

Doc 8168
OPS/611



**Procedures for
Air Navigation Services**

Aircraft Operations

**Volume I
Flight Procedures**

This edition incorporates all amendments approved by the Council prior to 3 October 2006 and supersedes, on 23 November 2006, all previous editions of Doc 8168, Volume I.

Fifth edition – 2006

International Civil Aviation Organization



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AMENDMENTS

Amendments are announced in the supplements to the *Catalogue of ICAO Publications*; 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

1. INTRODUCTION

1.1 The *Procedures for Air Navigation Services — Aircraft Operations* (PANS-OPS) consists of two volumes as follows:

Volume I — *Flight Procedures*

Volume II — *Construction of Visual and Instrument Flight Procedures*

The division of the PANS-OPS into the two volumes was accomplished in 1979 as a result of an extensive amendment to the obstacle clearance criteria and the construction of approach-to-land procedures. Prior to 1979, all PANS-OPS material was contained in a single document. Table A shows the origin of amendments together with a list of the principal subjects involved and the dates on which the PANS-OPS and the amendments were approved by the Council and when they became applicable.

1.2 Volume I — *Flight Procedures* describes operational procedures recommended for the guidance of flight operations personnel and flight crew. It also outlines the various parameters on which the criteria in Volume II are based so as to illustrate the need to adhere strictly to the published procedures in order to achieve and maintain an acceptable level of safety in operations.

1.3 Volume II — *Construction of Visual and Instrument Flight Procedures* is intended for the guidance of procedures specialists and describes the essential areas and obstacle clearance requirements for the achievement of safe, regular instrument flight operations. It provides the basic guidelines to States, and those operators and organizations producing instrument flight charts that will result in uniform practices at all aerodromes where instrument flight procedures are carried out.

1.4 Both volumes present coverage of operational practices that are beyond the scope of Standards and Recommended Practices (SARPs) but with respect to which a measure of international uniformity is desirable.

1.5 The design of procedures in accordance with PANS-OPS criteria assumes normal operations. It is the responsibility of the operator to provide contingency procedures for abnormal and emergency operations.

2. COMMENTARY ON THE MATERIAL CONTAINED IN VOLUME I

2.1 Part I — Flight Procedures — General

2.1.1 Section 1 — Definitions, abbreviations and acronyms

This section contains a description of the terminology to assist in the interpretation of terms which are used in the procedures and have a particular technical meaning. In some cases, the terms are defined in other ICAO documents. A list of abbreviations and acronyms is also provided.

2.1.2 Section 2 — General principles

Section 2 provides general principles to flight procedures such as accuracy to fixes and turn area construction.

2.1.3 Section 3 — Departure procedures

2.1.3.1 The specifications concerning instrument departure procedures were developed by the Obstacle Clearance Panel (OCP) in 1983. The material contained in Volume I was developed from criteria contained in Volume II and prepared for the use of flight operations personnel and flight crew.

2.1.3.2 The procedures include areas and obstacle clearance criteria for the instrument departure phase of flight covering the airborne portion of the take-off and climb to a point where obstacle clearance criteria associated with the next phase of flight are applicable. Minimum flight altitudes for each ATS route are determined and promulgated by each Contracting State in accordance with Annex 11, Chapter 2, 2.21.

2.1.3.3 Contingency procedures are required to provide for any situation in which the aeroplane is unable to utilize these instrument departure procedures. It is the responsibility of the operator to ensure that the performance requirements of Annex 6 are met by the provision of contingency procedures.

2.1.4 Section 4 — Arrival and approach procedures

These procedures were first developed by the Operations Division in 1949 and were approved by the Council for inclusion in the PANS-OPS in 1951 and have since been amended a number of times. In 1966, the Obstacle Clearance Panel (OCP) was created to update these procedures for application to all types of aeroplanes taking into account requirements for subsonic multi-jet aeroplanes and technical developments with respect to standard radio navigation aids. As a result of this work, instrument approach procedures were completely revised. The new procedures were incorporated in 1980 in the First Edition of Volume I of PANS-OPS (Amendment 14).

2.1.5 Section 5 — En-route criteria

En-route obstacle clearance criteria were added to the document on 7 November 1996 as a result of the tenth meeting of the Obstacle Clearance Panel. The criteria were amended in 2004 to include simplified en-route criteria.

2.1.6 Section 6 — Holding procedures

The specifications concerning holding procedures were first developed by the Operations Division in 1949 and were approved by the Council for inclusion in the PANS-OPS in 1951. A major revision of this matter was accomplished in 1965 as a result of the work of the Holding Procedures Panel (HOP). The material developed by the HOP was subsequently divided in 1979 and that part of the material concerning flight operations was incorporated in PANS-OPS, Volume I, and the material covering the construction of holding procedures incorporated in Volume II. In 1982, as a result of the work of the Obstacle Clearance Panel, new material and changes to the old material were introduced concerning VOR/DME holding, use of holding procedures by helicopters, buffer areas and entry procedures. In 1986, changes were introduced concerning the VOR TO/FROM indication error zone, and holding speeds, particularly above 4 250 m (14 000 ft).

2.1.7 Section 7 — Noise abatement procedures

2.1.7.1 Noise abatement procedures were developed by the Operations Panel (OPSP) and approved by the Council for inclusion in the PANS-OPS in 1983. These procedures were amended in 2001 by the Committee of Aviation Environmental Protection (CAEP).

2.1.7.2 For related provisions, see Annex 16, Volume I, and Annex 6, Part I.

2.1.8 Section 8 — Procedures for use by helicopters

Conditions under which the criteria in Part I may be applied to helicopters are specified in this section, which was revised at the third meeting of the HELIOPS Panel to include provisions on operational constraints on helicopter descent gradient and minimum final approach airspeeds. As a result of the fourth meeting of the HELIOPS Panel, specifications concerning flight procedures and the obstacle clearance criteria for use by helicopters only are included in this section.

2.1.9 Section 9 — Procedures for the establishment of aerodrome operating minima

Note.— This material is under development and no text is presently available. For related material, see Annex 6.

2.2 Part II — Flight Procedures — RNAV and Satellite-based

2.2.1 Section 1— General

This section contains general information on area navigation (RNAV) and satellite-based flight procedures. Material on TAA, SBAS and GBAS were added as a result of the thirteenth meeting of the Obstacle Clearance Panel (Amendment 13).

2.2.2 Section 2 — Departure procedures

Area navigation (RNAV) departure material regarding VOR/DME and DME/DME was included in 1995 (Amendment 9). Material on basic GNSS and RNP was added in 2001 (Amendment 11), and SBAS and GBAS in 2004 (Amendment 12).

2.2.3 Section 3 — Arrival and non-precision approach procedures

Area navigation (RNAV) approach material regarding VOR/DME and DME material was included in 1993 (Amendment 7). Material on basic GNSS and RNP was added in 2001 (Amendment 11), and GBAS in 2004 (Amendment 13).

2.2.4 Section 4 — Approach procedures with vertical guidance

Material on barometric vertical navigation (baro-VNAV) was added in 2001 (Amendment 11).

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2.2.5 Section 5 — Precision approach procedures

Material on GBAS Category I was added in 2004 (Amendment 13).

2.2.6 Section 6 — RNAV holding

Area navigation (RNAV) holding procedures based on VOR/DME were included as a result of the ninth meeting of the Obstacle Clearance Panel, to become applicable in 1993 (Amendment 7).

2.2.7 Section 7 — En route

Material on RNAV and RNP routes was added in 1998 (Amendment 11).

2.3 Part III — Aircraft Operating Procedures

2.3.1 Section 1 — Altimeter setting procedures

The altimeter setting procedures were developed from the basic principles established by the third session of the Operations Division in 1949 and are the result of evolution through the recommendations of a number of Regional Air Navigation Meetings. They formerly appeared as Part 1 of the *Regional Supplementary Procedures* (Doc 7030) and had previously been approved by the Council for use in the majority of ICAO regions as supplementary procedures. Part 1 of Doc 7030 now contains only regional procedures which are supplementary to the procedures contained in this document. The incorporation of these procedures in the PANS-OPS was approved by the Council in 1961 on the understanding that this action was not to be construed as a decision of principle on the question of flight levels or on the relative merits of metres or feet for altimetry purposes. Subsequently the Council approved the definitions of flight level and transition altitude. To comply with Amendment 13 to Annex 5, the primary unit of atmospheric pressure was changed to hectopascal (hPa) in 1979.

2.3.2 Section 2 — Simultaneous operations on parallel or near-parallel instrument runways

In 1990 as a result of the work of an air navigation study group, new material was included concerning specifications, procedures and guidance material relating to simultaneous operations on parallel or near-parallel instrument runways, including the minimum distances between runways.

2.3.3 Section 3 — Secondary surveillance radar (SSR) transponder operating procedures

These procedures were originally developed at the Sixth Air Navigation Conference in 1969. The operating procedures are intended to provide international standardization for the safe and efficient use of SSR and to minimize the workload and voice procedures for pilots and controllers.

2.3.4 Section 4 — Operational flight information

Material related to Operational Flight Information was added to the PANS-OPS as a result of conclusion 9/30 of ASIA/PAC Air Navigation Planning and Implementation Regional Group.

2.3.5 Section 5 — Standard operating procedures (SOPs) and checklists

Material related to standard operating procedures was added to the PANS-OPS as result of conclusion 9/30 of ASIA/PAC Air Navigation Planning and Implementation Regional Group.

2.3.6 Section 6 — Voice communication procedures and controller-pilot data link communications procedures

Note.— This material is under development and while no text is presently available in this document, provisions and procedures relevant to aircraft operations have been combined with those concerning the provision of air traffic services in Annex 10, Volume II, and the Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM) (Doc 4444).

3. STATUS

Procedures for Air Navigation Services (PANS) do not have the same status as SARPs. While the latter are *adopted* by the Council in pursuance of Article 37 of the Convention and are subject to the full procedure of Article 90, PANS are *approved* by the Council and are recommended to Contracting States for worldwide application.

4. IMPLEMENTATION

The implementation of procedures is the responsibility of Contracting States; they are applied in actual operations only after, and in so far as States have enforced them. However, with a view to facilitating their processing towards implementation by States, they have been prepared in a language which will permit direct use by operations personnel. While uniform application of the basic procedures in this document is very desirable, latitude is permitted for the development of detailed procedures which may be needed to satisfy local conditions.

5. PUBLICATION OF DIFFERENCES

5.1 The PANS do not carry the status afforded to Standards adopted by the Council as Annexes to the Convention and, therefore, do not come within the obligation imposed by Article 38 of the Convention to notify differences in the event of non-implementation.

5.2 However, attention of States is drawn to the provision of Annex 15 related to the publication in their Aeronautical Information Publications of lists of significant differences between their procedures and the related ICAO procedures.

6. PROMULGATION OF INFORMATION

The establishment and withdrawal of and changes to facilities, services and procedures affecting aircraft operations provided in accordance with the procedures specified in this document should be notified and take effect in accordance with the provisions of Annex 15.

7. UNITS OF MEASUREMENT

Units of measurement are given in accordance with the provisions contained in Annex 5, Fourth Edition. In those cases where the use of an alternative non-SI unit is permitted, the non-SI unit is shown in brackets immediately following the primary SI unit. In all cases the value of the non-SI unit is considered to be operationally equivalent to the primary SI unit in the context in which it is applied. Unless otherwise indicated, the allowable tolerances (accuracy) are indicated by the number of significant figures given and, in this regard, it is to be understood in this document that all zero digits, either to the right or left of the decimal marker, are significant figures.

Table A. Amendments to the PANS-OPS

<i>Amendment</i>	<i>Source(s)</i>	<i>Subject(s)</i>	<i>Approved Applicable</i>
(1st Edition)	Council action	Previous operations procedures brought together into a single document.	26 June 1961 1 October 1961
1	Internal ICAO action to resolve inconsistencies	Alignment of the definition of “Final approach” and provisions relating to intermediate and final approach procedures.	27 June 1962 1 July 1962
2	AIS/MAP Divisional Meeting (1959)	Minimum sector altitudes.	14 December 1962 1 November 1963
3	Second Meeting of Holding Procedures Panel (1964)	Updating of holding procedures.	5 April 1965 5 May 1966
4	Meteorology and Operations Divisional Meeting (1964)	Addition of meteorological information for flight operations.	7 June 1965 (advisory material)
5 (2nd Edition)	Fourth Air Navigation Conference (1965) and Amendment 8 to Annex 2	ILS Category I procedures, radar approach procedures, introduction of ILS Category II procedures, altimeter setting procedures.	12 December 1966 24 August 1967
6	Fifth Air Navigation Conference (1967), First Meeting of Obstacle Clearance Panel (1968) and Air Navigation Commission	QNH altimeter setting procedures for take-off and landing, new advisory material relating to instrument approach procedures for offset facilities and editorial changes.	23 January 1969 18 September 1969
7	Sixth Air Navigation Conference (1969)	Operating procedures for the use of secondary surveillance radar (SSR) transponders.	15 May 1970 4 February 1971
8	Second Meeting of the Obstacle Clearance Panel (1970)	New profile diagrams and editorial changes.	19 March 1971 6 January 1972
9	Third Meeting of the Obstacle Clearance Panel (1971)	Editorial changes relating to special procedures, areas and obstacle clearances — Precision Aids — ILS with glide path inoperative.	15 November 1972 16 August 1973

<i>Amendment</i>	<i>Source(s)</i>	<i>Subject(s)</i>	<i>Approved Applicable</i>
10	Council action in pursuance of Assembly Resolutions A17-10 and A18-10	Practices to be followed in the event of unlawful interference.	7 December 1973 23 May 1974
11	Air Navigation Commission study	Practices to be followed in the event of unlawful interference.	12 December 1973 12 August 1976
12	Ninth Air Navigation Conference (1976)	Definitions of flight level and transition altitude, operational use of transponders, advisory material on ground exchange operational meteorological information.	9 December 1977 10 August 1978
13 (Volume II, 1st Edition)	Sixth Meeting of the Obstacle Clearance Panel (1978)	Complete revision of material related to procedure construction and obstacle clearance criteria for instrument approach procedures. First part of editorial rearrangement of the PANS-OPS into two volumes.	29 June 1979 25 November 1982
14 (Volume I, 1st Edition)	Sixth Meeting of the Obstacle Clearance Panel (1978)	Second and final part of editorial rearrangement of the PANS-OPS into two volumes.	17 March 1980 25 November 1982
1 (Volume I, 2nd Edition)	Seventh Meeting of the Obstacle Clearance Panel (1981)	Consequential changes to Part III resulting from Amendment No. 1 to the PANS-OPS, Volume II, and alignment of presentation of units with Annex 5, Fourth Edition.	8 February 1982 25 November 1982
2	Seventh Meeting of the Obstacle Clearance Panel (1981), Third and Fourth Meetings of the Operations Panel (1980 and 1981)	Changes to the holding criteria, e.g. introduction of VOR/DME holding criteria. Introduction of new Part V— Noise Abatement Procedures. Introduction of new Part X for helicopter-only procedures.	30 March 1983 24 November 1983
3	Seventh Meeting of the Obstacle Clearance Panel (1981)	Introduction of departure procedures and editorial amendments.	25 November 1983 22 November 1984
4	Council, Air Navigation Commission	Secondary surveillance radar (SSR) transponder operating procedures.	14 March 1986 20 November 1986
5 (Volume I, 3rd Edition)	Eighth Meeting of the Obstacle Clearance Panel (1984)	Deletion, in the missed approach segment, of the turn point defined by a distance (timing); change in VOR TO/FROM indication error zone; new holding speeds; editorial amendments.	7 May 1986 20 November 1986
6	Obstacle Clearance Panel, Third and Fourth Meetings of the HELIOPS Panel, Council, Air Navigation Commission	Introduction of new Part VII — Simultaneous operations on parallel or near-parallel instrument runways. Introduction in Part X (now renumbered as Part XI) of new and revised provisions related to procedures specified for use by helicopters only, and joint helicopter/aeroplane procedures. Editorial amendments.	23 March 1990 15 November 1990
7 (Volume I, 4th Edition)	Ninth Meeting of the Obstacle Clearance Panel (1990), Fifth	Amendment of the definitions of decision altitude/height (DA/H), minimum descent altitude/height (MDA/H), obstacle clearance	

<i>Amendment</i>	<i>Source(s)</i>	<i>Subject(s)</i>	<i>Approved Applicable</i>
	Meeting of the Operations Panel (1989), Fourth Meeting of the Secondary Surveillance Radar Improvements and Collision Avoidance Systems Panel (1989) and Amendment 69 to Annex 10	altitude/height (OCA/H) and minimum sector altitude and inclusion of the definitions of area navigation (RNAV), waypoint and airborne collision avoidance system (ACAS). Amendment of Part II related to departure procedures to include secondary areas, clarify the application of the gradient criteria, include the concept of close-in obstacles and deletion of the acceleration segment. Amendment of Part III, Chapter 4, to include criteria on visual manoeuvring using a prescribed track. Introduction of Part III, Chapter 5, related to RNAV approach procedures based on VOR/DME. Deletion of Attachment A to Part III. Introduction in Part IV, Chapter 1, of RNAV holding procedures based on VOR/DME. Amendment of Part IV, Chapter 1, related to VOR/DME entry procedures. Amendment of Part V, Chapter 1, related to noise abatement procedures. Introduction of a new Part VIII, Chapter 3, concerning operation of ACAS equipment. Amendment of the DME fix tolerances to reflect current DME/N accuracy characteristics.	3 March 1993 11 November 1993
8	Air Navigation Commission	Simultaneous operations on parallel or near-parallel instrument runways.	13 March 1995 9 November 1995
9	Tenth Meeting of the Obstacle Clearance Panel (1994), Fourth and Fifth Meetings of the Secondary Surveillance Radar Improvements and Collision Avoidance Systems Panel (1989 and 1993 respectively)	Introduction of new definitions and abbreviations in Part I, Chapter 1. Modification of the provisions concerning departure procedures in Part II, Chapter 2. Revision of the departure procedures published information in Part II, Chapter 4. Inclusion of a new Part II, Chapter 5, on area navigation (RNAV) departures based on VOR/DME. Inclusion of a new Part II, Chapter 6, on the use of FMS/RNAV equipment to follow conventional departure procedures. Modification of existing provisions and introduction of new provisions in Part III, Chapter 3, concerning criteria for arrival and reversal procedures. Modification of the RNAV approach procedures based on VOR/DME in Part III, Chapter 5. Inclusion of a new Part III, Chapter 6, on the use of FMS/RNAV equipment to follow conventional non-precision approach procedures. Modification of the holding procedures in Part IV. Amendment to Part VIII, Chapter 1, to reflect current technology in the area of secondary surveillance radar transponders, taking into account the use of MODE S transponders in addition to MODE A/C transponders and introduction of transponder failure procedures when the carriage of a functioning transponder is mandatory. Introduction of new requirements in Part VIII, Chapter 3, for the operation of ACAS equipment. Introduction of a new Part XII concerning en-route obstacle clearance criteria.	4 March 1996 7 November 1996
10	Eleventh Meeting of the Obstacle Clearance Panel, Amendment 51 to Annex 4 and Amendment 38 to Annex 11	Introduction of new and amended definitions in Part I. Modification of the turning departures in Part II, Chapter 2. Amendment of the factors affecting operational minima in Part III, Chapter 1. Modification of the final approach alignment and descent gradients in Part III, Chapter 2. Introduction of new material related	1 May 1998 5 November 1998

<i>Amendment</i>	<i>Source(s)</i>	<i>Subject(s)</i>	<i>Approved Applicable</i>
		to steep angle approaches in Part III, Chapter 3. Modification of the area navigation (RNAV) approach procedures based on VOR/DME in Part III, Chapter 5. Introduction of a new Part III, Chapter 7, on RNAV approach procedures for basic GNSS receivers. Introduction of a new Chapter 8 on RNAV approach procedures based on DME/DME. Updating of RNAV holding procedures in Part IV, Chapter 1. Introduction of material related to RNAV/RNP routes in Part XII, Chapter 1. Editorial amendments.	
11	Eleventh Meeting of the Obstacle Clearance Panel, Twelfth Meeting of the Obstacle Clearance Panel, Fifth Meeting of the Automatic Dependent Surveillance Panel, Conclusion 9/30 of ASIA/PAC Air Navigation Planning and Implementation Regional Group, Air Navigation Commission studies, Fifth Meeting of the Committee on Aviation Environmental Protection	Amendment of the Foreword to notify operational requirements and procedures for air traffic service (ATS) data link applications in Part XIV. Introduction of new definitions in Part I. Introduction in Parts II and III of required navigation performance (RNP) procedures for departure, arrival and approach procedures, including criteria for fixed radius turns, and basic GNSS departure and arrival procedures. Introduction in Part III of a specification of maximum descent rate for the final approach segment for non-precision approach (NPA) procedures, barometric vertical navigation (baro-VNAV) criteria and RNAV database path terminator concept. Amendment of Part III regarding basic GNSS approach procedures and DME/DME procedures to account for reversion. Introduction of new Part VI, Chapter 3, regarding altimeter corrections. Deletion of material with regard to the global exchange of operational meteorological (OPMET) information in Part IX. Addition of Human Factors-related provisions in Parts IX and XIII. Integration of helicopter criteria throughout the document. Introduction of new noise abatement procedures.	29 June 2001 1 November 2001
12	Air Navigation Commission study concerning the operation of airborne collision avoidance system (ACAS) equipment, review by the Surveillance and Conflict Resolution Systems Panel (SCRSP) of ACAS II training guidelines for pilots	Revised provisions in Part VIII, Chapter 3, to improve the clarity of the text and to strengthen the provisions to prevent a manoeuvre in the opposite sense to a resolution advisory. Introduction of a new Attachment A to Part VIII — ACAS II Training Guidelines for Pilots.	30 June 2003 27 November 2003
13	Thirteenth Meeting of the Obstacle Clearance Panel (2003)	Foreword — introduction of a phrase to amplify the notion that PANS-OPS applies to normal operations; Part I — introduction of new definitions and abbreviations; Part II — amendment to GNSS area navigation (RNAV) departure procedures to account for multi-sensor RNAV systems, introduction of altitude depiction requirements, SBAS and GBAS departure procedures; Part III — amendment to the basis of categorization of aircraft, introduction of helicopter	27 April 2004 25 November 2004

<i>Amendment</i>	<i>Source(s)</i>	<i>Subject(s)</i>	<i>Approved Applicable</i>
		point-in-space procedures, introduction of the procedure altitude concept to address CFIT, introduction of altitude depiction requirements, amendment to GNSS RNAV approach procedures to account for multi-sensor RNAV systems, amendment to the standard aircraft dimensions for determination of DA/H, introduction of procedures for SBAS and GBAS, introduction of the TAA concept; Part XI — amendment to procedures specified for use by helicopters; Part XII — amendment to en-route criteria to include a simplified method; Part XIII — amendment to parameters for stabilized approach to include cold temperature correction.	
14 (Volume I, 5th Edition)	Eleventh meeting of the Obstacle Clearance Panel (OCP/11)	Editorial amendment to provide a more logical layout and improve the consistency and clarity of the document in order to: a) facilitate correct implementation; and b) provide a better framework for future development.	2 October 2006 23 November 2006
1	Fourteenth meeting of the Obstacle Clearance Panel (OCP/14); sixth meeting of the Operations Panel (OPSP/6), first meeting of the Surveillance and Conflict Resolution Systems Panel (SCRSP/1)	a) new provisions for units of measurement; b) area minimum altitudes; c) new approach procedures with vertical guidance (APV) for satellite-based augmentation system (SBAS) operations; d) vertical navigation (VNAV) operations; e) provisions related to basic global navigation satellite system (GNSS); f) revisions to noise abatement departure procedures; and g) revisions to ACAS II provisions.	30 November 2006 15 March 2007
2	Air Navigation Commission review of provisions related to air traffic services; first meeting of the Surveillance and Conflict Resolution Systems Panel (SCRSP/1)	a) new definition and provisions for hot spots; and b) procedures relating to ACAS.	6 June 2007 22 November 2007
3	First working group of the whole meeting of the Instrument Flight Procedures Panel (IFPP/WG/WHL/1); Seventh Meeting of the Operations Panel (OPSP/7)	a) amendment to indicate the different usage of baro-VNAV in order to address possible confusion among pilots; and b) new criteria to help prevent controlled flight into terrain (CFIT) during helicopter operations in visual flight rules (VFR) conditions. These criteria include protection for the visual segment between the missed approach point (MAPt) and the intended landing location and adds guidance and criteria to pilots and procedure designers on the development of a direct visual segment (VS); c) revisions to criteria on manual RNAV holding; and	8 October 2008 20 November 2008

<i>Amendment</i>	<i>Source(s)</i>	<i>Subject(s)</i>	<i>Approved Applicable</i>
		d) introduction of a new definition for a continuous descent final approach (CDFA) and a description of methods of controlling the vertical flight path on non-precision approaches to include CDFA.	
4	Second and third working group of the whole meetings of the Instrument Flight Procedures Panel (IFPP/WG/WHL/2 and 3)	a) Introduction of the definition of GBAS landing system (GLS); b) new provisions pertaining to RNAV holding requirements consequential to existing PANS-OPS, Volume II, design criteria that seek alignment with the PBN concept; and c) new provisions concerning the use of satellite-based augmentation system (SBAS) approach procedures with vertical guidance (APV)/barometric vertical navigation (baro-VNAV) that are consequential to existing PANS-OPS, Volume II, design criteria.	23 July 2010 18 November 2010
5	Secretariat supported by the Approach Classification Task Force (ACTF) in coordination with the Aerodromes Panel (AP), the Instrument Flight Procedure Panel (IFPP), the Navigation Systems Panel (NSP) and the Operations Panel (OPSP)	Amendment concerning provisions related to instrument approach operations and procedures as a result of the new approach classification.	20 March 2013 13 November 2014
6	Separation and Airspace Safety Panel (SASP), Operational Data Link Panel (OPLINKP), Operations Panel (OPSP) and the Airborne Surveillance Task Force (ASTAF); seventh, eighth, ninth, tenth and eleventh meetings of the Instrument Flight Procedures Panel Working Group of the Whole (IFPP/WG WHL/7, 8, 9, 10 and 11)	Amendment concerning: a) automatic dependent surveillance — broadcast (ADS-B), controller-pilot data link communications (CPDLC) and in-trail procedure (ITP); b) procedure design criteria and charting requirements to support performance-based navigation (PBN) as well as helicopter point-in-space (PinS) approach and departure operations	23 April 2014 13 November 2014

**Procedures for
Air Navigation Services**

AIRCRAFT OPERATIONS

Part I

FLIGHT PROCEDURES — GENERAL

I-(i)



Documents
Document Sharing Hub

Section 1

DEFINITIONS, ABBREVIATIONS AND ACRONYMS AND UNITS OF MEASUREMENT

I-I-(i)



Documents
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Chapter 1

DEFINITIONS

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

Aerodrome elevation. The elevation of the highest point of the landing area.

Airborne collision avoidance system (ACAS). An aircraft system based on secondary surveillance radar (SSR) transponder signals which operates independently of ground-based equipment to provide advice to the pilot on potential conflicting aircraft that are equipped with SSR transponders.

Alternate aerodrome. An aerodrome to which an aircraft may proceed when it becomes either impossible or inadvisable to proceed to or to land at the aerodrome of intended landing where the necessary services and facilities are available, where aircraft performance requirements can be met and which is operational at the expected time of use. Alternate aerodromes include the following:

Take-off alternate. An alternate aerodrome at which an aircraft would be able to land should this become necessary shortly after take-off and it is not possible to use the aerodrome of departure.

En-route alternate. An alternate aerodrome at which an aircraft would be able to land in the event that a diversion becomes necessary while en route.

Destination alternate. An alternate aerodrome at which an aircraft would be able to land should it become either impossible or inadvisable to land at the aerodrome of intended landing.

Note.— *The aerodrome from which a flight departs may also be an en-route or a destination alternate aerodrome for that flight.*

Altitude. The vertical distance of a level, a point or an object considered as a point, measured from mean sea level (MSL).

Area minimum altitude (AMA). The minimum altitude to be used under instrument meteorological conditions (IMC), that provides a minimum obstacle clearance within a specified area, normally formed by parallels and meridians.

Area navigation (RNAV). A method of navigation which permits aircraft operation on any desired flight path within the coverage of the station-referenced navigation aids or within the limits of the capability of self-contained aids, or a combination of these.

Balked landing. A landing manoeuvre that is unexpectedly discontinued at any point below the OCA/H.

Base turn. A turn executed by the aircraft during the initial approach between the end of the outbound track and the beginning of the intermediate or final approach track. The tracks are not reciprocal.

Note.— *Base turns may be designated as being made either in level flight or while descending, according to the circumstances of each individual procedure.*

Circling approach. An extension of an instrument approach procedure which provides for visual circling of the aerodrome prior to landing.

Continuous climb operation (CCO). An operation, enabled by airspace design, procedure design and ATC, in which a departing aircraft climbs continuously, to the greatest possible extent, by employing optimum climb engine thrust and climb speeds until reaching the cruise flight level.

Continuous descent final approach (CDFA). A technique, consistent with stabilized approach procedures, for flying the final approach segment of a non-precision instrument approach procedure as a continuous descent, without level-off, from an altitude/height at or above the final approach fix altitude/height to a point approximately 15 m (50 ft) above the landing runway threshold or the point where the flare manoeuvre should begin for the type of aircraft flown.

Continuous descent operation (CDO). An operation, enabled by airspace design, procedure design and ATC, in which an arriving aircraft descends continuously, to the greatest possible extent, by employing minimum engine thrust, ideally in a low drag configuration, prior to the final approach fix/final approach point.

Controlled airspace. An airspace of defined dimensions within which air traffic control service is provided in accordance with the airspace classification.

Note.— Controlled airspace is a generic term which covers ATS airspace Classes A, B, C, D and E as described in Annex 11, 2.6.

Dead reckoning (DR) navigation. The estimating or determining of position by advancing an earlier known position by the application of direction, time and speed data.

Decision altitude (DA) or decision height (DH). A specified altitude or height in a 3D instrument approach operation at which a missed approach must be initiated if the required visual reference to continue the approach has not been established.

Note 1.— Decision altitude (DA) is referenced to mean sea level and decision height (DH) is referenced to the threshold elevation.

Note 2.— The required visual reference means that section of the visual aids or of the approach area which should have been in view for sufficient time for the pilot to have made an assessment of the aircraft position and rate of change of position, in relation to the desired flight path. In Category III operations with a decision height the required visual reference is that specified for the particular procedure and operation.

Note 3.— For convenience where both expressions are used they may be written in the form “decision altitude/height” and abbreviated “DA/H”.

Dependent parallel approaches. Simultaneous approaches to parallel or near-parallel instrument runways where radar separation minima between aircraft on adjacent extended runway centre lines are prescribed.

Descent fix. A fix established in a precision approach at the FAP to eliminate certain obstacles before the FAP, which would otherwise have to be considered for obstacle clearance purposes.

Descent point (DP). A point defined by track and distance from the MAPt to identify the point at which the helicopter may descend below the OCA/H on a visual descent to the heliport or landing location.

Direct visual segment (Direct-VS). A visual segment designed as:

- a) a leg in a PinS approach, which may contain a single turn, from the MAPt direct to the heliport or landing location or via a descent point to the heliport or landing location; or
- b) a straight leg from the heliport or landing location to the IDF in a PinS departure.

DME distance. The line of sight distance (slant range) from the source of a DME signal to the receiving antenna.

Elevation. The vertical distance of a point or a level, on or affixed to the surface of the earth, measured from mean sea level.

Final approach and take-off area (FATO). 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 performance Class 1 helicopters, the defined area includes the rejected take-off area available.

Final approach segment (FAS). That segment of an instrument approach procedure in which alignment and descent for landing are accomplished.

Flight level (FL). A surface of constant atmospheric pressure which is related to a specific pressure datum, 1 013.2 hectopascals (hPa), and is separated from other such surfaces by specific pressure intervals.

Note 1.— A pressure type altimeter calibrated in accordance with the Standard Atmosphere:

- a) *when set to a QNH altimeter setting, will indicate altitude;*
- b) *when set to a QFE altimeter setting, will indicate height above the QFE reference datum; and*
- c) *when set to a pressure of 1 013.2 hPa, may be used to indicate flight levels.*

Note 2.— The terms “height” and “altitude”, used in Note 1 above, indicate altimetric rather than geometric heights and altitudes.

GBAS landing system (GLS). A system for approach and landing operations utilizing GNSS, augmented by a ground-based augmentation system (GBAS), as the primary navigational reference.

Heading. The direction in which the longitudinal axis of an aircraft is pointed, usually expressed in degrees from North (true, magnetic, compass or grid).

Height. The vertical distance of a level, a point or an object considered as a point, measured from a specified datum.

Height above surface (HAS). The difference in height between the OCA and the elevation of the highest terrain, water surface or obstacle within a radius of at least 1.5 km (0.8 NM) from the MAPt in a PinS “Proceed VFR” procedure.

Heliport reference point (HRP). The designated location of a heliport or a landing location.

Holding fix. A geographical location that serves as a reference for a holding procedure.

Holding procedure. A predetermined manoeuvre which keeps an aircraft within a specified airspace while awaiting further clearance.

Hot spot. A location on an aerodrome movement area with a history or potential risk of collision or runway incursion, and where heightened attention by pilots/drivers is necessary.

Independent parallel approaches. Simultaneous approaches to parallel or near-parallel instrument runways where radar separation minima between aircraft on adjacent extended runway centre lines are not prescribed.

Independent parallel departures. Simultaneous departures from parallel or near-parallel instrument runways.

Initial approach fix (IAF). A fix that marks the beginning of the initial segment and the end of the arrival segment, if applicable. In RNAV applications this fix is normally defined by a fly-by waypoint.

Initial approach segment. That segment of an instrument approach procedure between the initial approach fix and the intermediate fix or, where applicable, the final approach fix or point.

Initial departure fix (IDF). The terminal fix for the visual segment and the fix where the instrument phase of the PinS departure begins.

Instrument approach operations. An approach and landing using instruments for navigation guidance based on an instrument approach procedure. There are two methods for executing instrument approach operations:

- a) a two-dimensional (2D) instrument approach operation, using lateral navigation guidance only; and
- b) a three-dimensional (3D) instrument approach operation, using both lateral and vertical navigation guidance.

Note.— *Lateral and vertical navigation guidance refers to the guidance provided either by:*

- a) *a ground-based radio navigation aid; or*
- b) *computer-generated navigation data from ground-based, space-based, self-contained navigation aids or a combination of these.*

Instrument approach procedure (IAP). A series of predetermined manoeuvres by reference to flight instruments with specified protection from obstacles from the initial approach fix, or where applicable, from the beginning of a defined arrival route to a point from which a landing can be completed and thereafter, if a landing is not completed, to a position at which holding or en-route obstacle clearance criteria apply. Instrument approach procedures are classified as follows:

Non-precision approach (NPA) procedure. An instrument approach procedure designed for 2D instrument approach operations Type A.

Note.— *Non-precision approach procedures may be flown using a continuous descent final approach (CDFA) technique. CDFAs with advisory VNAV guidance calculated by on-board equipment (see Part I, Section 4, Chapter 1, paragraph 1.8.1) are considered 3D instrument approach operations. CDFAs with manual calculation of the required rate of descent are considered 2D instrument approach operations. For more information on CDFAs, refer to Part I, Section 4, Chapter 1, paragraphs 1.7 and 1.8.*

Approach procedure with vertical guidance (APV). A performance-based navigation (PBN) instrument approach procedure designed for 3D instrument approach operations Type A.

Precision approach (PA) procedure. An instrument approach procedure based on navigation systems (ILS, MLS, GLS and SBAS CAT I) designed for 3D instrument approach operations Type A or B.

Note.— *Refer to Annex 6 for instrument approach operation types.*

Intermediate approach segment. That segment of an instrument approach procedure between either the intermediate fix and the final approach fix or point, or between the end of a reversal, racetrack or dead reckoning track procedure and the final approach fix or point, as appropriate.

Intermediate fix (IF). A fix that marks the end of an initial segment and the beginning of the intermediate segment. In RNAV applications this fix is normally defined by a fly-by waypoint.

Landing location. A marked or unmarked area that has the same physical characteristics as a visual heliport final approach and take-off area (FATO).

Level. A generic term relating to the vertical position of an aircraft in flight and meaning variously, height, altitude or flight level.

Localizer performance with vertical guidance (LPV). The label to denote minima lines associated with APV-I or APV-II performance on approach charts.

Manoeuvring visual segment (Manoeuvring-VS). PinS visual segment protected for the following manoeuvres for:

PinS approaches. Visual manoeuvre from the MAPt around the heliport or landing location to land from a direction other than directly from the MAPt.

PinS departures. Take-off in a direction other than directly to the IDF followed by visual manoeuvre to join the instrument segment at the IDF.

Minimum descent altitude (MDA) or minimum descent height (MDH). A specified altitude or height in a 2D instrument approach operation or circling approach operation below which descent must not be made without the required visual reference.

Note 1.— Minimum descent altitude (MDA) is referenced to mean sea level and minimum descent height (MDH) is referenced to the aerodrome elevation or to the threshold elevation if that is more than 2 m (7 ft) below the aerodrome elevation. A minimum descent height for a circling approach is referenced to the aerodrome elevation.

Note 2.— The required visual reference means that section of the visual aids or of the approach area which should have been in view for sufficient time for the pilot to have made an assessment of the aircraft position and rate of change of position, in relation to the desired flight path. In the case of a circling approach the required visual reference is the runway environment.

Note 3.— For convenience when both expressions are used they may be written in the form “minimum descent altitude/height” and abbreviated “MDA/H”.

Minimum en-route altitude (MEA). The altitude for an en-route segment that provides adequate reception of relevant navigation facilities and ATS communications, complies with the airspace structure and provides the required obstacle clearance.

Minimum instrument meteorological conditions airspeed (V_{min}). The minimum indicated airspeed that a specific helicopter is certified to operate in instrument meteorological conditions.

Minimum obstacle clearance altitude (MOCA). The minimum altitude for a defined segment that provides the required obstacle clearance.

Minimum sector altitude (MSA). The lowest altitude which may be used which will provide a minimum clearance of 300 m (1 000 ft) above all objects located in an area contained within a sector of a circle of 46 km (25 NM) radius centred on a significant point, the aerodrome reference point (ARP) or the heliport reference point (HRP).

Minimum stabilization distance (MSD). The minimum distance to complete a turn manoeuvre and after which a new manoeuvre can be initiated. The minimum stabilization distance is used to compute the minimum distance between waypoints.

Missed approach holding fix (MAHF). A fix used in RNAV applications that marks the end of the missed approach segment and the centre point for the missed approach holding.

Missed approach point (MAPt). That point in an instrument approach procedure at or before which the prescribed missed approach procedure must be initiated in order to ensure that the minimum obstacle clearance is not infringed.

Missed approach procedure. The procedure to be followed if the approach cannot be continued.

Near-parallel runways. Non-intersecting runways whose extended centre lines have an angle of convergence/divergence of 15 degrees or less.

No transgression zone (NTZ). In the context of independent parallel approaches, a corridor of airspace of defined dimensions located centrally between the two extended runway centre lines, where a penetration by an aircraft requires a controller intervention to manoeuvre any threatened aircraft on the adjacent approach.

Normal operating zone (NOZ). Airspace of defined dimensions extending to either side of an ILS localizer course and/or MLS final approach track. Only the inner half of the normal operating zone is taken into account in independent parallel approaches.

Obstacle assessment surface (OAS). A defined surface intended for the purpose of determining those obstacles to be considered in the calculation of obstacle clearance altitude/height for a specific ILS facility and procedure.

Obstacle clearance altitude (OCA) or obstacle clearance height (OCH). The lowest altitude or the lowest height above the elevation of the relevant runway threshold or the aerodrome elevation as applicable, used in establishing compliance with appropriate obstacle clearance criteria.

Note 1.— Obstacle clearance altitude is referenced to mean sea level and obstacle clearance height is referenced to the threshold elevation or in the case of non-precision approach procedures to the aerodrome elevation or the threshold elevation if that is more than 2 m (7 ft) below the aerodrome elevation. An obstacle clearance height for a circling approach procedure is referenced to the aerodrome elevation.

Note 2.— For convenience when both expressions are used they may be written in the form “obstacle clearance altitude/height” and abbreviated “OCA/H”.

Note 3.— See Section 4, Chapter 1, 1.5, for specific application of this definition.

Note 4.— See PANS-OPS, Volume II, Part IV, Chapter 2, for area navigation (RNAV) point-in-space (PinS) approach procedures for helicopters using basic GNSS receivers.

Obstacle free zone (OFZ). The airspace above the inner approach surface, inner transitional surfaces, and balked landing surface and that portion of the strip bounded by these surfaces, which is not penetrated by any fixed obstacle other than a low-mass and frangibly mounted one required for air navigation purposes.

Point-in-space (PinS) approach. An approach procedure designed for helicopters only that includes both a visual and an instrument segment.

Point-in-space (PinS) departure. A departure procedure designed for helicopters only that includes both a visual and an instrument segment.

Point-in-space reference point (PRP). Reference point for the point-in-space approach as identified by the latitude and longitude of the MAPt.

Point-in-space (PinS) visual segment. The segment of a helicopter PinS procedure between a point (MAPt or IDF) and the heliport or the landing location.

Primary area. A defined area symmetrically disposed about the nominal flight track in which full obstacle clearance is provided. (See also *Secondary area*.)

Procedure altitude/height. A specified altitude/height flown operationally at or above the minimum altitude/height and established to accommodate a stabilized descent at a prescribed descent gradient/angle in the intermediate/final approach segment.

Procedure turn. A manoeuvre in which a turn is made away from a designated track followed by a turn in the opposite direction to permit the aircraft to intercept and proceed along the reciprocal of the designated track.

Note 1.— Procedure turns are designated “left” or “right” according to the direction of the initial turn.

Note 2.— Procedure turns may be designated as being made either in level flight or while descending, according to the circumstances of each individual procedure.

Racetrack procedure. A procedure designed to enable the aircraft to reduce altitude during the initial approach segment and/or establish the aircraft inbound when the entry into a reversal procedure is not practical.

Reference datum height (RDH). The height of the extended glide path or a nominal vertical path at the runway threshold.

Required navigation performance (RNP). A statement of the navigation performance necessary for operation within a defined airspace.

Note.— Navigation performance and requirements are defined for a particular RNP type and/or application.

Reversal procedure. A procedure designed to enable aircraft to reverse direction during the initial approach segment of an instrument approach procedure. The sequence may include procedure turns or base turns.

Secondary area. A defined area on each side of the primary area located along the nominal flight track in which decreasing obstacle clearance is provided. (See also *Primary area*.)

Segregated parallel operations. Simultaneous operations on parallel or near-parallel instrument runways in which one runway is used exclusively for approaches and the other runway is used exclusively for departures.

Significant point. A specified geographical location used in defining an ATS route or the flight path of an aircraft and for other navigation and ATS purposes.

Note.— There are three categories of significant points: ground-based navigation aid, intersection and waypoint. In the context of this definition, intersection is a significant point expressed as radials, bearings and/or distances from ground-based navigation aids.

Standard instrument arrival (STAR). A designated instrument flight rule (IFR) arrival route linking a significant point, normally on an ATS route, with a point from which a published instrument approach procedure can be commenced.

Standard instrument departure (SID). A designated instrument flight rule (IFR) departure route linking the aerodrome or a specified runway of the aerodrome with a specified significant point, normally on a designated ATS route, at which the en-route phase of a flight commences.

Terminal arrival altitude (TAA). The lowest altitude that will provide a minimum clearance of 300 m (1 000 ft) above all objects located in an arc of a circle defined by a 46 km (25 NM) radius centred on the initial approach fix (IAF), or where there is no IAF on the intermediate fix (IF), delimited by straight lines joining the extremity of the arc to the IF. The combined TAAs associated with an approach procedure shall account for an area of 360 degrees around the IF.

Threshold (THR). The beginning of that portion of the runway usable for landing.

Track. The projection on the earth's surface of the path of an aircraft, the direction of which path at any point is usually expressed in degrees from North (true, magnetic or grid).

Transition altitude. The altitude at or below which the vertical position of an aircraft is controlled by reference to altitudes.

Transition layer. The airspace between the transition altitude and the transition level.

Transition level. The lowest flight level available for use above the transition altitude.

Vertical path angle (VPA). Angle of the published final approach descent in baro-VNAV procedures.

Visual manoeuvring (circling) area. The area in which obstacle clearance should be taken into consideration for aircraft carrying out a circling approach.

Visual segment descent angle (VSDA). The angle between the MDA/H at the MAPt/DP and the heliport crossing height.

Visual segment design gradient (VSDG). The gradient of the visual segment in a PinS departure procedure. The visual segment connects the heliport or landing location with the initial departure fix (IDF) minimum crossing altitude (MCA).

Waypoint. A specified geographical location used to define an area navigation route or the flight path of an aircraft employing area navigation. Waypoints are identified as either:

Fly-by waypoint. A waypoint which requires turn anticipation to allow tangential interception of the next segment of a route or procedure, or

Flyover waypoint. A waypoint at which a turn is initiated in order to join the next segment of a route or procedure.

Waypoint distance (WD). Distance on the WGS ellipsoid from a defined waypoint to the aircraft RNAV receiver.

Chapter 2

ABBREVIATIONS AND ACRONYMS

(used in this document)

AAIM	Aircraft autonomous integrity monitoring
AC	Advisory Circular
ACAS	Airborne collision avoidance system
ADS-B	Automatic dependent surveillance — broadcast
AGL	Above ground level
AHRS	Attitude and heading reference system
AIP	Aeronautical Information Publication
AIRAC	Aeronautical information regulation and control
APCH	Approach
APV	Approach procedure with vertical guidance
ATC	Air traffic control
ATIS	Automatic terminal information service
ATM	Air traffic management
ATS	Air traffic services
ATTCS	Automatic take-off thrust control systems
baro-VNAV	Barometric vertical navigation
CAT	Category
CBT	Computer-based training
CCO	Continuous climb operation
CDFA	Continuous descent final approach
CDI	Course deviation indicator
CDO	Continuous descent operation
C/L	Centre line
CPA	Closest point of approach
CRC	Cyclic redundancy check
CRM	Collision risk model
CRM	Crew resource management
DA/H	Decision altitude/height
DER	Departure end of the runway
Direct-VS	Direct visual segment
DME	Distance measuring equipment
DP	Descent point
DR	Dead reckoning
EFIS	Electronic flight instrument system
ESDU	Engineering Sciences Data Unit
EUROCAE	European Organization for Civil Aviation Equipment
FAA	Federal Aviation Administration
FAF	Final approach fix
FAP	Final approach point
FAS	Final approach segment
FATO	Final approach and take-off area

FHP	Fictitious heliport
FL	Flight level
FMC	Flight management computer
FMS	Flight management system
FSD	Full-scale deflection
ft	Foot (feet)
FTE	Flight technical error
FTP	Fictitious threshold point
FTT	Flight technical tolerance
GBAS	Ground-based augmentation system
GLS	GBAS landing system
GNSS	Global navigation satellite system
GP	Glide path
GPIP	Glide path intercept point
GPWS	Ground proximity warning system
HAL	Horizontal alarm limit
HAS	Height above surface
HCH	Heliport crossing height
HP	Heliport
hPa	Hectopascal(s)
HPL	Horizontal protection level
HRP	Heliport reference point
HSI	Horizontal situation indicator
HVR	High vertical rate
IAC	Instrument approach chart
IAF	Initial approach fix
IAP	Instrument approach procedure
IAS	Indicated airspeed
IDF	Initial departure fix
IF	Intermediate fix
IFR	Instrument flight rules
ILS	Instrument landing system
IMC	Instrument meteorological conditions
INS	Inertial navigation system
IRS	Inertial reference system
ISA	International standard atmosphere
JAA	Joint Aviation Authorities
KIAS	Knots indicated airspeed
kt	Knot(s)
km	Kilometre(s)
LNAV	Lateral navigation
LORAN	Long range air navigation system
LPV	Localizer performance with vertical guidance
LTP	Landing threshold point
m	Metre(s)
MAHF	Missed approach holding fix
Manoeuvring-VS	Manoeuvring visual segment
MAPt	Missed approach point
MCA	Minimum crossing altitude
MCH	Minimum crossing height
MDA/H	Minimum descent altitude/height
MEA	Minimum en-route altitude
MLS	Microwave landing system

MOC	Minimum obstacle clearance
MOCA	Minimum obstacle clearance altitude
MOPS	Minimum operational performance standards
MSA	Minimum sector altitude
MSD	Minimum stabilization distance
MSL	Mean sea level
NADP	Noise abatement departure procedure
NDB	Non-directional beacon
NM	Nautical mile(s)
NOTAM	Notice to airmen
NOZ	Normal operating zone
NPA	Non-precision approach
NSE	Navigation system error
NTZ	No transgression zone
OAS	Obstacle assessment surface
OCA/H	Obstacle clearance altitude/height
OCS	Obstacle clearance surface
OFZ	Obstacle free zone
OIS	Obstacle identification surface
OLS	Obstacle limitation surface
OM	Outer marker
PA	Precision approach
PAOAS	Parallel approach obstacle assessment surface
PAPI	Precision approach path indicator
PAR	Precision approach radar
PDG	Procedure design gradient
PinS	Point-in-space
PRP	Point-in-space reference point
PVT	Position, velocity and time
QFE	Atmospheric pressure at aerodrome elevation (or at runway threshold)
QNH	Altimeter sub-scale setting to obtain elevation when on the ground
RA	Resolution advisory
RAIM	Receiver autonomous integrity monitoring
RDH	Reference datum height
RNAV	Area navigation
RNP	Required navigation performance
RSR	En-route surveillance radar
RSS	Root sum square
RVR	Runway visual range
RWY	Runway
SBAS	Satellite-based augmentation system
SD	Standard deviation
SI	International system of units
SID	Standard instrument departure
SOC	Start of climb
SOPs	Standard operating procedures
SPI	Special position indicator
SSR	Secondary surveillance radar
SST	Supersonic transport
STAR	Standard instrument arrival
TA	Traffic advisory
TAA	Terminal arrival altitude
TAR	Terminal area surveillance radar



TAS	True airspeed
TCH	Threshold crossing height
TF	Track to fix
THR	Threshold
TMA	Terminal control area
TP	Turning point
TSO	Technical Standard Order
V _{mini}	Minimum instrument meteorological conditions airspeed
VAL	Vertical alarm limit
VASIS	Visual approach slope indicator system
VNAV	Vertical navigation
VOR	Very high frequency omnidirectional radio range
VPA	Vertical path angle
VPL	Vertical protection level
VSDA	Visual segment descent angle
VSDG	Visual segment design gradient
VTF	Vector to final
WD	Waypoint distance
WGS	World geodetic system

Chapter 3

UNITS OF MEASUREMENT

3.1 Units of measurement are expressed in conformance with Annex 5.

3.2 The values of the parameters are usually shown in integers. Where this does not provide the required accuracy, the parameter is shown with the required number of decimal places. Where the parameter directly affects the flight crew in its control of the aircraft, it is normally rounded as a multiple of five. In addition, slope gradients are normally expressed in percentages, but may be expressed in other units.

3.3 The rounding of values to be published on aeronautical charts meets the corresponding chart resolution requirements in Annex 4, Appendix 6.

Section 2

GENERAL PRINCIPLES

I-2-(i)



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Chapter 1

GENERAL INFORMATION

1.1 GENERAL

1.1.1 Obstacle clearance is a primary safety consideration in the development of instrument flight procedures. The criteria used and the detailed method of calculation are covered in PANS-OPS, Volume II.

1.1.2 Procedures contained in PANS-OPS assume that all engines are operating.

Note.— Development of contingency procedures is the responsibility of the operator.

1.1.3 All procedures depict tracks. Pilots should attempt to maintain the track by applying corrections to heading for known wind.

1.1.4 All examples of calculations in this document are based on an altitude of 600 m (2 000 ft) above mean sea level (MSL) and a temperature of international standard atmosphere (ISA) +15°C unless otherwise stated.

1.1.5 For helicopters operated as Category A aeroplanes, failure to maintain the minimum speed could lead to an excursion of the protected airspace provided because of high drift angles or errors in turning point determinations. Similarly, high vertical speeds could hazard the helicopter when over a stepdown fix (see Figure I-2-1-1), or could result in the helicopter on departure initiating a turn at a height of 120 m (394 ft), but prior to reaching the departure area.

1.1.6 The minimum final approach speed considered for a Category A aeroplane is 130 km/h (70 kt). This is only critical when the missed approach point (MAPt) is specified by a distance from the final approach fix (FAF) (e.g. an “off aerodrome” NDB or VOR procedure). In these cases (if the FAF to MAPt distance exceeds certain values dependent on aerodrome elevation), a slower speed when combined with a tailwind may cause the helicopter to reach start of climb (SOC) after the point calculated for Category A aeroplanes. This will reduce the obstacle clearance in the missed approach phase.

1.1.7 Conversely, a slower speed combined with a headwind could cause the helicopter to reach the MAPt (and any subsequent turn altitude) before the point calculated for Category A aeroplanes, and hence depart outside the protected area.

1.1.8 Therefore, for helicopters, speed should be reduced below 130 km/h (70 kt) only after the visual references necessary for landing have been acquired and the decision has been made that an instrument missed approach procedure will not be performed.

1.2 OBSTACLE CLEARANCE

1.2.1 Obstacle clearance is a primary safety consideration in the development of instrument flight procedures. The criteria used and the detailed method of calculation are covered in PANS-OPS, Volume II. However, from the

I-2-1-1

operational point of view it is stressed that the obstacle clearance applied in the development of each instrument procedure is considered to be the minimum required for an acceptable level of safety in operations.

1.2.2 The protected areas and obstacle clearance applicable to individual types of procedures are specified in Parts I and II.

1.3 AREAS

1.3.1 Where track guidance is provided in the design of a procedure, each segment comprises a specified volume of airspace, the vertical cross-section of which is an area located symmetrically about the centre line of each segment. The vertical cross-section of each segment is divided into primary and secondary areas. Full obstacle clearances are applied over the primary areas reducing to zero at the outer edges of the secondary areas (see Figure I-2-1-2).

1.3.2 On straight segments, the width of the primary area at any given point is equal to one-half of the total width. The width of each secondary area is equal to one-quarter of the total width.

1.3.3 Where no track guidance is provided during a turn specified by the procedure, the total width of the area is considered primary area.

1.3.4 The minimum obstacle clearance (MOC) is provided for the whole width of the primary area. In the secondary area, MOC is provided at the inner edges reducing to zero at the outer edges (see Figure I-2-1-2).

1.4 USE OF FLIGHT MANAGEMENT SYSTEM (FMS)/ AREA NAVIGATION (RNAV) EQUIPMENT

1.4.1 Where FMS/RNAV equipment is available, it may be used to fly conventional procedures provided:

- a) the procedure is monitored using the basic display normally associated with that procedure; and
- b) the tolerances for flight using raw data on the basic display are complied with.

1.4.2 Lead radials

Lead radials are for use by non-RNAV-equipped aircraft and are not intended to restrict the use of turn anticipation by the FMS.

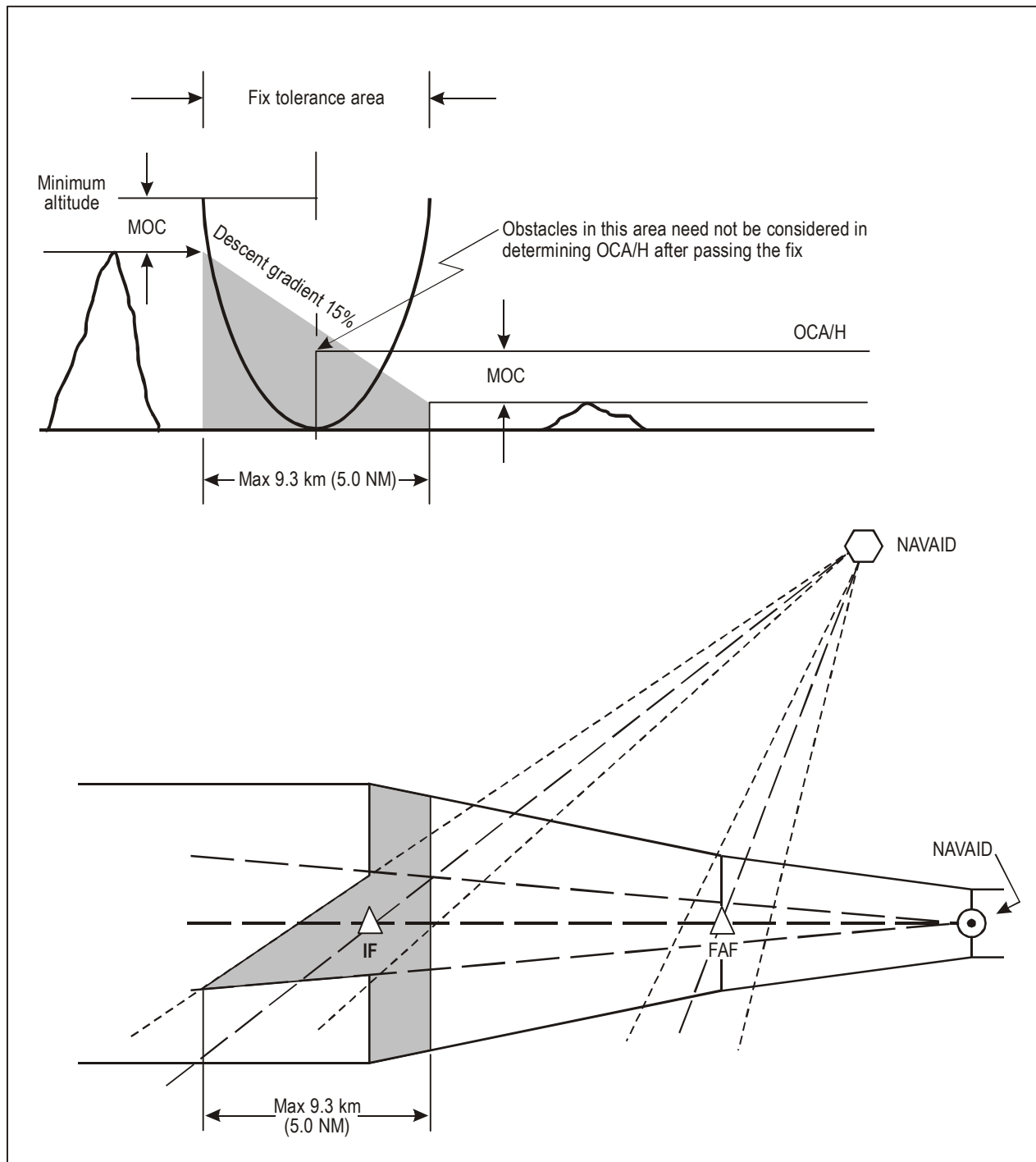


Figure I-2-1-1. Area where obstacles need not be considered

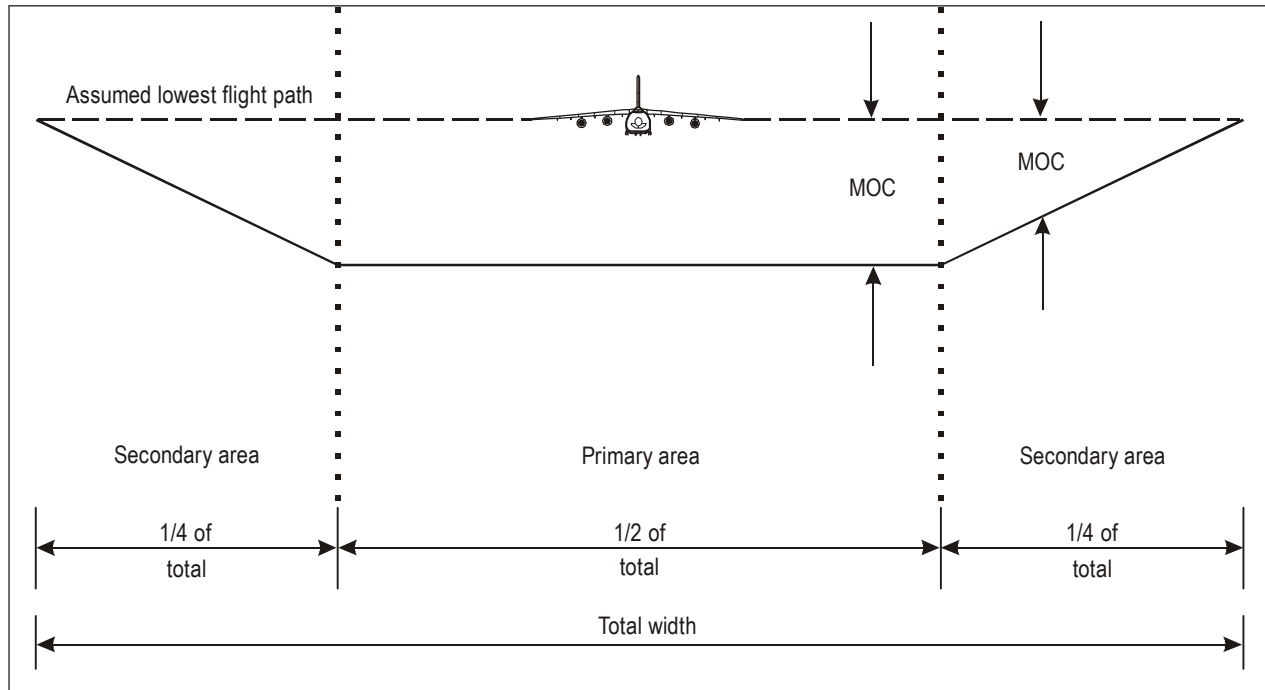


Figure I-2-1-2. Relationship of minimum obstacle clearances in primary and secondary areas in cross-section

Chapter 2

ACCURACY OF FIXES

2.1 GENERAL

Fixes and points used in designing flight procedures are normally based on standard navigation systems.

2.2 FIX FORMED BY INTERSECTION

Because all navigation facilities and waypoints have accuracy limitations, the geographic point which is identified is not precise but may be anywhere within an area called the fix tolerance area which surrounds its plotted point of intersection. Figure I-2-2-1 illustrates the intersection of two radials or tracks from different navigation facilities.

2.3 FIX TOLERANCE FACTORS

2.3.1 The dimensions of the fix tolerance area are determined by the system use accuracy of the navigation aid(s) on which the fix is based, and the distance from the facility.

2.3.2 System use accuracy is based on a root sum square calculation using the following tolerances:

- a) ground system tolerance;
- b) airborne receiving system tolerance; and
- c) flight technical tolerance.

See Table I-2-2-1 for system use accuracies and Table I-2-2-2 for the tolerances on which these values are based.

2.4 FIX TOLERANCE FOR OTHER TYPES OF NAVIGATION SYSTEMS

2.4.1 Surveillance radar

Radar fix tolerances are based on radar mapping accuracies, azimuth resolution, flight technical tolerance, controller technical tolerances, and the speed of aircraft in the terminal area. The fix tolerances are listed below:

- a) terminal area surveillance radar (TAR) within 37 km (20 NM): fix tolerance is ± 1.5 km (0.8 NM); and
- b) en-route surveillance radar (RSR) within 74 km (40 NM): fix tolerance is ± 3.1 km (1.7 NM).

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2.4.2 Distance measuring equipment (DME)

Fix tolerance is ± 0.46 km (0.25 NM) + 1.25 per cent of distance to the antenna.

2.4.3 75 MHz marker beacon

Use Figure I-2-2-2 to determine the fix tolerance for instrument landing system (ILS) and “z” markers for use with instrument approach procedures.

2.4.4 Fix tolerance overheading a station

2.4.4.1 Very high frequency omnidirectional radio range (VOR)

Fix tolerance overheading a VOR is based upon a circular cone of ambiguity generated by a straight line passing through the facility and making an angle of 50° from the vertical, or a lesser angle as determined by flight test. Entry into the cone is assumed to be achieved within such an accuracy from the prescribed track as to keep the lateral deviation abeam the VOR:

$d = 0.2 h$ (d and h in km); or

$d = 0.033 h$ (d in NM, h in thousands of feet).

For a cone angle of 50° , the accuracy of entry is $\pm 5^\circ$. Tracking through the cone is assumed to be within an accuracy of $\pm 5^\circ$. Station passage is assumed to be within the limits of the cone of ambiguity. See Figure I-2-2-3 for an illustration of fix tolerance area.

2.4.4.2 Non-directional beacon (NDB)

Fix tolerance overheading an NDB is based upon an inverted cone of ambiguity extending at an angle of 40° either side of the facility. Entry into the cone is assumed to be achieved within an accuracy of $\pm 15^\circ$ from the prescribed track. Tracking through the cone is assumed to be within an accuracy of $\pm 5^\circ$. See Figure I-2-2-4 for an illustration of fix tolerance area.

2.5 AREA SPLAY

2.5.1 The construction of area outer boundaries is derived from the fix tolerance of the facility providing track. This value is multiplied by a factor of 1.5 to provide a 99.7 per cent probability of containment (3 SD).

2.5.2 The area width at a facility is:

- a) 3.7 km (2.0 NM) for VOR; and
- b) 4.6 km (2.5 NM) for NDB.

2.5.3 The area splays from the facility at the following angle:

- a) 7.8° for VOR; and
- b) 10.3° for NDB.