Standards Document

Civil Aviation Authority
Of Fiji

STANDARDS DOCUMENT AIRCRAFT WEIGHT AND PERFORMANCE

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Civil Aviation Authority of Fiji
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Standards Document

AIRCRAFT WEIGHT AND PERFORMANCE

SD – Aircraft Weight and Performance

Civil Aviation Authority of Fiji
Private Mail Bag, NAP 0354
Nadi International Airport
Fiji

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PREFACE

General

Fiji's National Aviation Law consists of a three tier or triple system regulatory system, comprising Acts, Regulations and Standards Documents; the purpose of which is to ensure, where deemed appropriate, compliance and conformance with ICAO Standards and Recommended Practices (SARPS).

The 'three tier' or 'triple system' regulatory system represents Fiji's Primary Legislation System and Specific Operating Regulations to meet Critical Elements CE1 and CE2 of ICAO's Eight Critical Element of a safety oversight system

Standards Documents (SD) are issued by the Civil Aviation Authority of Fiji under the provision of Section 14 (3) (b) of the Civil Aviation Authority Act 1979 (CAP 174A)

Where appropriate, the SD also contains technical guidance (Critical Element CE5) on standards, practices, and procedures that are acceptable to the Authority.

Notwithstanding the above, and where specifically indicated in this Standards Document that such a provision is available, consideration may be given to other methods of compliance that may be presented to the Authority provided they have compensating factors that can demonstrate a level of safety equivalent to or better than those prescribed herein. Accordingly, the Authority will consider each case based on its own merits holistically in the context of and relevancy of the alternative methods to the individual applicant.

When new standards, practices, or procedures are determined to be acceptable, they will be added to this document.

Purpose

This Standards Document, Aircraft Weight and Performance, is hereby issued by the Civil Aviation Authority of Fiji pursuant to the International Civil Aviation Organisation Annex 6, Regulations 13(6) (7), and 42 of the Air Navigation Regulations 1981 (as amended). This Document is intended for use by the Authority, private operators, applicants, and holders of an Air Operator Certificate, and their staff.

Change Notice

This Standards Document has been developed pursuant to the Authority's obligation to provide oversight on certified operators and their personnel, as well as the operator's obligation to comply with standards notified by the Authority and is the means by which such notification is given.

CIVIL AVIATION AUTHORITY OF FIJI
CHIEF EXECUTIVE

....
THERESA LEVESTAM
ACTING CHIEF EXECUTIVE

AMENDMENT RECORD

The following space is provided to keep a record of all amendments.

Amendment No.	Effective Date	Entered By	Date Entered	Amendment No.	Effective Date	Entered By	Date Entered
1	20/08/19	FT	20/08/19	**29**			
2				**30**			
3				**31**			
4				**32**			
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DEFINITIONS.

For the purpose of this Regulation, the following definitions shall apply:

1. 'Accelerate-stop distance available (ASDA)' means the length of the take-off run available plus the length of stopway, if such stopway is declared available by the State of the aerodrome and is capable of bearing the mass of the aeroplane under the prevailing operating conditions.

2. 'Acceptable Means of Compliance (AMC)' means non-binding standards adopted by the Authority to illustrate means to establish compliance with Regulation.

3. 'Acceptance checklist' means a document used to assist in carrying out a check on the external appearance of packages of dangerous goods and their associated documents to determine that all appropriate requirements have been met with.

4. 'Adequate aerodrome' means an aerodrome on which the aircraft can be operated, taking account of the applicable performance requirements and runway characteristics.

5. 'Aeroplane' means an engine-driven fixed-wing aircraft heavier than air that is supported in flight by the dynamic reaction of the air against its wings.

6. 'Aircraft' means a machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface.

7. 'Alternative means of compliance' mean those means that propose an alternative to an existing Acceptable Means of Compliance or those that propose new means to establish compliance with Regulation and its Implementing Rules for which no associated AMC have been adopted by the Authority.

8. '**Category A with respect to helicopters**' means a multi-engined helicopter designed with engine and system isolation features specified in the applicable airworthiness codes and capable of operations using take-off and landing data scheduled under a critical engine failure concept that assures adequate designated surface area and adequate performance capability for continued safe flight or safe rejected take-off in the event of engine failure.

9. '**Category B with respect to helicopters**' means a single-engined or multi-engined helicopter that does not meet Category A standards. Category B helicopters have no guaranteed capability to continue safe flight in the event of an engine failure, and unscheduled landing is assumed.

10. 'Certification Specifications' (CS) mean technical standards adopted by the Authority indicating means to show compliance with Regulation and its Implementing Rules and which can be used by an organisation for the purpose of certification.

11. 'Clearway' means a defined rectangular area on the ground or water under the control of the appropriate authority, selected or prepared as a suitable area over which an aeroplane may make a portion of its initial climb to a specified height.

12. 'Cloud base' means the height of the base of the lowest observed or forecast cloud element in the vicinity of an aerodrome or operating site or within a specified area of operations, normally measured above aerodrome elevation or, in the case of off shore operations, above mean sea level.

13. 'Congested area' means in relation to a city, town or settlement, any area which is substantially used for residential, commercial or recreational purposes.

14. 'Contaminated runway' means a runway of which more than 25% of the runway surface area within the required length and width being used is covered by the following:

    (a) surface water more than 3 mm (0.125 in) deep, or by slush, or loose snow, equivalent to more than 3 mm (0.125 in) of water;

    (b) snow which has been compressed into a solid mass which resists further compression and will hold together or break into lumps if picked up (compacted snow); or

15. 'Critical phases of flight' in the case of aeroplanes means the take-off run, the take-off flight path, the final approach, the missed approach, the landing, including the landing roll, and any other phases of flight as determined by the pilot-in-command.

16. 'Critical phases of flight' in the case of helicopters means taxiing, hovering, take-off , final approach, missed approach, the landing and any other phases of flight as determined by the pilot-in-command.

17. 'Damp runway' means a runway where the surface is not dry, but when the moisture on it does not give it a shiny appearance. 36. 'Defined point after take-off (DPATO)' means the point, within the take-off and initial climb phase, before which the helicopter's ability to continue the flight safely, with the critical engine inoperative, is not assured and a forced landing may be required.

18. 'Defined point before landing (DPBL)' means the point within the approach and landing phase, after which the helicopter's ability to continue the flight safely, with the critical engine inoperative, is not assured and a forced landing may be required.

19. 'Distance DR' means the horizontal distance that the helicopter has travelled from the end of the take-off distance available.

20. 'Dry runway' means a runway which is neither wet nor contaminated, and includes those paved runways which have been specially prepared with grooves or porous pavement and maintained to retain 'effectively dry' braking action even when moisture is present.

21. 'Elevated final approach and take-off area (elevated FATO)' means a FATO that is at least 3 m above the surrounding surface.

22. 'Final approach and take-off area (FATO)' means a defined area for helicopter operations, over which the final phase of the approach manoeuvre to hover or land is completed, and from which the take-off manoeuvre is commenced. In the case of helicopters operating in performance class 1, the defined area includes the rejected take-off area available.

23. 'Flight data monitoring (FDM)' means the proactive and non-punitive use of digital flight data from routine operations to improve aviation safety.

24. 'Helicopter' means a heavier-than-air aircraft supported in flight chiefly by the reactions of the air on one or more power-driven rotors on substantially vertical axes.

25. 'Helideck' means a FATO located on a floating or fixed off shore structure.

26. 'Hostile environment' means:

    (a) an environment in which:

        A safe forced landing cannot be accomplished because the surface is inadequate;

        (ii) The helicopter occupants cannot be adequately protected from the elements;

        (iii) Search and rescue response/capability is not provided consistent with anticipated exposure; or

        (iv) There is an unacceptable risk of endangering persons or property on the ground.

    (b) In any case, the following areas:

        (ii) Those parts of a congested area without adequate safe forced landing areas.

27. 'Landing decision point (LDP)' means the point used in determining landing performance from which, an engine failure having been recognised at this point, the landing may be safely continued or a balked landing initiated.

28. 'Landing distance available (LDA)' means the length of the runway which is declared available by the State of the aerodrome and suitable for the ground run of an aeroplane landing.

29. 'Local helicopter operation' means an air transport operation of helicopters with a maximum certified take-off mass (MCTOM) over 3175 kg and a maximum operational passenger seating configuration (MOPSC) of nine or less, by day, over routes navigated by reference to visual landmarks, conducted within a local and defined geographical area specified in the operations manual.

30. 'Maximum operational passenger seating configuration (MOPSC)' means the maximum passenger seating capacity of an individual aircraft, excluding crew seats, established for operational purposes and specified in the operations manual. Taking as a baseline the maximum passenger seating configuration established during the certification process conducted for the type certificate (TC), supplemental type certificate (STC) or change to the TC or STC as relevant to the individual aircraft, the MOPSC may establish an equal or lower number of seats, depending on the operational constraints.

31. 'Night' means the period between the end of evening civil twilight and the beginning of morning civil twilight or such other period between sunset and sunrise as may be prescribed by the appropriate authority, as defined by the Member State.

32. 'Non-hostile environment' means an environment in which:

(a) a safe forced landing can be accomplished;

(b) the helicopter occupants can be protected from the elements; and

(c) Search and rescue response/capability is provided consistent with the anticipated exposure. In any case, those parts of a congested area with adequate safe forced landing areas shall be considered non-hostile.

33. ‘Operating site’ means a site, other than an aerodrome, selected by the operator or pilot-in-command for landing, take-off and/or external load operations.

34. ‘**Operation in performance class 1**’ means an operation that, in the event of failure of the critical engine, the helicopter is able to land within the rejected take-off distance available or safely continue the flight to an appropriate landing area, depending on when the failure occurs.

35. ‘**Operation in performance class 2**’ means an operation that, in the event of failure of the critical engine, performance is available to enable the helicopter to safely continue the flight, except when the failure occurs early during the take-off manoeuvre or late in the landing manoeuvre, in which cases a forced landing may be required.

36. ‘**Operation in performance class 3**’ means an operation that, in the event of an engine failure at any time during the flight, a forced landing may be required in a multi-engined helicopter and will be required in a single-engined helicopter.

37. ‘Operational control’ means the responsibility for the initiation, continuation, termination or diversion of a flight in the interest of safety.

38. ‘**Performance class A aeroplanes**’ means multi-engined aeroplanes powered by turbo-propeller engines with an MOPSC of more than nine or a maximum take-off mass exceeding 5700 kg, and all multi-engined turbo-jet powered aeroplanes.

39. ‘**Performance class B aeroplanes**’ means aeroplanes powered by propeller engines with an MOPSC of nine or less and a maximum take-off mass of 5700 kg or less.

40. ‘**Performance class C aeroplanes**’ means aeroplanes powered by reciprocating engines with an MOPSC of more than nine or a maximum take-off mass exceeding 5700 kg.

41. ‘Pilot-in-command’ means the pilot designated as being in command and charged with the safe conduct of the flight.

42. ‘Rectification interval’ means a limitation on the duration of operations with inoperative equipment.

43. ‘Rejected take-off distance available (RTODAH)’ means the length of the final approach and take-off area declared available and suitable for helicopters operated in performance class 1 to complete a rejected take-off.

44. ‘Rejected take-off distance required (RTODRH)’ means the horizontal distance required from the start of the take-off to the point where the helicopter comes to a full stop following an engine failure and rejection of the take-off at the take-off decision point.

45. ‘Runway visual range (RVR)’ means the range over which the pilot of an aircraft on the centre line of a runway can see the runway surface markings or the lights delineating the runway or identifying its centreline.

46. ‘Safe forced landing’ means an unavoidable landing or ditching with a reasonable expectancy of no injuries to persons in the aircraft or on the surface.

47. ‘Seaplane’ means a fixed wing aircraft which is designed for taking off and landing on water and includes amphibians operated as seaplanes.

48. ‘Separate runways’ means runways at the same aerodrome that are separate landing surfaces. These runways may overlay or cross in such a way that if one of the runways is blocked, it will not prevent the planned type of operations on the other runway. Each runway shall have a separate approach procedure based on a separate navigation aid.

49. ‘Stabilised approach (SAp)’ means an approach that is flown in a controlled and appropriate manner in terms of configuration, energy and control of the flight path from a pre-determined point or altitude/ height down to a point 50 ft above the threshold or the point where the flare manoeuvre is initiated if higher.

50. ‘Take-off decision point (TDP)’ means the point used in determining take-off performance from which, an engine failure having been recognised at this point, either a rejected take-off may be made or a take-off safely continued.

51. 'Take-off distance available (TODA)' in the case of aeroplanes means the length of the take-off run available plus the length of the clearway, if provided.

52. 'Take-off distance available (TODAH)' in the case of helicopters means the length of the final approach and take-off area plus, if provided, the length of helicopter clearway declared available and suitable for helicopters to complete the take-off.

53. 'Take-off distance required (TODRH)' in the case of helicopters means the horizontal distance required from the start of the take-off to the point at which take-off safety speed (V_{TOSS}), a selected height and a positive climb gradient are achieved, following failure of the critical engine being recognised at the TDP, the remaining engines operating within approved operating limits.

54. 'Take-off flight path' means the vertical and horizontal path, with the critical engine inoperative, from a specified point in the take-off for aeroplanes to 1500 ft above the surface and for helicopters to 1000 ft above the surface.

55. 'Take-off mass' means the mass including everything and everyone carried at the commencement of the take-off for helicopters and take-off run for aeroplanes.

56. 'Take-off run available (TORA)' means the length of runway that is declared available by the State of the aerodrome and suitable for the ground run of an aeroplane taking off.

57. 'V1' means the maximum speed in the take-off at which the pilot must take the first action to stop the aeroplane within the accelerate-stop distance. V1 also means the minimum speed in the take-off, following a failure of the critical engine at VEF, at which the pilot can continue the take-off and achieve the required height above the take-off surface within the take-off distance.

58. 'VEF' means the speed at which the critical engine is assumed to fail during take-off.

59. 'Visual approach' means an approach when either part or all of an instrument approach procedure is not completed and the approach is executed with visual reference to the terrain.

60. 'Wet runway' means a runway of which the surface is covered with water, or equivalent, less than specified by the 'contaminated runway' definition or when there is sufficient moisture on the runway surface to cause it to appear reflective, but without significant areas of standing water.

AIRCRAFT PERFORMANCE AND OPERATING LIMITATIONS

Aircraft weight and performance

ANR 42.

(1) No operator domiciled in Fiji shall fly an aircraft for the purpose of public transport, except for the sole purpose of training persons to perform duties in the aircraft, unless in compliance with –

(a) For an aircraft registered in Fiji or an aircraft for which the responsibility has been transferred to Fiji, the requirements of this regulation; or

(b) For any other aircraft not covered by paragraph (a), the requirements of the State of Registry in regard to aircraft weight and performance.

Section 1 — Aeroplanes

Chapter 1 — General requirements

1.1 Performance classes

(a) The aeroplane shall be operated in accordance with the applicable performance class requirements.

(b) Where full compliance with the applicable requirements of this Section cannot be shown due to specific design characteristics, the operator shall apply approved performance standards that ensure a level of safety equivalent to that of the appropriate chapter.

1.2 General

(a) The mass of the aeroplane:

(1) At the start of the take-off; or

(2) In the event of in-flight replanning, at the point from which the revised operational flight plan applies, shall not be greater than the mass at which the requirements of the appropriate chapter can be complied with for the flight to be undertaken. Allowance may be made for expected reductions in mass as the flight proceeds and for fuel jettisoning.

(b) The approved performance data contained in the AFM shall be used to determine compliance with the requirements of the appropriate chapter, supplemented as necessary with other data as prescribed in the relevant chapter. The operator shall specify other data in the operations manual. When applying the factors prescribed in the appropriate chapter, account may be taken of any operational factors already incorporated in the AFM performance data to avoid double application of factors.

(c) Due account shall be taken of aeroplane configuration, environmental conditions and the operation of systems that have an adverse effect on performance.

(d) For performance purposes, a damp runway, other than a grass runway, may be considered to be dry.

(e) The operator shall take account of charting accuracy when assessing the take-off requirements of the applicable chapters.

1.3 Alleviations

(a) The DHC-3 Otter shall be categorised in Performance Class B in accordance with this SD.

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Chapter 2 — Performance class A

'Performance class A aeroplanes' means multi-engined aeroplanes powered by turbo-propeller engines with an MOPSC of more than nine or a maximum take-off mass exceeding 5700 kg, and all multi-engined turbo-jet powered aeroplanes.

2.1 General

(a) The approved performance data in the AFM shall be supplemented as necessary with other data if the approved performance data in the AFM is insufficient in respect of items such as:

(1) accounting for reasonably expected adverse operating conditions such as take-off and landing on contaminated runways; and

(2) Consideration of engine failure in all flight phases.

(b) For wet and contaminated runways, performance data determined in accordance with applicable standards on certification of large aeroplanes or equivalent shall be used.

(c) The use of other data referred to in (a) and equivalent requirements referred to in (b) shall be specified in the operations manual.

AMC 1 to 2.1 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.

2.2 Take-off

(a) The take-off mass shall not exceed the maximum take-off mass specified in the AFM for the pressure altitude and the ambient temperature at the aerodrome of departure.

(b) The following requirements shall be met when determining the maximum permitted take-off mass:

(1) The accelerate-stop distance shall not exceed the accelerate-stop distance available (ASDA);

(2) The take-off distance shall not exceed the take-off distance available, with a clearway distance not

Exceeding half of the take-off run available (TORA);

(3) The take-off run shall not exceed the TORA;

(4) A single value of V1 shall be used for the rejected and continued take-off; and

(5) On a wet or contaminated runway, the take-off mass shall not exceed that permitted for a take-off

On a dry runway under the same conditions.

(c) When showing compliance with (b), the following shall be taken into account:

(1) The pressure altitude at the aerodrome;

(2) The ambient temperature at the aerodrome;

(3) The runway surface condition and the type of runway surface;

(4) The runway slope in the direction of take-off;

(5) Not more than 50% of the reported headwind component or not less than 150% of the reported tailwind component; and

(6) The loss, if any, of runway length due to alignment of the aeroplane prior to take-off.

AMC 1 to 2.2 Take-off

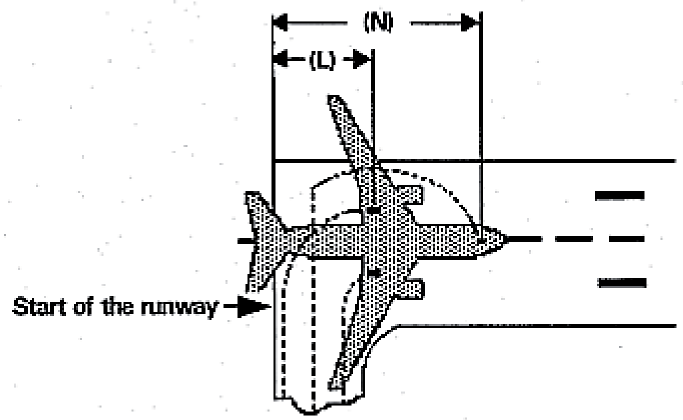
LOSS OF RUNWAY LENGTH DUE TO ALIGNMENT

(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:

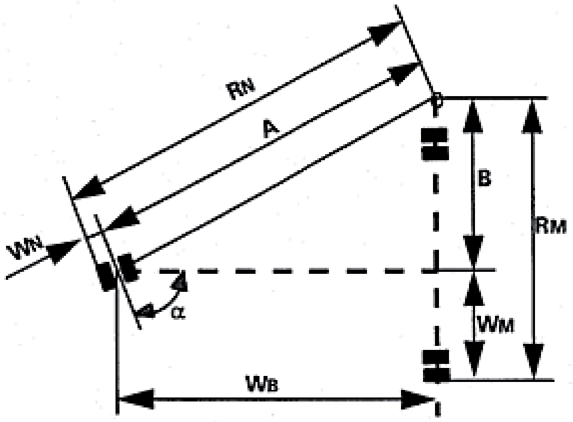
(1) the minimum distance of the main wheels from the start of the runway for determining TODA and TORA,'L'; and

(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°-α) + WN

RM = B + WM = WB tan (90°-α) + 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.

GM 1 to 2.2 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 Pilot in Command 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 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.

2.3 Take-off obstacle clearance

(a) The net take-off flight path shall be determined in such a way that the aeroplane clears all obstacles by a vertical distance of at least 35 ft or by a horizontal distance of at least 90 m plus 0.125 × D, where D is the horizontal distance the aeroplane has travelled from the end of the take-off distance available (TODA) or the end of the take-off distance if a turn is scheduled before the end of the TODA. For aeroplanes with a wingspan of less than 60 m, a horizontal obstacle clearance of half the aeroplane wingspan plus 60 m, plus 0.125 × D may be used.

(b) When showing compliance with (a):

(1) The following items shall be taken into account:

(i) The mass of the aeroplane at the commencement of the take-off run;

(ii) The pressure altitude at the aerodrome;

(iii) The ambient temperature at the aerodrome; and

(iv) Not more than 50% of the reported headwind component or not less than 150% of the reported tailwind component.

(2) Track changes shall not be allowed up to the point at which the net take-off flight path has achieved a height equal to one half the wingspan but not less than 50 ft above the elevation of the end of the TORA. Thereafter, up to a height of 400 ft it is assumed that the aeroplane is banked by no more than 15°. Above 400 ft height bank angles greater than 15°, but not more than 25° may be scheduled.

(3) Any part of the net take-off flight path in which the aeroplane is banked by more than 15° shall clear all obstacles within the horizontal distances specified in (a), (b)(6) and (b)(7) by a vertical distance of at least 50 ft.

(4) Operations that apply increased bank angles of not more than 20° between 200 ft and 400 ft, or not more than 30° above 400 ft, shall be carried out in accordance with '2.9 Approval of operations with increased bank angles'.

(5) Adequate allowance shall be made for the effect of bank angle on operating speeds and flight path including the distance increments resulting from increased operating speeds.

(6) For cases where the intended flight path does not require track changes of more than 15°, the operator does not need to consider those obstacles that have a lateral distance greater than:

(i) 300 m, if the pilot is able to maintain the required navigational accuracy through the obstacle accountability area; or

(ii) 600 m, for flights under all other conditions.

(7) For cases where the intended flight path requires track changes of more than 15°, the operator does not need to consider those obstacles that have a lateral distance greater than:

(i) 600 m, if the pilot is able to maintain the required navigational accuracy through the obstacle accountability area; or

(ii) 900 m, for flights under all other conditions.

(c) The operator shall establish contingency procedures to satisfy the requirements in (a) and (b) and to provide a safe route, avoiding obstacles, to enable the aeroplane to either comply with the en-route requirements of '2.4 En-route - one-engine-inoperative (OEI)', or land at either the aerodrome of departure or at a take-off alternate aerodrome.

AMC 1 to 2.3 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 (V1) 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 (V1) 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 (V1) 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.

AMC 2 to 2.3 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

Bank	Speed	Gradient correction
15°	V2	1 x AFM 15° gradient loss
20°	V2	+ 5 Kts 2 x AFM 15° gradient loss
25°	V2	+ 10 Kts 3 x AFM 15° gradient loss

AMC 3 to 2.3 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.

GM 1 to 2.3 Take-off obstacle clearance

CONTINGENCY PROCEDURES FOR OBSTACLES CLEARANCES

If compliance with 2.3 Take-off obstacle clearance 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.

2.4 En-route — one-engine-inoperative (OEI)

(a) The OEI en-route net flight path data shown in the AFM, appropriate to the meteorological conditions expected for the flight, shall allow demonstration of compliance with (b) or (c) at all points along the route. The net flight path shall have a positive gradient at 1 500 ft above the aerodrome where the landing is assumed to be made after engine failure. In meteorological conditions requiring the operation of ice protection systems, the effect of their use on the net flight path shall be taken into account.

(b) The gradient of the net flight path shall be positive at least 1000 ft above all terrain and obstructions along the route within 9.3 km (5 NM) on either side of the intended track.

(c) The net flight path shall permit the aeroplane to continue flight from the cruising altitude to an aerodrome where a landing can be made in accordance with 2.6 Landing — destination and alternate aerodromes or 2.7 Landing - dry runways, as appropriate. The net flight path shall clear vertically, by at least 2000 ft, all terrain and obstructions along the route within 9.3 km (5 NM) on either side of the intended track in accordance with the following:

(1) The engine is assumed to fail at the most critical point along the route;

(2) Account is taken of the effects of winds on the flight path;

(3) Fuel jettisoning is permitted to an extent consistent with reaching the aerodrome with the required fuel reserves, if a safe procedure is used; and

(4) The aerodrome where the aeroplane is assumed to land after engine failure shall meet the following criteria:

(i) The performance requirements at the expected landing mass are met; and

(ii) Weather reports and/or forecasts and field condition reports indicate that a safe landing can be accomplished at the estimated time of landing.

(d) The operator shall increase the width margins of (b) and (c) to 18.5 km (10 NM) if the navigational accuracy does not meet at least required navigation performance 5 (RNP5).

AMC 1 to 2.4 En-route – one-engine-inoperative (OEI)

ROUTE ANALYSIS

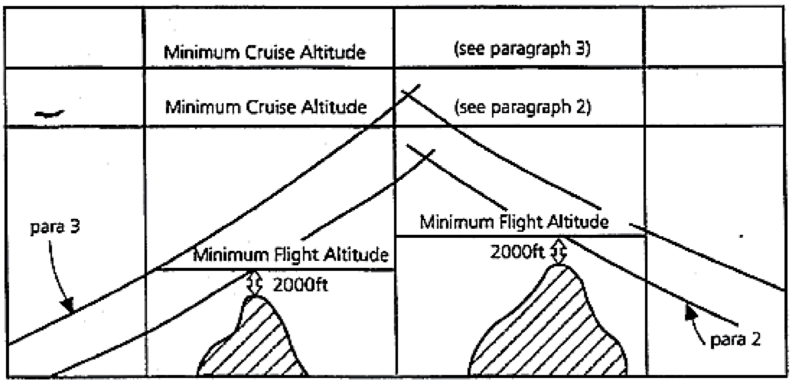
(a) The high terrain or obstacle analysis required should be carried out by a detailed analysis of the route.

(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 1000 ft above the highest point of the crossing. If this is not possible, or if the associated weight penalties are unacceptable, a drift down procedure should be worked out, based on engine failure at the most critical point and clearing critical obstacles during the drift down by at least 2000 ft. The minimum cruise altitude is determined by the intersection of the two drift down 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 drift down 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 Chapter 2 2.4 (c) En-route – one-engine-inoperative (OEI), one means of compliance is the use of MORA and, with Chapter 2 2.4 (d) En-route – one-engine-inoperative (OEI), MEA provided that the aeroplane meets the navigational equipment standard assumed in the definition of MEA.

Figure 1: Intersection of the two drift down paths



Note: MEA or MORA normally provide the required 2000 ft obstacle clearance for drift down. However, at and below 6000 ft altitude, MEA and MORA cannot be used directly as only 1000 ft clearance is ensured.

2.5 En-route — aeroplanes with three or more engines, two engines inoperative

(a) At no point along the intended track shall an aeroplane having three or more engines be more than

90 minutes, at the all-engines long range cruising speed at standard temperature in still air, away from an aerodrome at which the performance requirements applicable at the expected landing mass are met, unless it complies with (b) to (f).

(b) The two-engines-inoperative en-route net flight path data shall allow the aeroplane to continue the flight, in the expected meteorological conditions, from the point where two engines are assumed to fail simultaneously to an aerodrome at which it is possible to land and come to a complete stop when using the prescribed procedure for a landing with two engines inoperative. The net flight path shall clear vertically, by at least 2000 ft, all terrain and obstructions along the route within 9.3 km (5 NM) on either side of the intended track. At altitudes and in meteorological conditions requiring ice protection systems to be operable, the effect of their use on the net flight path data shall be taken into account. If the navigational accuracy does not meet at least RNP5, the operator shall increase the width margin given above to 18.5 km (10 NM).

(c) The two engines shall be assumed to fail at the most critical point of that portion of the route where the aeroplane is more than 90 minutes, at the all-engines long range cruising speed at standard temperature in still air, away from an aerodrome at which the performance requirements applicable at the expected landing mass are met.

(d) The net flight path shall have a positive gradient at 1500 ft above the aerodrome where the landing is assumed to be made after the failure of two engines.

(e) Fuel jettisoning shall be permitted to an extent consistent with reaching the aerodrome with the required fuel reserves, if a safe procedure is used.

(f) The expected mass of the aeroplane at the point where the two engines are assumed to fail shall not be less than that which would include sufficient fuel to proceed to an aerodrome where the landing is assumed to be made, and to arrive there at least 1500 ft directly over the landing area and thereafter to fly level for 15 minutes.

2.6 Landing — destination and alternate aerodromes

(a) The landing mass of the aeroplane determined in accordance with Chapter 1 1.2 (a) General, shall not exceed the maximum landing mass specified for the altitude and the ambient temperature expected for the estimated time of landing at the destination aerodrome and alternate aerodrome.

AMC 1 to 2.6 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.

AMC 2 to 2.6 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.

GM 1 to 2.6 Landing – destination and alternate aerodromes

MISSED APPROACH GRADIENT

(a) Where an aeroplane cannot achieve the missed approach gradient specified in AMC 2 Landing – destination and alternate aerodromes, 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 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.

2.7 Landing — dry runways

(a) The landing mass of the aeroplane determined in accordance with Chapter 1 1.2 (a) General, for the estimated time of landing at the destination aerodrome and at any alternate aerodrome shall allow a full stop landing from 50 ft above the threshold:

(1) For turbo-jet powered aeroplanes, within 60% of the landing distance available (LDA); and

(2) For turbo-propeller powered aeroplanes, within 70% of the LDA.

(b) For steep approach operations, the operator shall use the landing distance data factored in accordance with (a), based on a screen height of less than 60 ft, but not less than 35 ft, and shall comply with Chapter 2 2.10 Approval of steep approach operations.

(c) For short landing operations, the operator shall use the landing distance data factored in accordance with (a) and shall comply with Chapter 2 2.11 Approval of short landing operations.

(d) When determining the landing mass, the operator shall take the following into account:

(1) The altitude at the aerodrome;

(2) Not more than 50% of the headwind component or not less than 150% of the tailwind component; and

(3) The runway slope in the direction of landing if greater than ±2%.

(e) For dispatching the aeroplane it shall be assumed that:

(1) The aeroplane will land on the most favourable runway, in still air; and

(2) The aeroplane will land on the runway most likely to be assigned, considering the probable wind speed and direction, the ground handling characteristics of the aeroplane and other conditions such as landing aids and terrain.

(f) If the operator is unable to comply with (e) (1) for a destination aerodrome having a single runway where a landing depends upon a specified wind component, the aeroplane may be dispatched if two alternate aerodromes are designated that permit full compliance with (a) to (e). Before commencing an approach to land at the destination aerodrome, the Pilot in Command shall check that a landing can be made in full compliance with (a) to (d) and 2.6 Landing – destination and alternate aerodromes.

(g) If the operator is unable to comply with (e) (2) for the destination aerodrome, the aeroplane shall be only dispatched if an alternate aerodrome is designated that allows full compliance with (a) to (e).

AMC 1 to 2.7 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 Chapter 2 2.7 (a)(1) and Chapter 2 2.8 Landing — wet and contaminated runways, the landing mass of the aeroplane should be the lesser of:

(a) The landing mass determined in accordance with Chapter 2 2.7 (a) (1) or Chapter 2 2.8 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 over speed, should also be included.

GM 1 to 2.7 Landing – dry runways

LANDING MASS

Chapter 2 2.7 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.

2.8 Landing — wet and contaminated runways

(a) When the appropriate weather reports and/or forecasts indicate that the runway at the estimated time of arrival may be wet, the LDA shall be at least 115% of the required landing distance, determined in accordance with Chapter 2 2.7.

(b) When the appropriate weather reports and/or forecasts indicate that the runway at the estimated time of arrival may be contaminated, the LDA shall be at least the landing distance determined in accordance with (a), or at least 115% of the landing distance determined in accordance with approved contaminated landing distance data or equivalent, whichever is greater. The operator shall specify in the operations manual if equivalent landing distance data are to be applied.

(c) A landing distance on a wet runway shorter than that required by (a), but not less than that required by Chapter 2 2.7 (a), may be used if the AFM includes specific additional information about landing distances on wet runways.

(d) A landing distance on a specially prepared contaminated runway shorter than that required by (b), but not less than that required by Chapter 2 2.7 (a), may be used if the AFM includes specific additional information about landing distances on contaminated runways.

(e) For (b), (c) and (d), the criteria of Chapter 2 2.7 shall be applied accordingly, except that Chapter 2 2.7 (a) shall not be applied to (b) above.

2.9 Approval of operations with increased bank angles

(a) Operations with increased bank angles require prior approval by the authority.

(b) To obtain the approval, the operator shall provide evidence that the following conditions are met:

(1) the AFM contains approved data for the required increase of operating speed and data to allow the construction of the flight path considering the increased bank angles and speeds;

(2) Visual guidance is available for navigation accuracy;

(3) Weather minima and wind limitations are specified for each runway; and

(4) The flight crew has obtained adequate knowledge of the route to be flown and of the procedures to be used in accordance with the Operations Manual.

2.10 Approval of steep approach operations

(a) Steep approach operations using glideslope angles of 4.5° or more and with screen heights of less than

60 ft, but not less than 35 ft, require prior approval by the authority.

(b) To obtain the approval, the operator shall provide evidence that the following conditions are met:

(1) the AFM states the maximum approved glideslope angle, any other limitations, normal, abnormal or emergency procedures for the steep approach as well as amendments to the field length data when using steep approach criteria;

(2) For each aerodrome at which steep approach operations are to be conducted:

(i) A suitable glide path reference system comprising at least a visual glide path indicating system shall be available;

(ii) Weather minima shall be specified; and

(iii) The following items shall be taken into consideration:

(A) The obstacle situation;

(B) The type of glide path reference and runway guidance;

(C) The minimum visual reference to be required at decision height (DH) and MDA;

(D) Available airborne equipment;

(E) Pilot qualification and special aerodrome familiarisation;

(F) AFM limitations and procedures; and

(G) Missed approach criteria.

2.11 Approval of short landing operations

(a) Short landing operations require prior approval by the authority.

(b) To obtain the approval, the operator shall provide evidence that the following conditions are met:

(1) The distance used for the calculation of the permitted landing mass may consist of the usable length of the declared safe area plus the declared LDA;

(2) The State of the aerodrome has determined a public interest and operational necessity for the operation, either due to the remoteness of the aerodrome or to physical limitations relating to extending the runway;

(3) The vertical distance between the path of the pilot's eye and the path of the lowest part of the wheels, with the aeroplane established on the normal glide path, does not exceed 3 m;

(4) RVR/VIS minimum shall not be less than 1500 m and wind limitations are specified in the operations manual;

(5) Minimum pilot experience, training and special aerodrome familiarisation requirements are specified and met;

(6) The crossing height over the beginning of the usable length of the declared safe area is 50 ft;

(7) The use of the declared safe area is approved by the State of the aerodrome;

(8) The usable length of the declared safe area does not exceed 90 m;

(9) the width of the declared safe area is not less than twice the runway width or twice the wing span, whichever is greater, centred on the extended runway centre line;

(10) the declared safe area is clear of obstructions or depressions that would endanger an aeroplane undershooting the runway and no mobile object is permitted on the declared safe area while the runway is being used for short landing operations;

(11) The slope of the declared safe area does not exceed 5% upward nor 2% downward in the direction of landing; and

(12) Additional conditions, if specified by the authority, taking into account aeroplane type characteristics, orographic characteristics in the approach area, available approach aids and missed approach/balked landing considerations.

Chapter 3 — Performance class B

'Performance class B aeroplanes' means aeroplanes powered by propeller engines with an MOPSC of nine or less and a maximum take-off mass of 5,700 kg or less.

3.1. General

(a) The operator shall not operate a single-engined aeroplane:

(1) At night; or

(2) In IMC except under special VFR.

(b) The operator shall treat two-engined aeroplanes that do not meet the climb requirements of Chapter 3 3.9 as single-engined aeroplanes.

3.2. Take-off

(a) The take-off mass shall not exceed the maximum take-off mass specified in the AFM for the pressure altitude and the ambient temperature at the aerodrome of departure.

(b) The unfactored take-off distance, specified in the AFM, shall not exceed:

(1) When multiplied by a factor of 1.25, the take-off run available (TORA); or

(2) When stop way and/or clearway is available, the following:

(i) The TORA;

(ii) When multiplied by a factor of 1.15, the take-off distance available (TODA); or

(iii) When multiplied by a factor of 1.3, the ASDA.

(c) When showing compliance with (b), the following shall be taken into account:

(1) The mass of the aeroplane at the commencement of the take-off run;

(2) The pressure altitude at the aerodrome;

(3) The ambient temperature at the aerodrome;

(4) The runway surface condition and the type of runway surface;

(5) The runway slope in the direction of take-off; and

(6) Not more than 50% of the reported headwind component or not less than 150% of the reported tailwind component.

AMC 1 to 3.2 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 Chapter 3 3.2

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.

AMC 2 to 3.2 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 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 %.

GM 1 to 3.2 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 Pilot in Command should also consider the excess runway length available including the criticality of the overrun area.

3.3. Take-off obstacle clearance — multi-engined aeroplanes

(a) The take-off flight path of aeroplanes with two or more engines shall be determined in such a way that the aeroplane clears all obstacles by a vertical distance of at least 50 ft, or by a horizontal distance of at least 90 m plus 0.125 × D, where D is the horizontal distance travelled by the aeroplane from the end of the TODA or the end of the take-off distance if a turn is scheduled before the end of the TODA, except as provided in (b) and (c). For aeroplanes with a wingspan of less than 60 m, a horizontal obstacle clearance of half the aeroplane wingspan plus 60 m plus 0.125 × D may be used. It shall be assumed that:

(1) the take-off flight path begins at a height of 50 ft above the surface at the end of the take-off distance required by Chapter 3 3.2 (b) and ends at a height of 1 500 ft above the surface;

(2) The aeroplane is not banked before the aeroplane has reached a height of 50 ft above the surface, and thereafter the angle of bank does not exceed 15°;

(3) Failure of the critical engine occurs at the point on the all engine take-off flight path where visual reference for the purpose of avoiding obstacles is expected to be lost;

(4) the gradient of the take-off flight path from 50 ft to the assumed engine failure height is equal to the average all-engines gradient during climb and transition to the en-route configuration, multiplied by a factor of 0.77; and

(5) the gradient of the take-off flight path from the height reached in accordance with (a)(4) to the end of the take-off flight path is equal to the OEI en-route climb gradient shown in the AFM.

(b) For cases where the intended flight path does not require track changes of more than 15°, the operator does not need to consider those obstacles that have a lateral distance greater than:

(1) 300 m, if the flight is conducted under conditions allowing visual course guidance navigation, or if navigational aids are available enabling the pilot to maintain the intended flight path with the same accuracy; or

(2) 600 m, for flights under all other conditions.

(c) For cases where the intended flight path requires track changes of more than 15°, the operator does not need to consider those obstacles that have a lateral distance greater than:

(1) 600 m, for flights under conditions allowing visual course guidance navigation; or

(2) 900 m, for flights under all other conditions.

(d) When showing compliance with (a) to (c), the following shall be taken into account:

(1) The mass of the aeroplane at the commencement of the take-off run;

(2) The pressure altitude at the aerodrome;

(3) The ambient temperature at the aerodrome; and

(4) Not more than 50% of the reported headwind component or not less than 150% of the reported tailwind component.

AMC 1 to 3.3 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).

AMC 2 to 3.3 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 CHAPTER 3 3.3 is already included where:

Y300 = average all-engines gradient from 50 ft to 300 ft;

YERC = scheduled all engines en-route gross climb gradient;

VERC = en-route climb speed, all engines knots true airspeed (TAS);

V2 = 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 Chapter 3 3.3 is already included where:

Y200 = average all-engines gradient from 50 ft to 200 ft;

YERC = scheduled all engines en-route gross climb gradient;

VERC = en-route climb speed, all engines, knots TAS;

V2 = 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 enroute 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.

GM 1 to 3.3 Take-off obstacle clearance – multi-engined aeroplanes

OBSTACLE CLEARANCE IN LIMITED VISIBILITY

(a) Unlike the airworthiness codes applicable for performance class an 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 Chapter 3 3.3. 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.

GM 2 to 3.3 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 Chapter 3 3.3. 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 – 1000 m;

– Take-off speed, V2 – 90 Kts;

– en-route climb speed, VERC – 120 Kts;

– en-route all-engines climb gradient, YERC – 0.2;

– en-route OEI climb gradient, YERC-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 CHAPTER 3 3.3 is already included where:

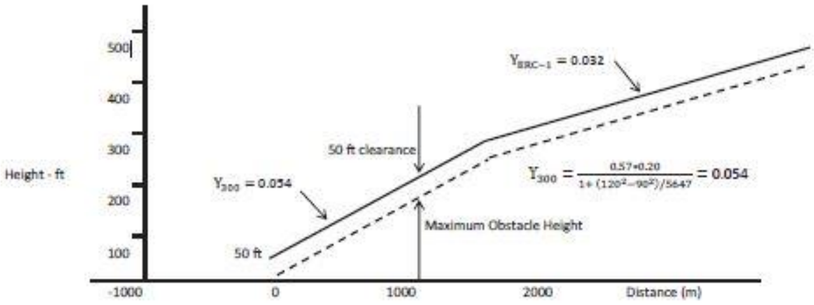
Y300 = average all-engines gradient from 50 ft to 300 ft;

YERC = scheduled all engines en-route gross climb gradient;

VERC = en-route climb speed, all engines knots TAS; and

V2 = 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 Chapter 3 3.3 is already included where:

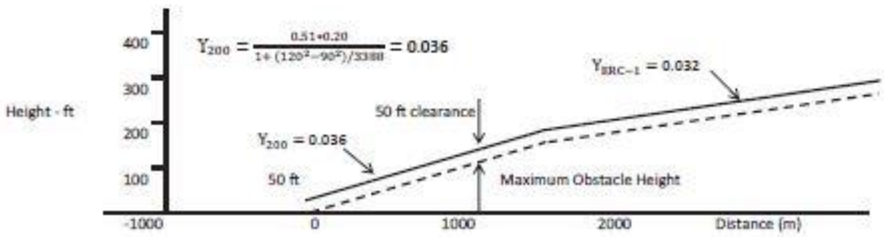
Y200 = average all-engines gradient from 50 ft to 200 ft;

YERC = scheduled all engines en-route gross gradient;

VERC = en-route climb speed, all engines, knots TAS; and

V2 = take-off speed at 50 ft, knots TAS.

Figure 2: Assumed engine failure height 200 ft



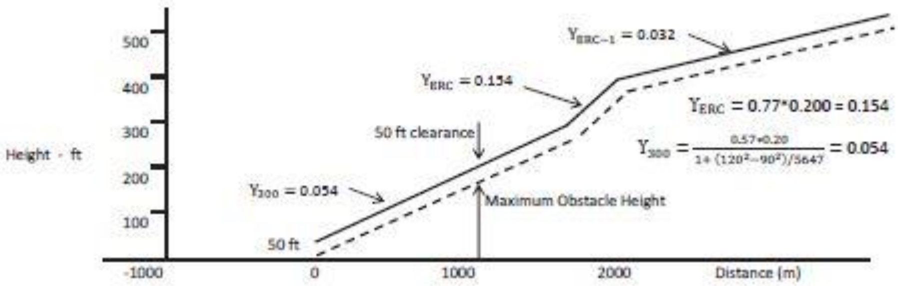
(3) Assumed engine failure height less than 200 ft

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



3.4. En-route — multi-engined aeroplanes

(a) The aeroplane, in the meteorological conditions expected for the flight and in the event of the failure of one engine, with the remaining engines operating within the maximum continuous power conditions specified, shall be capable of continuing flight at or above the relevant minimum altitudes for safe flight stated in the operations manual to a point of 1000 ft above an aerodrome at which the performance requirements can be met.

(b) It shall be assumed that, at the point of engine failure:

(1) the aeroplane is not flying at an altitude exceeding that at which the rate of climb equals 300 ft per minute with all engines operating within the maximum continuous power conditions specified; and

(2) The en-route gradient with OEI shall be the gross gradient of descent or climb, as appropriate, respectively increased by a gradient of 0.5%, or decreased by a gradient of 0.5%.

GM 1 to 3.4 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 drift down procedure can be planned to start.

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

3.5. En-route — single-engined aeroplanes

(a) In the meteorological conditions expected for the flight, and in the event of engine failure, the aeroplane shall be capable of reaching a place at which a safe forced landing can be made.

(b) It shall be assumed that, at the point of engine failure:

(1) the aeroplane is not flying at an altitude exceeding that at which the rate of climb equals 300 ft per minute, with the engine operating within the maximum continuous power conditions specified; and

(2) The en-route gradient is the gross gradient of descent increased by a gradient of 0.5%.

AMC 1 to 3.5 En-route – single-engined aeroplanes

ENGINE FAILURE

Chapter 3 3.5 (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 authority, this point should be 1000 ft above the intended landing area.

GM 1 to 3.5 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.

3.6. Landing — destination and alternate aerodromes

The landing mass of the aeroplane determined in accordance with Chapter 1 1.2 (a) shall not exceed the maximum landing mass specified for the altitude and the ambient temperature expected at the estimated time of landing at the destination aerodrome and alternate aerodrome.

AMC 1 to 3.6 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.

3.7. Landing — dry runways

(a) The landing mass of the aeroplane determined in accordance with Chapter 1 1.2 (a) for the estimated time of landing at the destination aerodrome and at any alternate aerodrome shall allow a full stop landing from 50 ft above the threshold within 70% of the LDA taking into account:

(1) The altitude at the aerodrome;

(2) Not more than 50% of the headwind component or not less than 150% of the tailwind component;

(3) The runway surface condition and the type of runway surface; and

(4) The runway slope in the direction of landing.

(b) For steep approach operations, the operator shall use landing distance data factored in accordance with (a) based on a screen height of less than 60 ft, but not less than 35 ft, and comply with Chapter 3 3.10.

(c) For short landing operations, the operator shall use landing distance data factored in accordance with (a) and comply with Chapter 3 3.11.

(d) For dispatching the aeroplane in accordance with (a) to (c), it shall be assumed that:

(1) The aeroplane will land on the most favourable runway, in still air; and

(2) The aeroplane will land on the runway most likely to be assigned considering the probable wind speed and direction, the ground handling characteristics of the aeroplane and other conditions such as landing aids and terrain.

(e) If the operator is unable to comply with (d) (2) for the destination aerodrome, the aeroplane shall only be dispatched if an alternate aerodrome is designated that permits full compliance with (a) to (d).

AMC 1 to 3.7 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 Chapter 3 3.7 (a).

Table 1: to 3.7 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.

AMC 2 to 3.7 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.

GM 1 to 3.7 Landing – dry runways

LANDING MASS

Chapter 3 3.7 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.

3.8. Landing — wet and contaminated runways

(a) When the appropriate weather reports and/or forecasts indicate that the runway at the estimated time of arrival may be wet, the LDA shall be equal to or exceed the required landing distance, determined in accordance with Chapter 3 3.7, multiplied by a factor of 1.15.

(b) When the appropriate weather reports and/or forecasts indicate that the runway at the estimated time of arrival may be contaminated, the landing distance shall not exceed the LDA. The operator shall specify in the operations manual the landing distance data to be applied.

(c) A landing distance on a wet runway shorter than that required by (a), but not less than that required by Chapter 3 3.7 (a), may be used if the AFM includes specific additional information about landing distances on wet runways.

GM 1 to 3.8 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.

3.9. Take-off and landing climb requirements

The operator of a two-engined aeroplane shall fulfil the following take-off and landing climb requirements.

(a) Take-off climb

- (1) All engines operating
  - (i) The steady gradient of climb after take-off shall be at least 4% with:
    - (A) take-off power on each engine;
    - (B) The landing gear extended, except that if the landing gear can be retracted in not more than 7 seconds, it may be assumed to be retracted;
    - (C) The wing flaps in the take-off position(s); and
    - (D) A climb speed not less than the greater of 1.1 VMC (minimum control speed on or near ground) and 1.2 VS1 (stall speed or minimum steady flight speed in the landing configuration).
- (2) OEI
  - (i) The steady gradient of climb at an altitude of 400 ft above the take-off surface shall be measurably positive with:
    - (A) The critical engine inoperative and its propeller in the minimum drag position;
    - (B) The remaining engine at take-off power;
    - (C) The landing gear retracted;
    - (D) The wing flaps in the take-off position(s); and
    - (E) A climb speed equal to that achieved at 50 ft.
  - (ii) The steady gradient of climb shall be not less than 0.75% at an altitude of 1 500 ft above the take-off surface with:
    - (A) The critical engine inoperative and its propeller in the minimum drag position;
    - (B) The remaining engine at not more than maximum continuous power;
    - (C) The landing gear retracted;
    - (D) The wing flaps retracted; and
    - (E) A climb speed not less than 1.2 VS1.

(b) Landing climb

- (1) All engines operating
  - (i) The steady gradient of climb shall be at least 2.5% with:

(A) Not more than the power or thrust that is available 8 seconds after initiation of movement of the power controls from the minimum flight idle position;

(B) The landing gear extended;

(C) The wing flaps in the landing position; and

(D) A climb speed equal to VREF (reference landing speed).

(2) OEI

(i) The steady gradient of climb shall be not less than 0.75% at an altitude of 1 500 ft above the landing surface with:

(A) The critical engine inoperative and its propeller in the minimum drag position;

(B) The remaining engine at not more than maximum continuous power;

(C) The landing gear retracted;

(D) The wing flaps retracted; and

(E) A climb speed not less than 1.2 VS1.

3.10. Approval of steep approach operations

(a) Steep approach operations using glideslope angles of 4.5° or more and with screen heights of less than 60 ft, but not less than 35 ft, require prior approval by the authority.

(b) To obtain the approval, the operator shall provide evidence that the following conditions are met:

(1) the AFM states the maximum approved glideslope angle, any other limitations, normal, abnormal or emergency procedures for the steep approach as well as amendments to the field length data when using steep approach criteria; and

(2) For each aerodrome at which steep approach operations are to be conducted:

(i) A suitable glide path reference system, comprising at least a visual glide path indicating system, is available;

(ii) Weather minima are specified; and

(iii) The following items are taken into consideration:

(A) The obstacle situation;

(B) The type of glide path reference and runway guidance;

(C) The minimum visual reference to be required at DH and MDA;

(D) Available airborne equipment;

(E) Pilot qualification and special aerodrome familiarisation;

(F) AFM limitations and procedures; and

(G) Missed approach criteria.

3.11. Approval of short landing operations

(a) Short landing operations require prior approval by the authority.

(b) To obtain the approval, the operator shall provide evidence that the following conditions are met:

(1) The distance used for the calculation of the permitted landing mass may consist of the usable length of the declared safe area plus the declared LDA;

(2) The use of the declared safe area is approved by the State of the aerodrome;

(3) the declared safe area is clear of obstructions or depressions that would endanger an aeroplane undershooting the runway and no mobile object is permitted on the declared safe area while the runway is being used for short landing operations;

(4) The slope of the declared safe area does not exceed 5% upward nor 2% downward slope in the direction of landing;

(5) The usable length of the declared safe area does not exceed 90 m;

(6) The width of the declared safe area is not less than twice the runway width, centred on the extended runway centre line;

(7) The crossing height over the beginning of the usable length of the declared safe area is not less than 50 ft;

(8) Weather minima are specified for each runway to be used and are not less than the greater of VFR or NPA minima;

(9) Pilot experience, training and special aerodrome familiarisation requirements are specified and met;

(10) Additional conditions, if specified by the authority, taking into account the aeroplane type characteristics, orographic characteristics in the approach area, available approach aids and missed approach/balked landing considerations.

Chapter 4 — Performance class C

'Performance class C aeroplanes' means aeroplanes powered by reciprocating engines with an MOPSC of more than nine or a maximum take-off mass exceeding 5 700 kg.

4.1. Take-off

(a) The take-off mass shall not exceed the maximum take-off mass specified in the AFM for the pressure altitude and the ambient temperature at the aerodrome of departure.

(b) For aeroplanes that have take-off field length data contained in their AFM that do not include engine failure accountability, the distance from the start of the take-off roll required by the aeroplane to reach a height of 50 ft above the surface with all engines operating within the maximum take-off power conditions specified, when multiplied by a factor of either:

(1) 1.33 for aeroplanes having two engines;

(2) 1.25 for aeroplanes having three engines; or

(3) 1.18 for aeroplanes having four engines,

Shall not exceed the take-off run available (TORA) at the aerodrome at which the take-off is to be made.

(c) For aeroplanes that have take-off field length data contained in their AFM which accounts for engine failure, the following requirements shall be met in accordance with the specifications in the AFM:

(1) The accelerate-stop distance shall not exceed the ASDA;

(2) The take-off distance shall not exceed the take-off distance available (TODA), with a clearway distance not exceeding half of the TORA;

(3) The take-off run shall not exceed the TORA;

(4) A single value of V1 for the rejected and continued take-off shall be used; and

(5) On a wet or contaminated runway the take-off mass shall not exceed that permitted for a take-off on a dry runway under the same conditions.

(d) The following shall be taken into account:

(1) The pressure altitude at the aerodrome;

(2) The ambient temperature at the aerodrome;

(3) The runway surface condition and the type of runway surface;

(4) The runway slope in the direction of take-off;

(5) Not more that 50% of the reported headwind component or not less than 150% of the reported tailwind component; and

(6) The loss, if any, of runway length due to alignment of the aeroplane prior to take-off.

AMC 1 to 4.1 Take-off

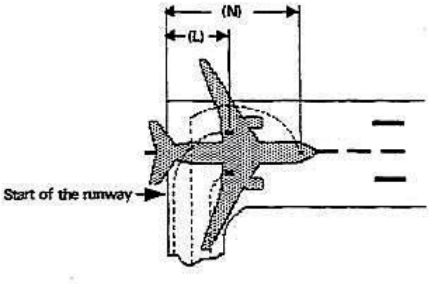
LOSS OF RUNWAY LENGTH DUE TO ALIGNMENT

(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

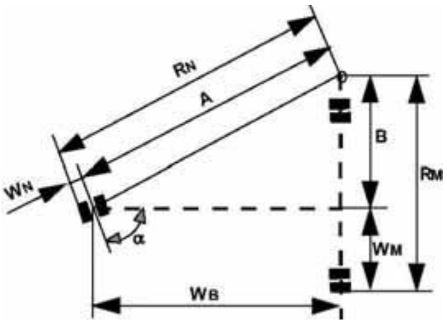
(2) The minimum distance of the most forward wheel(s) from the start of the runway for determining ASDA, 'N'.

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:

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

RM = B + WM = WB tan (90°-α) + 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

WM = wheel base

α = steering angle.

AMC 2 to 4.1 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 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 %.

GM 1 to 4.1 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 Pilot in Command 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.

4.2. Take-off obstacle clearance

(a) The take-off flight path with OEI shall be determined such that the aeroplane clears all obstacles by a vertical distance of at least 50 ft plus 0.01 × D, or by a horizontal distance of at least 90 m plus 0.125 × D, where D is the horizontal distance the aeroplane has travelled from the end of the TODA. For aeroplanes with a wingspan of less than 60 m, a horizontal obstacle clearance of half the aeroplane wingspan plus 60 m plus 0.125 × D may be used.

(b) The take-off flight path shall begin at a height of 50 ft above the surface at the end of the take-off distance required by Chapter 4 4.2 (b) or (c), as applicable, and end at a height of 1500 ft above the surface.

(c) When showing compliance with (a), the following shall be taken into account:

(1) The mass of the aeroplane at the commencement of the take-off run;

(2) The pressure altitude at the aerodrome;

(3) The ambient temperature at the aerodrome; and

(4) Not more than 50% of the reported headwind component or not less than 150% of the reported tailwind component.

(d) Track changes shall not be allowed up to that point of the take-off flight path where a height of 50 ft above the surface has been achieved. Thereafter, up to a height of 400 ft it is assumed that the aeroplane is banked by no more than 15°. Above 400 ft height bank angles greater than 15°, but not more than 25°, may be scheduled. Adequate allowance shall be made for the effect of bank angle on operating speeds and flight path, including the distance increments resulting from increased operating speeds.

(e) For cases that do not require track changes of more than 15°, the operator does not need to consider those obstacles that have a lateral distance greater than:

(1) 300 m, if the pilot is able to maintain the required navigational accuracy through the obstacle accountability area; or

(2) 600 m, for flights under all other conditions.

(f) For cases that do require track changes of more than 15°, the operator does not need to consider those obstacles that have a lateral distance greater than:

(1) 600 m, if the pilot is able to maintain the required navigational accuracy through the obstacle accountability area; or

(2) 900 m, for flights under all other conditions.

(g) The operator shall establish contingency procedures to satisfy (a) to (f) and to provide a safe route, avoiding obstacles, to enable the aeroplane to either comply with the en-route requirements of Chapter 4 4.3, or land at either the aerodrome of departure or at a take-off alternate aerodrome.

AMC 1 to 4.2 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

Bank	Speed	Gradient correction
15°	V2	1 x AFM 15° gradient loss
20°	V2 + 5 Kts	2 x AFM 15° gradient loss
25°	V2 + 10 Kts	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.

AMC 2 to 4.2 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.

4.3. En-route — all engines operating

(a) In the meteorological conditions expected for the flight, at any point on its route or on any planned diversion therefrom, the aeroplane shall be capable of a rate of climb of at least 300 ft per minute with all engines operating within the maximum continuous power conditions specified at:

(1) the minimum altitudes for safe flight on each stage of the route to be flown, or of any planned diversion therefrom, specified in or calculated from the information contained in the operations manual relating to the aeroplane; and

(2) The minimum altitudes necessary for compliance with the conditions prescribed in Chapter 4 4.4 and Chapter 4 4.5, as appropriate.

4.4. En-route — OEI

(a) In the meteorological conditions expected for the flight, in the event of any one engine becoming inoperative at any point on its route or on any planned diversion therefrom and with the other engine(s) operating within the maximum continuous power conditions specified, the aeroplane shall be capable of continuing the flight from the cruising altitude to an aerodrome where a landing can be made in accordance with Chapter 4 4.7 or Chapter 4 4.8, as appropriate. The aeroplane shall clear obstacles within 9.3 km (5 NM) either side of the intended track by a vertical interval of at least:

(1) 1000 ft, when the rate of climb is zero or greater; or

(2) 2000 ft, when the rate of climb is less than zero.

(b) The flight path shall have a positive slope at an altitude of 450 m (1500 ft) above the aerodrome where the landing is assumed to be made after the failure of one engine.

(c) The available rate of climb of the aeroplane shall be taken to be 150 ft per minute less than the gross rate of climb specified.

(d) The width margins of (a) shall be increased to 18.5 km (10 NM) if the navigational accuracy does not meet at least RNP5.

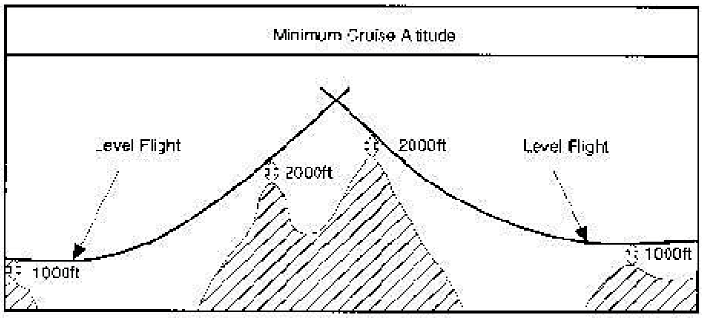
(e) Fuel jettisoning is permitted to an extent consistent with reaching the aerodrome with the required fuel reserves, if a safe procedure is used.

AMC 1 to 4.4 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 1000 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 2000 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



4.5. En-route — aeroplanes with three or more engines, two engines inoperative

(a) At no point along the intended track shall an aeroplane having three or more engines be more than 90 minutes, at the all-engines long range cruising speed at standard temperature in still air, away from an aerodrome at which the performance requirements applicable at the expected landing mass are met, unless it complies with (b) to (e).

(b) The two-engines-inoperative flight path shall permit the aeroplane to continue the flight, in the expected meteorological conditions, clearing all obstacles within 9.3 km (5 NM) either side of the intended track by a vertical interval of at least 2000 ft, to an aerodrome at which the performance requirements applicable at the expected landing mass are met.

(c) The two engines are assumed to fail at the most critical point of that portion of the route where the aeroplane is more than 90 minutes, at the all-engines long range cruising speed at standard temperature in still air, away from an aerodrome at which the performance requirements applicable at the expected landing mass are met.

(d) The expected mass of the aeroplane at the point where the two engines are assumed to fail shall not be less than that which would include sufficient fuel to proceed to an aerodrome where the landing is assumed to be made, and to arrive there at an altitude of a least 450 m (1 500 ft) directly over the landing area and thereafter to fly level for 15 minutes.

(e) The available rate of climb of the aeroplane shall be taken to be 150 ft per minute less than that specified.

(f) The width margins of (b) shall be increased to 18.5 km (10 NM) if the navigational accuracy does not meet at least RNP5.

(g) Fuel jettisoning is permitted to an extent consistent with reaching the aerodrome with the required fuel reserves, if a safe procedure is used.

4.6. Landing — destination and alternate aerodromes

The landing mass of the aeroplane determined in accordance with Chapter 1 1.2 (a) shall not exceed the maximum landing mass specified in the AFM for the altitude and, if accounted for in the AFM, the ambient temperature expected for the estimated time of landing at the destination aerodrome and alternate aerodrome.

AMC 1 to 4.6 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.

4.7. Landing — dry runways

(a) The landing mass of the aeroplane determined in accordance with Chapter 1 1.2 (a) for the estimated time of landing at the destination aerodrome and any alternate aerodrome shall allow a full stop landing from 50 ft above the threshold within 70% of the LDA taking into account:

(1) The altitude at the aerodrome;

(2) Not more than 50% of the headwind component or not less than 150% of the tailwind component;

(3) The type of runway surface; and

(4) The slope of the runway in the direction of landing.

(b) For dispatching the aeroplane it shall be assumed that:

(1) The aeroplane will land on the most favourable runway in still air; and

(2) The aeroplane will land on the runway most likely to be assigned considering the probable wind speed and direction, the ground handling characteristics of the aeroplane and other conditions such as landing aids and terrain.

(c) If the operator is unable to comply with (b) (2) for the destination aerodrome, the aeroplane shall only be dispatched if an alternate aerodrome is designated that permits full compliance with (a) and (b).

AMC 1 to 4.7 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 Chapter 4 4.7.

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.

AMC 2 to 4.7 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.

GM 1 to 4.7 Landing – dry runways

LANDING MASS

Chapter 4 4.7 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.

4.8. Landing — wet and contaminated runways

(a) When the appropriate weather reports and/or forecasts indicate that the runway at the estimated time of arrival may be wet, the LDA shall be equal to or exceed the required landing distance, determined in accordance with Chapter 4 4.7 , multiplied by a factor of 1.15.

(b) When the appropriate weather reports and/or forecasts indicate that the runway at the estimated time of arrival may be contaminated, the landing distance shall not exceed the LDA. The operator shall specify in the operations manual the landing distance data to be applied.

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Section 2 — Helicopters

Chapter 1 — General requirements

1.0 CATEGORY A AND CATEGORY B

(a) Helicopters that have been certified according to any of the following standards are considered to satisfy the Category a criteria. Provided that they have the necessary performance information scheduled in the AFM, such helicopters are therefore eligible for performance class 1 or 2 operations:

(1) Certification as Category A under CS-27 or CS-29;

(2) Certification as Category A under JAR-27 or JAR-29;

(3) Certification as Category A under FAR Part 29;

(4) Certification as group A under BCAR Section G; and

(5) Certification as group A under BCAR-29.

(b) In addition to the above, certain helicopters have been certified under FAR Part 27 and with compliance with FAR Part 29 engine isolation requirements as specified in FAA Advisory Circular AC 27-1. Provided that compliance is established with the following additional requirements of CS-29:

(1) CS 29.1027(a) Independence of engine and rotor drive system lubrication;

(2) CS 29.1187(e);

(3) CS 29.1195(a) & (b) Provision of a one-shot fire extinguishing system for each engine;

(i) The requirement to fit a fire extinguishing system may be waived if the helicopter manufacturer can demonstrate equivalent safety, based on service experience for the entire fleet showing that the actual incidence of fires in the engine fire zones has been negligible.

(4) CS 29.1197;

(5) CS 29.1199;

(6) CS 29.1201; and

(7) CS 29.1323(c)(1) Ability of the airspeed indicator to consistently identify the take-off decision point, these helicopters are considered to satisfy the requirement to be certified as equivalent to Category A.

(c) The performance operating rules of JAR-OPS 3, which were transposed into this Part, were drafted in conjunction with the performance requirements of JAR-29 Issue 1 and FAR Part 29 at amendment 29-39. For helicopters certificated under FAR Part 29 at an earlier amendment, or under BCAR section G or BCAR-29, performance data will have been scheduled in the AFM according to these earlier requirements.

(d) Before any AOC is issued under which performance class 1 or 2 operations are conducted, it should be established that scheduled performance data are available that are compatible with the requirements of performance class 1 and 2 respectively.

(e) Any properly certified helicopter is considered to satisfy the Category B criteria. If appropriately equipped (in accordance with ANR 23), such helicopters are therefore eligible for performance class 3 operations.

1.1. Applicability

(a) Helicopters shall be operated in accordance with the applicable performance class requirements.

(b) Helicopters shall be operated in performance class 1:

(1) When operated to/from aerodromes or operating sites located in a congested hostile environment; or

(2) When having an MOPSC of more than 19, except when operated to/from a helideck in performance class 2 under an approval in accordance with Chapter 3.1.

(c) Unless otherwise prescribed by (b), helicopters that have an MOPSC of 19 or less but more than nine shall be operated in performance class 1 or 2.

(d) Unless otherwise prescribed by (b), helicopters that have an MOPSC of nine or less shall be operated in performance class 1, 2 or 3.

1.2. General

(a) The mass of the helicopter:

(1) At the start of the take-off; or

(2) in the event of in-flight replanning, at the point from which the revised operational flight plan applies, shall not be greater than the mass at which the applicable requirements of this Section can be complied with for the flight to be undertaken, taking into account expected reductions in mass as the flight proceeds and such fuel jettisoning as is provided for in the relevant requirement.

(b) The approved performance data contained in the AFM shall be used to determine compliance with the requirements of this Section, supplemented as necessary with other data as prescribed in the relevant requirement. The operator shall specify such other data in the operations manual. When applying the factors prescribed in this Section, account may be taken of any operational factors already incorporated in the AFM performance data to avoid double application of factors.

(c) When showing compliance with the requirements of this Section, account shall be taken of the following parameters:

(1) Mass of the helicopter;

(2) The helicopter configuration;

(3) The environmental conditions, in particular:

(I) pressure altitude and temperature;

(ii) Wind:

(A) except as provided in (C), for take-off , take-off flight path and landing requirements, accountability for wind shall be no more than 50% of any reported steady headwind component of 5 Kts or more;

(B) where take-off and landing with a tailwind component is permitted in the AFM, and in all cases for the take-off flight path, not less than 150% of any reported tailwind component shall be taken into account; and

(C) where precise wind measuring equipment enables accurate measurement of wind velocity over the point of take-off and landing, wind components in excess of 50% may be established by the operator, provided that the operator demonstrates to the authority that the proximity to the FATO and accuracy enhancements of the wind measuring equipment provide an equivalent level of safety;

(4) The operating techniques; and

(5) The operation of any systems that have an adverse effect on performance.

GM to 1.2(c) (3) (ii) (A) General

REPORTED HEADWIND COMPONENT

The reported headwind component should be interpreted as being that reported at the time of flight planning and may be used, provided there is no significant change of unfactored wind prior to take-off.

1.3. Obstacle accountability

(a) For the purpose of obstacle clearance requirements, an obstacle located beyond the FATO, in the take-off flight path, or the missed approach flight path shall be considered if its lateral distance from the nearest point on the surface below the intended flight path is not further than the following:

(1) For operations under VFR:

(i) Half of the minimum width defined in the AFM — or, when no width is defined, '0.75 × D', where D is the largest dimension of the helicopter when the rotors are turning;

(ii) Plus, the greater of '0.25 × D' or '3 m';

(iii) Plus:

(A) 0.10 × distance DR for operations under VFR by day; or

(B) 0.15 × distance DR for operations under VFR at night.

(2) For operations under IFR:

(i) '1.5 D' or 30 m, whichever is greater, plus:

(A) 0.10 × distance DR, for operations under IFR with accurate course guidance;

(B) 0.15 × distance DR, for operations under IFR with standard course guidance; or

(C) 0.30 × distance DR for operations under IFR without course guidance.

(ii) When considering the missed approach flight path, the divergence of the obstacle accountability area only applies after the end of the take-off distance available.

(3) For operations with initial take-off conducted visually and converted to IFR/IMC at a transition point, the criteria required in (1) apply up to the transition point, and the criteria required in (2) apply after the transition point. The transition point cannot be located before the end of the take-off distance required for helicopters (TODRH) operating in performance class 1 or before the defined point after take-off (DPATO) for helicopters operating in performance class 2.

(b) For take-off using a back-up or a lateral transition procedure, for the purpose of obstacle clearance requirements, an obstacle located in the back-up or lateral transition area shall be considered if its lateral distance from the nearest point on the surface below the intended flight path is not further than:

(1) Half of the minimum width defined in the AFM or, when no width is defined, '0.75 × D';

(2) Plus the greater of '0.25 × D' or '3 m';

(3) Plus:

(i) For operations under VFR by day 0.10 × the distance travelled from the back of the FATO, or

(ii) For operations under VFR at night 0.15 × the distance travelled from the back of the FATO.

(c) Obstacles may be disregarded if they are situated beyond:

(1) 7 × rotor radius (R) for day operations, if it is assured that navigational accuracy can be achieved by reference to suitable visual cues during the climb;

(2) 10 × R for night operations, if it is assured that navigational accuracy can be achieved by reference to suitable visual cues during the climb;

(3) 300 m if navigational accuracy can be achieved by appropriate navigation aids; or

(4) 900 m in all other cases.

GM1 to Chapter 1.3 (a) (2) (i) Obstacle accountability

COURSE GUIDANCE

Standard course guidance includes automatic direction finder (ADF) and VHF omnidirectional radio range (VOR) guidance. Accurate course guidance includes ILS, MLS or other course guidance providing an equivalent navigational accuracy.

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Chapter 2 — Performance class 1

2.1 General

Helicopters operated in performance class 1 shall be certified in Category A or equivalent as determined by the Authority.

2.2 Take-off

(a) The take-off mass shall not exceed the maximum take-off mass specified in the AFM for the procedure to be used.

(b) The take-off mass shall be such that:

(1) It is possible to reject the take-off and land on the FATO in case of the critical engine failure being recognised at or before the take-off decision point (TDP);

(2) The rejected take-off distance required (RTODRH) does not exceed the rejected take-off distance available (RTODAH); and

(3) The TODRH does not exceed the take-off distance available (TODAH).

(4) Notwithstanding (b)(3), the TODRH may exceed the TODAH if the helicopter, with the critical engine failure recognised at TDP can, when continuing the take-off , clear all obstacles to the end of the TODRH by a vertical margin of not less than 10.7 m (35 ft).

(c) When showing compliance with (a) and (b), account shall be taken of the appropriate parameters of Chapter 1 1.2 (c) at the aerodrome or operating site of departure.

(d) That part of the take-off up to and including TDP shall be conducted in sight of the surface such that a rejected take-off can be carried out.

(e) For take-off using a backup or lateral transition procedure, with the critical engine failure recognition at or before the TDP, all obstacles in the back-up or lateral transition area shall be cleared by an adequate margin.

AMC 1 to 2.2(b) (4) Take-off

THE APPLICATION OF TODRH

The selected height should be determined with the use of AFM data, and be at least 10.7 m (35 ft) above:

(a) The take-off surface; or

(b) As an alternative, a level height defined by the highest obstacle in the take-off distance required.

GM 1 to 2.2(b) (4) Take-off

THE APPLICATION OF TODRH

(a) Introduction

Original definitions for helicopter performance were derived from aeroplanes; hence the definition of take-off distance owes much to operations from runways. Helicopters on the other hand can operate from runways, confined and restricted areas and rooftop FATOs – all bounded by obstacles. As an analogy this is equivalent to a take-off from a runway with obstacles on and surrounding it. It can therefore be seen that unless the original definitions from aeroplanes are tailored for helicopters, the flexibility of the helicopter might be constrained by the language of operational performance. This GM concentrates on the critical term – take-off distance required (TODRH) – and describes the methods to achieve compliance with it and, in particular, the alternative procedure described in ICAO Annex 6 Attachment a 4.1.1.3:

(1) The take-off distance required does not exceed the take-off distance available; or

(2) as an alternative, the take-off distance required may be disregarded provided that the helicopter with the critical engine failure recognised at TDP can, when continuing the take-off, clear all obstacles between the end of the take-off distance available and the point at which it becomes established in a climb at VTOSS by a vertical margin of 10.7 m (35 ft) or more. An obstacle is considered to be in the path of the helicopter if its distance from the nearest point on the surface below the intended line of flight does not exceed 30 m or 1.5 times the maximum dimension of the helicopter, whichever is greater.

(b) Definition of TODRH

The definition of TODRH from Annex I is as follows:

'Take-off distance required (TODRH)' in the case of helicopters means the horizontal distance required from the start of the take-off to the point at which take-off safety speed (V_{TOSS}), a selected height and a positive climb gradient are achieved, following failure of the critical engine being recognised at the TDP, the remaining engines operating within approved operating limits.

AMC 1 to 2.2(b) (4) states how the specified height should be determined.

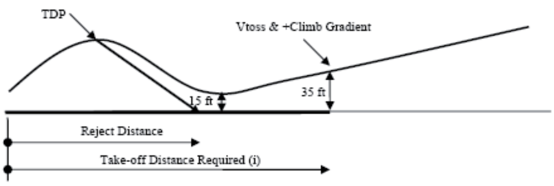
The original definition of TODRH was based only on the first part of this definition.

(c) The clear area procedure (runway)

In the past, helicopters certified in Category A would have had, at the least, a 'clear area' procedure. This procedure is analogous to an aeroplane Category A procedure and assumes a runway (either metaled or grass) with a smooth surface suitable for an aeroplane take-off (see Figure 1).

The helicopter is assumed to accelerate down the FATO (runway) outside of the height velocity (HV) diagram. If the helicopter has an engine failure before TDP, it must be able to land back on the FATO (runway) without damage to helicopter or passengers; if there is a failure at or after TDP the aircraft is permitted to lose height – providing it does not descend below a specified height above the surface (usually 15 ft if the TDP is above 15 ft). Errors by the pilot are taken into consideration but the smooth surface of the FATO limits serious damage if the error margin is eroded (e.g. by a change of wind conditions).

Figure 1: Clear Area take – off



The operator only has to establish that the distances required are within the distance available (take-off distance and reject distance). The original definition of TODRH meets this case exactly.

From the end of the TODRH obstacle clearance is given by the climb gradient of the first or second climb segment meeting the requirement of Chapter 2.3 (or for performance class 2 (PC2): Chapter 3.3). The clearance margin from obstacles in the take-off flight path takes account of the distance travelled from the end of the take-off distance required and operational conditions (IMC or VMC).

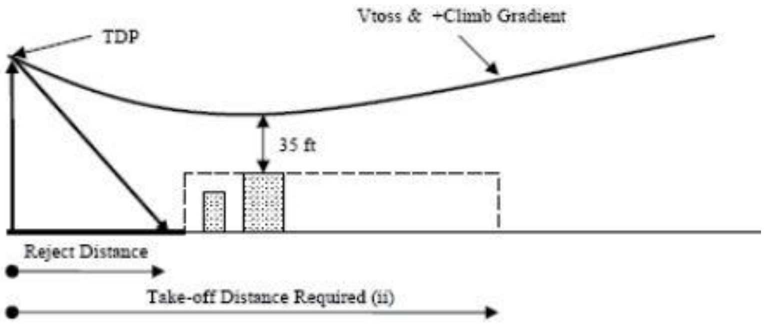
(d) Category a procedures other than clear area Procedures other than the clear area are treated somewhat differently. However, the short field procedure is somewhat of a hybrid as either (a) or (b) of AMC1 to 2.2(b)(4) can be utilised (the term 'helipad' is used in the following section to illustrate the principle only, it is not intended as a replacement for 'aerodrome' or 'FATO').

(1) Limited area, restricted area and helipad procedures (other than elevated)

The exact names of the procedure used for other than clear area are as many as there are manufacturers. However, principles for obstacle clearance are generic and the name is unimportant.

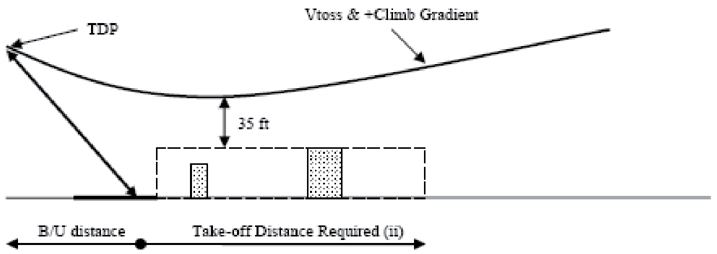
These procedures (see Figure 2 and Figure 3) are usually associated with an obstacle in the continued take-off area – usually shown as a line of trees or some other natural obstacle. As clearance above such obstacles is not readily associated with an accelerative procedure, as described in (c), a procedure using a vertical climb (or a steep climb in the forward, sideways or rearward direction) is utilised.

Figure 2: Short Field take – off



With the added complication of a TDP principally defined by height together with obstacles in the continued take off area, a drop down to within 15 ft of the take-off surface is not deemed appropriate and the required obstacle clearance is set to 35 ft (usually called min-dip). The distance to the obstacle does not need to be calculated (provided it is outside the rejected distance required), as clearance above all obstacles is provided by ensuring that helicopter does not descend below the min-dip associated with a level defined by the highest obstacle in the continued take-off area.

Figure 3: Helipad take – off



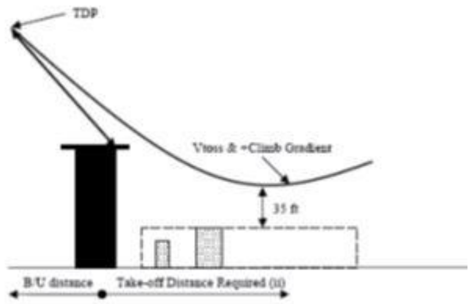
These procedures depend upon (b) of AMC 1 2.2(b) (4).

As shown in Figure 3, the point at which VTOSS and a positive rate of climb are met defines the TODRH. Obstacle clearance from that point is assured by meeting the requirement of Chapter 2.3 (or for PC2 – Chapter 3.3). Also shown in Figure 3 is the distance behind the helipad which is the backup distance (B/U distance).

(2) Elevated helipad procedures

The elevated helipad procedure (see Figure 4) is a special case of the ground level helipad procedure discussed above.

Figure 4: Elevate Helipad take – off



The main difference is that drop down below the level of the take-off surface is permitted. In the drop down phase, the Category A procedure ensures deck-edge clearance but, once clear of the deck-edge, the 35 ft clearance from obstacles relies upon the calculation of drop down. Item (b) of AMC1 to 2.2(b) (4) is applied.

Although 35 ft is used throughout the requirements, it may be inadequate at particular elevated FATOs that are subject to adverse airflow effects, turbulence, etc.

AMC 1 2.2(e) Take-off

OBSTACLE CLEARANCE IN THE BACKUP AREA

(a) The requirement in Chapter 2 2.2(e) has been established in order to take into account the following factors:

(1) In the backup: the pilot has few visual cues and has to rely upon the altimeter and sight picture through the front window (if flight path guidance is not provided) to achieve an accurate rearward flight path;

(2) in the rejected take-off : the pilot has to be able to manage the descent against a varying forward speed whilst still ensuring an adequate clearance from obstacles until the helicopter gets in close proximity for landing on the FATO; and

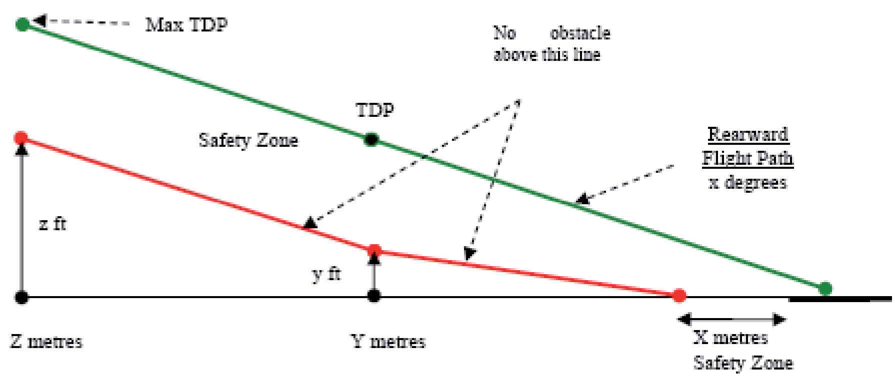
(3) In the continued take-off; the pilot has to be able to accelerate to V_{TOSS} (take-off safety speed for Category A helicopters) whilst ensuring an adequate clearance from obstacles.

(b) The requirements of Chapter 2 2.2(e) may be achieved by establishing that:

(1) In the backup area no obstacles are located within the safety zone below the rearward flight path when described in the AFM (see Figure 1 – in the absence of such data in the AFM, the operator should contact the manufacturer in order to define a safety zone); or

(2) During the backup, the rejected take-off and the continued take-off manoeuvres, obstacle clearance is demonstrated to the authority.

Figure 1: Rearward flight path

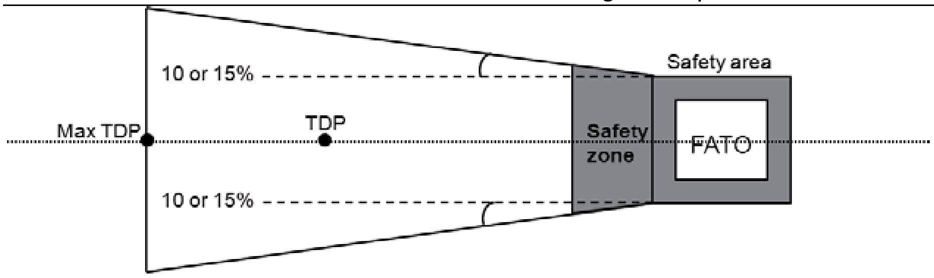


(c) An obstacle, in the backup area, is considered if its lateral distance from the nearest point on the surface below the intended flight path is not further than:

(1) Half of the minimum FATO (or the equivalent term used in the AFM) width defined in the AFM (or, when no width is defined 0.75 D, where D is the largest dimension of the helicopter when the rotors are turning); plus

(2) 0.25 times D (or 3 m, whichever is greater); plus (3) 0.10 for VFR day, or 0.15 for VFR night, of the distance travelled from the back of the FATO (see Figure 2).

Figure 2: Obstacle accountability



AMC 1 to 2.2 & 2.5 Take-off and landing

APPLICATION FOR ALTERNATIVE TAKE-OFF AND LANDING PROCEDURES

(a) A reduction in the size of the take-off surface may be applied when the operator has demonstrated to the authority that compliance with the requirements of Chapters 2.2, 2.3 and 2.5 can be assured with:

(1) A procedure based upon an appropriate Category a take-off and landing profile scheduled in the AFM;

(2) a take-off or landing mass not exceeding the mass scheduled in the AFM for a hover-out-of-ground effect one-engine-inoperative (HOGE OEI) ensuring that:

(i) Following an engine failure at or before TDP, there are adequate external references to ensure that the helicopter can be landed in a controlled manner; and

(ii) Following an engine failure at or after the landing decision point (LDP) there are adequate external references to ensure that the helicopter can be landed in a controlled manner.

(b) An upwards shift of the TDP and LDP may be applied when the operator has demonstrated to the authority that compliance with the requirements of Chapters 2.2, 2.3 and 2.5 can be assured with:

(1) A procedure based upon an appropriate Category a take-off and landing profile scheduled in the AFM;

(2) A take-off or landing mass not exceeding the mass scheduled in the AFM for a HOGE OEI ensuring that:

(i) Following an engine failure at or after TDP compliance with the obstacle clearance requirements of Chapters 2.2(b) (4) and 2.3 can be met; and

(ii) Following an engine failure at or before the LDP the balked landing obstacle clearance requirements of Chapters 2.5 (b) and 2.3 can be met.

(c) The Category a ground level surface area requirement may be applied at a specific elevated FATO when the operator can demonstrate to the authority that the usable cue environment at that aerodrome/ operating site would permit such a reduction in size.

GM 1 2.2 & 2.5 Take-off and landing

APPLICATION FOR ALTERNATIVE TAKE-OFF AND LANDING PROCEDURES

The manufacturer's Category A procedure defines profiles and scheduled data for take-off, climb, performance at minimum operating speed and landing, under specific environmental conditions and masses.

Associated with these profiles and conditions are minimum operating surfaces, take-off distances, climb performance and landing distances; these are provided (usually in graphic form) with the take-off and landing masses and the take-off decision point (TDP) and landing decision point (LDP).

The landing surface and the height of the TDP are directly related to the ability of the helicopter – following an engine failure before or at TDP – to reject onto the surface under forced landing conditions. The main considerations in establishing the minimum size of the landing surface are the scatter during flight testing of the reject manoeuvre, with the remaining engine operating within approved limits, and the required usable cue environment.

Hence, an elevated site with few visual cues – apart from the surface itself – would require a greater surface area in order that the helicopter can be accurately positioned during the reject manoeuvre within the specified area. This usually results in the stipulation of a larger surface for an elevated site than for a ground level site (where lateral cues may be present).

This could have the unfortunate side-effect that a FATO that is built 3 m above the surface (and therefore elevated by definition) might be out of operational scope for some helicopters – even though there might be a rich visual cue environment where rejects are not problematical. The presence of elevated sites where ground level surface requirements might be more appropriate could be brought to the attention of the authority.

It can be seen that the size of the surface is directly related to the requirement of the helicopter to complete a rejected take-off following an engine failure. If the helicopter has sufficient power such that a failure before or at TDP will not lead to a requirement for rejected take-off , the need for large surfaces is removed; sufficient power for the purpose of this GM is considered to be the power required for hover-out-of-ground-effect one-engine in operative (HOGE OEI).

Following an engine failure at or after the TDP, the continued take-off path provides OEI clearance from the take-off surface and the distance to reach a point from where climb performance in the first, and subsequent segments, is assured.

If HOGE OEI performance exists at the height of the TDP, it follows that the continued take-off profile, which has been defined for a helicopter with a mass such that a rejected take-off would be required following an engine failure at or before TDP, would provide the same, or better, obstacle clearance and the same, or less, distance to reach a point where climb performance in the first, and subsequent segments, is assured.

If the TDP is shifted upwards, provided that the HOGE OEI performance is established at the revised TDP, it will not affect the shape of the continued take-off profile but should shift the min-dip upwards by the same amount that the revised TDP has been increased – with respect to the basic TDP.

Such assertions are concerned only with the vertical or the backup procedures and can be regarded as achievable under the following circumstances:

(a) When the procedure is flown, it is based upon a profile contained in the AFM – with the exception of the necessity to perform a rejected take-off;

(b) The TDP, if shifted upwards (or upwards and backward in the backup procedure) will be the height at which the HOGE OEI performance is established; and

(c) If obstacles are permitted in the backup area they should continue to be permitted with a revised TDP.

2.3 Take-off flight path

(a) From the end of the TODRH with the critical engine failure recognised at the TDP:

  (1) The take-off mass shall be such that the take-off flight path provides a vertical clearance, above all obstacles located in the climb path, of not less than 10.7 m (35 ft) for operations under VFR and 10.7 m (35 ft) + 0.01 × distance DR for operations under IFR. Only obstacles as specified in Chapter 1.3 have to be considered.

  (2) Where a change of direction of more than 15° is made, adequate allowance shall be made for the effect of bank angle on the ability to comply with the obstacle clearance requirements. This turn is not to be initiated before reaching a height of 61 m (200 ft) above the take-off surface unless it is part of an approved procedure in the AFM.

(b) When showing compliance with (a), account shall be taken of the appropriate parameters of Chapter 1.2(c) at the aerodrome or operating site of departure.

2.4 En-route — critical engine inoperative

(a) The mass of the helicopter and flight path at all points along the route, with the critical engine inoperative and the meteorological conditions expected for the flight, shall permit compliance with (1), (2) or (3):

  (1) When it is intended that the flight will be conducted at any time out of sight of the surface, the mass of the helicopter permits a rate of climb of at least 50 ft/minute with the critical engine inoperative at an altitude of at least 300 m (1000 ft), or 600 m (2000 ft) in areas of mountainous terrain, above all terrain and obstacles along the route within 9.3 km (5 NM) on either side of the intended track.

  (2) When it is intended that the flight will be conducted without the surface in sight, the flight path permits the helicopter to continue flight from the cruising altitude to a height of 300 m (1000 ft) above a landing site where a landing can be made in accordance with Chapter 2.5. The flight path clears vertically, by at least 300 m (1000 ft) or 600 m (2000 ft) in areas of mountainous terrain, all terrain and obstacles along the route within 9.3 km (5 NM) on either side of the intended track. Drift-down techniques may be used.

  (3) When it is intended that the flight will be conducted in VMC with the surface in sight, the flight path permits the helicopter to continue flight from the cruising altitude to a height of 300 m (1000 ft) above a landing site where a landing can be made in accordance with Chapter 2.5, without flying at any time below the appropriate minimum flight altitude. Obstacles within 900 m on either side of the route need to be considered.

(b) When showing compliance with (a) (2) or (a) (3):

  (1) The critical engine is assumed to fail at the most critical point along the route;

(2) Account is taken of the effects of winds on the flight path;

(3) Fuel jettisoning is planned to take place only to an extent consistent with reaching the aerodrome or operating site with the required fuel reserves and using a safe procedure; and

(4) Fuel jettisoning is not planned below 1000 ft above terrain.

(c) The width margins of (a) (1) and (a) (2) shall be increased to 18.5 km (10 NM) if the navigational accuracy cannot be met for 95% of the total flight time.

2.5 Landing

(a) The landing mass of the helicopter at the estimated time of landing shall not exceed the maximum mass specified in the AFM for the procedure to be used.

(b) In the event of the critical engine failure being recognised at any point at or before the landing decision point (LDP), it is possible either to land and stop within the FATO, or to perform a balked landing and clear all obstacles in the flight path by a vertical margin of 10.7 m (35 ft). Only obstacles as specified in Chapter 1.3 have to be considered.

(c) In the event of the critical engine failure being recognised at any point at or after the LDP, it is possible to:

(1) Clear all obstacles in the approach path; and

(2) Land and stop within the FATO.

(d) When showing compliance with (a) to (c), account shall be taken of the appropriate parameters of Chapter 1.2 (c) for the estimated time of landing at the destination aerodrome or operating site, or any alternate if required.

(e) That part of the landing from the LDP to touchdown shall be conducted in sight of the surface.

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Chapter 3 — Performance class 2

GM to Section 2, Chapter 3 performance class 2

3.0 OPERATIONS IN PERFORMANCE CLASS 2

(a) Introduction

This GM describes performance class 2, it has been produced for the purpose of:

(1) Explaining the underlying philosophy of operations in performance class 2;

(2) Showing simple means of compliance; and

(3) Explaining how to determine – with examples and diagrams:

(i) The take-off and landing masses;

(ii) The length of the safe forced landing area;

(iii) Distances to establish obstacle clearance; and

(iv) Entry point(s) into performance class 1.

It explains the derivation of performance class 2 from ICAO Annex 6 Part III and describes an alleviation that may be approved in accordance with Chapter 3.1 following a risk assessment. It examines the basic requirements, discusses the limits of operation, and considers the benefits of the use of performance class 2.

It contains examples of performance class 2 in specific circumstances, and explains how these examples may be generalised to provide operators with methods of calculating landing distances and obstacle clearance.

(b) Definitions used in this GM

The definitions for the following terms, used in this GM, are contained in the leading pages of this document:

(1) Distance DR

(2) Defined point after take-off (DPATO)

(3) Defined point before landing (DPBL)

(4) Landing distance available (LDAH)

(5) Landing distance required (LDRH)

(6) Performance class 2

(7) Safe forced landing (SFL)

(8) take-off distance available (TODAH).

The following terms, which are not defined in the leading pages, are used in this GM:

– V_T: a target speed at which to aim at the point of minimum ground clearance (min-dip) during acceleration from TDP to V_{TOSS}

– V_{50}. : a target speed and height utilised to establish an AFM distance (in compliance with the requirement of CS/JAR 29.63) from which climb out is possible; and

– V_{stayup}: a colloquial term used to indicate a speed at which a descent would not result following an engine failure. This speed is several knots lower than V_{TOSS} at the equivalent take-off mass.

(c) What defines performance class 2?

Performance class 2 can be considered as performance class 3 take-off or landing, and performance class 1 climb, cruise and descent. It comprises an all-engines-operating (AEO) obstacle clearance regime for the take-off or landing phases, and an OEI obstacle clearance regime for the climb, cruise, descent, approach and missed approach phases.

For the purpose of performance calculations, the CS/JAR 29.67 Category A climb performance criteria is used:

– 150 ft/min at 1000 ft (at V_y);

And depending on the choice of DPATO:

– 100 ft/min up to 200 ft (at V_{TOSS})

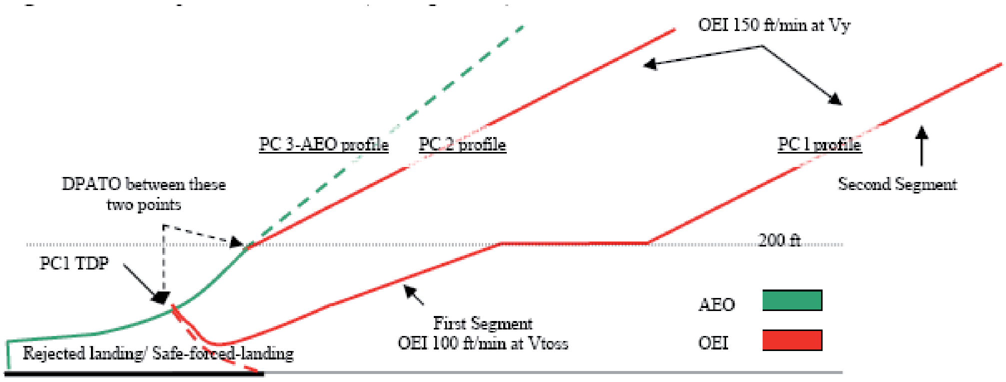
At the appropriate power settings.

(1) Comparison of obstacle clearance in all performance classes

Figure 1 shows the profiles of the three performance classes – superimposed on one diagram.

– Performance class 1 (PC1): from TDP, requires OEI obstacle clearance in all phases of flight; the construction of Category A procedures, provides for a flight path to the first climb segment, a level acceleration segment to V_y (which may be shown concurrent with the first segment), followed by the second climb segment from V_y at 200 ft (see Figure 1).

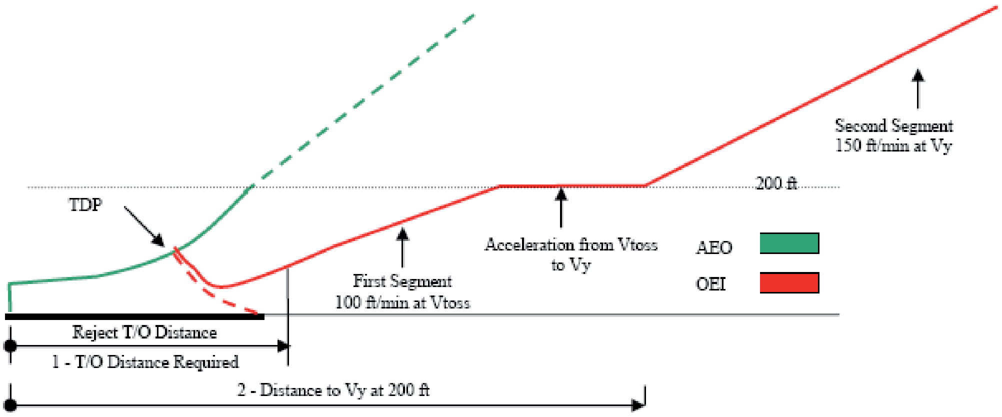
Figure 1: All Performance Classes (a comparison)



– Performance class 2 (PC2): requires AEO obstacle clearance to DPATO and OEI from then on. The take-off mass has the PC1 second segment climb performance at its basis therefore, at the point where V_y at 200 ft is reached, Performance Class 1 is achieved (see also Figure 3).

– Performance class 3 (PC3): requires AEO obstacle clearance in all phases.

Figure 2: Performance Class 1 distances



(2) Comparison of the discontinued take-off in all performance classes

(i) PC1 – requires a prepared surface on which a rejected landing can be undertaken (no damage); And

(ii) PC2 and 3 – require a safe forced landing surface (some damage can be tolerated but there must be a reasonable expectancy of no injuries to persons in the aircraft or third parties on the surface).

(d) The derivation of performance class 2

PC2 is primarily based on the text of ICAO Annex 6 Part III Section II and its attachments – which provide for the following:

(1) Obstacle clearance before DPATO: the helicopter shall be able, with all engines operating, to clear all obstacles by an adequate margin until it is in a position to comply with (2);

(2) obstacle clearance after DPATO: the helicopter shall be able, in the event of the critical engine becoming inoperative at any time after reaching DPATO, to continue the take-off clearing all obstacles along the flight path by an adequate margin until it is able to comply with en-route clearances; and

(3) Engine failure before DPATO: before the DPATO, failure of the critical engine may cause the helicopter to force land; therefore a safe forced landing should be possible (this is analogous to the requirement for a reject in performance class 1 but where some damage to the helicopter can be tolerated.)

(e) Benefits of performance class 2

Operations in performance class 2 permit advantage to be taken of an AEO procedure for a short period during take-off and landing – whilst retaining engine failure accountability in the climb, descent and cruise. The benefits include the ability to:

(1) Use (the reduced) distances scheduled for the AEO – thus permitting operations to take place at smaller aerodromes and allowing airspace requirements to be reduced;

(2) operate when the safe forced landing distance available is located outside the boundary of the aerodrome;

(3) Operate when the take-off distance required is located outside the boundary of the aerodrome; and

(4) use existing Category a profiles and distances when the surface conditions are not adequate for a reject but are suitable for a safe forced landing (for example when the ground is waterlogged).

Additionally, following a risk assessment when the use of exposure is approved by the authority the ability to:

(i) Operate when a safe forced landing is not assured in the take-off phase; and

(ii) Penetrate the HV curve for short periods during take-off or landing.

(f) The following sections explain the principles of the implementation of performance class 2.

(1) ICAO Annex 6 does not give guidance on how DPATO should be calculated nor does it require that distances be established for the take-off. However, it does require that, up to DPATO AEO, and from DPATO OEI, obstacle clearance is established (see Figure 3 and Figure 4 which are simplified versions of the diagrams contained in Annex 6 Part III, Attachment A).

(ICAO Annex 8 – Airworthiness of Aircraft (Part IVA 2.2.3.1.4' and 'Part IVB 2.2.7 d) requires that an AEO distance be scheduled for all helicopters operating in performance classes 2 & 3. ICAO Annex 6 is dependent upon the scheduling of the AEO distances, required in Annex 8, to provide data for the location of DPATO.)

When showing obstacle clearance, the divergent obstacle clearance height required for IFR is – as in performance class 1 – achieved by the application of the additional obstacle clearance of 0.01 distance DR (the distance from the end of 'take-off -distance-available' – see the pictorial representation in Figure 4 and the definition in Annex I).

As can also be seen from Figure 4, flight must be conducted in VFR until DPATO has been achieved (and deduced that if an engine failure occurs before DPATO, entry into IFR is not permitted (as the OEI climb gradient will not have been established)).

Figure 3: Performance Class 2 Obstacle Clearance

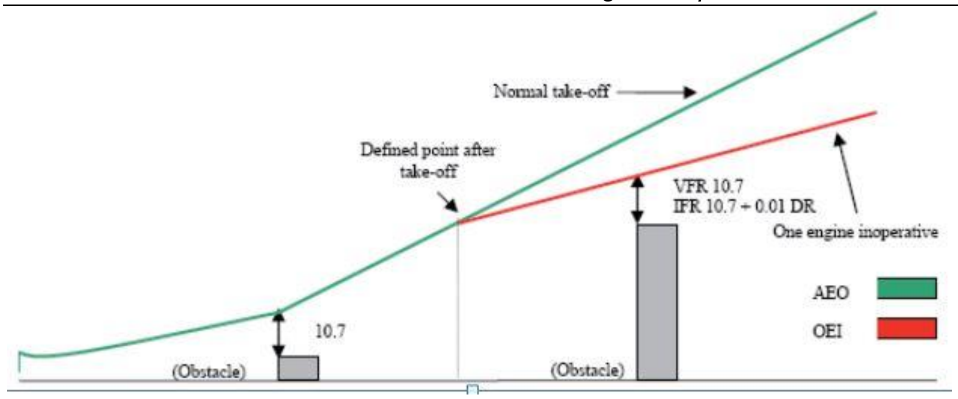
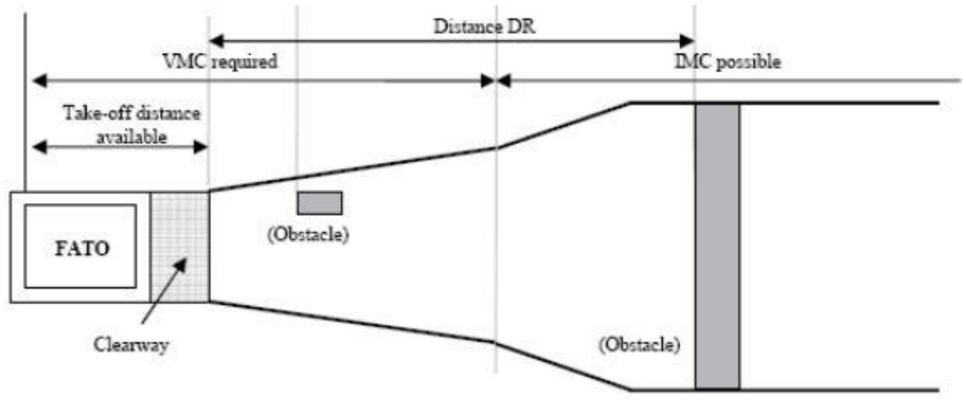


Figure 4: Performance Class 2 Obstacle Clearance (plan view)



(2) Function of DPATO

From the preceding paragraphs it can be seen that DPATO is germane to PC2. It can also be seen that, in view of the many aspects of DPATO, it has, potentially, to satisfy a number of requirements that are not necessarily synchronised (nor need to be).

It is clear that it is only possible to establish a single point for DPATO, satisfying the requirement of (d) (2) & (d) (3), when:

– accepting the TDP of a Category A procedure; or

– extending the safe forced landing requirement beyond required distances (if data are available to permit the calculation of the distance for a safe forced landing from the DPATO).

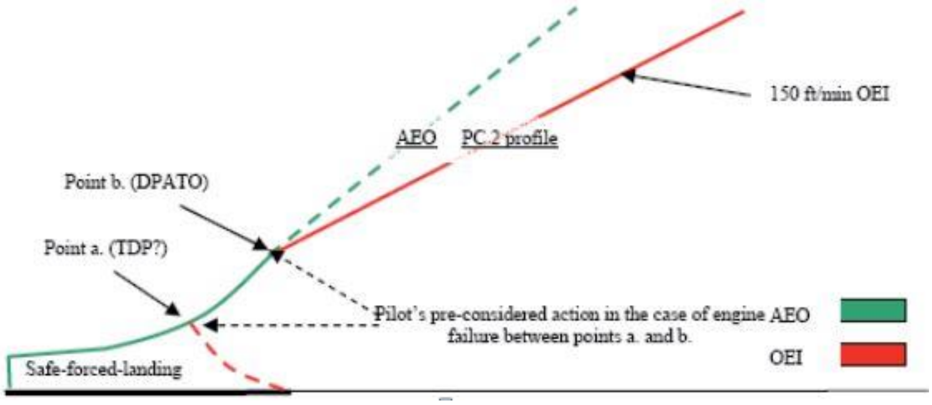
It could be argued that the essential requirement for DPATO is contained in section (d) (2) – OEI obstacle clearance. From careful examination of the flight path reproduced in Figure 3 above, it may be reasonably deduced that DPATO is the point at which adequate climb performance is established (examination of Category A procedures would indicate that this could be (in terms of mass, speed and height above the take-off surface) the conditions at the start of the first or second segments – or any point between.)

(The diagrams in Attachment a of ICAO Annex 6 do not appear to take account of drop down – permitted under category A procedures; similarly with helideck departures, the potential for acceleration in drop down below deck level (once the deck edge has been cleared) is also not shown. These omissions could be regarded as a simplification of the diagram, as drop down is discussed and accepted in the accompanying ICAO text.)

It may reasonably be argued that, during the take-off and before reaching an appropriate climb speed (V_{TOSS} or V_y), V_{stayup} will already have been achieved (where V_{stayup} is the ability to continue the flight and accelerate without descent – shown in some Category A procedures as VT or target speed) and where, in the event of an engine failure, no landing would be required.

It is postulated that, to practically satisfy all the requirements of (d) (1), (2) and (3), DPATO does not need to be defined at one synchronised point; provisions can be met separately – i.e. defining the distance for a safe forced landing, and then establishing the OEI obstacle clearance flight path. As the point at which the helicopter's ability to continue the flight safely, with the critical engine inoperative is the critical element, it is that for which DPATO is used in this text.

Figure 5: The three elements in a PC 2 take – off



(i) The three elements from the pilot's perspective

When seen from the pilot's perspective (see Figure 5), there are three elements of the PC 2 take-off – each with associated related actions which need to be considered in the case of an engine failure:

(A) Action in the event of an engine failure – up to the point where a forced-landing will be required;

(B) Action in the event of an engine failure – from the point where OEI obstacle clearance is established (DPATO); and

(C) pre-considered action in the event of an engine failure – in the period between (A) and (B)

The action of the pilot in (A) and (Bb) is deterministic, i.e. it remains the same for every occasion. For pre-consideration of the action at point (C), as is likely that the planned flight path will have to be abandoned (the point at which obstacle clearance using the OEI climb gradients not yet being reached), the pilot must (before take-off) have considered his/her options and the associated risks, and have in mind the course of action that will be pursued in the event of an engine failure during that short period. (As it is likely that any action will involve turning manoeuvres, the effect of turns on performance must be considered.)

(3) Take-off mass for performance class 2

As previously stated, performance class 2 is an AEO take-off that, from DPATO, has to meet the requirement for OEI obstacle clearance in the climb and en-route phases. Take-off mass is therefore the mass that gives at least the minimum climb performance of 150 ft/min at V_y, at 1000 ft above the take-off point, and obstacle clearance.

As can be seen in Figure 6 below, the take-off mass may have to be modified when it does not provide the required OEI clearance from obstacles in the take-off -flight path (exactly as in performance class 1). This could occur when taking off from an aerodrome/operating site where the flight path has to clear an obstacle such a ridge line (or line of buildings) that can neither be:

(i) Flown around using VFR and see and avoid; nor

(Ii) cleared using the minimum climb gradient given by the take-off mass (150 ft/min at 1000 ft).

In this case, the take-off mass has to be modified (using data contained in the AFM) to give an appropriate climb gradient.

(4) Safe forced landing distance

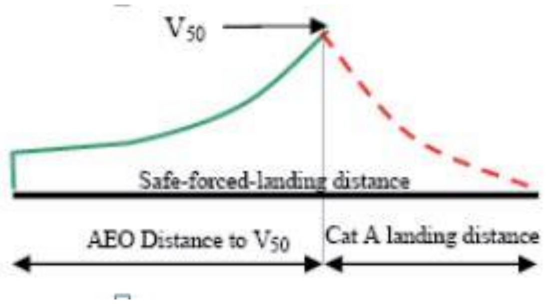
The establishment of the safe forced landing distance could be problematical as it is not likely that PC2 specific data will be available in the AFM.

By definition, the Category a reject distance may be used when the surface is not suitable for a reject, but may be satisfactory for a safe forced landing (for example where the surface is flooded or is covered with vegetation).

Any Category A (or other accepted) data may be used to establish the distance. However, once established it remains valid only if the Category A mass (or the mass from the accepted data) is used and the Category A (or accepted) AEO profile to the TDP is flown. In view of these constraints, the likeliest Category A procedures are the clear area or the short field (restricted area/site) procedures.

From Figure 10, it can be seen that if the Category B V_{50} procedure is used to establish DPATO, the combination of the distance to 50 ft and the Category A 'clear area' landing distance, required by CS/ JAR 29.81 (the horizontal distance required to land and come to a complete stop from a point 50 ft above the landing surface), will give a good indication of the maximum safe forced landing distance required (see also the explanation on V_{stayup} above).

Figure 10: Category B (V50) safe – forced – landing distance



(5) Performance class 2 landing

For other than PC2 operations to elevated FATOs or helidecks (see section (g) (4) (i)), the principles for the landing case are much simpler. As the performance requirements for PC1 and PC2 landings are virtually identical, the condition of the landing surface is the main issue.

If the engine fails at any time during the approach, the helicopter must be able either: to perform a go-around meeting the requirements of Chapter 1.4; or perform a safe forced landing on the surface. In view of this, and if using PC1 data, the LDP should not be lower that the corresponding TDP (particularly in the case of a variable TDP).

The landing mass will be identical to the take-off mass for the same site (with consideration for any reduction due to obstacle clearance – as shown in Figure 6 above).

In the case of a balked landing (i.e. the landing site becomes blocked or unavailable during the approach), the full requirement for take-off obstacle clearance must be met.

(g) Operations in performance class 2 with exposure

The Implementing Rules offer an opportunity to discount the requirement for an assured safe forced landing area in the take-off or landing phase – subject to an approval from the authority. The following sections deals with this option:

(1) Limit of exposure

As stated above, performance class 2 has to ensure AEO obstacle clearance to DPATO and OEI obstacle clearance from that point. This does not change with the application of exposure.

It can therefore be stated that operations with exposure are concerned only with alleviation from the requirement for the provision of a safe forced landing.

The absolute limit of exposure is 200 ft – from which point OEI obstacle clearance must be shown.

(2) The principle of risk assessment

ICAO Annex 6 Part III Chapter 3.1.2 states that:

"3.1.2 In conditions where the safe continuation of flight is not ensured in the event of a critical engine failure, helicopter operations shall be conducted in a manner that gives appropriate consideration for achieving a safe forced landing."

Although a safe forced landing may no longer be the (absolute) Standard, it is considered that risk assessment is obligatory to satisfy the amended requirement for 'appropriate consideration'.

Risk assessment used for fulfilment of this proposed Standard is consistent with principles described in 'AS/NZS 4360:1999'. Terms used in this text and defined in the AS/NZS Standard are shown in Sentence Case e.g. risk assessment or risk reduction.

(3) The application of risk assessment to performance class 2

Under circumstances where no risk attributable to engine failure (beyond that inherent in the safe forced landing) is present, operations in performance class 2 may be conducted in accordance with the non-alleviated requirements contained above – and a safe forced landing will be possible.

Under circumstances where such risk would be present, i.e. operations to an elevated FATO (deck edge strike); or, when permitted, operations from a site where a safe forced landing cannot be accomplished because the surface is inadequate; or where there is penetration into the HV curve for a short period during take-off or landing (a limitation in CS/JAR 29 AFMs), operations have to be conducted under a specific approval.

Provided such operations are risk assessed and can be conducted to an established safety target – they may be approved in accordance with Chapter 3.1.

(i) The elements of the risk management

The approval process consists of an operational risk assessment and the application of four principles:

(A) A safety target;

(B) A helicopter reliability assessment;

(C) Continuing airworthiness; and

(D) Mitigating procedures.

(ii) The safety target

The main element of the risk assessment when exposure was initially introduced was the assumption that turbine engines in helicopters would have failure rates of about 1:100 000 per flying hour, which would permit (against the agreed safety target of 5 x 10-8 per event) an exposure of about 9 seconds for twins during the take-off or landing event. (When choosing this target it was assumed that the majority of current well maintained turbine powered helicopters would be capable of meeting the event target – it therefore represents the residual risk).

(Residual risk is considered to be the risk that remains when all mitigating procedures – airworthiness and operational – are applied (see sections (g) (3) (IV) and (g) (3) (v))).

(iii) The reliability assessment

The reliability assessment was initiated to test the hypothesis (stated in (g) (3) (ii)) that the majority of turbine powered types would be able to meet the safety target. This hypothesis could only be confirmed by an examination of the manufacturers' power-loss data.

(iv) Mitigating procedures (airworthiness)

Mitigating procedures consist of a number of elements:

(A) The fulfilment of all manufacturers' safety modifications;

(B) A comprehensive reporting system (both failures and usage data); and

(C) The implementation of a usage monitoring system (UMS).

Each of these elements is to ensure that engines, once shown to be sufficiently reliable to meet the safety target, will sustain such reliability (or improve upon it).

The monitoring system is felt to be particularly important as it had already been demonstrated that when such systems are in place it inculcates a more considered approach to operations. In addition the elimination of 'hot starts', prevented by the UMS, itself minimises the incidents of turbine burst failures.

(v) Mitigating procedures (operations)

Operational and training procedures, to mitigate the risk – or minimise the consequences – are required of the operator. Such procedures are intended to minimise risk by ensuring that:

(A) The helicopter is operated within the exposed region for the minimum time; and

(B) Simple but effective procedures are followed to minimise the consequence should an engine failure occur.

(4) Operation with exposure

When operating with exposure, there is alleviation from the requirement to establish a safe forced landing area (which extends to landing as well as take-off). However, the requirement for obstacle clearance – AEO in the take-off and from DPATO OEI in the climb and en-route phases – remains (both for take-off and landing).

The take-off mass is obtained from the more limiting of the following:

– The climb performance of 150 ft/min at 1000 ft above the take-off point; or

– Obstacle clearance (in accordance with (f) (3) above); or

– AEO hover out of ground effect (HOGE) performance at the appropriate power setting. (AEO HOGE is required to ensure acceleration when (near) vertical dynamic take-off techniques are being used. Additionally for elevated FATO or helidecks, it ensures a power reserve to offset ground cushion dissipation; and ensures that, during the landing manoeuvre, a stabilised HOGE is available – should it be required.)

3.1. Operations without an assured safe forced landing capability

(a) Operations without an assured safe forced landing capability during the take-off and landing phases shall only be conducted if the operator has been granted an approval by the authority.

(b) To obtain and maintain such approval the operator shall:

(1) Conduct a risk assessment, specifying:

(i) The type of helicopter; and

(ii) The type of operations;

(2) Implement the following set of conditions:

(i) Attain and maintain the helicopter/engine modification standard defined by the manufacturer;

(ii) Conduct the preventive maintenance actions recommended by the helicopter or engine manufacturer;

(iii) Include take-off and landing procedures in the operations manual, where they do not already exist in the AFM;

(iv) Specify training for flight crew; and

(v) Provide a system for reporting to the manufacturer loss of power, engine shutdown or engine failure events; and

(3) Implement a usage monitoring system (UMS).

AMC to 3.1(b) Helicopter operations without an assured safe forced landing capability

ENGINE RELIABILITY STATISTICS

(a) As part of the risk assessment prior to granting an approval under Chapter 3.1, the operator should provide appropriate engine reliability statistics available for the helicopter type and the engine type.

(b) Except in the case of new engines, such data should show sudden power loss from the set of in-flight shutdown (IFSD) events not exceeding 1 per 100,000 engine hours in a 5 year moving window. However, a rate in excess of this value, but not exceeding 3 per 100,000 engine hours, may be accepted by the authority after an assessment showing an improving trend.

(c) New engines should be assessed on a case-by-case basis.

(d) After the initial assessment, updated statistics should be periodically reassessed; any adverse sustained trend will require an immediate evaluation to be accomplished by the operator in consultation with the authority and the manufacturers concerned. The evaluation may result in corrective action or operational restrictions being applied.

(e) The purpose of this paragraph is to provide guidance on how the in-service power plant sudden power loss rate is determined.

(1) Share of roles between the helicopter and engine type certificate holders (TCH)

(i) The provision of documents establishing the in-service sudden power loss rate for the helicopter/ engine installation; the interface with the operational authority of the State of the operator should be the engine TCH or the helicopter TCH depending on the way they share the corresponding analysis work.

(ii) The engine TCH should provide the helicopter TCH with a document including: the list of in service power loss events, the applicability factor for each event (if used), and the assumptions made on the efficiency of any corrective actions implemented (if used).

(iii) The engine or helicopter TCH should provide the operational authority of the State of the operator, with a document that details the calculation results – taking into account the following:

(A) Events caused by the engine and the events caused by the engine installation;

(B) Applicability factor for each event (if used), the assumptions made on the efficiency of any corrective actions implemented on the engine and on the helicopter (if used); and

(C) Calculation of the power plant power loss rate.

(2) Documentation

The following documentation should be updated every year:

(i) The document with detailed methodology and calculation as distributed to the authority of the State of design;

(ii) A summary document with results of computation as made available on request to any operational authority; and

(iii) A service letter establishing the eligibility for such operation and defining the corresponding required configuration as provided to the operators.

(3) Definition of 'sudden in-service power loss'

Sudden in-service power loss is an engine power loss:

(i) Larger than 30 % of the take-off power;

(ii) Occurring during operation; and

(iii) Without the occurrence of an early intelligible warning to inform and give sufficient time for the pilot to take any appropriate action.

(4) Database documentation

Each power loss event should be documented, by the engine and/or helicopter TCHs, as follows:

(i) Incident report number;

(ii) Engine type;

(iii) Engine serial number;

(iv) Helicopter serial number;

(v) Date;

(vi) Event type (demanded IFSD, un-demanded IFSD);

(Vii) presumed cause;

(viii) Applicability factor when used; and

(ix) Reference and assumed efficiency of the corrective actions that will have to be applied (if any).

(5) Counting methodology

Various methodologies for counting engine power loss rate have been accepted by authorities.

The following is an example of one of these methodologies.

(i) The events resulting from:

(A) Unknown causes (wreckage not found or totally destroyed, undocumented or unproven statements);

(B) Where the engine or the elements of the engine installation have not been investigated (for example when the engine has not been returned by the customer); or

(C) An unsuitable or non-representative use (operation or maintenance) of the helicopter or the engine, are not counted as engine in-service sudden power loss and the applicability factor is 0 %.

(ii) The events caused by:

(A) The engine or the engine installation; or

(B) The engine or helicopter maintenance, when the applied maintenance was compliant with the maintenance manuals, are counted as engine in-service sudden power loss and the applicability factor is 100 %.

(iii) For the events where the engine or an element of the engine installation has been submitted for investigation but where this investigation subsequently failed to define a presumed cause, the applicability factor is 50 %.

(6) Efficiency of corrective actions.

The corrective actions made by the engine and helicopter manufacturers on the definition or maintenance of the engine or its installation may be defined as mandatory for specific operations. In this case the associated reliability improvement may be considered as a mitigating factor for the event.

A factor defining the efficiency of the corrective action may be applied to the applicability factor of the concerned event.

(7) Method of calculation of the powerplant power loss rate

The detailed method of calculation of the powerplant power loss rate should be documented by engine or helicopter TCH and accepted by the relevant authority.

AMC 2 to 3.1(b) Helicopter operations without an assured safe forced landing capability

IMPLEMENTATION OF THE SET OF CONDITIONS

To obtain an approval under Chapter 3.1 (a), the operator conducting operations without an assured safe forced landing capability should implement the following:

(a) Attain and then maintain the helicopter/engine modification standard defined by the manufacturer that has been designated to enhance reliability during the take-off and landing phases.

(b) Conduct the preventive maintenance actions recommended by the helicopter or engine manufacturer as follows:

(1) Engine oil spectrometric and debris analysis – as appropriate;

(2) Engine trend monitoring, based on available power assurance checks;

(3) Engine vibration analysis (plus any other vibration monitoring systems where fitted); and

(4) Oil consumption monitoring.

(c) The usage monitoring system should fulfil at least the following:

(1) Recording of the following data:

(i) Date and time of recording, or a reliable means of establishing these parameters;

(ii) Amount of flight hours recorded during the day plus total flight time;

(iii) N1 (gas producer RPM) cycle count;

(iv) N2 (power turbine RPM) cycle count (if the engine features a free turbine);

(v) Turbine temperature exceedance: value, duration;

(vi) Power-shaft torque exceedance: value, duration (if a torque sensor is fitted);

(vii) Engine shafts speed exceedance: value, duration.

(2) Data storage of the above parameters, if applicable, covering the maximum flight time in a day, and not less than 5 flight hours, with an appropriate sampling interval for each parameter.

(3) The system should include a comprehensive self-test function with a malfunction indicator and a detection of power-off or sensor input disconnection.

(4) A means should be available for downloading and analysis of the recorded parameters. Frequency of downloading should be sufficient to ensure data is not lost through over-writing.

(5) The analysis of parameters gathered by the usage monitoring system, the frequency of such analysis and subsequent maintenance actions should be described in the maintenance documentation.

(6) The data should be stored in an acceptable form and accessible to the authority for at least 24 months.

(d) The training for flight crew should include the discussion, demonstration, use and practice of the techniques necessary to minimise the risks.

(e) Report to the manufacturer any loss of power control, engine shutdown (precautionary or otherwise) or engine failure for any cause (excluding simulation of engine failure during training). The content of each report should provide:

(1) Date and time;

(2) Operator (and maintenance organisations where relevant);

(3) Type of helicopter and description of operations;

(4) Registration and serial number of airframe;

(5) Engine type and serial number;

(6) Power unit modification standard where relevant to failure;

(7) Engine position;

(8) Symptoms leading up to the event;

(9) Circumstances of engine failure including phase of flight or ground operation;

(10) Consequences of the event;

(11) weather/environmental conditions;

(12) Reason for engine failure – if known;

(13) In case of an in-flight shutdown (IFSD), nature of the IFSD (demanded/un-demanded);

(14) Procedure applied and any comment regarding engine restart potential;

(15) Engine hours and cycles (from new and last overhaul);

(16) Airframe flight hours;

(17) Rectification actions applied including, if any, component changes with part number and serial number of the removed equipment; and

(18) Any other relevant information.

GM 1 to 3.1(b) Helicopter operations without an assured safe forced landing capability

USE OF FULL AUTHORITY DIGITAL ENGINE CONTROL (FADEC)

Current technology increasingly allows for the recording function required in (c) (1) of AMC 2 to 3.1(b) to be incorporated in the full authority digital engine control (FADEC).

Where a FADEC is capable of recording some of the parameters required by (c) (1) of AMC 2 to 3.1(b) it is not intended that the recording of the parameters is to be duplicated.

Providing that the functions as set out in (c) of AMC 2 to 3.1 (b) are satisfied, the FADEC may partially, or in whole, fulfil the requirement for recording and storing parameters in a usage monitoring system.

3.2. Take-off

(a) The take-off mass shall not exceed the maximum mass specified for a rate of climb of 150 ft/min at 300 m (1000 ft) above the level of the aerodrome or operating site with the critical engine inoperative and the remaining engine(s) operating at an appropriate power rating.

(b) For operations other than those specified in Chapter 3.1, the take-off shall be conducted such that a safe forced landing can be executed until the point where safe continuation of the flight is possible.

(c) For operations in accordance with Chapter 3.1 in addition to the requirements of (a):

(1) the take-off mass shall not exceed the maximum mass specified in the AFM for an all engines operative out of ground effect (AEO OGE) hover in still air with all engines operating at an appropriate power rating; or

(2) For operations from a helideck:

(i) any helicopter operated from a helideck located in a hostile environment, the take-off mass shall take into account: the procedure; deck-edge miss and drop down appropriate to the height of the helideck with the critical engine(s) inoperative and the remaining engines operating at an appropriate power rating.

(d) When showing compliance with (a) to (c), account shall be taken of the appropriate parameters of Chapter 1.3 (c) at the point of departure.

(e) That part of the take-off before the requirement of Chapter 1.4 is met shall be conducted in sight of the surface.

GM 1 to 3.2 & 3.5 Take-off and landing

TAKE-OFF AND LANDING TECHNIQUES

(a) This GM describes three types of operation to/from helidecks and elevated FATOs by helicopters operating in performance class 2.

(b) In two cases of take-off and landing, exposure time is used. During the exposure time (which is only approved for use when complying with Chapter 3.1) the probability of an engine failure is regarded as extremely remote. If an engine failure occurs during the exposure time a safe forced landing may not be possible.

(c) Take-off – non-hostile environment (without an approval to operate with an exposure time) Chapter 3.2(b).

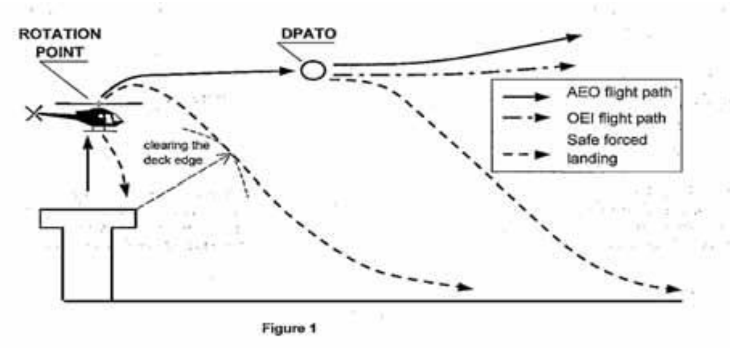
(1) Figure 1 shows a typical take-off profile for performance class 2 operations from a helideck or an elevated FATO in a non-hostile environment.

(2) If an engine failure occurs during the climb to the rotation point, compliance with Chapter 3.2 (b) will enable a safe landing or a safe forced landing on the deck.

(3) If an engine failure occurs between the rotation point and the DPATO, compliance with Chapter 3.2(b) will enable a safe forced landing on the surface, clearing the deck edge.

(4) At or after the DPATO, the OEI flight path should clear all obstacles by the margins specified in Chapter 3.3.

Figure 1: Typical take-off profile PC2 from a helideck/elevated FATO, non-hostile environment



(d) Take-off – non-hostile environment (with exposure time) Chapter 3.2(c)

(1) Figure 2 shows a typical take-off profile for performance class 2 operations from a helideck or an elevated FATO in a non-hostile environment (with exposure time).

(2) If an engine failure occurs after the exposure time and before DPATO, compliance with Chapter 3.2(c) will enable a safe forced landing on the surface.

(3) At or after the DPATO, the OEI flight path should clear all obstacles by the margins specified in Chapter 3.3.

3.3. Take-off flight path

From the defined point after take-off (DPATO) or, as an alternative, no later than 200 ft above the take-off surface, with the critical engine inoperative, the requirements of Chapter 2.3 (a)(1), (a)(2) and (b) shall be complied with.

3.4. En-route — critical engine inoperative

The requirement of Chapter 2.4 shall be complied with.

3.5. Landing

(a) The landing mass at the estimated time of landing shall not exceed the maximum mass specified for a rate of climb of 150 ft/min at 300 m (1 000 ft) above the level of the aerodrome or operating site with the critical engine inoperative and the remaining engine(s) operating at an appropriate power rating.

(b) If the critical engine fails at any point in the approach path:

- (1) A balked landing can be carried out meeting the requirement of Chapter 3.3; or
- (2) For operations other than those specified in Chapter 3.1, the helicopter can perform a safe forced landing.

(c) For operations in accordance with Chapter 3.1, in addition to the requirements of (a):

- (1) the landing mass shall not exceed the maximum mass specified in the AFM for an AEO OGE hover in still air with all engines operating at an appropriate power rating; or
- (2) For operations to a helideck:
  - (i) With a helicopter that has an MOPSC of more than 19; or
  - (ii) Any helicopter operated to a helideck located in a hostile environment, the landing mass shall take into account the procedure and drop down appropriate to the height of the helideck with the critical engine inoperative and the remaining engine(s) operating at an appropriate power rating.

(d) When showing compliance with (a) to (c), account shall be taken of the appropriate parameters of Chapter 1.3 (c) at the destination aerodrome or any alternate, if required.

(e) That part of the landing after which the requirement of (b) (1) cannot be met shall be conducted in sight of the surface.

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Chapter 4 — Performance class 3

4.0 General

(a) Helicopters operated in performance class 3 shall be certified in Category A or equivalent as determined by the Authority, or Category B.

(b) Operations shall only be conducted in a non-hostile environment, except:

(1) When operating in accordance with Chapter 4.4; or

(2) For the take-off and landing phase, when operating in accordance with (c).

(c) Provided the operator is approved in accordance with Chapter 3.1, operations may be conducted to/from an aerodrome or operating site located outside a congested hostile environment without an assured safe forced landing capability:

(1) during take-off , before reaching V_y (speed for best rate of climb) or 200 ft above the take-off surface; or

(2) During landing, below 200 ft above the landing surface.

(d) Operations shall not be conducted:

(1) Out of sight of the surface;

(2) At night;

(3) When the ceiling is less than 600 ft; or

(4) When the visibility is less than 800 m.

GM 1 to 4.0(c) General

THE TAKE-OFF AND LANDING PHASES (PERFORMANCE CLASS 3)

(a) To understand the use of ground level exposure in performance class 3, it is important first to be aware of the logic behind the use of ‘take-off and landing phases’. Once this is clear, it is easier to appreciate the aspects and limits of the use of ground level exposure. This GM shows the derivation of the term from the ICAO definition of the ‘en-route phase’ and then gives practical examples of the use, and limitations on the use, of ground level exposure in Chapter 4.0(c).

(b) The take-off phase in performance class 1 and performance class 2 may be considered to be bounded by ‘the specified point in the take-off’ from which the take-off flight path begins.

(1) In performance class 1 this specified point is defined as ‘the end of the take-off distance required’.

(2) In performance class 2 this specified point is defined as DPATO or, as an alternative, no later than 200 ft above the take-off surface.

(3) There is no simple equivalent point for bounding of the landing in performance classes 1 & 2.

(c) Take-off flight path is not used in performance class 3 and, consequently, the term ‘take-off and landing phases’ is used to bind the limit of exposure. For the purpose of performance class 3, the take-off and landing phases are as set out in Chapter 4.0(c) and are considered to be bounded by:

(1) During take-off before reaching V_y (speed for best rate of climb) or 200 ft above the take-off surface; and

(2) During landing, below 200 ft above the landing surface.

(ICAO Annex 6 Part III, defines en-route phase as being “That part of the flight from the end of the take-off and initial climb phase to the commencement of the approach and landing phase.” The use of take-off and landing phase in this text is used to distinguish the take-off from the initial climb, and the landing from the approach: they are considered to be complimentary and not contradictory.)

(d) Ground level exposure – and exposure for elevated FATOs or helidecks in a non-hostile environment – is permitted for operations under an approval in accordance with Chapter 3.1. Exposure in this case is limited to the ‘take-off and landing phases’.

The practical effect of bounding of exposure can be illustrated with the following examples:

(1) A clearing: the operator may consider a take-off /landing in a clearing when there is sufficient power, with all engines operating, to clear all obstacles in the take-off path by an adequate margin (this, in ICAO, is

meant to indicate 35 ft). Thus, the clearing may be bounded by bushes, fences, wires and, in the extreme, by power lines, high trees etc. Once the obstacle has been cleared – by using a steep or a vertical climb (which itself may infringe the height velocity (HV) diagram) – the helicopter reaches V_y or 200 ft, and from that point a safe forced landing must be possible. The effect is that whilst operation to a clearing is possible, operation to a clearing in the middle of a forest is not (except when operated in accordance with Chapter 4.4).

(2) An aerodrome/operating site surrounded by rocks: the same applies when operating to a landing site that is surrounded by rocky ground. Once V_y or 200 ft has been reached, a safe forced landing must be possible.

(3) An elevated FATO or helideck: when operating to an elevated FATO or helideck in performance class 3, exposure is considered to be twofold: firstly, to a deck-edge strike if the engine fails after the decision to transition has been taken; and secondly, to operations in the HV diagram due to the height of the FATO or helideck. Once the take-off surface has been cleared and the helicopter has reached the knee of the HV diagram, the helicopter should be capable of making a safe forced landing.

(e) Operation in accordance with Chapter 4.0(b) does not permit excursions into a hostile environment as such and is specifically concerned with the absence of space to abort the take-off or landing when the take-off and landing space are limited; or when operating in the HV diagram.

(f) Specifically, the use of this exception to the requirement for a safe forced landing (during take-off or landing) does not permit semi-continuous operations over a hostile environment such as a forest or hostile sea area.

4.1. Take-off

(a) The take-off mass shall be the lower of:

(1) The MCTOM; or

(2) the maximum take-off mass specified for a hover in ground effect with all engines operating at take-off power, or if conditions are such that a hover in ground effect is not likely to be established, the take-off mass specified for a hover out of ground effect with all engines operating at take-off power.

(b) Except as provided in Chapter 4.0 (b), in the event of an engine failure the helicopter shall be able to perform a safe forced landing.

4.2. En-route

(a) The helicopter shall be able, with all engines operating within the maximum continuous power conditions, to continue along its intended route or to a planned diversion without flying at any point below the appropriate minimum flight altitude.

(b) Except as provided in Chapter 4.4, in the event of an engine failure the helicopter shall be able to perform a safe forced landing.

4.3. Landing

(a) The landing mass of the helicopter at the estimated time of landing shall be the lower of:

(1) The maximum certified landing mass; or

(2) The maximum landing mass specified for a hover in ground effect, with all engines operating at take-off power, or if conditions are such that a hover in ground effect is not likely to be established, the landing mass for a hover out of ground effect with all engines operating at take-off power.

(b) Except as provided in Chapter 4.0(b), in the event of an engine failure, the helicopter shall be able to perform a safe forced landing.

4.4. Helicopter operations over a hostile environment located outside a congested area

(a) Operations over a non-congested hostile environment without a safe forced landing capability with turbine-powered helicopters with an MOPSC of six or less shall only be conducted if the operator has been granted an approval by the authority, following a safety risk assessment performed by the operator. Before such operations take place in another Member State, the operator shall obtain an endorsement from the authority of that State.

(b) To obtain and maintain such approval the operator shall:

(1) Only conduct these operations in the areas and under the conditions specified in the approval;

(2) substantiate that helicopter limitations, or other justifiable considerations, preclude the use of the appropriate performance criteria; and

(3) Be approved in accordance with Chapter 3.1(b).

(c) Such operations may be conducted without supplemental oxygen equipment, provided the cabin altitude does not exceed 10000 ft for a period in excess of 30 minutes and never exceeds 13000 ft pressure altitude.

AMC 1 to 4.4 Helicopter operations over a hostile environment located outside a congested area

SAFETY RISK ASSESSMENT

(a) Introduction

Two cases that are deemed to be acceptable for the alleviation under the conditions of Chapter 4.4for the en-route phase of the flight (operations without an assured safe forced landing capability during take-off and landing phases are subject to a separate approval under Chapter 4.0(c)) are flights over mountainous areas and remote areas, both already having been considered in comparison to ground transport in the case of remote areas and respectively to multi-engined helicopters in the case of mountain areas.

(1) Remote areas

Remote area operation is acceptable when alternative surface transportation does not provide the same level of safety as helicopter transportation. In this case, the operator should demonstrate why the economic circumstances do not justify replacement of single-engined helicopters by multi-engined helicopters.

(2) Mountainous areas

Current generation twin-engined helicopters may not be able to meet the performance class 1 or 2 requirements at the operational altitude; consequently, the outcome of an engine failure is the same as a single-engined helicopter. In this case, the operator should justify the use of exposure in the en-route phase.

(b) Other areas of operation

For other areas of operations to be considered for the operational approval, a risk assessment should be conducted by the operator that should, at least, consider the following factors:

(1) Type of operations and the circumstances of the flight;

(2) area/terrain over which the flight is being conducted;

(3) Probability of an engine failure and the consequence of such an event;

(4) Safety target;

(5) Procedures to maintain the reliability of the engine(s);

(6) Installation and utilisation of a usage monitoring system; and

(7) When considered relevant, any available publications on (analysis of) accident or other safety data.

GM 1 to 4.4 Helicopter operations over a hostile environment located outside a congested area

EXAMPLE OF A SAFETY RISK ASSESSMENT

(a) Introduction

Where it can be substantiated that helicopter limitations, or other justifiable considerations, preclude the use of appropriate performance, the approval effectively alleviates from compliance with the requirement in; '**Routes and areas of operation — helicopters;** where an operator shall ensure that:

(a) for helicopters operated in performance class 3, surfaces are available that permit a safe forced landing to be executed, except when the helicopter has an approval to operate in accordance with Chapter 4.4;

(b) for helicopters operated in performance class 3 and conducting 'coastal transit' operations, the operations manual contains procedures to ensure that the width of the coastal corridor, and the equipment carried, is consistent with the conditions prevailing at the time,' that requires the availability of surfaces that permit a safe forced landing to be executed.

Circumstances where an engine failure will result in a catastrophic event are those defined for a hostile environment:

(1) A lack of adequate surfaces to perform a safe landing;

(2) The inability to protect the occupants of the helicopter from the elements; or

(3) A lack of search and rescue services to provide rescue consistent with the expected survival time in such environment.

(b) The elements of the risk assessment

The risk assessment process consists of the application of three principles:

– A safety target;

– A helicopter reliability assessment; and

– continuing airworthiness.

(1) The safety target

The main element of the risk assessment when exposure was initially introduced the assumption was that turbine engines in helicopters would have failure rates of about 1:100 000 per flying hour – which would permit (against the agreed safety target of 5 x 10-8 per event) an exposure of about 9 seconds for twin-engined helicopters and 18 seconds for single-engined helicopters during the take-off or landing event.

An engine failure in the en-route phase over a hostile environment will inevitably result in a higher risk (in the order of magnitude of 1 x 10-5 per flying hour) to a catastrophic event.

The approval to operate with this high risk of endangering the helicopter occupants should therefore only be granted against a comparative risk assessment (i.e. compared to other means of transport the risk is demonstrated to be lower), or where there is no economic justification to replace single-engined helicopters by multi-engined helicopters.

(2) The reliability assessment

The purpose of the reliability assessment is to ensure that the engine reliability remains at or better than 1 x 10-5.

(3) Continuing airworthiness

Mitigating procedures consist of a number of elements:

(i) The fulfilment of all manufacturers' safety modifications;

(ii) A comprehensive reporting system (both failures and usage data); and

(iii) The implementation of a usage monitoring system (UMS).

Each of these elements is to ensure that engines, once shown to be sufficiently reliable to meet the safety target, will sustain such reliability (or improve upon it).

The monitoring system is felt to be particularly important as it had already been demonstrated that when such systems are in place it inculcates a more considered approach to operations. In addition the elimination of 'hot starts', prevented by the UMS, itself minimises the incidents of turbine burst failures.

GM 2 to 4.4(a) Helicopter operations over a hostile environment located outside a congested area

ENDORSEMENT FROM ANOTHER STATE

(a) Application to another State

To obtain an endorsement from another State the operator should submit to that State the safety risk assessment and the reasons and justification that preclude the use of appropriate performance criteria, over those hostile areas outside a congested area over which the operator is planning to conduct operations.

(b) Endorsement from another State

Upon receiving the endorsement from another State the operator should submit it together with the safety risk assessment and the reasons and justification that preclude the use of appropriate performance criteria, to the competent authority issuing the AOC to obtain the approval or extend the existing approval to a new area.

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