ICAO

Doc 8168

PROCEDURES FOR AIR NAVIGATION SERVICES

Aircraft Operations

Volume III – Aircraft Operating Procedures

First Edition, 2018

This first edition of Doc 8168, Volume III, was approved by the President of the Council on behalf of the Council on 28 August 2018 and becomes applicable on 8 November 2018.

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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	4/11/21	—	ICAO
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CORRIGENDA			
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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 III

2.1 *Section 2 — Altimeter setting procedures*

The altimeter setting procedures were developed from the basic principles established by the third session of the Operations Division in 1949 and are the result of evolution through the recommendations of a number of Regional Air Navigation Meetings. They formerly appeared as Part 1 of the *Regional Supplementary Procedures* (Doc 7030) and had previously been approved by the Council for use in the majority of ICAO regions as supplementary procedures.

Part 1 of Doc 7030 now contains only regional procedures which are supplementary to the procedures contained in this document. The incorporation of these procedures in the PANS-OPS was approved by the Council in 1961 on the understanding that this action was not to be construed as a decision of principle on the question of flight levels or on the relative merits of metres or feet for altimetry purposes. Subsequently the Council approved the definitions of flight level and transition altitude. To comply with Amendment 13 to Annex 5, the primary unit of atmospheric pressure was changed to hectopascal (hPa) in 1979.

2.2 *Section 3 — Simultaneous operations on parallel or near-parallel instrument runways*

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

2.3 *Section 4 — Secondary surveillance radar (SSR) transponder operating procedures*

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

2.4 *Section 5 — Operational flight information*

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

2.5 *Section 6 — Standard operating procedures (SOPs) and checklists*

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

2.6 *Section 7 — Voice communication procedures and controller-pilot data link communications procedures*

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

2.7 *Section 8 — Airborne surveillance*

Information related to the operation of ADS-B IN traffic display.

2.8 *Section 9 — Noise abatement procedures*

Noise abatement procedures were developed by the Operations Panel (OPSP) and approved by the Council for inclusion in the PANS-OPS in 1983. These procedures were amended in 2001 by the Committee on Aviation Environmental Protection (CAEP). For related provisions, see Annex 16, Volume I, and Annex 6, Part I.

2.9 *Section 10 — Flight tracking*

These provisions complement the Standards of Annex 6, Part I, related to Aircraft Tracking (3.5) and the Location of an aeroplane in Distress (6.18), and provide operator requirements for the implementation of a tracking and monitoring programme. They also establish a requirement to take appropriate action in the event of a loss of aircraft tracking data, or on notification that an aircraft is in a distress condition.

2.10 *Section 11 — RNAV substitution*

The procedures in this section outline the requirements for the use of the aircraft navigation system (RNAV system or RNP system) when operating on conventional routes and 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, Fourth Edition. In those cases where the use of an alternative non-SI unit is permitted, the non-SI unit is shown in brackets immediately following the primary SI unit. In all cases the value of the non-SI unit is considered to be operationally equivalent to the primary SI unit in the context in which it is applied. Unless otherwise indicated, the allowable tolerances (accuracy) are indicated by the number of significant figures given and, in this regard, it is to be understood in this document that all zero digits, either to the right or left of the decimal marker, are significant figures.

Table A. Amendments to the PANS-OPS

Amendment	*Source(s)*	*Subject(s)*	*Approved* *Applicable*
First edition (2018)	Third meeting of the Flight Operations Panel (FLTOPSP/3) Twelfth meeting of the Aeronautical Information Service (AIS) to Aeronautical Information Management (AIM) Study Group (AIS-AIMSG/12) First meeting of the Separation and Airspace Safety Panel (SASP/1)	Operating procedures transferred from PANS-OPS, Volume I, Parts I and II.	28 August 2018 8 November 2018
1	Global Aeronautical Distress and Safety System Advisory Group (GADSS-AG); Sixth meeting of the Flight Operations Panel (FLTOPSP/6)	The proposals complete air operator provisions supporting the implementation of the GADSS concept by establishing requirements for operators to develop procedures to: a) monitor the aircraft tracking systems in use for their aircraft; b) respond to any information received from such tracking systems in an appropriate manner; and c) require that information received from an autonomous distress tracking system be forwarded to the location of an aircraft in distress repository (LADR).	19 April 2021 4 November 2021
2	The fifth, sixth and seventh meetings of the Flight Operations Panel (FLTOPSP/5, 6, 7)	Amendment concerning: a) the use of RNAV on conventional routes and procedures; and b) crew briefings.	30 May 2022 3 November 2022

Section 1

DEFINITIONS, ABBREVIATIONS AND 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).

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

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

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

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

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

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

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

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.

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.

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

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

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

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 PANS-OPS, (Doc 8168) Volume I, 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.

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

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.

Normal operating zone (NOZ). Airspace of defined dimensions extending to either side of a published instrument approach procedure final approach course or track. Only that half of the normal operating zone adjacent to a no transgression zone (NTZ) is taken into account in independent parallel approaches.

NOTAM. A notice distributed by means of telecommunication containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations.

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

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.

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.

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.

Chapter 2

ABBREVIATIONS AND ACRONYMS

(used in this document)

AC	Advisory Circular
ACAS	Airborne collision avoidance system
ADS-B	Automatic dependent surveillance — broadcast
AGL	Above ground level
AHRS	Attitude and heading reference system
AIRAC	Aeronautical information regulation and control
APV	Approach procedure with vertical guidance
ATC	Air traffic control
ATIS	Automatic terminal information service
ATM	Air traffic management
ATS	Air traffic services
CAT	Category
CBT	Computer-based training
CCO	Continuous climb operation
CDFA	Continuous descent final approach
CDO	Continuous descent operation
CPA	Closest point of approach
CRC	Cyclic redundancy check
CRM	Collision risk model
CRM	Crew resource management
DME	Distance measuring equipment
ESDU	Engineering Sciences Data Unit
EUROCAE	European Organization for Civil Aviation Equipment
FAA	Federal Aviation Administration
FAF	Final approach fix
FHP	Fictitious helipoint
FL	Flight level
FMS	Flight management system
ft	Foot (feet)
FTP	Fictitious threshold point
GPIP	Glide path intercept point
GPWS	Ground proximity warning system
HP	Helipoint
hPa	Hectopascal(s)
HPL	Horizontal protection level
HVR	High vertical rate
IFR	Instrument flight rules
ILS	Instrument landing system
IMC	Instrument meteorological conditions
INS	Inertial navigation system
IRS	Inertial reference system

ISA	International standard atmosphere
JAA	Joint Aviation Authorities
kt	Knot(s)
km	Kilometre(s)
LORAN	Long range air navigation system
LTP	Landing threshold point
m	Metre(s)
MEL	Minimum equipment list
MLS	Microwave landing system
MOC	Minimum obstacle clearance
MOPS	Minimum operational performance standards
NADP	Noise abatement departure procedure
NAT HLA	North Atlantic high level airspace
NM	Nautical mile(s)
NOZ	Normal operating zone
NTZ	No transgression zone
OAS	Obstacle assessment surface
OCA/H	Obstacle clearance altitude/height
OEI	One-engine-inoperative
OIS	Obstacle identification surface
OLS	Obstacle limitation surface
PA	Precision approach
PAOAS	Parallel approach obstacle assessment surface
PF	Pilot flying
PM	Pilot monitoring
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
RSR	En-route surveillance radar
RSS	Root sum square
SI	International system of units
SOPs	Standard operating procedures
SPI	Special position indicator
SSR	Secondary surveillance radar
SST	Supersonic transport
TA	Traffic advisory
TSO	Technical Standard Order
VAL	Vertical alarm limit
VPL	Vertical protection level
VTF	Vector to final

Chapter 3

UNITS OF MEASUREMENT

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

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

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

Section 2

ALTIMETER SETTING PROCEDURES

Chapter 1

INTRODUCTION TO ALTIMETER SETTING PROCEDURES

1.1 These procedures describe the method for providing adequate vertical separation between aircraft and for providing adequate terrain clearance during all phases of a flight. This method is based on the following basic principles:

a) States may specify a fixed altitude known as the transition altitude. In flight, when an aircraft is at or below the transition altitude, its vertical position is expressed in terms of altitude, which is determined from an altimeter set to sea level pressure (QNH).

b) In flight above the transition altitude, the vertical position of an aircraft is expressed in terms of flight levels, which are surfaces of constant atmospheric pressure based on an altimeter setting of 1 013.2 hPa.

c) The change in reference from altitude to flight levels, and vice versa, is made:

   1) at the transition *altitude*, when climbing; and

   2) at the transition *level*, when descending.

d) The transition level may be nearly coincident with the transition altitude to maximize the number of flight levels available. Alternatively, the transition level may be located 300 m (or 1 000 ft) above the transition altitude to permit the transition altitude and the transition level to be used concurrently in cruising flight, with vertical separation ensured. The airspace between the transition level and the transition altitude is called the transition layer.

e) Where no transition altitude has been established for the area, aircraft in the en-route phase shall be flown at a flight level.

f) The adequacy of terrain clearance during any phase of a flight may be maintained in any of several ways, depending upon the facilities available in a particular area. The recommended methods in the order of preference are:

   1) the use of current QNH reports from an adequate network of QNH reporting stations;

   2) the use of such QNH reports as are available, combined with other meteorological information such as forecast lowest mean sea level pressure for the route or portions thereof; and

   3) where relevant current information is not available, the use of values of the lowest altitudes or flight levels, derived from climatological data.

g) During the approach to land, terrain clearance may be determined by using:

   1) the QNH altimeter setting (giving altitude); or

2) under specified circumstances (see Chapter 2, 2.4.2 and Chapter 3, 3.5.4), a QFE setting (giving height above the QFE datum).

1.2 This method provides flexibility to accommodate variations in local procedures without compromising the fundamental principles.

1.3 These procedures apply to all IFR flights and to other flights which are operating at specific cruising levels in accordance with Annex 2 — *Rules of the Air* or the *Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM, Doc 4444) or the *Regional Supplementary Procedures* (Doc 7030).

Chapter 2

BASIC ALTIMETER SETTING REQUIREMENTS

2.1 GENERAL

2.1.1 System of flight levels

2.1.1.1 Flight level zero shall be located at the atmospheric pressure level of 1 013.2 hPa. Consecutive flight levels shall be separated by a pressure interval corresponding to at least 500 ft (152.4 m) in the standard atmosphere.

Note.— This does not preclude reporting intermediate levels in increments of 30 m (100 ft). (Refer to Section 4, Chapter 1, 1.2, "Use of Mode C".)

2.1.1.2 Flight levels shall be numbered according to Table 2-2-1 which indicates the corresponding height in the standard atmosphere in feet and the approximate equivalent height in metres.

2.1.2 Transition altitude

2.1.2.1 A transition altitude shall normally be specified for each aerodrome by the State in which the aerodrome is located.

2.1.2.2 Where two or more closely spaced aerodromes are located so that coordinated procedures are required, a common transition altitude shall be established. This common transition altitude shall be the highest that would be required if the aerodromes were considered separately.

2.1.2.3 As far as possible, a common transition altitude should be established:

a) for groups of aerodromes of a State or all aerodromes of that State;

b) on the basis of an agreement, for:

   1) aerodromes of adjacent States;

   2) States of the same flight information region; and

   3) States of two or more adjacent flight information regions or one ICAO region; and

c) for aerodromes of two or more ICAO regions when agreement can be obtained between these regions.

2.1.2.4 The height above the aerodrome of the transition altitude shall be as low as possible but normally not less than 900 m (3 000 ft).

2.1.2.5 The calculated height of the transition altitude shall be rounded up to the next full 300 m (1 000 ft).

2.1.2.6 Despite the provisions in 2.1.2, "Transition altitude", a transition altitude may be established for a specified area on the basis of regional air navigation agreements.

2.1.2.7 Transition altitudes shall be published in aeronautical information publications and shown on the appropriate charts.

2.1.3 Transition level

2.1.3.1 States shall make provision for the determination of the transition level to be used at any given time at each of their aerodromes.

2.1.3.2 Where two or more closely spaced aerodromes are located so that coordinated procedures and a common transition altitude are required, a common transition level shall also be used at those aerodromes.

2.1.3.3 Appropriate personnel shall have available at all times the number of the flight level representing the current transition level for an aerodrome.

Note.— The transition level is normally passed to aircraft in the approach and landing clearances.

2.1.4 References to vertical position

2.1.4.1 The vertical position of aircraft operating at or below the transition altitude shall be expressed in terms of altitude. Vertical position at or above the transition level shall be expressed in terms of flight levels. This terminology applies during:

a) climb;

b) en-route flight; and

c) approach and landing (except as provided for in 2.4.3, "References to vertical positioning after approach clearance").

Note.— This does not preclude a pilot using a QFE setting for terrain clearance purposes during the final approach to the runway.

2.1.4.2 *Passing through the transition layer*

While passing through the transition layer, vertical position shall be expressed in terms of:

a) flight levels when climbing; and

b) altitude when descending.

2.2 TAKE-OFF AND CLIMB

A QNH altimeter setting shall be made available to aircraft in taxi clearances prior to take-off.

2.3 EN ROUTE

2.3.1 When complying with the specifications of Annex 2, an aircraft shall be flown at altitudes or flight levels (as applicable) corresponding to the magnetic tracks shown in the table of cruising levels in Appendix 3 to Annex 2.

2.3.2 Terrain clearance

2.3.2.1 QNH altimeter setting reports should be provided from sufficient locations to permit determination of terrain clearance with an acceptable degree of accuracy.

2.3.2.2 For areas where adequate QNH altimeter setting reports cannot be provided, the appropriate authorities shall provide the information required to determine the lowest flight level which will ensure adequate terrain clearance. This information shall be made available in the most usable form.

2.3.2.3 Appropriate services shall at all times have available the information required to determine the lowest flight level which will ensure adequate terrain clearance for specific routes or segments of routes. This information shall be made available for flight planning purposes and for transmission to aircraft in flight, on request.

2.4 APPROACH AND LANDING

2.4.1 The QNH altimeter setting shall be made available to aircraft in approach clearances and in clearances to enter the traffic circuit.

2.4.2 A QFE altimeter setting, clearly identified as such, should be made available in approach and landing clearances. This should be available on request or on a regular basis, in accordance with local arrangements.

2.4.3 References to vertical positioning after approach clearance

After approach clearance has been issued and the descent to land is begun, the vertical positioning of an aircraft above the transition level may be by reference to altitudes (QNH) provided that level flight above the transition altitude is not indicated or anticipated.

Note.— This applies primarily to turbine engine aircraft for which an uninterrupted descent from a high altitude is desirable and to aerodromes equipped to control such aircraft by reference to altitudes throughout the descent.

2.5 MISSED APPROACH

The relevant parts of 2.2, “Take-off and climb”, 2.3, “En route”, and 2.4, “Approach and landing” shall apply in the event of a missed approach.

Table 2-2-1. Flight level numbers

Flight level number	Height in standard atmosphere		Flight level number	Height in standard atmosphere	
	Metres	*Feet*		*Metres*	*Feet*
10	300	1 000	50	1 500	5 000
15	450	1 500	...	. ...	.. ...
20	600	2 000	100	3 050	10 000
25	750	2 500	...	. ...	.. ...
30	900	3 000	150	4 550	15 000
35	1 050	3 500	...	. ...	.. ...
40	1 200	4 000	200	6 100	20 000
45	1 350	4 500	...	. ...	.. ...
			500	15 250	50 000

Note.— The heights shown in metres correspond to those in the table of cruising levels given in Appendix 3 to Annex 2.

Chapter 3

PROCEDURES FOR OPERATORS AND PILOTS

3.1 FLIGHT PLANNING

3.1.1 The levels at which a flight is to be conducted shall be specified in a flight plan:

a) as flight levels if the flight is to be conducted at or above the transition level (or the lowest usable flight level, if applicable); and

b) as altitudes if the flight is to be conducted at or below the transition altitude.

3.1.2 The altitudes or flight levels selected for flight:

a) should ensure adequate terrain clearance at all points along the route;

b) should satisfy air traffic control requirements; and

c) should be compatible with the table of cruising levels in Appendix 3 to Annex 2, if relevant.

Note 1.— The information required to determine the lowest altitude or flight level which ensures adequate terrain clearance may be obtained from the appropriate services unit (e.g. aeronautical information, air traffic or meteorological).

Note 2.— The choice of altitudes or flight levels depends upon how accurately their vertical position relative to the terrain can be estimated. This in turn depends upon the type of meteorological information available. A lower altitude or flight level may be used with confidence when its position is based on current information which is relevant to the particular route to be flown and when it is known that amendments to this information will be available in flight. See 3.4.2, "Terrain clearance". A higher altitude or flight level will be used when based on information less relevant to the particular route to be flown and the time of the flight. The latter type of information may be provided in chart or table form and may be applicable to a large area and any period of time.

Note 3.— Flights over level terrain may often be conducted at one altitude or flight level. On the other hand, flights over mountainous terrain may require several changes in altitudes or flight levels to account for changes in the elevation of the terrain. The use of several altitudes or flight levels may also be required to comply with air traffic services requirements.

3.2 PRE-FLIGHT OPERATIONAL TEST

The following test should be carried out in an aircraft by flight crew members before flight. Flight crews should be advised of the purpose of the test and the manner in which it should be carried out. They should also be given specific instructions on the action to be taken based on the test results.

QNH setting

1. With the aircraft at a known elevation on the aerodrome, set the altimeter pressure scale to the current QNH setting.

2. Vibrate the instrument by tapping unless mechanical vibration is provided.

A serviceable altimeter indicates the elevation of the point selected, plus the height of the altimeter above this point, within a tolerance of:

a) ±20 m or 60 ft for altimeters with a test range of 0 to 9 000 m (0 to 30 000 ft); and

b) ±25 m or 80 ft for altimeters with a test range of 0 to 15 000 m (0 to 50 000 ft).

QFE setting

1. With the aircraft at a known elevation on the aerodrome, set altimeter pressure scale to the current QFE setting.

2. Vibrate the instrument by tapping unless mechanical vibration is provided.

A serviceable altimeter indicates the height of the altimeter in relation to the QFE reference point, within a tolerance of:

a) ±20 m or 60 ft for altimeters with a test range of 0 to 9 000 m (0 to 30 000 ft); and

b) ±25 m or 80 ft for altimeters with a test range of 0 to 15 000 m (0 to 50 000 ft).

Note 1.— If the altimeter does not indicate the reference elevation or height exactly but is within the specified tolerances, no adjustment of this indication should be made at any stage of a flight. Also, any error which was within tolerance on the ground should be ignored by the pilot during flight.

Note 2.— The tolerance of 20 m or 60 ft for altimeters with a test range of 0 to 9 000 m (0 to 30 000 ft) is considered acceptable for aerodromes having elevations up to 1 100 m (3 500 ft) (Standard atmospheric pressure). Table 2-3-1 indicates the permissible range for aerodromes at different elevations when the atmospheric pressure at an aerodrome is lower than the standard, i.e. when the QNH setting is as low as 950 hPa.

Note 3.— The tolerance of 25 m or 80 ft for altimeters with a test range of 0 to 15 000 m (0 to 50 000 ft) is considered acceptable for aerodromes having elevations up to 1 100 m (3 500 ft) (Standard atmospheric pressure). Table 2-3-2 indicates the permissible range for aerodromes at different elevations when the atmospheric pressure at an aerodrome is lower than the standard, i.e. when the QNH setting is as low as 950 hPa.

3.3 TAKE-OFF AND CLIMB

3.3.1 Before taking off, one altimeter shall be set on the latest QNH altimeter setting for the aerodrome.

3.3.2 During climb to, and while at the transition altitude, references to the vertical position of the aircraft in air-ground communications shall be expressed in terms of altitudes.

3.3.3 On climbing through the transition altitude, the reference for the vertical position of the aircraft shall be changed from altitudes (QNH) to flight levels (1 013.2 hPa), and thereafter the vertical position shall be expressed in terms of flight levels.

3.4 EN ROUTE

3.4.1 Vertical separation

3.4.1.1 During en-route flight at or below the transition altitude, an aircraft shall be flown at altitudes. References to the vertical position of the aircraft in air-ground communications shall be expressed in terms of altitudes.

3.4.1.2 During en-route flight at or above transition levels or the lowest usable flight level, whichever is applicable, an aircraft shall be flown at flight levels. References to the vertical position of the aircraft in air-ground communications shall be expressed in terms of flight levels.

3.4.2 Terrain clearance

3.4.2.1 Where adequate QNH altimeter setting reports are available, the latest and most appropriate reports shall be used for assessing terrain clearance.

3.4.2.2 Where the adequacy of terrain clearance cannot be assessed with an acceptable degree of accuracy by means of the QNH reports available or forecast lowest mean sea level pressure, other information shall be obtained for checking the adequacy of terrain clearance.

3.5 APPROACH AND LANDING

3.5.1 Before beginning the initial approach to an aerodrome, the number of the transition level shall be obtained.

Note.— The transition level is normally obtained from the appropriate air traffic services unit.

3.5.2 Before descending below the transition level, the latest QNH altimeter setting for the aerodrome shall be obtained.

Note.— The latest QNH altimeter setting for the aerodrome is normally obtained from the appropriate air traffic services unit.

3.5.3 As the aircraft descends through the transition level, the reference for the vertical position of the aircraft shall be changed from flight levels (1 013.2 hPa) to altitudes (QNH). From this point on, the vertical position of the aircraft shall be expressed in terms of altitudes.

Note.— This does not preclude a pilot using a QFE setting for terrain clearance purposes during the final approach to the runway in accordance with 3.5.4.

3.5.4 When an aircraft which has been given a clearance as number one to land is completing its approach using QFE, the vertical position of the aircraft shall be expressed in terms of the height above the aerodrome datum which was used in establishing obstacle clearance height (OCH) (see PANS-OPS, Volume I, Part I, Section 4, Chapter 1, 1.5, "Obstacle clearance altitude/height (OCA/H)"). All subsequent references to vertical position shall be made in terms of height.

Table 2-3-1. Tolerance range for altimeters with a test range of 0 to 9 000 m (0 to 30 000 ft)

Elevation of the aerodrome (metres)	*Permissible range*	*Elevation of the aerodrome (feet)*	*Permissible range*
600	581.5 to 618.5		1 940 to 2 060
900	878.5 to 921.5	3 000	2 930 to 3 070
1 200	1 177 to 1 223	4 000	3 925 to 4 075
1 500	1 475.5 to 1 524.5	5 000	4 920 to 5 080
1 850	1 824 to 1 876	6 000	5 915 to 6 085
2 150	2 121 to 2 179	7 000	6 905 to 7 095
2 450	2 418 to 2 482	8 000	7 895 to 8 105
2 750	2 715 to 2 785	9 000	8 885 to 9 115
3 050	3 012 to 3 088	10 000	9 875 to 10 125
3 350	3 309 to 3 391	11 000	10 865 to 11 135
3 650	3 606 to 3 694	12 000	11 855 to 12 145
3 950	3 903 to 3 997	13 000	12 845 to 13 155
4 250	4 199.5 to 4 300.5	14 000	13 835 to 14 165
4 550	4 496.5 to 4 603.5	15 000	14 825 to 15 175

Table 2-3-2. Tolerance range for altimeters with a test range of 0 to 15 000 m (0 to 50 000 ft)

Elevation of the aerodrome (metres)	*Permissible range*	*Elevation of the aerodrome (feet)*	*Permissible range*
600	569.5 to 630.5	2 000	1 900 to 2 100
900	868 to 932	3 000	2 895 to 3 105
1 200	1 165 to 1 235	4 000	3 885 to 4 115
1 500	1 462 to 1 538	5 000	4 875 to 5 125
1 850	1 809 to 1 891	6 000	5 865 to 6 135
2 150	2 106 to 2 194	7 000	6 855 to 7 145
2 450	2 403 to 2 497	8 000	7 845 to 8 155
2 750	2 699.5 to 2 800.5	9 000	8 835 to 9 165
3 050	2 996.5 to 3 103.5	10 000	9 825 to 10 175
3 350	3 293.5 to 3 406.5	11 000	10 815 to 11 185
3 650	3 590.5 to 3 709.5	12 000	11 805 to 12 195
3 950	3 887.5 to 4 012.5	13 000	12 795 to 13 205
4 250	4 184.5 to 4 315.5	14 000	13 785 to 14 215
4 550	4 481.5 to 4 618.5	15 000	14 775 to 15 225

Chapter 4

ALTIMETER CORRECTIONS

Note.— This chapter deals with altimeter corrections for pressure, temperature and, where appropriate, wind and terrain effects. The pilot is responsible for these corrections, except when under vectoring. In that case, the controller issues clearances such that the prescribed obstacle clearance will exist at all times, taking the cold temperature correction into account.

4.1 RESPONSIBILITY

4.1.1 Pilot's responsibility

The pilot-in-command is responsible for the safety of the operation and the safety of the aeroplane and of all persons on board during flight time (Annex 6, 4.5.1). This includes responsibility for obstacle clearance, except when an IFR flight is being vectored.

Note.— When an IFR flight is being vectored, air traffic control (ATC) may assign minimum vectoring altitudes which are below the minimum sector altitude. Minimum vectoring altitudes provide obstacle clearance at all times until the aircraft reaches the point where the pilot will resume own navigation. The pilot-in-command should closely monitor the aircraft's position with reference to pilot-interpreted navigation aids to minimize the amount of navigation assistance required and to alleviate the consequences resulting from a failure of the ATS surveillance system. The pilot-in-command should also continuously monitor communications with ATC while being vectored, and should immediately climb the aircraft to the minimum sector altitude if ATC does not issue further instructions within a suitable interval, or if a communications failure occurs.

4.1.2 Operator's responsibility

The operator is responsible for establishing minimum flight altitudes, which may not be less than those established by States that are flown over (Annex 6, 4.2.6). The operator is responsible for specifying a method for determining these minimum altitudes (Annex 6, 4.2.6). Annex 6 recommends that the method should be approved by the State of the Operator and also recommends the factors to be taken into account.

4.1.3 State's responsibility

PANS-AIM, Appendix 2 (Contents of Aeronautical Information Publication), indicates that States should publish in Section GEN 3.3.5, "The criteria used to determine minimum flight altitudes". If nothing is published, it should be assumed that no corrections have been applied by the State.

Note.— The determination of lowest usable flight levels by air traffic control units within controlled airspace does not relieve the pilot-in-command of the responsibility for ensuring that adequate terrain clearance exists, except when an IFR flight is being vectored.

4.1.4 Air traffic control (ATC)

If an aircraft is cleared by ATC to an altitude which the pilot-in-command finds unacceptable due to low temperature, then the pilot-in-command should request a higher altitude. If such a request is not received, ATC will consider that the clearance has been accepted and will be complied with. See Annex 2 and the PANS-ATM (Doc 4444), Chapter 6.

4.1.5 Flights outside controlled airspace

4.1.5.1 For IFR flights outside controlled airspace, including flights operating below the lower limit of controlled airspace, the determination of the lowest usable flight level is the responsibility of the pilot-in-command. Current or forecast QNH and temperature values should be taken into account.

4.1.5.2 It is possible that altimeter corrections below controlled airspace may accumulate to the point where the aircraft's position may impinge on a flight level or assigned altitude in controlled airspace. The pilot-in-command must then obtain clearance from the appropriate control agency.

4.2 PRESSURE CORRECTION

4.2.1 Flight levels

When flying at levels with the altimeter set to 1 013.2 hPa, the minimum safe altitude must be corrected for deviations in pressure when the pressure is lower than the standard atmosphere (1 013 hPa). An appropriate correction is 10 m (30 ft) per hPa below 1 013 hPa. Alternatively, the correction can be obtained from standard correction graphs or tables supplied by the operator.

4.2.2 QNH/QFE

When using the QNH or QFE altimeter setting (giving altitude or height above QFE datum respectively), a pressure correction is not required.

4.3 TEMPERATURE CORRECTION

4.3.1 Requirement for temperature correction

The calculated minimum safe altitudes/heights must be adjusted when the ambient temperature on the surface is much lower than that predicted by the standard atmosphere. In such conditions, an approximate correction is 4 per cent height increase for every 10°C below standard temperature as measured at the altimeter setting source. This is safe for all altimeter setting source altitudes for temperatures above –15°C.

4.3.2 Tabulated corrections

For colder temperatures, a more accurate correction should be obtained from Tables 2-4-1 a) and 2-4-1 b). These tables are calculated for a sea level aerodrome. They are therefore conservative when applied at higher aerodromes. To calculate the corrections for specific aerodromes or altimeter setting sources above sea level, or for values not tabulated, see 4.3.3, "Corrections for specific conditions".

Note 1.— The corrections have been rounded up to the next 5 m or 10 ft increment.

Note 2.— Temperature values from the reporting station (normally the aerodrome) nearest to the position of the aircraft should be used.

4.3.3 Corrections for specific conditions

Tables 2-4-1 a) and 2-4-1 b) were calculated assuming a linear variation of temperature with height. They were based on the following equation, which may be used with the appropriate value of t_0, H, L_0 and H_{ss} to calculate temperature corrections for specific conditions. This equation produces results that are within 5 per cent of the accurate correction for altimeter setting sources up to 3 000 m (10 000 ft) and with minimum heights up to 1 500 m (5 000 ft) above that source.

$$\text{Correction} = H \times \left(\frac{15 - t_0}{273 + t_0 - 0.5 \times L_0 \times (H + H_{ss})}\right)$$

where:

H	=	minimum height above the altimeter setting source (setting source is normally the aerodrome unless otherwise specified)
t_0	=	$t_{aerodrome} + L_0 \times h_{aerodrome}$ . . . aerodrome (or specified temperature reporting point) temperature adjusted to sea level
L_0	=	0.0065°C per m or 0.00198°C per ft
H_{ss}	=	altimeter setting source elevation
$t_{aerodrome}$	=	aerodrome (or specified temperature reporting point) temperature
$h_{aerodrome}$	=	aerodrome (or specified temperature reporting point) elevation

4.3.4 Accurate corrections

4.3.4.1 For occasions when a more accurate temperature correction is required, this may be obtained from Equation 24 of the Engineering Sciences Data Unit (ESDU) publication, *Performance,* Volume 2, Item Number 77022[1]. This assumes an off-standard atmosphere.

$$\frac{-\Delta t_{std}}{L_0} \ln\left(\frac{1 + L_0 \times \Delta h_{PAirplane}}{t_0 + L_0 \times \Delta h_{PAerodrome}}\right)$$

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where:

$\Delta h_{PAirplane}$	=	aircraft height above aerodrome (pressure)
$\Delta h_{GAirplane}$	=	aircraft height above aerodrome (geopotential)
Δt_{std}	=	temperature deviation from the International Standard Atmosphere (ISA) temperature
L_0	=	standard temperature lapse rate with pressure altitude in the first layer (sea level to tropopause) of the ISA
t_0	=	standard temperature at sea level

Note.— Geopotential height includes a correction to account for the variation of g (average 9.8067 m sec^2) with heights. However, the effect is negligible at the minimum altitudes considered for obstacle clearance: the difference between geometric height and geopotential height increases from zero at mean sea level to –59 ft at 36 000 ft.

4.3.4.2 The above equation cannot be solved directly in terms of $\Delta h_{GAirplane}$, and an iterative solution is required. This can be done with a simple computer or spreadsheet programme.

4.3.5 Assumption regarding temperature lapse rates

Both the above equations assume a constant off-standard temperature lapse rate. The actual lapse rate may vary considerably from the assumed standard, depending on latitude and time of year. However, the corrections derived from the linear approximation can be taken as a satisfactory estimate for general application at levels up to 4 000 m (12 000 ft). The correction from the accurate calculation is valid up to 11 000 m (36 000 ft).

Note 1.— Where required for take-off performance calculations or wherever accurate corrections are required for non-standard (as opposed to off-standard) atmospheres, appropriate methods are given in ESDU Item 78012, Height relationships for non-standard atmospheres. *This allows for non-standard temperature lapse rates and lapse rates defined in terms of either geopotential height or pressure height.*

Note 2.— Temperature values are those at the altimeter setting source (normally the aerodrome). En route, the setting source nearest to the position of the aircraft should be used.

4.3.6 Small corrections

For practical operational use, it is appropriate to apply a temperature correction when the value of the correction exceeds 20 per cent of the associated minimum obstacle clearance (MOC).

4.4 MOUNTAINOUS AREAS — EN ROUTE

The MOC over mountainous areas is normally applied during the design of routes and is stated in State aeronautical information publications. However, where no information is available, the margins in Tables 2-4-2 and 2-4-3 may be used when:

a) the selected cruising altitude or flight level or one engine inoperative stabilizing altitude is at or close to the calculated minimum safe altitude; and

b) the flight is within 19 km (10 NM) of terrain having a maximum elevation exceeding 900 m (3 000 ft).

4.5 MOUNTAINOUS TERRAIN — TERMINAL AREAS

4.5.1 The combination of strong winds and mountainous terrain can cause local changes in atmospheric pressure due to the Bernoulli effect. This occurs particularly when the wind direction is across mountain crests or ridges. It is not possible to make an exact calculation, but theoretical studies (CFD Norway, Report 109.1989) have indicated altimeter errors as shown in Tables 2-4-4 and 2-4-5. Although States may provide guidance, it is up to the pilot-in-command to evaluate whether the combination of terrain, wind strength and direction are such as to make a correction for wind necessary.

4.5.2 Corrections for wind speed should be applied in addition to the standard corrections for pressure and temperature, and ATC should be advised.

Table 2-4-1 a). Values to be added by the pilot to minimum promulgated heights/altitudes (m)

Aerodrome temperature (°C)	*Height above the elevation of the altimeter setting source (metres)*													
	60	90	120	150	180	210	240	270	300	450	600	900	1 200	1 500
0	5	5	10	10	10	15	15	15	20	25	35	50	70	85
–10	10	10	15	15	25	20	25	30	30	45	60	90	120	150
–20	10	15	20	25	25	30	35	40	45	65	85	130	170	215
–30	15	20	25	30	35	40	45	55	60	85	115	170	230	285
–40	15	25	30	40	45	50	60	65	75	110	145	220	290	365
–50	20	30	40	45	55	65	75	80	90	135	180	270	360	450

Table 2-4-1 b). Values to be added by the pilot to minimum promulgated heights/altitudes (ft)

Aerodrome temperature (°C)	*Height above the elevation of the altimeter setting source (feet)*													
	200	300	400	500	600	700	800	900	1 000	1 500	2 000	3 000	4 000	5 000
0	20	20	30	30	40	40	50	50	60	90	120	170	230	280
–10	20	30	40	50	60	70	80	90	100	150	200	290	390	490
–20	30	50	60	70	90	100	120	130	140	210	280	420	570	710
–30	40	60	80	100	120	140	150	170	190	280	380	570	760	950
–40	50	80	100	120	150	170	190	220	240	360	480	720	970	1 210
–50	60	90	120	150	180	210	240	270	300	450	590	890	1 190	1 500

Table 2-4-2. Margin in mountainous areas (SI units)

Terrain variation	*MOC*
Between 900 m and 1 500 m	450 m
Greater than 1 500 m	600 m

Table 2-4-3. Margin in mountainous areas (non-SI units)

Terrain variation	*MOC*
Between 3 000 ft and 5 000 ft	1 476 ft
Greater than 5 000 ft	1 969 ft

Table 2-4-4. Altimeter error due to wind speed (SI units)

Wind speed (km/h)	*Altimeter error (m)*
37	17
74	62
111	139
148	247

Table 2-4-5. Altimeter error due to wind speed (non-SI units)

Wind speed (kt)	*Altimeter error (ft)*
20	53
40	201
60	455
80	812

Note.— The wind speed values were measured 30 m above aerodrome elevation.

Section 3

SIMULTANEOUS OPERATIONS ON PARALLEL OR NEAR-PARALLEL INSTRUMENT RUNWAYS

Chapter 1

MODES OF OPERATION

1.1 INTRODUCTION

1.1.1 The impetus for considering simultaneous operations on parallel or near-parallel instrument runways in instrument meteorological conditions (IMC) is provided by the need to increase capacity at busy aerodromes. An aerodrome that already has published procedures approved for simultaneous parallel approach operations could increase its capacity if these runways could be safely operated simultaneously and independently under IMC.

1.1.2 However, various factors, such as surface movement guidance and control, environmental considerations, and landside/airside infrastructure, may negate the advantage to be gained from simultaneous operations.

Note.— Guidance material is contained in the Manual on Simultaneous Operations on Parallel or Near-Parallel Instrument Runways (SOIR) *(Doc 9643).*

1.2 MODES OF OPERATION

1.2.1 There can be a variety of modes of operation associated with the use of parallel or near-parallel instrument runways.

1.2.1.1 *Modes One and Two — Simultaneous parallel instrument approaches*

There are two basic modes of operation for approaches made to parallel runways:

> *Mode 1, Independent parallel approaches:* In this mode, ATS surveillance system separation minima between aircraft using adjacent published instrument approach procedures are not prescribed.
>
> *Mode 2, Dependent parallel approaches:* In this mode, ATS surveillance system separation minima between aircraft using adjacent published instrument approach procedures are prescribed.

1.2.1.2 *Mode 3 — Simultaneous instrument departures*

> *Mode 3, Independent parallel departures:* In this mode, aircraft are departing in the same direction from parallel runways simultaneously.

Note.— When the minimum distance between two parallel runway centre lines is less than the specified value dictated by wake turbulence considerations, the parallel runways are considered as a single runway in regard to separation between departing aircraft. A simultaneous dependent parallel departure mode of operation is therefore not used.

1.2.1.3 *Mode 4 — Segregated parallel approaches/departures*

Mode 4, Segregated parallel operations: In this mode, one runway is used for approaches and one runway is used for departures.

1.2.1.4 *Semi-mixed and mixed operations*

1.2.1.4.1 In the case of parallel approaches and departures, there may be semi-mixed operations. In this scenario:

a) one runway is used exclusively for departures while the other runway accepts a mixture of approaches and departures; or

b) one runway is used exclusively for approaches while the other runway accepts a mixture of approaches and departures.

1.2.1.4.2 There may also be mixed operations, i.e. simultaneous parallel approaches with departures interspersed on both runways.

1.2.1.4.3 Semi-mixed or mixed operations may be related to the four basic modes listed in 1.2.1.1 through 1.2.1.3 as follows:

a) *Semi-mixed operations:*	*Mode*
1) One runway is used exclusively for approaches while:	
i) approaches are being made to the other runway; or	1 or 2
ii) departures are in progress on the other runway.	4
2) One runway is used exclusively for departures while:	
i) approaches are being made to the other runway; or	4
ii) departures are in progress on the other runway.	3
b) *Mixed operations:*	
All modes of operation are possible.	1, 2, 3, 4

1.3 OPERATIONAL APPROVAL

1.3.1 Aircraft Eligibility

1.3.1.1 An aircraft may be utilized for parallel operations if:

a) for operations utilizing a precision approach, the aircraft has the relevant precision approach capability; and

b) for operations utilizing a PBN approach, the aircraft meets the eligibility requirements for the particular navigation specification used in the design of the procedures.

Note.— More information on aircraft eligibility for navigation specification is contained in the Performance-based Navigation (PBN) Manual *(Doc 9613).*

1.4 PARALLEL APPROACH OPERATIONS

Independent/dependent parallel approaches operations may be conducted using any combination of three-dimensional (3D) instrument approach operations provided that:

a) instrument approach charts are available that contain operational notes regarding the parallel approach procedures;

b) aircraft are advised as early as possible of the assigned runway, instrument approach procedures and any additional information considered necessary to confirm correct selection;

c) the final approach course or track is intercepted by use of:

   1) vectoring; or

   2) a published arrival and approach procedure that intercepts with the IAF or IF;

d) as early as practicable after an aircraft has established communication with approach control, the aircraft is advised that independent parallel approaches are in force. This information may be provided through the automatic terminal information service (ATIS) broadcasts. In addition, the aircraft shall be advised of the runway identification and the ILS localizer and/or MLS frequency to be used; and

e) dedicated radio channels or override capability for the monitoring controllers to use for the appropriate voice communication facilities are provided.

Note.— Refer to Procedures for Air Navigation Services — Air Traffic Management *(PANS-ATM, Doc 4444), Chapter 6 for further detail.*

1.5 INTERCEPTING THE FINAL APPROACH COURSE OR TRACK

1.5.1 When simultaneous independent parallel approaches are in progress, the following apply:

a) the main objective is that both aircraft be established on the approved instrument approach procedure final approach course or track before the 300 m (1 000 ft) vertical separation is reduced;

b) all approaches, regardless of weather conditions, will be monitored using an ATS surveillance system. Control instructions and information to ensure separation between aircraft and to ensure that aircraft do not enter the NTZ will be issued as necessary. The air traffic control procedure will be to either vector arriving aircraft or use an arrival or approach procedure to position the aircraft for an intercept of one or the other of the parallel approach courses or tracks. When cleared for an ILS or MLS approach, a procedure turn is not permitted;

c) when vectoring to intercept the final approach course or track, the final vector will meet the following conditions:

   1) enable the aircraft to intercept at an angle not greater than 30 degrees;

2) provide at least 1.9 km (1.0 NM) straight and level flight prior to the final approach course or track intercept; and

3) enable the aircraft to be established on the final approach course or track, in level flight for at least 3.7 km (2.0 NM) prior to intercepting the glide path or vertical path for the selected instrument approach procedure;

d) the published arrival or approach procedure used to position the aircraft for an intercept of the final course or track will be designed in accordance with the procedures detailed in PANS-OPS, Volume II, Part II, Section 1, with specific reference to simultaneous approaches to parallel or near-parallel instrument runways;

e) each pair of parallel approaches will have a "high side" and a "low side" for positioning aircraft to provide vertical separation until aircraft are established inbound on their respective parallel final approach course or track. The low side altitude will normally be such that the aircraft will be established on the final approach course or track well before glide path or vertical path interception. The high side altitude will be 300 m (1 000 ft) above the low side.

Note.— The application of vertical separation may be discontinued after the initial approach fix (IAF) or intermediate approach fix (IF) when an aircraft is established on an RNP AR APCH procedure, in accordance with the provisions in the Procedures for Air Navigation Services — Air Traffic Management *(PANS-ATM, Doc 4444)*, Chapter 6.

f) when the aircraft is assigned its final heading to intercept the final approach course or track, it will be advised of:

1) the altitude to be maintained until:

i) the aircraft is established on the final approach course or track; and

ii) the aircraft has reached the glide path or vertical path intercept point; and

2) if required, clearance for the final approach;

g) if an aircraft is observed to overshoot the turn-to-final or to continue on a track which will penetrate the NTZ, the aircraft will be instructed to return immediately to the correct track. Pilots are not required to acknowledge these transmissions or subsequent instructions while on final approach unless requested to do so;

h) once the 300 m (1 000 ft) vertical separation is reduced, the controller monitoring the approach will issue control instructions if the aircraft deviates substantially from the final approach course or track;

i) if an aircraft that deviates substantially from the final approach course or track fails to take corrective action and penetrates the NTZ, the aircraft on the adjacent final approach course or track will be instructed to immediately climb and turn to the assigned altitude and heading in order to avoid the deviating aircraft.

1.5.2 Where parallel approach obstacle assessment surfaces (PAOAS) criteria are applied for obstacle assessment, the heading instruction will not exceed 45 degrees track difference with the final approach course or track. The air traffic controller will not issue the heading instruction to the aircraft below 120 m (400 ft) above the runway threshold elevation.

1.5.3 Due to the nature of this break-out manoeuvre, the pilot is expected to arrest the descent and immediately initiate a climbing turn.

1.6 TERMINATION OF FLIGHT PATH MONITORING

Note.— Provisions concerning the termination of flight path monitoring during simultaneous parallel operations are contained in the PANS-ATM (Doc 4444), Chapter 6.

1.7 TRACK DIVERGENCE

Simultaneous parallel operations require diverging tracks for missed approach procedures and departures. When turns are prescribed to establish divergence, pilots shall begin the turns as soon as practicable.

1.8 SUSPENSION OF INDEPENDENT PARALLEL APPROACHES TO CLOSELY SPACED PARALLEL RUNWAYS

Note.— Provisions concerning the suspension of independent parallel approaches to closely spaced parallel runways are contained in the PANS-ATM (Doc 4444), Chapter 6.

Section 4

SECONDARY SURVEILLANCE RADAR (SSR) TRANSPONDER OPERATING PROCEDURES

Chapter 1

OPERATION OF TRANSPONDERS

1.1 GENERAL

1.1.1 When an aircraft carries a serviceable transponder, the pilot shall operate the transponder at all times during flight, regardless of whether the aircraft is within or outside airspace where secondary surveillance radar (SSR) is used for ATS purposes.

1.1.2 Except in case of emergency, communication failure or unlawful interference (see 1.4, 1.5 and 1.6), the pilot shall:

a) operate the transponder and select Mode A codes as directed by the ATC unit with which contact is being made; or

b) operate the transponder on Mode A codes as prescribed on the basis of regional air navigation agreements; or

c) in the absence of any ATC directions or regional air navigation agreements, operate the transponder on Mode A Code 2000.

1.1.3 When the aircraft carries serviceable Mode C equipment, the pilot shall continuously operate this mode, unless otherwise directed by ATC.

1.1.4 When requested by ATC to specify the capability of the transponder aboard the aircraft, pilots shall indicate this in item 10 of the flight plan by inserting the appropriate letter prescribed for the purpose.

1.1.5 When requested by ATC to CONFIRM SQUAWK (*code),* the pilot shall:

a) verify the Mode A code setting on the transponder;

b) reselect the assigned code if necessary; and

c) confirm to ATC the setting displayed on the controls of the transponder.

Note.— For action in case of unlawful interferences, see 1.6.2.

1.1.6 Pilots shall not SQUAWK IDENT unless requested by ATC.

1.2 USE OF MODE C

Whenever Mode C is operated, pilots shall, in air-ground voice communications where level information is required, give such information by stating their level to the nearest full 30 m or 100 ft as indicated on the pilot's altimeter.

1.3 USE OF MODE S

Pilots of aircraft equipped with Mode S having an aircraft identification feature shall set the aircraft identification in the transponder. This setting shall correspond to the aircraft identification specified in item 7 of the ICAO flight plan, or, if no flight plan has been filed, the aircraft registration.

Note.— All Mode S equipped aircraft engaged in international civil aviation are required to have an aircraft identification feature.

1.4 EMERGENCY PROCEDURES

The pilot of an aircraft in a state of emergency shall set the transponder to Mode A Code 7700 unless ATC has previously directed the pilot to operate the transponder on a specified code. In the latter case, the pilot shall continue to use the specified code unless otherwise advised by ATC. However, a pilot may select Mode A Code 7700 whenever there is a specific reason to believe that this would be the best course of action.

1.5 COMMUNICATION FAILURE PROCEDURES

The pilot of an aircraft losing two-way communications shall set the transponder to Mode A Code 7600.

Note.— A controller who observes an SSR response indicating selection of the communications failure code will determine the extent of the failure by instructing the pilot to SQUAWK IDENT or to change code. If it is determined that the aircraft receiver is functioning, further control of the aircraft will be continued using code changes or IDENT transmission to acknowledge receipt of clearances. Different procedures may be applied to Mode S equipped aircraft in areas of Mode S coverage.

1.6 UNLAWFUL INTERFERENCE WITH AIRCRAFT IN FLIGHT

1.6.1 If there is unlawful interference with an aircraft in flight, the pilot-in-command shall attempt to set the transponder to Mode A Code 7500 in order to indicate the situation. If circumstances so warrant, Code 7700 should be used instead.

1.6.2 If a pilot has selected Mode A Code 7500 and has been requested to confirm this code by ATC (in accordance with 1.1.5), the pilot shall, according to circumstances, either confirm this or not reply at all.

Note.— If the pilot does not reply, ATC will take this as confirmation that the use of Code 7500 is not an inadvertent false code selection.

1.7 TRANSPONDER FAILURE PROCEDURES WHEN THE CARRIAGE OF A FUNCTIONING TRANSPONDER IS MANDATORY

1.7.1 In case of a transponder failure after departure, ATC units shall attempt to provide for continuation of the flight to the destination aerodrome in accordance with the flight plan. Pilots may, however, expect to comply with specific restrictions.

1.7.2 In the case of a transponder which has failed and cannot be restored before departure, pilots shall:

a) inform ATS as soon as possible, preferably before submission of a flight plan;

b) insert in item 10 of the ICAO flight plan form under SSR the character N for complete unserviceability of the transponder or, in case of partial transponder failure, insert the character corresponding to the remaining transponder capability;

c) comply with any published procedures for requesting an exemption from the requirements to carry a functioning SSR transponder; and

d) if required by the appropriate ATS authority, plan to proceed, as directly as possible, to the nearest suitable aerodrome where repair can be carried out.

Chapter 2

PHRASEOLOGY

2.1 PHRASEOLOGY USED BY ATS

The phraseology used by ATS is contained in the PANS-ATM (Doc 4444), Chapter 12.

2.2 PHRASEOLOGY USED BY PILOTS

Pilots shall read back the mode and code to be set when they acknowledge mode/code setting instructions.

Chapter 3

OPERATION OF AIRBORNE COLLISION AVOIDANCE SYSTEM (ACAS) EQUIPMENT

3.1 ACAS OVERVIEW

3.1.1 The information provided by an ACAS is intended to assist pilots in the safe operation of aircraft by providing advice on appropriate action to reduce the risk of collision. This is achieved through resolution advisories (RAs), which propose manoeuvres, and through traffic advisories (TAs), which are intended to prompt visual acquisition and to act as a warning that an RA may follow. TAs indicate the approximate positions of intruding aircraft that may later cause resolution advisories. RAs propose vertical manoeuvres that are predicted to increase or maintain separation from threatening aircraft. ACAS I equipment is only capable of providing TAs, while ACAS II is capable of providing both TAs and RAs. In this chapter, reference to ACAS means ACAS II.

3.1.2 ACAS indications shall be used by pilots in the avoidance of potential collisions, the enhancement of situational awareness, and the active search for, and visual acquisition of, conflicting traffic.

3.1.3 Nothing in the procedures specified in 3.2 hereunder shall prevent pilots-in-command from exercising their best judgement and full authority in the choice of the best course of action to resolve a traffic conflict or avert a potentia1 collision.

Note 1.— The ability of ACAS to fulfil its role of assisting pilots in the avoidance of potential collisions is dependent on the correct and timely response by pilots to ACAS indications. Operational experience has shown that the correct response by pilots is dependent on the effectiveness of the initial and recurrent training in ACAS procedures.

Note 2.— The normal operating mode of ACAS is TA/RA. The TA-only mode of operation is used in certain aircraft performance limiting conditions caused by in-flight failures or as otherwise promulgated by the appropriate authority.

Note 3.— ACAS Training Guidelines for Pilots are provided in the Attachment, "ACAS Training Guidelines for Pilots".

3.2 USE OF ACAS INDICATIONS

The indications generated by ACAS shall be used by pilots in conformity with the following safety considerations:

a) pilots shall not manoeuvre their aircraft in response to traffic advisories (TAs) only;

Note 1.— TAs are intended to alert pilots to the possibility of a resolution advisory (RA), to enhance situational awareness, and to assist in visual acquisition of conflicting traffic. However, visually acquired traffic may not be the same traffic causing a TA. Visual perception of an encounter may be misleading, particularly at night.

Note 2.— The above restriction in the use of TAs is due to the limited bearing accuracy and to the difficulty in interpreting altitude rate from displayed traffic information.

b) on receipt of a TA, pilots shall use all available information to prepare for appropriate action if an RA occurs; and

c) in the event of an RA, pilots shall:

1) respond immediately by following the RA as indicated, unless doing so would jeopardize the safety of the aeroplane;

Note 1.— Stall warning, wind shear, and ground proximity warning system alerts have precedence over ACAS.

Note 2.— Visually acquired traffic may not be the same traffic causing an RA. Visual perception of an encounter may be misleading, particularly at night.

2) follow the RA even if there is a conflict between the RA and an air traffic control (ATC) instruction to manoeuvre;

3) not manoeuvre in the opposite sense to an RA;

Note.— In the case of an ACAS-ACAS coordinated encounter, the RAs complement each other in order to reduce the potential for collision. Manoeuvres, or lack of manoeuvres, that result in vertical rates opposite to the sense of an RA could result in a collision with the intruder aircraft.

4) as soon as possible, as permitted by flight crew workload, notify the appropriate ATC unit of any RA which requires a deviation from the current ATC instruction or clearance;

Note.— Unless informed by the pilot, ATC does not know when ACAS issues RAs. It is possible for ATC to issue instructions that are unknowingly contrary to ACAS RA indications. Therefore, it is important that ATC be notified when an ATC instruction or clearance is not being followed because it conflicts with an RA.

5) promptly comply with any modified RAs;

6) limit the alterations of the flight path to the minimum extent necessary to comply with the RAs;

7) promptly return to the terms of the ATC instruction or clearance when the conflict is resolved; and

8) notify ATC when returning to the current clearance.

Note 1.— Procedures in regard to ACAS-equipped aircraft and the phraseology to be used for the notification of manoeuvres in response to a resolution advisory are contained in the PANS-ATM (Doc 4444), Chapters 15 and 12, respectively.

Note 2.— Where aircraft can provide automatic following of an RA when the autopilot is engaged supported by a link between ACAS and autopilot, the operational procedures in items 4) and 8) still apply.

3.3 HIGH VERTICAL RATE (HVR) ENCOUNTERS

Pilots should use appropriate procedures by which an aeroplane climbing or descending to an assigned altitude or flight level, especially with an autopilot engaged, may do so at a rate less than 8 m/s (or 1 500 ft/min) throughout the last 300 m (or 1 000 ft) of climb or descent to the assigned altitude or flight level when the pilot is made aware of another aircraft at or approaching an adjacent altitude or flight level, unless otherwise instructed by ATC. Some aircraft have auto-flight systems with the capability to detect the presence of such aircraft and adjust their vertical rate accordingly. These procedures are intended to avoid unnecessary ACAS II resolution advisories in aircraft at or approaching adjacent altitudes or flight levels. For commercial operations, these procedures should be specified by the operator. Detailed information on HVR encounters and guidance material concerning the development of appropriate procedures is contained in Attachment B to this chapter.

Attachment A to Section 4, Chapter 3

ACAS TRAINING GUIDELINES FOR PILOTS

Note.— The acronym "ACAS" is used in this attachment to indicate "ACAS II".

1. INTRODUCTION

1.1 During the implementation of ACAS and the operational evaluations conducted by States, several operational issues were identified that were attributed to deficiencies in pilot training programmes. To address these deficiencies, a set of performance-based training objectives for ACAS pilot training was developed. The training objectives cover: theory of operation; pre-flight operations; general in-flight operations; response to traffic advisories (TAs); and response to resolution advisories (RAs). The training objectives are further divided into the areas of: ACAS academic training; ACAS manoeuvre training; ACAS initial evaluation; and ACAS recurrent qualification.

1.2 ACAS academic training material has been divided into items that are considered essential training and those that are considered desirable. Those items that are deemed to be essential are a requirement for each ACAS operator. In each area, a list of objectives and acceptable performance criteria is defined. All manoeuvre training is considered essential.

1.3 In developing this material, no attempt was made to define how the training programme should be implemented. Instead, objectives were established that define the knowledge a pilot operating ACAS is expected to possess and the performance expected from a pilot who has completed ACAS training. Therefore, all pilots who operate ACAS equipment should receive the ACAS training described below.

2. ACAS ACADEMIC TRAINING

2.1 General

This training is typically conducted in a classroom environment. The knowledge demonstrations specified in this section may be achieved through the successful completion of written tests or providing correct responses to non-real-time computer-based training (CBT) questions.

2.2 Essential items

2.2.1 *Theory of operation.* The pilot must demonstrate an understanding of ACAS operation and the criteria used for issuing TAs and RAs. This training should address the following topics:

2.2.1.1 *System operation*

OBJECTIVE: Demonstrate knowledge of how ACAS functions.

CRITERIA: The pilot must demonstrate an understanding of the following functions:

a) Surveillance:

1) ACAS interrogates other transponder-equipped aircraft within a nominal range of 26 km (14 NM); and

2) ACAS surveillance range can be reduced in geographic areas with a large number of ground interrogators and/or ACAS-equipped aircraft. A minimum surveillance range of 8.5 km (4.5 NM) is guaranteed for ACAS aircraft that are airborne.

Note.— If the operator's ACAS installation provides for the use of the Mode S extended squitter, the normal surveillance range may be increased beyond the nominal 14 NM. However, this information is not used for collision avoidance purposes.

b) Collision avoidance:

1) TAs can be issued against any transponder-equipped aircraft that responds to the ICAO Mode C interrogations, even if the aircraft does not have altitude-reporting capability;

Note.— SSR transponders having only Mode A capability do not generate TAs. ACAS does not use Mode A interrogations; therefore, the Mode A transponder codes of nearby aircraft are not known to ACAS. In ICAO SARPs, Mode C minus the altitude is not considered Mode A because of the difference in the pulse intervals. ACAS uses the framing pulses of replies to Mode C interrogations and will track and may display aircraft equipped with an operating Mode A/C transponder whether or not the altitude-reporting function has been enabled.

2) RAs can be issued only against aircraft that are reporting altitude and in the vertical plane only;

3) RAs issued against an ACAS-equipped intruder are coordinated to ensure that complementary RAs are issued;

4) failure to respond to an RA deprives the aircraft of the collision protection provided by its ACAS. Additionally, in ACAS-ACAS encounters, it also restricts the choices available to the other aircraft's ACAS and thus renders the other aircraft's ACAS less effective than if the first aircraft were not ACAS-equipped; and

5) manoeuvring in a direction opposite to that indicated by an RA is likely to result in further reduction in separation. This is particularly true in the case of an ACAS-ACAS coordinated encounter.

2.2.1.2 *Advisory thresholds*

OBJECTIVE: Demonstrate knowledge of the criteria for issuing TAs and RAs.

CRITERIA: The pilot must be able to demonstrate an understanding of the methodology used by ACAS to issue TAs and RAs and the general criteria for the issuance of these advisories to include:

a) ACAS advisories are based on time to closest point of approach (CPA) rather than distance. The time must be short and vertical separation must be small, or projected to be small, before an advisory can be issued. The separation standards provided by air traffic services are different from those against which ACAS issues alerts;

b) thresholds for issuing a TA or RA vary with altitude. The thresholds are larger at higher altitudes;

c) TAs generally occur from 20 to 48 seconds prior to CPA. When ACAS is operated in TA-only mode, RAs will be inhibited;

d) RAs occur from 15 to 35 seconds before the projected CPA; and

e) RAs are chosen to provide the desired vertical separation at CPA. As a result, RAs can instruct a climb or descent through the intruder aircraft's altitude.

2.2.1.3 *ACAS limitations*

OBJECTIVE: To verify that the pilot is aware of the limitations of ACAS.

CRITERIA: The pilot must demonstrate a knowledge and understanding of the ACAS limitations including:

a) ACAS will neither track nor display non-transponder-equipped aircraft, nor aircraft with an inoperable transponder, nor aircraft with a Mode A transponder;

b) ACAS will automatically fail if the input from the aircraft's barometric altimeter, radio altimeter, or transponder is lost;

Note.— In some installations, the loss of information from other on-board systems such as an inertial reference system (IRS) or attitude and heading reference system (AHRS) may result in an ACAS failure. Individual operators should ensure that their pilots are aware of what types of aircraft system failures will result in an ACAS failure.

c) some aircraft within 116 m (380 ft) above ground level (AGL) (nominal value) will not be displayed. If ACAS is able to determine that an aircraft below this altitude is airborne, it will be displayed;

d) ACAS may not display all proximate transponder-equipped aircraft in areas of high-density traffic; however, it will still issue RAs as necessary;

e) because of design limitations, the bearing displayed by ACAS is not sufficiently accurate to support the initiation of horizontal manoeuvres based solely on the traffic display;

f) because of design limitations, ACAS will neither display nor give alerts against intruders with a vertical speed in excess of 3 048 m/min (10 000 ft/min). In addition, the design implementation may result in some short-term errors in the tracked vertical speed of an intruder during periods of high vertical acceleration by the intruder; and

g) stall warnings, ground proximity warning system (GPWS) warnings and wind shear warnings take precedence over ACAS advisories. When either a GPWS or wind shear warning is active, ACAS will automatically switch to the TA-only mode of operation except that ACAS aural annunciations will be inhibited. ACAS will remain in TA-only mode for 10 seconds after the GPWS or wind shear warning is removed.

2.2.1.4 *ACAS inhibits*

OBJECTIVE: To verify that the pilot is aware of the conditions under which certain functions of ACAS are inhibited.

CRITERIA: The pilot must demonstrate a knowledge and understanding of the various ACAS inhibits including:

a) increase descent RAs are inhibited below 442 (±30) m (1 450 (±100) ft) AGL;

b) descend RAs are inhibited below 335 (±30) m (1 100 (±100) ft) AGL;

c) all RAs are inhibited below 305 (±30) m (1 000 (±100) ft) AGL;

d) all ACAS aural annunciations are inhibited below 152 (±30) m (500 (±100) ft) AGL. This includes the aural annunciation for TAs; and

e) altitude and configuration under which climb and increase climb RAs are inhibited. ACAS can still issue climb and increase climb RAs when operating at the aircraft's maximum altitude or certified ceiling. However, if aeroplane performance at maximum altitude is not sufficient to enable compliance with the climb rate required by a climb RA, the response should still be in the required sense but not beyond the extent permitted by aeroplane performance limitations.

Note.— In some aircraft types, climb or increase climb RAs are never inhibited.

2.2.2 *Operating procedures*. The pilot must demonstrate the knowledge required to operate ACAS and interpret the information presented by ACAS. This training should address the following topics:

2.2.2.1 *Use of controls*

OBJECTIVE: To verify that the pilot can properly operate all ACAS and display controls.

CRITERIA: Demonstrate the proper use of controls including:

a) aircraft configuration required to initiate a self-test;

b) steps required to initiate a self-test;

c) recognizing when the self-test is successful and when it is unsuccessful. When the self-test is unsuccessful, recognizing the reason for the failure, and, if possible, correcting the problem;

d) recommended usage of traffic display range selection. Low ranges are used in the terminal area, and the higher display ranges are used in the en-route environment and in the transition between the terminal and en-route environment;

e) if available, recommended usage of the AAbove/Below@ mode selector. AAbove@ mode should be used during climb, and ABelow@ mode should be used during descent;

f) recognition that the configuration of the traffic display, i.e. range and AAbove/Below@ selection, does not affect the ACAS surveillance volume;

g) selection of lower ranges on the traffic display to increase display resolution when an advisory is issued;

h) if available, proper selection of the display of absolute or relative altitude and the limitations of using the absolute display option if a barometric correction is not provided to ACAS; and

i) proper configuration to display the appropriate ACAS information without eliminating the display of other needed information.

Note.— The wide variety of display implementations makes it difficult to establish more definitive criteria. When the training programme is developed, these general criteria should be expanded to cover specific details for an operator's specific display implementation.

2.2.2.2 *Display interpretation*

OBJECTIVE: To verify that a pilot understands the meaning of all information that can be displayed by ACAS.

CRITERIA: The pilot must demonstrate the ability to properly interpret information displayed by ACAS including:

a) other traffic, i.e. traffic within the selected display range that is not proximate traffic, or causing a TA or RA to be issued;

b) proximate traffic, i.e. traffic that is within 11 km (6 NM) and ∀366 m (1 200 ft);

c) non-altitude reporting traffic;

d) no bearing TAs and RAs;

e) off-scale TAs and RAs. The selected range should be changed to ensure that all available information on the intruder is displayed;

f) traffic advisories. The minimum available display range that allows the traffic to be displayed should be selected to provide the maximum display resolution;

g) resolution advisories (traffic display). The minimum available display range of the traffic display that allows the traffic to be displayed should be selected to provide the maximum display resolution;

h) resolution advisories (RA display). Pilots should demonstrate knowledge of the meaning of the red and green areas or the meaning of pitch or flight path angle cues displayed on the RA display. For displays using red and green areas, pilots should demonstrate knowledge of when the green areas will and will not be displayed. Pilots should also demonstrate an understanding of the RA display limitations, i.e. if a vertical speed tape is used and the range of the tape is less than 762 m/min (2 500 ft/min), how an increase rate RA will be displayed; and

i) if appropriate, awareness that navigation displays oriented ATrack-Up@ may require a pilot to make a mental adjustment for drift angle when assessing the bearing of proximate traffic.

Note.— The wide variety of display implementations will require the tailoring of some criteria. When the training programme is developed, these criteria should be expanded to cover details for an operator's specific display implementation.

2.2.2.3 *Use of the TA-only mode*

OBJECTIVE: To verify that a pilot understands the appropriate times to select the TA-only mode of operation and the limitations associated with using this mode.

CRITERIA: The pilot must demonstrate the following:

a) knowledge of the operator's guidance for the use of TA-only mode;

b) reasons for using this mode and situations in which its use may be desirable. These include operating in known close proximity to other aircraft such as when visual approaches are being used to closely spaced parallel runways or taking off towards aircraft operating in a VFR corridor. If TA-only mode is not selected when an airport is conducting simultaneous operations from parallel runways separated by less than 366 m (1 200 ft), and to some intersecting runways, RAs can be expected. If an RA is received in these situations, the response should comply with the operator's approved procedures; and

c) the TA aural annunciation is inhibited below 152 m (∀30) m (500 ft (∀100 ft)) AGL. As a result, TAs issued below 152 m (500 ft) AGL may not be noticed unless the TA display is included in the routine instrument scan.

2.2.2.4 *Crew coordination*

OBJECTIVE: To verify that pilots adequately brief other crew members on how ACAS advisories will be handled.

CRITERIA: Pilots must demonstrate that their pre-flight briefing addresses the procedures that will be used in responding to TAs and RAs including:

a) division of duties between the pilot flying (PF) and the pilot not flying, including a clear definition of whether the pilot flying or the pilot-in-command will fly the aircraft during a response to an RA;

b) expected call-outs;

c) communications with ATC; and

d) conditions under which an RA may not be followed and who will make this decision.

Note 1.— Different operators have different procedures for conducting pre-flight briefings and for responding to ACAS advisories. These factors should be taken into consideration when implementing the training programme.

Note 2.— The operator must specify the conditions under which an RA need not be followed, reflecting advice published by States' Civil Aviation Authorities. This should not be an item left to the discretion of a crew.

Note 3.— This portion of the training may be combined with other training such as crew resource management (CRM).

2.2.2.5 *Reporting requirements*

OBJECTIVE: To verify that the pilot is aware of the requirements for reporting RAs to the controller and other authorities.

CRITERIA: The pilot must demonstrate the following:

a) the use of the phraseology contained in the *Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM, Doc 4444); and

b) where information can be obtained regarding the need for making written reports to various States when an RA is issued. Various States have different reporting requirements and the material available to the pilot should be tailored to the airline's operating environment.

2.3 Desirable items

2.3.1 *Advisory thresholds*

OBJECTIVE: Demonstrate knowledge of the criteria for issuing TAs and RAs.

CRITERIA: The pilot must be able to demonstrate an understanding of the methodology used by ACAS to issue TAs and RAs and the general criteria for the issuance of these advisories to include:

a) the TA altitude threshold is 259 m (850 ft) below FL 420 and 366 m (1 200 ft) above FL 420;

b) when the vertical separation at CPA is projected to be less than the ACAS-desired separation, an RA requiring a change to the existing vertical speed will be issued. The ACAS-desired separation varies from 91 m (300 ft) at low altitude to a maximum of 213 m (700 ft) above FL 300;

c) when the vertical separation at CPA is projected to be greater than the ACAS-desired separation, an RA that does not require a change to the existing vertical speed will be issued. This separation varies from 183 to 244 m (600 to 800 ft); and

d) RA fixed-range thresholds vary between 0.4 km (0.2 NM) at low altitude and 2 km (1.1 NM) at high altitude. These fixed-range thresholds are used to issue RAs in encounters with slow closure rates.

3. ACAS MANOEUVRE TRAINING

3.1 When training pilots to properly respond to ACAS-displayed information, TAs and RAs are most effective when accomplished in a flight simulator equipped with an ACAS display and controls similar in appearance and operation to those in the aircraft. If a simulator is utilized, CRM aspects of responding to TAs and RAs should be practised during this training.

3.2 If an operator does not have access to an ACAS-equipped simulator, the initial ACAS evaluation should be conducted by means of an interactive CBT with an ACAS display and controls similar in appearance and operation to those in the aircraft the pilot will fly. This interactive CBT should depict scenarios in which real-time responses must be made. The pilot should be informed whether or not the responses made were correct. If the response was incorrect or inappropriate, the CBT should show what the correct response should be.

3.3 The scenarios in the manoeuvre training should include initial RAs that require a change in vertical speed; initial RAs not requiring a change in vertical speed; maintain rate RAs; altitude crossing RAs; increase rate RAs; RA reversals; weakening RAs; RAs issued while the aircraft is at a maximum altitude, and multi-aircraft encounters. In all scenarios, excursions should be limited to the extent required by the RA. The scenarios should be concluded with a return to the original flight profile. The scenarios should also include demonstrations of the consequences of not responding to RAs, slow or late responses, and manoeuvring opposite to the direction called for by the displayed RA as follows:

3.3.1 *TA responses*

OBJECTIVE: To verify that the pilot properly interprets and responds to TAs.

CRITERIA: The pilot must demonstrate:

a) proper division of responsibilities between the pilot flying and the pilot not flying. The pilot flying should continue to fly the aeroplane and be prepared to respond to any RA that might follow. The pilot not flying should provide updates on the traffic location shown on the ACAS traffic display and use this information to help visually acquire the intruder;

b) proper interpretation of the displayed information. Visually search for the traffic causing the TA at a location shown on the traffic display. Use should be made of all information shown on the display, note being taken of the bearing and range of the intruder (amber circle), whether it is above or below (data tag), and its vertical speed direction (trend arrow);

c) other available information is used to assist in visual acquisition. This includes ATC "party-line" information, traffic flow in use, etc.;

d) because of the limitations described in 2.2.1.3 e), that no manoeuvres are made based solely on the information shown on the ACAS display; and

e) when visual acquisition is attained, right of way rules are used to maintain or attain safe separation. No unnecessary manoeuvres are initiated. The limitations of making manoeuvres based solely on visual acquisition are understood.

3.3.2 *RA responses*

OBJECTIVE: To verify that the pilot properly interprets and responds to RAs.

CRITERIA: The pilot must demonstrate:

a) proper division of responsibilities between the pilot flying and the pilot not flying. The pilot flying should respond to the RA with positive control inputs, when required, while the pilot not flying is providing updates on the traffic location, checking the traffic display and monitoring the response to the RA. Proper CRM should be used. If the operator's procedures require the pilot-in-command to fly all RAs, transfer of aircraft control should be demonstrated;

b) proper interpretation of the displayed information. The pilot recognizes the intruder causing the RA to be issued (red square on display). The pilot responds appropriately;

c) for RAs requiring a change in vertical speed, initiation of a response in the proper direction within five seconds of the RA being displayed. Pilot actions must focus on tasks related to manoeuvring the aeroplane in response to the RA and flight crew coordination, avoiding distractions that may interfere with a correct and timely response. After initiating the manoeuvre, and as soon as possible, as permitted by flight workload, ATC is notified using the standard phraseology if the manoeuvre requires a deviation from the current ATC instruction or clearance;

Note.— Chapter 3, 3.2 c) 1), states that in the event of an RA, pilots should respond immediately and manoeuvre as indicated, unless doing so would jeopardize the safety of the aeroplane.

d) for RAs not requiring a change in vertical speed, focus on tasks associated with following the RA, including preparedness for a modification to the initially displayed RA where a change in vertical speed may be required. Distractions that may interfere with a correct and timely response must be avoided;

e) recognition of and the proper response to modifications to the initially displayed RA:

1) for increase rate RAs, the vertical speed is increased within 2 1/2 seconds of the RA being displayed;

2) for RA reversals, the manoeuvre is initiated within 2 1/2 seconds of the RA being displayed;

3) for RA weakenings, the vertical speed is modified to initiate a return towards level flight within 2 1/2 seconds of the RA being displayed; and

4) for RAs that strengthen, the manoeuvre to comply with the revised RA is initiated within 2 1/2 seconds of the RA being displayed;

f) recognition of altitude crossing encounters and the proper response to these RAs;

g) for RAs that do not require a change in vertical speed, the vertical speed needle or pitch angle remains outside the red area on the RA display;

h) for maintain rate RAs, the vertical speed is not reduced. Pilots should recognize that a maintain rate RA may result in crossing through the intruder's altitude;

i) that if a justified decision is made to not follow an RA, the resulting vertical rate is not in a direction opposite to the sense of the displayed RA;

j) that the deviation from the current clearance is minimized by levelling the aircraft when the RA weakens and when "Clear of Conflict" is annunciated, executing a prompt return to the current clearance; and notifying ATC as soon as possible, as permitted by flight crew workload;

k) that when possible, an ATC clearance is complied with while responding to an RA. For example, if the aircraft can level at the assigned altitude while responding to a reduce climb or reduce descent RA, it should be done;

l) that when simultaneous conflicting instructions to manoeuvre are received from ATC and an RA, the RA is followed and, as soon as possible, as permitted by flight crew workload, ATC is notified using the standard phraseology;

m) a knowledge of the ACAS multi-aircraft logic and its limitations, and that ACAS can optimize separation from two aircraft by climbing or descending towards one of them. For example, ACAS considers as intruders only aircraft that it finds to be a threat when selecting an RA. As such, it is possible for ACAS to issue an RA against one intruder, which results in a manoeuvre towards another intruder that is not classified as a threat. If the second intruder becomes a threat, the RA will be modified to provide separation from that intruder;

n) a knowledge of the consequences of not responding to an RA and manoeuvring in the direction opposite to the RA; and

o) that a prompt response is made when a climb RA is issued while the aircraft is at the maximum altitude.

4. ACAS INITIAL EVALUATION

4.1 The pilot's understanding of the academic training items should be assessed by means of a written test or interactive CBT that records correct and incorrect responses to questions.

4.2 The pilot's understanding of the manoeuvre training items should be assessed in a flight simulator equipped with an ACAS display and controls similar in appearance and operation to those in the aircraft the pilot will fly, and the results assessed by a qualified instructor, inspector, or check pilot. The range of scenarios should include: initial RAs requiring a change in vertical speed; initial RAs that do not require a change in vertical speed; maintain rate RAs; altitude crossing RAs; increase rate RAs; RA reversals; weakening RAs; RAs issued while the aircraft is at the maximum altitude, and multi-aircraft encounters. In all scenarios, excursions should be limited to the extent required by the RA. The scenarios should be concluded with a return to the original flight profile. The scenarios should also include demonstrations of the consequences of not responding to RAs, slow or late responses, and manoeuvring opposite to the direction called for by the displayed RA.

4.3 If an operator does not have access to an ACAS-equipped simulator, the initial ACAS evaluation should be conducted by means of an interactive CBT with an ACAS display and controls similar in appearance and operation to those in the aircraft the pilot will fly. This interactive CBT should depict scenarios in which real-time responses must be made, and a record should be made of whether or not each response was correct. The CBT should include all types of RAs described in 4.2.

5. ACAS RECURRENT TRAINING

5.1 ACAS recurrent training ensures that pilots maintain the appropriate ACAS knowledge and skills. ACAS recurrent training should be integrated into and/or conducted in conjunction with other established recurrent training programmes. An essential item of recurrent training is the discussion of any significant issues and operational concerns that have been identified by the operator.

5.2 ACAS monitoring programmes periodically publish findings from their analyses of ACAS events. The results of these analyses typically discuss technical and operational issues related to the use and operation of ACAS. This information is available from ICAO or directly from the monitoring programmes. ACAS recurrent training programmes should address the results of monitoring programmes in both the academic and simulator portions of recurrent training visits.

Note.— ACAS monitoring programmes are carried out by some States and international organizations including the United States' Federal Aviation Administration (FAA) and the European Organisation for the Safety of Air Navigation (EUROCONTROL).

5.3 Recurrent training should include both academic and manoeuvre training and address any significant issues identified by line operating experience, system changes, procedural changes, or unique characteristics such as the introduction of new aircraft/ display systems or operations in airspace where high numbers of TAs and RAs have been reported.

5.4 Pilots should fly all scenarios once every four years.

5.5 Pilots should complete all scenarios once every two years if CBT is used.

Attachment B to Section 4, Chapter 3

ACAS HIGH VERTICAL RATE (HVR) ENCOUNTERS

1. ACAS PERFORMANCE DURING HIGH VERTICAL RATE (HVR) ENCOUNTERS

1.1 As of 2006, data collected by ACAS monitoring programmes continue to show that a large percentage of ACAS RAs are a result of climbing or descending aircraft maintaining a high vertical speed while approaching their ATC-assigned altitude. Changes have been made to the ACAS SARPs and guidance material (see Annex 10, Volume I) that have been effective in reducing the frequency of occurrence for these types of RAs, but these types of RAs continue to occur with a high degree of regularity in airspace throughout the world. It has been determined that no further changes are feasible within ACAS to address this issue without resulting in an unacceptable degradation of the safety provided by ACAS.

1.2 Modern aircraft and their flight guidance systems (autopilots, flight management systems, and autothrottles) are designed to fly specific flight profiles that provide fuel and time-efficient flight paths. An integral concept of the design of the flight guidance systems includes allowing an aircraft to quickly climb to higher, more efficient operating altitudes and to remain at these altitudes as long as possible, which results in descents also being made with high vertical speeds. For economic benefits, the high vertical speeds used in a climb or descent are retained as long as feasible before initiating a smooth capture of the aircraft's assigned altitude.

1.3 The design of the flight guidance systems can result in vertical speeds in excess of 15 m/s (or 3 000 ft/min) until they are within 150 m (or 500 ft) of the aircraft's assigned altitude. When a climbing or descending aircraft maintains a vertical speed in excess of 15 m/s (or 3 000 ft/min) until it is within 150 m (or 500 ft) of the aircraft's assigned altitude, it is less than 30 seconds away from being at the adjacent IFR altitude, which may be occupied by an ACAS-equipped aircraft flying level at that altitude. If the intruder aircraft is horizontally within the protected area provided by ACAS, there is a high probability that an RA against the climbing or descending aircraft will be issued just as the intruder aircraft begins to reduce its vertical speed to capture its assigned altitude.

1.4 Figure 4-3-B-1 provides a representation of the encounter geometry of this scenario. ACAS typically issues a climb RA, which calls for a climb at 8 m/sec (or 1 500 ft/min). Depending on the altitude of the level aircraft, this RA will typically be issued when the intruder aircraft is approximately 150 m (or 500 ft) below its assigned altitude and the vertical speed of the intruder is in excess of 15 m/s (or 3 000 ft/min).

1.5 ACAS in the level aircraft is tracking a climbing/descending (intruder) aircraft and is using replies to its interrogations to determine the intruder's altitude and its vertical speed. The ACAS track is updated once per second. The intruding aircraft's track information, along with the track of the level ACAS aircraft (own aircraft), is used within ACAS to determine if the intruder aircraft is currently a threat or will be in the near future.

1.6 In determining whether the intruder aircraft will be a threat in the future, ACAS projects the existing vertical speed of the intruder and own aircraft, to estimate the vertical separation that will exist at the closest point of horizontal approach during the encounter. These projections use the current vertical speed of both aircraft, and ACAS is not aware of the intruder aircraft's intent to level at an adjacent altitude above or below its own aircraft's current altitude. Should this projection be less than the ACAS desired vertical separation, an RA will be issued.

1.7 Should the intruder aircraft continue to climb/descend with the high vertical speed until it is 15 to 25 seconds from being at the same altitude as the level ACAS aircraft (again depending on the ACAS aircraft's altitude), ACAS will issue an RA calling for the own aircraft to manoeuvre to increase vertical separation from the intruder aircraft.

2. OPERATIONAL IMPACTS OF RAS RESULTING FROM HVR ENCOUNTERS

2.1 Shortly after ACAS issues the RA (climb RA for the encounter geometry shown in Figure 4-3-B-1), the intruder aircraft begins reducing its vertical rate to capture its assigned altitude.

2.2 While the intruder aircraft is initiating its level-off, the ACAS aircraft has started responding to its RA and may have left its assigned altitude. Both pilots and controllers agree that RAs issued in this encounter geometry are unwelcome. The RAs can be disruptive to a controller's current traffic flow and plans, and thus represent an increase in their workload. The response to the RA can also result in a loss of standard ATC separation if another aircraft is above the ACAS aircraft.

2.3 Pilots have reported that these types of RAs decrease their confidence in the performance of ACAS. These RAs typically occur repeatedly in the same geographic area, and repeated RAs of this type result in pilots being reluctant to follow the RA. This can be potentially hazardous in the event that the intruder aircraft passes through its assigned altitude.

3. FREQUENCY OF OCCURRENCE

3.1 ACAS monitoring shows that the frequency of occurrence is dependent on how airspace is structured and managed. Data collected during 2001 indicate that up to 70 per cent of the RAs issued are caused by the intruder aircraft maintaining a high vertical speed while approaching its assigned altitude. Depending on the airspace structure and the flow of traffic, it is possible to have several of these RAs issued within one hour, although airspace containing a lower density of traffic will have relatively few RAs of this type. Some air traffic service providers have been able to change their traffic flows and/or operational procedures to reduce the occurrence of these types of RAs, but these types of RAs continue to occur with a high degree of regularity in airspace throughout the world.

3.2 HVR RAs have been observed in both terminal and en-route airspace, although because of the previously higher vertical separation above FL 290 in non-RVSM airspace, very few RAs of this type have been observed above FL 290 in the past. With the current reduced separation, it is possible that HVR RAs may occur more frequently above FL 290 in RVSM airspace. Many HVR RAs occur in close proximity to large airports where departures are kept below arriving aircraft until some distance from the airport before being allowed to climb to higher altitudes, and a large percentage of these RAs occur in geographic areas where there is a concentration of climbing and descending aircraft.

4. ACAS FEATURES THAT REDUCE THE LIKELIHOOD OF RAS BEING ISSUED IN THESE SITUATIONS

4.1 ACAS recognizes HVR encounters, such as that shown in Figure 4-3-B-1. When this encounter geometry is detected, the issuance of RAs can be delayed by up to ten seconds. This delay allows additional time for the intruder aircraft to initiate a level-off and for ACAS to then detect this level-off. However, when the intruder aircraft maintains a vertical speed in excess of 15 m/s (or 3 000 ft/min) until it is within 150 m (or 500 ft) of its assigned altitude, even this 10-second delay may be insufficient for ACAS to detect the level-off, and an RA may be issued. Safety studies have shown that further delays in issuing the RA result in unacceptable degradation in the safety provided by ACAS.

4.2 Consideration has also been given to providing ACAS with information regarding the intruder aircraft's intent. However, this is not considered to be a viable approach to reducing these types of RAs while retaining the existing level of safety provided by ACAS.

4.3 A solution to the problem of HVR encounters has been found and implemented in some aircraft. This solution comprises a) the coupling of the autopilot with ACAS; and b) the introduction of a new altitude capture logic. The first item will provide the detection of an intruder (e.g. issuance of a traffic advisory (TA)). The second item will enable the aircraft's auto-flight system to adjust the vertical profile in order to prevent the issuance of RAs. In combination, these two improvements should provide a significant reduction of the disruptive RAs occurring during HVR encounters.

5. OPERATOR-SPECIFIED PROCEDURES

5.1 Due to the operational impacts on pilots and controllers caused by these types of RAs, and the continued existence of these RAs and the constraints on further modifications to ACAS, operators should specify procedures by which an aeroplane climbing or descending to an assigned altitude or flight level with an autopilot engaged may do so at a rate less than 8 m/sec (or 1 500 ft/min) within 300 m (or 1 000 ft) of the assigned level. Such procedural changes should provide an immediate operational benefit to both pilots and controllers by reducing the occurrence of HVR RAs.

5.2 The implementation of such procedures will not completely eliminate these RAs, but in the absence of other solutions, such as the redesign of airspace, their implementation will reduce the frequency of these undesirable RAs until a technical solution can be developed. Options that operators should consider include flying the entire climb or descent at a preselected rate, modifying the climb or descent in the latter stage and employing use of less than economic climb thrust in lower airspace.

5.3 A recommended procedure would call for a climbing or descending aircraft to adjust its vertical rate when approaching an assigned altitude or flight level, *and* when the pilot is aware that there is an aircraft at or approaching an adjacent altitude or flight level. The crew can be made aware of the presence of that aircraft by several means, including information provided by an air traffic controller, an ACAS TA or by visual acquisition. When a crew of an intruder aircraft becomes aware that another aircraft is at or approaching an adjacent altitude or flight level, it is recommended that the vertical speed of the intruder aircraft be reduced to less than 8 m/s (or 1 500 ft/min) when approaching an altitude that is 300 m (or 1 000 ft) above or below the assigned altitude or flight level.

Note.— There is no intent in this recommendation to require a modification in vertical speed for every level-off. This is not necessary and would introduce a significant increase in pilot workload.

5.4 When the autopilot is in the altitude capture mode, subsequent vertical mode changes such as the selection of a vertical speed mode may cause some autopilots either to cancel the altitude capture or to not properly capture the selected altitude. Altitude deviations represent a significant percentage of pilot deviations, and the performance of the autopilot during any altitude capture should be closely monitored in accordance with existing procedures.

5.5 Additional tasks may be required during some level-off manoeuvres. However, the procedure is a recommendation, not a requirement. Further, the procedure does not suggest that adjustments to the aircraft's vertical speed be made unless the pilot is aware that traffic is at an adjacent altitude.

5.6 The operator should specify procedures that the pilot may use to reduce vertical speed when an autopilot is engaged, as appropriate for the type of aircraft. Also, the operator should consider authorizing pilots to use a modest vertical speed throughout a climb or descent when the vertical interval is not large — such as a change of altitude in a holding pattern — specifying how this should be accomplished.

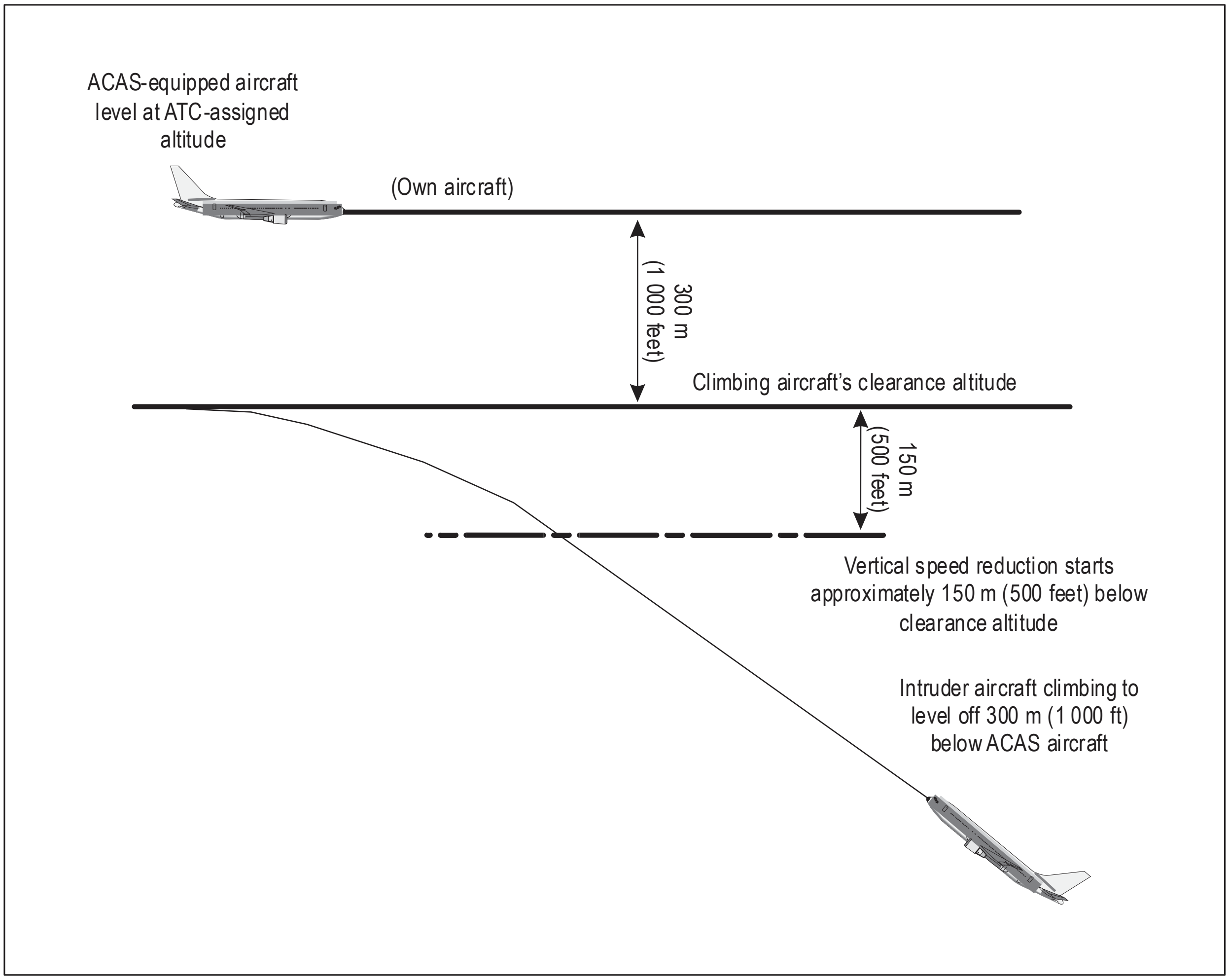

Figure 4-3-B-1. Representative HVR encounter geometry

Section 5

OPERATIONAL FLIGHT INFORMATION

Chapter 1

AERODROME SURFACE OPERATIONS

1.1 Operators shall develop and implement standard operating procedures (SOPs) for aerodrome surface operations. The development and implementation of SOPs shall take into consideration the risk factors (listed in 1.3) associated with the following operations:

a) runway intersection take-offs;

b) line-up and wait clearances;

c) land and hold-short clearances;

d) take-offs from displaced runway thresholds;

e) hazards associated with runway crossing traffic;

f) hazards associated with runway crossing traffic in the case of closely spaced parallel runways; and

g) hazards associated with the risk of collision at hot spot locations on aerodromes.

Note 1.— The Manual of Surface Movement Guidance and Control Systems (SMGCS*) (Doc 9476), Chapter 1, and the* Advanced Surface Movement Guidance and Control Systems (A-SMGCS) Manual *(Doc 9830) discuss the safety considerations in aerodrome surface operations.*

Note 2.— See Section 6, Chapter 1, Standard operating procedures (SOPs).

Note 3.— Land and hold-short clearances/simultaneous intersecting runway operations are not ICAO procedures.

1.2 The development and implementation of SOPs for aerodrome surface operations should address, but not be limited to, the risk factors listed in 1.3 by means of:

a) provisions regarding the timely acknowledgement of ground movement instructions;

b) provisions to ensure the acknowledgement, in standard phraseology, of all clearances to enter, land on, take off from, hold short of, cross or backtrack the runway in use;

Note.— The proper identification of the runway in use is prescribed in Annex 14, Volume I (Aerodromes), Chapter 5, 5.2.2.4.

c) provisions for the use of aircraft exterior lights to increase the conspicuity of aircraft manoeuvring on aerodrome surfaces; and

d) provisions regarding avoidance of collision risk at hot spot locations on aerodromes.

Note.— The Manual of Surface Movement Guidance and Control Systems (SMGCS*) (Doc 9476), Chapter 4, 4.8, discusses radiotelephony procedures and phraseology in aerodrome surface operations. Chapter 7, 7.3.6, discusses misunderstood clearances.*

1.3 Operators should ensure that flight personnel are aware of the risk factors in the aerodrome surface operations listed in 1.1. Such risk factors should include, but not be limited to:

a) human error due to excessive workload, loss of vigilance and fatigue;

b) potential distractions associated with the performance of flight deck tasks; and

c) failure to use standard phraseology in aeronautical communications.

Note.— The safety of aerodrome surface operations is especially vulnerable to the failure to use standard phraseology in aeronautical communications. Frequency congestion, as well as operational considerations, may adversely affect the issuance and read-back of clearances, leaving flight crews and controllers vulnerable to misunderstandings.

Chapter 2

READ-BACK OF CLEARANCES
AND SAFETY-RELATED INFORMATION

Note.— Provisions on read-back of clearances and safety-related information are included in Annex 11, Chapter 3, 3.7.3, and in the PANS-ATM (Doc 4444), Chapter 4.

Chapter 3

STABILIZED APPROACH PROCEDURE

3.1 GENERAL

The primary safety consideration in the development of the stabilized approach procedure shall be maintenance of the intended flight path as depicted in the published approach procedure, without excessive manoeuvring. The parameters to be considered in the definition of a stabilized approach are listed in 3.2.

3.2 PARAMETERS FOR THE STABILIZED APPROACH

The parameters for the stabilized approach shall be defined by the operator's standard operating procedures (SOPs) (Section 6, Chapter 1). These parameters shall be included in the operator's operations manual and shall provide details regarding at least the following:

a) range of speeds specific to each aircraft type;

b) minimum power setting(s) specific to each aircraft type;

c) range of attitudes specific to each aircraft type;

d) crossing altitude deviation tolerances;

e) configuration(s) specific to each aircraft type;

f) maximum sink rate; and

g) completion of checklists and crew briefings.

3.3 ELEMENTS OF THE STABILIZED APPROACH

The elements of a stabilized approach (according to the parameters in 3.2) shall be stated in the operator's SOPs. These elements should include as a minimum:

a) that in instrument meteorological conditions (IMC), all flights shall be stabilized by no lower than 300 m (1 000 ft) height above threshold; and

b) that all flights of any nature shall be stabilized by no lower than 150 m (500 ft) height above threshold.

3.4 GO-AROUND POLICY

Standard operating procedures should include the operator's policy with regard to the parameters in 3.2 and the elements in 3.3. This policy should state that if an approach is not stabilized in accordance with 3.3, or has become destabilized at any subsequent point during an approach, a go-around is required. Operators should reinforce this policy through training.

Note.— The Preparation of an Operations Manual *(Doc 9376), Chapter 8, 8.6.13, includes general considerations about stabilized approaches.*

Chapter 4

REDUCED POWER TAKE-OFF

Reduced power take-off should not be required in adverse operating conditions such as:

a) if the runway surface conditions are adversely affected (e.g. by snow, slush, ice, water, mud, rubber, oil or other substances);

b) when the horizontal visibility is less than 1.9 km (1 NM);

c) when the crosswind component, including gusts, exceeds 28 km/h (15 kt);

d) when the tailwind component, including gusts, exceeds 9 km/h (5 kt); and

e) when wind shear has been reported or forecast or when thunderstorms are expected to affect the approach or departure.

Note.— Some operating manuals (or the flight manual) may impose restrictions on the use of reduced take-off power while engine anti-icing systems are operating.

Section 6

STANDARD OPERATING PROCEDURES (SOPs) AND CHECKLISTS

Chapter 1

STANDARD OPERATING PROCEDURES (SOPs)

1.1 GENERAL

Operators shall establish standard operating procedures (SOPs) that provide guidance to flight operations personnel to ensure safe, efficient, logical and predictable means of carrying out flight procedures.

Note.— The Preparation of an Operations Manual *(Doc 9376), Chapter 8, 8.6.2, includes general considerations about SOPs. The* Human Factors Training Manual *(Doc 9683), Part 1, Chapter 2, 2.5.11, includes general considerations about SOPs design.*

1.2 SOPS OBJECTIVES

SOPs specify a sequence of tasks and actions to ensure that flight procedures can be carried out according to 1.1. To achieve these objectives, SOPs should unambiguously express:

a) what the task is;

b) when the task is to be conducted (time and sequence);

c) by whom the task is to be conducted;

d) how the task is to be done (actions);

e) what the sequence of actions consists of; and

f) what type of feedback is to be provided as a result of the actions (verbal call-out, instrument indication, switch position, etc.).

1.3 SOPS DESIGN

1.3.1 To ensure compatibility with specific operational environments and compliance by flight operations personnel, SOPs design should take into consideration:

a) the nature of the operator's environment and type of operation;

b) the operational philosophy, including crew coordination;

c) the training philosophy, including human performance training;

d) the operator's corporate culture, including the degree of flexibility to be built into SOPs design;

e) the levels of experience of different user groups, such as flight crews, aircraft maintenance engineers and cabin attendants;

f) resource conservation policies, such as fuel conservation or wear on power plants and systems;

g) flight deck automation, including flight deck and systems layout and supporting documentation;

h) the compatibility between SOPs and operational documentation; and

i) procedural deviation during abnormal/unforeseen situations.

1.3.2 Flight operations personnel should be involved in the development of SOPs.

1.4 SOPS IMPLEMENTATION AND USE

Operators should establish a formal process of feedback from flight operations personnel to ensure standardization, compliance and evaluation of reasons for non-compliance during SOPs implementation and use.

Chapter 2

CHECKLISTS

2.1 GENERAL

Operators shall establish checklists as an integral part of standard operating procedures (SOPs). Checklists should describe the actions relevant to specific phases of operations (engine start, taxi, take-off, etc.) that flight crews must perform or verify and which relate to flight safety. Checklists should also provide a framework for verifying aircraft and systems configuration that guards against vulnerabilities in human performance.

2.2 CHECKLIST OBJECTIVES

2.2.1 Normal checklists should aid flight crews in the process of configuring the aircraft and its systems by:

a) providing logical sequences of coverage of the flight deck panels;

b) providing logical sequences of actions to meet both internal and external flight deck operational requirements;

c) allowing mutual monitoring among flight crew members to keep all flight crew members in the information loop; and

d) facilitating crew coordination to assure a logical distribution of flight deck tasks.

2.2.2 Checklists for use in abnormal situations and those for emergency situations should aid flight crews in coping with malfunctions of aircraft systems and/or emergency situations. They should also guard against vulnerabilities in human performance during high workload situations by fulfilling the objectives in 2.2.1 and, in addition, by:

a) ensuring a clear allocation of duties to be performed by each flight crew member;

b) acting as a guide to flight crews for diagnosis, decision making and problem solving, (prescribing sequences of steps and/or actions); and

c) ensuring that critical actions are taken in a timely and sequential manner.

2.3 CHECKLIST DESIGN

2.3.1 Order of checklist items

2.3.1.1 The following factors should be considered when deciding the order of the items in checklists:

a) the operational sequence of aircraft systems so that items are sequenced in the order of the steps for activation and operation of these systems;

b) the physical flight deck location of items so that they are sequenced following a flow pattern;

c) the operational environment so that the sequence of checklists considers the duties of other operational personnel such as cabin crew and flight operations officers;

d) operator policies (for example, resource conservation policies such as single-engine taxi) that may impinge on the operational logic of checklists;

e) verification and duplication of critical configuration-related items so that they are checked in the normal sequence and again immediately before the phase of flight for which they are critical; and

f) sequencing of critical items in abnormal and emergency checklists so that items most critical are completed first.

2.3.1.2 Critical items should appear no more than twice on a given checklist (see 2.3.1.1 e)). Critical items should be verified by more than one flight crew member.

2.3.2 Number of checklist items

The number of items in checklists should be restricted to those critical to flight safety.

Note.— The introduction of advanced technology in the flight deck, allowing for automated monitoring of flight status, may justify a reduction in the number of items required in checklists.

2.3.3 Checklist interruptions

SOPs should include techniques to ensure a step-by-step, uninterrupted sequence of completing checklists. SOPs should unambiguously indicate the actions by flight crews in case of checklist interruptions.

2.3.4 Checklist ambiguity

Checklist responses should portray the actual status or the value of the item (switches, levers, lights, quantities, etc.). Checklists should avoid non-specific responses such as “set”, “checked” or “completed”.

2.3.5 Checklist coupling

Checklists should be coupled to specific phases of flight (engine start, taxi, take-off, etc.). SOPs should avoid tight coupling of checklists with the critical part of a phase of flight (for example, completing the take-off checklist on the active runway). SOPs should dictate a use of checklists that allows buffers for detection and recovery from incorrect configurations.

2.3.6 Typography

2.3.6.1 Checklist layout and graphical design should observe basic principles of typography, including at least legibility of print (discriminability) and readability under all flight deck lighting conditions.

2.3.6.2 If colour coding is used, standard industry colour coding should be observed in checklist graphical design. Normal checklists should be identified by green headings, system malfunctions by yellow headings, and emergency checklists by red headings.

2.3.6.3 Colour coding should not be the only means of identifying normal, abnormal and emergency checklists.

Chapter 3

CREW BRIEFINGS

Note.— Unless specified as flight crew or cabin crew, the term "crew" refers to all operational crew required on board for the air operator to support the flight.

3.1 GENERAL

3.1.1 Operators shall establish crew briefings as an integral part of standard operating procedures (SOPs). Crew briefings identify and mitigate potential threats, standardize activities, ensure that a plan of action is shared by crew members and enhance crew situational awareness.

3.1.2 Operators shall establish both individual and combined crew briefings for flight crew and cabin crew.

Note.— The Preparation of an Operations Manual *(Doc 9376), Chapter 8, 8.6.8, includes general considerations about briefings.*

3.2 OBJECTIVES

Crew briefings should aid crews to:

a) identify and manage threats, and manage errors relevant to specific phases of flight;

b) create a shared mental model of the intended operation;

c) identify significant differences and develop a shared strategy to allow detection of deviations to standardize the operation; and

d) refresh specific procedures or techniques if they are relevant and expected for the ongoing operation.

Note.— Without briefings, and under the pressure of time constraints and stress, retrieving information from memory may be an extremely unreliable process.

3.3 PRINCIPLES

3.3.1 When establishing crew briefings, the following principles should be considered:

a) aim to keep them as short as possible, but long enough to cover all relevant items;

b) organize the briefing in a way such that interruptions and distractions are avoided as much as possible; and

c) maintain a conversational, interactive style and use open-ended questions engaging all crew members to share their experiences and expectations.

Note.— Crew briefings that become routine recitations do not refresh prior knowledge and are ineffective.

3.4 APPLICATION

3.4.1 Operators shall implement flight and cabin crew briefings for specific phases of operations to include actual conditions and circumstances, as well as special aspects of operations.

3.4.2 Flight crew briefings shall be conducted for, but not be limited to, the following phases of operations:

a) pre-flight;

b) departure; and

c) arrival.

3.4.3 Additional briefings should be conducted depending on the operational scenario:

a) cruise briefing: required when expecting specific operational threats in cruise, such as high terrain en-route or weather avoidance, or for areas with special operational rules such as the North Atlantic high level airspace (NAT HLA); and

b) crew relief briefing: required when changing flight crew members in augmented crew operation.

3.4.4 Cabin crew briefings shall be conducted for, but not be limited to, the following phases of operations:

a) pre-flight; and

b) first departure of the day.

3.4.5 Cabin crew briefings should be conducted following changes of aircraft type or crew and before flights involving a stop of more than two hours.

3.5 SCOPE

3.5.1 The main purpose of a crew briefing is to identify threats impending the intended operation and decide on a mitigation plan, which includes avoidance and management, for those identified threats. The briefing should result in an agreement on the general plan of the flight trajectory and plan for significant differences to routine operation.

3.5.2 At the end of a crew briefing, all crew members should have a shared mental model of the intended operation, the identified threats, the mitigations and the deviations from standard operations.

3.5.3 Briefings should empower the pilot monitoring (PM) by setting the expected monitoring framework.

3.5.4 Crew briefings should complement SOPs and should not be merely a repetition of SOP items.

3.6 TECHNIQUE AND CONTENT

3.6.1 Each briefing should be initiated and managed by the pilot flying.

3.6.2 An effective briefing requires unique thinking, beyond the pure reflection of standard operation and routine. It should focus on the risks associated with the operational-, aircraft-, environmental- and crew-related information.

3.6.3 The source of the briefing material is obtained from the pre-flight preparation, aircraft operation and the knowledge and experience of all crew members engaged in the operation.

3.6.4 The briefing should contain the following elements:

a) threats;

b) mitigations;

c) operational plan;

d) differences from the standard operation; and

e) a summary of key points.

Note.— Abnormal procedures or techniques should only be briefed when the crew have information that makes the use of such a procedure or technique likely in order to mitigate a threat, such as wind shear reported in ATIS.

3.6.5 Threats, and the associated mitigation strategies, should be identified with regard to the:

a) crew factors;

b) aircraft;

c) airport and airspace including terrain; and

d) environment.

Note.— Threat and error management is a comprehensive process. A checklist-style briefing aid to identify threats is discouraged as it may lead to automatic repetition without due consideration of the real issues.

3.6.6 A briefing on the operational plan of the flight should make all flight crew members aware of the planned taxi and flight trajectory. This should be a high-level description and not be confused with the detailed setting and checking of the flight trajectory in the flight management system (FMS) accomplished by the respective SOP items.

3.6.7 The briefing should include significant differences or deviations to routine operations and how they will be managed.

Note.— Examples of significant differences could be: non-routine supplementary or special operational procedures, minimum equipment list (MEL) operational procedures, using an approach technique rarely used in routine operations and briefing of a one-engine-inoperative (OEI) climb profile.

3.6.8 Each briefing should be concluded with a summary of key points.

Section 7

VOICE COMMUNICATION PROCEDURES AND CONTROLLER-PILOT DATA LINK COMMUNICATIONS PROCEDURES

(To be developed)

Section 8

AIRBORNE SURVEILLANCE

Chapter 1

OPERATION OF AUTOMATIC DEPENDENT SURVEILLANCE — BROADCAST IN (ADS-B IN) TRAFFIC DISPLAY

1.1 ADS-B IN TRAFFIC DISPLAY OVERVIEW

1.1.1 ADS-B IN on-board traffic displays are based on aircraft receiving and making use of ADS-B message information transmitted by other aircraft/vehicles or ground stations. The applications enhance the pilot's traffic situational awareness both while airborne and on the airport surface through the display of traffic symbols enriched by the received ADS-B messages (e.g. aircraft identification, track, altitude).

Note.— Depending on the implementation, a single display can show ADS-B traffic symbols and those generated by ACAS.

1.1.2 Training on the use of the ADS-B IN traffic display shall be provided to pilots.

1.2 USE OF INFORMATION PROVIDED BY ADS-B IN TRAFFIC DISPLAY

1.2.1 When using an ADS-B IN traffic display:

a) in the event of a TA or an RA, pilots shall comply with the ACAS procedures whether or not the tracks generated by ADS-B are shown on the same display as those generated by ACAS;

b) unless approved by the State of the Operator, ADS-B IN traffic display shall only be used as supplementary information to current procedures;

c) its use should not lead to a significant increase in radio communications; and

d) pilots shall not undertake any manoeuvres relative to traffic based solely on the ADS-B IN traffic display that would lead to either a deviation from or a non-execution of an ATC clearance or instruction unless exercising their emergency authority.

Note 1.— See Annex 2 — Rules of the Air*, sections 3.2 and 3.6.2.*

Note 2.— ADS-B IN is not a collision avoidance system.

Note 3.— Acceptable reaction to a traffic situation observed on an ADS-B IN traffic display may, for example, include manoeuvring into airspace visually cleared for traffic within the limitations of the current ATC clearance and remaining stationary during surface operations when a clearance to enter a runway has been provided.

Note 4.— The ADS-B IN traffic picture displayed may be incomplete, e.g. due to the presence of non-ADS-B equipped aircraft in the same airspace.

1.2.2 Pilots may use the information provided by the ADS-B IN traffic display to aid with the visual acquisition of surrounding traffic. The ADS-B IN information supplements other information such as that which may be obtained through visual scanning or radio communications.

1.2.3 Operators shall include in their standard operating procedures (SOPs) (see Section 6, Chapter 1) specific guidance for using ADS-B IN to support ATC procedures specified in PANS-ATM (Doc 4444).

Note.— An example is the in-trail procedure (ITP) described in PANS-ATM, Chapter 5, 5.4.2.7, "Longitudinal separation minima based on distance using ADS-B in-trail procedure (ITP)". Details of the ITP equipment are specified in RTCA DO-312/EUROCAE ED-159, Safety Performance and Interoperability Requirements Document for the In-Trail Procedure in Oceanic Airspace (ATSA-ITP) Application. *Additional information can be found in RTCA DO-317A/EUROCAE ED-194,* Minimum Operational Performance Standards (MOPS) for Aircraft Surveillance Applications (ASA) System *and Supplement.*

Section 9

NOISE ABATEMENT PROCEDURES

Chapter 1

GENERAL NOISE ABATEMENT INFORMATION

1.1 Nothing in these procedures shall prevent the pilot-in-command from exercising authority for the safe operation of the aeroplane.

1.2 Noise abatement procedures shall not be implemented except where a need for such procedures has been determined. (See Annex 16, Volume I, Part V.)

1.3 The procedures herein describe the methods for noise abatement when a problem is shown to exist. They have been designed for application to turbojet aeroplanes. They can comprise any one or more of the following:

a) use of noise preferential runways to direct the initial and final flight paths of aeroplanes away from noise-sensitive areas;

b) use of noise preferential routes to assist aeroplanes in avoiding noise-sensitive areas on departure and arrival, including the use of turns to direct aeroplanes away from noise-sensitive areas located under or adjacent to the usual take-off and approach flight paths; and

c) use of noise abatement take-off or approach procedures, designed to minimize the overall exposure to noise on the ground and at the same time maintain the required levels of flight safety.

1.4 For the purpose of these procedures, the heights given in metres and feet and speeds given in kilometres/hour and knots are considered to be operationally acceptable equivalents.

Chapter 2

NOISE PREFERENTIAL RUNWAYS AND ROUTES

2.1 NOISE PREFERENTIAL RUNWAYS

2.1.1 A runway for take-off or landing, appropriate to the operation, may be nominated for noise abatement purposes, the objective being to utilize whenever possible those runways that permit aeroplanes to avoid noise-sensitive areas during the initial departure and final approach phases of flight.

2.1.2 Runways should not be selected for noise abatement purposes for landing operations unless they are equipped with suitable glide path guidance, e.g. ILS, or a visual approach slope indicator system for operations in visual meteorological conditions.

2.1.3 A pilot-in-command prompted by safety concerns can refuse a runway offered for noise preferential reasons.

2.1.4 Noise abatement shall not be a determining factor in runway nomination under the following circumstances:

a) if the runway surface conditions are adversely affected (e.g. by snow, slush, ice, water, mud, rubber, oil or other substances);

b) for landing in conditions:

   1) when the ceiling is lower than 150 m (500 ft) above aerodrome elevation or the visibility is less than (1 900 m); or

   2) when the approach requires vertical minima greater than 100 m (300 ft) above aerodrome elevation and:

      i) the ceiling is lower than 240 m (800 ft) above aerodrome elevation; or

      ii) the visibility is less than 3 000 m;

c) for take-off when the visibility is less than 1 900 m;

d) when wind shear has been reported or forecast or when thunderstorms are expected to affect the approach or departure;

e) when the crosswind component, including gusts, exceeds 28 km/h (15 kt), or the tailwind component, including gusts, exceeds 9 km/h (5 kt).

2.2 NOISE PREFERENTIAL ROUTES

2.2.1 Noise preferential routes are established to ensure that departing and arriving aeroplanes avoid over-flying noise-sensitive areas in the vicinity of the aerodrome as far as practicable.

2.2.2 In establishing noise preferential routes:

a) turns during take-off and climb should not be required unless:

   1) the aeroplane has reached (and can maintain throughout the turn) a height of not less than 150 m (500 ft) above terrain and the highest obstacles under the flight path;

Note.— PANS-OPS, Volume II, permits turns after take-off at 120 m (394 ft) (helicopters, 90 m (295 ft)) and obstacle clearance of at least 75 m (246 ft)(CAT H, 65 m (213 ft)) during the aircraft's turn. These are minimum requirements for noise abatement purposes.

   2) the bank angle for turns after take-off is limited to 15° except where adequate provision is made for an acceleration phase permitting attainment of safe speeds for bank angles greater than 15°;

b) no turns should be required coincident with a reduction of power associated with a noise abatement procedure; and

c) sufficient navigation guidance should be provided to permit aeroplanes to adhere to the designated route.

2.2.3 In establishing noise preferential routes, the safety criteria of standard departure and standard arrival routes regarding obstacle clearance climb gradients and other factors should be taken into full consideration (see PANS-OPS, Volume II).

2.2.4 Where noise preferential routes are established, these routes and standard departure and arrival routes should be compatible (see Annex 11, Appendix 3).

2.2.5 An aeroplane should not be diverted from its assigned route unless:

a) in the case of a departing aeroplane, it has attained the altitude or height which represents the upper limit for noise abatement procedures; or

b) it is necessary for the safety of the aeroplane (e.g. for avoidance of severe weather or to resolve a traffic conflict).

Chapter 3

AEROPLANE OPERATING PROCEDURES

3.1 INTRODUCTION

3.1.1 This chapter provides guidance with regard to aeroplane noise-mitigating measures associated with the development and/or application of departure climb, approach, and landing procedures and the use of displaced runway thresholds. CCO and CDO can enhance safety, capacity and efficiency and should be considered in order to benefit the environment (emissions and noise) (see *Continuous Climb Operations (CCO) Manual* (Doc 9993) and *Continuous Descent Operations (CDO) Manual* (Doc 9931)).

3.1.2 The State in which the aerodrome is located is responsible for ensuring that aerodrome operators specify the location of noise sensitive areas and/or the location of noise monitors and their respective maximum allowable noise levels, if applicable. Aircraft operators are responsible for developing operating procedures in accordance with this chapter to meet the noise concerns of aerodrome operators. The approval of the aircraft operators' procedures by the State of the Operator will ensure that the safety criteria contained in 3.3 of this chapter are met.

3.1.3 The appendix to this chapter contains two examples of noise abatement departure climb procedures. One example is designed to alleviate noise close to the aerodrome, and the other is designed to alleviate noise more distant from the aerodrome.

3.2 OPERATIONAL LIMITATIONS

3.2.1 General

The pilot-in-command has the authority to decide not to execute a noise abatement departure procedure if conditions preclude the safe execution of the procedure.

3.2.2 Departure climb

Aeroplane operating procedures for the departure climb shall ensure that the safety of flight operations is maintained while minimizing exposure to noise on the ground. The following requirements need to be satisfied:

a) All necessary obstacle data shall be made available to the operator, and the procedure design gradient shall be observed.

b) Conduct of noise abatement climb procedures is secondary to meeting obstacle clearance requirements.

c) The power or thrust settings specified in the aircraft operating manual are to take account of the need for engine anti-icing when applicable.

d) The power or thrust settings to be used subsequent to the failure or shutdown of an engine or any other apparent loss of performance, at any stage in the take-off or noise abatement climb, are at the discretion of the pilot-in-command, and noise abatement considerations no longer apply.

e) Noise abatement climb procedures are not to be required in conditions where wind shear warnings exist, or the presence of wind shear or downburst activity is suspected.

f) The maximum acceptable body angle specified for an aeroplane type shall not be exceeded.

3.3 DEVELOPMENT OF PROCEDURES

3.3.1 Noise abatement procedures shall be developed by the aircraft operator for each aeroplane type (with advice from the aeroplane manufacturer, as needed) and approved by the State of the Operator complying at a minimum with the following safety criteria.

a) Initial power or thrust reductions shall not be executed below a height of 240 m (800 ft) above the aerodrome elevation.

b) The level of power or thrust for the flap/slat configuration, after power or thrust reduction, shall not be less than:

   1) for aeroplanes in which derated take-off thrust and climb thrust are computed by the flight management system, the computed climb power/thrust; or

   2) for other aeroplanes, normal climb power/thrust.

3.3.2 To minimize the impact on training while maintaining flexibility to address variations in the location of noise sensitive areas, the aeroplane operator shall develop no more than two noise abatement procedures for each aeroplane type. It is recommended that one procedure should provide noise benefits for areas close to the aerodrome, and the other for areas more distant from the aerodrome.

3.3.3 Any difference of power or thrust reduction initiation height for noise abatement purposes constitutes a new procedure.

3.4 AEROPLANE OPERATING PROCEDURES — APPROACH

3.4.1 In noise abatement approach procedures which are developed:

a) the aeroplane shall not be required to be in any configuration other than the final landing configuration at any point after passing the outer marker or 5 NM from the threshold of the runway of intended landing, whichever is earlier; and

b) excessive rates of descent shall not be required.

Note.— Design criteria for descent gradients are contained in PANS-OPS, Volume II, Part I, Section 4, 3.3.5, 3.7.1, 4.3.3 and 5.3.

3.4.2 When it is necessary to develop a noise abatement approach procedure based on currently available (1982) systems and equipment, the following safety considerations shall be taken fully into account:

a) glide path or approach angles should not require an approach to be made:

1) above the ILS glide path angle;

2) above the glide path angle of the visual approach slope indicator system;

3) above the normal PAR final approach angle; and

4) above an angle of 3° except where it has been necessary to establish, for operational purposes, an ILS with a glide path angle greater than 3°;

Note 1.— New procedures will need to be developed as and when the introduction of new systems and equipment makes the use of significantly different approach techniques possible.

Note 2.— The pilot can accurately maintain a prescribed angle of approach only when provided with either continuous visual or radio navigation guidance.

b) the pilot should not be required to complete a turn on to final approach at distances less than will:

1) in the case of visual operations, permit an adequate period of stabilized flight on final approach before crossing the runway threshold; or

2) in the case of instrument approaches, permit the aircraft to be established on final approach prior to interception of the glide path, as detailed in PANS-OPS, Volume I, Section 4, Chapter 5, 5.2.4, "FAF crossing".

3.4.3 Within the constraints necessary at some locations to maintain efficient air traffic services, noise abatement descent and approach procedures utilizing continuous descent and reduced power/reduced drag techniques (or a combination of both) have proved to be both effective and operationally acceptable. The objective of such procedures is to achieve uninterrupted descents at reduced power and with reduced drag, by delaying the extension of wing flaps and landing gear until the final stages of approach. The speeds employed during the application of these techniques tend, accordingly, to be higher than would be appropriate for descent and approach with the flaps and gear extended throughout, and such procedures must therefore comply with the limitations in this section.

3.4.4 Compliance with published noise abatement approach procedures should not be required in adverse operating conditions such as:

a) if the runway is not clear and dry, i.e. it is adversely affected by snow, slush, ice or water, mud, rubber, oil or other substances;

b) in conditions when the ceiling is lower than 150 m (500 ft) above aerodrome elevation, or when the horizontal visibility is less than 1.9 km (1 NM);

c) when the crosswind component, including gusts, exceeds 28 km/h (15 kt);

d) when the tailwind component, including gusts, exceeds 9 km/h (5 kt); and

e) when wind shear has been reported or forecast or when adverse weather conditions, e.g. thunderstorms, are expected to affect the approach.

3.5 AEROPLANE OPERATING PROCEDURES — LANDING

Noise abatement procedures shall not contain a prohibition of use of reverse thrust during landing.

3.6 DISPLACED THRESHOLDS

The practice of using a displaced runway threshold as a noise abatement measure shall not be employed unless aircraft noise is significantly reduced by such use and the runway length remaining is safe and sufficient for all operational requirements.

Note.— Reduction of noise levels to the side of and at the beginning of a runway can be achieved by displacing the commencement of the take-off, but at the expense of increased noise exposures under the flight path. Displacement of the landing threshold will, in the interests of safety, involve clearly marking the threshold to indicate the displacement and relocation of the approach aids.

3.7 CONFIGURATION AND SPEED CHANGES

Deviations from normal configuration and speeds appropriate to the phase of flight shall not be made mandatory.

3.8 UPPER LIMIT

Noise abatement procedures shall include information on the altitude/height above which they are no longer applicable.

3.9 COMMUNICATIONS

In order not to distract flight crews during the execution of noise abatement procedures, air/ground communications should be kept to a minimum.

Appendix to Chapter 3

NOISE ABATEMENT DEPARTURE CLIMB GUIDANCE

1. GENERAL

1.1 Aeroplane operating procedures for the departure climb shall ensure that the necessary safety of flight operations is maintained while minimizing exposure to noise on the ground. These procedures are provided as examples because the noise reductions obtained depend greatly on the type of aeroplane, engine type, thrust required, and the height at which thrust is reduced. For this reason, procedures that provide the best possible noise benefit may differ significantly from one aeroplane type to another, and between aeroplanes of the same type with different engines. States should avoid the practice of requiring all operators to use one of the example procedures for departures from specific runways, and should instead allow aircraft operators to develop operational procedures that maximize the noise benefits obtainable from their aeroplanes. This is not intended to prevent States from suggesting the use of a procedure based on one of the examples, as an alternative to operator-specific procedures. The following two examples of operating procedures for the climb have been developed as guidance and are considered safe when the criteria in 3.2 are satisfied. The first example (NADP 1) is intended to describe one method, but not the only method, of providing noise reduction for noise-sensitive areas in close proximity to the departure end of the runway (see Figure 9-3-App-1). The second example (NADP 2) similarly describes one method, but not the only method, of providing noise reduction to areas more distant from the runway end (see Figure 9-3-App-2). Aircraft operators may find that to suit their particular route system (i.e. at aerodromes where they operate), two different procedures, one designed for close and the other designed for distant noise reduction, may be appropriate.

1.2 The two example procedures differ in that the acceleration segment for flap/slat retraction is either initiated prior to reaching the maximum prescribed height or at the maximum prescribed height. To ensure optimum acceleration performance, power or thrust reduction may be initiated at an intermediate flap setting.

Note.— For any procedure, intermediate flap transitions required for specific performance-related issues may be initiated prior to the prescribed minimum height; however, no power reduction can be initiated prior to attaining the prescribed minimum altitude.

2. NOISE ABATEMENT DEPARTURE CLIMB — EXAMPLE OF A PROCEDURE ALLEVIATING NOISE CLOSE TO THE AERODROME (NADP 1)

2.1 This procedure involves a power or thrust reduction at or above the prescribed minimum altitude (240 m (800 ft) above aerodrome elevation) and the delay of flap/slat retraction until the prescribed maximum altitude is attained. At the prescribed maximum altitude (900 m (3 000 ft) above aerodrome elevation), the aircraft is accelerated and the flaps/slats are retracted on schedule while maintaining a positive rate of climb, to complete the transition to normal en-route climb speed. The initial climbing speed to the noise abatement initiation point is not less than V_2 plus 20 km/h (V_2 plus 10 kt).

2.2 In the example shown below, on reaching an altitude of 240 m (800 ft) above aerodrome elevation, engine power or thrust is adjusted in accordance with the noise abatement power/thrust schedule provided in the aircraft operating manual. A climb speed of V_2 plus 20 to 40 km/h (V_2 plus 10 to 20 kt) is maintained with flaps and slats in the take-off configuration. On reaching an altitude of 900 m (3 000 ft) above aerodrome elevation, the aircraft is accelerated and the flaps/slats are retracted on schedule while maintaining a positive rate of climb to complete the transition to normal en-route climb speed.

3. NOISE ABATEMENT DEPARTURE CLIMB — EXAMPLE OF A PROCEDURE ALLEVIATING NOISE DISTANT FROM THE AERODROME (NADP 2)

3.1 This procedure involves initiation of flap/slat retraction at or above the prescribed minimum altitude (240 m (800 ft) above aerodrome elevation) but before reaching the prescribed maximum altitude (900 m (3 000 ft) above aerodrome elevation). The flaps/slats are to be retracted on schedule while maintaining a positive rate of climb. Intermediate flap retraction, if required for performance, may be accomplished below the prescribed minimum altitude. The power or thrust reduction is initiated at a point along the acceleration segment that ensures satisfactory acceleration performance. At the prescribed maximum altitude, a transition is made to normal en-route climb procedures. The initial climbing speed to the noise abatement initiation point is not less than V_2 plus 20 km/h (V_2 plus 10 kt).

3.2 In the example shown below, on reaching 240 m (800 ft) above aerodrome elevation, the aircraft body angle/angle of pitch is decreased, the aeroplane is accelerated towards V_{zf}, and the flaps/slats are retracted on schedule. Power or thrust reduction is initiated at a point along the acceleration segment that ensures satisfactory acceleration performance. A positive rate of climb is maintained to 900 m (3 000 ft) above aerodrome elevation. On reaching this altitude, a transition is made to normal en-route climb speed.

3.3 An aeroplane should not be diverted from its assigned route unless:

a) in the case of a departing aeroplane it has attained the altitude or height which represents the upper limit for noise abatement procedures; or

b) it is necessary for the safety of the aeroplane (e.g. for avoidance of severe weather or to resolve a traffic conflict).

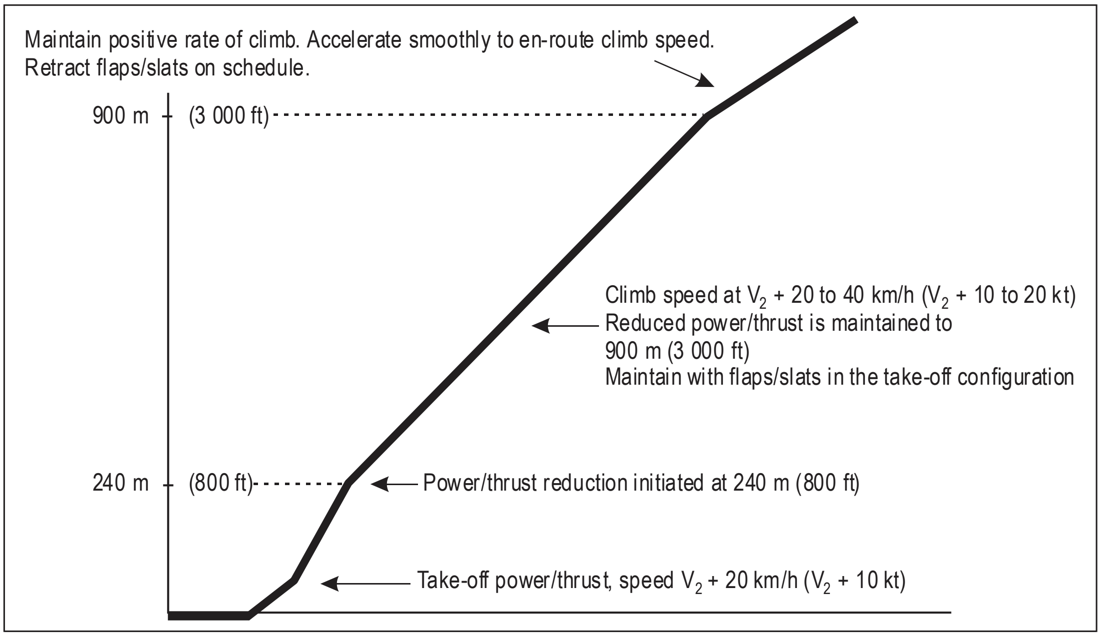

Figure 9-3-App-1. Noise abatement take-off climb — Example of a procedure alleviating noise close to the aerodrome (NADP 1)

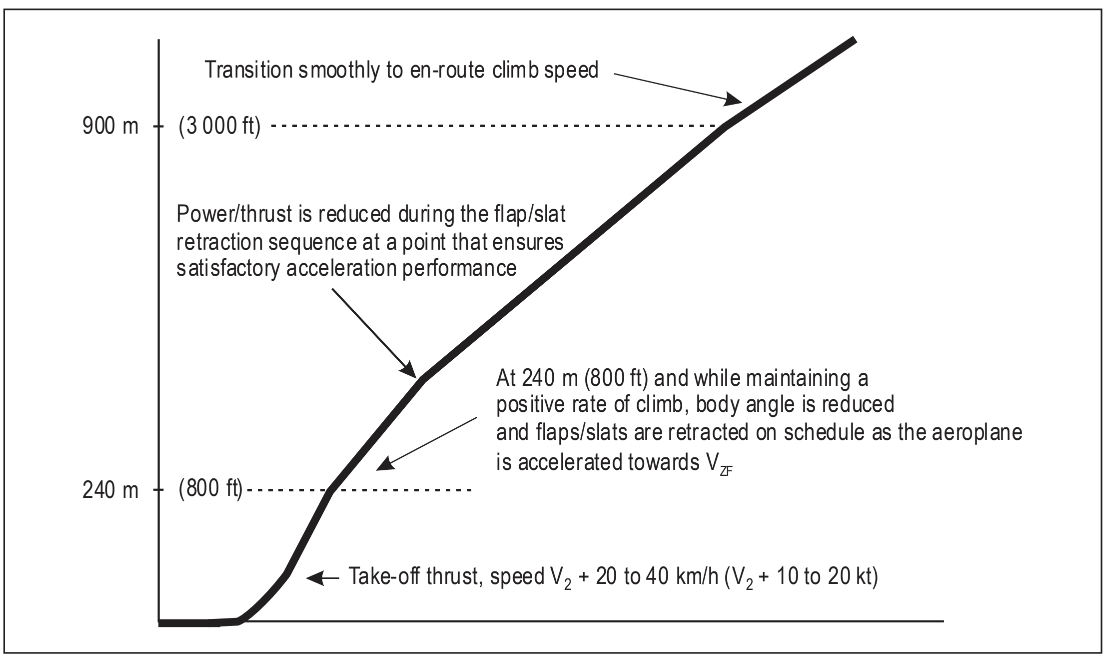

Figure 9-3-App-2. Noise abatement take-off climb — Example of a procedure alleviating noise distant from the aerodrome (NADP 2)

Section 10

FLIGHT TRACKING

Chapter 1

AIRCRAFT TRACKING

1.1 GENERAL

The following provisions are applicable to operators required to track their aircraft in accordance with Annex 6, Part I, 3.5 – *Aircraft tracking*.

1.2 OPERATOR RESPONSIBILITIES

1.2.1 Operators shall ensure that they have established and documented:

a) a training programme for flight operations officers/flight dispatchers, or other personnel nominated by the operator for the control and supervision of flights, on the policies and procedures for aircraft tracking; and

b) procedures for the monitoring of automated aircraft position reports, including actions to take in the event of a missed position report.

1.2.2 When information regarding a missed position report is required to be transmitted to an ATS unit, the aircraft tracking missed position report message template in the Appendix to this chapter should be used.

Note.— Further information on operator processes for aircraft tracking can be found in the Aircraft Tracking Implementation Guidelines *(Circular 347).*

1.2.3 Operators should provide and maintain up-to-date their operational contact details in the ICAO OPS Control Directory (OPS CTRL) to facilitate contact between operators and ATS units when responding to a tracking related event.

Note.— The OPS CTRL can be accessed at: www.icao.int/safety/globaltracking.

Appendix to Chapter 1

Aircraft tracking missed position report message template

	Aircraft tracking missed position report message **From:_______________________________________** **To:_______________________________________** **This message provides information regarding potential uncertainty as to the safety of an aircraft. This is a request for action to resolve this uncertainty.** **Please contact __________________ at __________________ with details of action taken.**	
	Required information	
1.	Initial or subsequent notification indication	
2.	Aircraft identification in Field 7 of filed flight plan	
3.	Aircraft type	
4.	Last known position (Time, Latitude and Longitude or bearing and range)	
5.	Time of last communication	
6.	Last known flight level or altitude	
7.	Next expected position (if known), and estimate	
8.	Name of air traffic services unit notified	
9.	Name of operator	
10.	Contact details of operator primary point of contact for this event	
	Supplementary information, if available	
11.	Contact actions attempted, including frequency channels and SATCOM numbers	
12.	Aircraft registration (if different from aircraft identification in 2 above)	
13.	Information contained in Item 19 of the filed flight plan	
14.	If not included in 13 above, fuel endurance or fuel endurance remaining at last known position	
15.	Total persons on board	
16.	Alternate or possible alternates	
17.	Any other relevant information (e.g. dangerous goods on board, etc.)	

Note.— Contact details for air navigation services providers (ANSPs) and operators can be obtained from the OPS CTRL directory, accessed at www.icao.int/safety/globaltracking.

Chapter 2

LOCATION OF AN AIRCRAFT IN DISTRESS

2.1 GENERAL

The following provisions are applicable to operators required to make position information of an aircraft in distress available, in accordance with Annex 6, Part I, 6.18 – *Location of an aeroplane in distress*.

2.2 OPERATOR RESPONSIBILITIES

2.2.1 The operator shall ensure that the Location of an Aircraft in Distress Repository (LADR) is automatically updated with position information from an aircraft in a distress condition.

Note 1.— Guidance on the format and means to update the information in the LADR is contained in the Manual on the Functional Specifications for the Location of an Aircraft in Distress Repository (LADR) *(Doc 10150).*

Note 2.— An aircraft is considered to be in a distress condition when it is in a state that, if the aircraft behaviour event is left uncorrected, can result in an accident.

2.2.2 The operator shall ensure that they have established and documented:

a) a training programme for flight operations officers/flight dispatchers, or other personnel nominated by the operator for the control and supervision of flights, on the use of the autonomous distress tracking (ADT) services and functionalities;

b) procedures for the monitoring of information received from the ADT system, including actions to be taken in the event of a notification of a distress condition; and

c) policy and procedures for the flight crew manual activation function.

Note 1.— Further information for autonomous distress tracking can be found in the Manual on Location of Aircraft in Distress and Flight Recorder Data Recovery *(Doc 10054).*

Note 2.— For more information on distress conditions, see the Manual on Location of Aircraft in Distress and Flight Recorder Data Recovery *(Doc 10054).*

Section 11

RNAV SUBSTITUTION

Chapter 1

INTRODUCTION TO RNAV SUBSTITUTION

1.1 GENERAL

1.1.1 RNAV substitution is the ability to use the FMS/RNAV system instead of conventional radio navigation aids.

1.1.2 RNAV substitution can have significant operational benefits, which are derived from the following:

a) flight crew workload is reduced;

b) flight crew are able to employ common procedures across a range of instrument approach operations; and

c) the ability to use the full functionality of modern navigation displays is maintained thereby improving situational awareness.

1.1.3 RNAV substitution depends on a coding of the conventional procedure into the navigation database in cases where it has not been originally designed with that intention. As a consequence, there are limitations associated with RNAV substitution and required operating procedures, in order to maintain the same level of safety.

1.2 SCOPE AND LIMITATIONS

Note.— This section defines the limitations (scope) of RNAV substitution and the operational criteria an operator has to comply with in order for it to be implemented.

1.2.1 RNAV substitution may be used in all phases of flight.

Note.— RNAV substitution may be used on the final segment of a conventional approach provided the conventional radio aid defining the approach is continuously displayed and monitored throughout the approach.

1.2.2 Applications of RNAV substitution are used to:

a) determine aircraft position relative to or at a distance from:

1) a very high frequency omnidirectional radio range (VOR);

2) a marker;

3) distance measuring equipment (DME) fix; or

4) a named fix defined by a VOR radial or non-directional beacon (NDB) bearing and DME distance;

b) navigate to or from a VOR or NDB;

c) hold over a VOR, NDB or DME fix;

d) fly an arc based upon DME;

e) fly an overlay of a conventional departure, arrival, approach or route except as lateral guidance in the final approach segment of an instrument approach procedure; and

f) fly a procedure where the chart contains a note requiring a particular type of conventional NAVAID, such as “ADF required”.

Note.— It is not intended that RNAV substitution be applied in order to permit an aircraft to be navigated on a route or procedure based on conventional radio aids, for which the underlying radio aid is unserviceable.

1.2.3 RNAV substitution shall not be applied to any route or procedure where RNAV substitution has been indicated as “not authorized” by an aeronautical information publication (AIP) entry or NOTAM.

Note.— Additional information regarding the validation of procedures and the use of radio navigation aids is provided in the Quality Assurance Manual for Flight Procedure Design *(Doc 9906), Volume 5 —* Validation of Instrument Flight Procedures*; and the* Performance-based Navigation (PBN) Manual *(Doc 9613).*

1.3 OPERATIONAL CRITERIA

1.3.1 RNAV substitution shall be restricted to operators authorized for RNAV 1, RNP 1 or A-RNP operations.

Note.— Where RNAV 1 is authorized, the use of GNSS may be required to mitigate for the lack of on-board performance monitoring and alerting.

1.3.2 The FMS/RNAV installation in the aircraft shall be certified for RNAV 1, RNP 1 or A-RNP operations.

1.3.3 The operator shall establish and document:

a) a policy for the use of RNAV substitution. Depending on its operational constraint(s), the operator may decide to limit the RNAV substitution to particular cases;

b) standard operating procedures to be used by the flight crew when utilizing the FMS/RNAV system for substitution, complying with any procedures and/or limitations developed by the aircraft manufacturer in its documentation (Aircraft Flight Manual (AFM), Quick Reference Handbook (QRH), etc.); and

c) training for the use of RNAV substitutions. The training programme shall, at a minimum, contain the limitations and operational criteria as detailed in this chapter. Such training shall be extended to support staff such as flight operations officers or flight dispatch personnel, as required.

1.3.4 The operator shall ensure that the minimum equipment list (MEL) is updated to include operating limitations associated with the FMS, RNAV and any system, such as GNSS, that supports RNAV substitution.

1.3.5 The operator shall verify that conventional navigational aids intended to be substituted are coded in the FMS/RNAV database, so they can be used as a waypoint.

1.3.6 The operator shall verify that the conventional procedure intended to be flown is coded in the FMS/RNAV navigation database. Depending on the complexity of the conventional procedure, for example where several conventional navigation aids are involved in the path definition with several turning points, a flyability check may be considered.

1.3.7 The use of RNAV substitution navigation techniques shall not be mandated, but may be authorized as a choice by the operator to comply with air traffic clearances that include conventional navigation routing.

1.4 OPERATING PROCEDURES

1.4.1 The pilot-in-command is responsible for:

a) applying pre-flight procedures associated with GNSS use, such as receiver autonomous integrity monitoring (RAIM) check if applicable;

b) checking that the navigation database is current;

c) ensuring that any procedures and waypoints used are retrieved from the navigation database;

d) verifying waypoint sequence, reasonableness of track angles and distances of any overlay procedure used, in particular where the use of RNAV substitution is used to replace offset DME associated with an ILS;

e) ensuring that FMS/RNAV and the GNSS systems are operational; and

f) complying with any limitation of RNAV substitution in the AFM and manufacturer’s documentation.

1.5 PILOT KNOWLEDGE AND TRAINING

The pilot shall be aware of the limitations of RNAV substitution and familiar with the operator’s policy and operating procedures.

— END —

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