroplane type over the required speed range for the existing runway conditions.

##### AMC1 CAT.POL.A.205 Take-off

###### LOSS OF RUNWAY LENGTH DUE TO ALIGNMENT

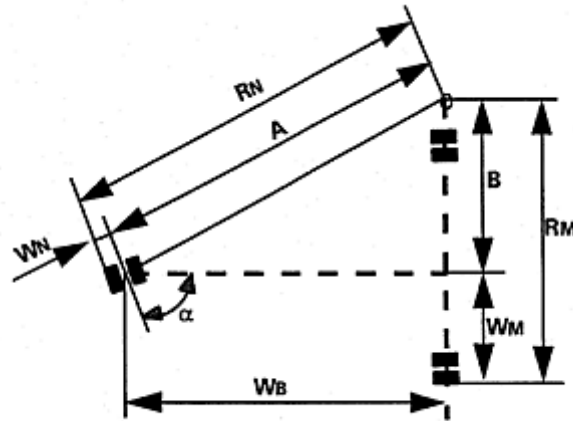
- (a) The length of the runway that is declared for the calculation of take-off distance available (TODA), accelerate-stop distance available (ASDA) and take-off run available (TORA) does not account for line-up of the aeroplane in the direction of take-off on the runway in use. This alignment distance depends on the aeroplane geometry and access possibility to the runway in use. Accountability is usually required for a 90° taxiway entry to the runway and 180° turnaround on the runway. There are two distances to be considered:
- (1) the minimum distance of the main wheels from the start of the runway for determining TODA and TORA, 'L'; and
  - (2) the minimum distance of the most forward wheel(s) from the start of the runway for determining ASDA, 'N'.

**Figure 1: Line-up of the aeroplane in the direction of take-off - L and N**



Where the aeroplane manufacturer does not provide the appropriate data, the calculation method given in (b) should be used to determine the alignment distance.

(b) Alignment distance calculation



The distances mentioned in (a)(1) and (a)(2) are:

	90° entry	180° turnaround
L=	RM + X	RN + Y
N=	RM + X + WB	RN + Y + WB

where:

$$RN = A + WN = WB/\cos(90^\circ-\alpha) + WN$$

$$RM = B + WM = WB \tan(90^\circ-\alpha) + WM$$

X = safety distance of outer main wheel during turn to the edge of the runway

Y = safety distance of outer nose wheel during turn to the edge of the runway

Note: Minimum edge safety distances for X and Y are specified in FAA AC 150/5300-13 and ICAO Annex 14, 3.8.3

RN = radius of turn of outer nose wheel

RM = radius of turn of outer main wheel

WN = distance from aeroplane centre-line to outer nose wheel

WM = distance from aeroplane centre-line to outer main wheel

WB = wheel base

α = steering angle.

**GM1 CAT.POL.A.205 Take-off**

## RUNWAY SURFACE CONDITION

- (a) Operation on runways contaminated with water, slush, snow or ice implies uncertainties with regard to runway friction and contaminant drag and therefore to the achievable performance and control of the aeroplane during take-off, since the actual conditions may not completely match the assumptions on which the performance information is based. In the case of a contaminated runway, the first option for the commander is to wait until the runway is cleared. If this is impracticable, he/she may consider a take-off, provided that he/she has applied the applicable performance adjustments, and any further safety measures he/she considers justified under the prevailing conditions.
- (b) An adequate overall level of safety will only be maintained if operations in accordance with AMC 25.1591 or equivalent are limited to rare occasions. Where the frequency of such operations on contaminated runways is not limited to rare occasions, the operator should provide additional measures ensuring an equivalent level of safety. Such measures could include special crew training, additional distance factoring and more restrictive wind limitations.

**AMC1 CAT.POL.A.210 Take-off obstacle clearance**

## TAKE-OFF OBSTACLE CLEARANCE

- (a) In accordance with the definitions used in preparing the take-off distance and take-off flight path data provided in the AFM:
  - (1) The net take-off flight path is considered to begin at a height of 35 ft above the runway or clearway at the end of the take-off distance determined for the aeroplane in accordance with (b) below.
  - (2) The take-off distance is the longest of the following distances:
    - (i) 115 % of the distance with all engines operating from the start of the take-off to the point at which the aeroplane is 35 ft above the runway or clearway;
    - (ii) the distance from the start of the take-off to the point at which the aeroplane is 35 ft above the runway or clearway assuming failure of the critical engine occurs at the point corresponding to the decision speed ( $V_1$ ) for a dry runway; or
    - (iii) if the runway is wet or contaminated, the distance from the start of the take-off to the point at which the aeroplane is 15 ft above the runway or clearway assuming failure of the critical engine occurs at the point corresponding to the decision speed ( $V_1$ ) for a wet or contaminated runway.
- (b) The net take-off flight path, determined from the data provided in the AFM in accordance with (a)(1) and (a)(2), should clear all relevant obstacles by a vertical distance of 35 ft. When taking off on a wet or contaminated runway and an engine failure occurs at the point corresponding to the decision speed ( $V_1$ ) for a wet or contaminated runway, this implies that the aeroplane can initially be as much as

20 ft below the net take-off flight path in accordance with (a) and, therefore, may clear close-in obstacles by only 15 ft. When taking off on wet or contaminated runways, the operator should exercise special care with respect to obstacle assessment, especially if a take-off is obstacle-limited and the obstacle density is high.

### **AMC2 CAT.POL.A.210 Take-off obstacle clearance**

#### EFFECT OF BANK ANGLES

- (a) The AFM generally provides a climb gradient decrement for a 15° bank turn. For bank angles of less than 15°, a proportionate amount should be applied, unless the manufacturer or AFM has provided other data.
- (b) Unless otherwise specified in the AFM or other performance or operating manuals from the manufacturer, acceptable adjustments to assure adequate stall margins and gradient corrections are provided by the following table:

**Table 1: Effect of bank angles**

<b>Bank</b>	<b>Speed</b>	<b>Gradient correction</b>
15°	$V_2$	1 x AFM 15° gradient loss
20°	$V_2 + 5 \text{ kt}$	2 x AFM 15° gradient loss
25°	$V_2 + 10 \text{ kt}$	3 x AFM 15° gradient loss

### **AMC3 CAT.POL.A.210 Take-off obstacle clearance**

#### REQUIRED NAVIGATIONAL ACCURACY

- (a) Navigation systems
 

The obstacle accountability semi-widths of 300 m and 600 m may be used if the navigation system under OEI conditions provides a two standard deviation accuracy of 150 m and 300 m respectively.
- (b) Visual course guidance
  - (1) The obstacle accountability semi-widths of 300 m and 600 m may be used where navigational accuracy is ensured at all relevant points on the flight path by use of external references. These references may be considered visible from the flight crew compartment if they are situated more than 45° either side of the intended track and with a depression of not greater than 20° from the horizontal.
  - (2) For visual course guidance navigation, the operator should ensure that the weather conditions prevailing at the time of operation, including ceiling and visibility, are such that the obstacle and/or ground reference points can be seen and identified. The operations manual should specify, for the aerodrome(s) concerned, the minimum weather conditions which enable the flight crew to continuously determine and maintain the correct flight path with

respect to ground reference points, so as to provide a safe clearance with respect to obstructions and terrain as follows:

- (i) the procedure should be well defined with respect to ground reference points so that the track to be flown can be analysed for obstacle clearance requirements;
- (ii) the procedure should be within the capabilities of the aeroplane with respect to forward speed, bank angle and wind effects;
- (iii) a written and/or pictorial description of the procedure should be provided for crew use; and
- (iv) the limiting environmental conditions (such as wind, the lowest cloud base, ceiling, visibility, day/night, ambient lighting, obstruction lighting) should be specified.

### **GM1 CAT.POL.A.210 Take-off obstacle clearance**

#### CONTINGENCY PROCEDURES FOR OBSTACLES CLEARANCES

If compliance with CAT.POL.A.210 is based on an engine failure route that differs from the all engine departure route or SID normal departure, a 'deviation point' can be identified where the engine failure route deviates from the normal departure route. Adequate obstacle clearance along the normal departure route with failure of the critical engine at the deviation point will normally be available. However, in certain situations the obstacle clearance along the normal departure route may be marginal and should be checked to ensure that, in case of an engine failure after the deviation point, a flight can safely proceed along the normal departure route.

### **AMC1 CAT.POL.A.215 En-route – one-engine-inoperative (OEI)**

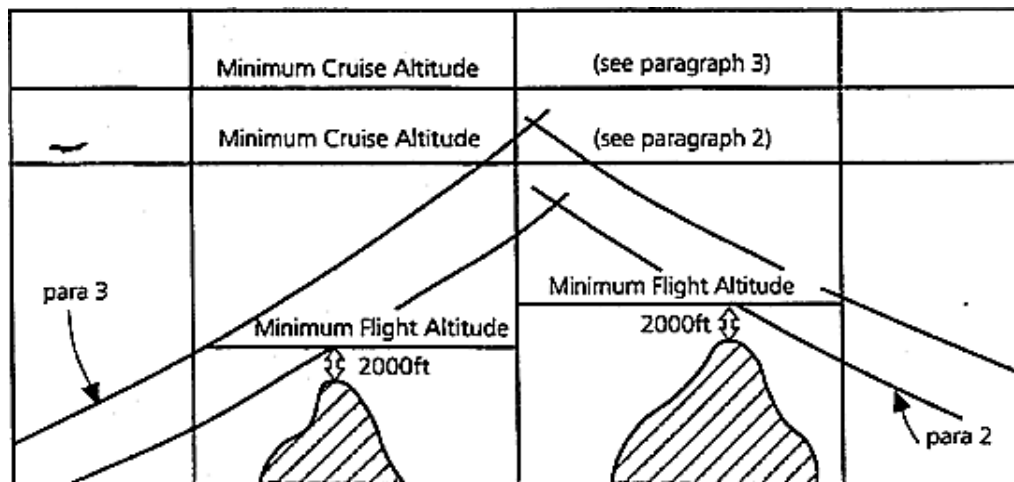
#### ROUTE ANALYSIS

- (a) The high terrain or obstacle analysis required should be carried out by a detailed analysis of the route.
- (b) A detailed analysis of the route should be made using contour maps of the high terrain and plotting the highest points within the prescribed corridor's width along the route. The next step is to determine whether it is possible to maintain level flight with OEI 1 000 ft above the highest point of the crossing. If this is not possible, or if the associated weight penalties are unacceptable, a driftdown procedure should be worked out, based on engine failure at the most critical point and clearing critical obstacles during the driftdown by at least 2 000 ft. The minimum cruise altitude is determined by the intersection of the two driftdown paths, taking into account allowances for decision making (see Figure 1). This method is time-consuming and requires the availability of detailed terrain maps.
- (c) Alternatively, the published minimum flight altitudes (MEA or minimum off-route altitude (MORA)) should be used for determining whether OEI level flight is feasible at the minimum flight altitude, or if it is necessary to use the published minimum flight altitudes as the basis for the driftdown construction (see Figure 1). This

procedure avoids a detailed high terrain contour analysis, but could be more penalising than taking the actual terrain profile into account as in (b).

- (d) In order to comply with CAT.POL.A.215 (c), one means of compliance is the use of MORA and, with CAT.POL.A.215 (d), MEA provided that the aeroplane meets the navigational equipment standard assumed in the definition of MEA.

**Figure 1: Intersection of the two driftdown paths**



Note: MEA or MORA normally provide the required 2 000 ft obstacle clearance for driftdown. However, at and below 6 000 ft altitude, MEA and MORA cannot be used directly as only 1 000 ft clearance is ensured.

**AMC1 CAT.POL.A.225 Landing – destination and alternate aerodromes**

ALTITUDE MEASURING

The operator should use either pressure altitude or geometric altitude for its operation and this should be reflected in the operations manual.

**AMC2 CAT.POL.A.225 Landing – destination and alternate aerodromes**

MISSED APPROACH

- (a) For instrument approaches with a missed approach climb gradient greater than 2.5 %, the operator should verify that the expected landing mass of the aeroplane allows for a missed approach with a climb gradient equal to or greater than the applicable missed approach gradient in the OEI missed approach configuration and at the associated speed.
- (b) For instrument approaches with DH below 200 ft, the operator should verify that the expected landing mass of the aeroplane allows a missed approach gradient of climb, with the critical engine failed and with the speed and configuration used for a missed approach of at least 2.5 %, or the published gradient, whichever is greater.

## **GM1 CAT.POL.A.225 Landing – destination and alternate aerodromes**

### MISSED APPROACH GRADIENT

- (a) Where an aeroplane cannot achieve the missed approach gradient specified in AMC2 CAT.POL.A.225, when operating at or near maximum certificated landing mass and in engine-out conditions, the operator has the opportunity to propose an alternative means of compliance to the competent authority demonstrating that a missed approach can be executed safely taking into account appropriate mitigating measures.
- (b) The proposal for an alternative means of compliance may involve the following:
  - (1) considerations to mass, altitude and temperature limitations and wind for the missed approach;
  - (2) a proposal to increase the DA/H or MDA/H; and
  - (3) a contingency procedure ensuring a safe route and avoiding obstacles.

## **AMC1 CAT.POL.A.230 Landing – dry runways**

### FACTORING OF AUTOMATIC LANDING DISTANCE PERFORMANCE DATA

In those cases where the landing requires the use of an automatic landing system, and the distance published in the AFM includes safety margins equivalent to those contained in CAT.POL.A.230 (a)(1) and CAT.POL.A.235, the landing mass of the aeroplane should be the lesser of:

- (a) the landing mass determined in accordance with CAT.POL.A.230 (a)(1) or CAT.POL.A.235 as appropriate; or
- (b) the landing mass determined for the automatic landing distance for the appropriate surface condition, as given in the AFM or equivalent document. Increments due to system features such as beam location or elevations, or procedures such as use of overspeed, should also be included.

## **GM1 CAT.POL.A.230 Landing – dry runways**

### LANDING MASS

CAT.POL.A.230 establishes two considerations in determining the maximum permissible landing mass at the destination and alternate aerodromes:

- (a) Firstly, the aeroplane mass will be such that on arrival the aeroplane can be landed within 60 % or 70 % (as applicable) of the landing distance available (LDA) on the most favourable (normally the longest) runway in still air. Regardless of the wind conditions, the maximum landing mass for an aerodrome/aeroplane configuration at a particular aerodrome cannot be exceeded.
- (b) Secondly, consideration should be given to anticipated conditions and circumstances. The expected wind, or ATC and noise abatement procedures, may indicate the use of a different runway. These factors may result in a lower landing mass than that permitted under (a), in which case dispatch should be based on this lesser mass.

- (c) The expected wind referred to in (b) is the wind expected to exist at the time of arrival.



### Chapter 3 - Performance class B

#### AMC1 CAT.POL.A.305 Take-off

##### RUNWAY SURFACE CONDITION

- (a) Unless otherwise specified in the AFM or other performance or operating manuals from the manufacturer, the variables affecting the take-off performance and the associated factors that should be applied to the AFM data are shown in Table 1 below. They should be applied in addition to the operational factors as prescribed in CAT.POL.A.305.

**Table 1: Runway surface condition - Variables**

Surface type	Condition	Factor
Grass (on firm soil)	Dry	1.2
up to 20 cm long	Wet	1.3
Paved	Wet	1.0

- (b) The soil should be considered firm when there are wheel impressions but no rutting.
- (c) When taking off on grass with a single-engined aeroplane, care should be taken to assess the rate of acceleration and consequent distance increase.
- (d) When making a rejected take-off on very short grass that is wet and with a firm subsoil, the surface may be slippery, in which case the distances may increase significantly.

#### AMC2 CAT.POL.A.305 Take-off

##### RUNWAY SLOPE

Unless otherwise specified in the AFM, or other performance or operating manuals from the manufacturer, the take-off distance should be increased by 5 % for each 1 % of upslope except that correction factors for runways with slopes in excess of 2 % should only be applied when the operator has demonstrated to the competent authority that the necessary data in the AFM or the operations manual contain the appropriated procedures and the crew is trained to take-off in runway with slopes in excess of 2 %.

#### GM1 CAT.POL.A.305 Take-off

##### RUNWAY SURFACE CONDITION

- (a) Due to the inherent risks, operations from contaminated runways are inadvisable, and should be avoided whenever possible. Therefore, it is advisable to delay the take-off until the runway is cleared.
- (b) Where this is impracticable, the commander should also consider the excess runway length available including the criticality of the overrun area.

**AMC1 CAT.POL.A.310 Take-off obstacle clearance – multi-engined aeroplanes**

## TAKE-OFF FLIGHT PATH – VISUAL COURSE GUIDANCE NAVIGATION

- (a) In order to allow visual course guidance navigation, the weather conditions prevailing at the time of operation, including ceiling and visibility, should be such that the obstacle and/or ground reference points can be seen and identified.
- (b) The operations manual should specify, for the aerodrome(s) concerned, the minimum weather conditions that enable the flight crew to continuously determine and maintain the correct flight path with respect to ground reference points, so as to provide a safe clearance with respect to obstructions and terrain as follows:
- (1) the procedure should be well defined with respect to ground reference points so that the track to be flown can be analysed for obstacle clearance requirements;
  - (2) the procedure should be within the capabilities of the aeroplane with respect to forward speed, bank angle and wind effects;
  - (3) a written and/or pictorial description of the procedure should be provided for crew use; and
  - (4) the limiting environmental conditions should be specified (e.g. wind, cloud, visibility, day/night, ambient lighting, obstruction lighting).

**AMC2 CAT.POL.A.310 Take-off obstacle clearance – multi-engined aeroplanes**

## TAKE-OFF FLIGHT PATH CONSTRUCTION

- (a) For demonstrating that the aeroplane clears all obstacles vertically, a flight path should be constructed consisting of an all-engines segment to the assumed engine failure height, followed by an engine-out segment. Where the AFM does not contain the appropriate data, the approximation given in (b) may be used for the all-engines segment for an assumed engine failure height of 200 ft, 300 ft, or higher.
- (b) Flight path construction
- (1) All-engines segment (50 ft to 300 ft)

The average all-engines gradient for the all-engines flight path segment starting at an altitude of 50 ft at the end of the take-off distance ending at or passing through the 300 ft point is given by the following formula:

$$Y_{300} = \frac{0.57(Y_{ERC})}{1 + (V_{ERC}^2 - V_2^2) / 5647}$$

The factor of 0.77 as required by CAT.POL.A.310 is already included where:

$Y_{300}$  = average all-engines gradient from 50 ft to 300 ft;

$Y_{ERC}$  = scheduled all engines en-route gross climb gradient;

$V_{ERC}$  = en-route climb speed, all engines knots true airspeed (TAS);

$V_2$  = take-off speed at 50 ft, knots TAS;

## (2) All-engines segment (50 ft to 200 ft)

This may be used as an alternative to (b)(1) where weather minima permit. The average all-engines gradient for the all-engines flight path segment starting at an altitude of 50 ft at the end of the take-off distance ending at or passing through the 200 ft point is given by the following formula:

$$Y_{200} = \frac{0.51(Y_{ERC})}{1 + (V_{ERC}^2 - V_2^2) / 3388}$$

The factor of 0.77 as required by CAT.POL.A.310 is already included where:

$Y_{200}$  = average all-engines gradient from 50 ft to 200 ft;

$Y_{ERC}$  = scheduled all engines en-route gross climb gradient;

$V_{ERC}$  = en-route climb speed, all engines, knots TAS;

$V_2$  = take-off speed at 50 ft, knots TAS.

## (3) All-engines segment (above 300 ft)

The all-engines flight path segment continuing from an altitude of 300 ft is given by the AFM en-route gross climb gradient, multiplied by a factor of 0.77.

## (4) The OEI flight path

The OEI flight path is given by the OEI gradient chart contained in the AFM.

**GM1 CAT.POL.A.310 Take-off obstacle clearance – multi-engined aeroplanes****OBSTACLE CLEARANCE IN LIMITED VISIBILITY**

- (a) Unlike the airworthiness codes applicable for performance class A aeroplanes, those for performance class B aeroplanes do not necessarily provide for engine failure in all phases of flight. It is accepted that performance accountability for engine failure need not be considered until a height of 300 ft is reached.
- (b) The weather minima given up to and including 300 ft imply that if a take-off is undertaken with minima below 300 ft an OEI flight path should be plotted starting on the all-engines take-off flight path at the assumed engine failure height. This path should meet the vertical and lateral obstacle clearance specified in CAT.POL.A.310. Should engine failure occur below this height, the associated visibility is taken as being the minimum that would enable the pilot to make, if necessary, a forced landing broadly in the direction of the take-off. At or below 300 ft, a circle and land procedure is extremely inadvisable. The weather minima provisions specify that, if the assumed engine failure height is more than 300 ft, the visibility should be at least 1 500 m and, to allow for manoeuvring, the same minimum visibility should apply whenever the obstacle clearance criteria for a continued take-off cannot be met.

**GM2 CAT.POL.A.310 Take-off obstacle clearance – multi-engined aeroplanes**

**TAKE-OFF FLIGHT PATH CONSTRUCTION**

(a) This GM provides examples to illustrate the method of take-off flight path construction given in AMC2 CAT.POL.A.310. The examples are based on an aeroplane for which the AFM shows, at a given mass, altitude, temperature and wind component the following performance data:

- factored take-off distance – 1 000 m;
- take-off speed,  $V_2$  – 90 kt;
- en-route climb speed,  $V_{ERC}$  – 120 kt;
- en-route all-engines climb gradient,  $Y_{ERC}$  – 0.2;
- en-route OEI climb gradient,  $Y_{ERC-1}$  – 0.032.

(1) Assumed engine failure height 300 ft

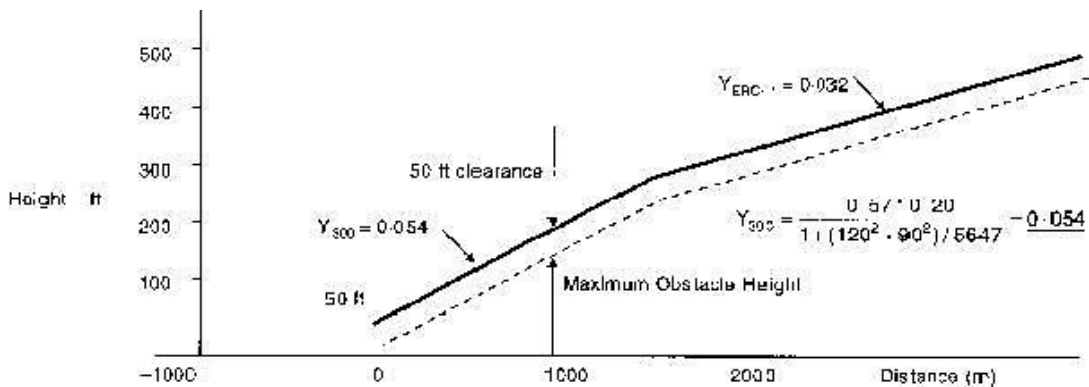
The average all-engines gradient from 50 ft to 300 ft may be read from Figure 1 or calculated with the following formula:

$$Y_{300} = \frac{0.57(Y_{ERC})}{1 + (V_{ERC}^2 - V_2^2) / 5647}$$

The factor of 0.77 as required by CAT.POL.A.310 is already included where:

- $Y_{300}$  = average all-engines gradient from 50 ft to 300 ft;
- $Y_{ERC}$  = scheduled all engines en-route gross climb gradient;
- $V_{ERC}$  = en-route climb speed, all engines knots TAS; and
- $V_2$  = take-off speed at 50 ft, knots TAS.

**Figure 1: Assumed engine failure height 300 ft**



(2) Assumed engine failure height 200 ft

The average all-engines gradient from 50 ft to 200 ft may be read from Figure 2 or calculated with the following formula:

$$Y_{200} = \frac{0.51(Y_{ERC})}{1 + (V_{ERC}^2 - V_2^2) / 3388}$$

The factor of 0.77 as required by CAT.POL.A.310 is already included where:

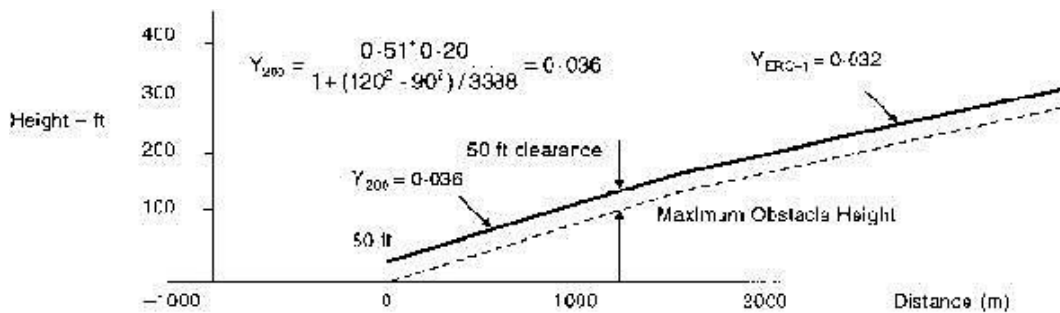
$Y_{200}$  = average all-engines gradient from 50 ft to 200 ft;

$Y_{ERC}$  = scheduled all engines en-route gross gradient;

$V_{ERC}$  = en-route climb speed, all engines, knots TAS; and

$V_2$  = take-off speed at 50 ft, knots TAS.

**Figure 2: Assumed engine failure height 200 ft**



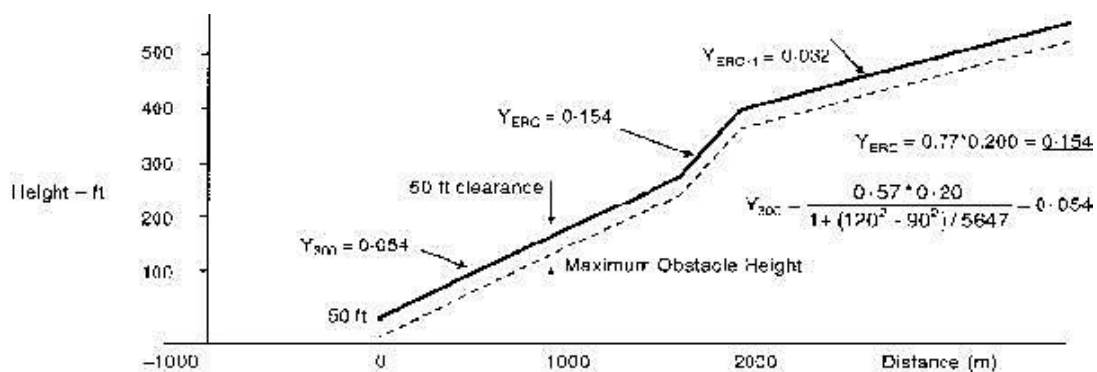
- (3) Assumed engine failure height less than 200 ft

Construction of a take-off flight path is only possible if the AFM contains the required flight path data.

- (4) Assumed engine failure height more than 300 ft.

The construction of a take-off flight path for an assumed engine failure height of 400 ft is illustrated below.

**Figure 3: Assumed engine failure height less than 200 ft**



**GM1 CAT.POL.A.315 En-route – multi-engined aeroplanes**

**CRUISING ALTITUDE**

- (a) The altitude at which the rate of climb equals 300 ft per minute is not a restriction on the maximum cruising altitude at which the aeroplane can fly in practice, it is merely the maximum altitude from which the driftdown procedure can be planned to start.

- (b) Aeroplanes may be planned to clear en-route obstacles assuming a driftdown procedure, having first increased the scheduled en-route OEI descent data by 0.5 % gradient.

### **AMC1 CAT.POL.A.320 En-route - single-engined aeroplanes**

#### ENGINE FAILURE

CAT.POL.A.320 (a) requires the operator to ensure that in the event of an engine failure, the aeroplane should be capable of reaching a point from which a safe forced landing can be made. Unless otherwise specified by the competent authority, this point should be 1 000 ft above the intended landing area.

### **GM1 CAT.POL.A.320 En-route – single-engined aeroplanes**

#### ENGINE FAILURE

- (a) In the event of an engine failure, single-engined aeroplanes have to rely on gliding to a point suitable for a safe forced landing. Such a procedure is clearly incompatible with flight above a cloud layer that extends below the relevant minimum safe altitude.
- (b) The operator should first increase the scheduled engine-inoperative gliding performance data by 0.5 % gradient when verifying the en-route clearance of obstacles and the ability to reach a suitable place for a forced landing.
- (c) The altitude at which the rate of climb equals 300 ft per minute is not a restriction on the maximum cruising altitude at which the aeroplane can fly in practice, it is merely the maximum altitude from which the engine-inoperative procedure can be planned to start.

### **AMC1 CAT.POL.A.325 Landing – destination and alternate aerodromes**

#### ALTITUDE MEASURING

The operator should use either pressure altitude or geometric altitude for its operation and this should be reflected in the operations manual.

### **AMC1 CAT.POL.A.330 Landing – dry runways**

#### LANDING DISTANCE CORRECTION FACTORS

- (a) Unless otherwise specified in the AFM, or other performance or operating manuals from the manufacturers, the variable affecting the landing performance and the associated factor that should be applied to the AFM data is shown in the table below. It should be applied in addition to the operational factors as prescribed in CAT.POL.A.330 (a).

**Table 1: Landing distance correction factors**

Surface type	Factor
Grass (on firm soil up to 20 cm long)	1.15

- (b) The soil should be considered firm when there are wheel impressions but no rutting.

**AMC2 CAT.POL.A.330 Landing – dry runways**

## RUNWAY SLOPE

Unless otherwise specified in the AFM, or other performance or operating manuals from the manufacturer, the landing distances required should be increased by 5 % for each 1 % of downslope.

**GM1 CAT.POL.A.330 Landing – dry runways**

## LANDING MASS

CAT.POL.A.330 establishes two considerations in determining the maximum permissible landing mass at the destination and alternate aerodromes.

- (a) Firstly, the aeroplane mass will be such that on arrival the aeroplane can be landed within 70 % of the LDA on the most favourable (normally the longest) runway in still air. Regardless of the wind conditions, the maximum landing mass for an aerodrome/aeroplane configuration at a particular aerodrome cannot be exceeded.
- (b) Secondly, consideration should be given to anticipated conditions and circumstances. The expected wind, or ATC and noise abatement procedures, may indicate the use of a different runway. These factors may result in a lower landing mass than that permitted under (a), in which case dispatch should be based on this lesser mass.
- (c) The expected wind referred to in (b) is the wind expected to exist at the time of arrival.

**GM1 CAT.POL.A.335 Landing - wet and contaminated runways**

## LANDING ON WET GRASS RUNWAYS

- (a) When landing on very short grass that is wet and with a firm subsoil, the surface may be slippery, in which case the distances may increase by as much as 60 % (1.60 factor).
- (b) As it may not be possible for a pilot to determine accurately the degree of wetness of the grass, particularly when airborne, in cases of doubt, the use of the wet factor (1.15) is recommended.

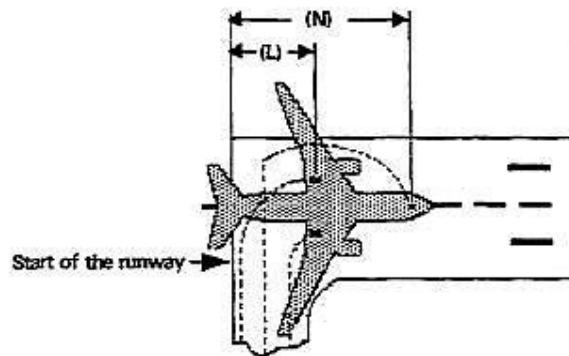
## Chapter 4 – Performance class C

### AMC1 CAT.POL.A.400 Take-off

#### LOSS OF RUNWAY LENGTH DUE TO ALIGNMENT

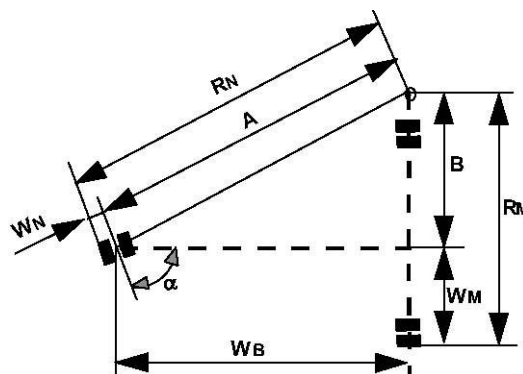
- (a) The length of the runway that is declared for the calculation of TODA, ASDA and TORA does not account for line-up of the aeroplane in the direction of take-off on the runway in use. This alignment distance depends on the aeroplane geometry and access possibility to the runway in use. Accountability is usually required for a 90° taxiway entry to the runway and 180° turnaround on the runway. There are two distances to be considered:
- (1) the minimum distance of the main wheels from the start of the runway for determining TODA and TORA, 'L'; and
  - (2) the minimum distance of the most forward wheel(s) from the start of the runway for determining ASDA, 'N'.

**Figure 1: Line-up of the aeroplane in the direction of take-off – L and N**



Where the aeroplane manufacturer does not provide the appropriate data, the calculation method given in (b) may be used to determine the alignment distance.

- (b) Alignment distance calculation





The distances mentioned in (a)(1) and (a)(2) above are:

	90° entry	180° turnaround
L =	RM + X	RN + Y
N =	RM + X + WB	RN + Y + WB

where:

$$RN = A + WN = \frac{W_B}{\cos(90^\circ - \alpha)}$$

$$RM = B + WM = WB \tan(90^\circ - \alpha) + WM$$

X = safety distance of outer main wheel during turn to the edge of the runway

Y = safety distance of outer nose wheel during turn to the edge of the runway

Note: Minimum edge safety distances for X and Y are specified in FAA AC 150/5300-13 and ICAO Annex 14, 3.8.3

RN = radius of turn of outer nose wheel

RM = radius of turn of outer main wheel

WN = distance from aeroplane centre-line to outer nose wheel

WM = distance from aeroplane centre-line to outer main wheel

WB = wheel base

$\alpha$  = steering angle.

### **AMC2 CAT.POL.A.400 Take-off**

#### RUNWAY SLOPE

Unless otherwise specified in the AFM, or other performance or operating manuals from the manufacturers, the take-off distance should be increased by 5 % for each 1 % of upslope. However, correction factors for runways with slopes in excess of 2 % should only be applied when:

- (a) the operator has demonstrated to the competent authority that the necessary data in the AFM or the operations manual contain the appropriated procedures; and
- (b) the crew is trained to take-off on runways with slopes in excess of 2 %.

### **GM1 CAT.POL.A.400 Take-off**

#### RUNWAY SURFACE CONDITION

Operation on runways contaminated with water, slush, snow or ice implies uncertainties with regard to runway friction and contaminant drag and therefore to the achievable performance and control of the aeroplane during take-off, since the actual conditions may not completely match the assumptions on which the performance information is based. An adequate overall level of safety can, therefore, only be maintained if such

operations are limited to rare occasions. In case of a contaminated runway the first option for the commander is to wait until the runway is cleared. If this is impracticable, he/she may consider a take-off, provided that he/she has applied the applicable performance adjustments, and any further safety measures he/she considers justified under the prevailing conditions.

### **AMC1 CAT.POL.A.405 Take-off obstacle clearance**

#### EFFECT OF BANK ANGLES

- (a) The AFM generally provides a climb gradient decrement for a 15° bank turn. Unless otherwise specified in the AFM or other performance or operating manuals from the manufacturer, acceptable adjustments to assure adequate stall margins and gradient corrections are provided by the following:

**Table 1: Effect of bank angles**

<b>Bank</b>	<b>Speed</b>	<b>Gradient correction</b>
15°	$V_2$	1 x AFM 15° gradient loss
20°	$V_2 + 5 \text{ kt}$	2 x AFM 15° gradient loss
25°	$V_2 + 10 \text{ kt}$	3 x AFM 15° gradient loss

- (b) For bank angles of less than 15°, a proportionate amount may be applied, unless the manufacturer or AFM has provided other data.

### **AMC2 CAT.POL.A.405 Take-off obstacle clearance**

#### REQUIRED NAVIGATIONAL ACCURACY

- (a) Navigation systems

The obstacle accountability semi-widths of 300 m and 600 m may be used if the navigation system under OEI conditions provides a two standard deviation accuracy of 150 m and 300 m respectively.

- (b) Visual course guidance

- (1) The obstacle accountability semi-widths of 300 m and 600 m may be used where navigational accuracy is ensured at all relevant points on the flight path by use of external references. These references may be considered visible from the flight crew compartment if they are situated more than 45° either side of the intended track and with a depression of not greater than 20° from the horizontal.
- (2) For visual course guidance navigation, the operator should ensure that the weather conditions prevailing at the time of operation, including ceiling and visibility, are such that the obstacle and/or ground reference points can be seen and identified. The operations manual should specify, for the aerodrome(s) concerned, the minimum weather conditions that enable the flight crew to continuously determine and maintain the correct flight path with

respect to ground reference points, so as to provide a safe clearance with respect to obstructions and terrain as follows:

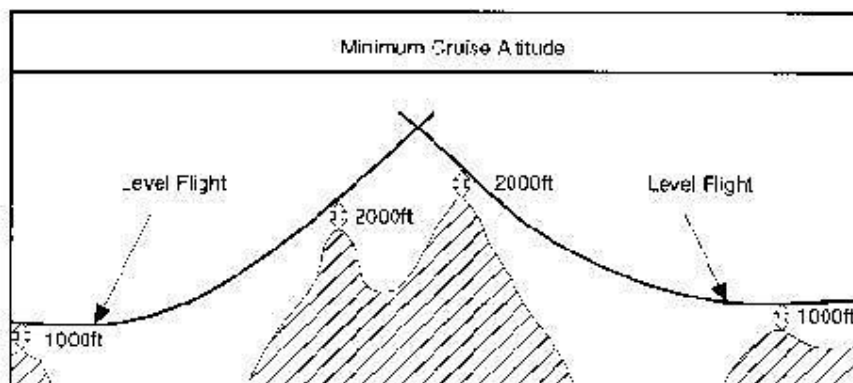
- (i) the procedure should be well defined with respect to ground reference points so that the track to be flown can be analysed for obstacle clearance requirements;
- (ii) the procedure should be within the capabilities of the aeroplane with respect to forward speed, bank angle and wind effects;
- (iii) a written and/or pictorial description of the procedure should be provided for crew use; and
- (iv) the limiting environmental conditions (such as wind, the lowest cloud base, ceiling, visibility, day/night, ambient lighting, obstruction lighting) should be specified.

### **AMC1 CAT.POL.A.415 En-route – OEI**

#### ROUTE ANALYSIS

The high terrain or obstacle analysis should be carried out by making a detailed analysis of the route using contour maps of the high terrain, and plotting the highest points within the prescribed corridor width along the route. The next step is to determine whether it is possible to maintain level flight with OEI 1 000 ft above the highest point of the crossing. If this is not possible, or if the associated weight penalties are unacceptable, a driftdown procedure must be evaluated, based on engine failure at the most critical point, and must show obstacle clearance during the driftdown by at least 2 000 ft. The minimum cruise altitude is determined from the driftdown path, taking into account allowances for decision making, and the reduction in the scheduled rate of climb (See Figure 1).

**Figure 1: Intersection of the driftdown paths**



### **AMC1 CAT.POL.A.425 Landing – destination and alternate aerodromes**

#### ALTITUDE MEASURING

The operator should use either pressure altitude or geometric altitude for its operation and this should be reflected in the operations manual.

**AMC1 CAT.POL.A.430 Landing – dry runways**

## LANDING DISTANCE CORRECTION FACTORS

- (a) Unless otherwise specified in the AFM or other performance or operating manuals from the manufacturers, the variables affecting the landing performance and the associated factors to be applied to the AFM data are shown in the table below. It should be applied in addition to the factor specified in CAT.POL.A.430.

**Table 1: Landing distance correction factor**

Surface type	factor
Grass (on firm soil up to 20 cm long)	1.2

- (b) The soil should be considered firm when there are wheel impressions but no rutting.

**AMC2 CAT.POL.A.430 Landing – dry runways**

## RUNWAY SLOPE

Unless otherwise specified in the AFM, or other performance or operating manuals from the manufacturer, the landing distances required should be increased by 5 % for each 1 % of downslope.

**GM1 CAT.POL.A.430 Landing - dry runways**

## LANDING MASS

CAT.POL.A.430 establishes two considerations in determining the maximum permissible landing mass at the destination and alternate aerodromes.

- (a) Firstly, the aeroplane mass will be such that on arrival the aeroplane can be landed within 70 % of the LDA on the most favourable (normally the longest) runway in still air. Regardless of the wind conditions, the maximum landing mass for an aerodrome/aeroplane configuration at a particular aerodrome cannot be exceeded.
- (b) Secondly, consideration should be given to anticipated conditions and circumstances. The expected wind, or ATC and noise abatement procedures, may indicate the use of a different runway. These factors may result in a lower landing mass than that permitted under (a), in which case dispatch should be based on this lesser mass.
- (c) The expected wind referred to in (b) is the wind expected to exist at the time of arrival.