ICAO

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PROCEDURES FOR AIR NAVIGATION SERVICES

Aircraft Operations

Volume I – Flight Procedures

Sixth Edition, 2018

This edition incorporates all amendments approved by the Council prior to 29 August 2018 and supersedes on 8 November 2018, all previous editions of Doc 8168, Volume I.

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INTERNATIONAL CIVIL AVIATION ORGANIZATION

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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

AMENDMENTS			
No.	Date applicable	Date entered	Entered by
1–8	Incorporated in this edition.		

CORRIGENDA			
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TABLE OF CONTENTS

FOREWORD

1. INTRODUCTION

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

Volume I — *Flight Procedures*
Volume II — *Construction of Visual and Instrument Flight Procedures*
Volume III — *Aircraft Operating 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. PANS-OPS, Volume III, applicable in 2018, was created from Part III of Volume I with the intention to separate the provisions related to aircraft operating procedures from the requirements for flying the procedures designed in accordance with the criteria provided in Volume II.

1.2 Volume I — *Flight Procedures* describes the operational requirements for flying the procedures designed in accordance with the criteria provided in Volume II.

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 Volume III — *Aircraft Operating Procedures* describes operational procedures recommended for the guidance of flight operations personnel and flight crew.

1.5 All three 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.

1.6 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, acronyms and units of measurement*

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, acronyms and units of measurement is also provided.

2.2 Part II — Flight Procedure Requirements

2.2.1 *Section 1 — General requirements*

Section 1 provides general requirements that are applicable for all phases of flight.

2.2.2 *Section 2 — Departure procedures*

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 pilots.

2.2.3 *Section 3 — En-route procedures*

En-route obstacle clearance procedures were added to Volume I in 1996 as a result of the tenth meeting of the Obstacle Clearance Panel (OCP). The procedures were amended in 2004 to include simplified en-route criteria.

2.2.4 *Section 4 — Arrival 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 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 the PANS-OPS (Amendment 14).

2.2.5 *Section 5 — 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 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 the PANS-OPS (Amendment 14).

2.2.6 *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 OCP, 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).

2.2.7 *Section 7 — Procedures for use by helicopters*

Conditions under which the criteria in Part II may be applied to helicopters are specified in this section. These were revised at the third meeting of the Helicopter Operations (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" were included in this section.

This section describes the general requirements applicable for helicopter procedures, the requirements applicable for helicopters operating to runways, the requirements for helicopters when flying instrument approach procedures promulgated for Category A aeroplanes and those applicable for helicopters-only procedures to runways (CAT H). This section also describes the requirements applicable for point-in-space departure and approach procedures.

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. 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

Amendment	*Source(s)*	*Subject(s)*	*Approved* *Applicable*
(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
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

Amendment	*Source(s)*	*Subject(s)*	*Approved* *Applicable*
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 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	Amendment of the definitions of decision altitude/height (DA/H), minimum descent altitude/height (MDA/H), obstacle clearance 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

Amendment	*Source(s)*	*Subject(s)*	*Approved* *Applicable*
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 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.	1 May 1998 5 November 1998

Amendment	*Source(s)*	*Subject(s)*	*Approved* *Applicable*
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 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.	27 April 2004 25 November 2004

Amendment	*Source(s)*	*Subject(s)*	*Approved* *Applicable*
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 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.	8 October 2008 20 November 2008
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

Amendment	*Source(s)*	*Subject(s)*	*Approved* *Applicable*
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
7	The twelfth meeting of the Instrument Flight Procedures Panel (IFPP/12); The first meeting of the Flight Operations Panel (FLTOPSP/1)	Provisions concerning MOC reduction for turning departure procedures and improvements to ACAS provisions.	26 May 2016 10 November 2016
8 (Volume I, 6th Edition)	Twelfth meeting of the Instrument Flight Procedures Panel (IFPP/12); thirteenth meeting of the Instrument Flight Procedures Panel (IFPP/13); third meeting of the Flight Operations Panel (FLTOPSP/3); first meeting of the Separation and Airspace Safety Panel (SASP/1)	Amendment concerning: a) Restructuring of Parts I and II focussing on information required by pilots to operate safely on procedures designed using the criteria in PANS-OPS, Volume II; b) introduction of two attachments on charting information and procedure design principles; c) updated definition of procedure altitude/height; d) clarification of intermediate segment protection area limits; e) update of helicopter point-in-space (PinS) criteria; f) consequential amendments to references arising from the restructure of Annex 15 and the introduction of PANS-AIM; and g) new PBN approach procedures for parallel runway operations.	28 August 2018 8 November 2018

Procedures for
Air Navigation Services

AIRCRAFT OPERATIONS

Part I

GENERAL

Section 1

DEFINITIONS, ABBREVIATIONS, ACRONYMS AND UNITS OF MEASUREMENT

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 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.

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".

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 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 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 II, Section 5.

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 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_{mini}). 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.

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 5, Chapter 1, 1.6, 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 published altitude/height used in defining the vertical profile of a flight procedure, at or above the minimum obstacle clearance altitude/height where established.

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)

ACAS	Airborne collision avoidance system
ADS-B	Automatic dependent surveillance — broadcast
APCH	Approach
APV	Approach procedure with vertical guidance
ARP	Aerodrome reference point
ATC	Air traffic control
ATM	Air traffic management
ATS	Air traffic services
ATT	Along-track tolerance
baro-VNAV	Barometric vertical navigation
CAT	Category
CDFA	Continuous descent final approach
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
FAF	Final approach fix
FAP	Final approach point
FAS	Final approach segment
FATO	Final approach and take-off area
FL	Flight level
FMS	Flight management system
FSD	Full-scale deflection
ft	Foot (feet)
FTE	Flight technical error
FTT	Flight technical tolerance
GBAS	Ground-based augmentation system
GLS	GBAS landing system
GNSS	Global navigation satellite system
GP	Glide path
HAS	Height above surface
HCH	Heliport crossing height
hPa	Hectopascal(s)
HRP	Heliport reference point
HSI	Horizontal situation indicator
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
KIAS	Knots indicated airspeed
kt	Knot(s)
km	Kilometre(s)
LNAV	Lateral navigation
LP	Localizer performance
LPV	Localizer performance with vertical guidance
m	Metre(s)
MAHF	Missed approach holding fix
Manoeuvring-VS	Manoeuvring visual segment
MAPt	Missed approach point
MCA/H	Minimum crossing altitude/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
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
OM	Outer marker
PA	Precision approach
PAPI	Precision approach path indicator
PAR	Precision approach radar
PBN	Performance-based navigation
PDE	Path definition error
PDG	Procedure design gradient
PEE	Position estimation error
PinS	Point-in-space
PRP	Point-in-space reference point
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
RF	Constant radius arc to a fix
RNAV	Area navigation
RNP	Required navigation performance
RVR	Runway visual range
RWY	Runway
SBAS	Satellite-based augmentation system
SD	Standard deviation
SDF	Step down fix
SI	International system of units
SID	Standard instrument departure
SOC	Start of climb
SOPs	Standard operating procedures
SSR	Secondary surveillance radar
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
TSE	Total system error
V_{mini}	Minimum instrument meteorological conditions airspeed
VASIS	Visual approach slope indicator system
VNAV	Vertical navigation
VOR	Very high frequency omnidirectional radio range
VPA	Vertical path angle
VSDA	Visual segment descent angle
VSDG	Visual segment design gradient
WD	Waypoint distance
WGS	World geodetic system
XTT	Cross-track tolerance

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 pilot in their 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.

Procedures for
Air Navigation Services

AIRCRAFT OPERATIONS

Part II

FLIGHT PROCEDURE REQUIREMENTS

Section 1

GENERAL REQUIREMENTS

Chapter 1

GENERAL REQUIREMENTS

1.1 GENERAL

1.1.1 Procedures contained in the PANS-OPS assume that all engines are operating. Development of contingency procedures is the responsibility of the operator.

1.1.2 Procedures depict tracks or bearings. The pilot should attempt to maintain the track or bearing by applying corrections to heading for known wind.

1.1.3 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.

Note.— Detailed specifications for instrument approach procedure construction, primarily for the use of procedures specialists, are contained in PANS-OPS, Volume II.

1.2 OBSTACLE CLEARANCE

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 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.

1.3 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 II-1-1-1).

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.

Note.— Areas for RNP AR Procedures are described in the Required Navigation Performance Authorization Required (RNP AR) Procedure Design Manual *(Doc 9905).*

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

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

1.5 TURNING POINTS

The turning point (TP) may be specified in one of two ways:

a) *at a designated conventional facility or fix* — the turn is made upon arrival overhead a facility or fix; or

b) *at a designated altitude* — the turn is made upon reaching the designated altitude unless an additional fix or distance is specified to limit early turns (departures and missed approach only); or

c) *at a designated waypoint* — turns in performance-based navigation (PBN) procedures may be either fly-by, fly-over or constant radius arc to a fix (RF). See Figures II-1-1-2, II-1-1-3 and II-1-1-4.

1.6 PROTECTION AREA FOR TURNS

Speed is a controlling factor in determining the aircraft track during the turn. The outer boundary of the turning area is based on the highest speed of the category for which the procedure is authorized. The inner boundary caters for the slowest aircraft.

Note.— For more information about the construction of protected areas for turns, see Attachment A, section 2.

1.7 COLD TEMPERATURE CORRECTION

1.7.1 Temperatures lower than those of the standard atmosphere result in the actual altitude of an aircraft being lower than that indicated by the barometric altimeter. As a consequence, the MOC actually achieved could be lower than the prescribed MOC. In order to prevent this, the pilot shall correct for low temperatures. The pilot is responsible for any necessary cold temperature corrections to all published minimum altitudes/heights in both conventional and PBN procedures. This includes:

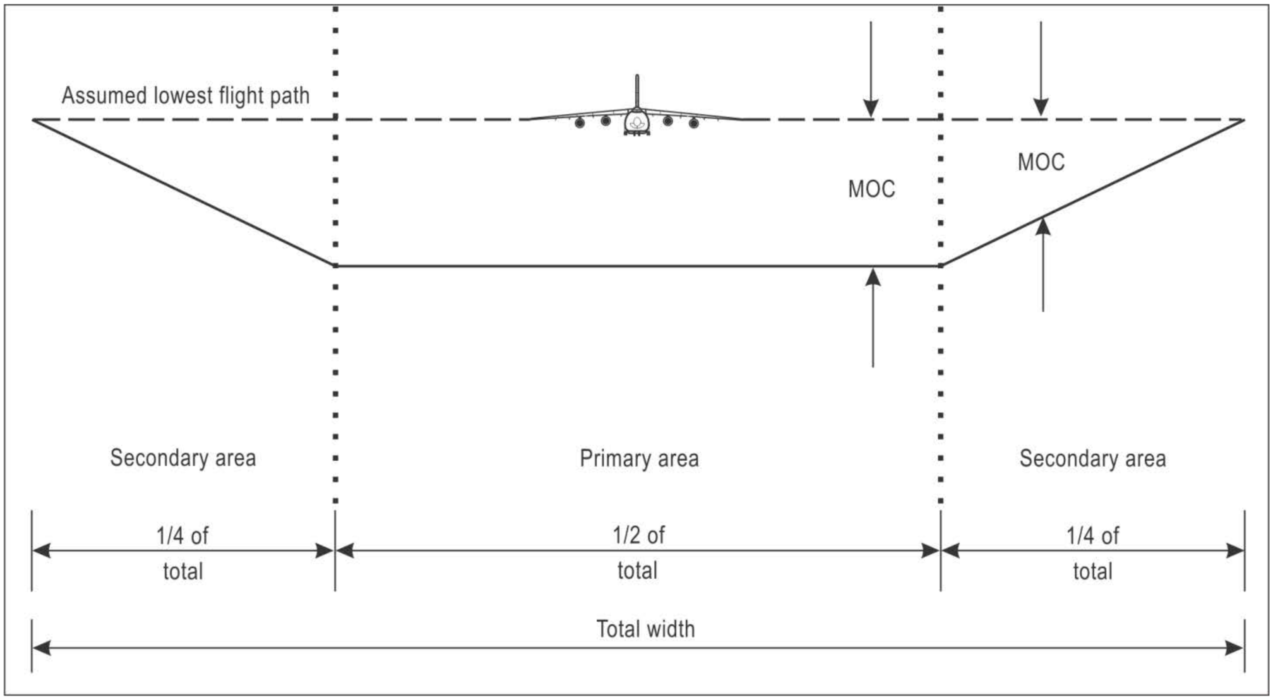
a) the altitudes/heights for the initial and intermediate segment(s);

b) the decision altitude/height (DA/H) or minimum descent altitude/height (MDA/H); and

c) subsequent missed approach altitudes/heights.

1.7.2 The final approach path vertical path angle (VPA) on a 3D approach operation which is based on barometric vertical navigation (baro-VNAV) criteria is safeguarded against the effects of low temperature by the design of the procedure. This will ensure that the effective VPA at the minimum temperature published on the chart will not be less than 2.5° and has been obstacle assessed. By applying the cold temperature correction to this procedure type the nominal VPA will actually be flown. This can be achieved by manual application of the correction by the pilot, or in some cases where certified systems are used, through automatic application of the correction by an FMS.

Note.— For more information on the use of automated systems for temperature compensation, see the Performance-based Navigation (PBN) Manual *(Doc 9613).*



II-1-1-1. Relationship of minimum obstacle clearances in primary and secondary areas in cross-section

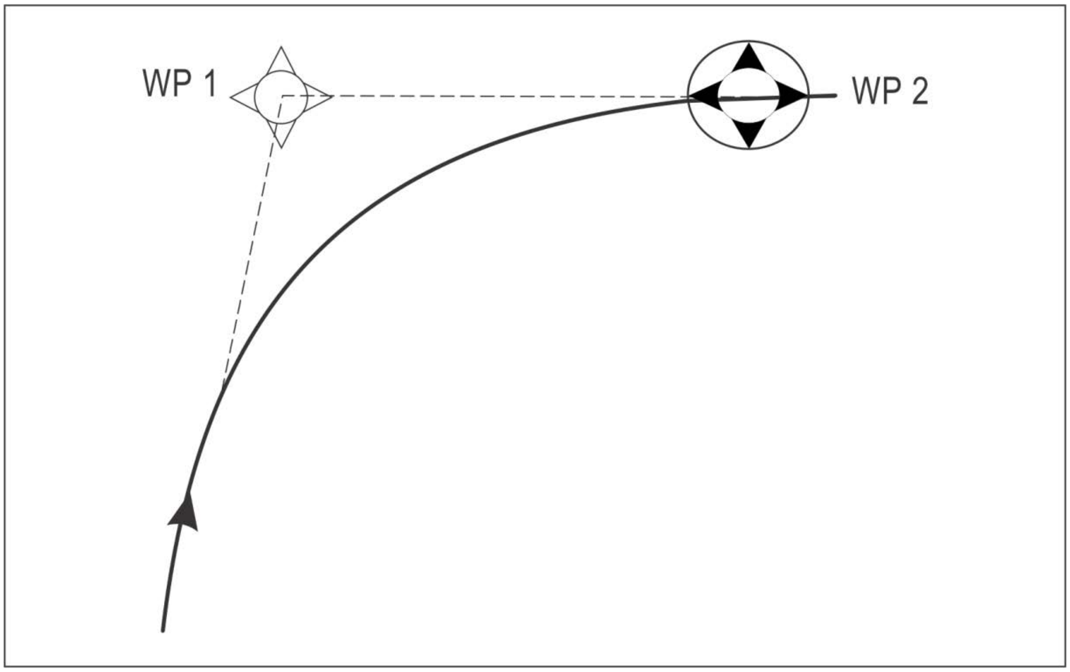


Figure II-1-1-2. Fly-by waypoint (WP1)

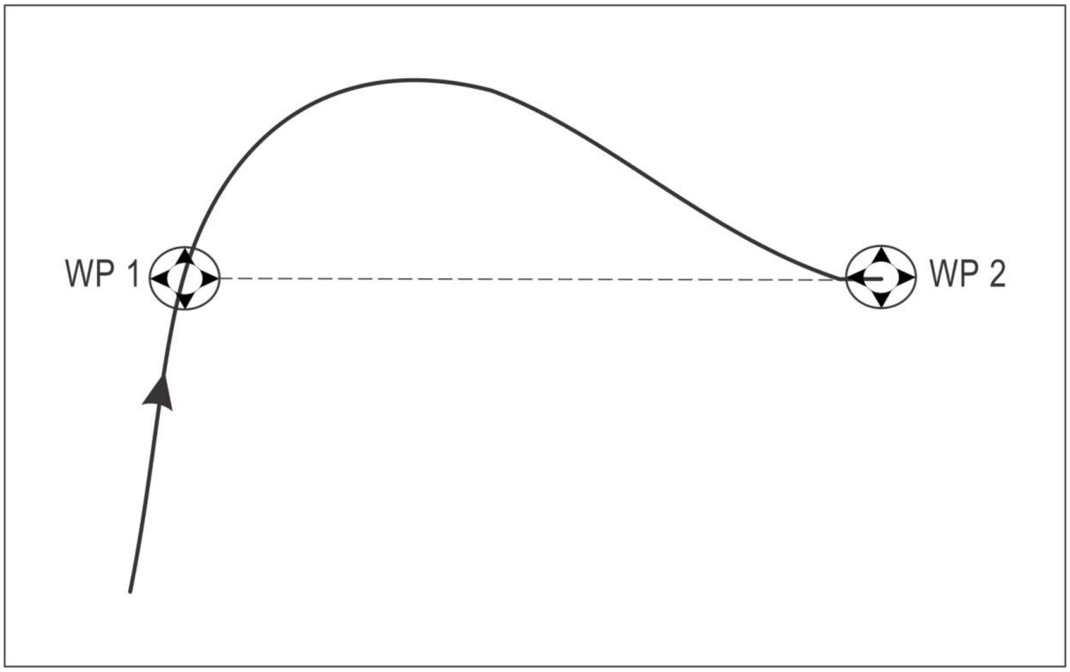


Figure II-1-1-3. Fly-over waypoint

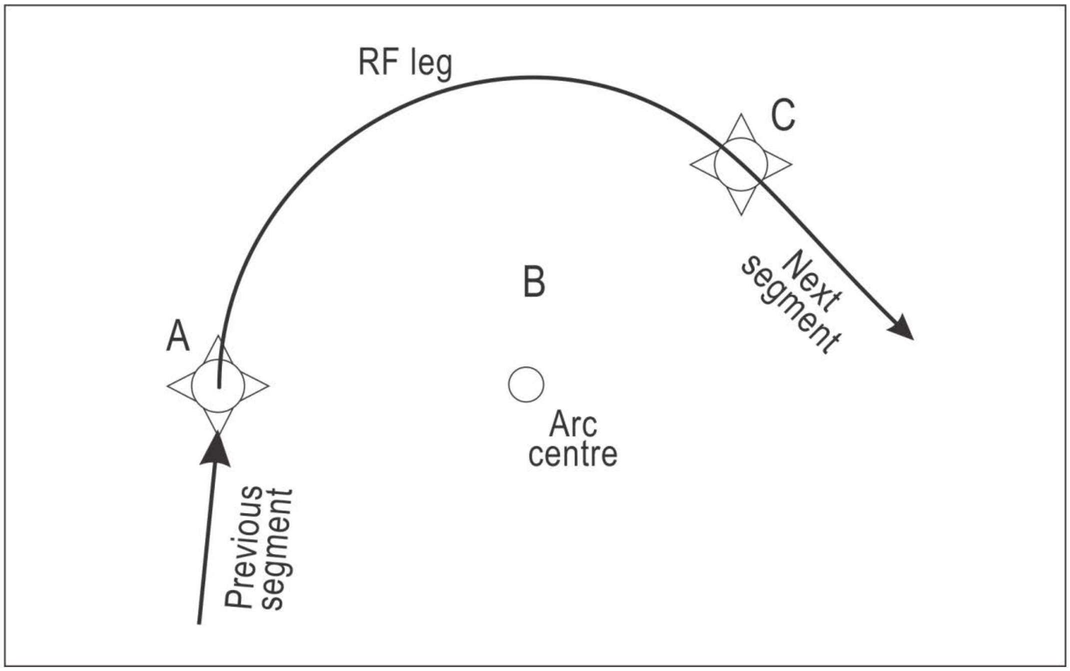


Figure II-1-1-4. RF turn

Section 2

DEPARTURE PROCEDURES

Chapter 1

GENERAL REQUIREMENTS

1.1 INTRODUCTION

1.1.1 The criteria in this section are designed to provide the pilot and other flight operations personnel with an appreciation, from the operational point of view, of the parameters and criteria used in the design of instrument departure procedures. These include, but are not limited to, standard instrument departure (SID) routes and associated procedures (see Annex 11, Appendix 3).

1.1.2 These procedures assume that all engines are operating. In order to ensure acceptable clearance above obstacles during the departure phase, instrument departure procedures may be published as specific routes to be followed or as omnidirectional departures, together with procedure design gradients and details of significant obstacles.

1.1.3 A departure procedure is established for each runway on which an instrument departure is expected to be used. Procedures will be developed for different categories of aircraft as required.

1.2 CONTINGENCY PROCEDURES

1.2.1 Development of contingency procedures, required to cover the case of engine failure or an emergency in flight which occurs after V1, is the responsibility of the operator, in accordance with Annex 6. An example of such a procedure, developed by one operator for a particular runway and aircraft type(s), is shown in Figure II-2-1-1. Where terrain and obstacles permit, these procedures should follow the normal departure route.

1.2.2 Turning procedures

When it is necessary to develop a turning procedure to avoid an obstacle which would have become limiting, the procedure should be described in detail in the appropriate operator or aircraft manual. The point for start of turn in this procedure shall be readily identifiable by the pilot when flying under instrument conditions.

1.3 INSTRUMENT DEPARTURE PROCEDURE

1.3.1 Design considerations

The design of an instrument departure procedure is, in general, dictated by the terrain surrounding the aerodrome. It may also be required to provide for air traffic control (ATC) requirements in the case of SID routes. These factors in turn influence the type and siting of navigation aids in relation to the departure route. Airspace restrictions may also affect the routing and siting of navigation aids.

1.3.2 Aerodrome operating minima

Where obstacles cannot be cleared by the appropriate margin when the aircraft is flown on instruments, aerodrome operating minima are established to permit visual flight clear of obstacles.

1.3.3 Wind effect

1.3.3.1 When flying departure routes expressed as tracks or bearings, the pilot shall compensate for known or estimated winds.

1.3.3.2 When being vectored, the pilot should not compensate for wind effects.

1.3.4 Vectors

Pilots should not accept vectors during departure unless:

a) they are above the minimum altitude(s)/height(s) required to maintain obstacle clearance in the event of engine failure. This relates to engine failure between V_1 and minimum sector altitude or the end of the contingency procedure as appropriate; or

b) the departure route is non-critical with respect to obstacle clearance.

1.4 OBSTACLE CLEARANCE

1.4.1 The minimum obstacle clearance (MOC) equals zero at the departure end of the runway (DER). From that point, it increases by 0.8 per cent of the horizontal distance in the direction of flight assuming a maximum turn of 15°.

1.4.2 During the turn, a MOC of 75 m (246 ft) (CAT H, 65 m (213 ft)) is provided.

1.5 PROCEDURE DESIGN GRADIENT (PDG)

1.5.1 Unless otherwise published, a PDG of 3.3 per cent is assumed.

1.5.2 For conversion of climb gradient for cockpit use, see Figure II-2-1-2.

1.6 FIXES AS AN AID IN OBSTACLE AVOIDANCE

Whenever suitably located distance measuring equipment (DME) exists, additional specific height/distance information intended for obstacle avoidance may be published. Waypoints or other suitable fixes should be used by the pilot to provide a means of monitoring climb performance.

1.7 PERFORMANCE-BASED NAVIGATION (PBN) DEPARTURES

1.7.1 *Description.* A PBN departure is a departure procedure containing area navigation (RNAV) or required navigation performance (RNP) segments.

1.7.2 *PBN requirements box.* PBN departure procedures are promulgated with a PBN requirements box. The box contains the following information:

a) identification of the applicable navigation specification(s) that were used to design the departure procedure;

b) restrictions on navigation equipment required to fly the procedure (for example, global navigation satellite system (GNSS) only) if applicable; and

c) information related to optional functionality of the applicable navigation specification such as the use of constant radius arc to a fix (RF) legs or RNP scalability, if applicable.

1.7.3 Applicable navigation specifications

The applicable navigation specifications for PBN departure operations are:

a) RNAV 2;

b) RNAV 1;

c) RNP 1;

d) RNP 0.3 (Helicopters); and

e) Advanced RNP (A-RNP).

Note.— For complete details of the applicability of PBN navigation specifications to departure procedures, see the Performance-based Navigation (PBN) Manual *(Doc 9613).*

1.7.4 The navigation specifications may be applied on a departure route segment basis.

1.7.5 *Navigation database.* Departure procedure information is contained in a navigation database using the WGS-84 coordinate system. If the navigation database does not contain the departure procedure, the procedure shall not be used.

1.7.6 PBN operational approval

1.7.6.1 Pilots shall verify, before operating on any PBN route or procedure, that they have approval to operate on the navigation specification used. Where there are additional restrictions, for example, sensor use or optional functionality as discussed in 1.7.2 above, the pilot shall also verify that these restrictions are complied with.

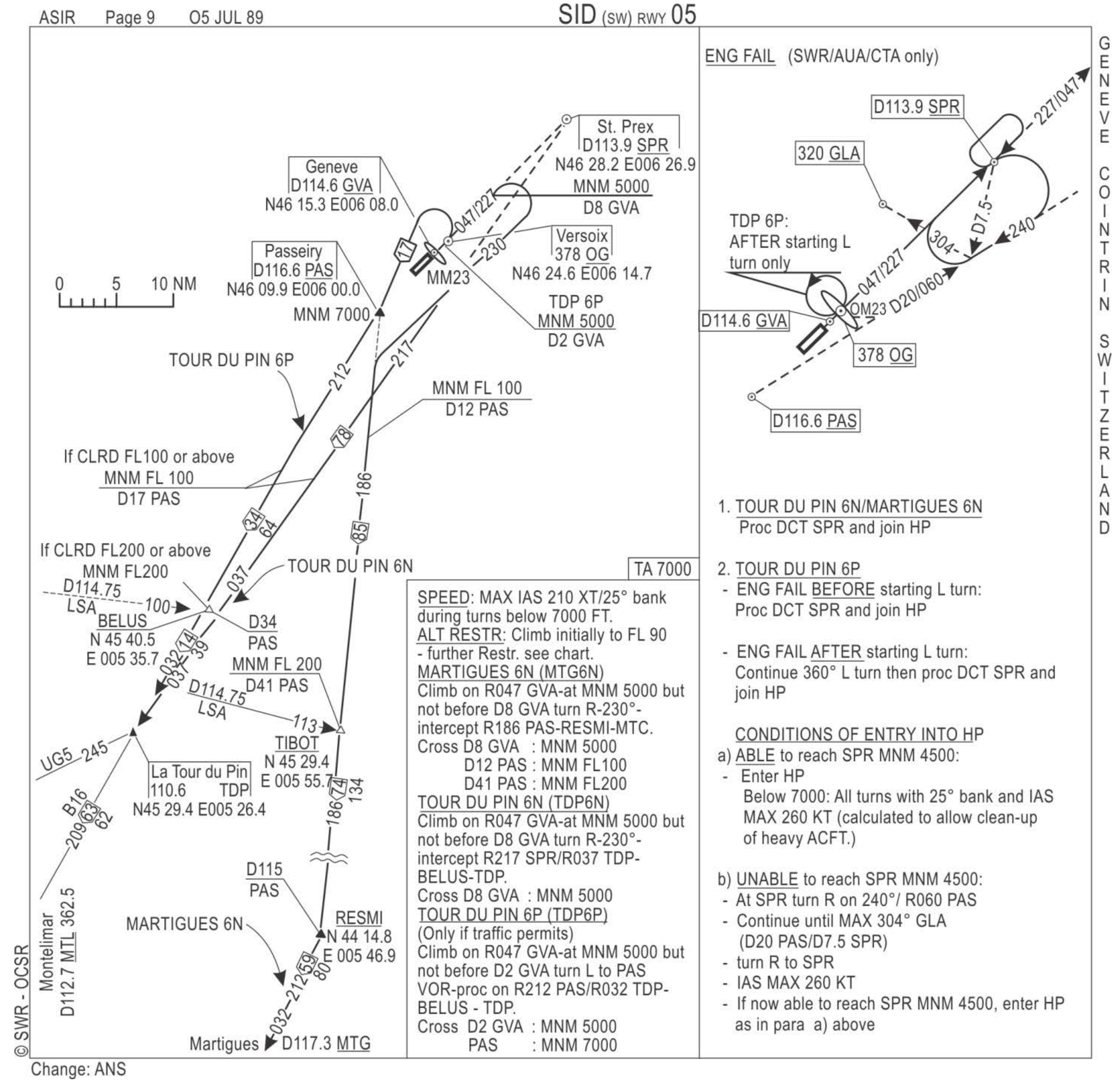
1.7.6.2 Prior to operating on any PBN procedure, the pilot shall confirm:

a) the operation of all required navigation aids (ground and space-based);

b) the correct functioning of the navigation equipment;

c) the validity of the navigation database; and

d) waypoint and segment data, with reference to the published chart.



SPEED: MAX IAS 210 XT/25° bank during turns below 7000 FT.

ALT RESTR: Climb initially to FL 90 - further Restr. see chart.

MARTIGUES 6N (MTG6N)
Climb on R047 GVA-at MNM 5000 but not before D8 GVA turn R-230°-intercept R186 PAS-RESMI-MTC.
Cross D8 GVA : MNM 5000
D12 PAS : MNM FL100
D41 PAS : MNM FL200

TOUR DU PIN 6N (TDP6N)
Climb on R047 GVA-at MNM 5000 but not before D8 GVA turn R-230°-intercept R217 SPR/R037 TDP-BELUS-TDP.
Cross D8 GVA : MNM 5000

TOUR DU PIN 6P (TDP6P)
(Only if traffic permits)
Climb on R047 GVA-at MNM 5000 but not before D2 GVA turn L to PAS VOR-proc on R212 PAS/R032 TDP-BELUS - TDP.
Cross D2 GVA : MNM 5000
PAS : MNM 7000

1. TOUR DU PIN 6N/MARTIGUES 6N
Proc DCT SPR and join HP

2. TOUR DU PIN 6P
- ENG FAIL BEFORE starting L turn:
Proc DCT SPR and join HP

- ENG FAIL AFTER starting L turn:
Continue 360° L turn then proc DCT SPR and join HP

CONDITIONS OF ENTRY INTO HP
a) ABLE to reach SPR MNM 4500:
- Enter HP
Below 7000: All turns with 25° bank and IAS MAX 260 KT (calculated to allow clean-up of heavy ACFT.)

b) UNABLE to reach SPR MNM 4500:
- At SPR turn R on 240°/ R060 PAS
- Continue until MAX 304° GLA (D20 PAS/D7.5 SPR)
- turn R to SPR
- IAS MAX 260 KT
- If now able to reach SPR MNM 4500, enter HP as in para a) above

Figure II-2-1-1. Example of contingency routes in relation to departure routes

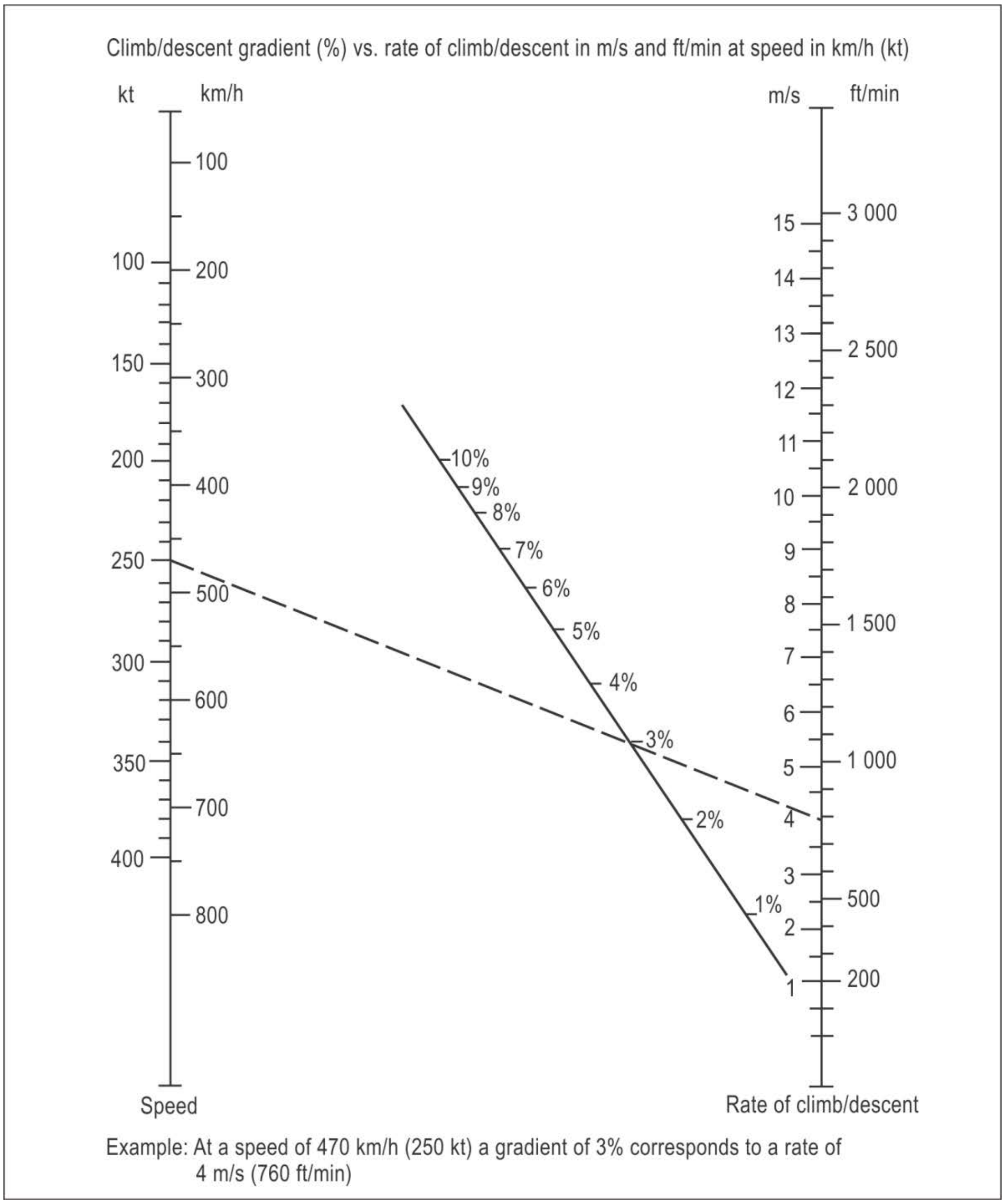


Figure II-2-1-2. Conversion nomogram

Chapter 2

STANDARD INSTRUMENT DEPARTURES

2.1 GENERAL

2.1.1 A standard instrument departure (SID) is a departure procedure that is normally developed to accommodate as many aircraft categories as possible. Departures that are limited to specific aircraft categories are clearly annotated (see Section 5, Chapter 1, 1.4, "Categories of aircraft").

2.1.2 For procedure design purposes, the SID terminates at the first fix/facility/waypoint of the en-route phase following the departure procedure.

2.1.3 SIDs are based on track guidance acquired:

a) for conventional straight departures, within 20.0 km (10.8 NM) from the DER;

b) for conventional turning departures within 10.0 km (5.4 NM) after completion of turns; and

c) for PBN departure procedures normally at the DER.

2.2 PROCEDURE DESIGN GRADIENT

2.2.1 The standard design gradient for departure procedures is 3.3 per cent.

2.2.2 When obstacles exist which affect the departure route, procedure design gradients greater than 3.3 per cent may be specified. When such a gradient is specified, the altitude/height to which it extends is promulgated.

2.2.3 For information regarding rates of climb necessary to meet the specified climb gradients the pilot should refer to Figure II-2-1-2.

2.3 STRAIGHT DEPARTURES

Wherever possible, a straight departure is specified. A straight departure is one in which the initial departure track is within 15° of the alignment of the runway centre line.

2.4 TURNING DEPARTURES

2.4.1 When a departure route requires a turn of more than 15°, it is called a turning departure. Straight flight is assumed until reaching an altitude/height of at least 120 m (394 ft). Procedures normally cater for turns at a point 600 m from the beginning of the runway. However, in some cases, turns should not be initiated before the DER (or a specified point), and this information will be noted on the departure chart.

2.4.2 For Category H procedures, turns may be initiated 90 m (295 ft) above the elevation of the DER or final approach and take-off area (FATO) and the earliest turn initiation point is at the beginning of the runway FATO.

2.4.3 Flight speeds for turning departure are specified in Table II-2-2-1. Wherever limiting speeds other than those specified in Table II-2-2-1 are promulgated, they shall be complied with in order to remain within the appropriate areas. If an aeroplane operation requires a higher speed, then an alternative departure procedure shall be requested.

2.4.4 Turn speeds

2.4.4.1 The maximum speeds used for departure turns shall be those of the final missed approach increased by 10 per cent to account for increased aeroplane mass in departure (see Table II-2-2-1), unless otherwise annotated on the procedure.

2.4.4.2 In exceptional cases, where acceptable terrain clearances cannot otherwise be provided, turning departure routes are constructed with maximum speeds as low as the intermediate missed approach speed increased by 10 per cent (see Tables II-5-1-1 and II-5-1-2). In such cases, the procedure is annotated "Departure turn limited to __________ km/h (kt) IAS maximum".

Table II-2-2-1. Maximum speeds for turning departures

Aeroplane category	*Maximum speed km/h (kt)*
A	225 (120)
B	305 (165)
C	490 (265)
D	540 (290)
E	560 (300)
H	165 (90)

Chapter 3

OMNIDIRECTIONAL DEPARTURES

3.1 GENERAL

3.1.1 In cases where no suitable navigation aid is available, or no track guidance is provided, omnidirectional procedures are used.

3.1.2 Where obstacles do not permit development of omnidirectional procedures, the pilot shall ensure that ceiling and visibility will permit obstacles to be avoided visually.

3.1.3 Omnidirectional departures may specify sectors to be avoided.

3.2 BEGINNING OF DEPARTURE

3.2.1 The departure procedure begins at the departure end of the runway (DER), which is the end of the area declared suitable for take-off (i.e. the end of the runway or clearway as appropriate).

3.2.2 Since the point of lift-off will vary, the departure procedure assumes that a turn at 120 m (394 ft) above the elevation of the aerodrome is not initiated by the pilot sooner than 600 m from the beginning of the runway.

3.2.3 Procedures are normally designed/optimized for turns at a point 600 m from the beginning of the runway. However, in some cases the pilot shall not be allowed to initiate a turn before the DER (or a specified point), and this information will be noted on the departure chart.

3.2.4 For Category H procedures, procedure turns may be initiated 90 m (295 ft) above the elevation if the DER or FATO and the earliest initiation point is at the beginning of the runway/FATO.

3.3 PROCEDURE DESIGN GRADIENT (PDG)

3.3.1 Unless otherwise specified, departure procedures assume a 3.3 per cent (helicopters, 5 per cent) PDG and straight climb on the extended runway centre line until reaching 120 m (394 ft) (helicopters, 90 m (295 ft)) above the aerodrome elevation.

3.3.2 The basic procedure ensures:

a) the aircraft climbs on the extended runway centre line to 120 m (394 ft) (helicopters, 90 m (295 ft)) before turning; and

b) at least 75 m (246 ft) (CAT H, 65 m (213 ft)) of obstacle clearance is provided before any turns greater than 15°.

Section 3

EN-ROUTE PROCEDURES

Chapter 1

GENERAL REQUIREMENTS

1.1 GENERAL

1.1.1 Procedures developed utilizing en-route criteria assume normal aircraft operations. Any requirements to satisfy Annex 6 aeroplane performance operating limitations must be considered separately by the operator.

1.2 OBSTACLE CLEARANCE AREAS

1.2.1 In defining obstacle clearance areas, both primary and secondary areas are specified. These are defined in such a way as to ensure that the aircraft position will be contained within the primary area 95 per cent of the time and within the secondary area 99.7 per cent of the time.

1.2.2 Area minimum altitudes

1.2.2.1 For en-route charts the area minimum altitude shall be shown within each quadrant referenced to true north, except in areas of high latitude where it is determined by the appropriate authority that true north orientation of the chart is impractical.

1.2.2.2 In high latitude areas as described in 1.2.2.1, the area minimum altitude should be shown within each quadrant formed by reference lines of the grid used.

1.2.2.3 Where charts are not true north orientated, this fact and the orientation used shall be clearly indicated.

1.3 CHARTING ACCURACIES

Charting accuracies are taken into account when establishing minimum en-route altitudes by adding both a vertical and a horizontal tolerance to the depicted objects on the chart.

1.4 OBSTACLE CLEARANCE

1.4.1 The minimum obstacle clearance (MOC) value to be applied in the primary area for the en-route phase of an instrument flight rules (IFR) flight is 300 m (1 000 ft). In mountainous areas, this shall be increased depending on the variation in terrain elevation as follows:

Variation in terrain elevation	*MOC*
Between 900 m (3 000 ft) and 1 500 m (5 000 ft	450 m (1 476 ft)
Greater than 1 500 m (5 000 ft))	600 m (1 969 ft)

1.4.2 The MOC to be applied outside the primary area is normally equal to half the value of that applied in the primary area. Where this is found to be too constraining an alternative method is to use a value which reduces from the full MOC at the edge of the primary area to zero at the outer edge of the secondary area.

1.4.3 *Minimum obstacle clearance altitude (MOCA).* The MOCA is the minimum altitude for a defined segment that provides the required MOC. A MOCA is determined and published for each segment of the route.

1.5 PERFORMANCE-BASED NAVIGATION (PBN) EN-ROUTE PROCEDURES

1.5.1 Standard conditions

1.5.1.1 The general criteria for very high frequency omnidirectional radio range (VOR) and non-directional beacon (NDB) routes apply except where amended in 1.5.1.2 and 1.5.2.

1.5.1.2 The standard assumptions on which en-route PBN procedures are developed are:

a) the fix tolerance area of the waypoint is a circle of radius equal to the navigation specification accuracy value; and

b) the navigation system provides information which the pilot monitors and uses to intervene in order to limit excursions outside of the designed area.

1.5.2 Applicable navigation specifications

The applicable navigation specifications for PBN en-route operations are:

a) RNAV 10;

b) RNAV 5;

c) RNAV 2;

d) RNAV 1;

e) RNP 4;

f) RNP 2;

g) RNP 0.3 (Helicopters); and

h) Advanced RNP (A-RNP).

Note.— For complete details of the applicability of PBN navigation specifications to en-route procedures, see the Performance-based Navigation (PBN) Manual *(Doc 9613).*

1.5.3 PBN operational approval

1.5.3.1 Pilots shall verify, before operating on any PBN route, that they have approval to operate on the navigation specification(s) used. Where there are additional restrictions, for example, sensor use or optional functionality, the pilot shall also verify that these restrictions are complied with.

1.5.3.2 Prior to operating on any PBN procedure, the pilot shall confirm:

a) the operation of all required navigation aids (ground and space-based);

b) the correct functioning of the navigation equipment; and

c) the validity of the navigation database, where required.

1.5.4 Magnetic bearing on a PBN (RNAV or RNP) route segment

1.5.4.1 The magnetic bearing for a PBN route segment is based on the true course and the magnetic variation at the significant point at origin of the route segment.

1.5.4.2 Pilots should use the magnetic bearing as reference only, because their navigation system will fly the true course from one significant point to another.

1.5.5 En-route turns

1.5.5.1 There are three types of turns for PBN routes:

a) the fly-over turn at a waypoint;

b) the fly-by turn at a waypoint; and

c) the fixed radius transition (FRT). An FRT may be applied at fixes between area navigation route segments on the en-route structure and may be used with Advanced RNP, RNP 4 and RNP 2 navigation specifications.

Note.— More information on constant radius turns in the en-route phase of flight is addressed in Doc 9613, Volume II, Part C, Appendix 2. Guidance on how to employ FRTs is still being developed and once it is mature, design criteria for FRT will be included in the PANS-OPS.

1.5.5.2 Pilots shall verify they are approved to operate on routes with FRTs prior to commencing any route which specifies their use.

Section 4

ARRIVAL PROCEDURES

Chapter 1

GENERAL REQUIREMENTS

1.1 GENERAL

1.1.1 A standard instrument arrival (STAR) route permits transition from the en-route phase to the approach phase.

1.1.2 When necessary or where an operational advantage is obtained, arrival routes from the en-route phase to a fix or facility used in the procedure are published. This is normally the initial approach fix (IAF).

1.1.3 Omnidirectional or sector arrivals can be provided taking into account minimum sector altitudes (MSA).

1.2 TERMINAL AREA RADAR (TAR)

When TAR is employed, the aircraft will be vectored to a fix, or onto the intermediate or final approach track, at a point where the approach may be continued by the pilot by referring to the instrument approach chart (IAC).

1.3 MINIMUM SECTOR ALTITUDES (MSA)/ TERMINAL ARRIVAL ALTITUDES (TAA)

MSAs and TAAs are established for each aerodrome and provide at least 300 m (1 000 ft) obstacle clearance within 46 km (25 NM) of the significant point, the aerodrome reference point (ARP) or the heliport reference point (HRP) associated with the approach procedure for that aerodrome.

1.4 PERFORMANCE-BASED NAVIGTION (PBN) ARRIVALS

1.4.1 *Description.* A PBN arrival is an arrival procedure containing PBN segments. PBN arrival procedures may use terminal arrival altitudes to establish procedure altitudes for arrivals.

Note.— See Chapter 2 for more information on the TAA.

1.4.2 *PBN requirements box.* PBN arrival procedures are promulgated with a PBN requirements box. The box contains the following information:

a) identification of the applicable navigation specification(s) that were used to design the arrival procedure;

b) restrictions on navigation equipment required to fly the procedure (for example, global navigation satellite system (GNSS) only); and

c) information related to optional functionality of the applicable navigation specification, such as the use of constant radius arc to a fix (RF) legs or required navigation performance (RNP) scalability.

1.4.3 Applicable navigation specifications

1.4.3.1 The applicable navigation specifications for PBN arrival operations are:

a) RNAV 5 (initial part of a STAR outside 56 km (30 NM and above MSA only);

b) RNAV 2;

c) RNAV 1;

d) RNP 1;

e) RNP 0.3 (Helicopters); and

f) Advanced RNP (A-RNP).

Note.— For complete details of the applicability of PBN navigation specifications to arrival procedures, see the Performance-based Navigation (PBN) Manual *(Doc 9613).*

1.4.3.2 *Navigation database.* Arrival waypoint information is contained in a navigation database using the WGS-84 coordinate system. If the navigation database does not contain the arrival procedure, the procedure shall not be used.

Note.— A navigation database is not required for RNAV 5 operations.

1.4.4 PBN operational approval

1.4.4.1 Pilots shall verify, before operating on any PBN route or procedure, that they have approval to operate on the navigation specification used. Where there are additional restrictions, for example, sensor use or optional functionality as discussed in 1.4.2, the pilot shall also verify that these restrictions are complied with.

1.4.4.2 Prior to operating on any PBN procedure, the pilot shall confirm:

a) the operation of all required navigation aids (ground and space-based);

b) the correct functioning of the navigation equipment;

c) the validity of the navigation database, where required; and

d) waypoint and segment data, with reference to the published chart.

Chapter 2

TERMINAL ARRIVAL ALTITUDE

2.1 GENERAL

2.1.1 TAAs are associated with a PBN procedure based upon the “T” or “Y” arrangement, with three IAFs arranged around the intermediate fix (IF) to allow for aircraft to join from all directions. (See Figures II-4-2-3 and II-4-2-4.)

2.1.2 Modifications to this standard pattern are sometimes necessary, for example, eliminating one or both of the base leg areas.

2.1.3 An aircraft approaching the terminal area and intending to conduct a PBN approach shall track via the appropriate IAF associated with the procedure. The publication of TAAs avoids the requirement for distance and/or azimuth information in relation to the MSA reference point and provides obstacle clearance while tracking direct to an IAF.

2.1.4 Where published, TAAs replace the 46 km (25 NM) MSA.

2.1.5 The standard TAA arrangement consists of three areas defined by the extension of the initial legs and the intermediate segment course from IF to final approach fix (FAF) or final approach point (FAP). These areas are called the straight-in, left base and right base areas.

2.1.6 TAA area boundaries are defined by a radial area navigation (RNAV) distance from, and magnetic bearings to, the TAA reference point. The TAA reference point is normally the associated IAF but in some cases may be the IF.

Note.—- In this chapter, the standard “T” or “Y” arrangement incorporating three IAFs will be assumed. Where one or more of the initial segments are not employed, the TAA reference point may be the IF.

2.1.7 The standard TAA radius is 46 km (25 NM) from the IAF, and the boundaries between TAAs are normally defined by the extension of the initial segments (see Figure II-4-2-1).

2.1.8 Minimum altitudes charted for each TAA shall provide at least 300 m (1 000 ft) obstacle clearance.

2.2 STEP DOWN ARCS

TAAs may contain step down arcs defined by distance from the IAF (see Figure II-4-2-2).

2.3 TAA ICONS

TAAs are depicted on the plan view of approach charts by the use of icons which identify the TAA reference point (IAF or IF), the radius from the reference point, and the bearings of the TAA boundaries. The icon will show minimum altitudes and step downs. The IAF for each TAA is identified by the waypoint name to help the pilot orient the icon to the approach procedure. The IAF name and the distance of the TAA boundary from the IAF are included on the outside arc of the TAA icon. TAA icons also identify, where necessary, the location of the intermediate fix by the letters "IF" and not the IF waypoint identifier to avoid misidentification of the TAA reference point and to assist in situational awareness (see Figures II-4-2-3 to II-4-2-5).

2.4 FLIGHT PROCEDURES

2.4.1 Establishment

Prior to operating at the TAA, the pilot shall determine that the aircraft is located within the TAA boundary. This should be done by selecting the relevant IAF and confirming the bearing and distance of the aircraft to the IAF. That bearing should then be compared with the published bearings that define the lateral boundaries of the TAA. This is critical when approaching the TAA near the boundary between areas, especially where TAAs are at different levels.

2.4.2 Manoeuvring

An aircraft may be manoeuvred at the TAA provided the flight path is contained within the TAA boundaries by reference to bearings and distance to the IAF.

2.4.3 Transitioning between TAAs

When transitioning from one TAA to another, the pilot shall ensure that the aircraft reaches or maintains the higher of the two TAA values prior to crossing the boundary between TAAs. The pilot shall exercise caution in transitioning to another TAA to ensure that reference is made to the correct IAF and that the aircraft is contained within the boundaries of both TAAs.

2.4.4 Entry to procedure

An aircraft established within a TAA area may enter the associated approach procedure at the IAF without conducting a procedure turn provided the angle of turn at the IAF does not exceed 110°. In most cases, the design of the TAA will not require a turn in excess of 110°; if necessary, the aircraft should be manoeuvred within the TAA to establish the aircraft on a track prior to arrival at the IAF that does not require a procedure turn (see Figure II-4-2-6).

2.4.5 Reversal procedures

Where entry cannot be made to the procedure with a turn at the IAF less than 110°, a reversal procedure shall be flown.

2.4.6 Arrival holding

A racetrack holding procedure will normally be located at an IAF or the IF. When one or more of the IAFs from the standard "T" or "Y" pattern are not provided, the holding pattern will normally be located to facilitate entry to the procedure (see Figure II-4-2-7).

2.5 NON-STANDARD TAA

2.5.1 Modification to the standard TAA design may be necessary to accommodate operational requirements. Variations may eliminate one or both of the base areas or modify the angular size of the straight-in area.

2.5.2 If both the left and right base areas are eliminated, the straight-in area is constructed on the straight-in IAF or IF with a 46 km (25 NM) radius, through 360° of arc (see Figure II-4-2-8).

2.5.3 For procedures with a single TAA, the TAA area may be subdivided by pie-shaped sectors with the boundaries identified by magnetic bearings to the IAF, and may have one step down arc (see Figure II-4-2-9).

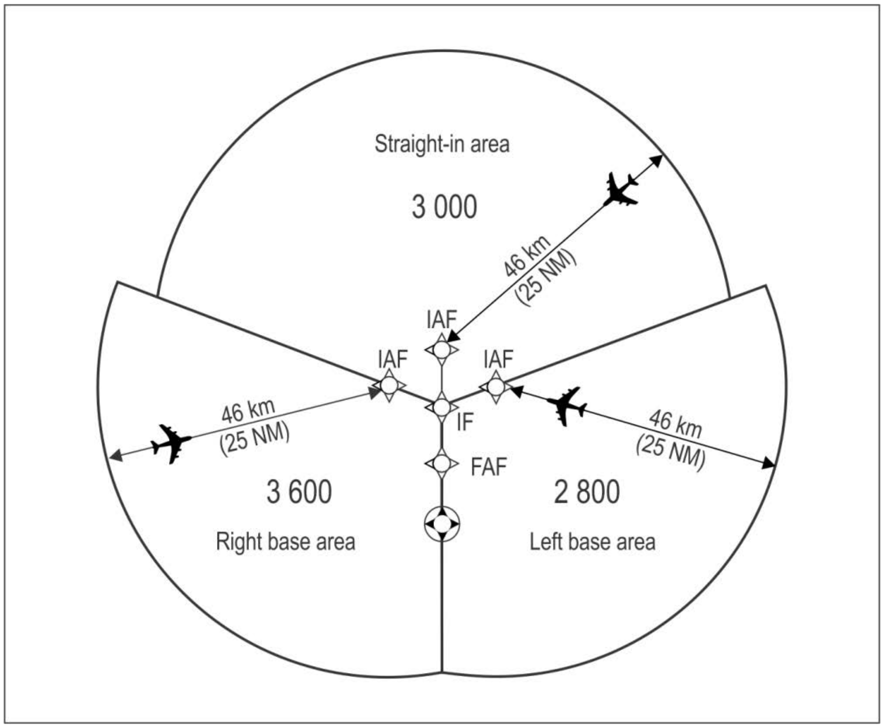


Figure II-4-2-1. Typical TAA arrangement

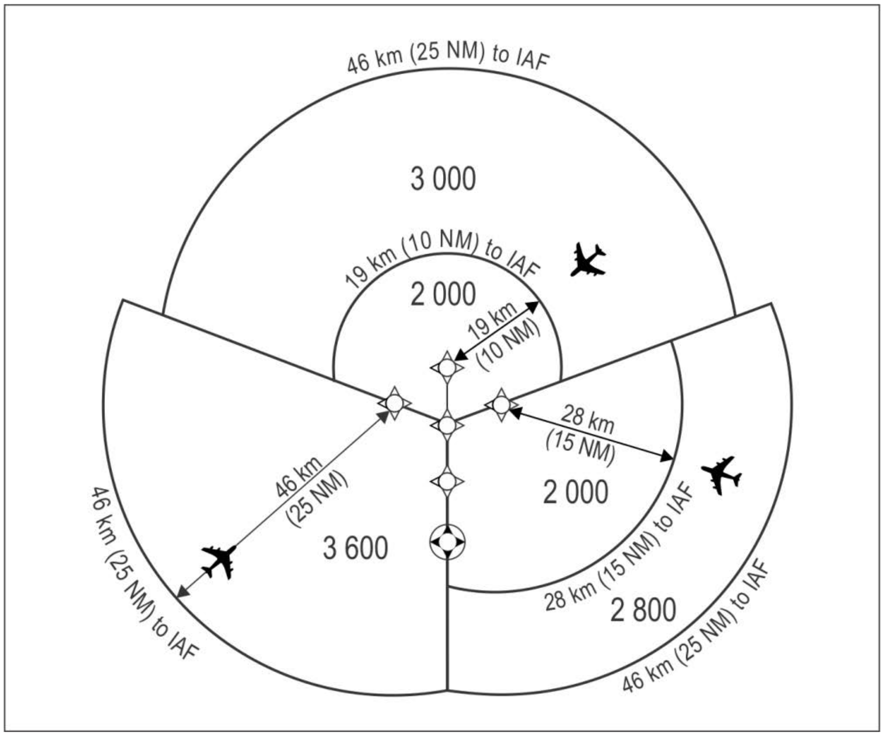


Figure II-4-2-2. TAA with step down arcs

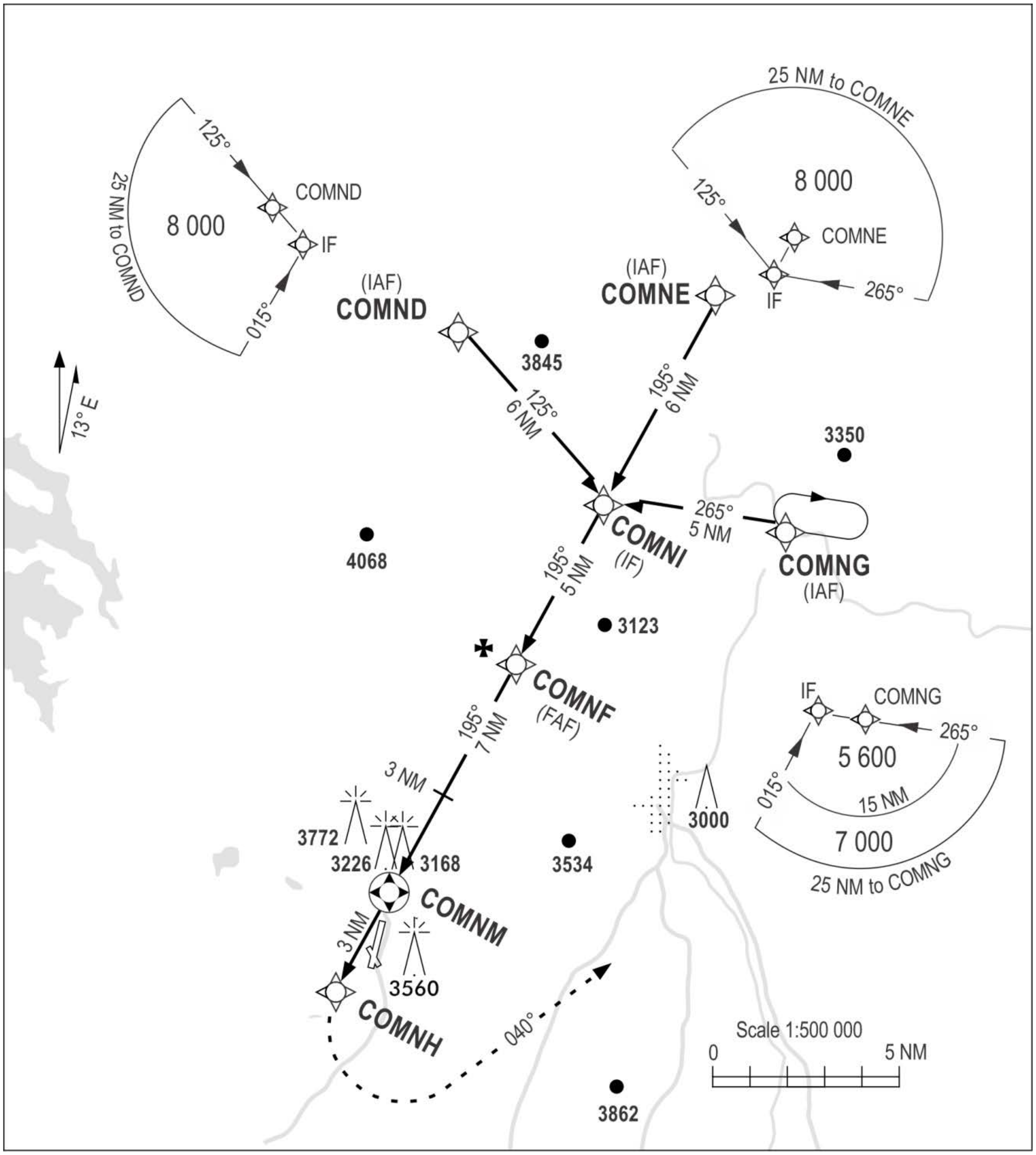


Figure II-4-2-3. TAA “Y” bar icon arrangement

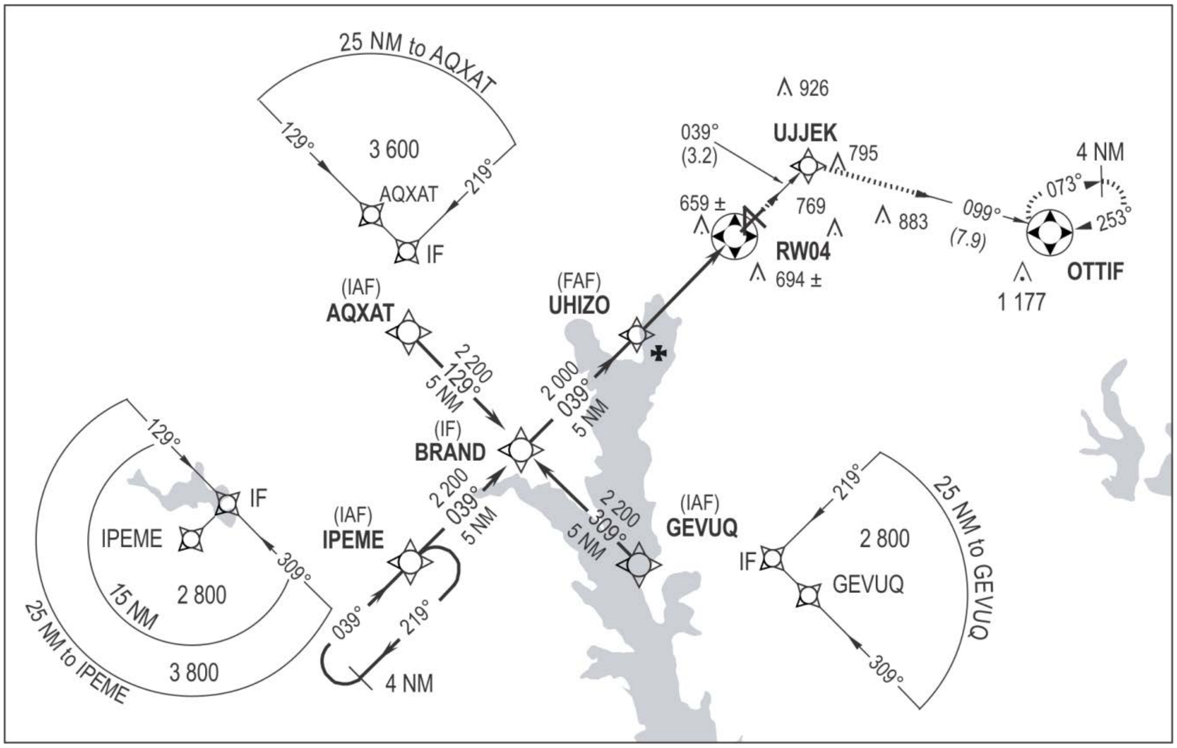


Figure II-4-2-4. “T” bar icon arrangement

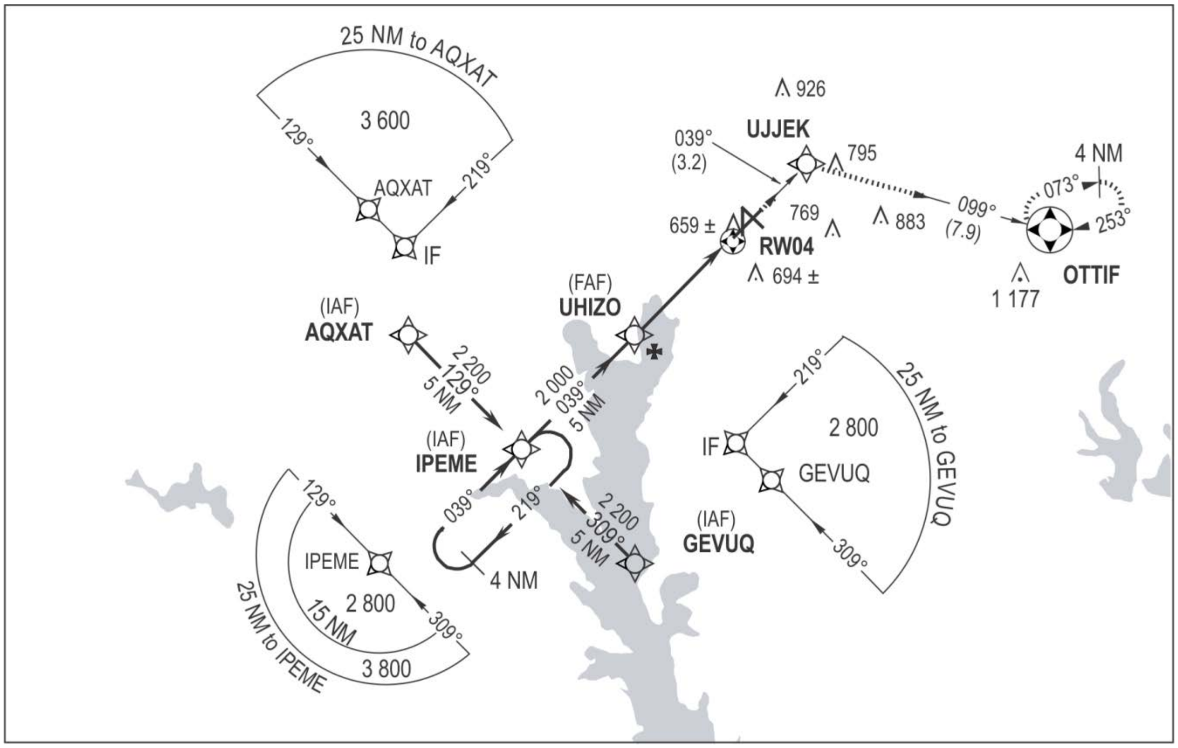


Figure II-4-2-5. “T” bar icon arrangement without centre initial approach fix

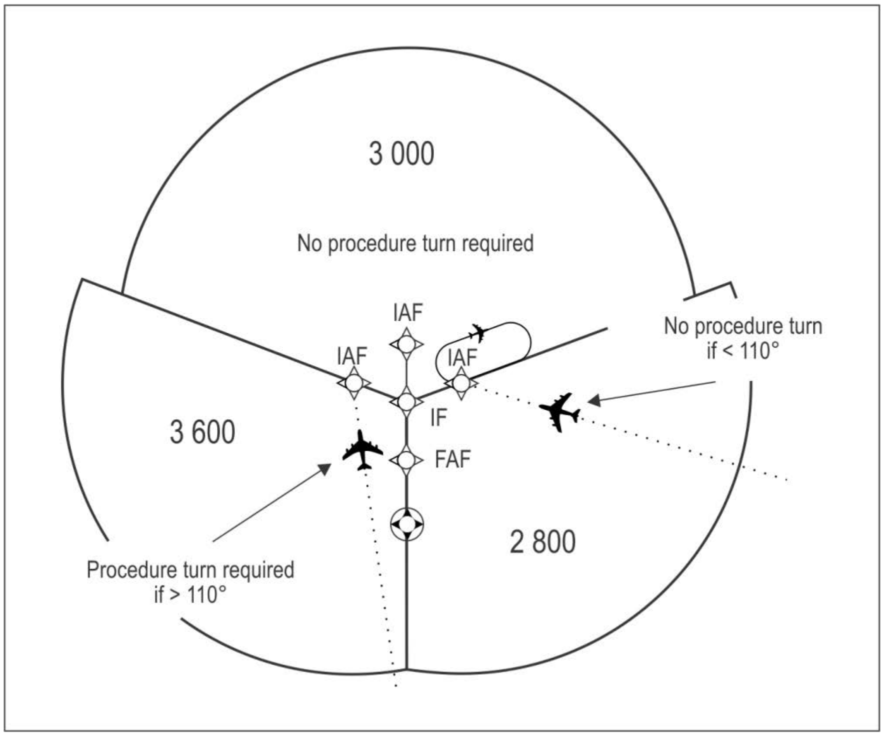


Figure II-4-2-6. Procedure entry

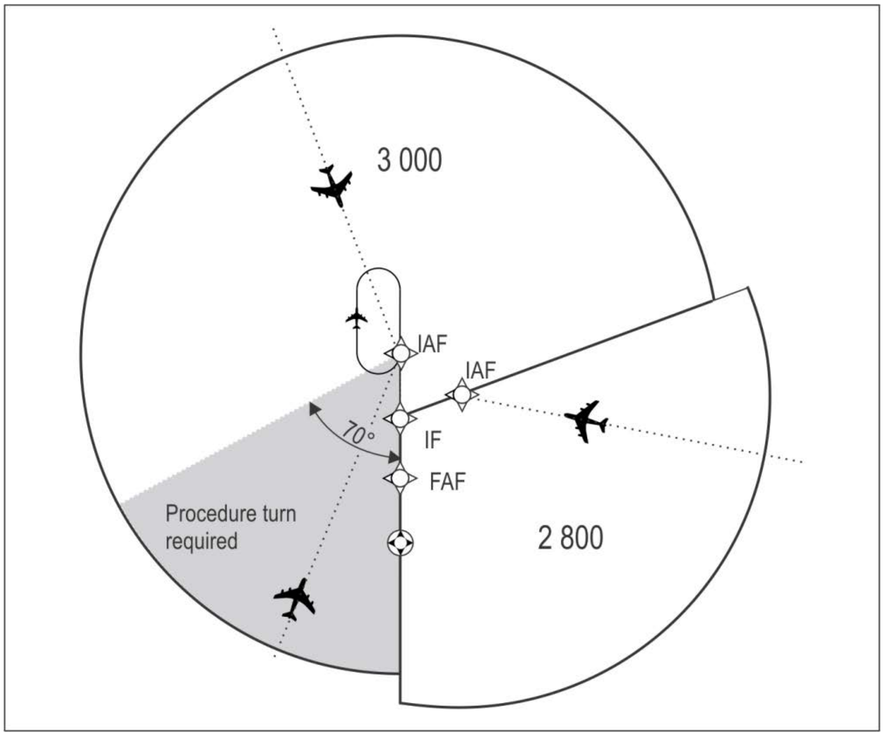


Figure II-4-2-7. TAA arrangement without right base

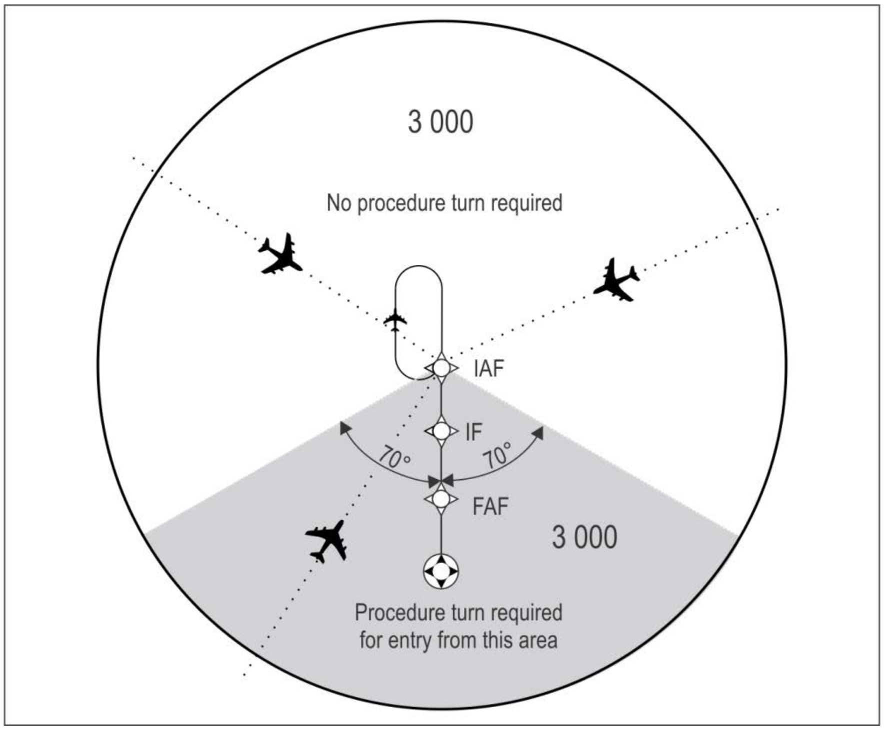


Figure II-4-2-8. TAA arrangement without left and right base

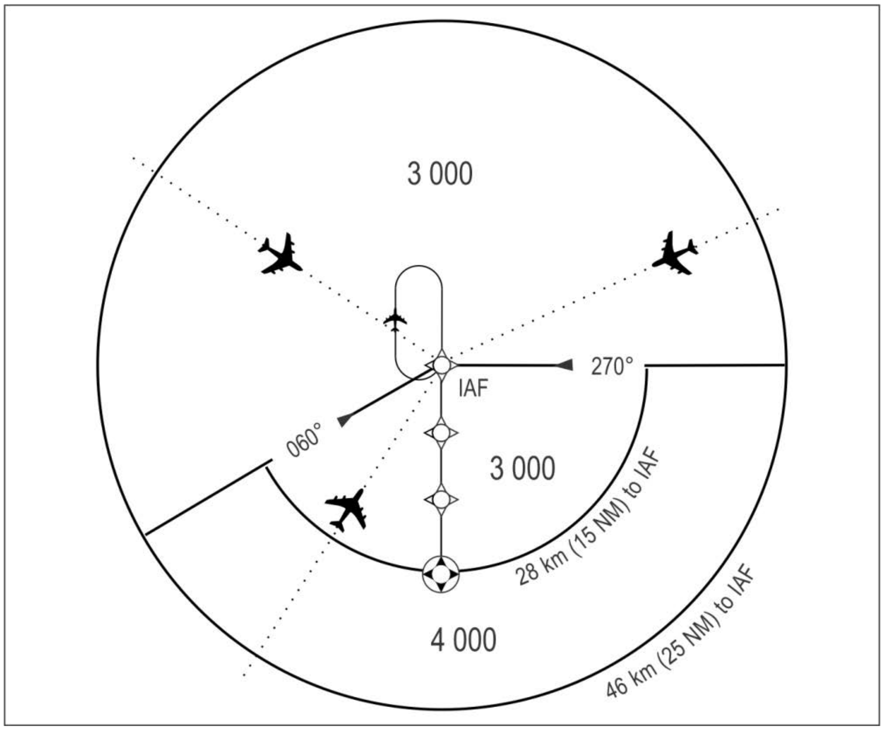


Figure II-4-2-9. Single TAA with sectorization and step down

Section 5

APPROACH PROCEDURES

Chapter 1

GENERAL REQUIREMENTS

1.1 INTRODUCTION

This chapter explains the procedures to be followed and the limitations to be observed in order to achieve an acceptable level of safety in the conduct of instrument approach procedures.

1.2 INSTRUMENT APPROACH PROCEDURE

1.2.1 Conventional instrument approach procedures are based on navigation guidance provided by ground-based systems.

1.2.2 For aircraft with a database of approach procedures, prior to commencing the approach the pilot shall verify the correct procedure was loaded into the navigation system by comparing it to the approach charts. This check shall include:

a) the waypoint sequence; and

b) the reasonableness of the tracks and distances of the approach segments, and the accuracy of the inbound course and length of the final approach segment (FAS).

1.2.3 Segments of the approach procedure

1.2.3.1 An instrument approach procedure may have five separate segments. They are the arrival, initial, intermediate, final and missed approach segments. (See Figure II-5-1-1.) In addition, an area for circling the aerodrome under visual conditions is also considered (see Chapter 5 of this section).

1.2.3.2 The approach segments begin and end at designated fixes. However, under some circumstances certain of the segments may begin at specified points where no fixes are available. For example, the FAS of a precision approach may start where the intermediate flight altitude intersects the nominal glide path (the final approach point).

1.2.4 Types of approach

1.2.4.1 There are two types of approach: straight-in and circling.

1.2.4.2 *Straight-in approach.* Wherever possible, a straight-in approach will be specified which is aligned with the runway centre line. The pilot should be aware that for non-precision approaches, a straight-in approach is considered acceptable if the angle between the final approach track and the runway centre line is 30° or less.

1.2.4.3 *Circling approach.* A circling approach will be specified in those cases where terrain or other constraints cause the final approach track alignment or descent gradient to fall outside the criteria for a straight-in approach. The final approach track of a circling approach procedure is in most cases aligned to pass over some portion of the usable landing surface of the aerodrome.

1.3 PERFORMANCE-BASED NAVIGATION (PBN) APPROACHES

1.3.1 *Description.* A PBN approach is an approach procedure containing PBN segments.

1.3.2 *PBN requirements box.* PBN approach procedures are promulgated with a PBN requirements box. The box contains the following information:

a) identification of the applicable navigation specification(s) that were used to design the approach procedure;

b) restrictions on navigation equipment required to fly the procedure (for example, global navigation satellite system (GNSS) only); and

c) information related to optional functionality of the applicable navigation specification, such as the use of constant radius arc to a fix (RF) legs or required navigation performance (RNP) scalability.

1.3.3 Applicable navigation specifications

The applicable navigation specifications for PBN approach operations are:

a) RNP APCH;

b) RNP AR APCH; and

c) Advanced RNP (A-RNP).

Note.— For complete details of the applicability of PBN navigation specifications to approach procedures, see the Performance-based Navigation (PBN) Manual *(Doc 9613).*

1.3.4 *Navigation database.* Approach procedure information is contained in a navigation database using the WGS-84 coordinate system. If the navigation database does not contain the approach procedure, the procedure shall not be used.

1.3.5 Hybrid approaches are possible, in which PBN segments are used to connect to a conventional final approach, such as an instrument landing system (ILS) approach. For such approaches the chart will be titled consistently with the final approach type but will also include a PBN requirements box as described in 1.3.2 above.

1.3.6 PBN operational approval

1.3.6.1 Pilots shall verify, before operating on any PBN route or procedure, that they have approval to operate on the navigation specification(s) used in the design of the procedure. Where there are additional restrictions, for example, sensor use or optional functionality as discussed in 1.3.2, the pilot shall also verify that these restrictions are complied with.

1.3.6.2 Prior to operating on any PBN procedure, the pilot shall confirm:

a) the operation of all required navigation aids (ground and space-based);

b) the correct functioning of the navigation equipment;

c) the validity of the navigation database; and

d) waypoint and segment data, with reference to the published chart.

1.4 CATEGORIES OF AIRCRAFT

1.4.1 Aircraft performance has a direct effect on the airspace and visibility required for the various manoeuvres associated with the conduct of instrument approach procedures. The most significant performance factor is aircraft speed. Accordingly, categories of typical aircraft have been established.

1.4.2 The criterion taken into consideration for the classification of aeroplanes by categories is the indicated airspeed at threshold (V_{at}).

1.4.3 Aircraft categories will be referred to by their letter designations as follows:

Category A: less than 169 km/h (91 kt) indicated airspeed (IAS)
Category B: 169 km/h (91 kt) or more but less than 224 km/h (121 kt) IAS
Category C: 224 km/h (121 kt) or more but less than 261 km/h (141 kt) IAS
Category D: 261 km/h (141 kt) or more but less than 307 km/h (166 kt) IAS
Category E: 307 km/h (166 kt) or more but less than 391 km/h (211 kt) IAS
Category H: see 1.4.7, "Helicopters".

Note.— Category A used in this volume refers to the classification of aircraft based on approach speed. Annex 6, Part III, Attachment A refers to Category A in terms of helicopter performance classifications for multi-engined helicopters meeting critical engine failure criteria. These terms are not related.

1.4.4 *Permanent change of category (maximum landing mass).* An operator may impose a permanent lower landing mass, and use of this mass for determining V_{at} if approved by the State of the Operator. The category defined for a given aeroplane shall be a permanent value and independent of changing day-to-day operations.

1.4.5 The instrument approach chart (IAC) specifies the individual categories of aircraft for which the procedure is approved. Normally, procedures will be designed to provide protected airspace and obstacle clearance for aircraft up to and including Category D. However, where airspace requirements are critical, procedures may be restricted to lower speed categories.

1.4.6 Alternatively, the procedure may specify a maximum IAS for a particular segment without reference to aircraft category. In any case, the pilot shall comply with the procedures and information depicted on instrument flight charts and the appropriate flight parameters shown in Tables II-5-1-1 and II-5-1-2 to ensure that the aircraft remains in the areas developed for obstacle clearance purposes.

1.4.7 Helicopters

Helicopter pilots may use Category A minima on instrument procedures designed for aeroplanes. However, specific procedures may be developed for helicopters and these shall be clearly designated "H". Category H procedures shall not be promulgated on the same IAC as joint helicopter/aeroplane procedures.

1.5 OBSTACLE CLEARANCE

Obstacle clearance is a primary safety consideration in the development of instrument approach procedures. The criteria used and the detailed method of calculation are covered in PANS-OPS, Volume II. However, from the operational point of view, the pilot should be aware that the obstacle clearance applied in the development of each instrument approach procedure is considered to be the minimum required for an acceptable level of safety in operations.

1.6 OBSTACLE CLEARANCE ALTITUDE/HEIGHT (OCA/H)

For each individual approach procedure an obstacle clearance altitude/height (OCA/H) is calculated in the development of the procedure and published on the IAC. In the case of precision approach and circling approach procedures, an OCA/H is specified for each category of aircraft listed in 1.4. Obstacle clearance altitude/height (OCA/H) is:

a) in a precision approach procedure, the lowest altitude (OCA) or alternatively the lowest height above the elevation of the relevant runway threshold (OCH), at which a missed approach shall be initiated to ensure compliance with the appropriate obstacle clearance criteria; or

b) in a non-precision approach procedure, the lowest altitude (OCA) or alternatively the lowest height above aerodrome elevation or the elevation of the relevant runway threshold, if the threshold elevation is more than 2 m (7 ft) below the aerodrome elevation (OCH), below which an aircraft cannot descend without infringing the appropriate obstacle clearance criteria; or

c) in a visual (circling) procedure, the lowest altitude (OCA) or alternatively the lowest height above the aerodrome elevation (OCH) below which an aircraft cannot descend without infringing the appropriate obstacle clearance criteria.

1.7 FACTORS AFFECTING OPERATIONAL MINIMA

In general, minima are developed by adding the effect of a number of operational factors to OCA/H to produce, in the case of precision approaches, decision altitude (DA) or decision height (DH) and, in the case of non-precision approaches, minimum descent altitude (MDA) or minimum descent height (MDH). The general operational factors to be considered are specified in Annex 6. The detailed criteria and methods for determining operating minima are currently under development for this document. The relationship of OCA/H to operating minima (landing) is shown in Figures II-5-1-2, II-5-1-3 and II-5-1-4.

1.8 VERTICAL PATH CONTROL ON NON-PRECISION APPROACH PROCEDURES

1.8.1 Introduction

1.8.1.1 Studies have shown that the risk of controlled flight into terrain (CFIT) is high on non-precision approaches. While the procedures themselves are not inherently unsafe, the use of the traditional step down descent technique for flying non-precision approaches is prone to error, and is therefore discouraged. Operators should reduce this risk by emphasizing training and standardization in vertical path control on non-precision approach procedures. Operators typically employ one of three techniques for vertical path control on non-precision approaches:

a) continuous descent final approach (CDFA);

b) constant angle descent; and

c) step down approach.

Of these techniques, the CDFA technique is preferred. Operators should use the CDFA technique whenever possible as it adds to the safety of the approach operation by reducing pilot workload and by lessening the possibility of error in flying the approach.

1.8.2 Continuous descent final approach (CDFA)

1.8.2.1 Many Contracting States require the use of the CDFA technique and apply increased visibility or runway visual range (RVR) requirements when the technique is not used.

1.8.2.2 This technique requires a continuous descent, flown either with vertical navigation (VNAV) guidance calculated by on-board equipment or based on manual calculation of the required rate of descent, without level-offs. The rate of descent is selected and adjusted to achieve a continuous descent 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. The descent shall be calculated and flown to pass at or above the minimum altitude at any step down fix (SDF).

Note.— CDFAs with advisory VNAV guidance calculated by on-board equipment are considered 3D operations. CDFAs with manual calculation of the required rate of descent are considered 2D operations.

1.8.2.3 If the visual references required to land have not been acquired when the aircraft is approaching the MDA/H, the vertical (climbing) portion of the missed approach shall be initiated at an altitude above the minimum descent altitude/height (MDA/H) sufficient to prevent the aircraft from descending through the MDA/H. At no time is the aircraft to be flown in level flight at or near the MDA/H. Any turns on the missed approach shall not begin until the aircraft reaches the missed approach point (MAPt). Likewise, if the aircraft reaches the MAPt before descending to near the MDA/H, the missed approach shall be initiated at the MAPt.

1.8.2.4 An increment for the MDA/H may be prescribed by the operator to determine the altitude/height at which the vertical portion of the missed approach shall be initiated in order to prevent descent below the MDA/H. In such cases, there is no need to increase the RVR or visibility requirements for the approach. The RVR and/or visibility published for the original MDA/H should be used.

1.8.2.5 Upon approaching the MDA/H only two options exist for the pilot: continue the descent below MDA/H to land with the required visual references in sight; or execute a missed approach. There is no level flight segment after reaching the MDA/H.

1.8.2.6 The CDFA technique simplifies the final segment of the non-precision approach by incorporating techniques similar to those used when flying a precision approach procedure or an approach procedure with vertical guidance (APV). The CDFA technique improves pilot situational awareness and is entirely consistent with all “stabilized approach” criteria.

1.8.3 Constant angle descent

1.8.3.1 The second technique involves achieving a constant, unbroken angle from the final approach fix (FAF), or optimum point on procedures without an FAF, to a reference datum above the runway threshold, e.g. 15 m (50 ft). When the aircraft approaches the MDA/H, a decision shall be made to either continue on the constant angle or level off at or above the MDA/H, depending on visual conditions.

1.8.3.2 If the visual conditions are adequate, the pilot should continue the descent to the runway without any intermediate level-off.

1.8.3.3 If visual conditions are not adequate to continue, the aircraft shall level off at or above the MDA/H and continue inbound until either:

a) encountering visual conditions sufficient to descend below the MDA/H to the runway; or

b) reaching the published MAPt and thereafter executing the missed approach procedure.

1.8.4 Step down descent

The third technique involves an expeditious descent and is described as “descend immediately to not below the minimum SDF altitude/height or MDA/H, as appropriate”. This technique is acceptable as long as the achieved descent gradient remains less than 15 per cent and the missed approach is initiated at or before the MAPt. Careful attention to altitude control shall be taken with this technique due to the high rates of descent before reaching the MDA/H and, thereafter, because of the increased time of exposure to obstacles at the MDA.

1.8.5 Temperature correction

In all cases, regardless of the flight technique used, a temperature correction shall be applied to all minimum altitudes (see PANS-OPS, Volume III, Section2, Chapter 4, 4.3, “Temperature correction”).

1.8.6 Missed approach

Regardless of the type of vertical path control that is used on a non-precision approach, in the event of a missed approach the lateral “turning” portion of the missed approach procedure shall not be executed prior to the MAPt.

1.8.7 Training

Regardless of which of the above described techniques an operator chooses to employ, the pilot shall receive specific and appropriate training for that technique.

1.9 APPROACH OPERATIONS UTILIZING BAROMETRIC VERTICAL NAVIGATION (BARO-VNAV) EQUIPMENT

1.9.1 Baro-VNAV equipment can be used in two different scenarios to provide vertical guidance on a 3D approach operation, detailed in Chapter 2 of this section:

a) *Approach operations on APV procedures designed for 3D operations.* In this case, the use of a baro-VNAV system is required. The operation shall be conducted to a DA/H.

b) *Approach operations on non-precision approach procedures.* In this case, the use of a baro-VNAV system is not required but auxiliary to facilitate the CDFA technique as described in 1.8.2. This means that advisory VNAV guidance is being overlaid on a non-precision approach. The lateral navigation guidance is predicated on the navigation system designated on the chart. The operation shall be conducted to a derived DA/H which shall be calculated by the operator, based on the MDA/H for the procedure. The derived decision altitude/height (DA/H) shall be not lower than the MDA/H.

Note.— Guidance on the operational approval for approach and landing operations with vertical guidance using baro-VNAV equipment can be found in the Performance-based Navigation (PBN) Manual *(Doc 9613), Volume II, Part C, Chapter 5, "Implementing RNP APCH" and Volume II, Attachment, "Barometric VNAV".*

1.10 DESCENT GRADIENT

1.10.1 Wherever possible, descent procedures are planned with an optimum gradient/angle of 5.2 per cent/3.0°. When necessary, the descent gradient may be increased up to a maximum value which is dependent on aircraft category.

1.10.2 In certain cases, the maximum allowable descent gradient results in descent rates which exceed the recommended rates of descent for some aircraft. For example, at 280 km/h (150 kt), this maximum gradient results in a 5 m/s (1 000 ft/min) rate of descent.

1.10.3 The pilot should consider carefully the descent rate required for non-precision FAS before starting the approach.

1.10.4 Any constant descent angle shall clear all SDF minimum crossing altitudes (MCAs) within any segment.

1.10.5 Procedure altitude/height

Procedure altitudes/heights are provided to support a stabilized descent gradient in the final segment in order to assist with CFIT prevention initiatives. Procedure altitudes/heights are therefore developed to place the aircraft at altitudes/heights that would normally be flown to intercept and fly an optimum 5.2 per cent (3.0°) descent path angle in the FAS to a 15 m (50 ft) threshold crossing for non-precision approach procedures and procedures with vertical guidance. In no case will a procedure altitude/height be less than any OCA/H.

Table II-5-1-1. Speeds for procedure calculations in kilometres per hour (km/h)

Aircraft category	V_{at}	*Range of speeds for initial approach*	*Range of final approach speeds*	*Maximum speeds for visual manoeuvring (circling)*	*Maximum speeds for missed approach*	
					Intermediate	*Final*
A	<169	165/280(205*)	130/185	185	185	205
B	169/223	220/335(260*)	155/240	250	240	280
C	224/260	295/445	215/295	335	295	445
D	261/306	345/465	240/345	380	345	490
E	307/390	345/467	285/425	445	425	510
H	N/A	130/220**	110/165***	N/A	165	165
CAT H (PinS)***	N/A	130/220	110/165	N/A	130 or 165	130 or 165

V_{at} — Speed at threshold based on 1.3 times stall speed V_{so} or 1.23 times stall speed V_{s1g} in the landing configuration at maximum certificated landing mass. (Not applicable to helicopters.)

* Maximum speed for reversal and racetrack procedures.

** Maximum speed for reversal and racetrack procedures up to and including 6 000 ft is 185 km/h, and maximum speed for reversal and racetrack procedures above 6 000 ft is 205 km/h.

*** Helicopter point-in-space procedures based on basic GNSS may be designed using maximum speeds of 220 km/h for initial and intermediate segments and 165 km/h on final and missed approach segments, or 165 km/h for initial and intermediate segments and 130 km/h on final and missed approach segments depending on the operational need.

Note.— The V_{at} speeds given in column 2 of this table are converted exactly from those in Table II-5-1-2, since they determine the category of aircraft. The speeds given in the remaining columns are converted and rounded to the nearest multiple of five for operational reasons and from the standpoint of operational safety are considered to be equivalent.

Table II-5-1-2. Speeds for procedure calculations in knots (kt)

Aircraft category	*V_{at}*	*Range of speeds for initial approach*	*Range of final approach speeds*	*Maximum speeds for visual manoeuvring (circling)*	*Maximum speeds for missed approach*	
					Intermediate	*Final*
A	<91	90/150(110*)	70/100	100	100	110
B	91/120	120/180(140*)	85/130	135	130	150
C	121/140	160/240	115/160	180	160	240
D	141/165	185/250	130/185	205	185	265
E	166/210	185/250	155/230	240	230	275
H	N/A	70/120**	60/90***	N/A	90	90
CAT H (PinS)***	N/A	70/120	60/90	N/A	70 or 90	70 or 90

V_{at} — Speed at threshold based on 1.3 times stall speed V_{so} or 1.23 times stall speed V_{s1g} in the landing configuration at maximum certificated landing mass. (Not applicable to helicopters.)

* Maximum speed for reversal and racetrack procedures.

** Maximum speed for reversal and racetrack procedures up to and including 6 000 ft is 100 kt, and maximum speed for reversal and racetrack procedures above 6 000 ft is 110 kt.

*** Helicopter point-in-space procedures based on basic GNSS may be designed using maximum speeds of 120 KIAS for initial and intermediate segments and 90 KIAS on final and missed approach segments, or 90 KIAS for initial and intermediate segments and 70 KIAS on final and missed approach segments depending on the operational need.

Note.— The V_{at} speeds given in column 2 of Table II-5-1-1 are converted exactly from those in this table, since they determine the category of aircraft. The speeds given in the remaining columns are converted and rounded to the nearest multiple of five for operational reasons and from the standpoint of operational safety are considered to be equivalent.

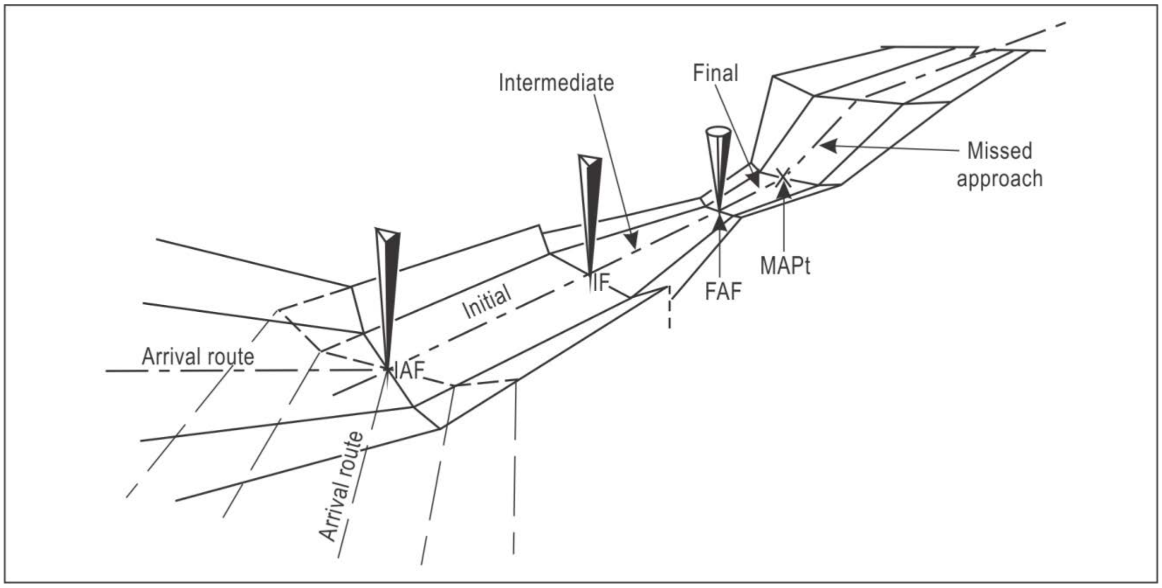
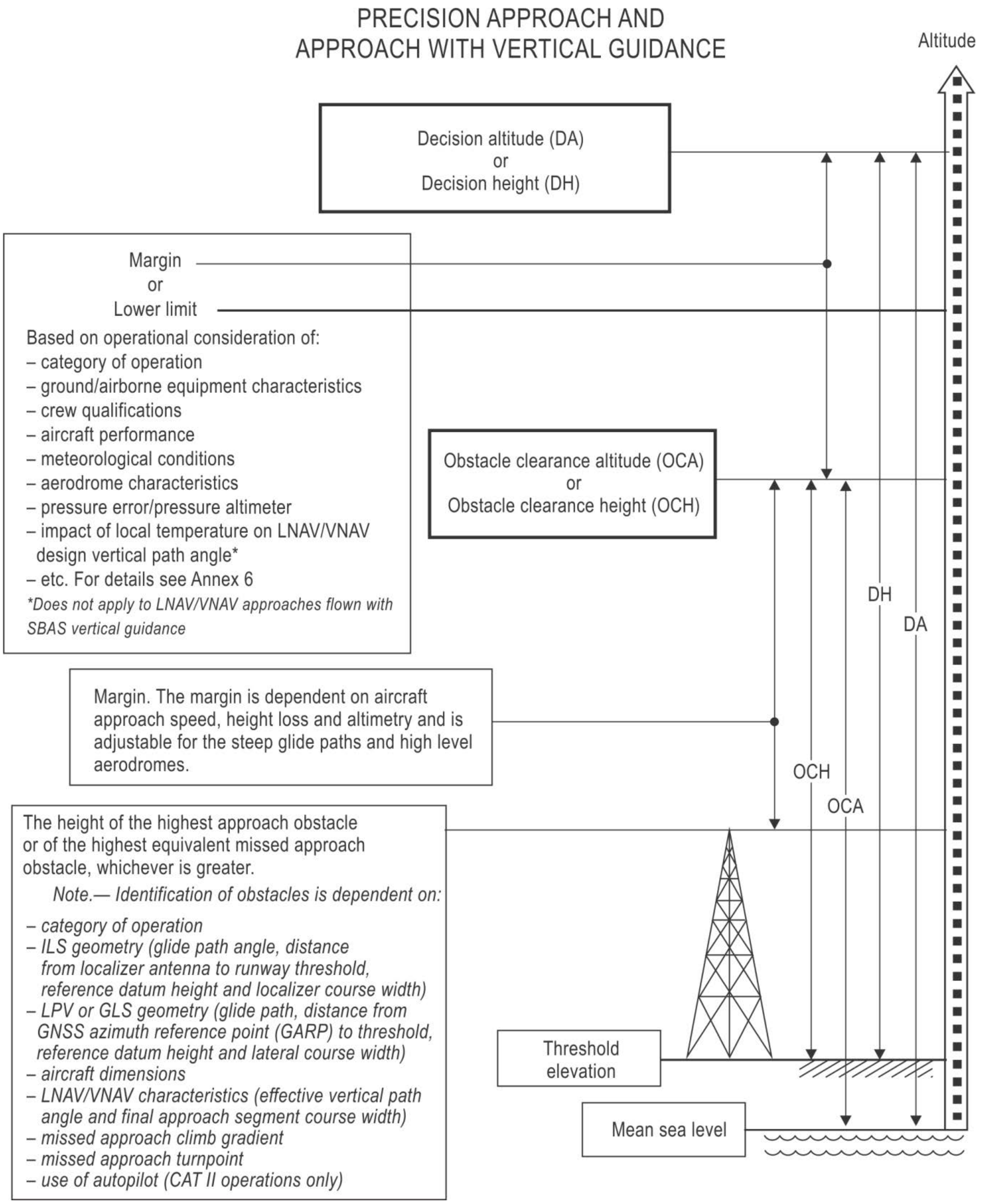


Figure II-5-1-1. Segments of instrument approach



Based on operational consideration of:

- category of operation
- ground/airborne equipment characteristics
- crew qualifications
- aircraft performance
- meteorological conditions
- aerodrome characteristics
- pressure error/pressure altimeter
- impact of local temperature on LNAV/VNAV design vertical path angle*
- etc. For details see Annex 6

**Does not apply to LNAV/VNAV approaches flown with SBAS vertical guidance*

Margin. The margin is dependent on aircraft approach speed, height loss and altimetry and is adjustable for the steep glide paths and high level aerodromes.

The height of the highest approach obstacle or of the highest equivalent missed approach obstacle, whichever is greater.

Note.— Identification of obstacles is dependent on:

- *category of operation*
- *ILS geometry (glide path angle, distance from localizer antenna to runway threshold, reference datum height and localizer course width)*
- *LPV or GLS geometry (glide path, distance from GNSS azimuth reference point (GARP) to threshold, reference datum height and lateral course width)*
- *aircraft dimensions*
- *LNAV/VNAV characteristics (effective vertical path angle and final approach segment course width)*
- *missed approach climb gradient*
- *missed approach turnpoint*
- *use of autopilot (CAT II operations only)*

Figure II-5-1-2. Relationship of obstacle clearance altitude/height (OCA/H) to decision altitude/height (DA/H) for precision approaches and approach procedures with vertical guidance (APVs)

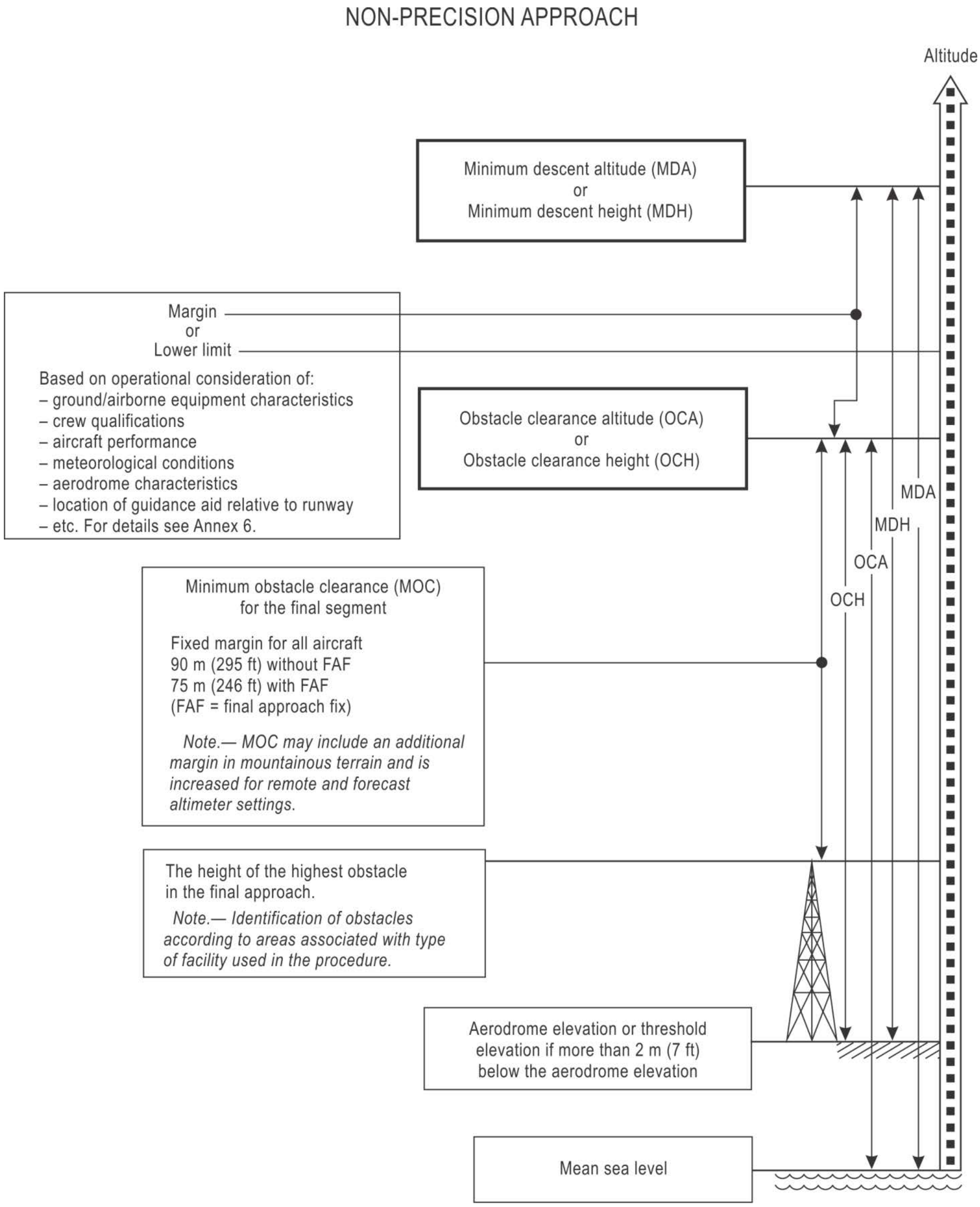


Figure II-5-1-3. Relationship of obstacle clearance altitude/height (OCA/H) to minimum descent altitude/height (MDA/H) for non-precision approaches (example with a controlling obstacle in the final approach)

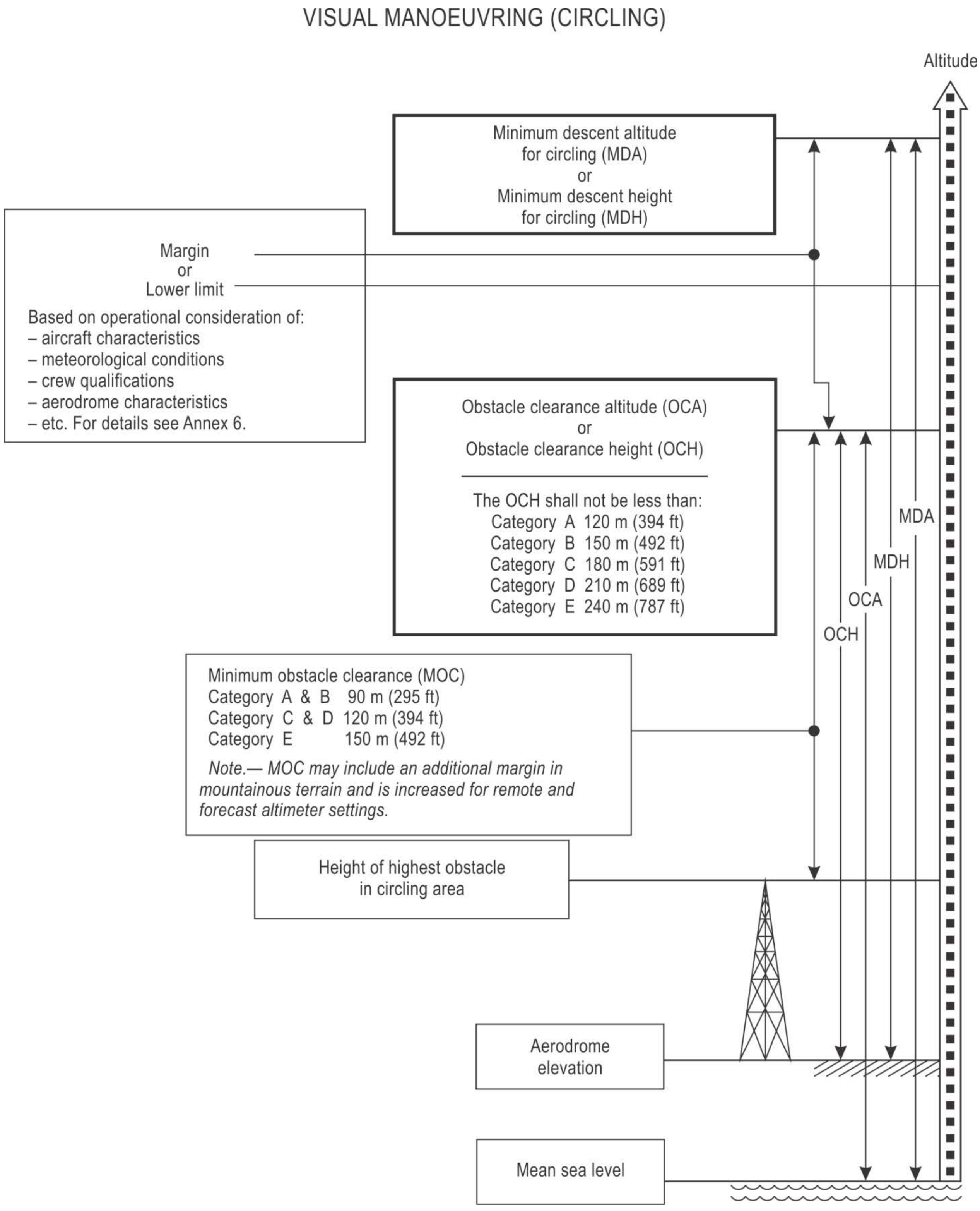


Figure II-5-1-4. Relationship of obstacle clearance altitude/height (OCA/H) to minimum descent altitude/height (MDA/H) for visual manoeuvring (circling)

Chapter 2

INSTRUMENT APPROACH OPERATIONS

2.1 GENERAL

2.1.1 Prior to the introduction of PBN procedures, there was a simple relationship between instrument approach procedures and instrument approach operations:

a) non-precision approach procedures (NPA) were published which were flown as a two-dimensional (2D) operation; and

b) precision approach procedures (PA) were published which were flown as a three-dimensional (3D) operation.

2.1.2 With the introduction of a variety of PBN vertically guided approaches which are not precision approaches (for example, the APV baro-VNAV approach and satellite-based augmentation system (SBAS) APV-I approach) there is no longer a simple relationship between the approach procedure and the type of operation.

2.1.3 From an operational perspective, the classification of different instrument approach procedures into precision, non-precision, etc., is no longer relevant. The important classification is whether the approach is operated as 2D or 3D.

2.2 INSTRUMENT APPROACH OPERATIONS

2.2.1 There are two methods for flying instrument approach operations, 2D and 3D. In a 2D approach operation, only lateral guidance will be displayed to the pilot, for example, in the form of a very high frequency omnidirectional radio range (VOR) needle or ILS lateral deviation scale. A 3D approach operation will also provide vertical guidance in the form of a vertical deviation scale.

2.2.2 The nature of the instrument approach operation depends on both the instrument approach procedure and the technique used to fly the procedure.

2.2.3 Operations using a CDFA technique may be considered to be 3D or 2D depending on how the vertical profile is determined and on the guidance provided to the pilot. (See 2.5 for more information.)

2.3 3D APPROACH OPERATIONS

2.3.1 A 3D instrument approach operation uses lateral and vertical navigation guidance.

2.3.2 Lateral and vertical navigation guidance refers to the guidance provided either by:

a) a ground-based radio navigation aid such as an ILS or microwave landing system (MLS); or

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

2.3.3 Manually calculated rate/angle of descent is not considered vertical guidance, therefore this is not considered to be a 3D approach operation.

2.3.4 3D operations are conducted to a DA/H, which allows for height loss after the commencement of the missed approach.

2.3.5 3D approach operations can be either:

a) Type A with a DH of 75 m (250 ft) or above; or

b) Type B with a DH less than 75 m (250 ft).

2.4 2D APPROACH OPERATIONS

2.4.1 A 2D instrument approach operation uses lateral navigation guidance only.

2.4.2 2D operations are conducted to an MDA/H, below which the aircraft should not descend without adequate visual references.

2.4.3 2D approach operations can only be Type A with an MDH of 75 m (250 ft) or above.

2.5 CONTINUOUS DESCENT FINAL APPROACH (CDFA) TECHNIQUE

2.5.1 The CDFA technique can support either 2D or 3D approach operations and is a method of flying a non-precision approach. This is described in Chapter 1, paragraph 1.8.2 of this section.

2.5.2 There are two methods of flying the CDFA:

a) using a manually calculated descent profile (rate/angle of descent); and

b) using a descent profile calculated by the on-board equipment such as baro-VNAV or SBAS.

2.5.3 In the case of a descent profile calculated manually by rate of decent/angle of descent, the lack of positive guidance means the operation shall be considered to be 2D and shall be operated to an MDA/H as normal.

2.5.4 Where on-board equipment, such as a baro-VNAV system or SBAS receiver, is used to generate the descent profile and associated positive guidance, the operation shall be considered to be 3D. In this case the following shall be confirmed prior to operation:

a) a derived DA/H shall be calculated to ensure the aircraft does not descend below the published MDA/H;

b) the pilot shall verify that the descent profile satisfies all the requirements for SDFs, as indicated on the approach chart;

c) the system in use (e.g. baro-VNAV, SBAS) shall be certified for use for the intended operation; and

d) in the case of a baro-VNAV system, operations shall only be flown with a current local altimeter setting source available, and the QNH/QFE, as appropriate, set on the aircraft's altimeter. Procedures using a remote altimeter setting source cannot support the use of the baro-VNAV function.

2.5.5 Table II-5-2-1 indicates how this technique affects the approach operation on different instrument approach procedures.

Table II-5-2-1. Instrument approach procedures versus operations

Procedure		*Operation*		
Chart identification	*Minima box label*	*Type of operation*	*Minima*	*Type (A or B)*
NDB RWY XX	NDB	2D	MDA/H	A
		3D (CDFA with Positive Guidance)	Derived DA	
VOR RWY XX	VOR	2D	MDA/H	A
		3D (CDFA with positive guidance)	Derived DA	
ILS RWY XX or LOC RWY XX	LOC	2D	MDA/H	A
		3D (CDFA with positive guidance)	Derived DA	
RNP RWY XX	LNAV	2D	MDA/H	A
		3D (CDFA with positive guidance)	Derived DA	
RNP RWY XX	LP	2D	MDA/H	A
		3D (CDFA with positive guidance)	Derived DA	
RNP RWY XX	LNAV/VNAV[1]	3D	DA/H	A
RNP RWY XX (AR)	RNP 0.X	3D	DA/H	A
RNP RWY XX	LPV[2]	3D	DA/H	A or B[3]
ILS RWY XX	CAT I CAT II CAT III A/B/C	3D	DA/H	A or B
MLS RWY XX	CAT I CAT II CAT III A/B/C	3D	DA/H	A or B
GLS RWY XX	CAT I	3D	DA/H	A or B

1. Requires baro-VNAV or SBAS equipment.
2. Requires SBAS equipment.
3. SBAS CAT I procedures may be Type A or Type B. SBAS APV procedures are only Type A.

Chapter 3

INITIAL APPROACH

3.1 GENERAL

3.1.1 Purpose

The initial approach segment begins at the initial approach fix (IAF) and ends at the intermediate fix (IF). In the initial approach, the aircraft has left the en-route structure and is manoeuvring to enter the intermediate approach segment.

3.1.2 Maximum angle of interception

Track guidance should be provided along the initial approach segment to the IF, with a maximum angle of interception of:

a) 90° for a precision approach; and

b) 120° for a non-precision approach.

3.1.3 Minimum obstacle clearance (MOC)

The initial approach segment provides at least 300 m (1 000 ft) of obstacle clearance in the primary area, reducing laterally to zero at the outer edge of the secondary area.

3.1.4 PBN initial segments

3.1.4.1 The PBN navigation specifications applicable to all segments of the approach are detailed in Chapter 1, 1.3. Additionally, PBN initial segments may be designed using the following navigation specifications:

a) RNAV 1;

b) RNP 1; and

c) RNP 0.3 (Helicopters); and

d) Advanced RNP (A-RNP).

Note.— For complete details of the applicability of PBN navigation specifications to approach procedures, see the Performance-based Navigation (PBN) Manual *(Doc 9613).*

3.1.4.2 A PBN initial segment may be used to link up with a non-PBN final approach, such as an ILS or GBAS landing system (GLS).

3.2 TYPES OF MANOEUVRES

3.2.1 Where no suitable IAF or IF is available to construct the instrument procedure, a reversal procedure, racetrack or holding pattern is required.

3.2.2 Reversal procedure

3.2.2.1 The reversal procedure may be in the form of a procedure or base turn. Entry is restricted to a specific direction or sector.

3.2.2.2 The directions and timing specified should be strictly followed in order to remain within the airspace provided. It should be noted that the airspace provided for these procedures does not permit a racetrack or holding manoeuvre to be conducted unless so specified.

3.2.2.3 There are three generally recognized manoeuvres related to the reversal procedure, as shown in Figure II-5-3-1:

a) *45°/180° procedure turn* (see Figure II-5-3-1 A), starts at a facility or fix and consists of:

   1) a straight leg with track guidance. This straight leg may be timed or may be limited by a radial or distance measuring equipment (DME) distance;

   2) a 45° turn;

   3) a straight leg without track guidance. This straight leg is timed. It is:

      i) 1 minute from the start of the turn for Category A and B aircraft; and

      ii) 1 minute 15 seconds from the start of the turn for Category C, D and E aircraft; and

   4) a 180° turn in the opposite direction to intercept the inbound track.

   Unless specifically excluded, this procedure can also be used where an 80°/260° procedure turn is specified (see 3.2.2.3 b)).

b) *80°/260° procedure turn* (see Figure II-5-3-1 B), starts at a facility or fix and consists of:

   1) a straight leg with track guidance. This straight leg may be timed or may be limited by a radial or DME distance;

   2) an 80° turn;

   3) an immediate 260° turn in the opposite direction on completion of the 80° turn, to intercept the inbound track.

   Unless specifically excluded, this procedure can also be used where a 45°/180° procedure turn is specified (see 3.2.2.3 a)).

c) base turn (see Figure II-5-3-1 C), consisting of:

   1) a specified outbound track and timing or DME distance from a facility; followed by

   2) a turn to intercept the inbound track.

3.2.3 Racetrack procedure

3.2.3.1 A racetrack procedure (see Figure II-5-3-1 D) consists of:

a) a turn from the inbound track through 180° from overhead the facility or fix on to the outbound track. The outbound leg may be timed or may be limited by a radial or DME distance; followed by

b) a 180° turn in the same direction to return to the inbound track.

3.3 FLIGHT PROCEDURES FOR RACETRACK AND REVERSAL PROCEDURES

3.3.1 Entry

3.3.1.1 Unless the procedure specifies particular entry restrictions, reversal procedures shall be entered from a track within ±30° of the outbound track of the reversal procedure. However, for base turns, where the ±30° direct entry sector does not include the reciprocal of the inbound track, the entry sector is expanded to include it. (See Figures II-5-3-2 and II-5-3-3.)

3.3.1.2 Typically, a racetrack procedure is used when aircraft arrive overhead the fix from a direction which does not allow direct entry to the reversal, as shown in Figure II-5-3-4. In these cases, aircraft should enter the procedure in a manner similar to that prescribed for a holding procedure entry with the following considerations:

a) offset entry from Sector 2 shall limit the time on the 30° offset track to 1 min 30 s, after which the pilot should turn to a heading parallel to the outbound track for the remainder of the outbound time. If the outbound time is only 1 min, the time on the 30° offset track shall be 1 min also;

b) parallel entry shall not return directly to the facility without first intercepting the inbound track when proceeding to the final segment of the approach procedure; and

c) all manoeuvring shall be done in so far as possible on the manoeuvring side of the inbound track.

3.3.2 Speed restrictions

These may be specified in addition to, or instead of, aircraft category restrictions. The speeds shall not be exceeded to ensure that the aircraft remains within the limits of the protected areas.

3.3.3 Bank angle

Procedures are based on average achieved bank angle of 25°, or the bank angle giving a rate of turn of 3°/second, whichever is less.

3.3.4 Descent

The aircraft shall cross the fix or facility and fly outbound on the specified track, descending as necessary to the procedure altitude/height but no lower than the minimum crossing altitude/height (MCA/H) associated with that segment. If a further descent is specified after the inbound turn, this descent shall not be started until the aircraft is established on the inbound track. An aircraft is considered established when it is:

a) within half full scale deflection for the ILS and VOR; or

b) within ±5° of the required bearing for the NDB.

3.3.5 Racetrack procedure outbound leg

3.3.5.1 When the procedure is based on a facility, the outbound timing starts:

a) from abeam the facility; or

b) on attaining the outbound heading,

whichever comes later.

3.3.5.2 When the procedure is based on a fix, the outbound timing starts from attaining the outbound heading.

3.3.5.3 The turn on to the inbound track should be started:

a) within the specified time (adjusted for wind); or

b) when encountering any DME distance; or

c) when the radial/bearing specifying a limiting distance has been reached,

whichever occurs first.

3.3.5.4 When a DME distance or radial/bearing is specified for the end of the outbound leg, it shall not be exceeded when flying on the outbound track.

3.3.6 Wind effect

To achieve a stabilized approach, due allowance should be made in both heading and timing to compensate for the effects of wind so that the aircraft regains the inbound track as accurately and expeditiously as possible. In making these corrections, full use should be made of the indications available from the aid and from estimated or known winds. This is particularly important for slow aircraft in high wind conditions. Failure to compensate for wind effects may result in the aircraft departing the protected area of the procedure.

3.3.7 Descent rates

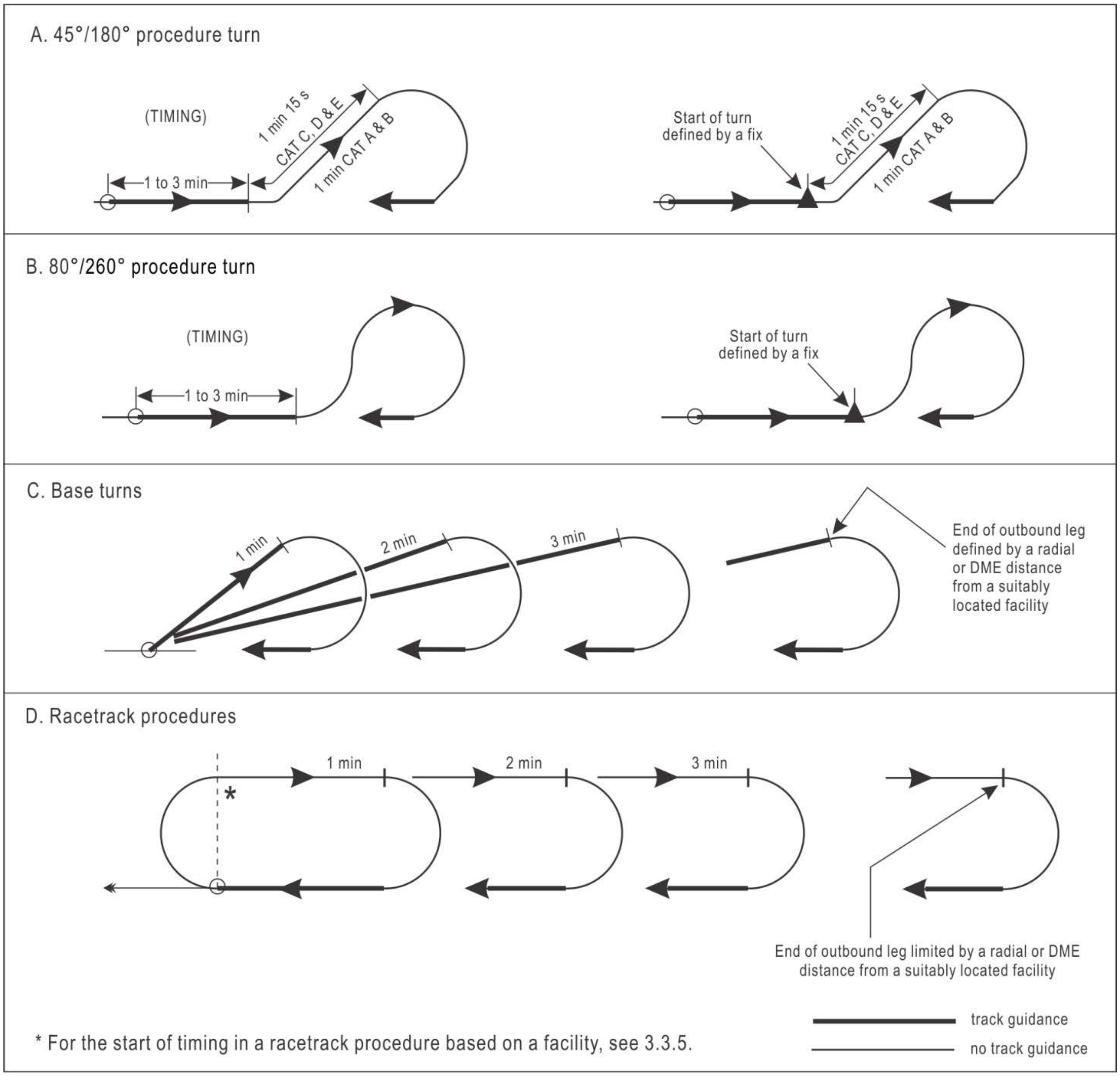
The specified timings and procedure altitudes are based on rates of descent that do not exceed the values shown in Table II-5-3-1.

3.3.8 Shuttle

A shuttle is defined as a descent or climb conducted in a holding pattern. This is normally prescribed where the descent required between the end of initial approach and the beginning of final approach exceeds the values shown in Table II-5-3-1.

Table II-5-3-1. Maximum/minimum descent rate to be specified on a reversal or racetrack procedure

Outbound track	*Maximum*	*Minimum*
Category A/B	245 m/min (804 ft/min)	N/A
Category C/D/E/H	365 m/min (1 197 ft/min)	N/A
Inbound track	*Maximum*	*Minimum*
Category A/B	200 m/min (655 ft/min)	120 m/min (394 ft/min)
Category H	230 m/min (755 ft/min)	N/A
Category C/D/E	305 m/min (1 000 ft/min)	180 m/min (590 ft/min)



* For the start of timing in a racetrack procedure based on a facility, see 3.3.5.

Figure II-5-3-1. Types of reversal and racetrack procedures

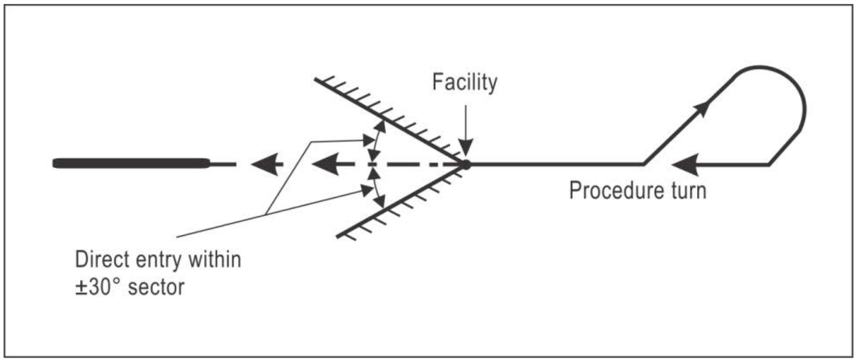


Figure II-5-3-2. Direct entry to procedure turn

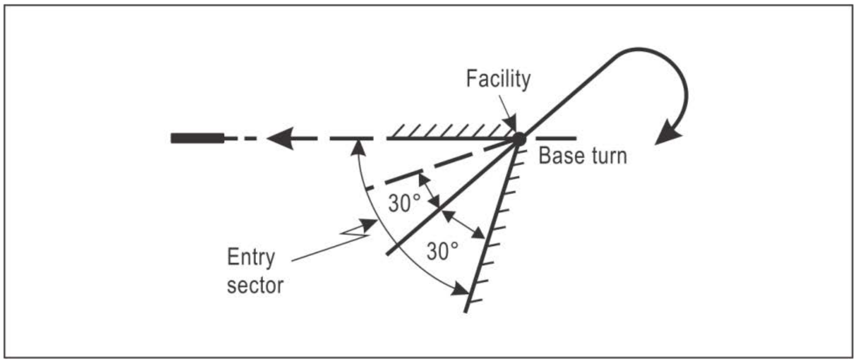


Figure II-5-3-3. Direct entry to base turn

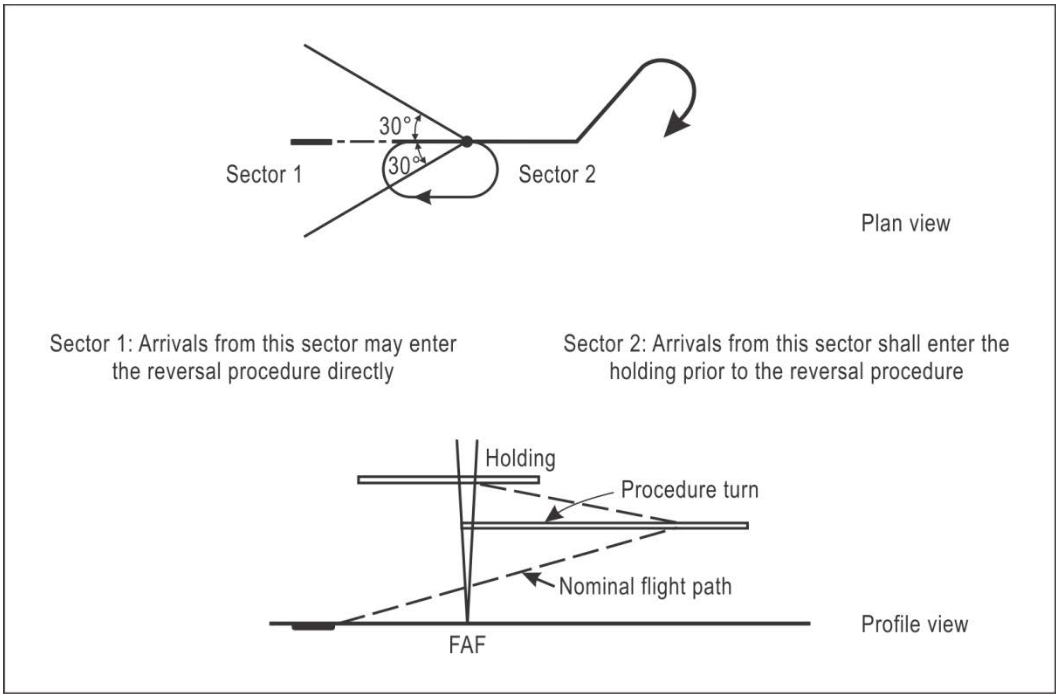


Figure II-5-3-4. Example of omnidirectional arrival using a holding procedure in association with a reversal procedure

Chapter 4

INTERMEDIATE APPROACH

4.1 PURPOSE

This is the segment during which the aircraft speed and configuration should be adjusted to prepare the aircraft for final approach. For this reason, the designed descent gradient is kept as shallow as possible. To fly an efficient descent profile, the pilot may elect to configure the aircraft while in a continuous descent along this segment.

4.2 MINIMUM OBSTACLE CLEARANCE (MOC)

During the intermediate approach, the obstacle clearance requirement is 150 m (492 ft) in the primary area, reducing laterally to zero at the outer edge of the secondary area.

4.3 BEGINNING AND END OF THE SEGMENT (CONVENTIONAL PROCEDURES)

4.3.1 Where a FAF is available, the intermediate approach segment begins when the aircraft is on the inbound track of the procedure turn, base turn or final inbound leg of the racetrack procedure. It ends at the FAF or final approach point (FAP), as applicable.

4.3.2 Where no FAF is specified, the inbound track is the FAS.

4.4 PBN INTERMEDIATE SEGMENTS

4.4.1 The PBN navigation specifications applicable to all segments of the approach are detailed in Chapter 1, 1.3. Additionally, PBN intermediate segments may be designed using the following navigation specifications:

a) RNAV 1;

b) RNP 1; and

c) RNP 0.3 (Helicopters).

Note.— For complete details of the applicability of PBN navigation specifications to approach procedures, see the Performance-based Navigation (PBN) Manual *(Doc 9613).*

4.4.2 A PBN intermediate segment may be used to link up with a non-PBN final approach, such as an ILS or GLS.

4.5 BEGINNING AND END OF THE SEGMENT (PBN PROCEDURES)

4.5.1 The intermediate segment usually contains a straight component immediately before the FAF/ FAP.

4.5.2 Where included, the length of the straight component is variable but will not be less than 3.7 km (2.0 NM) allowing the aircraft to be stabilized prior to the FAF/FAP and to provide for mode and display switching prior to the FAF/FAP.

4.5.3 Alternatively, an RF leg may be used linking directly to the FAF. In this case no straight component is provided.

Chapter 5

FINAL APPROACH

5.1 GENERAL

5.1.1 Purpose

This is the segment in which alignment and final descent for landing are made. Final approach may be made to a runway for a straight-in landing, or to an aerodrome for a visual circling manoeuvre.

5.1.2 Types of final approach

The criteria for final approach vary according to the type. These types are:

a) non-precision approach (NPA) with FAF;

b) NPA without FAF;

c) APV; and

d) precision approach (PA).

5.2 NON-PRECISION APPROACH (NPA) WITH FINAL APPROACH FIX (FAF)

5.2.1 These procedures are designed for 2D approach operations Type A, but may be flown as a 3D operation using the CDFA technique. For more information refer to Chapter 2 of this section.

5.2.2 FAF location

This segment begins at a facility or fix, called the FAF and ends at the MAPt (see Figure II-5-1-1). The FAF is sited on the final approach track at a distance that permits selection of final approach configuration, deceleration to final approach speed, and descent from intermediate approach altitude/height to the appropriate MDA/H either for a straight-in approach or for a visual circling manoeuvre.

5.2.3 Descent gradient

5.2.3.1 Compatible with the primary safety consideration of obstacle clearance an NPA provides the optimum final approach descent gradient of 5.2 per cent, or 3°, providing a rate of descent of 52 m per km (318 ft per NM).

5.2.3.2 Information provided in approach charts displays the optimum constant approach slope.

5.2.4 FAF crossing

5.2.4.1 The FAF should be crossed at the prescribed procedure altitude/height in descent but in all cases, not lower than the MCA associated with the FAF under international standard atmosphere (ISA) conditions. The descent should be initiated prior to the FAF, in order to achieve the prescribed descent gradient/angle. Delaying the descent until reaching the FAF at the procedure altitude/height will cause the descent gradient/angle to be greater than 3°. Where range information is available, descent profile information is provided.

5.2.4.2 In the event of an overshoot of the FAF, no descent below the MCA associated with the FAF shall be initiated before the aircraft is established on the final approach course.

5.2.5 Step down fix (SDF)

5.2.5.1 An SDF may be incorporated in some non-precision approach procedures. In this case, two OCA/H values are published:

a) a higher value applicable to the primary procedure; and

b) a lower value applicable only if the SDF is positively identified during the approach (see Figure II-5-5-1).

5.2.5.2 In the case of a VOR/DME, several SDFs may be depicted, each with its associated MCA.

5.2.5.3 For helicopter operations, rates of descent after crossing the FAF and any SDF should be limited, so as not to penetrate the obstacle plane.

5.2.5.4 Where a step down procedure using a suitably located DME is published, the pilot shall not begin descent until established on the specified track. Once established on track, descent shall be accomplished without descending below the published DME distance/height requirements.

5.2.5.5 *Performance-based navigation* (*PBN) procedure SDFs.* A PBN step down fix is flown in the same manner as a ground-based approach. Any required SDFs prior to the missed approach waypoint will be identified by along-track distances.

5.3 NPA WITHOUT FAF

5.3.1 In the case of an aerodrome served by a single facility located on or near the aerodrome where no other facility is suitably situated to form a FAF, a procedure may be designed where the facility is both the IAF and the MAPt.

5.3.2 In the absence of a FAF, descent to MDA/H is made once the aircraft is established inbound on the final approach track.

5.3.3 In procedures of this type, the final approach track may not be aligned on the runway centre line. Whether OCA/H for straight-in approach limits is published or not depends on the angular difference between the track and the runway, and position of the track with respect to the runway threshold.

5.4 APV APPROACH PROCEDURES

5.4.1 These procedures are designed for 3D approach operations Type A. For more information refer to Chapter 2 of this section.

5.4.2 Two types of APV approach procedures are considered:

a) procedures based on vertical guidance from Baro-VNAV systems; and

b) procedures based on SBAS vertical guidance.

5.4.3 APV/BARO-VNAV approach procedures

5.4.3.1 Baro-VNAV is a navigation system that presents to the pilot computed vertical guidance referenced to a specified vertical path angle (VPA), nominally 3°.

5.4.3.2 APV/baro-VNAV approach procedures are classified as instrument approach procedures in support of 3D approach operations. Such procedures use a DA/H charted as a lateral navigation/vertical navigation (LNAV/VNAV) line of minima. They should not be confused with classical NPA procedures, which use an MDA/H below which the aircraft shall not descend.

5.4.3.3 APV/baro-VNAV approach procedures provide a greater margin of safety than non-precision approach procedures by providing for a guided, stabilized descent to landing. They are particularly relevant to large commercial jet transport aircraft, for which they are considered safer than the alternative technique of an early descent to minimum altitudes. An independent altimeter cross-check which is available for ILS, MLS, GLS, SBAS APV-I/CAT I is not available with APV/baro-VNAV since the altimeter is also the source on which the vertical guidance is based. Mitigation of altimeter failures or incorrect settings shall be accomplished by means of standard operating procedures similar to those applied to non-precision approach procedures.

5.4.3.4 The inaccuracies inherent in barometric altimeters, combined with the certificated performance of the specific PBN navigation specification used, make these procedures less accurate than precision approach systems, and the pilot should consider this possibility when making the decision to land at DA/H.

5.4.3.5 The lateral portions of APV/baro-VNAV criteria are based on Advanced RNP, RNP APCH or RNP AR APCH criteria. However, the FAF is not part of the APV/baro-VNAV procedure and is replaced by a FAP. Similarly, the MAPt is replaced by an aircraft-category-dependent DA/H. This is analogous to a precision approach.

5.4.3.6 The lowest published APV/baro-VNAV DH is 75 m (250 ft).

5.4.3.7 Temperature constraints

5.4.3.7.1 The pilot shall be responsible for any necessary cold temperature corrections to all published minimum altitudes/heights. This includes:

a) the altitudes/heights for the initial and intermediate segment(s);

b) the DA/H or MDA/H; and

c) subsequent missed approach altitudes/heights.

5.4.3.7.2 Only the FAS VPA of the APV baro-VNAV procedure is safeguarded against the effects of low temperature by the design of the procedure. The minimum temperature on the chart relates to a minimum VPA of 2.5°, and the maximum temperature on the chart relates to a maximum VPA of 3.5°.

5.4.3.7.3 Baro-VNAV procedures are not permitted when the aerodrome temperature is below the promulgated minimum aerodrome temperature for the procedure, unless the flight management system (FMS) is equipped with approved automated cold temperature compensation for the final approach.

5.4.3.7.4 The charted temperature range applies to the LNAV/VNAV minima only and does not apply to other minima.

5.4.3.7.5 For aircraft with approved automated cold temperature compensation FMS systems, the promulgated minimum temperature can be disregarded provided the actual temperature is within the limits of the aircraft certification.

5.4.3.7.6 Below the equipment certified limiting temperature, an LNAV procedure may still be used provided that such a procedure is promulgated for the approach and the appropriate cold temperature altimeter correction is applied to all minimum promulgated altitudes/heights by the pilot.

5.4.3.7.7 Procedure temperature restrictions do not apply when SBAS is used to fly LNAV/VNAV procedures.

5.4.3.7.8 A VPA deviation table provides an aerodrome temperature with an associated true VPA. This table is intended to advise the pilot that, although the non-temperature compensated aircraft's avionics system may be indicating the promulgated final approach VPA, the actual VPA is different from the information presented to them by the aircraft's avionics system. This table is not intended to have the pilot adjust the VPA flown to achieve the actual promulgated VPA, nor is it meant to affect those avionics systems that have a capacity to properly apply temperature compensation to a baro-derived final approach VPA. To show the difference in the minimum temperature application, examples of these tables for aerodrome elevations at mean sea level and at 6 000 feet are provided in Tables II-5-5-1 and II-5-5-2.

Table II-5-5-1
VPA deviations at MSL

Aerodrome temperature	*Actual VPA*
+30°C	3.2°
+15°C	3.0°
0°C	2.8°
–15°C	2.7°
–31°C	2.5°

Table II-5-5-2
VPA deviations at 6 000 ft MSL

Aerodrome temperature	*Actual VPA*
+22°C	3.2°
+3°C	3.0°
–20°C	2.7°
–30°C	2.6°
–43°C	2.5°

Note.— Values presented in Tables II-5-5-1 and II-5-5-2 are not representative of actual values that may be calculated for a particular aerodrome.

5.4.3.7.9 Some baro-VNAV systems have the capability to correctly compensate for the temperature effects on the VPA of an instrument approach procedure following an input of the aerodrome (altimeter source) temperature by the pilot. A pilot operating aircraft with this feature active can expect that the angle displayed will be the corrected VPA, thus the VPA deviation table is not applicable.

5.4.3.8 Altimeter setting

Baro-VNAV approach operations shall only be flown with a current local altimeter setting source available and the QNH/QFE, as appropriate, set on the aircraft's altimeter. Remote altimeter settings are not approved for this type of operation.

5.4.3.9 Vertical guidance sensitivity

5.4.3.9.1 Cockpit displays showing vertical path deviation shall be suitably located and have sufficient sensitivity to enable the pilot to limit vertical path excursions to less than ±22 m (±75 ft).

5.4.3.9.2 Where equipment does not meet these criteria, an operational assessment and specific flight crew procedure may be required for the approval of baro-VNAV operations. This may include requirements for the availability and use of a flight director or autopilot system coupled to the vertical guidance.

5.4.4 SBAS approach procedures

5.4.4.1 These procedures are designed for the following types of operations:

a) 2D approach operation type A: LP minima;

b) 3D approach operation type A: LPV minima (APV); and

c) 3D approach operation type A or B: LPV minima (CAT I).

5.4.4.2 SBAS equipment may be used to operate on procedures based on baro-VNAV criteria. In such cases, published temperature restrictions for barometric VNAV procedures do not apply.

5.4.4.3 The charted minima lines associated with SBAS APV-I or CAT I performance levels are labelled “LPV” (localizer performance with vertical guidance). This labelling indicates that the lateral performance is equivalent to an ILS localizer lateral performance. The charted lines of minima for an SBAS 2D approach operation are labelled “LP”.

5.4.4.4 The term APV-I refers to a performance level of GNSS approach and landing operations with vertical guidance, and this term is not intended to be used for charting.

5.5 PRECISION APPROACH

5.5.1 These procedures are designed for 3D approach operations and may be classified as either Type A or Type B, depending on the DA/H in use. For more information refer to Chapter 2 of this section.

5.5.2 Final approach point (FAP)

The FAS begins at the FAP. This is a point in space on the final approach track where the intermediate approach altitude/height intercepts the nominal glide path of the ILS, GLS or SBAS CAT I, or the MLS elevation angle.

5.5.3 Final approach length

The intermediate approach altitude/height generally intercepts the glide path of the ILS, GLS or SBAS CAT I, or the MLS elevation angle, at heights from 300 m (1 000 ft) to 900 m (3 000 ft) above runway elevation.

5.5.4 Outer marker/DME fix/waypoint

5.5.4.1 The final approach area contains a fix, waypoint or facility that permits verification of the ILS, GLS or SBAS CAT I glide path or MLS elevation angle/altimeter relationship. The outer marker, waypoint or equivalent DME fix is normally used for this purpose. Prior to crossing the outer marker, waypoint or DME fix, descent may be made on the ILS, GLS or SBAS CAT I glide path or MLS elevation angle to the altitude/height of the published outer marker, waypoint or DME fix crossing altitude/height.

5.5.4.2 Descent below the fix crossing altitude/height should not be made prior to crossing the outer marker, waypoint or DME fix. Allowance should be made for non-ISA conditions (see PANS-OPS, Volume III).

Note.— Pressure altimeters are calibrated to indicate true altitude under ISA conditions. Any deviation from ISA will therefore result in an erroneous reading on the altimeter. If the temperature is higher than ISA, then the true altitude will be higher than the figure indicated by the altimeter. Similarly, the true altitude will be lower when the temperature is lower than ISA. The altimeter error may be significant in extremely cold temperatures.

5.5.4.3 In the event of loss of ILS, GLS or SBAS CAT I glide path or MLS elevation angle guidance during the approach, the procedure may become a non-precision approach. The OCA/H and associated procedure published for the glide path/MLS elevation angle inoperative case will then apply.

5.6 PRECISION APPROACH GLIDE PATH ANGLE/ELEVATION ANGLE

For ILS/MLS/GLS the following minimum, optimum and maximum glide path angles/elevation angles are established:

minimum:	–2.5°
optimum:	–3°
maximum:	3.5° (3° for CAT II/III operations)

5.7 DETERMINATION OF DECISION ALTITUDE (DA) OR DECISION HEIGHT (DH)

5.7.1 In addition to the physical characteristics of the ILS/MLS/GBAS installation, or SBAS CAT I procedure design, obstacles both in the approach and in the missed approach areas are considered in the calculation of the OCA/H for a procedure. The calculated OCA/H is the height of the highest approach obstacle or equivalent missed approach obstacle, plus an aircraft category related allowance. (See Attachment A, section 2 for more information).

5.7.2 In assessing these obstacles, the operational variables of the aircraft category, approach coupling, category of operation and missed approach climb performance are considered. The OCA/H values, as appropriate, are promulgated on the IAC for those categories of aircraft for which the procedure is designed.

5.7.3 Additional factors, including those in Annex 6, Part I, Chapter 4, 4.2.8, are considered by the operator and are applied to the OCA/H. This results in the DA/H value.

5.7.4 *Height loss margins.* Table II-5-5-3 shows the allowance used by the procedures specialist for vertical displacement during initiation of a missed approach. It takes into account the type of altimeter used and the height loss due to aircraft characteristics. It should be recognized that no allowance has been included in the table for any abnormal meteorological conditions; for example, wind shear and turbulence.

5.7.4.1 Height loss is a function of speed; therefore, Table II-5-5-3 shows the calculation only for a reference speed, which is the upper limit of each category. This provides a conservative figure that can be used in all cases.

5.7.4.2 If a height loss/altimeter margin is required for a specific V_{at}, the following formulae apply:

Use of radio altimeter	*Use of pressure altimeter*
Margin = $(0.096\ V_{at} - 3.2)$ metres where V_{at} in km/h Margin = $(0.177\ V_{at} - 3.2)$ metres where V_{at} in kt	Margin = $(0.068\ V_{at} + 28.3)$ metres where V_{at} in km/h Margin = $(0.125\ V_{at} + 28.3)$ metres where V_{at} in kt

5.7.5 Non-standard procedures

5.7.5.1 Non-standard procedures are those involving glide paths greater than 3.5° or any angle when the nominal rate of descent exceeds 5 m/sec (1 000 ft/min). Procedure design takes into account multiple additional factors. (See Attachment A, section 2 for more information).

5.7.5.2 Non-standard procedures are normally restricted to specifically approved operators and aircraft, and are promulgated with appropriate aircraft and crew restrictions annotated on the approach chart.

5.7.5.3 Consideration shall also be given to operational factors including configuration, engine-out operation, maximum tailwind/minimum headwind limits, weather minima, visual aids and crew qualifications.

5.7.6 Protection of the precision segment

5.7.6.1 Descent on the ILS/GLS/SBAS/CAT I glide path angle, the APV vertical path or the MLS elevation angle shall never be initiated until the aircraft is within the tracking tolerance of the localizer/azimuth/final approach course due to the narrower protection area.

5.7.6.2 To remain within the protection area, the pilot should not deviate from the centre line more than half-scale deflection after being established on track. Thereafter, the aircraft should adhere to the on-course, on-glide path/elevation angle position to ensure there is no loss of protection from obstacles.

5.7.7 Operators shall consider weight, altitude and temperature limitations and wind velocity when determining the DA/H for a missed approach, since the OCA/H might be based on an obstacle in the missed approach area and since advantage may be taken of variable missed approach climb performances.

Table II-5-5-3. Height loss/altimeter margin for maximum V_{at} by aircraft category

Aircraft category (maximum V_{at})	*Margin using radio altimeter*		*Margin using pressure altimeter*	
	Metres	*Feet*	*Metres*	*Feet*
A — 169 km/h (90 kt)	13	42	40	130
B — 223 km/h (120 kt)	18	59	43	142
C — 260 km/h (140 kt)	22	71	46	150
D — 306 km/h (165 kt)	26	85	49	161
H — 167 km/h (90 kt)	8	25	35	115

Note 1.— Cat H speed is the maximum final approach speed, not V_{at}.

Note 2.— Since height loss varies with speed, the table shows only the calculation for a reference speed, which is the upper limit for each category.

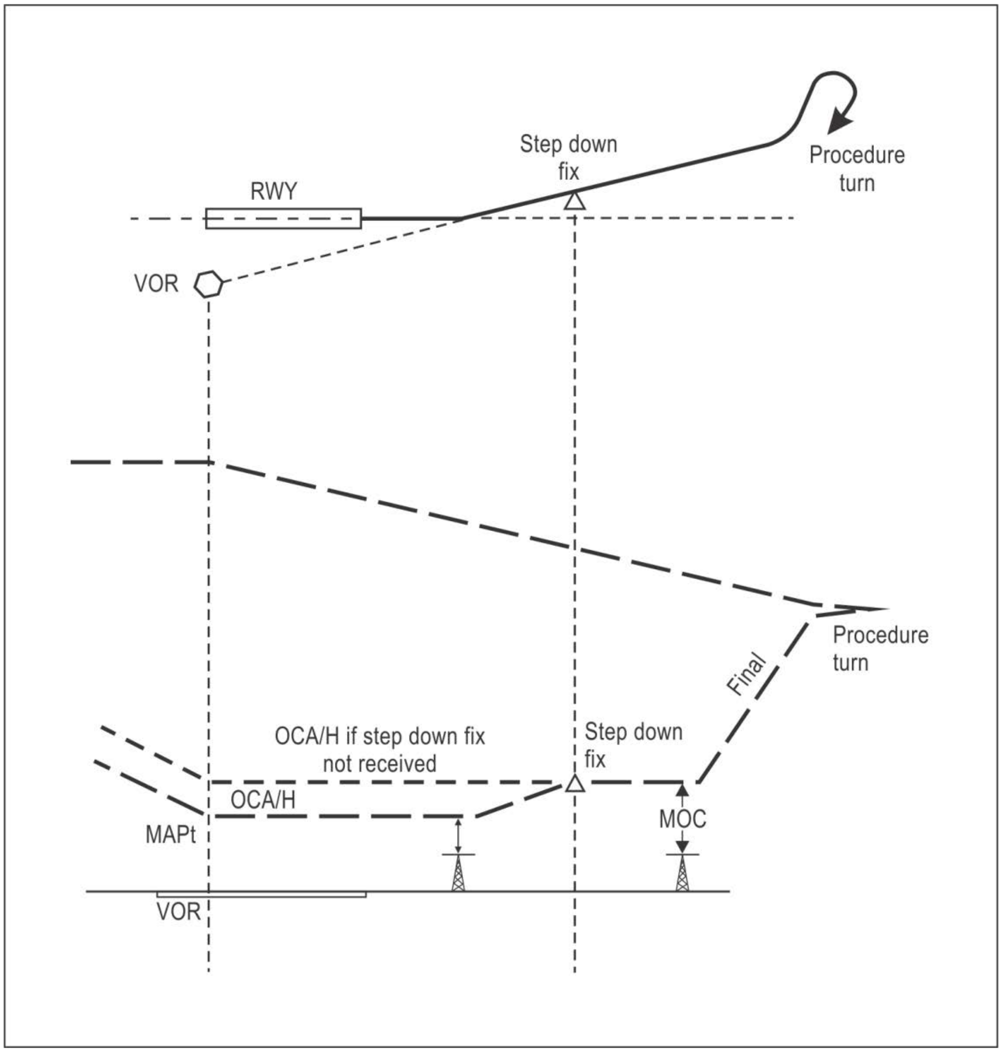


Figure II-5-5-1. Step down fix

Chapter 6

VISUAL MANOEUVRING (CIRCLING)

6.1 PURPOSE

6.1.1 Visual manoeuvring (circling) is the term used to describe the phase of flight after an instrument approach has been completed. It brings the aircraft into position for landing on a runway which is not suitably located for straight-in approach, i.e. one where the criteria for alignment or descent gradient cannot be met.

6.1.2 Circling procedures are not promulgated for helicopters; however, this does not preclude a helicopter from flying a circling procedure if desired. The helicopter pilot shall conduct visual manoeuvres in adequate meteorological conditions to see and avoid obstacles in the vicinity of the final approach course for Category A or H procedures. However, the pilot shall be alert to any operational notes regarding air traffic services (ATS) requirements while manoeuvring to land.

6.2 VISUAL FLIGHT MANOEUVRE

6.2.1 A circling approach is a visual flight manoeuvre. Each circling situation is different because of variables such as runway layout, final approach track, wind velocity and meteorological conditions. Therefore, there can be no single procedure designed that will cater for conducting a circling approach in every situation.

6.2.2 After initial visual contact, the runway environment should be kept in sight while the aircraft is kept within the visual manoeuvring area, and not below the MDA/H for circling. The runway environment includes features such as the runway threshold or approach lighting aids or other markings identifiable with the runway.

6.3 PROTECTION

6.3.1 The visual manoeuvring area

The visual manoeuvring area for a circling approach is determined by drawing arcs centred on each runway threshold and joining those arcs with tangent lines (see Figure II-5-6-1).

6.3.2 Obstacle clearance

When the visual manoeuvring (circling) area has been established, the OCA/H is determined for each category of aircraft (see Table II-5-6-1).

Note.— The information in Table II-5-6-1 should not be construed as operating minima.

6.3.3 Minimum descent altitude/height (MDA/H)

When the OCA/H is established, an MDA/H is also specified to allow for operational considerations. Descent below MDA/H should not be made until:

a) required visual reference has been established and can be maintained throughout the manoeuvre;

b) the pilot has the landing threshold in sight; and

c) the required obstacle clearance can be maintained and the aircraft is in a position to carry out a landing using normal rates of descent and angles of bank.

6.3.4 Visual manoeuvring (circling) area exclusions

6.3.4.1 A sector in the circling area where a prominent obstacle exists may be ignored for OCA/H calculations if it is outside the final approach and missed approach areas for the instrument approach. This sector is bounded by the dimensions of Annex 14, Volume I, instrument approach surfaces (see Figure II-5-6-2).

6.3.4.2 When this option is exercised, the published procedure prohibits circling within the entire sector in which the obstacle is located (see Figure II-5-6-2).

6.4 MISSED APPROACH PROCEDURE WHILE CIRCLING

6.4.1 If visual reference is lost while circling to land from an instrument approach, the missed approach specified for that particular procedure shall be followed. The transition from the visual (circling) manoeuvre to the missed approach should be initiated by a climbing turn, within the circling area, towards the landing runway, to return to the circling altitude or higher, immediately followed by interception and execution of the missed approach procedure. The indicated airspeed during these manoeuvres shall not exceed the maximum indicated airspeed associated with visual manoeuvring.

6.4.2 The circling manoeuvre may be carried out in more than one direction. For this reason, different patterns are required to establish the aircraft on the prescribed missed approach course depending on its position at the time visual reference is lost.

6.5 VISUAL MANOEUVRING USING PRESCRIBED TRACK

6.5.1 General

6.5.1.1 In those locations where clearly defined visual features permit (and if it is operationally desirable), a State may prescribe a specific track for visual manoeuvring in addition to the circling area.

6.5.1.2 Since visual manoeuvring with a prescribed track is intended for use where specific terrain features warrant such a procedure, the pilot shall be familiar with the terrain and visual cues to be used in weather conditions above the aerodrome operating minima prescribed for this procedure.

6.5.1.3 This procedure is based on the aircraft speed category. It is published on a special chart on which the visual features used to define the track, or other characteristic features near the track, are shown.

6.5.1.4 Note that in this procedure:

a) navigation is primarily by visual reference and any supplemental navigation information presented is advisory only; and

b) the missed approach for the normal instrument procedure applies, but the prescribed tracks provide for manoeuvring to allow for a go-around and to achieve a safe altitude/height thereafter (joining the downwind leg of the prescribed track procedure or the instrument missed approach trajectory).

6.5.2 Standard track (general case)

6.5.2.1 Figure II-5-6-3 shows a standard track general case.

6.5.2.2 The direction and the length of each segment are defined. If a speed restriction is prescribed, it is published on the chart.

6.5.3 Minimum obstacle clearance (MOC) and obstacle clearance altitude/height (OCA/H)

The OCA/H for visual manoeuvring on prescribed tracks provides the MOC over the highest obstacle within the prescribed track area and is not less than the OCA/H calculated for the instrument approach procedure which leads to the visual manoeuvre.

6.5.4 Visual aids

Visual aids associated with the runway used for the prescribed track (sequenced flashing lights, PAPI, VASIS, etc.) are shown on the chart with their main characteristics (i.e. slope of the PAPI or VASIS). Lighting on obstacles is specified on the chart.

Table II-5-6-1. OCA/H for visual manoeuvring (circling) approach

Aircraft category	*Obstacle clearance m (ft)*	*Lowest OCH above aerodrome elevation m (ft)*	*Minimum visibility km (NM)*
A	90 (295)	120 (394)	1.9 (1.0)
B	90 (295)	150 (492)	2.8 (1.5)
C	120 (394)	180 (591)	3.7 (2.0)
D	120 (394)	210 (689)	4.6 (2.5)
E	150 (492)	240 (787)	6.5 (3.5)

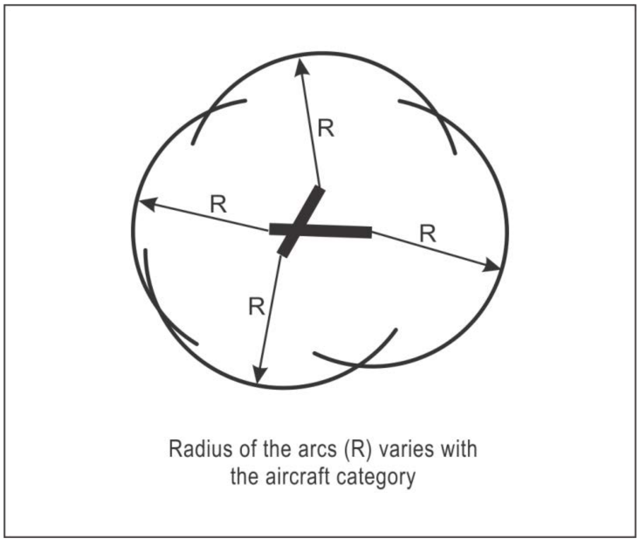


Figure II-5-6-1. Visual manoeuvring (circling) area

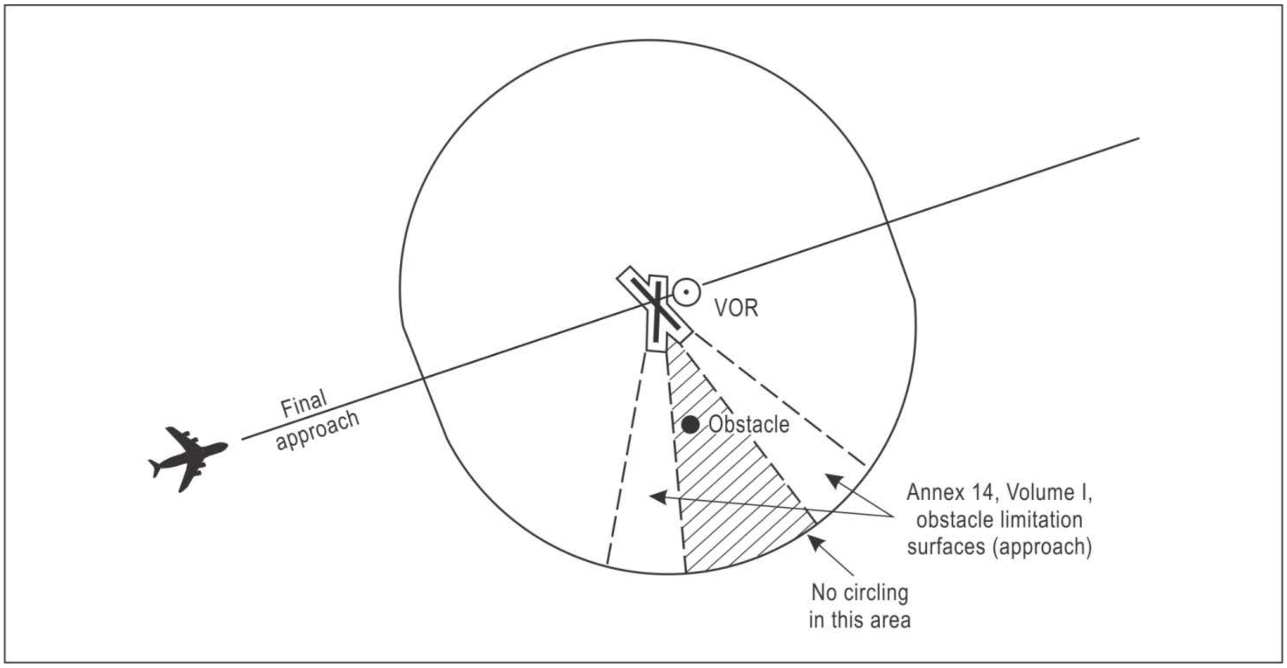


Figure II-5-6-2. Visual manoeuvring (circling) area — prohibition on circling

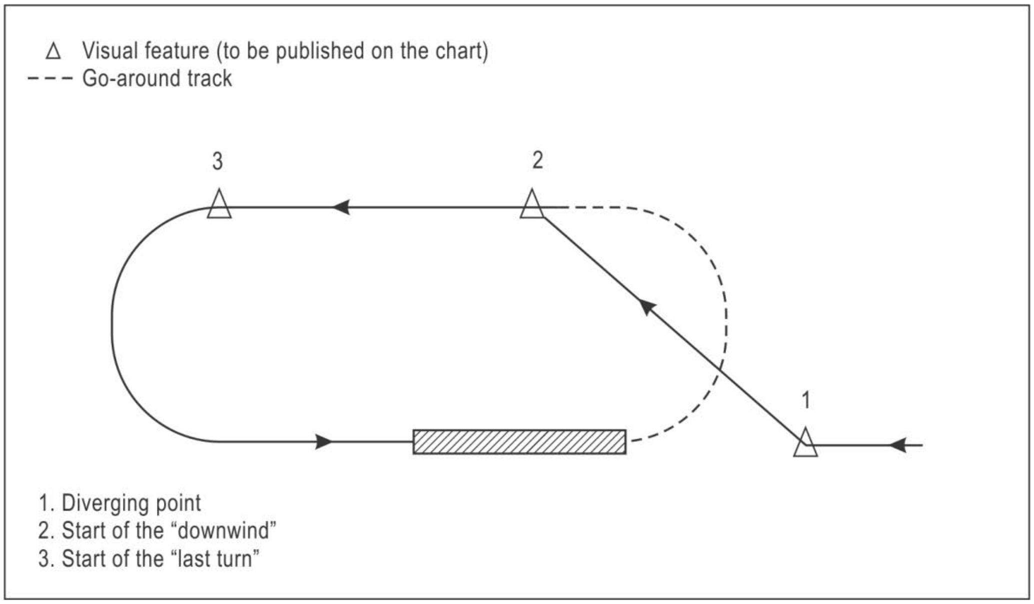


Figure II-5-6-3. Standard track general case

Chapter 7

MISSED APPROACH

7.1 GENERAL

7.1.1 During the missed approach phase of the instrument approach procedure, the pilot is faced with the demanding task of changing the aircraft configuration, attitude and altitude. For this reason, the design of the missed approach has been kept as simple as possible and consists of three phases (initial, intermediate and final). (See Figure II-5-7-1.)

7.1.2 Only one missed approach procedure is established for each instrument approach procedure. It is designed to provide protection from obstacles throughout the missed approach manoeuvre. It specifies a point where the missed approach begins, and a point or an altitude/height where it ends.

7.1.3 The missed approach should be initiated at the DA/H on a 3D approach operation if the required visual reference to continue the approach has not been established.

7.1.4 On a 2D approach operation, descent shall not be made below the MDA or MDH without the required visual reference. The pilot should be aware that no obstacle or terrain protection is provided when descending below MDA/H during the execution of the approach or missed approach.

7.1.5 The MAPt in a procedure may be defined by:

a) the point of intersection of a glide path with the applicable DA/H in APV or precision approaches; or

b) a navigation facility, a fix, a waypoint or a specified distance from the FAF in non-precision approaches. For PBN non-precision approach procedures, the MAPt waypoint is normally located at the landing runway threshold (LTP). However, for offset procedures and other procedures where the MAPt is not located at the LTP, it is located at the fictitious threshold point (FTP).

7.1.6 When the MAPt is defined by a navigation facility, a waypoint or a fix, the distance from the FAF to the MAPt is normally published as well, and may be used for timing to the MAPt. In all cases where timing may not be used, the procedure is annotated "timing not authorized for defining the MAPt".

7.1.7 If upon reaching the MAPt the required visual reference is not established, the procedure requires that a missed approach be initiated at once in order to maintain protection from obstacles.

7.1.8 Missed approach tracking requirements

7.1.8.1 Unless a greater priority exists, the pilot shall fly the missed approach procedure as published.

7.1.8.2 If upon reaching the MAPt the required visual reference is not established, the pilot shall initiate a missed approach immediately in order to maintain protection from obstacles.

7.1.8.3 If a missed approach is initiated before arriving at the MAPt, the pilot should continue the lateral tracking of the approach being conducted until reaching the MAPt, then follow the missed approach procedure as published in order to remain within the protected airspace. This does not preclude flying over the MAPt at an altitude/height greater than that required by the procedure.

7.1.8.4 When the first requirement of a missed approach procedure is defined by an altitude/height, additional protection is provided for the safeguarding of early turns, should they be operationally required. When an early turn is not possible, the approach chart will specify the earliest point (DME, MAPt or equivalent point) at which turns can be made.

7.1.9 Missed approach gradient

7.1.9.1 Normal missed approach procedures are based on a minimum climb gradient of 2.5 per cent (4.2 per cent CAT H). A gradient of 2 per cent may be used in the procedure construction if the necessary survey and safeguarding have been provided. With the approval of the appropriate authority, gradients of 3, 4 or 5 per cent may be used for aircraft whose climb performance permits an operational advantage to be thus obtained.

7.1.9.2 When a gradient other than 2.5 per cent is used, this is indicated on the IAC. In addition to the OCA/H for the non-standard gradient, the OCA/H applicable to the nominal 2.5 per cent gradient will also be shown.

7.1.9.3 The pilot should be aware that a missed approach procedure which is based on the nominal climb gradient of 2.5 per cent or greater cannot be used by all aircraft when operating at high gross mass and non-normal configurations, including engine-out conditions. The operation of aircraft under these conditions needs special consideration at aerodromes that are critical due to obstacles on the missed approach area. This may result in a special procedure being established with a possible increase in the DA/H or MDA/H.

7.2 INITIAL PHASE

The initial phase begins at the MAPt and ends at the start of climb (SOC). This phase requires the concentrated attention of the pilot on establishing the climb and the changes in aircraft configuration. It is assumed that guidance equipment is not extensively utilized during these manoeuvres, and for this reason, no turns are specified in this phase.

7.3 INTERMEDIATE PHASE

7.3.1 The intermediate phase begins at the SOC. The climb is continued, normally straight ahead. It extends to the first point where 50 m (164 ft) obstacle clearance is obtained and can be maintained.

7.3.2 The intermediate missed approach track may be changed by a maximum of 15° from that of the initial missed approach phase. During this phase, it is assumed that the aircraft begins track corrections.

7.4 FINAL PHASE

The final phase begins at the point where 50 m (164 ft) obstacle clearance is first obtained (for Category H procedures, 40 m (131 ft)) and can be maintained. It extends to the point where a new approach, holding or a return to en-route flight is initiated. Turns may be prescribed in this phase.

7.5 TURNING MISSED APPROACH

7.5.1 Turns in a missed approach procedure are only prescribed where terrain or other factors make a turn necessary.

7.5.2 Where an obstacle is located early in the missed approach procedure, the IAC is annotated "Missed approach turn as soon as operationally practicable to __________ heading". See Attachment B, 4.8.4 for more information.

7.5.3 Airspeed

7.5.3.1 The protected airspace for turns is based on the speeds for final missed approach (see Tables II-5-1-1 and II 5-1-2).

7.5.3.2 Where operationally required to avoid obstacles, the IAS as slow as for intermediate missed approach may be used. In this case, the IAC contains the following note: "Missed approach turn limited to ________ km/h (kt) IAS maximum".

7.5.3.3 Pilots shall comply with such annotations on approach charts and to execute the appropriate manoeuvres without undue delay.

7.6 PBN MISSED APPROACH ATTRIBUTES

7.6.1 *Description.* A PBN missed approach is a missed approach procedure containing RNAV or RNP segments.

7.6.2 *PBN requirements box.* PBN procedures are promulgated with a PBN requirements box. The box contains the following information:

a) identification of the applicable navigation specification(s) that were used to design the procedure;

b) restrictions on navigation equipment required to fly the procedure (for example GNSS only); and

c) information related to optional functionality of the applicable navigation specification, such as the use of RF legs or RNP scalability.

7.6.3 Applicable navigation specifications

The applicable navigation specifications for PBN missed approach segments are:

a) RNP APCH;

b) RNP AR APCH;

c) Advanced RNP;

d) RNP 0.3 (Helicopters);

e) RNAV 1; and

f) RNP 1.

Note.— For complete details of the applicability of PBN navigation specifications to the missed approach, see the Performance-based Navigation (PBN) Manual *(Doc 9613).*

7.6.4 The navigation specifications may be applied on a missed approach route segment basis. The aircraft and pilot shall be approved to operate on the navigation specification that applies to the missed approach.

7.6.5 *Navigation database.* Missed approach procedure information is contained in a navigation database using the WGS-84 coordinate system. If the navigation database does not contain the missed approach procedure, the procedure shall not be used.

7.6.6 PBN operational approval

7.6.6.1 Pilots shall verify, before operating on any PBN route or procedure, that they have approval to operate on the navigation specification used. Where there are additional restrictions, for example sensor use or optional functionality as discussed in 7.6.2, the pilot shall also verify that these are complied with.

7.6.6.2 Prior to operating on any PBN procedure, the pilot shall confirm:

a) the operation of all required navigation aids (ground and space-based);

b) the correct functioning of the navigation equipment;

c) the validity of the navigation database; and

d) waypoint and segment data, with reference to the published chart.

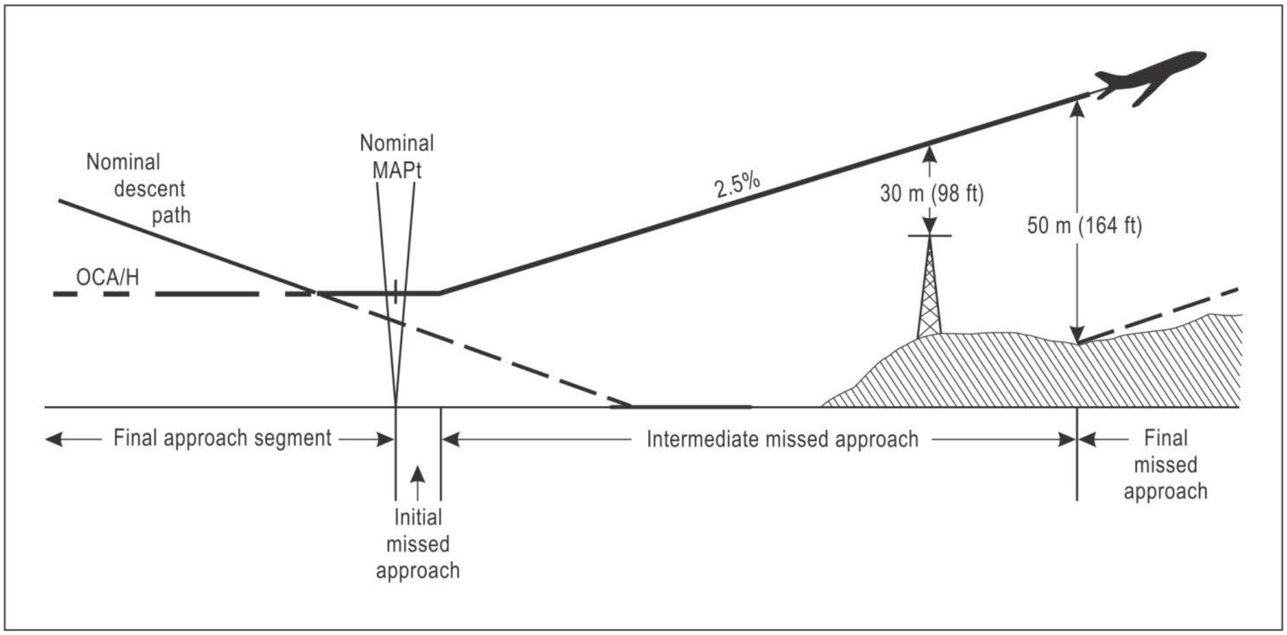


Figure II-5-7-1. Missed approach phases

Section 6

HOLDING PROCEDURES

Chapter 1

GENERAL REQUIREMENTS

1.1 GENERAL

The procedures described in this section are related to right turn holding patterns. For left turn holding patterns, the corresponding entry and holding procedures are symmetrical with respect to the inbound holding track.

1.2 SHAPE AND TERMINOLOGY ASSOCIATED WITH HOLDING PATTERN

The shape and terminology associated with the holding pattern are given in Figure II-6-1-1.

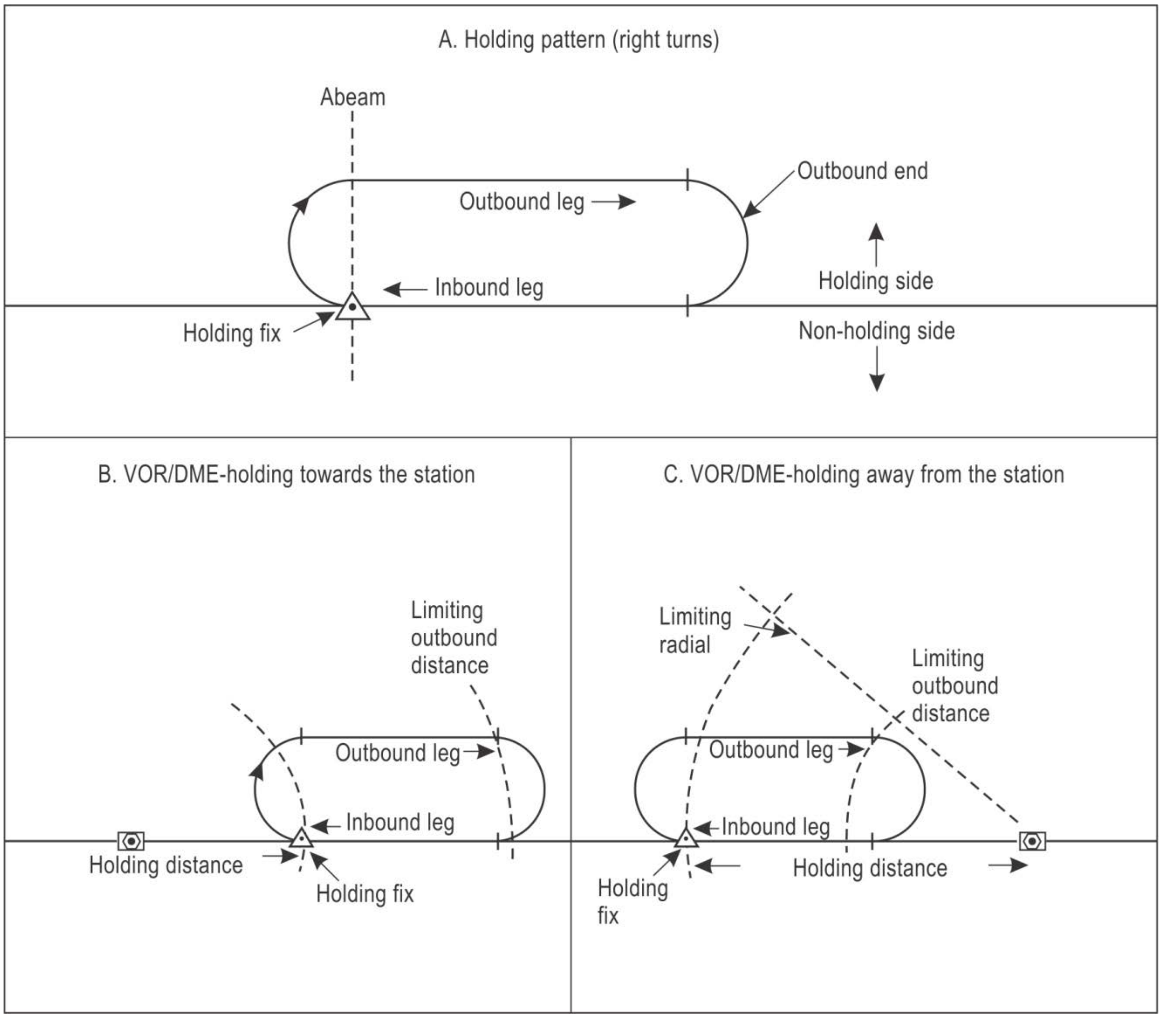


Figure II-6-1-1. Shape and terminology associated with right turn holding pattern

Chapter 2

HOLDING (CONVENTIONAL)

2.1 SPEEDS, RATE OF TURN, TIMING, DISTANCE AND LIMITING RADIAL

2.1.1 Speeds

2.1.1.1 Holding patterns shall be entered and flown at or below the airspeeds given in Tables II-6-2-1 and II-6-2-2.

2.2.2.2 These speeds are rounded to the nearest multiple of five for operational reasons. From the standpoint of operational safety, these speeds are considered to be equivalent to the unrounded originals.

2.1.2 Bank angle/rate of turn

All turns shall be made at a bank angle of 25° or at a rate of 3° per second, whichever requires the lesser bank.

2.1.3 Allowance for known wind

All procedures depict tracks. The pilot should attempt to maintain the track by making allowance for known wind by applying corrections both to heading and timing. This should be done during entry and while flying in the holding pattern.

2.1.4 Start of outbound timing

Outbound timing begins over or abeam the fix, whichever occurs later. If the abeam position cannot be determined, start timing when the turn to outbound is completed.

2.1.5 Outbound leg length based on a distance measuring equipment (DME) distance

If the outbound leg length is based on a DME distance, then the outbound leg terminates as soon as the limiting DME distance is reached.

2.1.6 Limiting radials

2.1.6.1 In the case of holding away from the station (see Figure II-6-1-1 C), where the distance from the holding fix to the very high frequency omnidirectional radio range/distance measuring equipment (VOR/DME) station is short, a limiting radial may be specified. A limiting radial may also be specified where airspace conservation is essential.

2.1.6.2 If the limiting radial is reached before the limiting DME distance, this radial should be followed until a turn inbound is initiated. The turn should be initiated at the latest where the limiting DME distance is reached.

2.1.7 Air traffic control (ATC) notification

If for any reason a pilot is unable to conform to the procedures for normal conditions, ATC should be advised as early as possible.

2.2 HOLD ENTRY

2.2.1 Paragraphs 2.2.3.2 and 2.2.9 related to hold entry represent general guidance. Variations of the basic procedure for local conditions may be authorized by States after appropriate consultation with the operators concerned.

2.2.2 The entry into the holding pattern shall be according to heading in relation to the three entry sectors shown in Figure II-6-2-1, recognizing a zone of flexibility of 5° on either side of the sector boundaries.

2.2.3 Restrictions on hold entry

2.2.3.1 For holding on a VOR intersection, the entry track is limited to the radials forming the intersection.

2.2.3.2 For holding on a VOR/DME fix, the entry track is limited to:

a) the VOR radial;

b) the DME arc (where specified); or

c) the entry radial to a VOR/DME fix at the end of the outbound leg, as published.

2.2.4 Sector 1 entry

Sector 1 procedure — parallel entry (see Figure II-6-2-1):

a) at the fix, the aircraft is turned left onto an outbound heading for the appropriate period of time (see 2.2.9,“Time/distance outbound”); then

b) the aircraft is turned toward the holding side to intercept the inbound track or to return directly to the fix; and then

c) on second arrival over the holding fix, the aircraft is turned right to follow the holding pattern.

2.2.5 Sector 2 entry

Sector 2 procedure — offset entry (see Figure II-6-2-1):

a) at the fix, the aircraft is turned onto a heading to make good a track making an angle of 30° from the reciprocal of the inbound track on the holding side; then

b) the aircraft will fly outbound:

  1) for the appropriate period of time (see 2.2.9, "Time/distance outbound"), where timing is specified; or

  2) until the appropriate limiting DME distance is reached, where distance is specified. If a limiting radial is also specified, then the outbound distance is determined either by the limiting DME distance or the limiting radial, whichever comes first;

c) the aircraft is turned right to intercept the inbound holding track; and

d) on second arrival over the holding fix, the aircraft is turned right to follow the holding pattern.

2.2.6 Sector 3 entry

Sector 3 procedure — direct entry (see Figure II-6-2-1):

Having reached the fix, the aircraft is turned right to follow the holding pattern.

2.2.7 DME arc entry

To be used where specified. At the fix, the aircraft shall enter the holding pattern in accordance with either the Sector 1 or Sector 3 entry procedure.

2.2.8 Special entry procedure for VOR/DME holding

2.2.8.1 Where a special entry procedure is used, the entry radial is clearly depicted.

2.2.8.2 Arrival to a VOR/DME holding pattern may be:

a) along the axis of the inbound track;

b) along a published track; or

c) by radar vectoring, when aircraft shall be established on prescribed protected flight paths.

2.2.8.3 The entry point should be either of the following two options:

a) the holding fix: In this case, the aircraft shall arrive at the entry point by means of:

  1) the VOR radial for the inbound leg; or

  2) the DME arc defining the holding fix.

b) the fix at the end of the outbound leg, in which case, the aircraft will arrive at the entry point by means of the VOR radial passing through the fix at the end of the outbound leg.

2.2.8.4 It is also possible to make use of guidance from another radio facility (e.g. non-directional beacon (NDB)).

2.2.8.5 The following describes the method of arrival at a VOR/DME holding and the corresponding entry procedures, where the entry point is the holding fix.

2.2.8.5.1 For arrival on the VOR radial of the inbound leg, on the same heading as the inbound track (see Figure II-6-2-2 A) the entry consists of following the holding pattern.

2.2.8.5.2 For arrival on the VOR radial of the inbound leg, on a heading reciprocal to the inbound track (see Figure II-6-2-2-B):

a) On arrival over the holding fix, the aircraft turns onto the holding side on a track making an angle of 30° with the reciprocal of the inbound track, until reaching the DME outbound limiting distance.

b) At this point it turns to intercept the inbound track.

c) In the case of a VOR/DME holding entry away from the facility with a limiting radial, if the aircraft encounters the radial ahead of the DME distance, it shall turn and follow it until reaching the DME outbound limiting distance, at which point it turns to join the inbound track.

2.2.8.5.3 For arrival on the DME arc defining the holding fix, from the non-holding side (see Figure II-6-2-2 C):

a) On arrival over the holding fix, the aircraft turns and follows a track parallel to and on the same heading as the outbound track.

b) When it reaches the DME outbound limiting distance, the aircraft turns to intercept the inbound track.

2.2.8.5.4 For arrival on the DME arc defining the holding fix, from the holding side (see Figure II-6-2-2 E):

a) On arrival over the holding fix, the aircraft turns and follows a track parallel and reciprocal to the inbound track, until reaching the DME limiting outbound distance. It then turns to intercept the inbound track.

b) If the entry point is the fix at the end of the outbound leg, arrival (or last segment thereof) is effected along the VOR radial passing through the outbound fix. On arrival over the fix at the end of the outbound leg, the aircraft turns and follows the holding pattern (see Figure II 6-2-2 F and G).

2.2.9 Time/distance outbound

2.2.9.1 The still air time for flying the outbound entry heading should not exceed:

a) one minute if at or below 4 250 m (14 000 ft); or

b) one and one-half minutes if above 4 250 m (14 000 ft).

2.2.9.2 Where DME is available, the length of the outbound leg may be specified in terms of distance instead of time.

2.3 HOLDING

2.3.1 Still air condition

After entering the holding pattern, on the second and subsequent arrivals over the fix, the aircraft turns to fly an outbound track to position the aircraft for the turn onto the inbound track. It continues outbound:

a) where timing is specified:

  1) for one minute if at or below 4 250 m (14 000 ft); or

  2) for one and one-half minutes if above 4 250 m (14 000 ft); or

b) where distance is specified until the appropriate limiting DME distance is reached.

Then, the aircraft turns so as to realign itself on the inbound track.

2.3.2 Corrections for wind effect

Allowance should be made in both heading and timing to compensate for the effects of wind to ensure the inbound track is regained before passing the holding fix inbound. In making these corrections, full use should be made of the indications available from the navaid and estimated or known wind.

2.3.3 Departing the pattern

When clearance is received specifying the time of departure from the holding point, the pilot should adjust the pattern within the limits of the established holding procedure in order to leave the holding point at the time specified.

2.4 OBSTACLE CLEARANCE

2.4.1 Holding area

The holding area includes the basic holding area and the entry area. The basic holding area is the airspace required for a holding pattern at a specific level, based on the allowances for aircraft speed, wind effect, timing errors, holding fix characteristics, etc. The entry area is the airspace required for the entry procedure.

2.4.2 Buffer area

2.4.2.1 An additional buffer area extends 9.3 km (5.0 NM) beyond the boundary of the holding area. Significant obstacles in the buffer area are taken into consideration when determining the minimum holding level.

2.4.2.2 For helicopter holding procedures, the buffer area is 3.7 km (2 NM) wide and only applies below 1 830 m (6 000 ft).

2.4.3 Minimum holding level

The minimum permissible holding level (see Figure II-6-2-3) provides a clearance of at least 300 m (984 ft) above obstacles in the holding area, and a clearance which ranges from 300 m (984 ft) at the edge of the holding area to a minimum of 60 m (197 ft) at the 5.0 NM limit of the buffer area.

2.4.4 Obstacle clearance over high terrain or in mountainous areas

Over high terrain or in mountainous areas, additional obstacle clearance up to a total of 600 m (1 969 ft) is provided to accommodate the possible effects of turbulence, down drafts and other meteorological phenomena on the performance of altimeters.

Reference to this para on figure corrected.

Table II-6-2-1. Holding speeds — Categories A through E

Levels[1]	*Normal conditions*	*Turbulence conditions*
Up to 4 250 m (14 000 ft) inclusive	425 km/h (230 kt)[2] 315 km/h (170 kt)[4]	520 km/h (280 kt)[3] 315 km/h (170 kt)[4]
Above 4 250 m (14 000 ft) to 6 100 m (20 000 ft) inclusive	445 km/h (240 kt)[5]	520 km/h (280 kt) or 0.8 Mach, whichever is less[3]
Above 6 100 m (20 000 ft) to 10 350 m (34 000 ft) inclusive	490 km/h (265 kt)[5]	
Above 10 350 m (34 000 ft)	0.83 Mach	0.83 Mach

1. The levels shown represent altitudes or corresponding flight levels depending upon the altimeter setting in use.
2. When the holding procedure is followed by the initial segment of an instrument approach procedure promulgated at a speed higher than 425 km/h (230 kt), the holding should also be promulgated at this higher speed wherever possible.
3. The speed of 520 km/h (280 kt) (0.8 Mach) reserved for turbulence conditions shall be used for holding only after prior clearance with ATC, unless the relevant publications indicate that the holding area can accommodate aircraft flight at these high holding speeds.
4. For holdings limited to CAT A and B aircraft only.
5. Wherever possible, 520 km/h (280 kt) should be used for holding procedures associated with airway route structures.

Table II-6-2-2. Holding speeds — Category H

Maximum speed up to 1 830 m (6 000 ft)	185 km/h (100 kt)
Maximum speed above 1 830 m (6 000 ft)	315 km/h (170 kt)

Note.— Minimum obstacle clearance (MOC) in secondary area for helicopter holding procedures is linear from zero to full MOC.

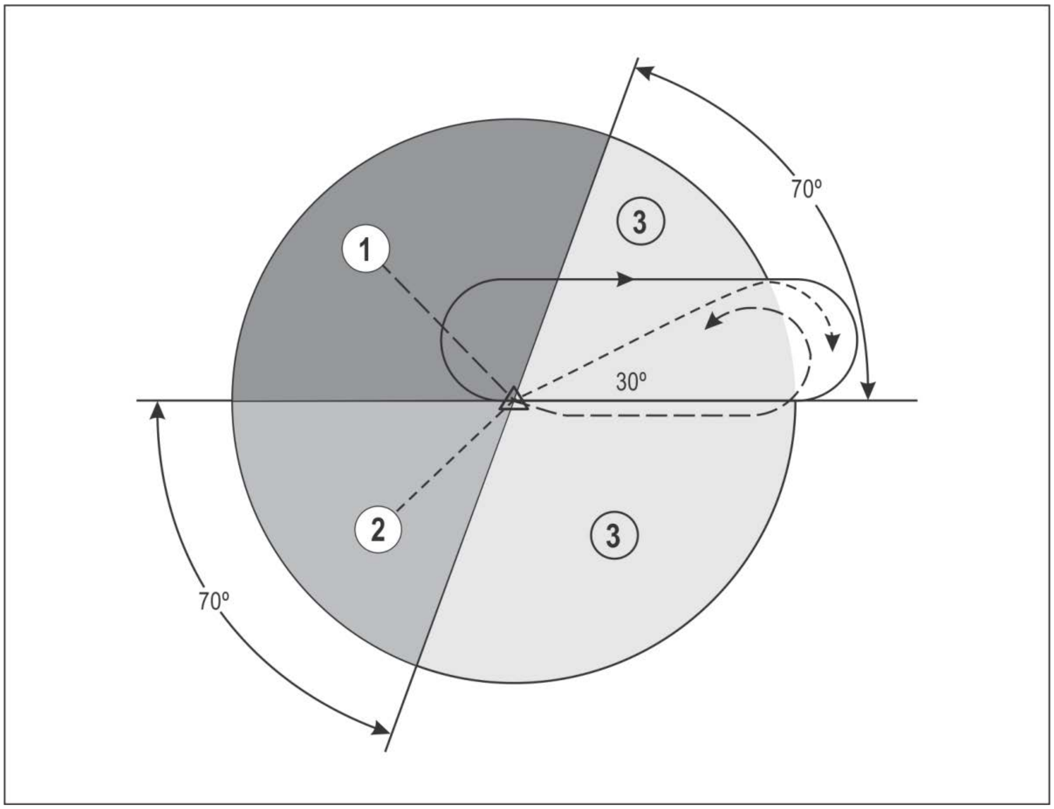


Figure II-6-2-1. Entry sectors

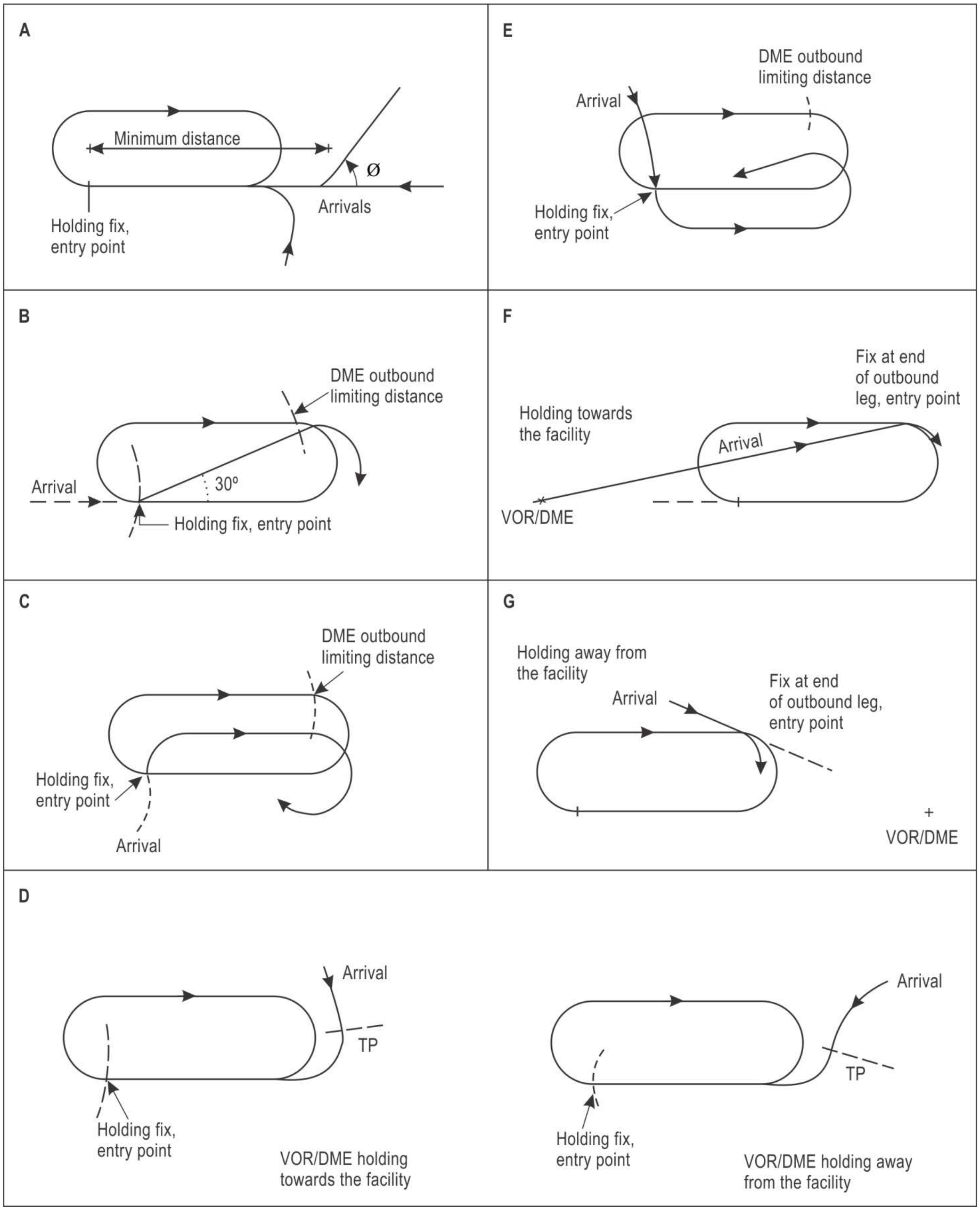


Figure II-6-2-2. VOR/DME holding entry procedures

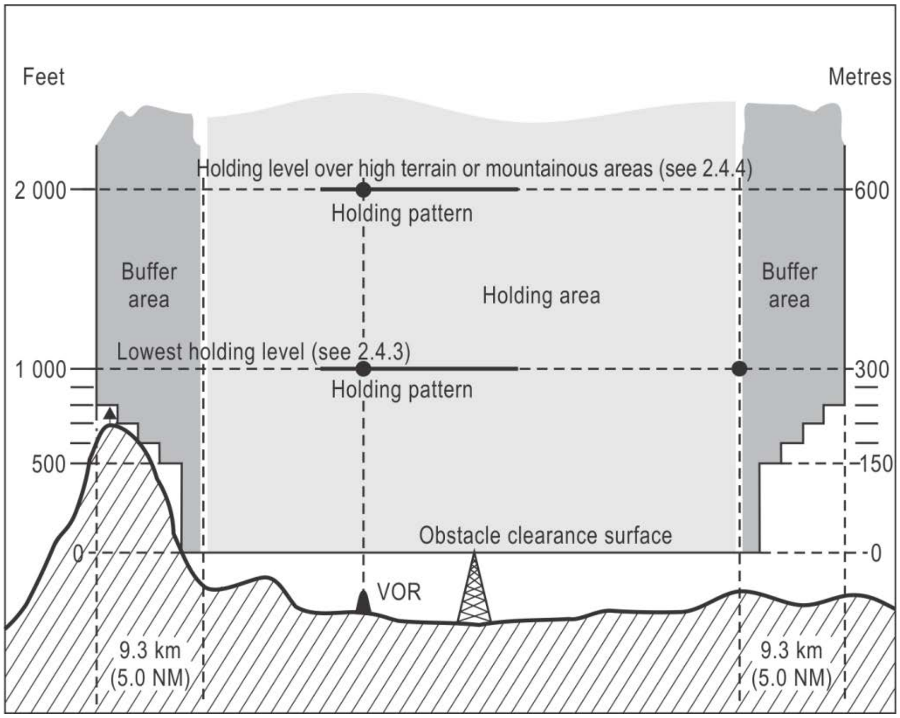


Figure II-6-2-3. Minimum holding level as determined by the obstacle clearance surface related to the holding area and the buffer area

Chapter 3

HOLDING (RNAV)

3.1 INTRODUCTION

3.1.1 The general criteria in Section 6, Chapter 2, “Holding (Conventional)”, are applicable except as modified or amplified by the material in this chapter.

3.1.2 Area navigation (RNAV) holding uses different criteria for defining the protected space and is only available to those aircraft which have a certified ability to comply with these criteria.

3.1.3 The RNAV holding pattern design criteria protect all types of RNAV systems.

3.2 AIRCRAFT EQUIPPED WITH RNAV SYSTEMS INCLUDING CERTIFIED RNAV HOLDING FUNCTIONALITY

3.2.1 These systems may be used to carry out RNAV holding, provided that:

a) the aircraft is fitted with serviceable RNAV equipment; and

b) the pilot has a current knowledge of how to operate the equipment to optimize navigation accuracy.

3.2.2 Holding waypoints and supporting data contained in the navigation database are calculated and promulgated by the State authority. Holding waypoints may also be input by the operator or the pilot for some applications (e.g. RNAV 5) when identified in operations approval documentation. Any errors introduced from the navigation database or manual entry will affect the actual computed position. The pilot should cross-check the waypoint position using VOR/DME fix information where this is available.

3.2.3 Some RNAV systems can fly conventional holding patterns without strict compliance with PANS-OPS, Volume II, assumptions. Before these systems are used operationally, they shall have demonstrated, to the satisfaction of the appropriate authority, that their commands will contain the aircraft within the basic holding area defined by PANS-OPS, Volume II, for the environmental conditions assumed by those criteria. The pilot shall verify overflight of the stipulated fixes by means of the reference facility.

3.2.4 Performance-based navigation (PBN) holding may be conducted in specifically designed holding patterns. These holding patterns utilize the criteria and flight procedure assumptions of conventional holding with orientations. However, the holding pattern is established on a track to the holding waypoint. These holding patterns assume that the aircraft is approved for the PBN navigation specification associated with the holding pattern and is being operated in accordance with that approval.

3.3 CONVENTIONAL HOLDING PATTERNS

Conventional holding patterns may be flown with the assistance of an RNAV system. In this case, the RNAV system has no other function than to provide guidance for the autopilot or flight director. The pilot remains responsible for ensuring that the aircraft complies with the speed, bank angle, timing and distance assumptions contained in Chapter 2, 2.1 of this section.

3.4 PILOT RESPONSIBILITIES

3.4.1 When RNAV equipment is used for non-RNAV holding procedures, the pilot shall verify inbound track, direction of turn and positional accuracy at the holding fix on each passage of the fix.

3.4.2 The pilot shall ensure that speeds used to fly the RNAV holding procedures comply with Tables II-6-2-1 and II 6 2-2.

3.5 RNAV HOLDING ENTRIES

Entries into an RNAV holding pattern are the same as for conventional holding unless clearly specified otherwise.

Section 7

PROCEDURES FOR USE BY HELICOPTERS

Chapter 1

GENERAL REQUIREMENTS

1.1 This section outlines requirements for the pilot and others concerning specific helicopter operations including:

a) the parameters and criteria used in the standardized development of instrument approach procedures;

b) the procedures to be followed and the limitations to be observed in order to achieve an acceptable level of safety in the conduct of specific helicopter instrument operations; and

c) references to the other sections of this document for procedures not specifically for helicopters.

1.2 In order to capitalize on the capabilities of helicopters, helicopter-only procedures may be designed and authorized for airspeeds lower than those established for Category A aeroplanes. Those procedures which have been designed under the special criteria for helicopter-use only are identified by the letter H and refer to the category of aircraft as Category H. Point-in-space (PinS) procedures utilize criteria only applicable to helicopter operations.

1.3 For flight operations using Category A procedures, the primary requirement is to manoeuvre the helicopter within the Category A airspeed tolerances as prescribed in Table II-7-2-1 and Table II-5-1-1 or Table II-5-1-2. Failure to maintain the minimum speed could lead to an excursion outside 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 step down fix (SDF), 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.

1.4 Circling procedures are not applicable to helicopters. The pilot should manoeuvre the helicopter visually to a suitable landing area. A helicopter pilot using a Category A procedure which authorizes both straight-in and circling minima may manoeuvre at the straight-in minimum descent height (MDH) if visibility permits. However, the pilot shall be alert to operational notes regarding air traffic services (ATS) requirements while manoeuvring to land and operate within the Category A circling protected airspace.

1.5 HELICOPTER POINT-IN-SPACE (PinS) PROCEDURES

Helicopter specific procedures addressed in this section include:

a) PinS “proceed VFR” departures;

b) PinS “proceed visually” direct visual segment departures;

c) PinS “proceed visually” manoeuvring visually departures;

d) PinS “proceed VFR” approaches;

e) PinS "proceed visually" direct visual segment approaches; and

f) PinS "proceed visually" manoeuvring approaches.

Chapter 2

HELICOPTER PROCEDURES TO RUNWAYS

2.1 HELICOPTER USE OF INSTRUMENT PROCEDURES PROMULGATED FOR CATEGORY A AEROPLANES

2.1.1 General

The criteria specified in Section 2, “Departure Procedures”, Section 4, “Arrival Procedures”, Section 5 “Approach Procedures” and Section 6, “Holding Procedures” may be applied for helicopter operations provided that the helicopter is operated as an aeroplane, especially in regard to the items noted in 2.1.2, “Departure Criteria” and 2.1.3, “Instrument Approach Criteria”. For helicopter-only procedures, refer to 2.2 below.

2.1.2 Departure criteria

When helicopters use a procedure designed for aeroplanes and when no special helicopter procedure has been promulgated, the pilot shall consider the following operational constraints:

— *straight departures:* It is important that helicopters cross the departure end of the runway (DER) within 150 m laterally of the runway centre line when using departure procedures designed for aeroplanes.

— *turning or omnidirectional departures:* Straight flight is assumed until reaching an altitude/height of at least 120 m (394 ft) above the elevation of the DER.

2.1.3 Instrument approach criteria

2.1.3.1 Categorization

Helicopters may be classified as Category A aeroplanes for the purpose of designing instrument approach procedures and specifications.

2.1.3.2 Operational constraints

2.1.3.2.1 When helicopters use procedures designed for Category A aeroplanes, and when no special helicopter procedure has been promulgated, the pilot shall consider the following operational constraints.

2.1.3.2.2 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” non-directional beacon (NDB) or very high frequency omnidirectional radar range (VOR) procedure). In these cases, a slower speed when combined with a tailwind may cause the helicopter to reach start of climb after the point calculated for Category A aeroplanes. This will reduce the obstacle clearance in the missed approach phase.

2.1.3.2.3 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.

2.1.3.2.4 Therefore, for helicopters, the pilot should reduce speed 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.

2.1.3.2.5 When obstacles are close to final approach or SDFs, they are discounted for Category A aeroplanes if they lie below a 15 per cent plane relative to the earliest point defined by the fix tolerance area and minimum obstacle clearance (MOC). Helicopters are capable of nominal descent gradients which could penetrate this plane. Therefore, for helicopters, the pilot should limit rates of descent after crossing the final approach and any SDF accordingly. On the final approach segment (FAS), nominal descent rates should not exceed 1 000 ft/min.

2.2 HELICOPTERS ONLY PROCEDURES (CAT H)

2.2.1 General

For flight operations and procedures based on helicopter-only criteria, Table II-7-2-1 provides a comparison between selected Category H helicopter criteria and the corresponding Category A aeroplane criteria. Pilot awareness of the differences between the two criteria is essential for the safety of helicopter instrument flight rules (IFR) operations.

Table II-7-2-1. Comparison between selected helicopter-only criteria and the corresponding aeroplane criteria

PANS-OPS, Volume II reference	*Criteria*	*CAT H*	*CAT A*
Part I	**General**		
Section 2 — General principles			
Chapter 2 — Terminal area fixes			
2.7.4	SDF gradient	15% to 25%	15%
Section 3 — Departure procedures			
Chapter 2 — General concepts			
2.3	Minimum height to initiate a turn	90 m (over the DER elevation)	120 m (over the DER elevation)
2.7	Procedure design gradient	5%	3.3%

PANS-OPS, Volume II reference	*Criteria*	*CAT H*	*CAT A*
Chapter 3 — Departure routes			
3.2	Straight departures		
3.2.3	Track adjustments will take place no further than a point corresponding to ______ above the DER, or at a specified track adjustment point	90 m	120 m
3.3	Turning departures		
3.3.1	Straight flight assumed until reaching a height of at least	90 m (295 ft)	120 m (394 ft)
3.3.2	Turn initiation area start point	See earliest limit for DER	600 m from beginning of runway
3.3.4	Turn parameters, max speed	165 km/h (90 kt)	225 km/h (121 kt)
3.3.4	Reduced speed limitation for obstacle avoidance (from Table I-4-1-2)	130 km/h (70 kt)	204 km/h (110 kt)
Chapter 4 — Omnidirectional departures			
4.1	Initial straight ahead climb	90 m (295 ft)	120 m (394 ft)
4.2.1	Turn initiation area	beginning of the FATO	600 m from beginning of runway
Chapter 5 — Published information			
5.1	Procedure design gradient	5%	3.3%
Section 4 — Arrival and approach procedures			
Chapter 1 — General criteria			
Table I-4-1-2	*Speeds (kt)*		
	Initial approach		
	a) general	70/120*	90/150
	b) reversal, racetrack below 6 000 ft MSL	100	110
	c) reversal, racetrack above 6 000 ft MSL	110	110
	Final approach	60/90*	70/100
	Circling	N/A	100
	Intermediate missed approach	90	100
	Final missed approach	90	110
Chapter 3 — Initial approach segment			
3.3.5	Optimum descent gradient	6.5%	4.0%
	Maximum descent gradient	10%	8.0%

PANS-OPS, Volume II reference	*Criteria*	*CAT H*	*CAT A*
Chapter 4 — Intermediate approach segment			
4.3.3	Maximum descent gradient	10%	5.2%
Chapter 5 — Final approach segment			
5.3.1.2	Maximum descent gradient	10%	6.5%
5.3.2	Origin of descent gradient	(above the beginning of the LDAH)	(above the threshold)
Chapter 6 — Missed approach segment			
6.2.3.2	Final phase MOC	40 m (130 ft)	50 m (164 ft)
6.4.3	Reduced turning speed	130 km/h (70 kt)	185 km/h (100 kt)
Part II	**Conventional procedures**		
Section 4 — Holding criteria			
Chapter 1 — Holding criteria			
Table II-4-1-2	*Holding*		
	Maximum speed up to 1 830 m (6 000 ft)	185 km/h (100 kt)	315 km/h (170 kt)
	Maximum speed above 1 830 m (6 000 ft)	315 km/h (170 kt)	315 km/h (170 kt)
1.3.12	Buffer area	3.7 km (2 NM) (only below 1 830 m (6 000 ft))	9 km (5 NM)
Table II-4-1-2	MOC (ft)	Linear from 0 to full MOC	Steps

* Helicopter PinS procedures based on basic GNSS or SBAS may be designed using maximum speeds of 120 KIAS for initial and intermediate segments and 90 KIAS on final and missed approach segments, or 90 KIAS for initial and intermediate segments and 70 KIAS on final and missed approach segments based on operational need. (See PANS-OPS, Volume II, Part IV, Chapter 1.)

Chapter 3

POINT-IN-SPACE PROCEDURES

3.1 HELICOPTER POINT-IN-SPACE (PinS) DEPARTURES FROM HELIPORTS OR LANDING LOCATIONS

3.1.1 PinS departure — General

3.1.1.1 The PinS departure consists of a visual segment followed by an instrument segment. The visual phase of flight starts from the heliport or landing location and ends at the initial departure fix (IDF) at or above the IDF minimum crossing altitude (MCA). Flight manoeuvring from the heliport or landing location to the IDF, where the helicopter transitions from the visual segment to the instrument segment, assumes adequate visual conditions for the pilot to see and avoid obstacles.

Note.— "VFR" includes specified minimum meteorological conditions established by the State for the airspace the operation is conducted in or the applicable operating regulation. "Visual" refers to meteorological conditions permitting visual reference to the surface but not necessarily meeting specified minimum meteorological conditions for VFR operations.

3.1.1.2 The IDF is identified by a fly-by waypoint. The global navigation satellite system (GNSS) (basic or satellite-based augmentation system (SBAS)) may be used to identify the IDF location and to provide directions to it.

3.1.1.3 PinS departure with a "proceed VFR" instruction

3.1.1.3.1 No obstacle protection is provided from the landing location to the IDF. The pilot shall cross the IDF at or above the MCA and shall remain in VFR conditions to see and avoid obstacles until crossing the IDF. PinS departures with a "proceed VFR" instruction can serve multiple heliports or landing locations.

3.1.1.3.2 After passing the IDF, instrument departure criteria provide obstacle protection. An IFR clearance shall be obtained prior to reaching the IDF.

3.1.1.4 PinS departure with a "proceed visually" instruction

3.1.1.4.1 A visual manoeuvring area and possibly a direct visual segment are identified from a single heliport or landing location to the IDF, and obstacle protection is provided within this area. The pilot shall navigate by visual reference to the earth's surface. The visibility shall be sufficient to see and avoid obstacles, and either to return to the heliport or landing location if it is not possible to continue visually, or continue to cross the IDF at or above the IDF MCA.

3.1.1.4.2 The helicopter shall depart on an IFR clearance from the heliport or landing location and fly visually until crossing the IDF at or above the IDF MCA.

3.1.2 Visual segment for a PinS departure with “proceed visually” instruction

3.1.2.1 The visual segment for a PinS departure with a “proceed visually” instruction can be either a direct visual segment (Direct-VS) or a manoeuvring visual segment (Manoeuvring-VS).

3.1.2.2 Direct visual segment (Direct-VS)

The pilot shall fly a visual segment directly from the heliport or landing location to the IDF, while operating at or above the standard visual segment design gradient (VSDG) of 5 per cent.

3.1.2.3 Manoeuvring visual segment (Manoeuvring-VS)

3.1.2.3.1 A Manoeuvring-VS is protected for a take-off in a direction other than directly to the IDF and a visual manoeuvre to join the initial instrument phase segment at the IDF.

3.1.2.3.2 The pilot shall conduct the visual manoeuvre as follows:

a) Before manoeuvring toward the IDF, climb initially on the centre line of the take-off climb surface to reach the greater of the IDF minimum crossing height (MCH)/2 or 90 m (295 ft) above the heliport/landing location elevation.

b) Continue climb and accelerate so as to cross the IDF at or above the MCA.

3.1.3 Visual segment for a PinS departure with a “proceed VFR” instruction

3.1.3.1 The visual segment of the PinS departure with a “proceed VFR” instruction is based on State regulatory requirements for VFR operations. No obstacle protection is provided from the heliport or landing location to the IDF.

3.1.3.2 The pilot shall cross the IDF at or above the MCA and shall remain in VFR conditions to see and avoid obstacles until crossing the IDF. PinS “proceed VFR” departures can serve multiple heliports or landing locations in a prescribed area that use a common instrument segment.

3.1.4 Instrument phase of the PinS departures

3.1.4.1 The instrument segment of the departure procedure is based on the applicable performance-based navigation (PBN) specifications.

3.1.4.2 The instrument flight phase starts when the helicopter crosses the IDF. The instrument phase consists of one or more segments and continues until the last waypoint of the departure procedure is reached.

3.1.4.3 The standard procedure design gradient (PDG) is 5 per cent. The PDG originates at the IDF MCA. Steeper PDGs are permitted when operationally required and annotated on the departure chart.

3.2 PBN PinS APPROACH PROCEDURES

3.2.1 General

3.2.1.1 A PinS approach is an instrument RNP APCH procedure flown to a point in space. It may be published with lateral navigation (LNAV) minima or localizer performance with vertical guidance (LPV) minima. The PinS approach procedure includes either a "proceed visually" instruction or a "proceed VFR" instruction from the MAPt or decision altitude/height (DA/H) to the heliport or landing location. This is further detailed in 3.2.2 and 3.2.3, respectively.

3.2.1.2 Obstacle clearance is provided for all IFR segments of the procedure including the missed approach segment based on the corresponding protection criteria. For a PinS RNP APCH with LNAV minima, the pilot shall initiate a missed approach, if needed, at or prior to the MAPt. For a PinS RNP APCH with LPV minima, the pilot shall initiate a missed approach, if needed, at or prior to the point where the DA/H is reached or the MAPt, whichever occurs first. Any visual flight manoeuvring beyond the MAPt assumes adequate visual or VFR conditions to see and avoid obstacles.

3.2.1.3 Some navigation systems will not change to "approach" mode after a track change of >30° at the FAF. Pilots should ensure they are aware of the limitations of their aircraft and follow suitable operational procedures to mitigate them.

3.2.2 PinS approach procedure with "proceed visually" instruction

3.2.2.1 A PinS approach with a "proceed visually" instruction is an instrument approach procedure developed for a heliport or a landing location. The PinS instrument approach segment delivers the helicopter to a MAPt. A visual segment connects the MAPt to the heliport or landing location, by Direct-VS or Manoeuvring-VS.

3.2.2.2 If the heliport or landing location or visual references associated with it can be acquired visually prior to the MAPt for approach procedures with an LNAV minima, or MAPt or DA (whichever occurs first) for procedures with an LPV minima, the pilot may decide to proceed visually to the heliport or landing location avoiding the "No Manoeuvring" areas, if they exist.

3.2.2.3 If the required visual references are not acquired prior to the MAPt the pilot shall execute a missed approach.

3.2.2.4 The required minimum visibility is based on the distance from the MAPt to the heliport or landing location. IFR obstacle clearance areas are not applied to the visual segment of the approach, and missed approach protection is not provided between the MAPt and the heliport or landing location.

3.2.2.5 Direct-VS description

3.2.2.5.1 The Direct-VS is protected for a straight-in landing from the MAPt to the heliport or landing location.

3.2.2.5.2 A descent point (DP) is used to identify the end of that portion of the visual segment that should be flown at the minimum descent altitude (MDA) and to identify the point at which the final descent for landing should begin.

3.2.2.5.3 The DP is defined by a distance from the MAPt on the Direct-VS track. It may be located at the MAPt.

3.2.2.6 Manoeuvring-VS description

3.2.2.6.1 The Manoeuvring -VS is protected for visual manoeuvres around the heliport or landing location to land from a direction other than directly from the MAPt.

3.2.2.6.2 The protection of a Manoeuvring -VS is based on the following:

a) the required turn at the MAPt in order to stay in the "manoeuvre area" cannot be more than 30°;

b) a speed of 93 km/h (50 KIAS) or lower in the visual part of flight;

c) the pilot may descend after the MAPt in the visual segment of the procedure to OCH/2 or 90 m (295 ft) above the heliport/landing location elevation, whichever is greater, taking account of the obstacles identified on the chart; and

d) the pilot shall not descend below OCH/2 or 90 m (295 ft) above the heliport/landing location elevation, whichever is greater, before being aligned on the centre line of the approach surface.

3.2.2.6.3 A manoeuvring area is defined within which the Manoeuvring-VS is conducted. The shape of the manoeuvring area is based upon the following assumptions:

a) *First trajectory:* The pilot shall fly at the OCA/H directly from the MAPt to the heliport/landing location and then perform a base turn to descend and align on the centre line of the approach surface;

b) *Second trajectory:* The pilot shall diverge from the "MAPt-HRP" axis after passing the MAPt in order to manoeuvre to align on the centre line of the approach surface.

3.2.2.6.4 The manoeuvring area may be reduced in size if a prominent obstacle is located near the heliport/landing location. In this case, the pilot shall both avoid overflight of the heliport/landing location and remain within the manoeuvring area by turning to intercept the centre line of the approach surface after passing the MAPt and prior to the heliport/landing location.

3.2.3 PinS approach procedure with a "proceed VFR" instruction

3.2.3.1 A PinS approach with a "proceed VFR" instruction is an instrument approach procedure developed for heliport or landing locations that do not meet the standards for a heliport or where PinS "proceed visually" criteria cannot be met. The PinS instrument approach delivers the helicopter to a MAPt.

3.2.3.2 Prior to or at the MAPt, the pilot shall determine whether the published minimum visibility or the visibility required by State regulations (whichever is higher), is available to safely transition from IFR to VFR flight and shall decide to proceed VFR or to execute a missed approach.

3.2.3.3 The pilot shall remain in VFR conditions after departing the MAPt. The pilot is responsible to see and avoid obstacles, and shall cancel IFR at the MAPt (see PANS-ATM, Chapter 4, 4.8).

3.2.3.4 A height above surface (HAS) diagram is charted for a PinS approach procedure and annotated with a "proceed VFR" to assist the pilot in the transition from IFR to VFR at the MAPt.

Chapter 4

HELIPORT INSTRUMENT FLIGHT PROCEDURES

(To be developed)

Attachment A

PROCEDURE DESIGN PRINCIPLES

Section 1

GENERAL PRINCIPLES OF PROCEDURE DESIGN

1.1 An instrument flight procedure is a series of predetermined manoeuvres designed to be flown by referring to the flight instruments. These provide specific protection from obstacles, and are typically used in the arrival, approach and departures phases of flight.

1.2 There are three main principles that apply to the design of all instrument flight procedures; they should be safe, as simple as possible and economical in both time and airspace. Safety requires the use of common sense and operational judgement. Simple procedures are essential at a time when pilot workload is high and the consequences of error can be fatal. Economical procedures are increasingly necessary where flight time can have an economic impact and where airspace is often in short supply.

1.3 The PANS-OPS caters for a wide variety of conditions in each area or segment of an instrument flight procedure. It is important that pilots understand the assumptions used in the design of procedures and the protections afforded by the procedures so as not to exceed them. The procedure design process involves the following concepts:

a) each instrument flight procedure is characterized by a sequence of segments based on surfaces or areas;

b) these areas or segments and their associated obstacle protection are designed in accordance with aircraft category and type of navigation facility; and

c) the areas or segments are assessed to find the highest obstacle within each area or segment.

The minimum obstacle clearance (MOC) applicable to each area or segment is added to the highest obstacle to calculate the minimum obstacle clearance altitudes for each area or segment.

1.4 Obstacle clearance is the primary safety consideration in developing instrument flight procedures, and because of variable factors such as terrain, aircraft characteristics and pilot ability, the detailed procedures are based on present standard equipment and practices. However, the obstacle clearance included in the specifications is considered to be the minimum which cannot be safely reduced.

1.5 Procedures contained in the PANS-OPS assume that all engines are operating. Development of contingency procedures is the responsibility of the operator.

1.6 The criteria in the PANS-OPS make use of standard conditions for aircraft characteristics. However, allowance is made in the criteria to deviate from these standard conditions when specific airspace or operational requirements apply.

1.7 Where example calculations are used, these assume an elevation of 2 000 ft above mean sea level (MSL) and a temperature of international standard atmosphere (ISA) +15°C.

1.8 For procedure design purposes where speeds are given in IAS and need to be converted to true airspeed (TAS), this conversion is achieved on the basis of the ISA where:

Atmospheric pressure	1013.2hPA
Temperature	+15°C
Temperature lapse rate	2° C/1 000 ft

1.9 All procedures depict tracks or bearings unless otherwise annotated. Pilots should attempt to therefore maintain the track or bearing by applying corrections to heading for known wind.

1.10 Navigation accuracy requirements in procedure design are normally omnidirectional, in that winds that have the most adverse effect are considered. Nevertheless, it is expected that pilots when flying an instrument flight procedure will always correct for the actual or estimated wind, except when being vectored.

1.11 Different assumed wind speed values are used in procedure design according to the phase of flight or segment of the procedure. Unless, site-specific, 95 per cent statistical values are available, the following assumed wind speed values are used:

Phase of flight	*Winds used*
Departure	30 kt omnidirectional for turns
En-route/initial approach segment	ICAO standard wind of (2 x altitude in feet/1 000) + 47 kt
Holding	ICAO standard wind of (2 x altitude in feet/1 000) + 47 kt
Final and missed approach segments	30 kt for turns

1.12 All published procedures use degrees magnetic.

1.13 Additional considerations for mountainous areas

When procedures are designed for use in mountainous areas, consideration is given to induced altimeter error and pilot control problems which result when winds of 37 km/h (20 kt) or more move over such areas. Where these conditions are known to exist, MOC may be increased by as much as 100 per cent.

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Section 2

BASIC DESIGN CONCEPTS

2.1 ACCURACY OF FIXES

2.1.1 General

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

2.1.1.2 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 the plotted location of the facility, waypoint or intersection. Figure A-2-1 illustrates the fix tolerance area formed by the intersection of two radials or tracks from different navigation facilities.

2.1.2 Fix tolerance factors

2.1.2.1 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 for conventional navigation aids, on the distance from the facility.

2.1.2.2 See Table A-2-1 for system use accuracies for conventional navigation aids and Table A-2-2 for the tolerances on which these values are based.

2.1.2.3 See 2.2.7 for fix tolerances when using performance-based navigation (PBN) systems.

2.1.3 Fix tolerance for other types of navigation systems

2.1.3.1 *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 ±1.6 km (0.8 NM); and

b) en-route surveillance radar (RSR) within 74 km (40 NM): fix tolerance is ±3.2 km (1.7 NM).

2.1.3.2 *Distance measuring equipment (DME).* Fix tolerance is ±0.46 km (0.25 NM) + 1.25 per cent of distance to the antenna.

2.1.3.3 *75 MHz marker beacon.* See Figure A-2-2 to determine the fix tolerance for instrument landing system (ILS) and “z” markers for use with instrument approach procedures.

Table A-2-1. System use accuracy (2 SD) of facility providing track guidance and facility not providing track guidance

	VOR[1]	*ILS*	*NDB*
System use accuracy of facility providing track	±5.2°	±2.4°	±6.9°
System use accuracy of facility NOT providing track	±4.5°	±1.4°	±6.2°

1. The VOR values of ±5.2° and ±4.5° may be modified according to the value of a) in Table A-2-2, resulting from flight tests.

Table A-2-2. Tolerances on which system use accuracies are based

	VOR	*ILS*	*NDB*
The values in Table A-2-1 are the result of a combination, on a root sum square basis, of the following tolerances:			
a) Ground system tolerance	±3.6°	±1°[1]	±3°
b) Airborne receiving system tolerance	±2.7°	±1°	±5.4°
c) Flight technical tolerance[2]	±2.5°	±2°	±3°

1. Includes beam bends.
2. Flight technical tolerance is only applied to navigation aids providing track guidance. It is not applied to fix intersecting navigation aids.

2.2 PROTECTED AREAS

2.2.1 Primary and secondary areas

2.2.1.1 For each straight segment of the procedure an area is specified extending either side of the defined track. Normally the area is symmetrical on both sides of the intended track.

2.2.1.2 In general, this area is subdivided into primary and secondary areas. However, in some cases, primary areas only are specified. When secondary areas are specified, the outer half of each side of the area (normally 25 per cent of the total width) is designated as secondary area. (See Figure A-2-3.)

2.2.1.3 Full obstacle clearance is provided throughout the entire primary area, and in the secondary area, the obstacle clearance is reduced linearly from the full clearance at the inner edge to zero at the outer edge, as shown in Figure A-2-3.

2.2.2 Calculation of area widths — conventional navigation

2.2.2.1 The actual width of the area is determined by the phase of flight.

2.2.2.2 En-route areas are constructed differently. See Part II, Section 3, Chapter 1 for details.

2.2.3 Standard arrival routes (STAR) of 46 km or longer (25 NM)

When the length of the arrival route is greater than or equal to 46 km (25 NM), en-route criteria apply prior to the 46 km (25 NM) distance to the initial approach fix (IAF). The area width decreases from 46 km (25 NM) with a convergence angle of 30° each side of the axis, until reaching the width determined by the initial approach criteria.

2.2.4 Arrival routes less than 46 km (25 NM)

When the length of the arrival route is less than 46 km (25 NM), the area width decreases from the beginning of the arrival route with a convergence angle of 30° each side of the axis, until reaching the width determined by the initial approach criteria.

2.2.5 Initial approach

The initial approach segment has no standard length. The length is that which is sufficient to permit the altitude change required by the procedure. The width is divided into:

a) a primary area which extends laterally 4.6 km (2.5 NM) on each side of the track; and

b) a secondary area which adds an additional 4.6 km (2.5 NM) on each side of the primary area.

2.2.6 Intermediate approach

In a straight-in approach, the width of the intermediate approach segment tapers from a maximum width of ±9.2 km (±5 NM) at the intermediate fix (IF) to its minimum width at the final approach fix (FAF) (or (FAP)). The segment is divided laterally as follows:

a) a primary area which extends laterally on each side of the track; and

b) a secondary area on each side of the primary area.

2.2.7 PBN fix tolerances and protected areas

2.2.7.1 The obstacle clearance area for PBN is based on the total system error (TSE) which is dependent upon position estimation error (PEE), path definition error (PDE), display error and flight technical error (FTE). The PBN protected areas are based upon calculations considering the following elements.

Note.— For a description of error as related to performance-based navigation, see the Performance-based Navigation (PBN) Manual *(Doc 9613).*

2.2.7.1.1 *Cross-track tolerance (XTT)*

A fix tolerance measured perpendicularly to the nominal track resulting from the airborne and ground equipment tolerances and the flight technical error (FTE).

2.2.7.1.2 *Along-track tolerance (ATT)*

A fix tolerance measured along the nominal track resulting from the airborne and ground equipment tolerances. See Figure A-2-4 for graphical depiction of XTT and ATT.

2.2.7.1.3 The TSE is then used to define the XTT and ATT values as follows:

a) XTT = TSE

b) ATT = 0.8*TSE

2.2.7.2 For PBN procedures, the width of the area is defined based on the required navigation performance (RNP) navigation accuracy requirement of the associated navigation specification, plus a buffer value (see 2.2.7.3).

2.2.7.2.1 Specifically, the semi-width (½ A/W) of the area is:

½ A/W = 1.5 x RNP navigation accuracy requirement + buffer value

2.2.7.2.2 Since the required accuracy figures are constant, there is no splay associated with the area width of a PBN route or procedure segment.

2.2.7.2.3 Figure A-2-5 shows an example of the area associated with a PBN procedure based on:

a) RNP 1 navigation specification; and

b) STAR route between 56 km (30 NM) and 28 km (15 NM) from the aerodrome reference point (ARP).

This results in a ½ A/W of (1.5 x 1) + 1 = 2.5 NM.

2.2.7.2.4 The ½ A/W value calculated in this way is used in all PBN procedures except RNP AR procedures and final approach segments (FAS) of RNP APCH procedures based on the use of satellite-based augmentation system (SBAS) (SBAS approach procedure with vertical guidance (APV)-I, SBAS CAT I and SBAS non-precision approach (NPA)). The buffer value is based on aircraft characteristics (speed, manoeuvrability, etc.) and the phase of flight and is used to address blunder errors beyond a 3 standard deviation value. Buffer values do not apply to the FAS of approach procedures based on the use of SBAS.

Note.— For the full list of calculated ½ A/W, see PANS-OPS, Volume II, Part III, Section 1, Chapter 2, Tables III-1-2-1 to III-1-2-22.

2.2.7.3 *Buffer values.* Buffer values for phase of flight are presented in Table A-2-3.

Note.— Helicopter only procedures use different buffer values.

Table A-2-3. Buffer values (BV) for phase of flight

Phase of flight	*En route*	*Terminal*	*FAS*	*Missed approach*
Application	Standard instrument departures (SIDs) and STARs greater than or equal to 56 km (30 NM) from departure or destination ARP	STARS, initial and intermediate segments less than 56 km (30 NM) from ARP and SIDs and missed approach segments less than 56 km (30 NM) from ARP but more than 28 km (15 NM) from ARP	—	Missed approach segments and SIDs up to 28 km (15 NM) from the ARP
BV for CAT A-E	3 7604 m (2.0 NM)	1 852 m (1.0 NM)	926 m (0.5 NM)	926 m (0.5 NM)

2.2.7.4 *XTT and ½ A/W values for phases of flight.* For PBN operations, values of XTT are assigned based on the phase of flight and the applicable navigation specifications to that phase of flight. Tables A-2-4 and A-2-7 present the XTT values for the phase of flight and applicable navigation specifications. A blank (—) cell in the table indicates the navigation specification is not applicable to that phase of flight. Tables A-2-5 and A-2-8 depict the ½ A/W values for the various flight phases and applicable navigation specifications.

Note.— The identification of applicable navigation specifications for a given phase of flight can be found in Doc 9613, Table II-A-1-1.

Table A-2-4. Navigation specification and phase of flight XTT fix tolerances (NM)

Navigation specification	*Phase of flight*					
	En route/SID/STAR (≥30 NM from ARP)	*STAR/IF/IAF/SID/ missed approach (<30 NM from ARP)*	*FAF*	*MAPt*	*Missed approach (<15 NM ARP)*	*SID (<15 NM ARP)*
RNAV 1/RNAV 2[1]	2.00	1.00	—	—	1.00	1.00
RNP 2	2.00	—	—	—	—	—
RNP 1	1.00 (SID/STAR)	1.00	—	—	1.00	1.00
RNP APCH	—	1.00	0.3[2]/ 0.0216[3]	0.32[2]/ 0.0216[3]	1.00	—
A-RNP[4]	2.00 or 1.00	1.00	0.3	0.3	1.00	1.00
RNP 0.3[5]	0.30	0.30	—	—	0.30	0.30

1. RNAV 2 is intended for use outside of the terminal control area (TMA), and RNAV 1 for TMA applications.
2. RNP APCH Section A (LNAV/VNAV) only.
3. RNP APCH Section B (LP/LPV) only.
4. A-RNP permits a range of scalable navigation accuracy requirements, as detailed in Doc 9613. However, PANS-OPS, Volume II, contains only criteria for 1 NM accuracy values, so for consistency this is the only value presented here.
5. Intended for helicopter operations only.

Table A-2-5. Navigation specification and phase of flight ½ A/W (NM)

Navigation specification	*Phase of flight*					
	En route/SID/STAR (≥30 NM from ARP)	*STAR/IF/IAF/SID/ missed approach (<30 NM from ARP)*	*FAF*	*MAPt*	*Missed approach (<15 NM ARP)*	*SID (<15 NM ARP)*
RNAV 1/RNAV 2[1]	5.00	2.50	—	—	2.00	2.00
RNP 2	5.00	—	—	—	—	—
RNP 1	3.50 (SID/STAR)	2.50	—	—	2.00	2.00
RNP APCH	—	2.50 (IF/IAF/missed approach only)	1.45[2]/ N/A[3]	0.95[2]/ N/A[3]	2.00	—
A-RNP[4]	5.00 or 3.50	2.50	1.45	0.95	2.00	2.00
RNP 0.3[5]	1.45	1.15	—	—	0.80	0.80

1. RNAV 2 is intended for use outside of the TMA, and RNAV 1 for TMA applications.
2. RNP APCH Section A (LNAV/VNAV) only.
3. RNP APCH Section B (LP/LPV) only.
4. A-RNP permits a range of scalable navigation accuracy requirements, as detailed in Doc 9613. However, PANS-OPS, Volume II, contains only criteria for 1 NM accuracy values, so for consistency this is the only value presented here.
5. Intended for helicopter operations only.

2.2.7.4.1 RNAV 1 criteria are used for SIDs and STARs that can be supported by either global navigation satellite system (GNSS) or DME/DME infrastructure.

2.2.7.4.2 RNP 1 criteria are used for SIDs and STARs using GNSS as the primary navigation sensor.

2.2.7.4.3 RNP APCH criteria are divided into two sections. Section A criteria, which are used for RNAV (GNSS) instrument approach procedures, are applied only within 56 km (30 NM) of the destination ARP. Outside this distance either RNAV 1 or RNP 1 criteria are used unless otherwise specified. For Section A criteria, the XTT at both the FAF and MAPt is 556 m (0.3 NM). Additionally, Section A ½ A/W criteria taper from ±2 685 m (1.45 NM) at the FAF to ±1 759 m (0.95 NM) at the MAPt.

2.2.7.4.4 Criteria associated with RNP APCH Section B are applicable to approach procedures based on the use of SBAS. Section B criteria capture the benefits of angular guidance on the FAS. The XTT value at the FAF and MAPt is 40.0 m. The final approach ½ A/W values at the FAF are dependent on the length of the FAS.

2.2.7.4.5 *Area width for CAT H.* Because of the flight characteristics of helicopters there are slight reductions in the ½ A/W values for arrival, approach and departure phases of flight when certain navigation specifications are used to design the procedure. The reduction is in the buffer values used to calculate the ½ A/W:

a) for en-route and SIDs/STARs >56 km (30 NM) from the ARP, the buffer value is 1 852 m (1.0 NM);

b) in the TMA the buffer value is 1 296 m (0.7 NM); and

c) for the final segment the buffer value is 648 m (0.35 NM).

2.2.7.4.6 Tables A-2-6 and A-2-9 identify ½ A/W values for CAT H that are different from those depicted in Table A-2-5.

Table A-2-6. Navigation specification and phase of flight ½ A/W (NM) (CAT H)

Navigation specification	*Phase of flight*					
	En route/SID/STAR (≥30 NM from ARP)	*STAR/IF/IAF/SID/ missed approach (<30 NM from ARP)*	*FAF*	*MAPt*	*Missed approach (<15 NM ARP)*	*SID (<15 NM ARP)*
RNAV 1/RNAV 2[1]	4.00	2.20	—	—	1.85	1.85
RNP 1	2.50 (SID/STAR)	2.20	—	—	1.85	1.85
RNP APCH	—	2.20 (IF/IAF/missed approach only)	1.15[2]/ N/A[3]	0.80[2]/ N/A[3]	1.85	—

1. RNAV 2 is intended for use outside of the TMA and RNAV 1 for TMA applications.
2. RNP APCH Section A (LNAV/VNAV) only.
3. RNP APCH Section B (LP/LPV) only.

Table A-2-7 Navigation specification and phase of flight XTT fix tolerances (m)

Navigation specification	*Phase of flight*					
	En route/SID/STAR (≥56 km from ARP)	*STAR/IF/IAF/SID/ missed approach (<56 km from ARP)*	*FAF*	*MAPt*	*Missed approach (<28 km ARP)*	*SID (<28 km ARP)*
RNAV 1/RNAV 2[1]	3 704	1 852	—	—	1 852	1 852
RNP 2	3 704	—	—	—	—	—
RNP 1	1 852 (SID/STAR)	1 852	—	—	1 852	1 852
RNP APCH	—	1 852	556[2]/ 40 m[3]	556[2]/ 40 m[3]	1 852	—
A-RNP[4]	3 704 or 1 852	1 852	556	556	1 852	1 852
RNP 0.3[5]	556	556	—	—	556	556

1. RNAV 2 is intended for use outside of the TMA, and RNAV 1 for TMA applications.
2. RNP APCH Section A (LNAV/VNAV) only.
3. RNP APCH Section B (LP/LPV) only.
4. A-RNP permits a range of scalable navigation accuracy requirements, as detailed in Doc 9613. However, PANS-OPS, Volume II, contains only criteria for 1 NM accuracy values so for consistency this is the only value presented here.
5. Intended for helicopter operations only.

Table A-2-8. Navigation specification and phase of flight ½ A/W (m)

Navigation specification	*Phase of flight*					
	En route/SID/STAR (≥56 km from ARP)	*STAR/IF/IAF/SID/ missed approach (<56 km from ARP)*	*FAF*	*MAPt*	*Missed approach (<28 km ARP)*	*SID (<28 km ARP)*
RNAV 1/RNAV 2[1]	9 260	4 630	—	—	3 704	3 704
RNP 2	9 260	—	—	—	—	—
RNP 1	6 482 (SID/STAR)	4 630	—	—	3 704	3 704
RNP APCH	—	4 630 (IF/IAF/missed approach only)	2 685[2]/ N/A[3]	1 759[2]/ N/A[3]	3 704	—
A-RNP[4]	9 260 or 6 482	4 630	2 685	1 759	3 704	3 704
RNP 0.3[5]	2 685	2 130	—	—	1 482	1 482

1. RNAV 2 is intended for use outside of the TMA, and RNAV 1 for TMA applications.
2. RNP APCH Section A (LNAV/VNAV) only.
3. RNP APCH Section B (LP/LPV) only.
4. A-RNP permits a range of scalable navigation accuracy requirements, as detailed in Doc 9613. However, PANS-OPS, Volume II, contains only criteria for 1 NM accuracy values so for consistency this is the only value presented here.
5. Intended for helicopter operations only.

Table A-2-9 Navigation specification and phase of flight ½ A/W (m) (CAT H)

Navigation specification	*Phase of flight*					
	En route/SID/STAR (≥56 km from ARP)	*STAR/IF/IAF/SID/ missed approach (<56 km from ARP)*	*FAF*	*MAPt*	*Missed approach (<28 km ARP)*	*SID (<28 km ARP)*
RNAV 1/RNAV 2[1]	7 400	4 074	—	—	3 426	3 426
RNP 1	4 630 (SID/STAR)	4 074	—	—	3 426	3 426
RNP APCH	—	4 074 (IF/IAF/missed approach only)	2 130[2]/ N/A[3]	1 482[2]/ N/A[3]	3 426	—

1. RNAV 2 is intended for use outside of the TMA, and RNAV 1 for TMA applications.
2. RNP APCH Section A (LNAV/VNAV) only.
3. RNP APCH Section B (LP/LPV) only.

2.3 TURN AREA CONSTRUCTION

2.3.1 General

A turning point may be specified in any of three ways. (See Part II, Section 1, 1.5 for a description.)

2.3.2 Turn parameters

The turn area is defined by a number of parameters, these include:

a) altitude;

b) indicated airspeed (IAS);

c) wind;

d) bank angle (α);

e) flight technical tolerances;

f) fix tolerance (see section 1 of this appendix); and

g) rate of turn (R) in degrees/second.

2.3.3 Calculation of the protection area for turns

2.3.3.1 As with any turning manoeuvre, speed is a controlling factor in determining the aircraft track during the turn.

2.3.3.1.1 *Inner boundary*

The inner boundary caters for the slowest aircraft. It starts at the earliest fix tolerance of the turning point and splays outward at an angle of 15º relative to the nominal track.

2.3.3.1.2 *Outer boundary*

The outer boundary of the turning area is based on the highest speed of the category for which the procedure is authorized.

2.3.3.1.3 The protection area starts at a point which is determined by the latest fix tolerance (See section 1 of this appendix) and discussion of FTE.

2.3.3.1.4 There are two methods for constructing the curving portion of the outer boundary.

2.3.3.1.4.1 *Wind spirals.* In the wind spiral method, the area is based on a radius of turn (r) calculated for a specific value of TAS and bank angle. The outer boundary of the turn area is constructed using a spiral derived from the still air radius (r). The resultant spiral is created from applying wind effect for the time taken to change heading by the specified amount for the turn.

2.3.3.1.4.2 *Bounding circles.* As an alternative to the wind spiral, a simplified method can be used in which circles are drawn to bound the turning area. Unlike the wind spiral method, the wind effect used here is always that of a course change of 90°. The area so constructed is larger and therefore, more conservative.

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

4. PERFORMANCE-BASED NAVIGATION — PATH TERMINATORS

2.4.1 General

2.4.1.1 All data used by a navigation system for PBN that is certified for terminal operations are held in a navigation database. These databases are derived from data that is coded in accordance with the aviation industry standard: ARINC 424 — *Navigation System Database Specification*, or an equivalent industry standard.

2.4.1.2 In order to achieve the translation of the textual description of a procedure, and the routes depicted on the charts into a code suitable for navigation systems, the aviation industry has developed the "path and termination" concept for terminal procedures.

2.4.1.3 The path terminators are described in detail in PANS-OPS, Volume II, Part III, Section 2, Chapter 5. They are used to define specific ground tracks on the assumption that aircraft approved to fly PBN procedures have the capability to maintain consistent tracks based upon the use of appropriate ARINC 424 path terminators or their equivalent.

2.4.1.4 Path terminators define each segment of a PBN route from take-off until the en-route segment is joined, and from the point where the aircraft leaves the en-route segment until the end of the PBN procedure(s).

2.4.1.5 Path terminators are not used to construct en-route segments or other routes outside terminal airspace.

2.4.1.6 Many aircraft are equipped with systems that are only capable of using a subset of the available ARINC 424 path terminators.

2.4.2 Path and terminator combinations

2.4.2.1 Each segment of the procedure is identified by a two-letter code which denotes the path and terminator for the segment. These codes are shown in Table A-2-10.

Table A-2-10. Path and terminator codes

Path	*Code*	*Terminator*	*Code*
Course to	C	Altitude	A
Direct track	D	Fix	F
Fix to	F	Intercept	I
Hold	H	Manual termination	M
Initial	I		
Constant radius	R		
Track between	T		
Heading to	V		

2.4.2.2 Combining these two elements creates a set of leg types for use in procedure design. For example, a CA leg is one where a specified course (C) is followed until reaching a defined altitude (A).

2.4.2.3 The minimum PBN leg type requirements for each navigation specification can be found in Doc 9613.

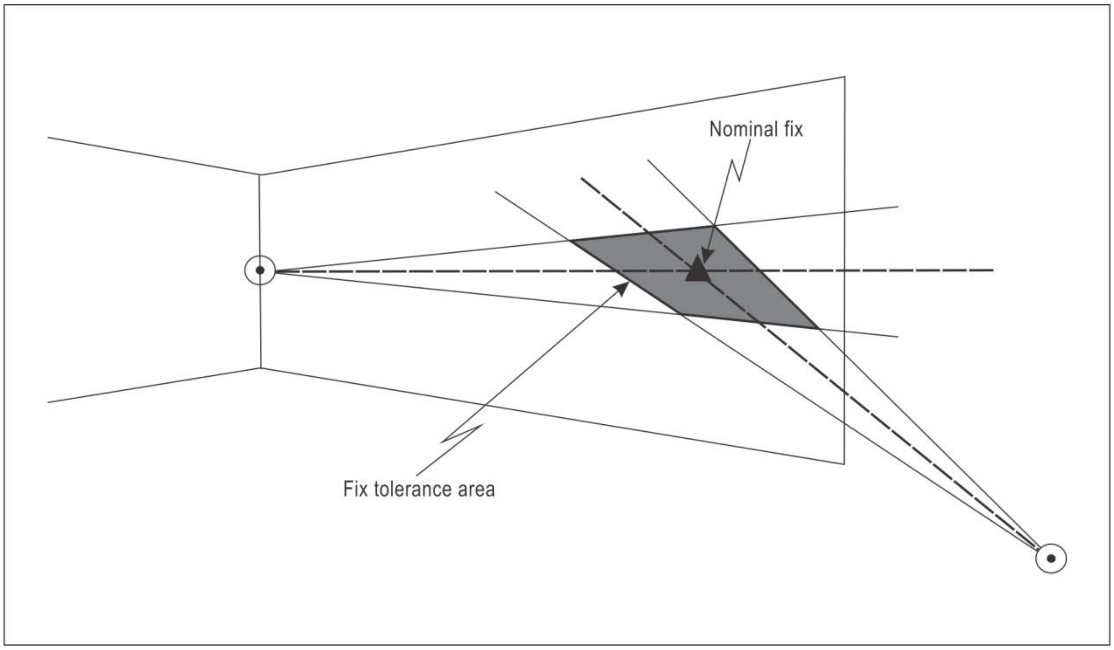
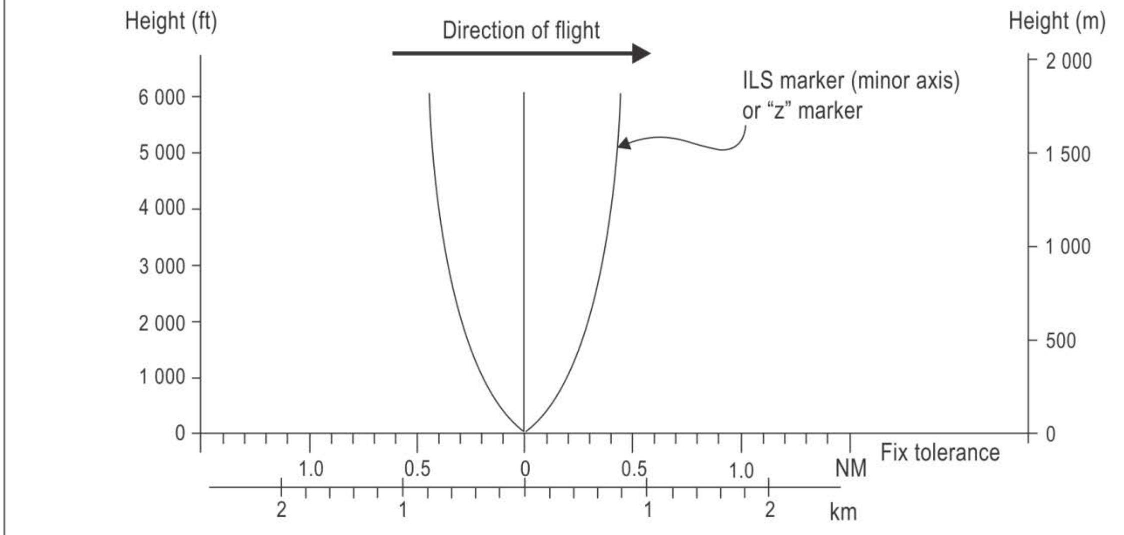


Figure A-2-1. Example of a fix tolerance area



Note.— This figure is based on the use of modern aircraft antenna systems with a receiver sensitivity setting of 1 000 µV up to 1 800 m (5 905 ft) above the facility.

Figure A-2-2. ILS or "z" marker coverage

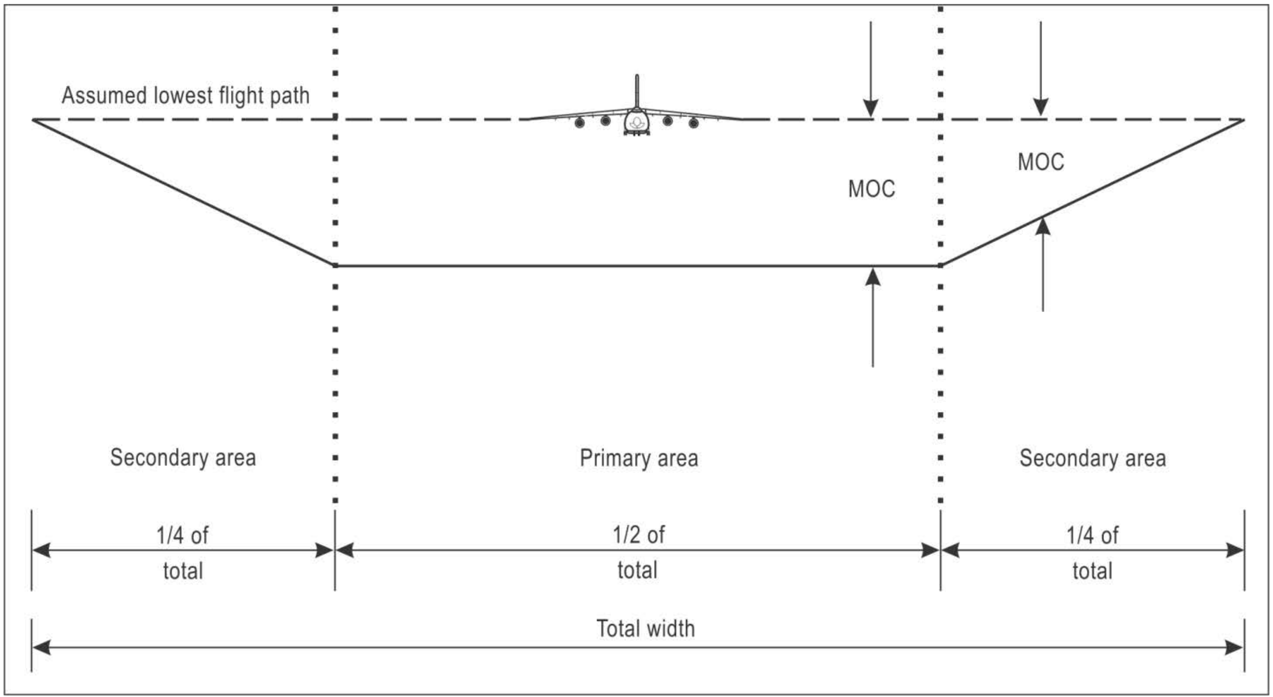


Figure A-2-3. Primary and secondary areas of a segment

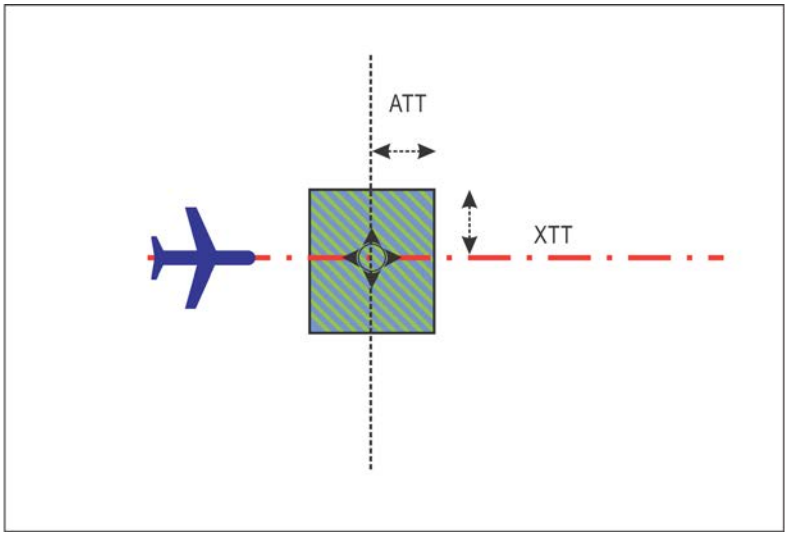


Figure A-2-4. Orientation of ATT and XTT relative to the intended flight path

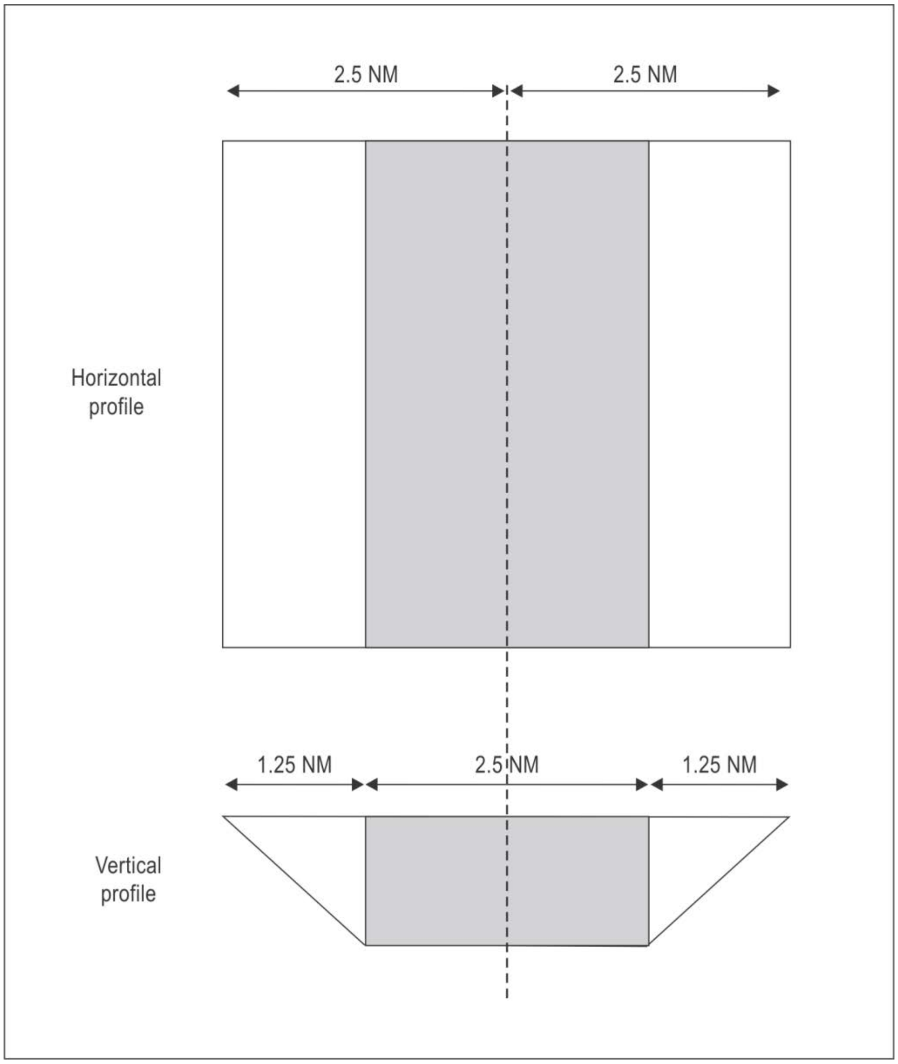


Figure A-2-5. Area width for an RNP 1 STAR between 15 NM and 30 NM from the ARP

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Section 3

FLIGHT PHASE SPECIFIC PRINCIPLES

3.1 DEPARTURE PROCEDURES

3.1.1 Procedure design gradient (PDG)

3.1.1.1 The PDG is used by the procedure designer to identify critical obstacles in the departure and to specify a minimum climb gradient for the procedure. The departure route may be adjusted to minimize the PDG consistent with other constraints.

3.1.1.2 Unless otherwise published, a PDG of 3.3 per cent (5.0 per cent for CAT H) is assumed.

3.1.1.3 The PDG is based on:

a) an obstacle identification surface (OIS) having a 2.5 per cent gradient (4.2 per cent for CAT H) or a gradient determined by the most critical obstacle penetrating the surface, whichever is the higher; and

b) an additional margin of 0.8 per cent.

3.1.1.4 For conversion of climb gradients to rates of climb for operational use, see Part II, Section 2, Chapter 1, Figure II-2-1-2.

3.1.2 Obstacle clearance

3.1.2.1 For other than turning departures and CAT H point-in-space (PinS) departures, the MOC provided by the procedure is determined as a factor of the distance from the departure end of the runway (DER).

3.1.2.2 A figure of 0.8 per cent of this distance is used to calculate the MOC. Some example values are shown in Tables A-3-1 and A-3-2.

Table A-3-1. Departure MOC for given distance from DER

Distance from DER (NM)	*Dist. from DER (ft)*	*MOC (ft)*
0	0	0
1	6 076	49
2	12 152	97
3	18 228	146
4	24 304	194
5	30 380	243
10	60 760	486
21	127 596	1 021

Table A-3-2. Departure MOC for given distance from DER (SI Units)

Distance from DER (km)	*MOC (m)*
0	0
2	16
4	32
6	48
8	64
10	80
20	160
40	320

1.2.3 The MOC in a turning departure is a fixed value of 75 m (246 ft) (for CAT H, 65 m (213 ft)).

1.2.4 CAT H PinS departures are based on visual or visual flight rules (VFR) flight to the initial departure fix (IDF), so no MOC is provided in this segment. For "proceed visually" PinS departures, the visual segment design gradient (VSDG) is established to provide a MOC of 30 m at the IDF. The MOC continues to expand with distance.

3.2 EN ROUTE

3.2.1 General

3.2.1.1 Two methods can be used to determine en-route obstacle clearance areas:

a) a simplified method, which is the standard method; and

b) a refined method, which can be used when the simplified method is too constraining.

3.2.1.2 Obstacle clearance areas

In the simplified method, the obstacle clearance area is divided into a central primary area and two lateral buffer areas, which use half the MOC value. In the refined method, the obstacle clearance area is divided into a central primary area and two lateral secondary areas, which use the progressively reducing MOC. The width of the primary area corresponds to 95 per cent probability of containment (2 SD). The total width of the area corresponds to 99.7 per cent probability of containment (3 SD).

3.2.1.3 Reductions to secondary area widths

Secondary areas for en-route operations may be reduced when justified by factors such as:

a) relevant information on flight operational experience;

b) regular flight inspection of facilities to ensure better than standard signals; and/or

c) surveillance.

3.2.1.4 Minimum obstacle clearance (MOC)

3.2.1.4.1 The MOC value to be applied in the primary area for the en-route phase of an instrument flight rules (IFR) flight is 300 m (984 ft). (See 3.2.4 for MOC in mountainous areas). In the buffer area, the MOC is equal to half the value of the primary area MOC (see Figure A-3-1). In secondary areas the MOC progressively reduces to zero at the outer edge.

3.2.1.4.2 A minimum obstacle clearance altitude (MOCA) is determined and published for each segment of the route. The MOCA provides the required MOC above obstacles contained inside the obstacle clearance areas.

3.2.2 En-route clearance areas — conventional routes

3.2.2.1 Area without track guidance

When track guidance is not provided, for example, outside the coverage of navigation facilities along the route, the primary area splays at an angle of 15° from its width at the last point where track guidance was available. The width of the buffer area (simplified method) or the secondary area (refined method) is progressively reduced to zero, ending in an area without track guidance where the full MOC is applied.

3.2.2.2 Area width

3.2.2.2.1 Abeam the facility, the total area has a constant width of 18.5 km (10.0 NM), which is comprised of the primary area and a buffer area. The primary area maintains a constant width of 9.3 km (5.0 NM) on either side of the nominal track. The buffer area also maintains a constant width of 9.3 km (5.0 NM) with half of this area on either side of the primary area.

3.2.2.2.2 When the distance from the facility increases beyond:

a) 92.3 km (49.8 NM) for very high frequency omnidirectional radio range (VOR); and

b) 60 km (32 NM) for non-directional beacon (NDB),

the widths of the primary and buffer areas are increased by an angle of splay which is determined by the type of facility. The angle of splay is depicted in Table A-3-3.

Table A-3-3. Angle of splay for en-route navigation aids

	Primary area	*Buffer area*
VOR	5.7°	9.1°
NDB	7.95°	13.0°

Note.— The area widths and splay angles outlined in 3.2.2.2.1 and 3.2.2.2.2 apply to the simplified method. For the refined method, the VOR widths are 2 NM less and angles for both VOR and NDB are slightly larger.

3.2.2.2.3 The buffer area is further increased by an additional fixed width on the outside of the buffer area, parallel to its edge. This width is:

a) 3.7 km (2.0 NM) for VOR; and

b) 4.6 km (2.5 NM) for NDB.

3.2.3 En-route clearance areas — PBN routes

3.2.3.1 En-route oceanic and remote areas. The applicable navigation specifications are:

a) RNAV 10;

b) RNP 4;

c) RNP 2;

d) A-RNP.

3.2.3.2 The clearance area ½ A/W established by the formula:

½ A/W = 1.5 x navigation specification navigation accuracy requirement + en-route buffer value of 2 NM.

Note.— In some cases, such as RNAV 5, a smaller value than the required accuracy of the navigation specification is used, depending on the nature of the errors and the integrity monitoring alarm limit of the system.

3.2.3.3 Table A-3-4 presents the applicable navigation accuracy requirements and clearance ½ A/W.

Table A-3-4. En-route oceanic/remote ½ A/W

Navigation specification	*Accuracy requirement (NM)*	*½ A/W (NM)*
RNAV 10	10	17
RNP 4	4	8
RNP 2	2	5

3.2.3.4 *En-route continental areas.* The applicable navigation specifications are:

a) RNAV 5;

b) RNAV 2;

c) RNP 2;

d) A-RNP;

e) RNP 0.3.

3.2.3.5 Table A-3-5 depicts the en-route continental clearance area ½ A/W for area navigation routes.

Table A-3-5. En-route continental ½ A/W

Navigation specification	*Accuracy requirement (NM)*	*½ A/W (NM)*
RNAV 5	5	5.77[1]
RNAV 2 (GNSS)	2	5
RNAV 2 (DME/DME)	2	4.26
RNP 2	2	5
RNP 0.3	0.3	1.45

1. This figure is calculated using 2.51 NM instead of 5 NM.

3.2.4 MOC in mountainous areas

3.2.4.1 In mountainous areas, the MOC is increased, depending on variation in terrain elevation as shown in the Table A-3-6.

Table A-3-6. MOC in mountainous areas

Elevation	*MOC*
Between 900 m (3 000 ft) and 1 500 m (5 000 ft)	450 m (1 476 ft)
Greater than 1 500 m (5 000 ft)	600 m (1 969 ft)

3.2.4.2 Mountainous areas are identified by the State and promulgated in the State Aeronautical Information Publication.

3.3 ARRIVAL AND APPROACH PROCEDURES

3.3.1 Categories of aircraft

3.3.1.1 Aircraft performance has a direct effect on the airspace required for the various manoeuvres associated with the conduct of instrument approach procedures. The most significant performance factor is aircraft speed.

3.3.1.2 Accordingly, categories of typical aircraft have been established. These categories provide a standardized basis for relating aircraft manoeuvrability to specific instrument approach procedures. For precision approach procedures, the dimensions of the aircraft are also a factor for the calculation of the obstacle clearance height (OCH). For Category D_L aircraft, an additional obstacle clearance altitude/height (OCA/H) is provided, when necessary, to take into account the specific dimensions of these aircraft.

3.3.1.3 The criterion taken into consideration for the classification of aeroplanes by categories is the indicated airspeed at threshold (V_{at}), which is equal to the stall speed V_{so} multiplied by 1.3, or stall speed V_{s1g} multiplied by 1.23 in the landing configuration at the maximum certificated landing mass. If both V_{so} and V_{s1g} are available, the higher resulting V_{at} shall be applied.

3.3.1.4 The landing configuration that is to be taken into consideration is defined by the operator or by the aircraft manufacturer.

3.3.1.5 Aircraft categories are listed in Part II, Section 5, Chapter 1.

3.3.1.6 The instrument approach chart (IAC) will specify the individual categories of aircraft for which the procedure is approved. Normally, procedures will be designed to provide protected airspace and obstacle clearance for aircraft up to and including Category D. However, where airspace requirements are critical, procedures may be restricted to lower speed categories.

3.3.1.7 Alternatively, the procedure may specify a maximum IAS for a particular segment. In any case, it is essential that pilots comply with the procedures and information depicted on instrument flight charts and the appropriate flight parameters shown in Tables II-5-1-1 and II-5-1-2 if the aircraft is to remain in the areas developed for obstacle clearance purposes.

3.3.1.8 Helicopters

3.3.1.8.1 The stall speed method of calculating aircraft category does not apply to helicopters. Pilots flying helicopters may utilize instrument approach procedures promulgated for Category A aeroplanes. However, specific procedures may be developed for helicopters, and these shall be clearly designated "CAT H". Category H procedures shall not be promulgated on the same IAC as joint helicopter/aeroplane procedures.

3.3.1.8.2 It is intended that helicopter only procedures should be designed using the same conventional techniques and practices as those pertaining to Category A aeroplanes. Some criteria such as minimum airspeeds and descent gradients may be different, but the principles are the same. For CAT H procedures, the maximum speed to be used on the final approach and missed approach segments is charted.

3.3.2 Descent gradient

3.3.2.1 In instrument approach procedure design, adequate space is allowed for descent from the facility, fix or waypoint crossing altitude/height to the runway threshold for straight-in approach or to OCA/H for circling approaches.

3.3.2.2 Adequate space for descent is provided by establishing a maximum allowable descent gradient for each segment of the procedure. The optimum descent gradient/angle in the FAS of a procedure with FAF is 5.2 per cent/3.0° (52 m/km (318 ft/NM)).

3.3.2.3 Where a steeper descent gradient is necessary, the maximum permissible is:

a) 6.5 per cent/3.7° (65 m/km (395 ft/NM)) for Category A and B aircraft;

b) 6.1 per cent/3.5° (61 m/km (370 ft/NM)) for Category C, D and E aircraft, and

c) 10 per cent (5.7°) for Category H.

3.3.2.4 For procedures with VOR or NDB on aerodrome and no FAF, rates of descent in the final approach phase are given in Table A-3-7. In the case of a precision approach, the operationally preferred glide path angle is 3.0° as specified in Annex 10, Volume I.

3.3.2.5 For ILS, the minimum descent gradient is 2.5°.

Table A-3-7. Rate of descent in the FAS of a procedure with no FAF

Aircraft categories	*Rate of descent*	
	Minimum	*Maximum*
A, B	2 m/s (394 ft/min)	3.33 m/s (655 ft/min)
C, D, E	3 m/s (590 ft/min)	5.08 m/s (1 000 ft/min)

3.3.3 RNP APCH "Y" and "T" bar construction

3.3.3.1 *Offset IAFs.* Offset IAFs in procedures based on the "Y" or "T" bar design concept for RNP APCH procedures are aligned such that a course change of 70° to 90° is required at the IF. A capture region is associated with each IAF of the RNP APCH procedure from which the aircraft will enter the procedure. The capture region for tracks inbound to the offset IAFs extends 180° about the IAFs, thus providing a Sector 3 entry in cases where the track change at the IF is 70°. The central IAF is aligned with the intermediate segment, the angle being identical to the track change at the IF for the corresponding offset IAF. In this way, there are no gaps between the capture regions of all IAFs regardless of the course change at the IF. Its capture region is 70° to 90° either side of the final track. For turns greater than 110° at the IAFs, Sector 1 or 2 entries should be used.

3.3.3.2 The initial approach segments have no maximum length. The optimum length is 9.3 km (5.0 NM). The minimum segment length is established by using the highest initial approach speed of the fastest category of aircraft for which the approach is designed and the minimum distance between waypoints required by the aircraft avionics in order to correctly sequence the waypoints.

3.3.4 Minimum obstacle clearance (MOC)

3.3.4.1 Minimum sector altitudes (MSAs)

3.3.4.1.1 MSAs are established for each aerodrome where instrument approach procedures have been established. Each MSA is calculated by:

a) taking the highest elevation in the sector concerned;

b) adding a clearance of at least 300 m (984 ft); and

c) rounding the resulting value up to the next higher 50-m or 100-ft increment, as appropriate.

3.3.4.1.2 If the difference between sector altitudes is insignificant (i.e. in the order of 100 m or 300 ft as appropriate) a minimum altitude applicable to all sectors may be established.

3.3.4.1.3 A minimum altitude shall apply within a radius of 46 km (25 NM) of the significant point, the ARP, or the heliport reference point (HRP) on which the instrument approach is based. The MOC when flying over mountainous areas should be increased by as much as 300 m (984 ft).

3.3.4.1.4 Obstacles within a buffer zone of 9 km (5 NM) around the boundaries of any given sector shall be considered as well.

3.3.4.2 Initial and intermediate segments

3.3.4.2.1 MOC for the initial segment of an approach is 300 m (984 ft).

3.3.4.2.2 MOC for the intermediate segment of an approach is 150 m (492 ft). The altitudes/heights selected by application of the obstacle clearance specified shall be rounded upwards to the next 50 m or 100 ft, as appropriate

3.3.4.3 Non-precision approaches (NPAs)

3.3.4.3.1 For an NPA with a FAF, a minimum of 75 m (246 ft) clearance is provided

3.3.4.3.2 For an NPA without a FAF this figure is increased to 90 m (295 ft).

3.3.4.4 Approach with vertical guidance (APV) approaches

3.3.4.4.1 *General.* APV approaches are 3D approach operations. Criteria for these procedures support stabilized flight on FAS. APV procedures are based on equipment that does not meet the requirements for precision approaches.

3.3.4.4.2 *Obstacle clearance criteria.* There are two different sets of criteria used for APV procedure design (APV/barometric vertical navigation (baro-VNAV) and SBAS APV-I criteria). Each set of criteria was prepared to address a specific section of the RNP APCH navigation specification, as described in Doc 9613.

3.3.4.4.2.1 APV/baro-VNAV criteria are designed to address procedure construction in accordance with Doc 9613, specifically Section A of the RNP APCH navigation specification, coupled with baro-VNAV vertical guidance as described in Attachment A of Doc 9613.

3.3.4.4.2.2 SBAS APV-I criteria were developed to meet the requirements of Section B of the RNP APCH navigation specification.

3.3.4.4.3 *Criteria differences.* Procedure construction for Section A procedures provides obstacle protection within a maximum-to-minimum temperature band published on the approach chart. The use of a remote altimeter setting source is not permitted with LNAV/VNAV procedures utilizing baro-VNAV vertical guidance. Procedure construction is based on the linear navigation guidance provide by GNSS/baro-VNAV equipment.

3.3.4.4.3.1 Procedure construction for Section B procedures utilizes criteria that cater to the angular lateral and vertical guidance on the FAS provided by SBAS equipment. Since barometric altimetry input is not used in generating vertical guidance with SBAS, there are no temperature restrictions or remote altimeter setting source restrictions with the SBAS criteria.

3.3.4.4.4 The minimum published decision height (DH) for APV procedures, regardless of the criteria set used, is 75 m (250 ft).

3.3.4.5 Precision approaches

3.3.4.5.1 Precision instrument approach criteria exist for ILS, microwave landing systems (MLS), GBAS landing systems (GLS) and SBAS CAT I.

3.3.4.5.2 Obstacle clearance altitudes for precision approaches can be calculated by a number of different methods. However, all methods use assessment surfaces to discriminate between significant and insignificant obstacles.

3.3.4.5.3 The highest significant obstacle on the approach (or missed approach, converted to an equivalent height) is used to determine the obstacle clearance altitude by adding a height loss margin to its elevation. The margin is dependent on the aircraft category and whether pressure or radio altimetry is used. The values are shown in Table A-3-8.

Table A-3-8. Height loss/altimeter margin for maximum V_{at} by aircraft category

Aircraft category (maximum V_{at})	*Margin using radio altimeter*		*Margin using pressure altimeter*	
	Metres	*Feet*	*Metres*	*Feet*
A — 169 km/h (90 kt)	13	42	40	130
B — 223 km/h (120 kt)	18	59	43	142
C — 260 km/h (140 kt)	22	71	46	150
D — 306 km/h (165 kt)	26	85	49	161
H — 167 km/h (90 kt)	8	25	35	115

Note 1.— CAT H speed is the maximum final approach speed, not V_{at}.

Note 2.— Since height loss varies with speed, the table shows only the calculation for a reference speed, which is the upper limit for each category.

3.3.4.5.4 It should be recognized that no allowance has been included in the table for any abnormal meteorological conditions; for example, wind shear and turbulence.

3.3.4.6 Missed approach — non-precision approach (NPA)

3.3.4.6.1 The beginning MOC on the missed approach is the value used for the final segment of the approach.

3.3.4.6.2 This initial phase continues until the start of climb (SOC); this marks the commencement of the intermediate phase of the missed approach. The SOC is defined by reference to aircraft category missed approach speed, a 10 kt tailwind and assumed delays to cater for pilot reaction time and aircraft configuration changes. No turns are designed prior to the SOC.

3.3.4.6.3 The MOC in the intermediate phase is 30 m (98 ft) when no turns are employed, otherwise 50 m (164 ft). Any track change greater than 15° is defined as a turn.

3.3.4.6.4 The final phase of the missed approach is at the point where a clearance of 50 m (164 ft) can be maintained.

3.3.4.6.5 The missed approach obstacle clearances are shown on Figure A-3-1.

3.3.4.7 Missed approach — precision approach and APV

For precision approaches and APVs, an SOC is not defined. The decision altitude is always established at a level that will accommodate height loss (see Table A-3-8). Therefore, the climb is assumed to commence after the full height loss has occurred. These factors are "worst case" and are subsumed by the design of the procedure's assessment surfaces.

3.3.5 Procedure altitude/height

3.3.5.1 In addition to minimum IFR altitudes established for each segment of the procedure, procedure altitudes/heights will also be provided. Procedure altitudes/heights will, in all cases, be at or above any minimum crossing altitude (MCA) associated with the segment. Procedure altitude/height will be established taking into account the air traffic control needs for that phase of flight.

3.3.5.2 Procedure altitudes/heights are developed to place the aircraft at altitudes/heights that would normally be flown to intercept and fly an optimum 5.2 per cent (3.0°) descent path angle in the FAS to a 15 m (50 ft) threshold crossing for NPA procedures and procedures with vertical guidance. In no case will a procedure altitude/height be lower than any OCA/H.

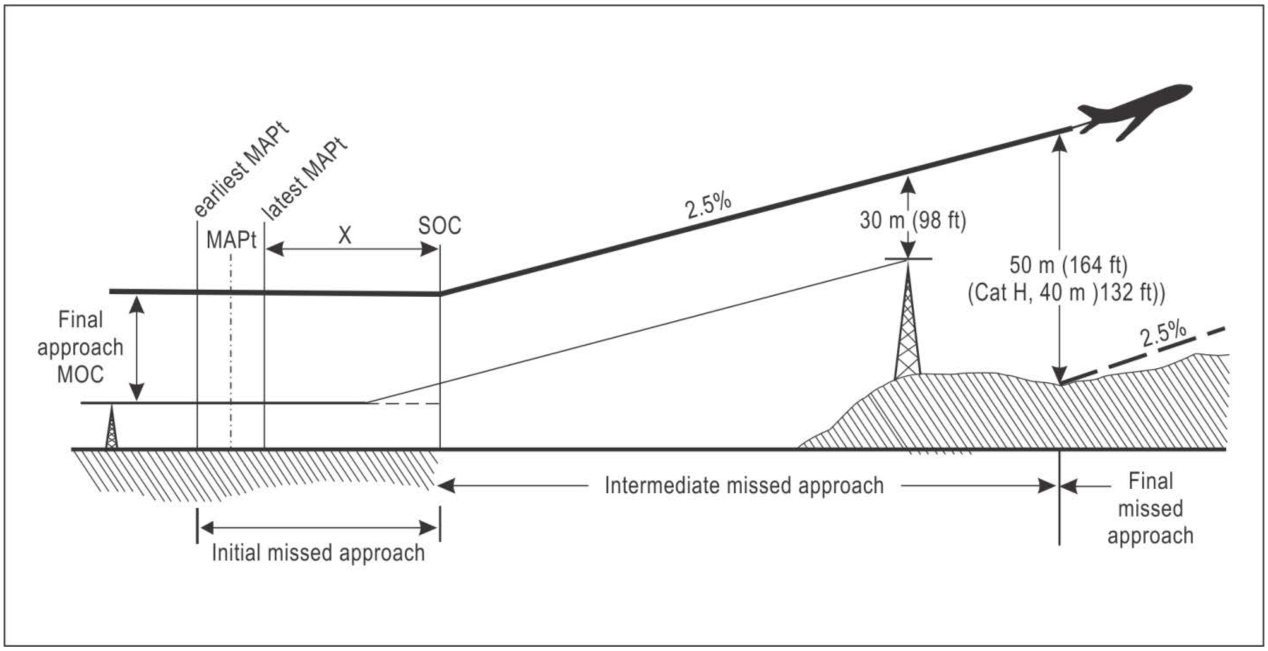


Figure A-3-1. Obstacle clearance in the missed approach

Attachment B

CHART CONTENT, EXAMPLES AND EXPLANATIONS

1. GENERAL

1.1 Depiction of bearings, tracks and radials

1.1.1 All published procedure bearings, tracks and radials are published in degrees magnetic. Radials are identified by prefixing the letter "R" to the magnetic bearing from the facility.

Example: R-027 or R-310

1.1.2 The published radial will be the radial which defines the desired flight track.

1.1.3 In areas of magnetic unreliability (i.e. in the vicinity of the earth's magnetic poles) procedure bearings, tracks and radials may be established in degrees true.

1.2 Charted altitudes/flight level depiction

The following identifies how altitudes/flight levels will be indicated on arrival and departure charts:

Altitude/flight level "window"	$\overline{\text{17 000}}$ $\underline{\text{10 000}}$	$\overline{\text{FL220}}$ $\underline{\text{10 000}}$
"At or above" altitude/flight level	$\underline{\text{7 000}}$	$\underline{\text{FL60}}$
"At or below" altitude/flight level	$\overline{\text{5 000}}$	$\overline{\text{FL50}}$
"Mandatory" altitude/flight level	$\overline{\underline{\text{3 000}}}$	$\overline{\underline{\text{FL30}}}$
"Recommended" procedure altitude/flight level	5 000	FL50
"Expected" altitude/flight level	Expect 5 000	Expect FL50

1.3 Aircraft categories

1.3.1 To allow for the different performance of aircraft, categories have been established. For a description of what these are, see Part II, Section 5, Chapter 1.

1.3.2 Aircraft categories will be referred to throughout this document by their letter designations: CAT A to CAT E (fixed wing) and CAT H (helicopters).

2. DEPARTURE PROCEDURES

2.1 Limitation to certain categories

2.1.1 Departure procedures are designed to accommodate all aircraft categories where possible.

2.1.2 When departures are limited to a particular category(ies) of aircraft, this will be clearly indicated on the chart. (See 1.3, “aircraft categories”, above.)

Example: A depiction of “CAT H” indicates the departure procedure shall only be flown by helicopters.

2.2 Use of altitudes

Departure procedures may use altitudes/flight levels that are not associated with any obstacle clearance requirements but are developed to separate arriving and departing air traffic procedurally.

2.3 Departure climb gradient

2.3.1 The climb gradient required for a departure is determined by obstacles, terrain and environmental conditions.

2.3.2 Departure procedures are designed, where possible, with a standard procedure design gradient (PDG) of 3.3 per cent (CAT H 5.0 per cent). Steeper procedure design gradients may be promulgated when noted on the chart.

2.3.3 Procedures may specify the climb gradient directly. Where this is the case, the pilot can use the diagram provided in Part II, Section 2, Chapter 1 (Figure II-2-1-2) to convert this gradient to a rate of climb.

2.3.4 Where a suitable fix is available, a climb gradient requirement may be described by specifying a distance measuring equipment (DME) distance/altitude or position/altitude restriction.

Example: “reach 5 000 ft by DME 15” or “reach 3 500 ft by VWXYZ”.

2.3.5 When a suitable fix or waypoint is not available, the pilot may be advised directly of the requirements.

Example: “50m/km (300 ft/NM)”

2.3.6 Where a suitably located DME exists or when suitably located area navigation (RNAV) waypoints can be established, an additional table showing specific height/distance information intended for obstacle avoidance may be published in order to provide the pilot with a means of monitoring aircraft position relative to critical obstacles.

2.4 Departure turns

2.4.1 All turns required in the procedure will be clearly described. A turn may be specified at a fix, waypoint, radio navigation facility or an altitude/height.

Example: “at DME 4 turn right, track 170°” or “at 2 500 ft turn left track to VWXYZ”.

2.4.2 When it is necessary, after a turn, to track to intercept a specified radial/bearing, the procedure will specify:

a) the turning point;

b) the track to be made good; and

c) the radial/bearing to be intercepted.

Example: "at DME 4 turn left, track 340° to intercept BNE R020 (VOR)"; or "at DME 2 turn left, track 340° to intercept 010° bearing to STN (NDB)".

2.4.3 For some departures the procedure design is based on the assumption that turns will not commence prior to the departure end of the runway (DER). If this is the case it will be clearly stated on the chart.

2.4.4 There are no provisions for procedure design of turning departures requiring a turn below 120 m (394 ft) above the elevation of the DER (or, in the case of helicopter point-in-space (PinS) departures, 90 m (295 ft) above the heliport reference point (HRP)).

2.5 Omnidirectional departures

2.5.1 At many aerodromes, a departure route is not required for air traffic control (ATC) purposes or to avoid particular obstacles. Nevertheless, there may be obstacles in the vicinity of the aerodrome which affect departures. An omnidirectional departure procedure is a convenient and flexible method of ensuring obstacle clearance. In cases where no track guidance is provided, departure procedures are designed using the omnidirectional method.

2.5.2 Such a departure may, however, have restrictions for specific sectors. An omnidirectional departure that restricts turn altitudes/heights and/or climb gradients to sectors will be published as follows:

a) sectors are described by bearings and distance from the centre of the turn area;

b) sectors may be defined in which flight is not permitted;

c) restrictions will be shown as sectors in which minimum altitudes and minimum turn altitudes/heights are specified or in which minimum climb gradients are required; and

d) when more than one sector is published, the required departure climb gradient for the procedure will be the highest required in any sector that may be entered.

2.6 Designation for standard instrument departure (SID) routes

2.6.1 See Sample Chart 1 for example.

2.6.2 The designation for a SID is constructed using:

a) a basic indicator;

b) a validity indicator;

c) a route indicator, where required;

d) the word "departure" where required; and

e) the word "visual", if the route is established for aircraft or helicopters operating in accordance with visual flight rules (VFR).

2.6.3 The basic indicator used is the name or name-code of the significant point where a standard departure route terminates.

2.6.4 The validity indicator is a number from 1 to 9 which is used to identify versions of the published departure. Whenever a route is amended, a new validity indicator, consisting of the next higher number is assigned. The number "9" is followed by the number "1".

2.6.5 The route indicator is a single letter. The letters "I" and "O" are not used.

2.6.6 Each route is assigned a separate designator.

2.6.7 To distinguish between two or more routes which relate to the same significant point (and therefore are assigned the same basic indicator), a separate route indicator is assigned to each route.

Example 1: BOR 1A (See Sample Chart 1)

Meaning:

The designator identifies a SID route which terminates at the significant point BOORSPIJK (basic indicator).

BOORSPIJK is a radio navigation facility with the identification BOR.

The validity indicator 1 signifies either that the original version of the route is still in effect or that a change has been made from the previous version 9 to the now effective version 1.

The route indicator signifies that more than one route has been established with reference to BOORSPIJK.

Example 2: KODAP 2A (See Sample Chart 1)

Meaning:

This designator identifies a SID route which ends at the significant point KODAP (basic indicator).

KODAP is a significant point not marked by the site of a radio navigation facility and therefore assigned a five-letter pronounceable name-code (5LNC).

The validity indicator 2 signifies that a change has been made from the previous version (1) to the now effective version 2.

The route indicator A identifies one of at least two routes established with reference to KODAP and is a specific character assigned to this route.

3. ARRIVAL PROCEDURES

3.1 General

3.1.1 Standard instrument arrival routes (STARs) are designed to be simple and easily understood, and only those navigation facilities, fixes or waypoints essential to define the flight path of an aircraft and for air traffic services (ATS) purposes are included.

3.2 Limitation to certain categories

3.2.1 Arrival procedures are designed to accommodate all aircraft categories where possible.

3.2.2 When arrivals are limited to a particular category(ies) of aircraft, this will be clearly indicated on the chart. (See 1.3, “aircraft categories”, above.)

Example: A depiction of “CAT H” indicates the arrival procedure shall only be flown by helicopters.

3.3 Designation for standard instrument arrival (STAR) routes

3.3.1 See Sample Chart 2 for example.

3.3.2 The designation for a STAR is constructed using:

a) a basic indicator;

b) a validity indicator;

c) a route indicator, where required;

d) the word “arrival” where required;

e) the word “visual”, if the route is established for aircraft or helicopter operating in accordance with VFR.

3.3.3 The basic indicator used is the name or name-code of the significant point where a standard arrival route commences.

3.3.4 The validity indicator is a number from 1 to 9 which is used to identify versions of the published arrival. Whenever a route is amended, a new validity indicator, consisting of the next higher number, is assigned. The number “9” is followed by the number “1”.

3.3.5 The route indicator is a single letter. The letters “I” and “O” are not used.

3.3.6 Each route is assigned a separate designator.

3.3.7 To distinguish between two or more routes which relate to the same significant point (and therefore are assigned the same basic indicator), a separate route indicator is assigned to each route.

Example 1: OST 1A (See Sample Chart 2)

Meaning:

The designator identifies a STAR route which starts at the significant point OSTO (basic indicator).

OSTO is a radio navigation facility with the identification OST.

The validity indicator 1 signifies either that the original version of the route is still in effect or that a change has been made from the previous version 9 to the now effective version 1.

The route indicator A signifies that more than one route has been established with reference to OSTO.

Example 2: KODAP 2B (See Sample Chart 2)

Meaning:

This designator identifies a STAR route which starts at the significant point KODAP (basic indicator).

KODAP is a significant point not marked by the site of a radio navigation facility and therefore assigned a 5LNC.

The validity indicator 2 signifies that a change has been made from the previous version 1 to the now effective version 2.

The route indicator B identifies one of at least two routes established with reference to BORAP and is a specific character assigned to this route.

4. APPROACH PROCEDURES

4.1 General

A single approach chart may portray more than one approach procedure when the procedures for the intermediate approach, final approach and missed approach segments are identical, except in the case of performance-based navigation (PBN) procedures supported by different navigation specifications for the final approach segment (FAS) (for example, RNP APCH and RNP AR APCH).

4.2 Limitation to certain categories

4.2.1 When necessary, separate procedures will be published for each category of aircraft.

4.2.2 Separate procedures are published when there are differences in:

a) procedure altitudes;

b) timings;

c) tracks; and

d) the procedure to be flown.

4.2.3 For helicopter approach operations, the pilot may use the Category A minima. However, specific procedures may be developed for helicopters and these will be clearly designated “CAT H”. Category H procedures are not promulgated on the same instrument approach chart (IAC) as aeroplane procedures.

4.3 Use of procedure altitudes/heights

4.3.1 The aviation industry has identified that the majority of large aircraft accidents occur when lined up with and within 19 km (10 NM) of the landing runway. To support the controlled flight into terrain (CFIT) prevention initiatives, IACs not only provide altitudes/heights to ensure appropriate obstacle clearance but also procedure altitudes/heights.

4.3.2 Procedure altitudes/heights are at or above the minimum obstacle clearance altitude (MOCA) and are intended to place the aircraft in a position to support a stabilized prescribed descent gradient/angle on the final segment.

4.4 Final approach segment (FAS) descent gradient

4.4.1 Where possible, the FAS provides the minimum/optimum final approach descent gradient of 5.2 per cent, or 3°, providing a rate of descent of 52 m per km (318 ft per NM).

4.4.2 The descent gradient(s)/angle(s) used in the construction of the procedure are published for the FAS. For procedures with a final descent gradient/angle greater than the maximum value specified in PANS-OPS, Volume II, Part I, Section 4, Chapter 5, "Final Approach Segment", a cautionary note is published on the IAC.

Example: "descent gradient 5.5 per cent".

4.4.3 A procedure is classed as non-standard if it involves glide paths greater than 3.5 degrees (including barometric vertical navigation (baro-VNAV) procedures with a vertical path angle (VPA) greater than 3.5 degrees), or any angle when the nominal rate of descent exceeds 5 m/s (1 000 ft/min).

4.4.4 For non-standard descent gradients a note will be added on the chart indicating that the descent gradient does not meet standard criteria. A note will be included stating that appropriate aircraft and pilot qualifications are required to use the procedure.

4.5 Visual manoeuvring (circling approach)

4.5.1 A chart depicting a circling approach may contain restrictions prohibiting the pilot from circling within certain sectors.

4.5.2 This is done to allow prominent obstacles in the circling area to be ignored for the purpose of obstacle clearance altitude/height (OCA/H) calculation, provided they are not contained within the final approach and missed approach areas.

4.5.3 When this option is exercised, the restriction will prohibit the pilot from circling within the total sector where the obstacle exists. (See Figure B-1.)

4.6 GBAS landing system (GLS) procedures

For approaches based on ground-based augmentation systems (GBAS) and titled as "GLS RWY XX", the GBAS channel number and the reference path identifier (RPI) for the procedure are promulgated with the procedure information.

4.7 Very high frequency omnidirectional radio range (VOR) or non-directional beacon (NDB) with final approach fix (FAF)

Where a DME is required for the procedure this will be indicated in a note on the chart.

4.8 Missed approach segment

4.8.1 Only one missed approach procedure is published for each approach procedure.

4.8.2 Where operationally required to avoid obstacles, reduced speeds may be required. In this case, the procedure will be suitably annotated.

Example: "Missed approach turn limited to _______ km/h (kt) IAS maximum."

4.8.3 Missed approach climb gradient

4.8.3.1 Normally, procedures are based on a minimum missed approach climb gradient of 2.5 per cent.

4.8.3.2 When a gradient steeper than 2.5 per cent is used, this is indicated on the IAC.

4.8.3.3 For procedures which use a higher climb gradient than the nominal 2.5 per cent, an OCA/H will be shown for both the higher climb gradient and the nominal climb gradient of 2.5 per cent.

4.8.4 Turning missed approach

4.8.4.1 Where the procedure requires that a turn be executed at a designated turning point, the following information will be published with the procedure:

a) the turning point, when it is designated by a fix, radio navigation facility or waypoint; and

b) the intersecting VOR radial, NDB bearing, or DME distance where there is no track guidance.

4.8.4.2 Alternatively, the procedure may be designed such that the turn is located at the start of climb. This will be clearly shown on the chart.

Example: “turn as soon as practicable to ... (heading or facility)”.

4.8.4.3 Where the procedure design assumes a turn will not be made earlier than the missed approach point (MAPt), a note will be added on the profile view of the approach chart to inform the pilot.

Example: “No turn before MAPt”

5. PROCEDURE CHART IDENTIFICATION — CONVENTIONAL AND GLS PROCEDURES

5.1 General

5.1.1 The chart identification for procedures requiring ground-based navigation aids (conventional procedures) contains the name describing the type of radio navigation aid providing the final approach lateral guidance.

Example:	ILS RWY 27L	(See Sample Chart 3)
	VOR RWY 24	
	LOC RWY 06	
	GLS RWY 27L	(See Sample Chart 4)

5.1.2 Helicopter approaches to a runway are identified in the same way as fixed wing approaches with the Category H included in the minima box.

5.1.3 A helicopter approach to a PinS is identified by the navigation aid type used for final approach guidance followed by the FAS track or radial.

Example: RNP 310 (See Sample Chart 6)

5.1.4 If two radio navigation aids are used for final approach lateral guidance, the chart identification includes only the last radio navigation aid used.

Example:

If an NDB is used as FAF and a VOR is used as the last navigation aid on the final approach to runway 06, the procedure shall be identified as VOR RWY 06.

If a VOR is used for the initial approach followed by a final approach to RWY 24 using an NDB, the procedure shall be identified as NDB RWY 24.

5.1.5 If more than one approach procedure is depicted on the same chart, the title contains the names of all the types of navigation aids used for final approach lateral guidance separated by the word "or". However, there should be no more than three types of approach procedures on one chart.

Example: ILS or NDB RWY 35L
ILS or LOC RWY 27L

5.1.6 If two or more procedures to the same runway cannot be distinguished by the radio navigation aid type only, a single letter suffix, starting with the letter Z, following the radio navigation aid type is used to distinguish between the procedures.

Example: VOR Y RWY 20
VOR Z RWY 20

5.1.7 Also, this is typically needed, for example, when there are different missed approaches associated with a common approach or different procedures are provided for different categories of aircraft.

5.2 ILS/MLS approaches — CAT II and CAT III

If Category II and/or III minima are included on the chart, the title includes this information.

Example: ILS RWY 27L CAT II
MLS RWY 27L CAT II & III

5.3 Circling procedures

5.3.1 When a chart is published with only circling minima provided, the approach procedure is identified by the last navigation aid providing final approach guidance, followed by a single letter, starting with the letter A.

Example: VOR-A

5.3.2 When there are two or more approaches with only circling minima at anaerodrome, a different letter is used for each circling approach. This identifying letter is not re-used at the aerodrome or at any other aerodrome serving the same city.

Example: VOR-A
VOR-B
NDB-C

5.3.3 If the instrument flight rules (IFR) portion of the circling procedure is the same but there are different circling tracks for the same procedure, only one procedure will be promulgated and the different circling procedures shown on the procedure chart.

6. PERFORMANCE-BASED NAVIGATION (PBN)

6.1 Waypoint naming

6.1.1 Waypoints used in support of PBN SIDs, STARs and instrument approach procedures are designated by either a unique 5LNC or a five-alphanumeric name-code.

6.1.2 Five-alphanumeric name-codes are used for waypoints unique to one aerodrome that has a properly assigned four-letter location indicator.

6.1.3 A 5LNC is used for:

a) the final waypoint of a SID;

b) the initial waypoint of a STAR;

c) waypoints common to more than one terminal control area or used in a procedure common to more than one aerodrome which are not used for en-route; and

d) other waypoints as required for ATC purposes.

6.2 Terminal arrival altitudes (TAA)

6.2.1 The purpose of the TAA is to provide a transition from the en-route structure to a PBN approach procedure.

6.2.2 Where published, TAAs replace the 46 km (25 NM) minimum sector altitude (MSA). Where TAAs are not provided, an MSA will be provided.

6.2.3 TAA sectors are depicted on the plan view of approach charts by the use of "icons" which identify the TAA reference point (initial approach fix (IAF) or intermediate fix (IF)), the radius from the sector reference point and the bearings of the TAA sector boundaries.

6.2.4 The icon for each TAA area will be located and oriented on the plan view with respect to the direction of arrival to the approach procedure and will show all TAA minimum altitudes and step down arcs for that area.

6.2.5 The IAF for each TAA is identified by the waypoint name to help the pilot orient the icon to the approach procedure. The IAF name and the distance of the TAA area boundary from the IAF are included on the outside arc of the TAA area icon. TAA icons also identify, where necessary, the location of the IF by the letters "IF" and not the IF waypoint identifier to avoid misidentification of the TAA reference point and to assist in situational awareness. (See Figure B-2.)

6.3 Critical DMEs

6.3.1 A theoretical viability check will determine the coverage and redundancy over the route. If, at any point on the procedure, the positioning can only be achieved using a specific DME pair, then those DMEs are considered to be critical to the procedure.

6.3.2 For PBN routes and procedures which allow the use of DME/DME for position fixing, critical DMEs will be identified on the chart, if applicable.

6.4 Constant radius arc to a fix (RF) legs

6.4.1 RF legs are depicted as shown in FigureB-3. This depiction includes the along track distance for the RF leg but no course value.

6.5 RNAV holding for RNAV systems with holding functionality

6.5.1 For this type of holding the outbound leg is defined by its length. The outbound length is published on the approach chart expressed in kilometres (nautical miles).

6.5.2 The holding waypoint may not be charted as a flyover waypoint but the pilot and/or aircraft navigation system is expected to treat the waypoint as a flyover waypoint while flying the holding.

7. PBN-SPECIFIC CHART INFORMATION

7.1 General

7.1.1 Each route is assigned a designator that is unique for that aerodrome. Additionally, the first four letters of any 5LNC used in a route designator are unique for the aerodrome.

7.1.2 Airborne navigation databases use a maximum of six characters to identify a route. If the coded route designator is longer than six characters, the fifth character of the 5LNC is not coded in navigation database route designation.

7.1.3 The coded route designator and the navigation specification name may be charted alongside the route in the plan view.

7.1.4 Separate charts should be published only if the routes differ laterally or vertically. When operationally required, separate charts may be published for each sensor or for a combination of sensors.

7.2 PBN requirements box

7.2.1 PBN required navigation capabilities associated with the procedure will be published in a PBN requirements box on the plan view of the chart immediately below the chart identifier.

7.2.2 The PBN requirements box will include:

a) the identification of the navigation specification(s) used in the procedure design;

b) any navigation sensor limitations; and

c) any required functionalities that are described as options in the navigation specification.

7.2.3 If necessary, lengthy text may be shown on the verso of the chart.

7.2.4 If the same required navigation performance (RNP) navigation accuracy applies to all initial and intermediate segments, a general procedure note will be used in the PBN requirements box. Where a different RNP navigation accuracy requirement exists on different initial segment legs, this will be identified by note on the chart referring to the leg(s) where it applies.

7.2.5 Sample Chart 6 shows a chart including a PBN requirements box.

7.3 PBN approach chart identification

7.3.1 In general, PBN approach charts are handled in the same manner as described in Section 5 above, "Procedure chart identification — conventional and GLS procedures", however there are additional elements that are included in the identification.

7.3.2 Additionally, a change to the PBN approach chart identification was recently introduced which allows for a transition period until 30 November 2022. During this transition period, new charts should be published according to the new identification guidelines but older charts may still retain the old identifications.

Note.— ICAO Circular 353 — Transition Planning for Change to Instrument Flight Procedure Approach Chart Identification from RNAV to RNP *provides guidance to assist States and other stakeholders with the transition from RNAV to RNP approach chart identification.*

7.3.3 The acceptable interim identification for RNP APCH procedures includes the term $\text{RNAV}_{(\text{GNSS})}$.

Example: $\text{RNAV}_{(\text{GNSS})}$ RWY 23

7.3.4 From 1 December 2022 all new procedures will be published as RNP.

Example: RNP RWY 23 (See Sample Chart 3)

7.3.5 The identification also includes a parenthetical suffix providing further information about the approach as described in Table B-1.

Table B-1. Approach chart title parenthetical suffixes

Condition	*Suffix*	*Example*
Procedure has only an LPV line of minima	LPV only	RNP RWY 23 (LPV only)
Procedure has only an LNAV/VNAV line of minima	LNAV/VNAV only	RNP RWY 23 (LNAV/VNAV only)
Procedure has both LPV and LNAV/VNAV lines of minima but no LNAV minima	LPV, LNAV/VNAV only	RNP RWY 23 (LPV, LNAV/VNAV only)
Procedure has only an LP line of minima	LP only	RNP RWY 23 (LP only)

Note.— The text in parentheses that is part of the procedure identification does not form part of the ATC clearance.

7.3.6 For RNP AR APCH, the acceptable interim identification until 30 November 2022 includes the term $\text{RNAV}_{\text{(RNP)}}$.

Example: $\text{RNAV}_{\text{(RNP)}}$ RWY 23

7.3.7 From 1 December 2022, RNP AR APCH will use the same identification as for RNP APCH above but with AR in a parenthetical suffix.

Example: RNP RWY 23 (AR)

7.3.8 Conventions for duplicate and circling only procedure identification are as described in Section 5 above, “Procedure chart identification — conventional and GLS procedures”.

7.4 Lines of minima

7.4.1 Minima for PBN approach procedures are labelled on the chart as shown in Table B-2.

Table B-2. Minima line labels for PBN approach procedures

Minima label	*Approach operation*	*Associated navigation specification*
LNAV	2D (MDA/H)	RNP APCH
LNAV/VNAV	3D (DA/H)	RNP APCH
LP	2D (MDA/H)	RNP APCH
LPV	3D (DA/H)	RNP APCH
RNP 0.x	3D (DA/H)	RNP AR APCH
Note.— LP and LPV minima will not be published on the same approach chart despite having a common associated navigation specification.		

7.4.2 For RNP AR APCH, there may be separate lines of minima related to different navigation accuracy figures. An operator approved to conduct RNP AR APCH operations must be aware of the accuracy limits defined by the regulator for their operation in order that they use the correct limits.

7.5 Temperature limitations

7.5.1 For baro-VNAV operations, the minimum/maximum temperatures will be promulgated on the plan view of the chart.

7.5.2 Baro-VNAV procedures are not permitted when the aerodrome temperature is outside of the promulgated minimum/maximum aerodrome temperature for the procedure.

7.5.3 An exception to this restriction exists for aircraft with flight management systems (FMS) equipped with approved automatic cold temperature compensation for the final approach. In this case, the minimum temperature can be disregarded provided it is within the minimum certificated temperature limits for the equipment.

7.5.4 Below this temperature and for aircraft that do not have FMSs equipped with approved cold temperature compensation for the final approach, an LNAV procedure may still be used provided that:

a) a conventional RNAV non-precision procedure and APV/LNAV OCA/H are promulgated for the approach; and

b) the appropriate cold temperature altimeter correction is applied to all minimum promulgated altitudes/heights by the pilot.

7.5.5 Charted baro-VNAV temperature restrictions do not apply when vertical guidance is provided by satellite-based augmentation systems (SBAS). This includes approach operations to LNAV/VNAV minima which can be conducted using SBAS equipment.

7.6 SBAS charts

For PBN approach procedures based on SBAS, charts will indicate the globally unique channel number in the range 40 000 to 99 999 and the procedure RPI.

8. PinS DEPARTURE PROCEDURES FOR HELICOPTERS

8.1 "CAT H" will be prominently depicted in the plan view for all procedures applicable only to helicopters.

8.2 PinS departures are identified by the last waypoint in the departure procedure.

Example: RNAV BLV DEPARTURE (See Sample Chart 5)

8.3 Climb gradient

8.3.1 A departure climb table is provided in the profile view giving details on the climb gradients required by the procedure.

8.3.2 The standard design gradient for a helicopter procedure is 5 per cent. Where a higher gradient has been used this will be stated on the chart.

8.3.3 Where multiple gradients exist for a PinS departure, for example due to multiple obstacle clearance requirements and/or ATC requirements or to meet en-route minimum crossing altitude (MCA) requirements, the highest climb gradient for that segment shall be published.

8.4 Manoeuvring area

8.4.1 The manoeuvring area is shown on the chart either in an inset on the plan view or on a continuation sheet or the verso of the chart.

8.4.2 In some cases it may be necessary to restrict the manoeuvring area due to obstacles, restricted use airspace or environmentally sensitive areas located near the heliport/landing location. Where this is done the boundaries of the manoeuvring area and any "no manoeuvring" areas will clearly be marked.

8.5 Chart insets and notes

8.5.1 The departure will be annotated “proceed visually to the IDF” or “proceed VFR to the IDF” as appropriate.

8.5.2 Chart insets include:

a) no manoeuvring areas if appropriate;

b) obstacle;

c) manoeuvring area boundaries;

d) heliport location and elevation; and

e) the IDF and associated MCA.

9. PinS APPROACH PROCEDURES FOR HELICOPTERS

9.1 “CAT H” will be prominently depicted in the plan view for all procedures applicable only to helicopters.

9.2 PinS approaches for helicopters to LP and LNAV minima

9.2.1 Chart inset and notes

9.2.1.1 PinS approaches contain a textual instruction to “proceed VFR” or “proceed visually”, to inform the pilot of the nature of the procedure (see Part II, Section 7, Chapter 3).

9.2.1.2 PinS approach charts include an inset, which will show:

a) obstacles;

b) final approach course to the MAPt;

c) heliport and elevation;

d) manoeuvring area boundaries;

e) no manoeuvring areas, if appropriate; and

f) for directional visual segments, the visual segment descent angle and heliport crossing height.

9.2.1.3 For PinS approaches annotated “proceed VFR” serving more than one heliport, the heliport name(s), heliport elevation(s), the bearing (to the nearest degree) and the distance (to the nearest two-tenths of a kilometre (tenth NM)) from MAPt to each HRP are included.

Example: MCCURTAIN MEMORIAL HOSPITAL, ELEV 693’, 123/3.2

9.2.2 Profile view

9.2.2.1 There is no visual segment profile view information for “proceed VFR”.

9.2.2.2 The profile view contains information relating to the instrument procedure profile and the direct visual segment profile, if it exists, with the text “proceed visually”.

9.2.2.3 The profile view of the direct visual segment will include:

a) fixes, altitudes and distances up to the MAPt;

b) the profile and track from the MAPt to the heliport or landing location;

c) the descent point (DP) if established;

d) the descent angle from the MAPt or DP;

e) the heliport crossing height (HCH);

f) the text “proceed visually”, which is located under the visual segment profile; and

g) a descent table indicating descent angle and descent rate in metres per minute (feet per minute) for appropriate speeds for applicable segments, i.e. FAF to step down fix (SDF), SDF to MAPt, and DP to HRP.

Note.— The descent table may be placed in the lower left or right corner of the plan view directly above the profile view.

9.3 PinS approaches to LPV minima

9.3.1 A vertical profile inset is provided for these procedures. Information depicted in the vertical profile inset includes:

a) LNAV direct visual segment profile;

b) LPV direct visual segment profile;

c) heliport or landing location;

d) location of the LNAV MAPt;

e) final portion of the LNAVFAS;

f) final portion of the LPVFAS;

g) heliport elevation;

h) HCH;

i) range scale originating from the MAPt to the heliport, which is also used to identify the DP, if one exists in the visual segment;

j) visual segment track; and

k) necessary notes needed to highlight certain attributes of the visual segment profiles.

9.3.2 Pins LPV charts include the SBAS channel number and the RPI. A sample PinS LPV chart is depicted in Sample Chart 6.

9.4 PinS approach — "proceed visually"

9.4.1 For procedures with a direct visual segment, the DP, if established, and bearings and distances from MAPt to DP and from MAPt or DP to the heliport/landing location are charted.

9.4.2 For procedures with a manoeuvring visual segment(s), only the ingress track(s) and the boundary of the manoeuvring area without dimensions are charted.

9.4.3 For procedures with a "no manoeuvring" area, the text "no manoeuvring" will be shown, along with the boundary of the "no manoeuvring" area. The "no manoeuvring" area is hachured. Other features or text may be added to the inset to aid the pilot in determining the no manoeuvring area to be avoided.

9.4.4 For procedures where overflight of the heliport or landing location is prohibited, the bearing and distance, from the MAPt to the heliport or landing location, on a line from the MAPt to the boundary of the prohibited overflight area will be shown.

9.4.5 An inset on the chart will show the following:

a) obstacles that penetrate the OIS;

b) final approach course to the MAPt;

c) text "proceed visually";

d) heliport and elevation;

e) manoeuvring area boundaries;

f) no manoeuvring areas, if appropriate; and

g) for a direct visual segment the visual segment descent angle and heliport crossing height.

Note.— The inset specified above is a separate framed diagram (located on the plan view, on the verso of the chart, or on a continuation sheet) which is charted to scale and is used to show pertinent information "close-in" to the heliport or landing location.

9.4.6 An example PinS approach proceed visually chart, with manoeuvring visual segments is shown in Sample Chart 6.

9.5 PinS approach —"proceed VFR"

9.5.1 The radius of the height above surface (HAS) diagram, centred on the MAPt of the PinS approach procedure with a "proceed VFR" instruction, is at least 1.5 km (0.8 NM). This minimum value may be increased depending on State specific requirements for helicopter VFR operations.

9.5.2 The difference in height between the OCA and the elevation of the highest terrain or water within 1.5 km (0.8 NM), or other higher value required by the State, of the MAPt will be indicated.

9.5.3 No obstacle protection is provided between the MAPt and the landing location.

9.5.4 For point-in-space approaches annotated "proceed VFR" serving more than one heliport, the heliport name(s), heliport elevation(s), the bearing (to the nearest degree) and the distance (to the nearest two-tenths of a kilometre (tenth NM)) from MAPt to each HRP shall be included.

Example: MCCURTAIN MEMORIAL HOSPITAL, ELEV 693', 123/3.2

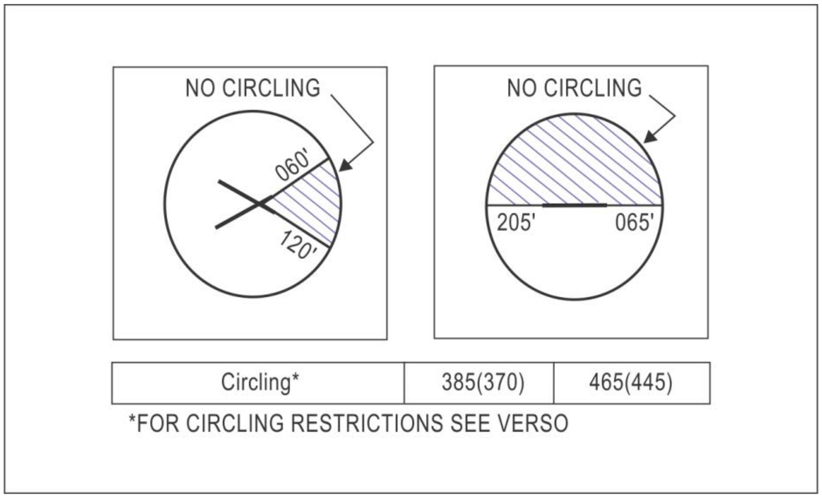


Figure B-1. Chart depicting restrictions

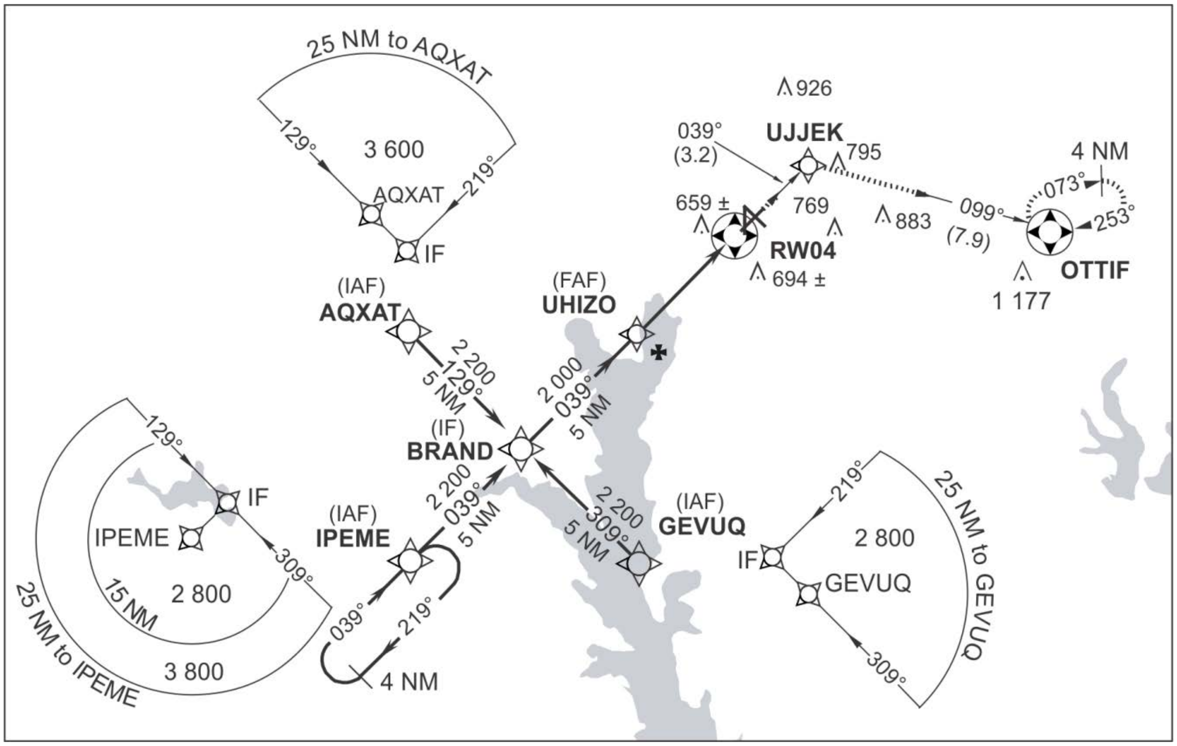


Figure B-2. Terminal arrival area

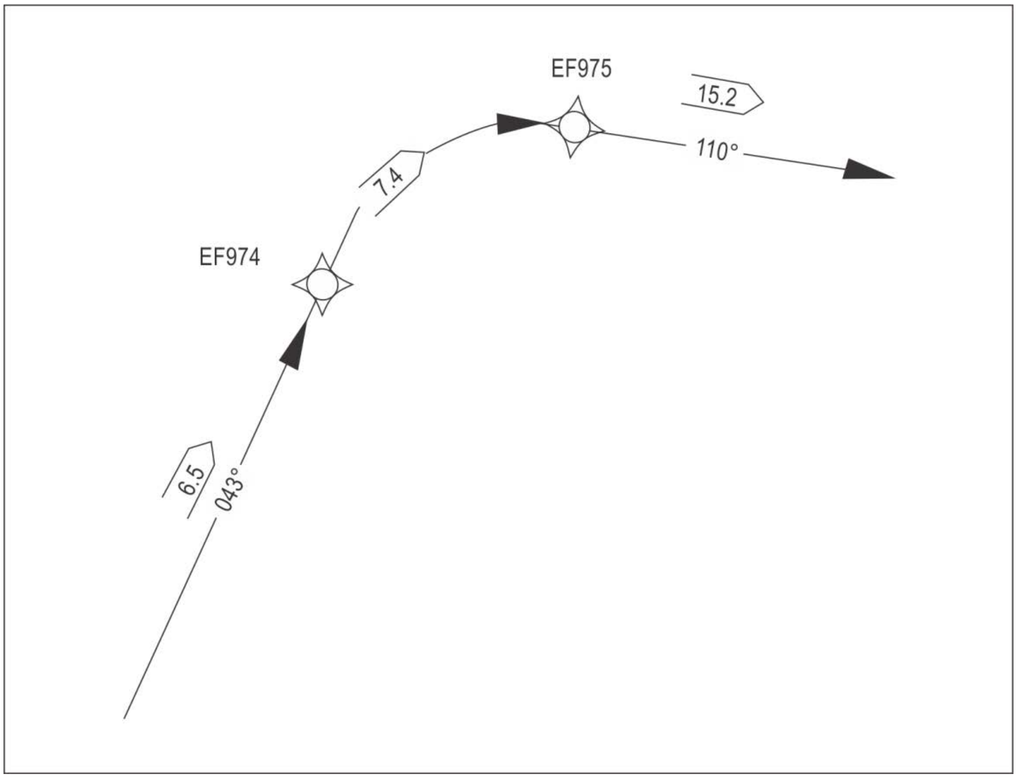
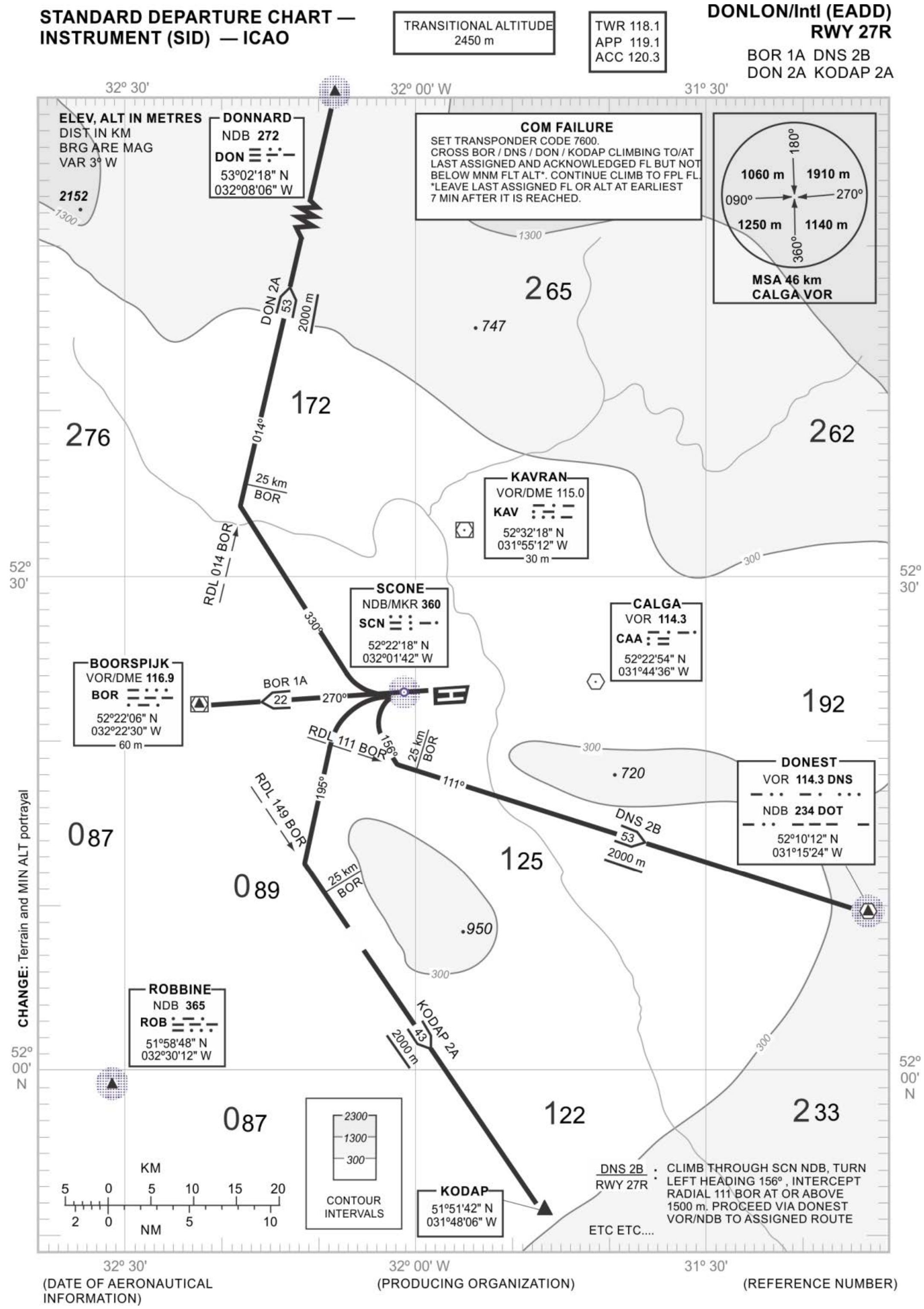
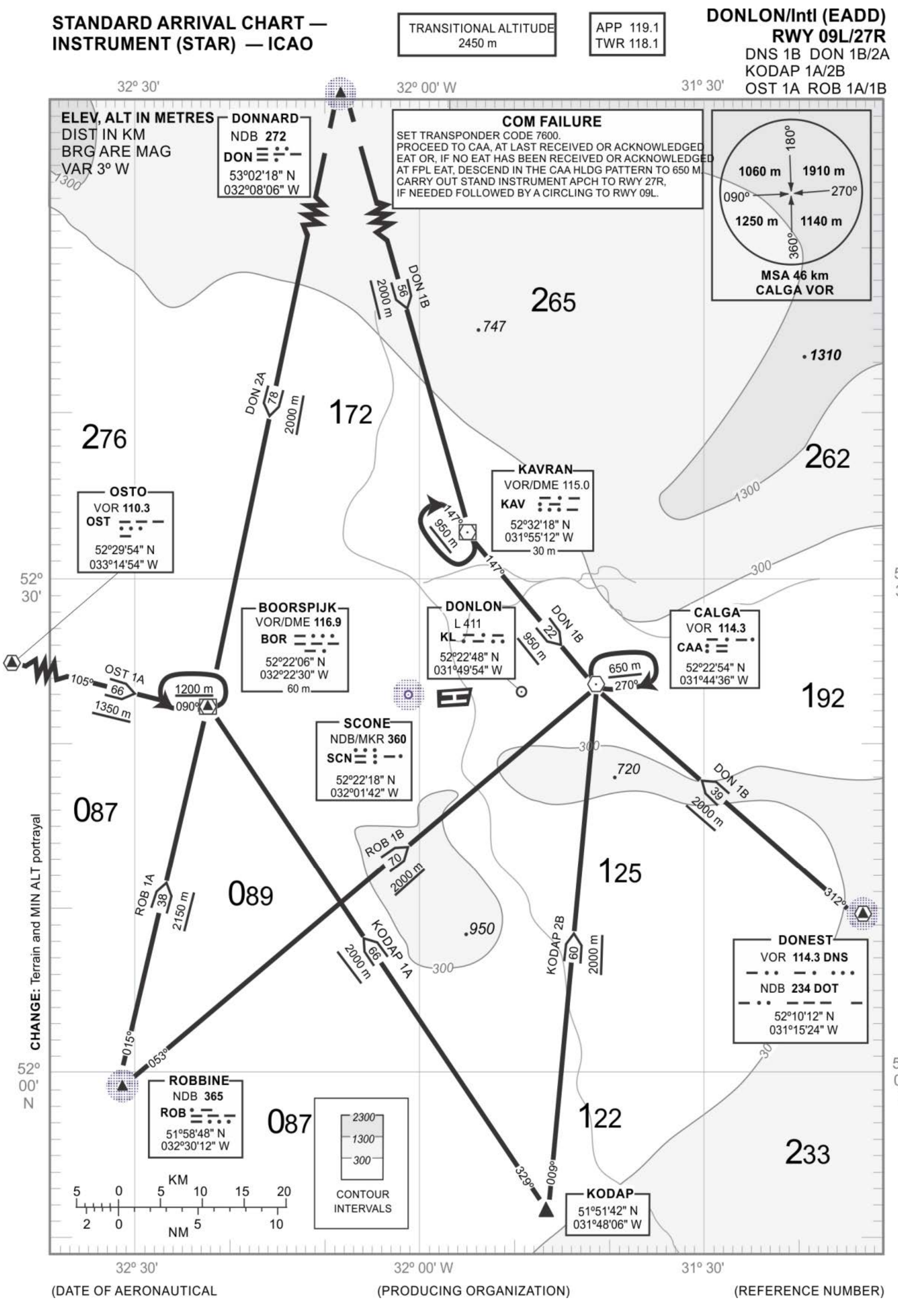


Figure B-3. RF leg depiction



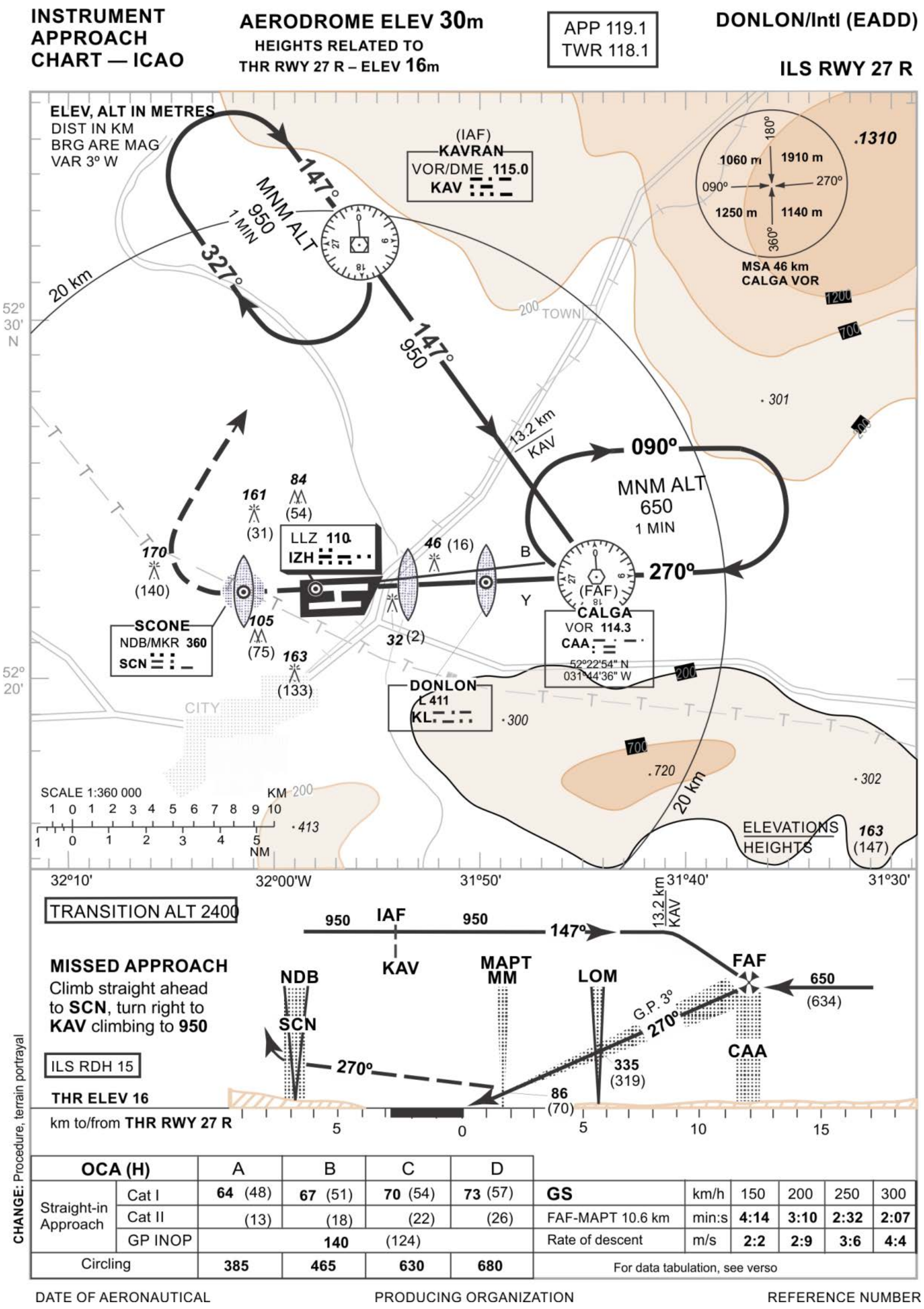
Sample Chart 1. Standard instrument departure (SID)



COM FAILURE

SET TRANSPONDER CODE 7600.
PROCEED TO CAA, AT LAST RECEIVED OR ACKNOWLEDGED EAT OR, IF NO EAT HAS BEEN RECEIVED OR ACKNOWLEDGED AT FPL EAT, DESCEND IN THE CAA HLDG PATTERN TO 650 M.
CARRY OUT STAND INSTRUMENT APCH TO RWY 27R, IF NEEDED FOLLOWED BY A CIRCLING TO RWY 09L.

Sample Chart 2. Standard instrument arrival (STAR)



MISSED APPROACH
Climb straight ahead to **SCN**, turn right to **KAV** climbing to **950**

OCA (H)		A	B	C	D
Straight-in Approach	Cat I	**64** (48)	**67** (51)	**70** (54)	**73** (57)
	Cat II	(13)	(18)	(22)	(26)
	GP INOP	**140** (124)			
Circling		**385**	**465**	**630**	**680**

GS	km/h	150	200	250	300
FAF-MAPT 10.6 km	min:s	**4:14**	**3:10**	**2:32**	**2:07**
Rate of descent	m/s	**2:2**	**2:9**	**3:6**	**4:4**

For data tabulation, see verso

Sample Chart 3. ILS approach

INSTRUMENT APPROACH CHART — ICAO

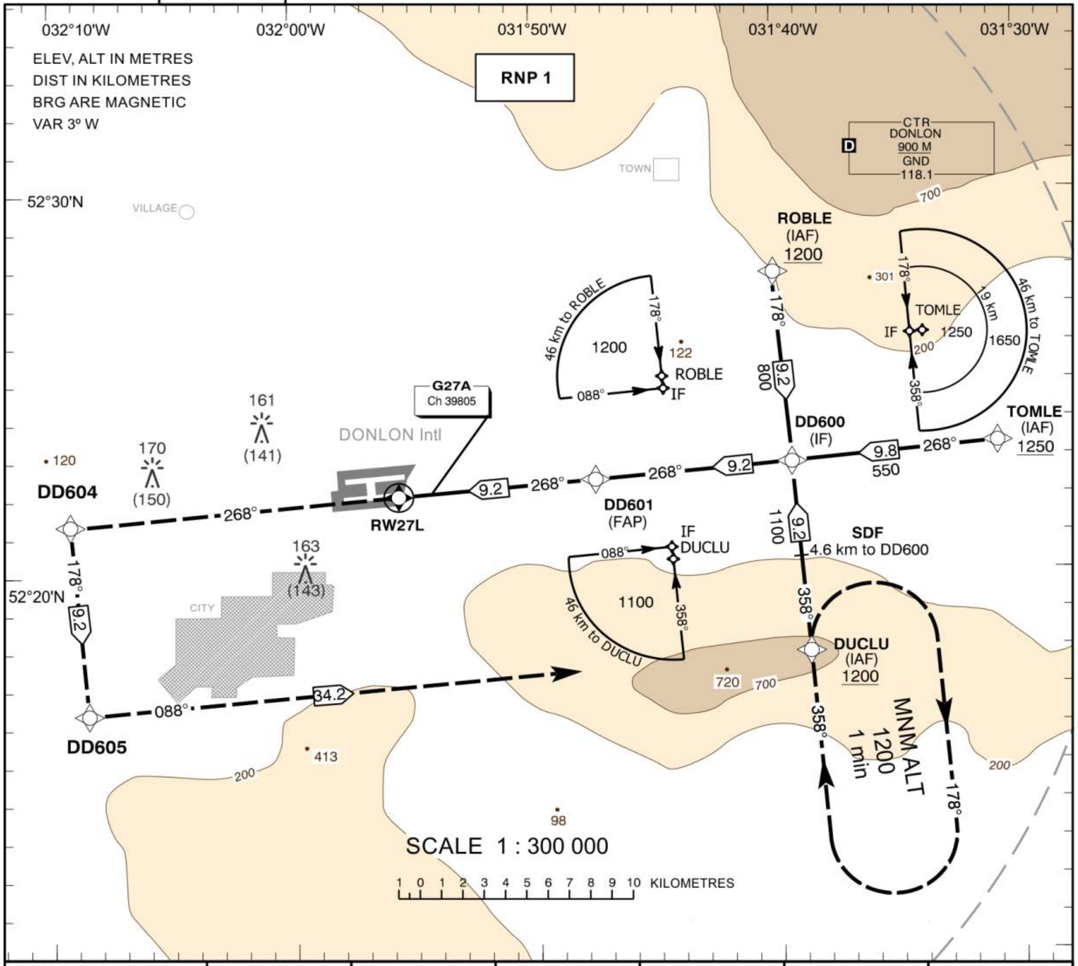
GBAS
CH 39805
G27A

AERODROME ELEV 30 m
HEIGHTS RELATED TO
THR RWY 27L — ELEV 20 m

APP	119.1
TWR	118.1

DONLON/Intl (EADD)

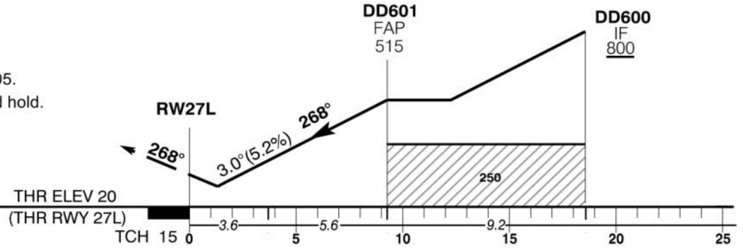
GLS RWY 27L



KM to NEXT WPT	RW27L	2	4	6	8	9.2
ALTITUDE		140	245	350	455	515

TRANSITIONAL ALTITUDE 2400

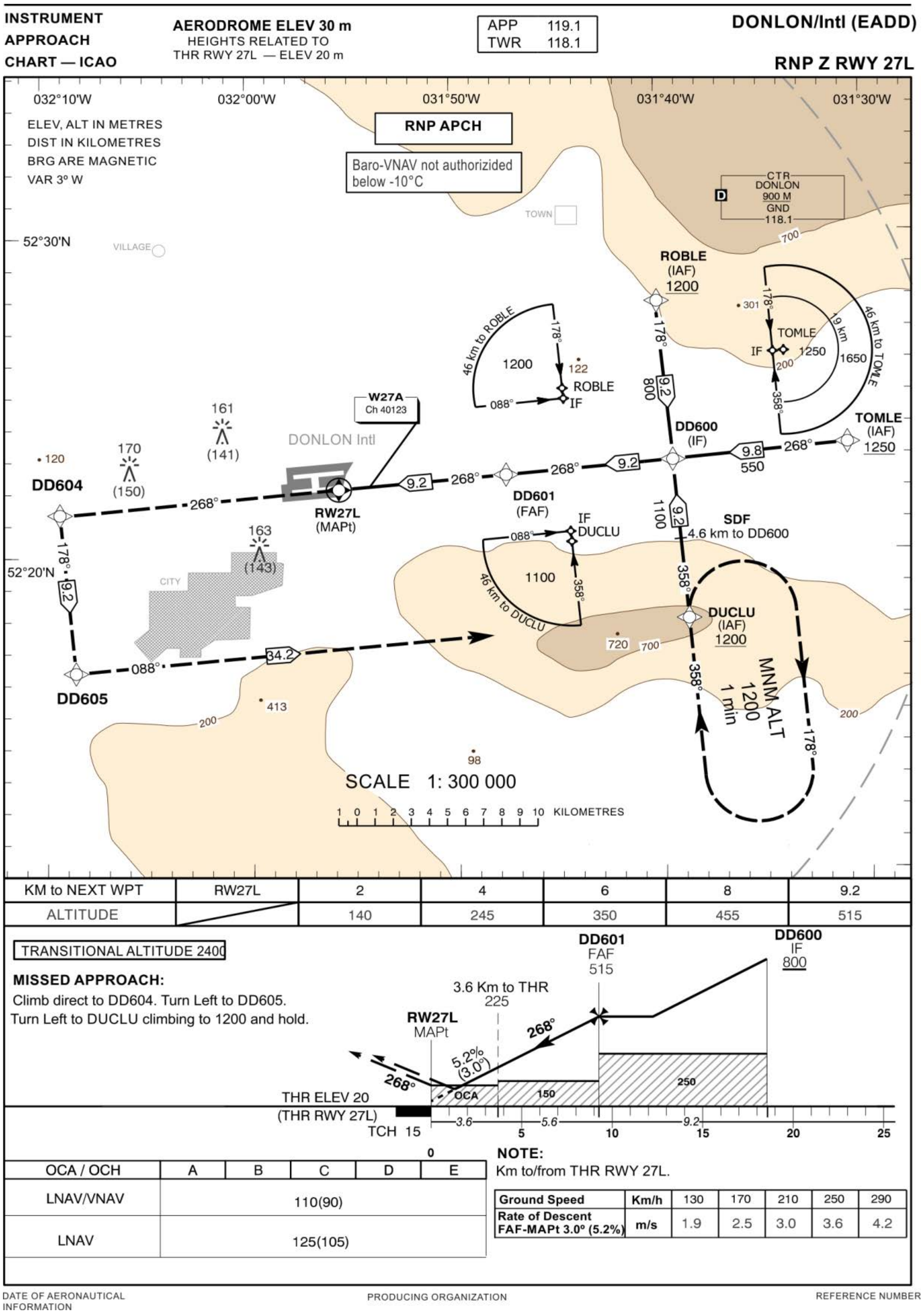
MISSED APPROACH:
Climb direct to DD604. Turn Left to DD605.
Turn Left to DUCLU climbing to 1200 and hold.



NOTE:
Km to/from THR RWY 27L.

OCA / OCH	A	B	C	D	E
GLS CAT I	100(80)				

Sample Chart 4. GLS approach with PBN segments



INSTRUMENT APPROACH CHART — ICAO

AERODROME ELEV 30 m
HEIGHTS RELATED TO
THR RWY 27L — ELEV 20 m

APP	119.1
TWR	118.1

DONLON/Intl (EADD)

RNP Z RWY 27L

KM to NEXT WPT	RW27L	2	4	6	8	9.2
ALTITUDE		140	245	350	455	515

TRANSITIONAL ALTITUDE 2400

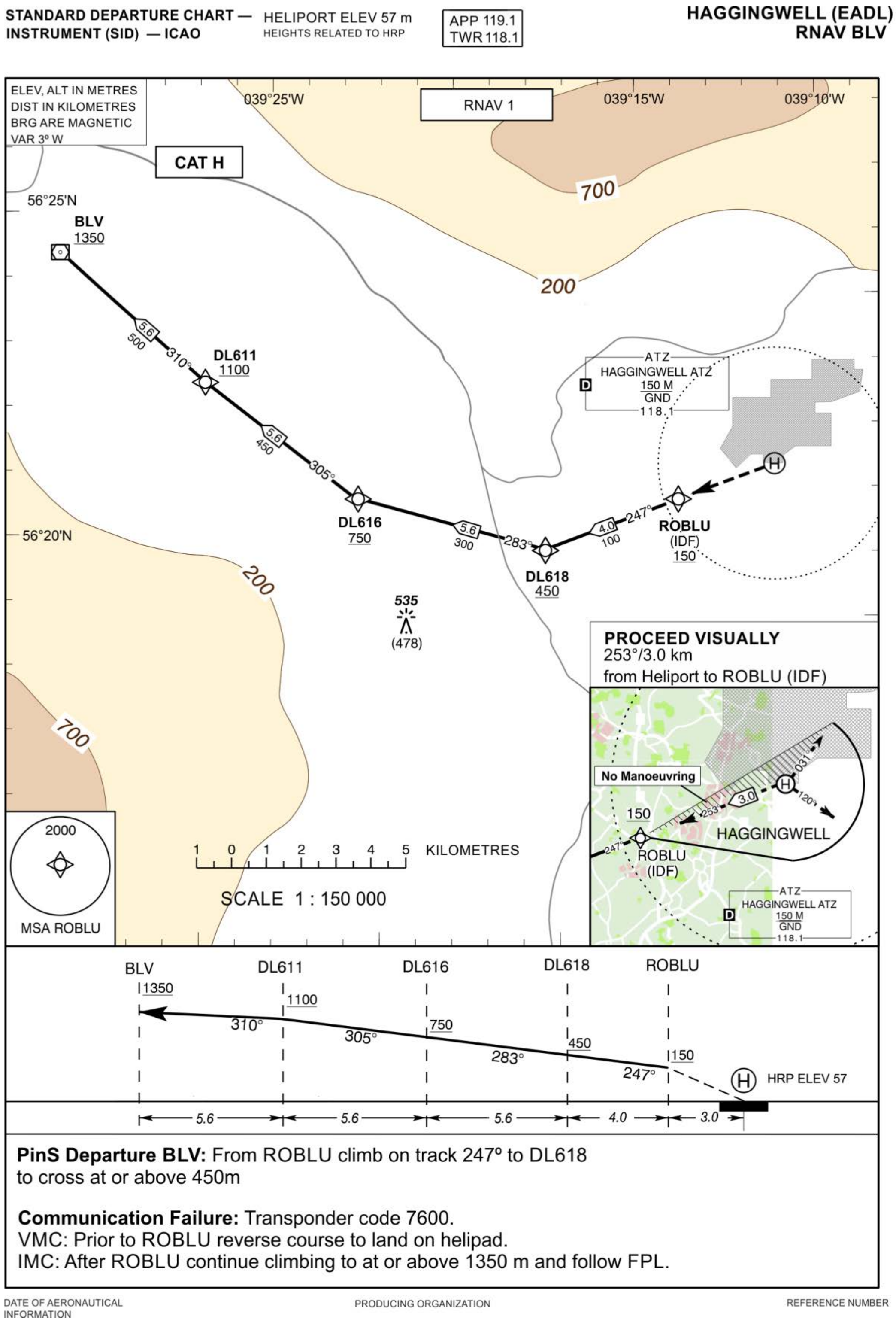
MISSED APPROACH:
Climb direct to DD604. Turn Left to DD605.
Turn Left to DUCLU climbing to 1200 and hold.

OCA / OCH	A	B	C	D	E
LNAV/VNAV	110(90)				
LNAV	125(105)				

NOTE:
Km to/from THR RWY 27L.

Ground Speed	Km/h	130	170	210	250	290
Rate of Descent FAF-MAPt 3.0º (5.2%)	m/s	1.9	2.5	3.0	3.6	4.2

Sample Chart 5. RNP APCH

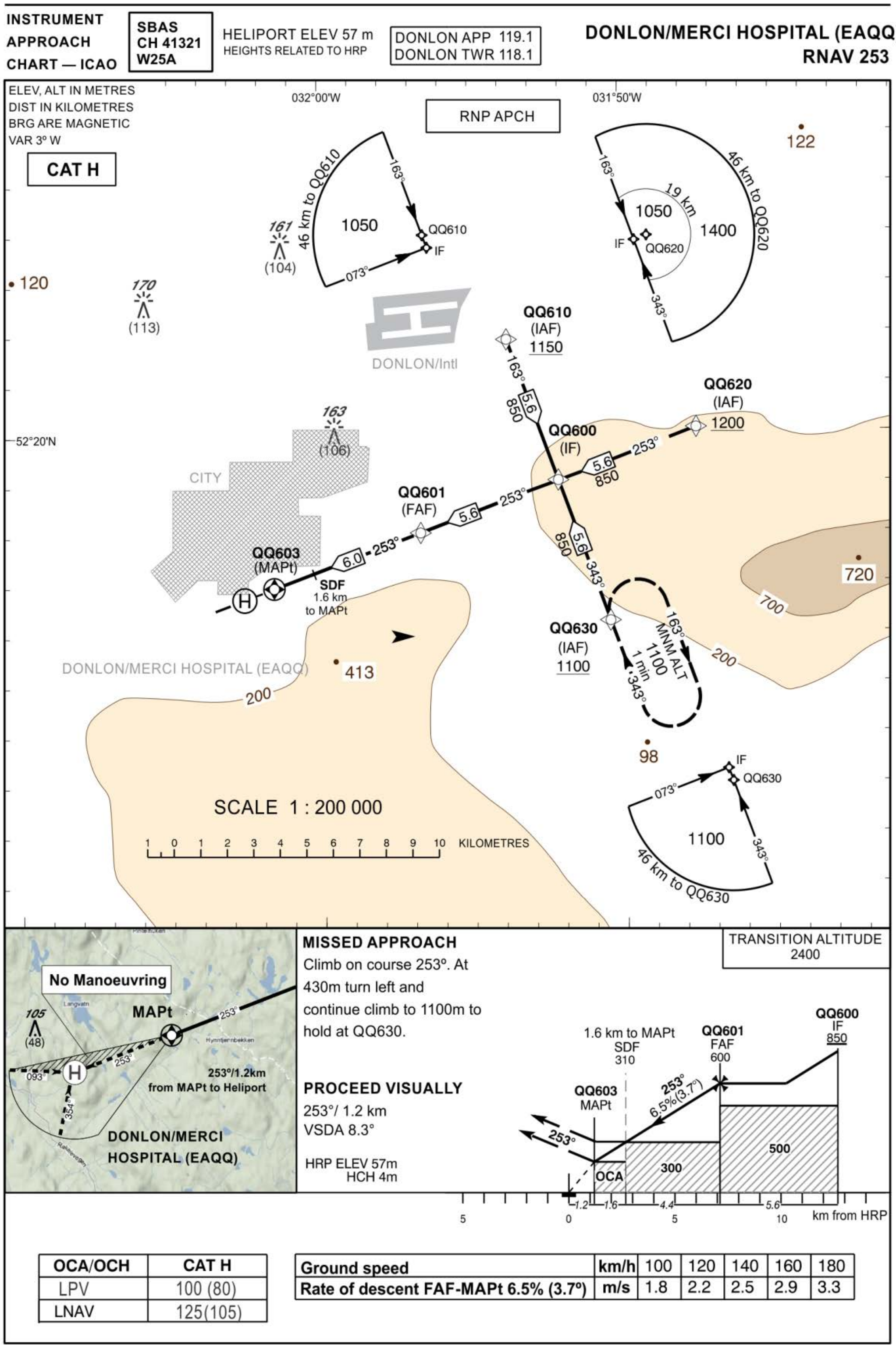


PROCEED VISUALLY
253°/3.0 km
from Heliport to ROBLU (IDF)

PinS Departure BLV: From ROBLU climb on track 247º to DL618 to cross at or above 450m

Communication Failure: Transponder code 7600.
VMC: Prior to ROBLU reverse course to land on helipad.
IMC: After ROBLU continue climbing to at or above 1350 m and follow FPL.

Sample Chart 6. Helicopter PinS departure



MISSED APPROACH

Climb on course 253°. At 430m turn left and continue climb to 1100m to hold at QQ630.

PROCEED VISUALLY

253°/ 1.2 km

VSDA 8.3°

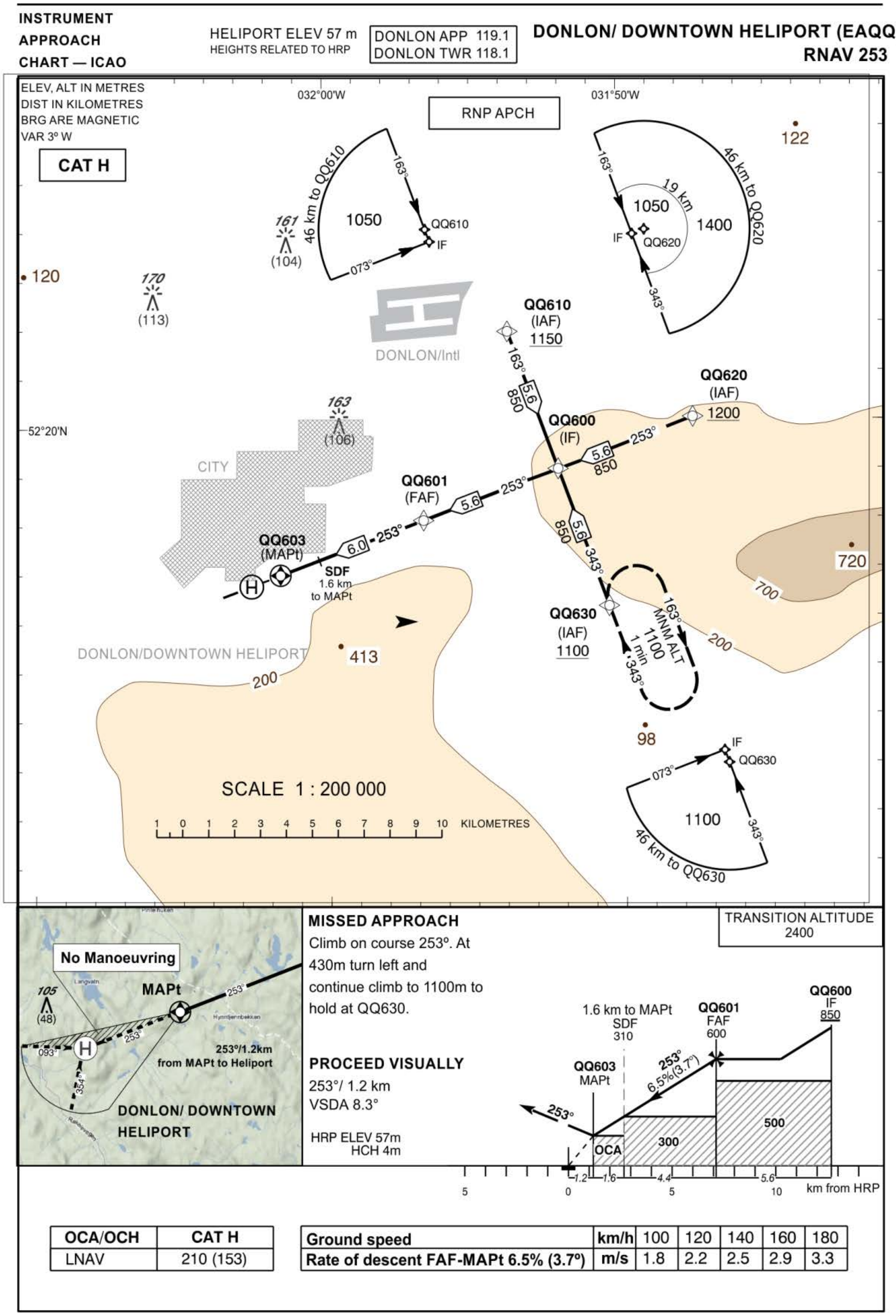
HRP ELEV 57m

HCH 4m

OCA/OCH	CAT H
LPV	100 (80)
LNAV	125(105)

Ground speed	km/h	100	120	140	160	180
Rate of descent FAF-MAPt 6.5% (3.7°)	m/s	1.8	2.2	2.5	2.9	3.3

Sample Chart 7. Helicopter PinS approach chart to LPV minima (“proceed visually”)



INSTRUMENT APPROACH CHART — ICAO

HELIPORT ELEV 57 m
HEIGHTS RELATED TO HRP

DONLON APP 119.1
DONLON TWR 118.1

DONLON/ DOWNTOWN HELIPORT (EAQQ)
RNAV 253

ELEV, ALT IN METRES
DIST IN KILOMETRES
BRG ARE MAGNETIC
VAR 3º W

CAT H

RNP APCH

MISSED APPROACH
Climb on course 253º. At 430m turn left and continue climb to 1100m to hold at QQ630.

PROCEED VISUALLY
253°/ 1.2 km
VSDA 8.3°

HRP ELEV 57m
HCH 4m

TRANSITION ALTITUDE
2400

OCA/OCH	CAT H
LNAV	210 (153)

Ground speed	km/h	100	120	140	160	180
Rate of descent FAF-MAPt 6.5% (3.7º)	m/s	1.8	2.2	2.5	2.9	3.3

Sample Chart 8. Helicopter PinS approach to LNAV minima ("proceed visually")

— END —

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