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Doc 10110

Helicopter Code of Performance Development Manual

First Edition, 2020



Approved by and published under the authority of the Secretary General

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Published in separate English, Arabic, Chinese, French, Russian
and Spanish editions by the
INTERNATIONAL CIVIL AVIATION ORGANIZATION
999 Robert-Bourassa Boulevard, Montréal, Quebec, Canada H3C 5H7

For ordering information and for a complete listing of sales agents
and booksellers, please go to the ICAO website at www.icao.int

First edition, 2020

Doc 10110, Helicopter Code of Performance Development Manual

Order Number: 10110

ISBN 978-92-9265-124-4

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AMENDMENTS

Amendments are announced in the supplements to the *Products and Services Catalogue*; the Catalogue and its supplements are available on the ICAO website at www.icao.int. The space below is provided to keep a record of such amendments.

RECORD OF AMENDMENTS AND CORRIGENDA

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FOREWORD

This manual provides guidance material to assist States, their civil aviation authorities and the operators under their jurisdiction in the development of a code of performance for international helicopter commercial air transport.

The technological advances in aviation developed over the last century would not have been possible without parallel achievements in the control and reduction of safety risks. It is only through the disciplined application of the best safety risk management practices that the frequency and severity of aviation occurrences can continue to decline.

Until the advent of this manual, ICAO Annex 6 — *Operation of Aircraft*, Part III — *International Operations — Helicopters* provided only general guidance on helicopter performance. The ability for a State to permit variations from the prescriptive standard within the code of performance was not sufficiently detailed.

This manual assists States to achieve flexibility by implementing a code of performance based on a prescriptive standard and allowing for variations without a safe forced landing while achieving acceptable levels of safety risk.

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GLOSSARY

DEFINITIONS

When the following terms are used in this manual, they have the following meanings:

Acceptable level of safety risk. The level of risk which is considered acceptable in particular circumstances.

Aerial work. An aircraft operation in which an aircraft is used for specialized services such as agriculture, construction, photography, surveying, observation and patrol, search and rescue, aerial advertisement, etc.

Note.— Aerial work is referred to but not addressed in this manual.

Aircraft tracking. A process, established by the operator, that maintains and updates, at standardized intervals, a ground-based record of the four dimensional position of individual aircraft in flight.

Category A. With respect to helicopters, means a multi-engined helicopter designed with engine and system isolation features specified in Annex 8 — *Airworthiness of Aircraft*, Part IVB, and capable of operations using take-off and landing data scheduled under a critical engine failure concept which assures adequate designated surface area and adequate performance capability for continued safe flight or safe rejected take-off.

Category B. With respect to helicopters, means a single engine or multi-engined helicopter which 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 a forced landing is assumed.

Commercial air transport operation. An aircraft operation involving the transport of passengers, cargo or mail for remuneration or hire.

Compliance-based regulatory oversight. The conventional and prescriptive method of ensuring safety used by a State's civil aviation authority that requires strict conformance to pre-established non-variable regulations by the operator.

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

Congested hostile environment. A hostile environment within a congested area.

Defined point after take-off. The point, within the take-off and initial climb phase, before which the helicopter's ability to continue the flight safely, with one engine inoperative, is not assured and a forced landing may be required.

Note.— Defined points apply to helicopters operating in performance Class 2 only.

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

Note.— Defined points apply to helicopters operating in performance Class 2 only.

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

Elevated heliport. A heliport located on a raised structure on land.

En-route phase. 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.

Note.— Where adequate obstacle clearance cannot be guaranteed visually, flights must be planned to ensure that obstacles can be cleared by an appropriate margin. In the event of failure of the critical engine, operators may need to adopt alternative procedures.

Exposure. Any part of a flight during which a system or engine failure leading to a forced landing is likely to result in a hazardous or catastrophic outcome.

Exposure time. The period during which the performance of the helicopter with the critical engine inoperative in still air does not guarantee a safe forced landing or the safe continuation of the flight.

Final approach and take-off area. A defined area over which the final phase of the approach manoeuvre to hover or landing is completed and from which the take-off manoeuvre is commenced. Where the FATO is to be used by helicopters operating in performance Class 1, the defined area includes the rejected take-off area available.

Note.— This requires an area free of obstacles, except for essential objects which because of their function are located on it, and of sufficient size and shape to ensure containment of every part of the design helicopter in the final phase of approach and commencement of take-off - in accordance with the intended procedures.

Hazard. A condition or an object with the potential to cause or contribute to an aircraft incident or accident.

Helicopter medical transport. A dedicated helicopter air medical operation which transports patients from helicopter medical transport (HMT) operating sites to heliports at health care facilities, and between such facilities.

Note.— An HMT flight includes all legs associated with a patient dispatch request, including the non-patient outbound response and repositioning legs of an HMT flight. It is intended that the following flight legs be regarded as integral parts of the HMT flight:

- a) to and from the HMT operating site;
- b) to and from a heliport for the delivery or pick-up of medical supplies and/or persons required for the completion of the HMT flight; and
- c) to and from a heliport for refuelling which is required for the continuation of the HMT flight or for its return to flight-ready status.

Helicopter medical transport operating site. A site selected by the commander during an HMT flight for helicopter hoist operations, landing and take-off.

Helideck. A heliport located on a floating or fixed offshore structure.

Hostile environment. An environment in which:

- a) a safe forced landing cannot be accomplished because the surface and surrounding environment are inadequate; or
- b) the helicopter occupants cannot be adequately protected from the elements; or
- c) search and rescue response/capability is not provided consistent with anticipated exposure; or

- d) there is an unacceptable safety risk of endangering persons or property on the ground.

Landing distance available (helicopter). The length of the final approach and take-off area plus any additional area declared available and suitable for helicopters to complete the landing manoeuvre from a defined height.

Landing distance required (helicopter). The horizontal distance required to land and come to a full stop from a point 15 m (50 ft) above the landing surface.

Landing decision point. The point used in determining landing performance from which, an engine failure occurring at this point, the landing may be safely continued or a balked landing initiated.

Note.— Landing decision point applies only to helicopters operating in performance Class 1.

Non-congested-hostile environment. A hostile environment outside a congested area.

Non-hostile environment. An environment in which:

- a) a safe forced landing can be accomplished because the surface and surrounding environment are adequate;
- b) the helicopter occupants can be adequately protected from the elements;
- c) search and rescue response/capability is provided consistent with anticipated exposure; and
- d) the assessed risk of endangering persons or property on the ground is acceptable.

Note.— Those parts of a congested area satisfying the above requirements are considered non-hostile.

Operation. An activity or group of activities which are subject to the same or similar hazards and which require a set of equipment to be specified, or the achievement and maintenance of a set of pilot competencies, to eliminate or mitigate the risk of such hazards.

Note 1.— This term is normally used in qualified form such as: 'on an operation', 'in the operation', 'area of operation', 'intended area of operation', 'type of operation', etc.

Note 2.— Such activities could include, but would not be limited to, offshore operations, heli-hoist operations or HMT operations.

Operations in performance Class 1. Operations with performance such that, in the event of a critical engine failure, performance is available to enable the helicopter to safely continue the flight to an appropriate landing area, unless the failure occurs prior to reaching the take-off decision point (TDP) or after passing the landing decision point (LDP), in which cases the helicopter must be able to land within the rejected take-off or landing area.

Operations in performance Class 2. Operations with performance such that, in the event of critical engine failure, performance is available to enable the helicopter to safely continue the flight to an appropriate landing area, 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.

Operations in performance Class 3. Operations with performance such that, in the event of an engine failure at any time during the flight, a forced landing will be required.

Performance-based regulatory oversight. An alternative regulatory oversight method which allows the operator to apply whatever means the operator deems appropriate and that is acceptable to the State, to achieve levels of safety performance acceptable to the State.

Prescriptive Compliance. See compliance-based regulatory oversight.

Rejected take-off distance required (helicopter). 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.

Rejected take-off distance available (helicopter). The length of the final approach and take-off area declared available and suitable for helicopters operating in performance Class 1 to complete a rejected take-off.

Safe forced landing. Unavoidable landing or ditching with a reasonable expectancy of no injuries to persons in the aircraft or on the surface.

Safety. The state in which risks associated with aviation activities, related to, or in direct support of the operation of aircraft, are reduced and controlled to an acceptable level.

Safety performance indicator. A data-based parameter used for monitoring and assessing safety performance.

Safety risk. The predicted probability and severity of the consequences or outcomes of a hazard.

Take-off and initial climb phase. That part of the flight from the start of take-off to 300 m (1 000 ft) above the elevation of the FATO, if the flight is planned to exceed this height, or to the end of the climb in the other cases.

Take-off decision point. The point used in determining take-off performance from which, an engine failure occurring at this point, either a rejected take-off may be made or a take-off safely continued.

Note.— Take-off decision point applies only to helicopters operating in performance Class 1.

Take-off distance available (helicopter). The length of the final approach and take-off area plus the length of any clearway (if provided) declared available and suitable for helicopters to complete the take-off.

Take-off distance required (helicopter). The horizontal distance required from the start of the take-off to the point at which V_{TOSS} , a selected height and a positive climb gradient are achieved, following failure of the critical engine being recognized at TDP, the remaining engines operating within approved operating limits.

Note.— The selected height stated above is to be determined with reference to either:

- a) the take-off surface; or
- b) a level defined by the highest obstacle in the take-off distance required.

Take-off flight path. The vertical and horizontal path, with the critical engine inoperative, from a specified point in the take-off to 300 m (1 000 ft) above the surface.

Touchdown and lift-off area. A load bearing area on which a helicopter may touchdown or lift-off.

Note.— This requires a surface which is free of obstacles and of sufficient size and shape to ensure containment of the undercarriage of the most demanding helicopter the TLOF is intended to serve in accordance with the intended orientation.

ACRONYMS AND ABBREVIATIONS*(used in the manual)*

AC	Advisory Circular (FAA)
AEO	All engines operating
AIP	Aeronautical Information Publication
ALSR	Acceptable level of safety risk
AMSL	Above mean sea level
ANC	Air Navigation Commission (ICAO)
ASAP	As soon as possible
ATC	Air Traffic Control
CAR	Canadian Aviation Regulation
CAT	Commercial air transport
CP	Committal point
D	Maximum dimension of helicopter
DPATO	Defined point after take-off
DPBL	Defined point before landing
DR	Distance travelled (helicopter)
EASA	European Aviation Safety Agency
EFS	Emergency Flotation System
FAA	Federal Aviation Administration
FADEC	Full authority digital engine control
FAR	Federal Aviation Regulations (US)
FATO	Final approach and take-off area
ft	Feet
HD	Helideck directory
HIGE	Hover in-ground effect
HMT	Helicopter medical transport
HOG	Hover out-of-ground effect
HTSG	Helicopter/ Tilt-rotor Study Group (ICAO)
HV	Height velocity
IFR	Instrument flight rules
IFSD	In-flight shut-down
IMC	Instrument meteorological conditions
JAA	Joint Aviation Authorities
JAR-OPS	Joint Aviation Requirements – Operations
kts	Knots
LDAH	Landing distance available (helicopter)
LDP	Landing decision point
LDRH	Landing distance required (helicopter)
LOS	Limited obstacle sector
m	Metres
MR	Main rotor
MRCA	Minimum Rotorcraft Containment Area
nm	Nautical miles
OEI	One engine inoperative
OEM	Original equipment manufacturer
OFS	Obstacle-free sector
PC1	Performance Class 1
PC2	Performance Class 2
PC2e	Performance Class 2 enhanced
PC3	Performance Class 3
R	Rotor radius of helicopter

RFM	Rotorcraft flight manual
ROC	Rate of climb
RPM	Revolutions per minute
RTODAH	Rejected take-off distance available (helicopter)
RTODRH	Rejected take-off distance required (helicopter)
SARPs	Standards and Recommended Practices (ICAO)
SERA	Standardised European Rules of the Air
SFL	Safe forced landing
SMS	Safety management system
TCH	Type certificate holder
TDP	Take-off decision point
TLOF	Touchdown and lift-off area
TODAH	Take-off distance available (helicopter)
TODRH	Take-off distance required (helicopter)
VFR	Visual flight rules
VMC	Visual meteorological conditions
V ₅₀	Speed at the 50 ft point in the take-off profile
V _{mini}	Minimum IFR Speed
V _{TOSS}	Take-off safety speed for helicopters certificated in Category A
V _Y	Best rate of climb speed
WAT	Weight/altitude/temperature

Chapter 1

INTRODUCTION

1.1 OVERVIEW

1.1.1 This manual provides guidance for States to establish a code of performance for international commercial air transport (CAT) helicopter operations in accordance with Annex 6 — *Operation of Aircraft*, Part III — *International Operations — Helicopters*, Section II, Chapter 3. States may also use this guidance when establishing the performance requirements for international general aviation helicopters in accordance with Annex 6, Part III, Section III, Chapter 3.

1.1.2 The guidance includes ways to establish a code of performance based on prescriptive compliance, and variations to the need for a safe forced landing (SFL).

1.1.3 Serious accidents and incidents occur in CAT for many reasons; engine failure is not the most prevalent of these. This manual does not attempt to address any of these apart from performance effects due to engine, and to some extent, system, failures. Mitigation, for causes/contributing factors other than engine failure, are addressed by the Standards and Recommended Practices (SARPs) outside those of Annex 6, Part III, Section II, Chapter 3. A systematic approach to addressing all causes can be found in Annex 19 — *Safety Management*, in particular Chapter 3. *State safety management responsibilities*, along with detailed guidance on safety management systems (SMSs) in Doc 9859, *Safety Management Manual*.

1.2 BACKGROUND

1.2.1 In formulating the Annex 6, Part III, performance SARPs in the 1980s, ICAO adopted the principle applicable to aeroplanes in Annex 6, Part I, of engine failure accountability or SFL.

1.2.2 With respect to performance operating limitations, the Foreword of Annex 6, Part I, illustrates the necessary integration of airworthiness and operational standards:

“An element of the safety of an operation is the intrinsic safety of the aircraft, that is, its level of airworthiness. The level of airworthiness of an aircraft is, however, not fully defined by the application of the airworthiness Standards of Annex 8, but also requires the application of those Standards in the present Annex that are complementary to them.”

1.2.3 Annex 6, Part III, was developed some time after the decision to include detailed guidance in Part I, and included the provision of an attachment to Annex 6, Part III, serving the same purpose.

1.2.4 The Joint Aviation Authorities (JAA) in Europe developed Joint Aviation Requirements – Operations (JAR-OPS 3) as the first helicopter requirements in compliance with the new ICAO performance standards in 1990, but quickly determined the need to reflect risk assessment and exposure. Specific variations to the standard were developed and the necessary changes were made to JAR-OPS 3. A proposal was subsequently submitted to the Air Navigation Commission (ANC) to amend Annex 6, Part III, accordingly.

1.2.5 In 2002, the Helicopter/Tilt-rotor Study Group (HTSG) was tasked with developing proposals for the introduction of a revision to Annex 6, Part III. The resulting SARPs provided States with a method of applying the intent of Annex 6 with a degree of flexibility that could be tailored to “acceptable safety risk” but provided little further guidance.

1.2.6 In 2017, the Flight Operations Panel was tasked by the ANC to provide a “Helicopter Code of Performance Development Manual” maintaining the overall aim of continued integration of Annexes 6, 8 and Annex 14 — *Aerodromes*¹.

1.3 SCOPE AND OBJECTIVES

1.3.1 The scope and objectives of this manual are to provide States with guidance on developing a code of performance, including variations without an SFL. It is designed to provide examples that meet the objectives of Annex 6, Part III, Section II, Chapter 3, 3.1.1, 3.1.2 and 3.1.3. The manual includes:

- a) a detailed description of:
 - 1) the environment over which operations are conducted, and how it may be classified into hostile and non-hostile² to inform the process of constructing a code of performance;
 - 2) the helicopter airworthiness certification Categories A and B, their relationship to and application within an operational classification; and
 - 3) the performance classes, their development and extensions;
- b) an example of operational objectives using the elements of the environmental classification, certification categories, and performance classes to inform a code of performance;
- c) an example of “helicopter performance and operating limitations” (adapted from an earlier version of Annex 6, Part III, Attachment A);
- d) an example of helicopter “performance regulation” (adapted from an earlier version of Annex 6, Part III, Attachment A);
- e) an introduction to risk assessments, followed by examples of risk assessments that support the introduction of variations without an SFL in a performance code;
- f) examples of variations without an SFL that may be introduced in a code of performance;
- g) a discussion on mitigation — how to:
 - 1) reduce engine abuse and improve reliability of engines with specimen systems for establishing reliability and provide preventative maintenance and trend monitoring;
 - 2) increase the potential for an SFL with pilot training, route planning and selection;

¹ The closely integrated Annexes with respect to “performance operating limitations” include Annex 14; although not mentioned in this introduction, the effect of the “code of performance”, set out in accordance with Annex 6, Part III, Section II, Chapter 3, 3.1.2, has a direct effect on the SARPs of Annex 14.

² Including the subsets of hostile.

- 3) better protect occupants during a forced landing; and
 - 4) enhance post forced landing survival.
-

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Chapter 2

HELICOPTER CODE OF PERFORMANCE BASED ON ESTABLISHED PERFORMANCE CLASSES

2.1 THE ENVIRONMENT OVER WHICH OPERATIONS ARE CONDUCTED

2.1.1 General

Environmental classification informs the process of establishing safe carriage of commercial air transport (CAT) passengers over varied surfaces, terrain, features, and in changing conditions. It is also used for over water operations to ensure an adequate standard of safety equipment is fitted, carried and worn, and appropriate procedures used.

2.1.2 Classifying the environment

All areas to/from and over which operations are conducted are either non-hostile or hostile (see Figure 2-1-1). The definitions contained in Annex 6 are as follows:

Non-hostile environment. An environment in which:

- a) a safe forced landing can be accomplished because the surface and surrounding environment are adequate;
- b) the helicopter occupants can be adequately protected from the elements;
- c) search and rescue response/capability is provided consistent with anticipated exposure; and
- d) the assessed risk of endangering persons or property on the ground is acceptable.

Note.— Those parts of a congested area satisfying the above requirements are considered non-hostile.

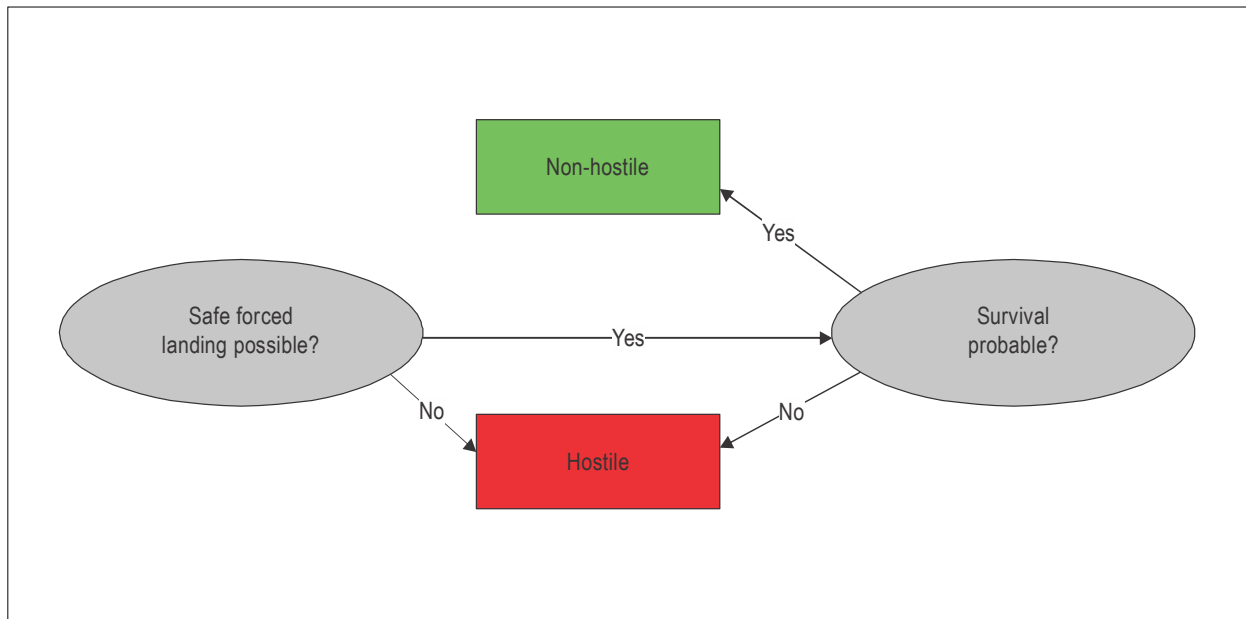


Figure 2-1-1 Hostile/Non-Hostile

Hostile environment. An environment in which:

- a) a safe forced landing cannot be accomplished because the surface and surrounding environment are inadequate; or
- b) the helicopter occupants cannot be adequately protected from the elements; or
- c) search and rescue response/capability is not provided consistent with anticipated exposure; or
- d) there is an unacceptable risk of endangering persons or property on the ground.

2.1.2.1 Safe forced landing (SFL)¹

2.1.2.1.1 The term safe forced landing originates from Annex 6, Part I where it applies to the consequence of an engine failure and forced landing on an unprepared surface with a single-engine aeroplane. Because of the unpredictable nature of arrival of the unpowered aeroplane at the surface — the choice of which has been driven by the limiting nature of the glide and required manoeuvring — there is a probability that the landing will result in damage to the aeroplane.

2.1.2.1.2 The same conditions apply to a helicopter, albeit that the area in which the landing can be achieved will be reduced by the steeper angle of glide and slower forward speed. As with the single-engine aeroplane, there is a probability that the unpowered, or not fully powered, landing will result in damage to the helicopter.

2.1.2.1.3 The outcome of an SFL includes known uncertainty — which is expressed as “...reasonable expectancy of

¹ For additional information on the derivation and meaning of a safe forced landing, see the description in Sections 3.2.2 and 3.2.3.

no injuries to persons in the aircraft or on the surface” in the definition. This uncertainty can be correlated with the safety risk severity category of “Major” as in the example safety risk severity table in the *Safety Management Manual* (Doc 9859):

MAJOR.

- a) A significant reduction in safety margins, a reduction in the ability of operational personnel to cope with adverse operating conditions as a result of an increase in workload or as a result of conditions impairing their efficiency
- b) Serious incident
- c) Injury to persons

2.1.2.1.4 A key element of the environmental classification is the existence of a surface on which a safe forced landing (SFL) (both on land and water) can be carried out. Some surfaces are generally suited for a safe (forced) landing — these include:

- a) runway/helipad
- b) prepared reject area
- c) open field
- d) extensive farms
- e) bog/marsh
- f) shrubs/bushes of a reasonable height
- g) large clearings

Other surfaces do not generally allow for an SFL — these include:

- a) forest/trees
- b) rough terrain
- c) sloping ground
- d) buildings

2.1.2.1.5 Most operating areas consist of a mix of features. These could predominantly be farmland or open fields separated by hedgerows, fences or lines of trees/forest bands, where SFL surfaces are in abundance.

2.1.2.1.6 Alternatively, the area might consist of rough terrain or tree-covered terrain with scattered level areas or clearings. Here, available surfaces for making an SFL will be present but more widely dispersed. These are areas which may be overflowed employing a suitable height and routing, such that the option of an SFL is always maintained.

2.1.2.1.7 Some environments present challenges because surfaces suitable for an SFL are very sparse, or absent, due to the extent and/or density of the features. These areas present the difficulty that a surface suitable for an SFL cannot be reached from a practical height or from any reasonable flight route through the area — these might be extensive tracts of:

- a) forests
- b) mountainous areas
- c) sea areas
- d) congested areas

2.1.2.1.8 The protection of occupants during touchdown and evacuation may also be dependent upon the level of crashworthiness and safety equipment worn and fitted; damage to the helicopter during the landing is accepted but with a reasonable expectation of no injuries.

2.1.2.2 *Safe forced landing (ditching)*

2.1.2.2.1 Over water operations are conducted in the knowledge that emergency situations may arise which may require an immediate or forced landing². Accordingly, Annex 6, Part III, Section II, 2.2.12³ and 4.5.1, specify those circumstances when certification for ditching is required and adequate flotation and safety equipment must be carried; “sea state”⁴ is an integral part of ditching information.

2.1.2.2.2 Experience has shown that ditching/water impact events can lead to avoidable loss of life in otherwise survivable water impacts. There have been avoidable drowning fatalities due to the inability of the occupants to rapidly escape from a capsized and flooded cabin or, after having successfully escaped, their subsequent inability to survive until the rescue services arrived. Even a successful helicopter ditching could still have catastrophic consequences due to the risk of a helicopter capsizing.

2.1.2.2.3 Helicopters flying over water may be certified for ditching or use certified “emergency flotation” systems. Certification for ditching is required for over-water flights in a hostile environment in accordance with Annex 6, Part III, Section II, 2.2.12. In 2018, more stringent design requirements were put into place that required “resistance to capsize in the sea conditions selected by the applicant” for both types of equipment. Both emergency flotation and ditching capability are demonstrated to a certain wave height or sea state. The demonstrated flotation capability should be taken into account to determine tolerance to the expected sea conditions.

2.1.2.2.4 Enhanced design standards were developed to both reduce the likelihood of capsize and further improve the ability of occupants to escape and survive. The amendment to certification improves the probability of survival for occupants in the event of either a helicopter ditching or a survivable water impact. This is achieved by introducing a new flotation stability certification methodology that takes into account the sea conditions for which certification is requested. In addition, the structural ditching provisions have been refined and the physical requirements for emergency exits and seating have been improved to enable occupants to make their escape in the event of either a ditching or a capsize as a result of a survivable water impact. Furthermore, the provisions for emergency flotation systems (EFSs), emergency and survival equipment, and emergency locator transmitters, have been enhanced.

2.1.2.2.5 Following a forced landing in water, the landing (water entry) and subsequent escape by occupants will be conditional upon the efficacy of the equipment — fitted, carried and worn — in the environmental conditions that exist at the time of the event.

² Aircraft emergency checklist contains failures that require pilots to “land immediately” that are not related to engine failure; there are examples of these having occurred in offshore operations in hostile environments.

³ Annex 6, Part III, Section 2, 2.2.12, states that “All helicopters on flights over water in a hostile environment... shall be certificated for ditching. Sea state shall be an integral part of ditching information”. This recognizes that for flight over a non-hostile environment, the fitting of “emergency flotation equipment” will provide sufficient protection.

⁴ The term “sea state” is likely to be replaced in due course by “significant wave height”. The significant wave height H_s is the most common and accepted parameter used to define the representative wave height of an irregular sea state.

2.1.3 Application of the classification

2.1.3.1 Application to forested areas

2.1.3.1.1 Forests may be classified as hostile due to their lack of SFL areas. When assessing the “hostile classification” of forests, consideration has to be given not only to the size of the forest, but also to its contiguous canopy, clearings or grasslands. A suitable height and route selection can also positively affect reaching the next SFL area.

2.1.3.2 Application to mountainous areas

2.1.3.2.1 Mountainous areas may be hostile because of rugged terrain, forestation (the consequential lack of SFL areas), and diminished survival prospects; the effect of density altitude on performance may also have to be considered.

2.1.3.2.2 Hostility due to altitude may have to be carefully assessed; differentiating between the approach and landing, and cruise flight, phases in mountainous areas may be necessary.

2.1.3.3 Application to sea areas

Judgement is required when applying the definition of SFL to over water flights as injury to persons in the aircraft extends beyond the touchdown and includes possible capsizing, the subsequent evacuation and access to safety equipment (such as life vests and life rafts) under, what might be, difficult conditions.

2.1.3.3.1 General

2.1.3.3.1.1 The boundary between hostile and non-hostile for over water flights will depend on the sea state over which the operation is being performed, the certification of the flotation equipment, the additional safety equipment, fitted and worn, and the time to rescue. It is suggested that water surface conditions, equal to or higher than sea state code 4 (see Table 2.1), is one basis for establishing hostility.

2.1.3.3.1.2 When applying a “hostile classification” to sea areas, it may be necessary to decide where the coastline boundary is set. Consideration of estuaries, fjords, and aggregation of offshore islands may be required. The use of the term “open sea areas”⁵ should provide sufficient flexibility to enable each State to determine the coastal boundary that reflects its topographical circumstances.

2.1.3.3.1.3 Sea areas are prone to frequent, and sometime rapid, changes of weather. The sea state and the hostility of the sea may vary. The transient nature of these conditions should be addressed.

2.1.3.3.2 Addressing transient hostility

2.1.3.3.2.1 A study of wave climates along a representative selection of main helicopter routes in the northern North Sea and west of Shetland indicates that sea state code 4 will be exceeded on 26% — 36% of occasions over the entire year. During the winter period between December and February, this increases to between 51% — 65%. When considering such areas for routine offshore operations they can, and should, be regarded as permanently hostile.

2.1.3.3.2.2 There are open sea areas which are primarily hostile but “transiently” non-hostile — the southern North Sea is an example. Conditions cannot be assured for any length of time — sometimes not even over the extent of a flight. In view of this, it may be necessary for the regulator to declare such an area as hostile. This could be achieved by appending a further element to the State definition of hostile specifying where such boundaries might be placed — an example might be:

⁵ In Europe, “open sea area” is now defined as “to seaward of the coastline” and States should define their coastline in their Aeronautical Information Publication (AIP) or other documentation.

"In any case, the following areas shall be considered hostile:

- (i) *For overwater operations, the open sea areas North of 45N⁶ and South of 45S⁷ unless any part is designated as non-hostile by the responsible authority of the State in which the operations take place. [Designation would appear in the relevant AIP.]"*

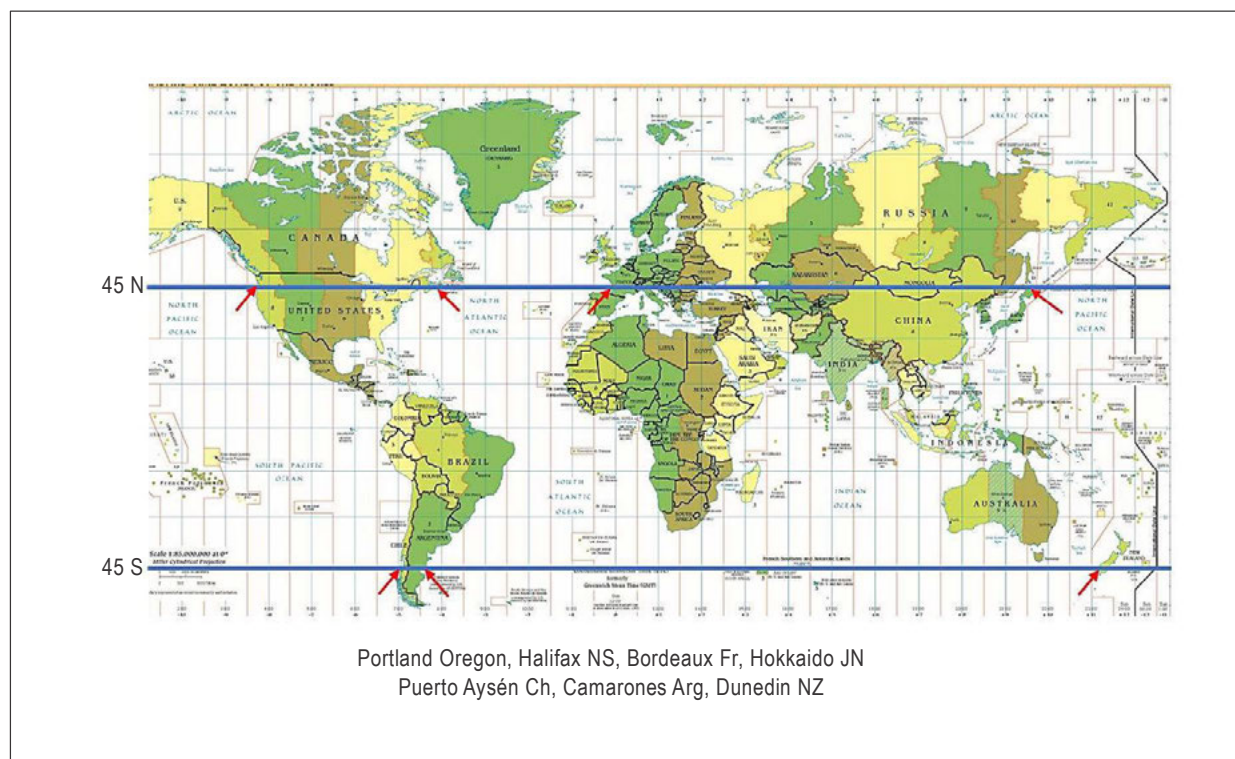


Figure 2-1-2 Boundaries of hostile open-sea areas

2.1.3.3.2.3 There are also open sea areas which are primarily non-hostile but become hostile in some weather patterns — the Gulf of Mexico is an example. Transient hostility should be addressed within the safety management process and should result in an adverse weather policy (this is for operators to provide in their operations manuals as an element of their safety management system). Where operators are in close proximity or serving similar locations, a harmonized adverse weather policy could avoid unnecessary commercial pressure to operate in marginal conditions.

⁶ This northerly line of latitude passes through Portland, Oregon; Halifax, Nova Scotia; Bordeaux, France; and Hokkaido, Japan.

⁷ The southerly line of latitude passes through Puerto Aysén, Chile; Camarones, Argentina; and Dunedin, New Zealand.

2.1.3.4 Application to congested areas

2.1.3.4.1 The definition of a congested area was produced initially for aeroplanes but applies to all air vehicles and is used in the provision of a “land clear” clause. This definition is too broad for helicopters because it precludes an otherwise safe operation over areas where a helicopter autorotation and SFL could be conducted — for example the heli-lanes established in some cities which are, by definition, in congested areas.

2.1.3.4.2 In order to provide the necessary flexibility and permit (safe) helicopter operations over this “assessed”⁸ non-hostile environment, the definition of a congested hostile environment was introduced into Annex 6, Part III.

2.1.3.4.3 This definition was intended to make clear that all parts of a congested area in which an SFL could not be accomplished were hostile; and, conversely, those areas within a congested area where an SFL could be accomplished “without undue hazard to persons and property on the surface” were non-hostile.

2.1.3.4.4 Further clarification of this concept was provided in the ICAO definition of a non-hostile environment — specifically, clause d) and the subsequent *Note*.

2.1.3.4.5 Although the absence of an area for an SFL is the main discriminator for defining a congested hostile environment, third-party risk in open spaces should also be considered.

2.1.3.4.6 This clarification can be used to assist in compliance with Annex 2 — *Rules of the Air*, which contains Standards for flights over a congested area “...without undue hazard to persons or property on the surface”.

Table 2-1.

SEA STATE CODE

(WORLD METEOROLOGICAL ORGANIZATION)

Sea State Code	Description of Sea	Significant Wave Height		Wind Speed
		Metres	Feet	Knots
0	Calm (Glassy)	0	0	0-3
1	Calm (Rippled)	0 to 0.1	0 to 1/3	4-6
2	Smooth (Wavelets)	0.1 to 0.5	1/3 to 1 2/3	7-10
3	Slight	0.5 to 1.25	1 2/3 to 4	11-16
4	Moderate	1.25 to 2.5	4 to 8	17-21
5	Rough	2.5 to 4	8 to 13	22-29
6	Very Rough	4 to 6	13 to 20	28-47
7	High	6 to 9	20 to 30	48-55
8	Very High	9 to 14	30 to 45	56-63
9	Phenomenal	Over 14	Over 45	64-118

⁸ The matter of “assessed by whom” is left moot at this point; there are two possibilities: a static assessment (by the State); or a dynamic assessment (by the pilot — taking into account the transit height). Clearly, a combination of the two would provide maximum flexibility with a safe result.

Notes:

- (1) The significant Wave Height is defined as the average value of the height (vertical distance between trough and crest) of the largest one-third of the waves present.
- (2) Maximum Wave Height is usually taken to be 1.6 x Significant Wave Height; e.g., Significant Wave Height of 6 metres gives Maximum Wave Height of 9.6 metres.
- (3) Winds speeds were obtained from Appendix R of the "American Practical Navigator" by Nathaniel Bowditch, LL.D.: Published by the U.S Naval Oceanographic Office, 1966.

2.2 AIRWORTHINESS CATEGORIES AND THE PERFORMANCE CLASSES

Note.— In this Section, the helicopter certification standards of Parts 27 and 29⁹ are used as examples of Annex 8-compliant airworthiness standards to show the relationship between the airworthiness categories and the performance classes.

2.2.1 General

2.2.1.1 The certification requirements of Parts 27 and 29 are there to facilitate the provision of a helicopter type that is certificated to "normal/small", "transport/large", and "Category A/Category B" — together with appropriate procedures and limitations in the rotorcraft flight manual (RFM).

2.2.1.2 The precise certification standard of any helicopter type reflects the revision status at the time that the type certificate was first issued. As certification standards develop, they are improved but are not applied retrospectively.

2.2.1.3 How and when the RFM procedures, and in some cases limitations, are required to be applied, should be described in a performance classification that is suited to the conduct of operations.

2.2.2 Certification categories — Category A (ICAO)

2.2.2.1 Category A is a helicopter certification standard based on a set of design requirements including engine and system isolation features. Engine isolation ensures that one engine failure is unlikely to lead to a second, and fire in an engine compartment can be detected, contained and/or extinguished. Category A certified helicopters are capable of continued safe flight or landing following any first failure including engines. For Category A certification, continued safe flight and landing is interpreted as continuing on to the original destination (or a suitable alternate) or returning to the point of departure.

2.2.2.2 Category A also includes the provision of performance data so that one engine inoperative (OEI) flight and obstacle clearance from take-off, through climb, cruise and landing can be achieved. This data includes: mass related take-off and landing procedures; heliport/helideck size limitations; climb gradients (or rates of climb and distances); and, one-engine inoperative climb performance graphs to meet the objective:

"a multi-engine helicopter...capable of operations using take-off and landing data scheduled under a critical engine failure concept which assures adequate designated surface area and adequate performance capability for continued safe flight or safe rejected take-off".¹⁰

⁹ Parts 27 and 29 refer to the harmonized text of US Federal Aviation Regulations Parts 27 and 29 and EASA Certification Specifications CS 27 and 29.

¹⁰ Extract taken from the definition of Category A in Annex 8.

2.2.2.3 It should be noted that certification provides a capability and does not set an operational requirement.

2.2.3 Certification categories — Category B (ICAO)

2.2.3.1 Category B is a certification standard for all single-engine or multi-engine helicopters which do not meet the Category A standard. Category B helicopters have no guaranteed ability to continue safe flight in the event of engine or system failure and a forced landing is assumed.

2.2.3.2 Category B performance requires the provision of all engines operating (AEO) hover, climb, and take-off distance data (under Annex 8: where required by operating rules), along with take-off procedures to ensure that, “a landing can be made safely at any point along the flight path if an engine fails”.¹¹

2.2.4 Applicability of Categories A and B in Parts 27 and 29

2.2.4.1 Part 27 — Normal Category/Small Rotorcraft

2.2.4.1.1 Certification in Part 27 is to the “Normal Category/Small Rotorcraft”; this standard is considered to be equivalent to Category B.

2.2.4.1.2 A Part 27 helicopter type may be certificated as Category A if it meets the additional design, installation and performance requirements contained in Appendix C¹² of Part 27 — which contains references to Category A paragraphs contained in Part 29.

2.2.4.2 Part 29 — Transport Category/Large Rotorcraft

The applicability of the Category A and Category B standards is contained in Part 29.1. The significant clauses are:

2.2.4.2.1 **“(b) Large rotorcraft [Transport category] must be certificated in accordance with either the Category A or Category B requirements. A multiengine rotorcraft may be type certificated as both Category A and Category B with appropriate and different operating limitations for each category.”**

2.2.4.2.1.1 This is transparent to the operator only if the RFM contains a clear statement of the “different operating limitation for each category”. This might be in the form of an entry in the limitation section of the RFM of the number of passenger seats or the height velocity (HV) diagram (the HV diagram could be a limitation or be provided as information) or any other operational limitations.

2.2.4.2.2 **“(c) Rotorcraft with a maximum weight greater than 9 072 kg (20 000 pounds) and 10 or more passenger seats must be type certificated as Category A rotorcraft.”**

2.2.4.2.2.1 All the provisions of Category A must be fulfilled – including those that are contained in Subpart B (which means that the RFM is required to contain the Category A performance procedures and graphs and include the HV diagram as a limitation). However, the range of procedures may be limited and might only include that for runway operations.

¹¹ Part 29.63 Take-off: Category B — paragraph (c)

¹² Appendix C to FAR Part 27 outlines “A small multiengine rotorcraft may not be type certificated for Category A operation unless it meets the design installation and performance requirements contained in this appendix in addition to the requirements of this part.”
Note — on the type certificate data sheet (TCDS), these rotorcraft remain certified in the normal/small category with a reference appended to the certification basis for the purposes of Category A.

2.2.4.2.3 “(d) Rotorcraft with a maximum weight greater than 9 072 kg (20 000 pounds) and nine or less passenger seats may be type certificated as Category B rotorcraft provided the Category A requirements of Subparts C, D, E, and F are met.”

2.2.4.2.3.1 The helicopter must meet the “engine and system isolation features” of Category A but does not have to meet the Category A performance criteria.

2.2.4.2.3.2 If the helicopter is dual certificated, the main operational distinctions will be the limit on passenger seat numbers and the HV diagram status.

2.2.4.2.4 “(e) Rotorcraft with a maximum weight of 9 072 kg (20 000 pounds) or less but with 10 or more passenger seats may be type certificated as Category B rotorcraft provided the Category A requirements of CS 29.67(a)(2), 29.87, 29.1517, and of Subparts C, D, E, and F are met.”

2.2.4.2.4.1 This is a Category B helicopter with the majority of the features required under Category A: although the helicopter must meet the Category A “engine and system isolation features”, the only Subpart B, Category A elements that have to be provided are the second segment climb and the HV diagram limitation. No Category A take-off and landing procedures have to be included in the RFM.

2.2.4.2.5 “(f) Rotorcraft with a maximum weight of 9 072 kg (20 000 pounds) or less and nine or less passenger seats may be type certificated as Category B rotorcraft.”

2.2.4.2.5.1 This is a Category B helicopter.

2.2.4.2.5.2 If the helicopter is dual certificated under 29.1(e) and (f), it will have the “engine and system isolation features” of Category A; the main operational distinctions will be the limit on passenger seats and the HV diagram status.

2.2.5 Direct application of certification categorization to operations

2.2.5.1 General

2.2.5.1.1 All performance procedures in the RFM remain optional unless mandated in the RFM or specified by an operational rule. As a result, application to the operations domain depends on the performance code.

2.2.5.1.2 The majority of helicopters in current use are “small” ($\leq 3\,175$ kg (7 000 lbs) with nine or fewer passenger seats) certificated under Part 27¹³; these helicopters are mostly certificated in Category B (or equivalent) but include several sophisticated multi-engine types — some of which are (additionally) certificated in Category A in accordance with Appendix C of Part 27.

2.2.5.1.3 For helicopters certificated under Part 29, the picture is more complex. Multi-engine helicopters may be certificated as Category A, Category B or both with appropriate and different operating limitations for each category.

2.2.5.2 Application of certification in Category B

2.2.5.2.1 Certification does not prescribe how a Category B (or equivalent) certificated helicopter is flown. Performance data and procedures that are deemed safe are provided in the RFM. HV curves are provided outside the limitation section of the RFM (except for Category B helicopters certified under 29.1(e)).

¹³ The mass and passenger limitation are the maximum permitted (Part 27.1(a)).

2.2.5.2.2 Certification does not restrict the type of surface over which the take-off (or landing) might be conducted in operations nor consider the obstacle environment. Flight manuals provide a take-off and landing procedure that remains clear of the HV curve.

2.2.5.2.3 It is left to the operational regulations to specify how and when Category B performance data and procedures are applied.

2.2.5.3 Application of certification in Category A

2.2.5.3.1 Certification also does not prescribe how a Category A certificated helicopter is flown. Category A performance data and procedures (more than one in most cases) are provided. The HV diagram should be in the limitations section unless the approved Category A procedures are mandated in the RFM.

2.2.5.3.2 In some States, the definition of Category A includes the term “utilizing...” rather than “capable of operations using...” “take-off and landing data”. If the term “utilizing” is considered by the State to be prescriptive, it could preclude the use of a Category A helicopter at a site other than one which meets the Annex 14, performance Class 1 standard or be dual certificated and restricted to carriage of nine or fewer passengers.

2.2.5.3.3 It is left to the operational regulations to specify how and when the Category A performance data and procedures are applied. This can be achieved by being very specific in the operational regulations (i.e. requires the use of Category A certified helicopter flown in accordance with the Category A limitations and procedures of the RFM).

2.2.5.3.4 If the helicopter is certificated only under Category A, these procedures and limitations are mandatory independent of any requirements in a performance code.

2.2.6 Three performance classes

2.2.6.1 There is a need for more precise “operational” terms, since the terms “operating in Category A” and “operating in Category B” have:

- a) no understanding of the operational environment;
- b) no knowledge of the surfaces to, from and over which operations are conducted; and
- c) no accepted regulatory meaning in operations.

2.2.6.2 It is necessary to specify, in operational requirements, how and when the certificated procedures, and in some cases limitations, are to be applied. This can be achieved by mapping from certification capability to operations using a three-level classification as follows:

2.2.6.2.1 Helicopters:

- a) Certificated in Category A, with take-off and landing procedures, can¹⁴ continue to destination (or suitable alternate) or return to the point of departure with engine failure accountability — this requires either:
 - 1) a runway and the associated profile; or
 - 2) a specific Category A procedure/profile and, in some cases, the application of a restricted take-off mass;

¹⁴ If the RFM contains the specified take-off procedure.

- b) certificated in 29.1(e) without take-off and Category A landing procedures, can achieve OEI climb at a defined speed — at a specified take-off mass;
- c) certificated in Category B have AEO take-off and landing procedures — at the maximum take-off mass.

2.2.6.2.2 These capabilities, in respect of surface dimensions, space and mass, are reflected in the three performance classes:

- a) performance Class 1: reflects the capability specified in a);
- b) performance Class 2: reflects the capability specified in b) and c); and
- c) performance Class 3: reflects the capability specified in c).

2.2.6.3 There is correlation between the Category A take-off and landing procedures defined in Part 29 and those required for operation in Performance Class 1 — and in some cases Performance Class 2¹⁵.

2.2.6.4 There is correlation between the take-off and landing procedures defined in Part 27 and Category B in Part 29, and those required for operation in performance Classes 2 and 3. Both require a corridor and surface over which to accelerate to the knee of the HV curve.

2.2.6.5 Under Part 29, the Category B procedures include establishment of:

For the Category B take-off:

- a) the take-off weight/altitude/temperature (WAT);
- b) the defined surface;
- c) the distance required to take-off and climb over a 15 m (50 ft) obstacle; and
- d) a profile outside of the HV curve such that a safe landing can be made at any point along the flight path if an engine fails.

For the Category B landing:

- a) the landing WAT;
- b) a defined surface;
- c) the landing distance from 15 m (50 ft); and
- d) a profile outside of the HV curve such that a safe landing can be made at any point along the flight path if an engine fails.

2.2.6.6 Sections 2.3, 2.4 and 2.5 further explain how the performance classes may be implemented.

¹⁵ Where the mass and the profile can be used but the surface would not permit a reject without damage to the undercarriage/helicopter.

2.2.7 Summary

2.2.7.1 Helicopter types certificated in Category A are capable of operations in Performance Class 1, 2 or 3.

2.2.7.2 Helicopter types certificated in Category B in accordance with 29.1(e) are capable of operations in performance Classes 2 or 3.

2.2.7.3 Helicopter types certificated in accordance with the performance provision in Part 27 and in Category B under the provisions of Part 29.1(d) and (f) are capable of operations in performance Class 3.

2.2.7.4 The Category A provisions in Part 29 meet the “engine and system isolation features” such that the malfunction of an engine, failure of a system or the required action of the crew to resolve an abnormal condition will not prevent continued safe flight. These requirements conform to the standard for operations in performance Classes 1 and 2.

2.2.7.5 The terms “Category A Operation” contained in Appendix C to Part 27, and “Category A (B) Operation¹⁶” in RFMs that are both Categories A and B certified, have no direct application to operations unless referred to in a performance code.

2.2.7.6 The “code of performance” should apply a mapping between the certification codes of Category A and B and the operational classification. Such a classification should be based upon the number of passengers carried and have consideration of the surface conditions to, from, and over which the flight is being conducted.

2.3 PERFORMANCE CLASS 1 (PC1)

2.3.1 Introduction

This Section discusses the fundamentals of operating in performance Class 1 as contained in Annex 6, Part III, Section II, Chapter 3.

2.3.2 What does Category A bring to performance Class 1?

Category A (see Section 2.2.2), is a helicopter certification standard which provides assurance of continued flight with the use of redundancy, design assessment and engine isolation to reduce the probability of, or provide tolerance to, engine failure. It also requires the provision of performance data and specific take-off and landing profiles (see Figure 2-3-1).

¹⁶ Also used are variations such as “Operations in Category A” or “Operations in Category B”.

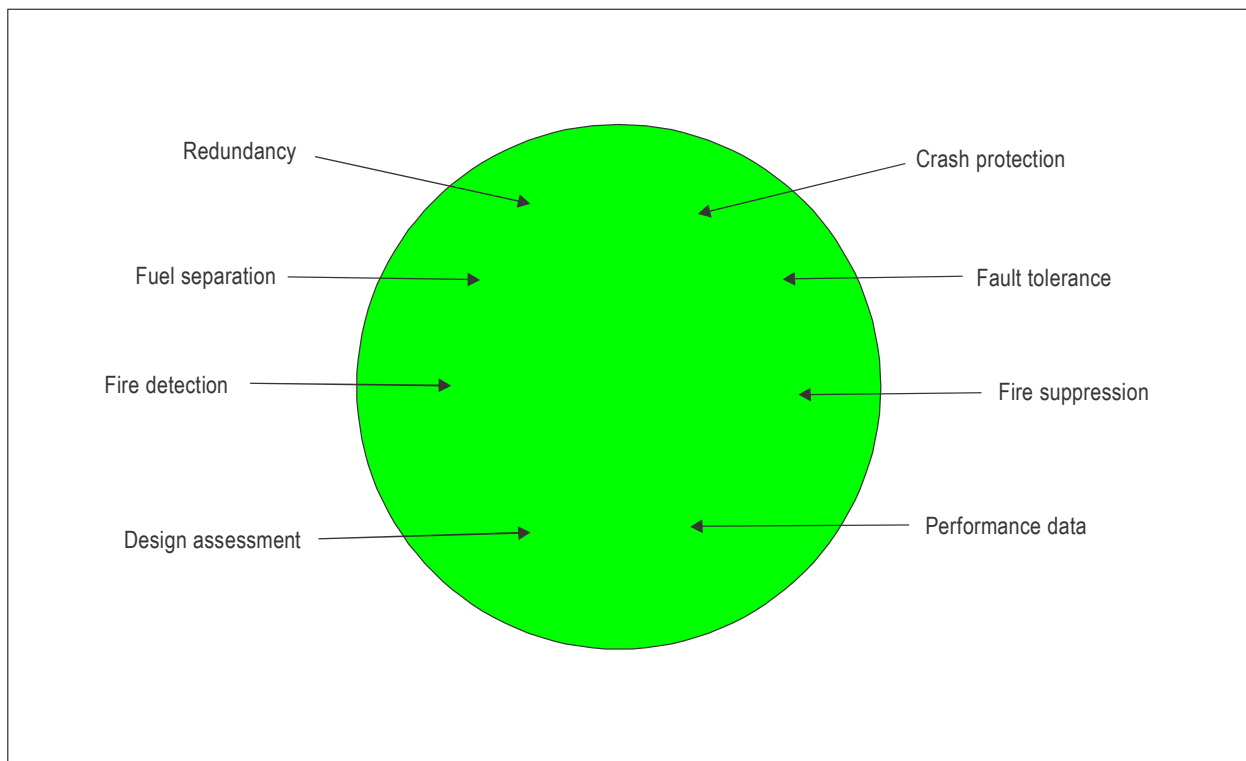


Figure 2-3-1 Category A Certification

2.3.3 Obstacle clearance — PC1 take-off

2.3.3.1 The Category A procedures provide non-adjusted profiles — i.e. they specify only the climb performance required by the rule (not a gradient¹⁷) and take-off mass is established in a weight/altitude/temperature (WAT) graph. Although a specific Category A procedure takes account of obstacles within the take-off distance required (helicopter) (TODRH), it has no knowledge of those in the take-off flight path.

2.3.3.2 Helicopter procedures derive from aeroplane Category A procedures. At an aerodrome, the approach and take-off climb surface slope profile is standard, or known, and promulgated. This permits the aeroplane manufacturer to provide Category A procedures with take-off climb gradients that can be used universally.

2.3.3.3 Heliports have had a much more informal development path: generally, surface areas are provided and declared, and manufacturers provide basic climb data. PC1 can be employed at aerodromes with standard gradients, or at heliports in obstacle-rich environments — using the unique characteristics of helicopters and coupled with specific and flexible Category A procedures. The downside to this flexibility is that obstacle clearance is put within the ambit of operational requirements and the precise flight path (clearing all obstacles) must be established by the operator.

2.3.3.4 Take-off procedures divide into two distinct groups¹⁸: runway-type procedures — with or without obstacles in the take-off flight path (shown in Figures 2-3-2, 2-3-3 and 2-3-4); and those with a vertical element — with obstacles in the take-off distance required and, perhaps, in take-off flight path (shown in Figures 2-3-5 to 2-3-7 below).

¹⁷ Although gradients are provided by some manufacturers.

¹⁸ These groupings are addressed in the two variants of the definition of take-off distance required shown in 2.4.2 — Definitions.

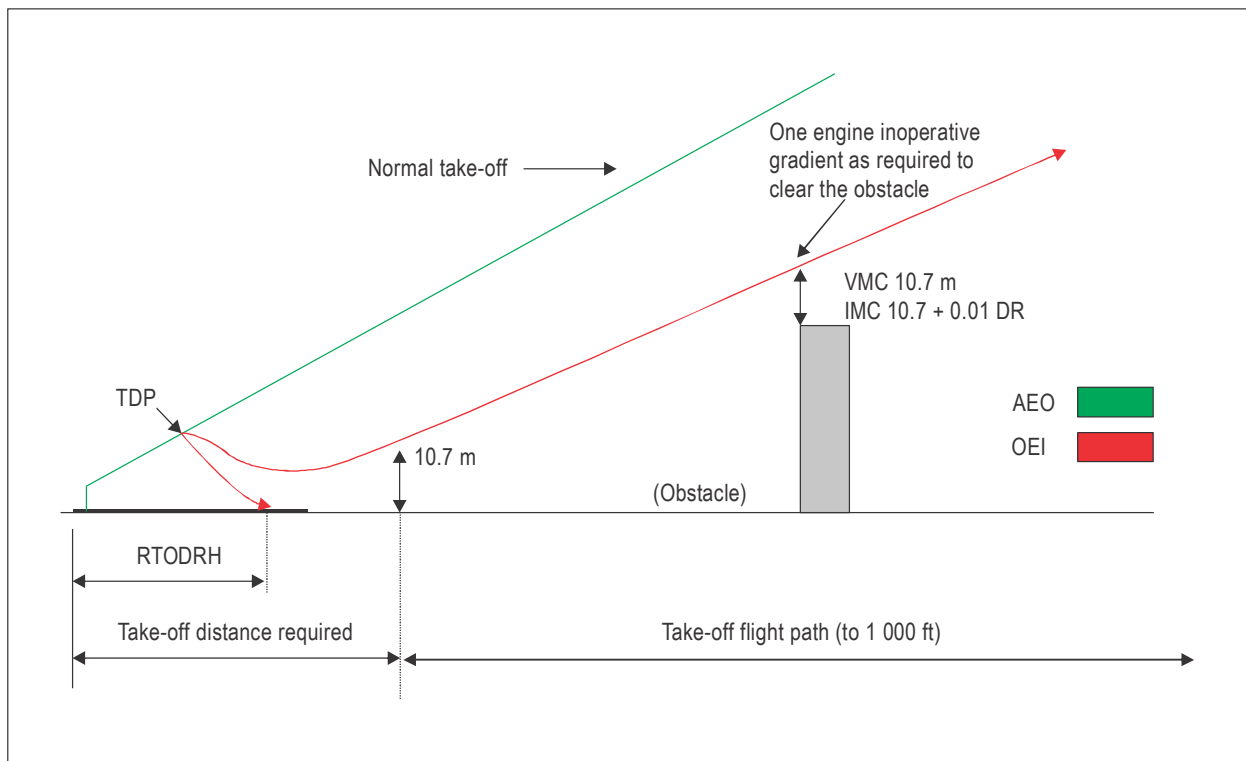


Figure 2-3-2 Performance Class 1 take-off (side view)

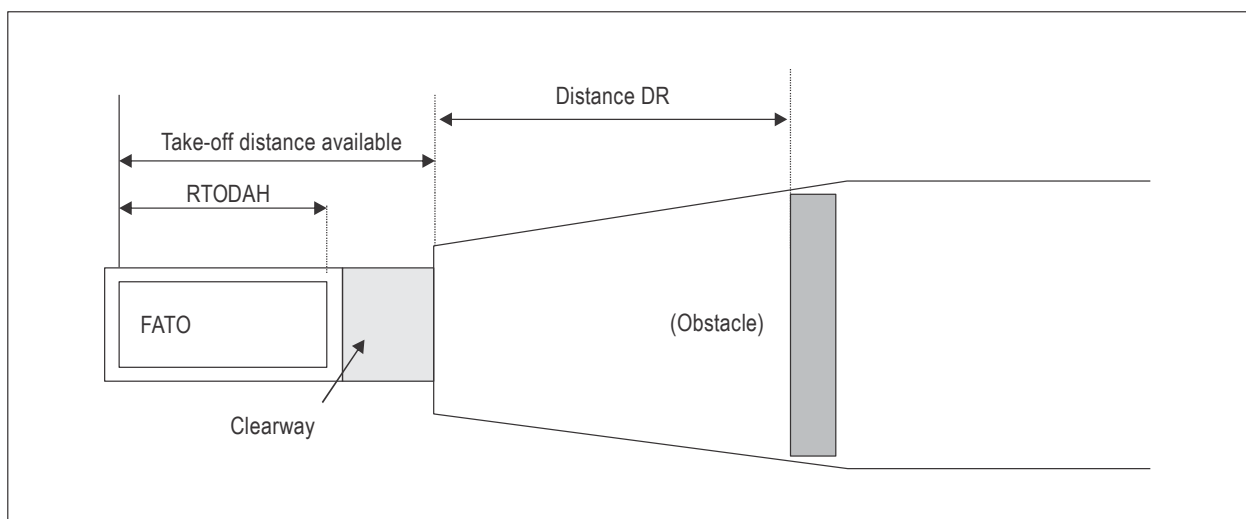


Figure 2-3-3 Performance Class 1 take-off (plan view)

2.3.4 PC1 take-off using Category A procedures

2.3.4.1 There are basically three types of Category A procedures (different names may be used in RFMs): the clear area; the restricted area; and the helipad (ground level and elevated):

2.3.4.1.1 **The clear area procedure** (Figure 2.3.4): is a runway-type procedure that is normally provided to fulfil the minimum requirement¹⁹ for the Category A data specified in Parts 27 and 29. Distances will be provided and consist of: the rejected take-off distance required (helicopter) (RTODRH); the take-off distance required (helicopter) (TODRH); the landing distance required (helicopter) (LDRH); the first and second segment climb performance data; and the distance to V_Y at 60 m (200 ft) (the start of the second segment).

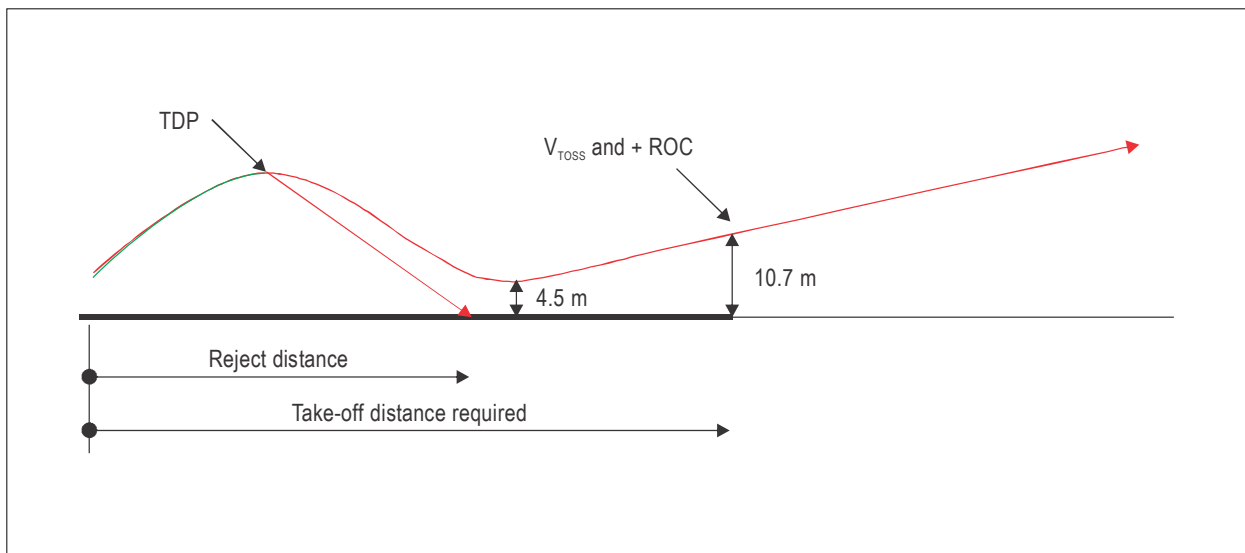


Figure 2-3-4 Clear area procedure

¹⁹ When this is provided, the helicopter can be designated as a Category A helicopter.

2.3.4.1.2 **The restricted area (confined space) procedure** (Figure 2-3-5); can be provided in a number of ways; an oblique steep climb, or vertical climb procedure - both with an oblique rejected take-off - are two common examples. As with the clear area procedure, distances will be provided. Features of this procedure are access to variable V_{TOSS} (which can reduce the take-off distance, against a possible reduction in take-off mass), and a variable take-off decision point (TDP) which, as it is raised, will permit higher-obstacles to be cleared (min-dip²⁰ must be set to 10.7 m (35 ft) above the highest obstacle in the continued take-off). The main constraint in this procedure is the amount of rejected take-off distance available — i.e. an oblique reject will require more space as the height of the TDP increases. A vertical reject can be used but it introduces visibility issues because of the limited field of vision ahead of the helicopter; this can be partially resolved by adding a sideways element to the vertical climb and providing visibility through the chin window or pilot's door.

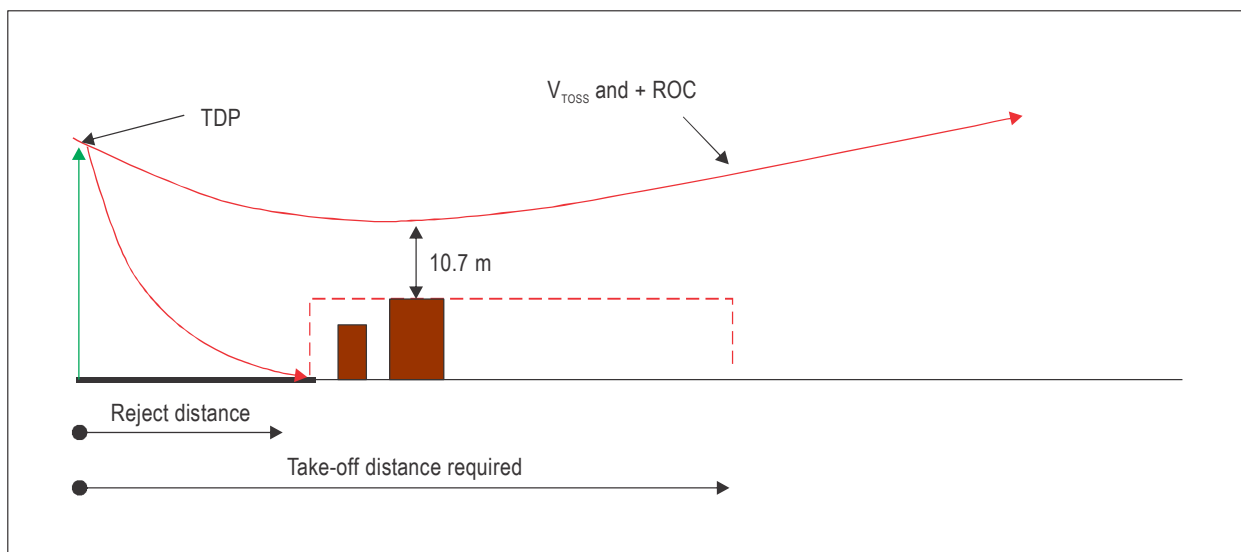


Figure 2-3-5 Restricted area procedure

2.3.4.1.3 **Helipad procedures** (Figures 2-3-6 and 2-3-7); have a single common feature in that the rejected take-off is restricted to the helipad (TLOF/FATO) itself. This procedure can be at ground-level or elevated and features a vertical or rearward/sideways climb (which must afford sufficient visibility to provide a return to the take-off surface should an engine fail before TDP).

2.3.4.1.3.1 The vertical climb element can be tailored to the application²¹ allowing for higher obstacles in the take-off flight path. For ground-level or elevated heliports where there are no obstacles behind the aircraft, the vertical section can be in a rearward climb area and, if facilitated in the RFM, the TDP can be set to a height which provides the specified clearance over obstacles at min-dip.

²⁰ The lowest point in the continued take-off.

²¹ For a helideck where there can be obstacles behind the helicopter, the (purely) vertical section is short and the TDP not normally set higher than 30ft (9 m).

2.3.4.1.3.2 Drop-down beyond the helipad, following an engine failure after TDP, can be used to gain speed where the obstacle environment permits.

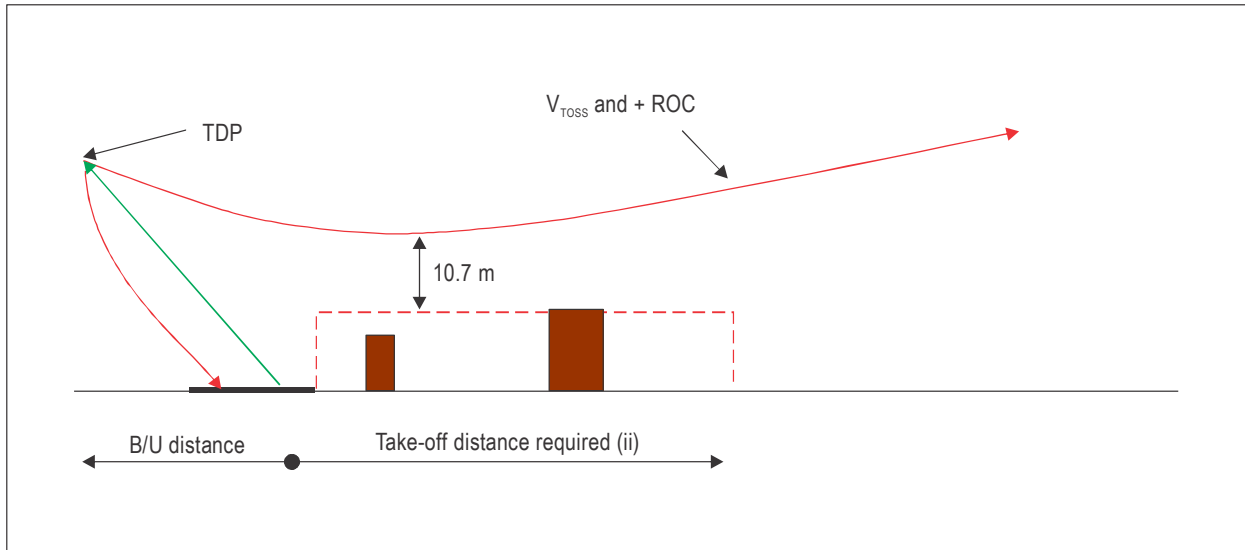


Figure 2-3-6 Helipad procedure

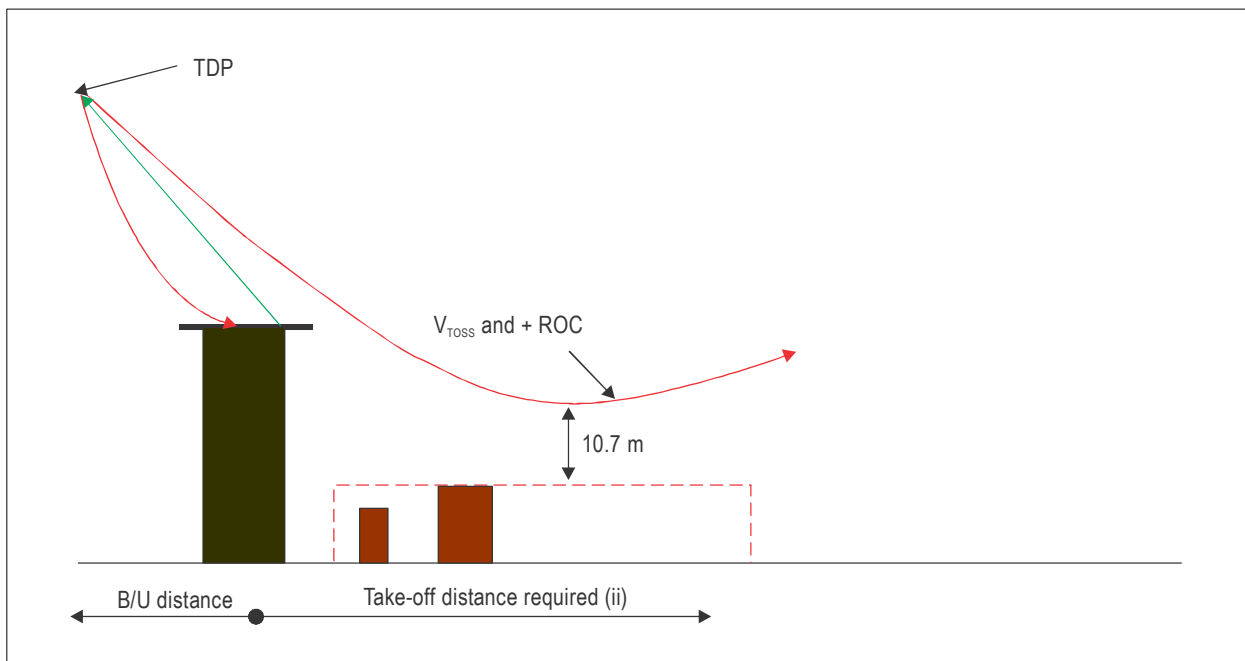


Figure 2-3-7 (Elevated) helipad procedure

2.3.4.1.4 As procedures become more configurable, they provide a toolbox of profiles and graphs that can be tailored to any location. The more power to weight ratio the helicopter has, the more configurable the TDP can be and fewer profiles are required. Helicopters having a higher power to weight ratio also benefit from a slower descent following an engine failure before TDP.

2.3.5 Obstacles in the back-up area of helipad procedures

2.3.5.1 With the advent of back-up procedures for ground-level sites, and the use of elevated heliports located in an obstacle-rich environment, came the need to provide guidance on obstacle clearance in the back-up area. The following text shows how obstacles in the back-up area can be tolerated²².

2.3.5.2 As can be seen in Figures 2-3-8 and 2-3-9, the obstacle accountability area is an inclined plane — or a combination of planes — sloping upwards and backwards from the end of the safety area, centred on a line passing through the centre of the FATO and contained within a defined area.

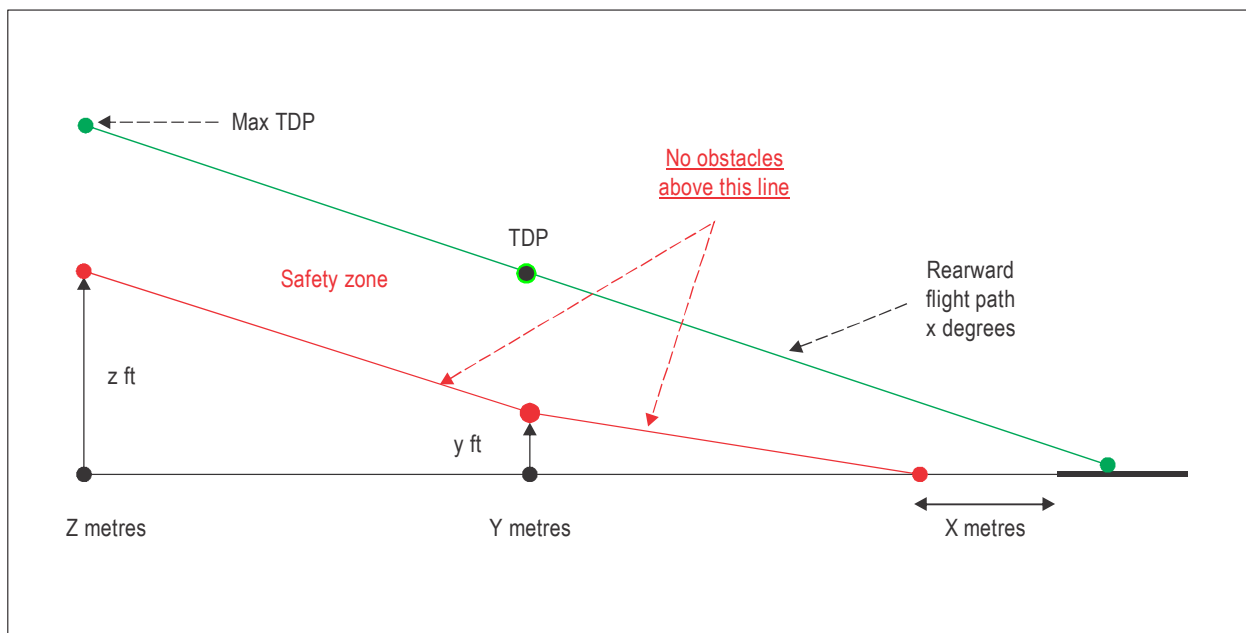


Figure 2-3-8 Obstacle accountability area (side view)

²² This discussion on obstacles in the back-up area is not well reflected in Annex 14, Volume II; there is a (logical) assumption within Annex 14 that the slopes in the approach path (the back-up area) will be obstacle free. However, that may not be a true reflection of the conditions that might prevail in some operational heliports utilizing these procedures.

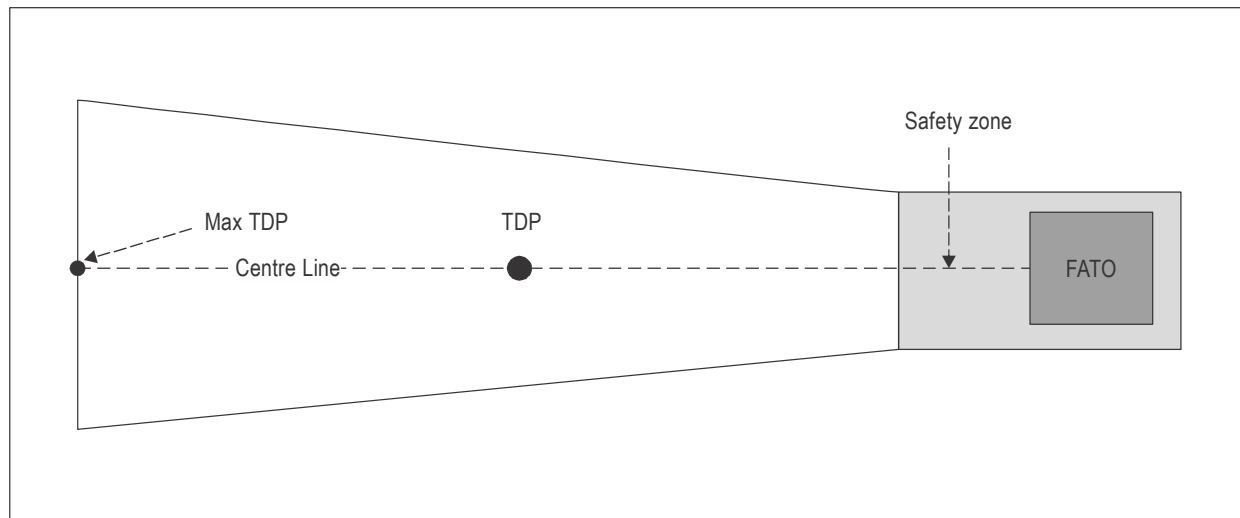


Figure 2-3-9 Obstacle accountability area (plan view)

2.3.5.3 *The back-up area*

2.3.5.3.1 The characteristics of the back-up area are:

- a) An inner edge horizontal and equal in length to the specified width of the FATO plus the safety zone, perpendicular to the centre line and located at the edge of the safety zone.
- b) Two side edges originating at the ends of the inner edge diverging uniformly at a specified rate from the vertical plane containing the centre line of the FATO (the specified rate might be 10 per cent for day operations and 15 per cent for night).
- c) An outer edge horizontal and perpendicular to the centre line at a specified height above the elevation of the FATO (the highest TDP for the procedure).

2.3.5.3.2 The elevation of the inner edge should be the elevation of the safety zone at the point on the inner edge that is intersected by the centre line of the obstacle limitation plane.

2.3.5.3.3 The slope of the plane (or combination of planes) should be measured in the vertical plane containing the centre line.

2.3.5.4 *Establishment of the obstacle clearance plane(s)*

2.3.5.4.1 It should be established that obstacles can be cleared in the three phases of the back-up take-off procedure:

- a) the back-up manoeuvre;

- b) the rejected take-off; and
 - c) the continued take-off.
- 2.3.5.4.2 The profile of each of these manoeuvres should be considered in establishing obstacle clearance:
- a) In the back-up; the pilot has few visual cues and should rely upon the altimeter and sight picture through the front, or chin, window (if flight path guidance is not provided) to achieve an accurate rearward flight path.
 - b) In the rejected take-off; the pilot should be able to manage the descent which permits a landing on the FATO, while ensuring clearance from obstacles.
 - c) In the continued take-off; the pilot should be able to accelerate to V_{TOSS} while ensuring a 10.7 m (35 ft) clearance from obstacles.
- 2.3.5.4.3 The manufacturer producing the profile (and procedure) should ensure that the construction (and testing) of the defined area permits obstacle clearance in all three phases when flown by a pilot without using exceptional piloting skills.
- 2.3.5.4.4 There will be occasions when the arrival and departure segments are not diametrically opposed, or when the back-up procedure has a lateral element; neither of these cases is specifically addressed in the example code in the Attachment to Appendix of Chapter 2²³, and it remains the responsibility of the operator to ensure that obstacle clearance is planned and achieved.

2.3.6 Additional flexibility — PC1 take-off using partial Category A data

- 2.3.6.1 The definition of Performance Class 1 does not require the operator to apply a Category A procedure. Compliance can be shown with alternative methods which provide engine failure accountability using hover out-of-ground-effect (HOGE) OEI performance²⁴, and procedures providing obstacle clearance (the distances from the scheduled data of any Category A procedure can be used and is likely to be conservative).
- 2.3.6.2 The continued take-off clearances/distances (shown in Figure 2.3.10 below) depend upon the operator/pilot either: overlaying the profile on an existing Category A profile; or, when using a vertical climb, ensuring that the vertical section of the profile is flown with enough (vertical) speed that an engine failure (when recognized at the take-off decision point (TDP)) will not cause the helicopter to descend below the horizontal plane of the TDP when rotation is applied.
- 2.3.6.3 The use of this alternative removes the need for heliport sizes prescribed by Category A rejected take-off and/or landing procedures, provided adequate visual cues are available.
- 2.3.6.4 The TDP and the landing decision point (LDP) are still defined, but the OEI hover capability allows them to be shifted vertically — as required for obstacle clearance — providing that visual cues are sufficient to permit a re-land from the TDP or continuation of the landing from the LDP.
- 2.3.6.5 The helicopter at TDP will be at zero (forward) speed and will not have a “calibrated” climb capability until it reaches V_{TOSS} .

²³ The procedure with a lateral transition is mentioned but only to ensure that responsibility for obstacle clearance is specifically placed with the operator (who alone has access to all of the salient dimensions).

²⁴ This is mentioned in the guidance of FAA AC 29-2C.