



ICAO

Doc 9365

Manual of All-Weather Operations

Fifth Edition, 2024



Approved by and published under the authority of the Secretary General

INTERNATIONAL CIVIL AVIATION ORGANIZATION **Documents**



Document Sharing Hub



| ICAO

Doc 9365

Manual of All-Weather Operations

Fifth Edition, 2024

Approved by and published under the authority of the Secretary General

INTERNATIONAL CIVIL AVIATION ORGANIZATION

 **Documents**
Document Sharing Hub

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

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

First published 1981
Second Edition, 1991
Third Edition, 2013
Fourth Edition, 2017
Fifth Edition, 2024

Doc 9365, *Manual of All-Weather Operations*

Order Number: 9365
ISBN 978-92-9275-286-6

© ICAO 2024

All rights reserved. No part of this publication may be reproduced, stored in a
retrieval system or transmitted in any form or by any means, without prior
permission in writing from the International Civil Aviation Organization.

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

[illegible][illegible]

FOREWORD

The fifth edition of Doc 9365 has been updated to align with Amendments 47, 40 and 24 to Annex 6 – *Operation of Aircraft*, Part I – *International Commercial Air Transport – Aeroplanes*, Part II – *International General Aviation – Aeroplanes* and Part III – *International Operations – Helicopters*, respectively.

This edition incorporates:

- a) more details on head-up displays (HUD), enhanced vision systems (EVS), synthetic vision systems (SVS), and combined vision systems (CVS);
- b) updates to the instrument landing system (ILS) classification material;
- c) continuous descent final approach (CDFA) technique elements including the use of minimum descent height (MDH) as decision height (DH);
- d) removal of Category (CAT) III subcategories;
- e) a harmonized description of Special Approval (SA) CAT I and II operations; and
- f) improvements in the “operational credits” and the resulting performance-based aerodrome operating minima.

The fifth edition also includes guidance on the standards related to various forms of authorizations (approval, specific approval and acceptance), as well as additional miscellaneous updates.

Helicopter-specific all-weather operations are not included in this manual. While they will initially be available in the form of a circular, they will be incorporated in the sixth edition of this manual.

Note.— The basic concepts described in the fifth edition will continue to apply for helicopters, but special care should be exercised when adapting operational aspects for a specific use case.

All-weather operations by remotely piloted aircraft systems (RPAS) are not currently included in this manual, as the related concepts of operations are still evolving.

Annex 6 requires the State of the Operator to ensure that the operator establishes aerodrome operating minima for each aerodrome to be used in operations and to approve the method of determination of such minima. Such minima should not be lower than any that may be established for such aerodromes by the State in which the aerodrome is located, except when specifically approved by that State. The Annex does not require the State of the Aerodrome to establish aerodrome operating minima. However, the State of the Operator needs to take responsibility for supervising the operator in the establishment of its operating minima. To assist States in fulfilling that role, the guidance material contained in this manual relates to surface movement, take-off, departure, approach and landing for all-weather operations. In addition, this manual provides guidance to the State of the Aerodrome concerning its obligations for providing the necessary facilities and services required to support a particular operation. The achievement of continuous improvement of operational safety and increased efficiency rests upon the willingness of States to cooperate in the sharing of experiences and the resolution of differences through harmonization.

This manual describes the technical and operational factors associated with methods of supervising the determination of aerodrome operating minima for surface movement, take-off, departure and instrument approaches, including CAT I, II and III operations, to the lowest minima. Information for States, air navigation service providers and airspace users on how to implement RNAV and RNP applications are in the *Performance-based Navigation (PBN) Manual* (Doc 9613). The information can be applied by the State of the Operator to its operators conducting international commercial air transport operations. Some of the information in this manual describing systems and system performance is applicable to international general aviation operations and international helicopter operations, where appropriate, according to Annex 6, Parts II and III.

The material in this manual is of general nature and may be used as guidance material by civil aviation authorities to develop their own requirements in their role as State of the Operator, State of Registry and State of the Aerodrome, as well as operators and service providers. It complements material in Annex 6 and in the *Procedures for Air Navigation Services – Aircraft Operations* (Doc 8168). As far as practical, Standards and Recommended Practices (SARPs) and Procedures for Air Navigation Services (PANS) are written with neutral intent toward the varying operating circumstances and technologies used. These are called performance-based Standards as opposed to prescriptive Standards, which are typically very detailed. To assist States, air operators and other service providers in understanding how to apply the Standards and resulting regulations and to appreciate the level of safety intended, guidance material is necessary. Such material can be in the form of a manual, like this one, or in the form of attachments to the respective Annexes.

In this manual, numerous references are made to Annexes, PANS, manuals and circulars. Since these documents are frequently amended, one should ensure that the document in question is current. Nothing in this manual should be construed as contradicting or conflicting with the SARPs and Procedures contained in the Annexes and PANS.

This manual includes examples and references to detailed requirements prescribed by some States. A State may find it advantageous to adopt the detailed requirements of another State which has already established comprehensive all-weather procedures consistent with the guidance material in this manual.

Comments on this manual are appreciated, particularly with respect to its application and usefulness. These comments will be taken into consideration in the preparation of subsequent editions. Comments concerning the manual should be addressed to:

The Secretary General
International Civil Aviation Organization
999 Robert-Bourassa Boulevard
Montréal, Québec, Canada H3C 5H7

CONTENTS

	<i>Page</i>
Glossary	ix
Abbreviations and acronyms	xvii
Reference documents	xxi
Chapter 1. Introduction	1-1
1.1 Purpose, scope and use of the manual	1-1
Chapter 2. General concepts	2-1
2.1 Aerodrome operating minima	2-1
2.2 Performance-based approach classification	2-5
2.3 The need for basic legislation	2-6
2.4 The need for specific rules	2-7
2.5 The need for directive, explanatory, advisory and informative material	2-9
Chapter 3. Provision of facilities and services at aerodromes	3-1
3.1 Introduction	3-1
3.2 Aerodrome facilities and requirements	3-1
3.3 Services at aerodromes	3-6
3.4 Instrument departure, arrival and approach procedures	3-8
Chapter 4. Basic requirements for the aircraft and flight crew	4-1
4.1 Introduction	4-1
4.2 The aircraft and its equipment	4-1
4.3 Advisory vertical guidance	4-2
4.4 The flight crew	4-3
4.5 Operating procedures	4-5
4.6 Continuous descent final approach	4-7
4.7 Visual approaches	4-13
Chapter 5. Additional requirements for Category II and III operations	5-1
5.1 General	5-1
5.2 Aerodrome facilities	5-1
5.3 Aerodrome services	5-5
5.4 Instrument approach procedures	5-8
5.5 The aircraft and its equipment	5-8
5.6 Operating procedures	5-11
5.7 Flight crew qualification and training	5-13

	<i>Page</i>
Chapter 6. Implementation of aerodrome operating minima	6-1
6.1 Approval of methods and compliance.....	6-1
6.2 Aerodrome operating minima	6-4
6.3 Take-off minima.....	6-6
6.4 Non-precision approach minima	6-8
6.5 Approach procedure with vertical guidance and precision approach minima	6-10
6.6 Standard Category II operations.....	6-16
6.7 Category III operations	6-18
6.8 Head-up display and equivalent displays	6-21
6.9 Vision systems	6-24
6.10 Operational credit and authorizations for automatic landing systems, head-up display and vision systems	6-30
6.11 Criteria for using automatic landing systems, head-up display, enhanced vision system, synthetic vision system, combined vision system or any combination thereof for the safe operation of an aircraft.....	6-33
Chapter 7. 2D and 3D instrument approach operations.....	7-1
7.1 Introduction.....	7-1
7.2 Approach operations versus approach procedures	7-1
7.3 Continuous descent final approach, 2D and 3D operations.....	7-3
Appendix A. Division of responsibilities between the State of the Aerodrome and the State of the Operator	App A-1
Appendix B. Approach lighting systems.....	App B-1
Appendix C. Instrument landing system facility classification and downgrading	App C-1
Appendix D. Planning minima for alternate aerodromes.....	App D-1
Appendix E. Conversion of reported meteorological visibility (runway visual range/ converted meteorological visibility) practices for the application of an approach ban.....	App E-1
Appendix F. Example of minima for approach and landing operations	App F-1
Appendix G. Example of operational credit for enhanced flight vision systems.....	App G-1
Appendix H. Example of vision systems compliance list (Applies to Annex 6, Parts I and II)	App H-1
Appendix I. Examples of training, checking and recent experience requirements for head-up displays and vision systems	App I-1
Appendix J. Approach classification summary	App J-1
Appendix K. Example of implementation of special approval CAT I operations	App K-1

GLOSSARY

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

Advanced aircraft. An aircraft with equipment in addition to that required for a basic aircraft for a given take-off, approach or landing operation.

Advisory vertical guidance. Vertical path deviation guidance indications provided as a non-essential aid to help pilots meet barometric altitude restrictions.

Aerodrome operating minima (AOM). The limits of usability of an aerodrome for:

- a) take-off, expressed in terms of runway visual range (RVR) and/or visibility and, if necessary, cloud conditions;
- b) landing in two-dimensional (2D) instrument approach operations, expressed in terms of VISIBILITY and/or RVR and minimum descent altitude/height (MDA/H) and, if necessary, cloud conditions; and
- c) landing in three-dimensional (3D) instrument approach operations, expressed in terms of VISIBILITY and/or RVR and decision altitude/height (DA/H) as appropriate to the type and/or category of the operation.

Aircraft state awareness synthetic vision system (ASA-SVS). A flight instrument display that combines the perspective view synthetic terrain depiction and overlaid primary flight display symbology.

Alert height. A height above the runway threshold (THR) based on the characteristics of the aircraft and its fail-operational landing system, above which a CAT III operation would be discontinued and a missed approach initiated if a failure occurred in one of the redundant parts of the landing system, or in the relevant ground equipment.

All-weather operations. Any surface movement, take-off, departure, approach or landing operations in conditions where visual reference is limited by weather conditions.

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. Alternate aerodromes include the following:

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

En-route alternate. An aerodrome at which an aircraft would be able to land after experiencing an abnormal or emergency condition while en-route.

Destination alternate. An alternate aerodrome to which an aircraft may proceed 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.

Approach ban point. The point from which an instrument approach shall not be continued below 300 m (1 000 ft) above the aerodrome elevation or into the final approach segment unless the reported VISIBILITY or controlling RVR is at or above the AOM.

Approved vertical guidance. Vertical guidance provided on instrument procedures where VNAV is required.

Automatic flight control system (AFCS) with coupled approach mode. An airborne system which provides automatic control of the flight path of the aircraft during approach.

Automatic landing system. The airborne system which provides automatic control of the aircraft during the approach and landing.

Basic aircraft. An aircraft which has the minimum equipment required to perform the intended take-off, approach or landing operation.

Categories of aeroplanes. The following five categories of aeroplanes have been established based on 1.3 times the stall speed in the landing configuration at maximum certificated landing mass:

Category A – less than 169 km/h (91 kt) IAS

Category B – 169 km/h (91 kt) or more but less than 224 km/h (121 kt) IAS

Category C – 224 km/h (121 kt) or more but less than 261 km/h (141 kt) IAS

Category D – 261 km/h (141 kt) or more but less than 307 km/h (166 kt) IAS

Category E – 307 km/h (166 kt) or more but less than 391 km/h (211 kt) IAS.

Ceiling. The height above the ground or water of the base of the lowest layer of cloud below 6 000 m (20 000 ft) covering more than half the sky.

Note.— The definition of ceiling may differ in some States.

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

Combined vision system (CVS). A system to display images from a combination of an enhanced vision system (EVS) and a synthetic vision system (SVS).

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

Continuous descent final approach (CDFA). A technique, consistent with stabilized approach procedures, for flying the final approach segment (FAS) of an instrument non-precision approach (NPA) 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 begins for the type of aircraft flown; for the FAS of an NPA procedure followed by a circling approach, the CDFA technique applies until circling approach minima (circling OCA/H) or visual flight manoeuvre altitude/height are reached.

Converted meteorological visibility (CMV). A value (equivalent to an RVR) which is derived from the reported meteorological visibility.

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

Note 1.— DA is referenced to mean sea level (MSL) and DH is referenced to the THR elevation or touchdown zone (TDZ) elevation as appropriate for the State of the Aerodrome.

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

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

Enhanced flight vision system (EFVS). An installed aircraft system using an electronic means to provide the flight crew with a real-time sensor-derived display of the external scene topography (the natural or artificial features of a place or region especially in a way to show their relative positions and elevation) through the use of imaging sensors.

Enhanced vision system (EVS). A system to display electronic real-time images of the actual external scene achieved through the use of image sensors.

Note.— EVS does not include night vision imaging system (NVIS).

Fail-operational automatic landing system. An automatic landing system is fail-operational if, in the event of a failure, the approach, flare and landing can be completed by the remaining part of the automatic system.

Fail-operational hybrid landing system. A system which consists of two or more independent landing systems and in the event of failure of one system, guidance or control is provided by the remaining system(s) to permit completion of the landing.

Note.— A fail-operational hybrid landing system may consist of a fail-passive automatic landing system with a monitored HUD which provides guidance to enable the pilot to complete the landing manually after failure of the automatic landing system.

Fail-passive automatic landing system. An automatic landing system is fail-passive if, in the event of a failure, there is no significant deviation of aircraft trim, flight path or attitude but the landing will not be completed automatically.

Final approach. That part of an instrument approach procedure which commences at the specified FAF or point, or where such a fix or point is not specified:

- a) at the end of the last procedure turn, base turn or inbound turn of a racetrack procedure, if specified; or
- b) at the point of interception of the last track specified in the approach procedure, and ends at a point in the vicinity of an aerodrome from which:
 - 1) a landing can be made; or
 - 2) a missed approach procedure is initiated.

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

Flight visibility. The visibility forward from the flight deck of an aircraft in flight.

Flight guidance system (FGS). The means available to the flight crew to manoeuvre the aircraft in a specific manner, either manually or automatically. It may include a number of components such as the autopilot, flight directors (F/D) and relevant display and annunciation elements.

GBAS landing system (GLS). An instrument approach operation that is based on GBAS.

Ground-based augmentation system (GBAS). An augmentation system to the Global Navigation Satellite System (GNSS) in which the user receives augmentation information directly from a ground-based transmitter.

Head-up display (HUD) (or equivalent display (ED)). A transparent display system that presents flight information into the pilot's forward external field of view.

Head-up display approach and landing guidance system (HUDLS). An airborne instrument system which presents sufficient information and guidance in a specific area of the aircraft windshield, superimposed for a conformal view with the external visual scene, which permits the pilot to manoeuvre the aircraft manually by reference to that information and guidance alone to a level of performance and reliability that is acceptable for the category of operation concerned.

Hybrid system. Two or more systems that are combined and regarded as one system for performance and approval purposes.

Note.— The component systems are normally approved as stand-alone systems.

ILS critical area. An area of defined dimensions about the localizer and glide path antennas where vehicles, including aircraft, are excluded during all ILS operations.

Note.— The critical area is protected because the presence of vehicles and/or aircraft inside its boundaries will cause unacceptable disturbance to the ILS signal-in-space (SIS).

ILS sensitive area. An area extending beyond the critical area where the parking and/or movement of vehicles, including aircraft, is controlled to prevent the possibility of unacceptable interference to the ILS signal during ILS operations.

Note.— The sensitive area is protected against interference caused by large moving objects outside the critical area but still normally within the airfield boundary.

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

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

Note.— LNAV and VNAV guidance refers to guidance provided either by:

- a) a ground-based radio navigation aid; or
- b) computer-generated navigation data from ground-based, space-based and 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. IAPs are classified as follows:

Non-precision approach (NPA) procedure. An instrument approach procedure designed for 2D instrument approach operations with DH at or above 75 m (250 ft).

Note.— NPA procedures may be flown using a continuous descent final approach (CDFA) technique. CDFAs with advisory vertical 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 CDFA 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 with DH at or above 75 m (250 ft).

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.

Instrument flight rules (IFR). A set of rules governing the conduct of flight under instrument meteorological conditions.

Note.— IFR specifications are found in Chapter 5 of Annex 2 – Rules of the Air. IFR may be followed in both IMC and VMC.

Instrument meteorological conditions (IMC). Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling, less than the minima specified for visual meteorological conditions.

Note.— The specified minima for VMC are contained in Chapter 4 of Annex 2.

Localizer performance (LP). The label to denote minima lines associated with the lateral element of APV-I performance on approach charts.

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

Low-visibility operations (LVO). Approach operations in RVRs less than 550 m and/or with a DH less than 60 m (200 ft) or take-off operations in RVRs less than 400 m.

Low-visibility procedures (LVP). Specific procedures applied by an aerodrome for the purpose of ensuring safe operations during CAT II and III approach operations and/or low-visibility take-offs.

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

Note 1.— MDA is referenced to MSL and MDH is referenced to the aerodrome elevation or to the THR elevation if it is more than 2 m (7 ft) below the aerodrome elevation. A MDH for a circling approach is referenced to the aerodrome elevation.

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

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

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

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

MLS critical area. An area of defined dimensions about the azimuth and elevation antennas where vehicles, including aircraft, are excluded during all microwave landing system (MLS) operations.

Note.— The critical area is protected because the presence of vehicles and/or aircraft inside its boundaries will cause unacceptable disturbance to the guidance signals.

MLS sensitive area. An area extending beyond the critical area where the parking and/or movement of vehicles, including aircraft, is controlled to prevent the possibility of unacceptable interference to the MLS signals during MLS operations.

Note.— The sensitive area provides protection against interference caused by large objects outside the critical area but still normally within the airfield boundary.

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.

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

Note 1.— OCA is referenced to MSL and OCH is referenced to the THR elevation or in the case of NPA procedures to the aerodrome elevation or the THR elevation if it is more than 2 m (7 ft) below the aerodrome elevation. An OCH for a circling approach procedure is referenced to the aerodrome elevation.

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

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

Operational credit. A credit authorized for operations with an advanced aircraft enabling a lower aerodrome operating minimum than would normally be authorized for a basic aircraft, based upon the performance of advanced aircraft systems utilizing the available external infrastructure.

Performance-based aerodrome operating minimum (PBAOM). A lower aerodrome operating minimum, for a given take-off, approach or landing operation, than is available when using a basic aircraft.

Note 1.— The PBAOM is derived by considering the combined capabilities of the aircraft and available ground facilities.

Note 2.— PBAOM may be based on operational credits.

Note 3.— PBAOM are not limited to PBN operations.

Performance-based navigation (PBN). Area navigation based on performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in a designated airspace.

Note.— Performance requirements are expressed in navigation specifications (RNAV specification, RNP specification) in terms of accuracy, integrity, continuity and functionality needed for the proposed operation in the context of a particular airspace concept. Availability of GNSS SIS and/or some other NAVAID infrastructure is considered within the airspace concept in order to enable the navigation application.

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 instrument approach procedure.

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

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

Runway-holding position. A designated position intended to protect a runway, an obstacle limitation surface, or an ILS/MLS critical and/or sensitive area at which taxiing aircraft and vehicles shall stop and hold, unless otherwise authorized by the aerodrome control tower.

Note.— In radiotelephony phraseologies, the expression “holding point” is used to designate the runway-holding position.

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

Satellite-based augmentation system (SBAS). A wide coverage augmentation system in which the user receives augmentation information from a satellite-based sensor.

Special Approval Category I Operations (SA CAT I). A CAT I approach operation that has a DH not lower than 45 m (150 ft) and not less than RVR 400 m and which requires specific approval.

Special Approval Category II Operations (SA CAT II). A CAT II approach operation to a runway that does not fulfil all CAT II infrastructure requirements and which requires specific approval.

Stabilized approach. An approach which is flown in a controlled and appropriate manner in terms of configuration, energy and control of the flight path from a pre-determined point or altitude/height down to a point 15 m (50 ft) above the THR or the point where the flare manoeuvre is initiated, if higher.

State of Registry. The State on whose register the aircraft is entered.

State of the Aerodrome. The State in whose territory the aerodrome is located.

State of the Operator. The State in which the operator’s principal place of business is located or, if there is no such place of business, the operator’s permanent residence.

Surveillance radar. Radar equipment used to determine the position of an aircraft in range and azimuth.

Synthetic vision guidance system (SVGS). SVGS is a type of SVS which combines flight guidance display technology and high precision position assurance monitors.

Synthetic vision system (SVS). A system to display data-derived synthetic images of the external scene from the perspective of the flight deck.

Touchdown zone (TDZ). The portion of a runway, beyond the THR, where it is intended that landing aircraft first contact the runway.

Vertical navigation (VNAV). A method of navigation which permits aircraft operation on a vertical flight profile using altimetry sources, external flight path references, or a combination of these.

Visibility. For aeronautical purposes, it is the greater of:

- a) the greatest distance at which a black object of suitable dimensions, situated near the ground, can be seen and recognized when observed against a bright background;
- b) the greatest distance at which lights in the vicinity of 1 000 candelas can be seen and identified against an unlit background.

Note 1.— The two distances have different values in air of a given extinction coefficient, and the latter b) varies with the background illumination. The former a) is represented by the meteorological optical range (MOR).

Note 2.— The definition applies to the observations of visibility in local routine and special reports, to the observations of prevailing and minimum visibility reported in METAR and SPECI and to the observations of ground VIS.

Visual approach. An approach by an IFR flight when either part or all of an IAP is not completed and the approach is executed by visual reference to terrain.

Visual flight rules (VFR). A set of rules governing the conduct of flight under VMC.

Note.— VFR specifications are found in Chapter 4 of Annex 2.

Visual meteorological conditions (VMC). Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling equal to or better than specified minima.

Note.— The specified minima for VMC are contained in Chapter 4 of Annex 2.

Visual segment surface (VSS). Vertically, the VSS originates at the runway THR height and has a slope of 1.12 degrees less than the promulgated approach procedure angle. The lateral surface of the VSS is defined in PANS-OPS, Volume II.

ABBREVIATIONS AND ACRONYMS

ACAS	Airborne collision avoidance system
AFCS	Automatic flight control system
AFM	Aircraft flight manual
AIC	Aeronautical information circular
AIP	Aeronautical information publication
AIS	Aeronautical information service
ALS	Approach lighting system
AOC	Air operator certificate
AOM	Aerodrome operating minima
APV	Approach procedure with vertical guidance
ASA-SVS	Aircraft state awareness synthetic vision system
A-SMGCS	Advanced surface movement guidance and control system
ATC	Air traffic control
ATIS	Automatic terminal information service
ATS	Air traffic services
AVG	Advisory vertical guidance
AWO	All-weather operations
BALS	Basic approach lighting system
Baro-VNAV	Barometric vertical navigation
CAT I	Category I
CAT II	Category II
CAT III	Category III
CDFA	Continuous descent final approach
CFIT	Controlled flight into terrain
CMV	Converted meteorological visibility
CRM	Collision risk model
CS	Certification specifications (EASA)
CVFP	Charted visual flight procedures
CVS	Combined vision system
DA	Decision altitude
DA/H	Decision altitude/height
DH	Decision height
DME	Distance measuring equipment
EASA	European Union Aviation Safety Agency
ED	Equivalent display
EDTO	Extended diversion time operations
EFVS	Enhanced flight vision system
EVS	Enhanced vision system
FAF	Final approach fix
FALS	Full approach lighting system
FAS	Final approach segment
FGS	Flight guidance system
FMS	Flight management system
FOR	Field of regard
FSTD	Flight simulation training device
GBAS	Ground-based augmentation system

GLS	GBAS landing system
GNSS	Global Navigation Satellite System
HATh	Height above threshold
HALS	High intensity approach lighting system
HUD	Head-up display
HUD/ED	Head-up display/equivalent display
HUDLS	Head-up display approach and landing guidance system
HWD	Head-worn display
IALS	Intermediate approach lighting system
IAS	Indicated airspeed
IAP	Instrument approach procedure
IFR	Instrument flight rules
ILS	Instrument landing system
IMC	Instrument meteorological conditions
ISA	International standard atmosphere
JAA	Joint Aviation Authorities
JAR	Joint Aviation Requirements
LED	Light-emitting diode
LOC	Localizer
LNAV	Lateral navigation
LP	Localizer performance
LPV	Localizer performance with vertical guidance
LVO	Low-visibility operations
LVP	Low-visibility procedures
MALS	Medium intensity approach lighting system
MAPt	Missed approach point
MDA	Minimum descent altitude
MDA/H	Minimum descent altitude/height
MDH	Minimum descent height
MEL	Minimum equipment list
MET	Meteorological services
METAR	Aerodrome routine meteorological report
MID	Runway mid-point
MLS	Microwave landing system
MOC	Minimum obstacle clearance
MSL	Mean sea level
MTBO	Mean time between outages
NALS	No approach lighting system
NDB	Non-directional beacon
NPA	Non-precision approach
NVIS	Night vision imaging systems
OCA	Obstacle clearance altitude
OCA/H	Obstacle clearance altitude/height
OCH	Obstacle clearance height
OFZ	Obstacle-free zone
PA	Precision approach
PAR	Precision approach radar
PBAOM	Performance-based aerodrome operating minimum
PBN	Performance-based navigation
PFD	Primary flight display
RCLL	Runway centre line light
RDH	Reference datum height
RTZL	Runway touchdown zone light

RVR	Runway visual range
SARPs	Standards and Recommended Practices
SBAS	Satellite-based augmentation system
SDF	Stepdown fix
SID	Standard instrument departure
SIS	Signal-in-space
SIGMET	Significant weather report
SMGCS	Surface movement guidance and control system
SOP	Standard operating procedures
SPECI	Aerodrome special meteorological report
SRA	Surveillance radar approach
STAR	Standard instrument arrival
SVR	Slant visual range
SVGS	Synthetic Vision Guidance System
SVS	Synthetic vision system
TDZ	Touchdown zone
THR	Threshold
VDF	Very high frequency direction-finding station
VDP	Visual descent point
VFR	Visual flight rules
VGSI	Visual glideslope indicators
VMC	Visual meteorological conditions
VNAV	Vertical navigation
VOR	Very high frequency omnidirectional radio range
V/S	Vertical speed

REFERENCE DOCUMENTS

ICAO PUBLICATIONS

Convention on International Civil Aviation, signed at Chicago on 7 December 1944 and amended by the ICAO Assembly (Doc 7300)

Annexes to the Convention on International Civil Aviation

- Annex 1 – Personnel Licensing*
- Annex 2 – Rules of the Air*
- Annex 3 – Meteorological Service for International Air Navigation*
- Annex 4 – Aeronautical Charts*
- Annex 5 – Units of Measurement to be Used in Air and Ground Operations*
- Annex 6 – Operation of Aircraft*
 - Part I – International Commercial Air Transport – Aeroplanes*
 - Part II – International General Aviation – Aeroplanes*
 - Part III – International Operations – Helicopters*
- Annex 8 – Airworthiness of Aircraft*
- Annex 10 – Aeronautical Telecommunications*
 - Volume I – Radio Navigation Aids*
- Annex 11 – Air Traffic Services*
- Annex 14 – Aerodromes*
 - Volume I – Aerodrome Design and Operations*
- Annex 15 – Aeronautical Information Services*
- Annex 19 – Safety Management*

Procedures for Air Navigation Services

- Procedures for Air Navigation Services – Air Traffic Management (PANS-ATM, Doc 4444)*
- Procedures for Air Navigation Services – Aircraft Operations (PANS-OPS, Doc 8168)*
 - Volume I – Flight Procedures*
 - Volume II – Construction of Visual and Instrument Flight Procedures*
 - Volume III – Aircraft Operating Procedures*

Manuals

Manual on Testing of Radio Navigation Aids (Doc 8071)

Volume I – *Testing of Ground-based Radio Navigation Systems*

Volume II – *Testing of Satellite-based Radio Navigation Systems*

Aeronautical Information Services Manual (Doc 8126)

Manual of Procedures for Operations Inspection, Certification and Continued Surveillance (Doc 8335)

Aeronautical Chart Manual (Doc 8697)

Manual of Aeronautical Meteorological Practice (Doc 8896)

Airport Services Manual (Doc 9137)

Part 6 – *Control of Obstacles*

Part 9 – *Airport Maintenance Practices*

Aerodrome Design Manual (Doc 9157)

Part 1 – *Runways*

Part 2 – *Taxiways, Aprons and Holding Bays*

Part 3 – *Pavements*

Part 4 – *Visual Aids*

Part 5 – *Electrical Systems*

Manual of Runway Visual Range Observing and Reporting Practices (Doc 9328)

Air Traffic Services Planning Manual (Doc 9426)

Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476)

Performance-based Navigation (PBN) Manual (Doc 9613)

Manual of Criteria for the Qualification of Flight Simulation Training Devices (Doc 9625)

Volume I – *Aeroplanes*

Volume II – *Helicopters*

Airworthiness Manual (Doc 9760)

Advanced Surface Movement Guidance and Control Systems (A-SMGCS) Manual (Doc 9830)

Safety Management Manual (Doc 9859)

Flight Planning and Fuel Management Manual (FPFM) (Doc 9976)

Performance-based Navigation (PBN) Operational Approval Manual (Doc 9997)

PUBLICATIONS OF OTHER STATES OR ORGANIZATIONS

Some States and international organizations have published related documentation of an informative or regulatory nature of which the following are referred to in this manual:

Europe

European Regulation (EU) 965/2012 Air Operations

European Aviation Safety Agency (EASA) Decision 2012/18/R on Part-CAT

EASA Decision 2012/19/R on Part-SPA

European Guidance Material on All Weather Operations at Aerodromes (EUR Doc 013)

European Guidance Material on Management of ILS Critical and Sensitive Areas (EUR Doc 040)

United States

Code of Federal Regulations (CFRs)

Federal Aviation Administration (FAA) Order 8260.3F, United States Standard for Terminal Instrument Procedures (TERPS)

Advisory Circular (AC) 120-118 *Criteria for Approval/Authorization of All Weather Operations (AWO) for Takeoff, Landing, and Rollout*

Currently:

Advisory Circular 120-29A, *Criteria for Approval of Category I and Category II Weather Minima for Approach*

Advisory Circular 120-28D, *Criteria for Approval of Category III Weather Minima for Takeoff, Landing, and Rollout*

To be replaced by:

AC 20-191, *Airworthiness Approval of Airborne Systems used for Takeoff, Precision Approach, Landing and Rollout in low-visibility conditions*

AC 20-185A, *Airworthiness Approval of Synthetic Vision Systems, Synthetic Vision Guidance Systems and Aircraft State Awareness Synthetic Vision Systems*

AC 90-106B, *Enhanced Flight Vision System Operations*

Chapter 1

INTRODUCTION

1.1 PURPOSE, SCOPE AND USE OF THE MANUAL

1.1.1 This document provides a total system concept from information derived from related ICAO Annexes and guidance material and from States' documents and practices. It is intended that this material will be useful to a State wishing to progress the systematic development of all-weather operations, both in regard to its role as State of the Operator or State of Registry and as State of the Aerodrome. It is also intended that this material will serve aerodrome and facility planners in fostering an understanding of the methodology used by operators in establishing their aerodrome operating minima.

Note.— The State of the Operator has an obligation under Annex 6 – Operation of Aircraft in respect of aerodrome operating minima (AOM). States can meet this obligation by supervising the determination of operating minima by operators. The guidelines contained herein describe one option that will enable either of two possible methods to satisfy this obligation.

1.1.2 Because of the complex nature of aircraft operations, there is a need to approach the subject of all-weather operations with a total-system concept. The major subsystems are the ground and airborne elements. The ground elements consist of facilities, services and obstacles: these relate, in principle, to the State of the Aerodrome. The airborne elements consist of the aircraft and its systems, flight crew capabilities and flight procedures, which fall under the jurisdiction of the State of the Operator or State of Registry.

1.1.3 With the previous distinction in mind, this manual provides guidance to:

- a) States of the Operator in the oversight of their operators in the establishment, implementation and use of operating minima, leading to standardization of the methods used in the establishment of AOM;
- b) States and their operators on suitable requirements for progression to the lowest possible minima;
- c) States of the Aerodrome to assist in the establishment of AOM as well as to highlight the need for the provision of ground facilities and services when planning to implement all-weather operations; and
- d) flight crew members and other personnel who need to understand these operations.

1.1.4 A State may play a dual role. As a State of the Operator (and State of Registry for general aviation operators), it is responsible for the authorization and monitoring of operations conducted by operators subject to its oversight. As a State of the Aerodrome, it is responsible for the oversight of the aerodrome, including associated facilities and services, located in its territory. Separate departments within the administration may be assigned the discharge of these two areas of responsibility. To facilitate use of this document:

- a) the general concepts of legislation, application and promulgation of information on all-weather operations are contained in Chapter 2;
- b) the provisions relevant to the State of the Aerodrome are contained in Chapter 3, Chapter 5, 5.2 to 5.4, and Chapter 7; and

- c) the provisions relevant to the State of the Operator (State of Registry for general aviation operators) are contained in Chapter 4, Chapter 5, 5.5 to 5.7, Chapter 6 and Chapter 7.

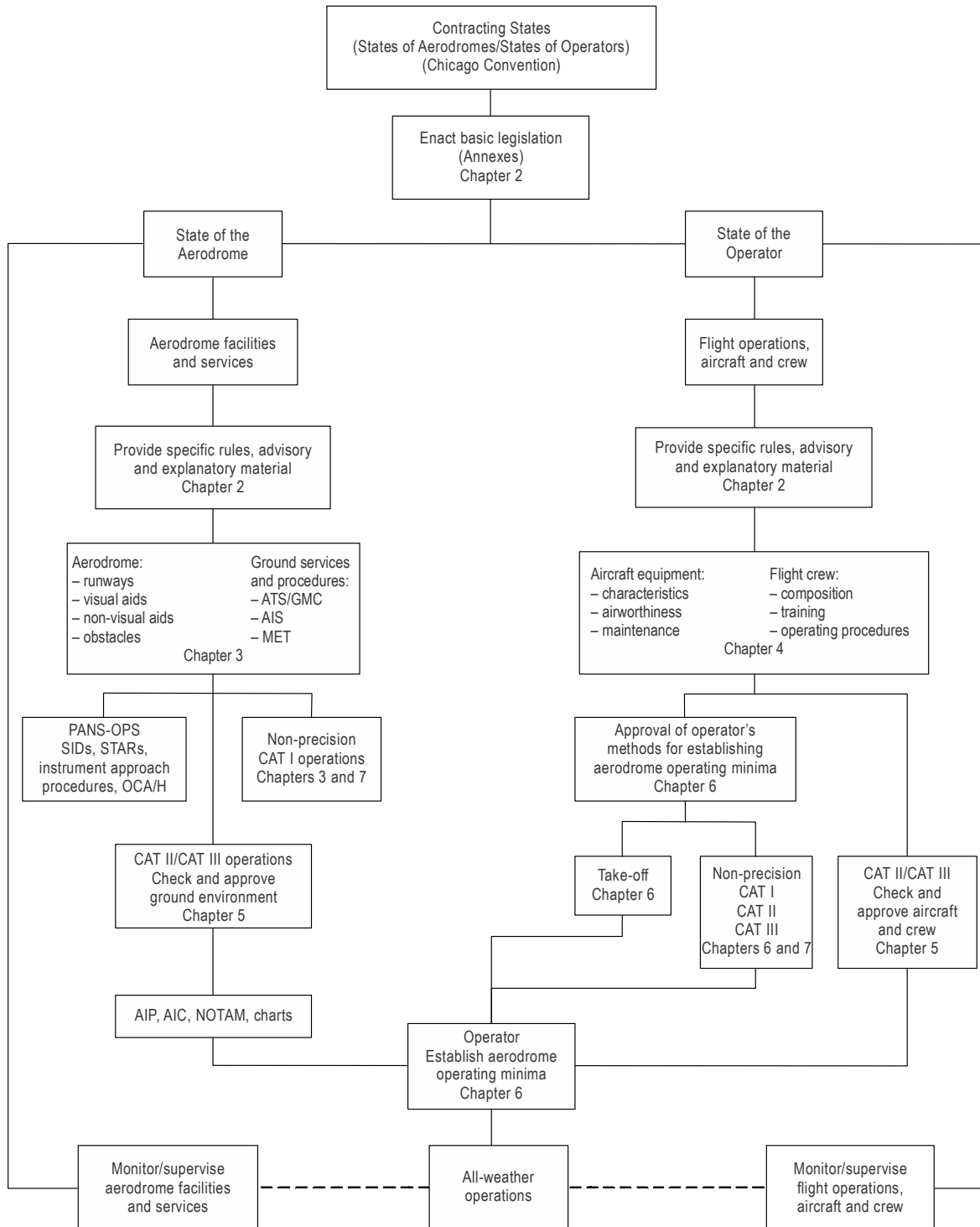


Figure 1-1. Relevant State responsibilities contained in this manual and cross-references to the relevant chapters

Chapter 2

GENERAL CONCEPTS

2.1 AERODROME OPERATING MINIMA

2.1.1 Components of aerodrome operating minima

2.1.1.1 The AOM for approach operations comprise a horizontal and a vertical component and are expressed in terms of minimum visibility/runway visual range (RVR) and minimum descent altitude/height (MDA/H) or decision altitude/height (DA/H). An operator needs to establish AOM in accordance with an approved method for each aerodrome to be used. In many States the designed approach procedure is published in the Aeronautical Information Publication (AIP) and includes the obstacle clearance altitude/height (OCA/H) only and gives no information on what the minimum visibility/RVR must be. Based on this information the operator will develop AOM.

2.1.1.2 Some States apply State minima in which case they publish the AOM in their AIP and/or in documents such as Operations Specifications. In such a case an operator will need to base the AOM on the published State minima if they are higher than the minima determined by the operator. The State minima typically include both the horizontal and vertical components of AOM for approach operations. Take-off minima are normally expressed as visibility or RVR limits, taking into account all relevant factors for each aerodrome planned to be used and the aircraft characteristics. Where there is a specific need to see and avoid obstacles on departure and/or for a forced landing, additional conditions (for example, ceiling) must be specified.

2.1.1.3 States which apply State minima for approach operations typically apply State minima for take-off operations as well.

2.1.2 Traditional versus performance-based aerodrome operating minima

2.1.2.1 Traditionally, AOM have been strictly limited by the kind of instrument approach procedure (IAP) (for example, non-precision approach (NPA), approach procedure with vertical guidance (APV) or precision approach (PA)) and the type and category of operation performed. The AOM have also been closely linked to a fixed set of the external navigation means. However, Annex 6 now opens up a more flexible, performance-based approach by possibly granting operational credits for operations with advanced aircraft, as described below.

2.1.2.2 The close relationship with IAPs means that the OCA/H for a certain procedure will always be observed when establishing the relevant MDA/H and DA/H. The PBAOM, based on the combined capabilities of the external infrastructure and airborne systems, relates primarily to visibility/RVR, but also to the MDA/H and DA/H in relation to the values found in the respective definitions above OCA/H.

2.1.2.3 For the purpose of take-off and approach operations, aircraft have been designated as *basic* or *advanced* aircraft. These terms are particularly useful in relation to AOM.

2.1.2.4 Advanced aircraft are defined as those with equipment in addition to that required for a given take-off, approach or landing operation. Such additional equipment could be an AFCS capable of coupled approaches and/or an automatic landing system, head-up display (HUD) (for example, head-worn devices), enhanced flight vision systems (EFVS), combined vision systems (CVS) or synthetic vision guidance systems (SVGS). The amount of operational credit that may be granted to an operation using an advanced aircraft depends on the demonstrated capability of the airborne equipment. Training considerations are contained in Appendix I.

Note.— This definition is not identical to other definitions used for the purpose of airworthiness.

2.1.2.5 The requirements for instrument and non-instrument runways are contained in Annex 14 – *Aerodromes*. Visual aids need not necessarily be matched to the scale of the non-visual aids provided. The criterion for selecting visual aids depends on the conditions in which operations are intended to be conducted. Typically, the presence of more visual and non-visual aids on a runway equates to lower operating minima. However, the use of advanced avionics in modern aircraft can mitigate the need for some visual and non-visual aids and/or allow for lower operating minima on a runway. Annex 14 also allows for instrument approach operations on a non-instrument runway under certain conditions. Some States prescribe circling minima to be applied to such operations.

2.1.3 Operational credit

2.1.3.1 Operational credit is defined as:

A credit authorized for operations with an advanced aircraft enabling a lower aerodrome operating minimum than would normally be authorized for a basic aircraft, based on the performance of advanced aircraft systems utilizing the available external infrastructure.

2.1.3.2 This means that an advanced aircraft can operate in poorer weather conditions than a basic aircraft. This can be expressed as reduction of the required visibility/RVR and/or DA/H, satisfying the flight visibility requirements or requiring fewer ground facilities when adequately compensated by airborne capabilities. For example, an operational credit is where the required flight visibility for an IAP is achieved through a certified enhanced vision system (EVS). The reported natural vision might be less than prescribed for the procedure but the enhanced flight visibility, as determined by the pilot, is sufficient to land.

2.1.4 Determining factors for surface movement

The minimum visibility required for take-off and landing is, in most cases, greater than that necessary for surface movement. The pilot-in-command is ultimately responsible for ensuring clearance from other aircraft, vehicles and obstacles. For low-visibility operations (LVO), aerodromes are commonly required to have low-visibility procedures (LVP) in place to enhance safety during low-visibility ground operations. Such systems need to be proportional to the traffic volume and the complexity of the aerodrome. Air operators should have a policy and procedures for low-visibility taxi operations.

2.1.5 Determining factors for take-off and initial climb minima

2.1.5.1 For take-off, the visual reference available should be sufficient to enable the pilot to keep the aircraft within acceptable limits relative to the runway centre line throughout the take-off roll until it is either airborne or has been brought to a stop following discontinuation of the take-off.

2.1.5.2 The guidance available should enable the pilot to judge the aircraft lateral position and rate of change of position. This is normally provided by external visual cues, such as runway edge lighting, runway centre line lights (RCLL) and runway marking but these may be supplemented by instrument-derived guidance (for example, HUD guidance).

2.1.5.3 In establishing take-off minima, due consideration should be given to the need for the pilot to continue to have adequate guidance in the event of abnormal situations or malfunctions of the aircraft systems such as an engine failure. It also should be ensured that once the aircraft is airborne, sufficient instrument guidance is available to enable a flight path to remain clear of obstacles.

2.1.5.4 At some locations, the onboard navigation systems and ground-based navigation aids may not provide sufficient guidance and, in cases such as mountainous terrain, special procedures and/or requirements may be necessary. Visual guidance may be required under such specific conditions. Minimum visibility or RVR for take-off depends on the visual cues provided for along the runway.

2.1.5.5 In cases where the take-off phase is guided or supplemented by instrumental means, the required visibility/RVR may be reduced.

2.1.6 Determining factors for instrument approach operations

2.1.6.1 For approach and landing the specific considerations involved in the determination of AOM are:

- a) the accuracy with which the aircraft can be controlled along its desired approach path by reference to the instrumentation and use of the equipment provided on board and by utilization of the guidance provided by navigation aids;
- b) the characteristics of the aircraft (for example, size, speed, missed approach performance) and equipment provided on-board (for example, HUD, automatic landing systems, vision systems) and of the ground environment (for example, obstacles in the approach or missed approach areas, availability of non-visual and visual aids);
- c) the proficiency of the flight crew in the operation of the aircraft;
- d) the flight technique applied: whether the final approach is flown applying a CDFA technique or whether a stepdown technique is used;
- e) the extent to which external visual information is required for use by the pilot in controlling the aircraft; and
- f) the interaction of all these factors in demonstrating satisfactory total system performance.

2.1.6.2 For the roll-out, the determining factor is the availability of a roll-out guidance system. Without a roll-out guidance system, a minimum RVR of 125 m or 175 m (depending on State regulations) has been seen as sufficient to control the aircraft during the deceleration phase of landing. Where a roll-out guidance system meeting the required accuracy and integrity is used, a minimum of 75 m RVR should be applied. This minimum value is based on the minimum visual requirements for taxiing the aircraft on the runway. Surface movements from the runway to the terminal require suitable aerodrome infrastructure to support operations at visibilities below about 150 m, as discussed in Chapter 5, 5.3.2.3.

2.1.7 Effect of navigation performance on landing minima

2.1.7.1 The accuracy, integrity and continuity of the airborne and ground-based guidance and control systems generally determine the size of the area in which obstacles need to be considered. A system with better navigation performance will require a smaller area. As a general rule, a smaller area means fewer obstacles need to be considered, which generally results in lower OCH and lower landing minima (that is, lower DA/H or MDA/H and visibility/RVR).

2.1.7.2 Where obstacles are not limiting, the minimum height to which an approach may be continued without external visual reference will be determined by the performance of the total system. The general rule is that better performance will allow lower minima. The area width required for obstacle evaluation is determined by the navigation capability of the aircraft and the ground and/or space element. While legacy systems, such as non-directional beacon (NDB), VHF omnidirectional radio range (VOR) and instrument landing systems (ILS), are still in use, newer systems such as satellite-based augmentation system (SBAS) and ground-based augmentation system (GBAS) have emerged. The continual development of diverging systems, together with the increase in airborne capabilities, has led to a fundamental change in thinking. To prevent further proliferation of systems, the performance-based navigation (PBN) concept was developed based on performance-based requirements. The PBN concept characterizes lateral and potentially vertical performance for airspace use and system performance. Use of this concept will simplify assignment of operating minima.

2.1.7.3 The path of an aircraft on a PA or APV procedure is defined in the vertical dimension by procedure design. Precision and APV IAPs optimize required protection in the vertical dimension. With vertical guidance, the protected airspace more closely follows the vertical flight path, eliminating potential obstacles. The required area needed for obstacle clearance is considerably less than for an NPA procedure. As a result, in most cases minima will be lower.

2.1.7.4 The final approach track may not be aligned with the runway. In such cases, additional visibility/RVR should be required in order to allow the pilot sufficient time to assess the position of the aircraft relative to the runway. In the case of a side-step manoeuvre, where the aircraft will manoeuvre at a relatively late stage toward a parallel runway, additional visibility/RVR should also be required.

2.1.8 Visibility/runway visual range requirement

The visibility/RVR requirement should be such that there is a high degree of probability that sufficient visual references will be acquired from a position where the DA/H or MDA/H intersects a normal descent path down to the touchdown zone (TDZ). The visibility element for landing minima is determined by the task, based on visual references, that the pilot is required to carry out below DA/H or MDA/H in order to complete the landing safely. It will depend on the extent of the visual reference requirements of the pilot. The availability of an approach lighting system (ALS) and its length will also affect the visibility/RVR required. As a general rule, a higher DA/H or MDA/H or visual reference requirement results in larger visibility/RVR minima.

2.1.9 Continuous descent final approach

Utilizing a CDFA flight technique is recommended to reduce the risk of controlled flight into terrain (CFIT). Where a CDFA technique is not applied, for example, if a stepdown approach technique has been used, there may be a need for additional visibility/RVR. If the approach is not stable at a critical point, the pilot may need additional reaction time for the vertical manoeuvre. In certain States, executing an NPA procedure without using a CDFA technique requires an operational approval which may increase the required visibility or RVR to aid in the visual transition to landing and to establish the aircraft's final descent to land.

2.1.10 Approach ban policy

2.1.10.1 Annex 6, Part I, Chapter 4, 4.4.1, specifies what has come to be known as an "approach ban policy" (commencement or continuation of the approach) to arriving aircraft when weather conditions are reported to be below landing minima. This policy is intended to facilitate the regularity of instrument approach operations, to prevent a landing/go-around decision at a low altitude and in a vulnerable condition, and to minimize unnecessary instrument approach operations where a successful landing would be highly unlikely.

2.1.10.2 The approach ban limits aircraft from proceeding beyond a point on an IAP, which is 300 m (1 000 ft) above the aerodrome elevation or the beginning of the final approach segment, unless weather conditions are reported at or above a specified minima. If weather deteriorates after an aircraft has passed the approach ban point, the policy may permit aircraft to continue, established on the approach, to DA/H or MDA/H. For some States, avionics and vision systems may provide additional capabilities that reduce the approach ban or permit the aircraft to initiate the approach using EVS.

2.1.11 Relationship to runway definitions in Annex 14

In relation to the definitions of various instrument runways, it is important to keep in mind the introductory note in Chapter 1 of Annex 14, Volume I, which states: "It is not intended that these specifications limit or regulate the operation of an aircraft". The consequence of this statement is that there is no conflict between the runway definitions and the actual AOM, which may be lower than the values in the definitions, in particular in cases granting operational credits.

2.2 PERFORMANCE-BASED APPROACH CLASSIFICATION

2.2.1 General

Performance-based navigation represents a shift from sensor-based navigation. Historically, aircraft navigation specifications were defined in terms of navigation sensors, which classified an approach as either precision or non-precision. Under PBN, requirements are identified through the use of navigation specifications detailing the system functionality, training and procedures needed for the intended operation. This transition and the evolution of new navigation systems such as SBAS and GBAS require abandoning the old, sensor-based terms *precision* and *NPA* in favour of a new approach classification system related to performance-based specifications. This new system also better facilitates future development of navigation applications associated with approach and landing operations such as those based on advanced aircraft systems.

2.2.2 Procedures versus operations

2.2.2.1 Performance-based approach classification makes a clear distinction between IAPs and instrument approach operations.

2.2.2.1.1 An IAP is the instrument flight procedure allowing an aircraft to navigate on the final approach down to a given OCH, relying on a given type of navigational infrastructure. IAPs are classified as either:

- a) an NPA procedure;
- b) an APV; or
- c) a PA procedure.

2.2.2.1.2 An instrument approach operation (two-dimensional (2D) or three-dimensional (3D)) is the manner in which an aircraft is operated on a procedure. Performance-based approach classification focuses on the operation and is based on operating minima and operating technique (type of vertical guidance).

2.2.2.2 Instrument approach operations are classified according to the operating minima specified for an approach and the operating technique applied for this type of approach operation. It is possible that an operational credit may be gained by an advanced aircraft which results in lower minima but does not change the category of operation. For example, the IAP may be designed to support a certain category of operation (for example CAT I) but the aircraft capabilities may allow for lower minima. The operating minima are categorized as:

- a) Category I (CAT I): a DH not lower than 60 m (200 ft) and with either a visibility not less than 800 m or an RVR not less than 550 m;
- b) Category II (CAT II): a DH lower than 60 m (200 ft) but not lower than 30 m (100 ft) and an RVR not less than 300 m;
- c) Category III (CAT III): a DH lower than 30 m (100 ft) or no DH and an RVR less than 300 m or no RVR limitation;

Note.— Appendix J summarizes approach classification.

2.2.2.3 The operating techniques for executing an instrument approach are 2D or 3D. A 2D instrument approach operation uses LNAV guidance only, and a 3D instrument approach operation uses both LNAV and VNAV guidance. LNAV and/or VNAV guidance can be provided either by a ground-based radio navigation aid or computer-generated navigation data from ground-based, spaced-based, self-contained navigation aids, or a combination of these. All 2D approach operations are flown to an MDA/H.

2.2.2.4 Examples of the navigation sensors used in 2D instrument approach operations include VOR, NDB, localizer (LOC), localizer performance (LP) and localizer type directional aid. Examples of navigation sensors used in 3D instrument approach operations include ILS, microwave landing system (MLS), GBAS and SBAS.

2.2.2.5 PBN IAPs are based on either the RNP APCH or RNP AR APCH navigation specification. For basic aircraft, procedures with minima lines labelled LNAV or LP are examples of procedures used in 2D approach operations. Advanced aircraft may be able to conduct 3D approaches using either Baro-VNAV or SBAS to provide vertical guidance. An APV is an example of a procedure designed for 3D instrument approach operations. Such procedures will have lines of minima labelled LNAV/VNAV and LPV. See Chapter 7 for additional information.

Note.— SBAS CAT I is classified as a PA and also uses minima lines labelled as LPV.

2.2.2.6 Benefits of performance-based approach classification include better alignment of the runway facilities provided with the instrument approach operations. Previously, the type of runway and required visual markings were aligned to the type of navigational aid or sensor required to fly the IAP. Under performance-based approach classification, the runway facilities needed are derived by the AOM applied regardless of the type of system used to fly the procedure.

2.2.2.7 For example, an ILS approach was classified as a PA procedure under the old system and would always require a precision approach runway regardless of the DA of the approach. With performance-based approach classification, an ILS approach operation with a DH or minimum descent height (MDH) of 75 m (250 ft) or higher can be performed on an NPA runway.

2.3 THE NEED FOR BASIC LEGISLATION

2.3.1 The State is responsible for ensuring the safe conduct of operations, including the development of legislation to implement the International Standards and Recommended Practices (SARPs) for the safety of air navigation required by Article 37 of the *Convention on International Civil Aviation*. These SARPs appear in Annex 6 for air operations and in Annex 14 for the design and certification of aerodromes. Although the methods for discharging its responsibility may vary from State to State, no particular method can, in any way, relieve the State of the responsibility to enact basic legislation, which will provide for the development and promulgation of a code of operational regulations and practices consistent with its obligations under the Convention.

2.3.2 For the safety of all-weather operations, States should fulfil the dual roles of State of the Operator and State of the Aerodrome as follows:

- a) regulate all-weather operations by national operators (State of the Operator); and
- b) regulate and ensure the provision of aerodrome facilities and services appropriate for such types of operation (State of the Aerodrome).

2.3.2.1 The State of the Operator should ensure that it has the basic legislation to provide for certification of operators, approval of the operator's methods for establishing AOM, and inspection and revision as needed. For the oversight of all-weather operations, there should be clear and specific references in law to provide for the establishment of the necessary rules to ensure safe conduct of the intended operations, such as those for establishing take-off and landing minima, flight crew qualifications and aircraft airworthiness.

2.3.2.2 Likewise, the State of the Aerodrome should have regulations concerning the installation and maintenance of the necessary aerodrome facilities and equipment, the development of appropriate procedures and the timely dissemination of information, as well as the certification of the aerodrome infrastructure and the aerodrome operator.

2.3.2.3 The State of the Aerodrome should also have regulations and procedures for the certification and oversight of its aerodromes. Appendix A describes the division of responsibilities and tasks between the State of the Aerodrome and the State of the Operator.

2.4 THE NEED FOR SPECIFIC RULES

2.4.1 Annex 19 – *Safety Management* contains provisions related to the need to establish specific operating regulations (see also the *Safety Oversight Manual* (Doc 9734)). The basic aviation law of the State should:

- a) require commercial air transport operations to be conducted in accordance with conditions the State may consider applicable in the interests of safety;
- b) make provision for the adoption of operating regulations compatible with the provisions of the Annexes to the *Convention on International Civil Aviation* (Doc 7300);
- c) make provision for the delegation to a designated official of the authority to develop and amend operating rules consistent with the operating regulations; and
- d) make provision for the enforcement of operating regulations and rules.

2.4.2 In establishing regulations governing AOM as part of a State's regulatory system, two basic prerequisites should be understood and accepted. These are:

- a) provision, in the basic aviation law of the State, for a code of operating regulations and the promulgation thereof; and
- b) establishment by the State of an appropriate entity with the necessary powers to ensure compliance with the regulations.

2.4.3 In accordance with the concepts of basic aviation law, States are empowered to formulate specific rules for the implementation of all-weather operations within their area of jurisdiction. These rules should apply to the States' operators and applicable aerodromes. While such requirements may also apply to foreign operators to the extent necessary to fulfil the obligations of States under the *Convention on International Civil Aviation*, the primary responsibility for the safety of take-off and landing operations resides with the State of the Operator. The primary responsibility of the State in which the operation takes place is the certification and oversight of aerodromes, navigation facilities, air traffic services (ATS), and promulgation, through the AIPs of information necessary to support all-weather operations. The principal aim of these rules is to ensure an adequate level of safety but they should also establish legal requirements and provide specific guidance to operators and aerodrome authorities involved in all-weather operations. The specific rules relating to such operations form part of those which generally relate to the authorization and control of flight operations. The rules should cover:

- a) the operations, taking into account:
 - 1) AOM;
 - 2) airworthiness requirements;
 - 3) flight crew qualification and training; and
 - 4) operating procedures and their validation;
- b) the aerodrome, taking into account:
 - 1) aerodrome operating procedures and approval;
 - 2) adequacy of runways and taxiways;
 - 3) availability of visual and non-visual aids;
 - 4) control of obstacles;
 - 5) meteorological service and assessment and dissemination of RVR; and
 - 6) ATS, including surface movement control if required;
- c) certification and/or authorization in relation to:
 - 1) the aircraft;
 - 2) the aerodrome; and
 - 3) the operator; and
- d) requirements for compliance with operating minima.

2.5 THE NEED FOR DIRECTIVE, EXPLANATORY, ADVISORY AND INFORMATIVE MATERIAL

2.5.1 Although authority to regulate may be granted by the State's basic legislation and specific rules may provide the necessary legal mechanism to promulgate the requirements considered necessary for safe operations, a certain amount of directive, explanatory and advisory material should be provided to sufficiently detail performance standards, facilitate compliance with specific rules and regularly update operational information. This material may directly specify a means to satisfy the criteria for aircraft or aerodrome operations, or it may describe the end result to be achieved and provide broad guidelines to be followed. Of the two methods, the latter is preferred. Material issued initially for informative or explanatory purposes may be upgraded subsequently to regulatory status if operational considerations warrant such action.

2.5.2 Directive material may be needed to set policy or detail criteria particularly in States where there are many operators or aerodromes or where there are State aviation organizations that implement national policies. The directive material in the form of "orders", "notices", "policy letters", "manuals", etc., serve to ensure that all elements of the authority are properly fulfilling the necessary functions related to all-weather operations. While directive material is primarily intended for use within the State aviation authority, it may also have value as explanatory material to those outside the authority or in the international community for purposes of coordinating activities or as guidance in training. Information primarily intended for use outside of the aviation authority normally would be issued through advisory circulars or similar methods.

2.5.3 The application of advisory and explanatory material in the area of all-weather operations should be clearly understood by the user community. The industry users are expected to carry out their professional responsibilities, and such material should not attempt to produce a description of every single facet of aviation. However, a State should be expected to publish sufficient information in order to establish and maintain an overall acceptable level of expertise and to:

- a) enable a common basis of understanding to be achieved among all parties;
- b) assist in the achievement of sound operational practices; and
- c) disseminate knowledge gained from experience.

2.5.4 The degree to which a State may need to use directives or advisory material to implement an all-weather operations programme should relate to the size and complexity of the State's civil aviation system, including its civil aviation authority, the number of aerodromes and/or operators, its internal organization and other such factors.

2.5.5 Directive, explanatory, advisory and informative material used wholly or in part in the implementation of all-weather operations takes various forms. Apart from this manual, other ICAO documents such as the *Procedures for Air Navigation Services – Aircraft Operations* (PANS-OPS, Doc 8168), the *Performance-based Navigation (PBN) Manual* (Doc 9613) and the *Aerodrome Design Manual* (Doc 9157) are available and should be used to provide the details necessary to carry out a specific function in specialized fields. These may be used directly or put into equivalent forms of directives, orders or notices. Some examples are given below:

- a) material that is required to be published in accordance with ICAO SARPs:
 - 1) a State's AIP provides details of services provided at aerodromes. It includes, for example, a description of the aerodrome, communications, ATS, navigation facilities and rescue and firefighting services available at the aerodrome; and
 - 2) NOTAM are used, among other things, to promulgate changes in the status of the aerodrome facility. They may also be used to give details about an item such as a trial period for the introduction of a new air traffic procedure;

b) other material that is published at the discretion of the State of the Operator:

- 1) circulars, which may be designated advisory circulars or aeronautical information circulars, may be used by States to define in detail the criteria for particular operations or to give advice on a particular aspect such as hazards associated with limited visual cues;
- 2) booklet formats may be used to describe, for example, the requirements to be satisfied for the issue of flight crew licenses or for the introduction and authorization of various types of all-weather operations;
- 3) operations bulletins may provide specific guidance to field offices or operators to highlight safety problems or to specify necessary remedial actions. Safety bulletins may be used by operators to impart this type of information to flight crew members; and
- 4) civil airworthiness requirements provide a means for airworthiness authorities to notify manufacturers and operators of the characteristics and performance Standards required for aircraft and equipment, for example, automatic landing systems.

2.5.6 A State should ensure that it has provided appropriate means to implement ICAO SARPs in terms of the material to be published. The State's system of directive and advisory material should be able to cover any specific areas identified in Chapters 3, 4, 5, 6 and 7 of this manual. The material so produced should provide adequate coverage of the subject matter, be amended and updated when necessary, and be appropriate in terms of format and content for the personnel to which it applies. These personnel may include pilots, air traffic controllers, aerodrome personnel and management, meteorological observers, aircraft maintenance staff, flight operations dispatchers and regulatory inspectors.

Chapter 3

PROVISION OF FACILITIES AND SERVICES AT AERODROMES

3.1 INTRODUCTION

3.1.1 This chapter describes the aerodrome facilities, visual aids, non-visual aids, aerodrome services, operating procedures, surface movement (guidance and control) and departure, arrival and IAPs.

3.1.2 Operations conducted under limited visual reference should have additional facilities and equipment, services and procedures available at aerodromes beyond those required for operations in good weather. The runways and taxiways should meet more stringent criteria, an instrument approach aid with associated IAPs should be required, and visual aids should be provided to assist the flight crew in transitioning from instrument to visual reference. Meteorological and aeronautical information should provide details of the weather conditions and the availability of the aerodrome facilities and equipment, and an air traffic control (ATC) service should be required in order to provide safe separation between aircraft in the air and to avoid collisions on the ground between aircraft, vehicles and objects.

3.1.3 Facilities, equipment, services and procedures that are provided at an aerodrome should be operated under the oversight of the competent authority in the State. This authority should ensure that the appropriate requirements in national regulations, ICAO Annexes and other relevant documents are met and that details are properly promulgated.

3.1.4 Where such facilities, equipment, services and procedures are provided, up-to-date information on any unserviceability or change of status should be immediately made available to pilots through ATS and/or aeronautical information service (AIS). Their details should be included in a publication issued by the AIS described in 3.3.4.

3.1.5 Some aircraft carry additional equipment such as EVS, HUD or automatic landing system. Aircraft with such systems will be able to operate in conditions of lower visibility/RVR for any given set of aerodrome facilities or conversely operate at aerodromes with fewer facilities.

3.2 AERODROME FACILITIES AND REQUIREMENTS

3.2.1 General

3.2.1.1 The following guidance assumes that basic facilities, equipment, services and procedures are provided and describes the extension of basic facilities to provide for all-weather operations at aerodromes. Aerodrome facilities and requirements to be considered fall under the following headings:

- a) physical characteristics of the runway environment, including approach and departure areas;
- b) obstacle limitation surfaces;
- c) visual aids;
- d) non-visual aids;

- e) secondary power supplies; and
- f) movement area safety.

3.2.1.2 The physical characteristics include the disposition of the manoeuvring area and the terrain in the approach and departure areas. The obstacle limitation surfaces assess geographic, artificial and mobile obstacles. The visual aids comprise lighting and markings in the approach area and on runways, taxiways and aprons. Non-visual aids are those aids used as guidance systems. The secondary power supply includes a reserve source and changeover time specifications.

3.2.2 Physical characteristics

3.2.2.1 Specifications for runways, taxiways and holding bays at an aerodrome are given in Annex 14, Volume I, and guidance on design is contained in Doc 9157. Explanations of the visibility conditions and levels of traffic density to be considered when developing systems for use in conditions of low-visibility are given in the *Manual of Surface Movement Guidance and Control Systems (SMGCS)* (Doc 9476) and the *Advanced Surface Movement Guidance and Control Systems (A-SMGCS) Manual* (Doc 9830), together with a comprehensive listing of appropriate aids and references to Annex 14, Volume I, and other relevant ICAO documents.

3.2.2.2 Sufficient taxiways should be provided to minimize the occupancy of an active runway and for taxiing in limited visibility. Appropriate facilities and procedures should be provided to protect an active runway against intrusion during take-off and landing operations. The layout and usage of the taxiway system should be determined so as to simplify the flow of traffic in limited visibility operations in order to minimize the possibility of loss of orientation and to avoid surface movement conflicts.

3.2.2.3 The topography of the terrain under the approach path can be important in all-weather operations because it can affect radio altimeter operation. Radio altimeters are useful for any operation and are typically required for automatic landing, HUD guidance to landing, and for CAT II and CAT III operations. The ground under the last part of the final approach should be regular and preferably level. This is important to ensure correct radio altimeter operation for pilot use, as well as for the terrain awareness and warning system and automatic landing system operation. At runways with significant irregularity of the terrain under the approach path, it may be necessary for an operator to conduct aircraft model-specific assessments of the effect of the irregular terrain on approach and landing operations. Isolated buildings or projections that do not materially disturb radio altimeter indications are usually acceptable (see also 5.2.5).

3.2.3 Obstacle limitation surfaces

3.2.3.1 A method to control obstacles should be established and maintained by the State of the Aerodrome. In accordance with Annex 14, Volume I, the airspace around aerodromes must be maintained free from obstacles so as to permit operations to be conducted safely and efficiently and to prevent the aerodromes from becoming unusable due to the growth of obstacles in the area where flight operations take place. This is achieved by establishing a series of obstacle limitation surfaces (OLS) that define the limits to which objects may penetrate into the associated obstacle-free zone (OFZ) around the aerodrome.

3.2.3.2 At aerodromes, various visual and non-visual aids, for example: approach lighting, meteorological equipment, and radio navigational aids, are located near runways, taxiways and aprons, where they may present a hazard to aircraft in the event of accidental impact during landing, take-off or ground manoeuvring. Only essential equipment and installations that cannot be located elsewhere because of their function should be placed on the runway strip (for example, an ILS glide path transmitter antenna) or in the runway end safety area. However, all such equipment and installations as well as their supports should be frangible and of minimum mass in order to ensure that impact does not result in loss of control of the aircraft.

3.2.3.3 Annex 14 recommends that OFZs be established for ILS CAT I runways and states as well that the OFZ must be established in the case of ILS CAT II and III approach procedures. Obstacles penetrating the obstacle limitation surfaces may in certain circumstances cause an increase in the OCA/H for an IAP or have other operational impact on flight procedure design.

3.2.3.4 For this purpose, PANS-OPS (Doc 8168), Volume II – *Construction of Visual and Instrument Flight Procedures*, specifies the dimensions and requirements related to the protection for obstacles in the visual segment surface (VSS) to safeguard the visual phase of all IAPs where navigation is based on visual cues. According to PANS-OPS, Volume II, no obstacles should penetrate a VSS associated to a straight-in or offset approach procedure. However, if the VSS is penetrated, the respective approach procedure should not be promulgated without conducting an aeronautical study. As a consequence, the study may result in mitigating actions to achieve an acceptable level of safety in operations such as listed in PANS-OPS, Volume II, Part I, Section 4, Chapter 5, 5.4.6.4.

3.2.3.5 The appropriate authority should be consulted before any new construction is started in the vicinity of an aerodrome. The authority should have the power to restrict any new construction that might have an adverse effect on operations. In assessing the effect of obstacle penetration of the Annex 14 obstacle limitation surfaces, the guidelines in respect of protection for the visual segment of the approach procedures as described in PANS-OPS, Volume II, should be taken into account. Guidance on the control of obstacles is contained in the *Airport Services Manual* (Doc 9137), Part 6 – *Control of Obstacles*.

3.2.4 Visual aids

3.2.4.1 The criteria for approach lighting, runway lighting and runway markings are contained in Annex 14, Volume I. Refer to Appendix B of this manual for detailed information related to ALSs. The length and shape of the ALS play an essential role in the determination of landing minima.

3.2.4.2 Visual aids are designed to increase the conspicuousness of the runway, provide visual references in the final stages of the approach and landing and expedite surface movement. The importance of visual aids increases as visibility becomes limited. Approach lighting, RCLL, runway edge lighting and runway markings provide a reference for the pilot to assess lateral position and cross-track velocity. The approach lighting and threshold (THR) lighting and markings provide a roll reference. Runway touchdown zone lights (RTZL) and markings indicate the plane of the runway surface and show the touchdown area providing vertical and longitudinal references.

3.2.4.3 The visual guidance derived from runway lights and/or markings should be sufficient to ensure adequate take-off alignment and directional control for take-off and stopping after landing or in an emergency. Although additional instruments or new technology displays may enhance the safety of the operation, reference to visual aids is a primary requirement unless operations can be shown to be safe, based on the use of non-visual guidance (for example, fail-operational automatic landing system or HUD guidance through roll-out).

3.2.4.4 Visual aids are also important for the safe and expeditious guidance and control of taxiing aircraft. Annex 14, Volume I contains specifications for markings, lights, signs and markers. Requirements may vary but they may consist of markings and signs supplemented by taxi-holding position lights to denote holding positions, taxiing guidance signs and markings on the centre line and edges of taxiways. RCLL and stop bars may be selectively operated to indicate the assigned routing as well as for the control of aircraft. Doc 9476 contains guidance on the selection of surface movement guidance and control system (SMGCS) aids and procedures.

3.2.4.5 The visual aids required for runways can be found in Annex 14, Volume I. These requirements can be mitigated by specifying conditions under which the operation can be conducted and by requiring additional capabilities of the airborne systems.

3.2.4.6 Alternate visual aid requirements for PBN procedures and for GBAS landing system (GLS) may be applicable. This is because both PBN and GLS procedures may be established to runways where it is impractical to install or maintain traditional visual aids in the approach zone, or where the approach paths may not necessarily follow a long straight-in final segment.

3.2.4.7 Visual cues can also be obtained through approved EVS (see Chapter 6, 6.9).

3.2.5 Non-visual aids

3.2.5.1 The term “non-visual aids” refers to the navigation aids or position-fixing systems (for example, GNSS) used to assist the pilot in executing an approach and landing in clouds or in limited visibility which prevents visual acquisition of the runway throughout much of the approach phase. In conditions of moderate cloud base and visibility, the purpose of the aid is to establish the aircraft in a position from which the pilot can safely complete the approach and landing by visual references. In such conditions, a relatively simple aid may suffice. In very low cloud base and/or low-visibility conditions, visual acquisition references may not be available before landing, and a much more accurate and reliable system will be required to locate the aircraft precisely in a vertical and lateral sense on the nominal approach path. Specifications for radio and radar aids are given in Annex 10 – *Aeronautical Telecommunications*, Volume I – *Radio Navigation Aids*. The criteria for terminal area fixes and information on the construction of IAPs are given in PANS-OPS (Doc 8168), Volume II.

3.2.5.2 Some approach aids provide azimuth and/or distance information only. Other approach aids provide vertical (that is, a glide path) information in addition to azimuth guidance and distance information.

3.2.5.3 Regardless of whether the DA/H or MDA/H are high or low, the use of HUD or auto-flight system to heights below the DA/H or MDA/H is preferable from a safety point of view, especially when the RVR is low or when facing other challenging conditions. When possible, these systems should be used all the way through landing and roll-out. When RVR is low (less than 550 m), LVP at the aerodrome need to be in force. Some States require LVPs for any automatic landing system operation. More information on automatic landing system operations is provided in Chapter 6, 6.10.

3.2.5.4 All facilities should be ground- and flight-checked at the time of commissioning and at regular intervals in accordance with the requirements of Annex 10, Volume I, to ensure an adequate and uniform standard of non-visual guidance. In the event that a facility fails to meet the requirements for which it was commissioned, or if a periodic flight test cannot be completed within the appropriate time interval, its status should be reviewed and the facility downgraded as necessary. Users should be advised of changes in facility status through the AIS or NOTAM process. Guidance material on flight testing is contained in the *Manual on Testing of Radio Navigation Aids* (Doc 8071).

3.2.5.5 To ensure that the integrity of the guidance signal radiated by the ground facility (that is, ILS, MLS) is maintained during aircraft approaches, all vehicles and aircraft on the ground must remain outside the facility's critical areas as described in Annex 10, Volume I, Attachment C, if the guidance signal is being used as the primary means of navigation. When a vehicle or aircraft is within the critical area it may cause reflection and/or diffraction of the facility's signals that may result in significant disturbances to the guidance signals on the approach path.

3.2.5.6 Diffraction and/or reflection may also be caused by one or more large aircraft or vehicles in the vicinity of the runway, which may affect both the glide path and localizer signals. This additional area, outside the critical area, is called the sensitive area. The extent of the sensitive area will vary with the characteristics of the facility and the category of operations. The level of interference caused by aircraft and vehicles at various positions on the aerodrome should be established so that the boundaries of the sensitive area may be determined.

3.2.5.7 In addition to critical areas, sensitive areas associated with a facility must be protected if the weather conditions are lower than 60 m (200 ft) cloud base or 550 m RVR when instrument approach operations are being carried out. In the latter case, aircraft which will overfly the localizer transmitter antenna after take-off should be past the antenna before an aircraft making an approach has descended to a height of 60 m (200 ft) above the runway; similarly, an aircraft manoeuvring on the ground, for example when clearing the runway after landing, should be clear of the critical and sensitive areas before an aircraft approaching to land has descended to a height of 60 m (200 ft) above the runway. The protection of these areas when the weather conditions are better than the minimum specified above will facilitate the use of automatic approach and landing systems and will provide a safeguard in deteriorating weather conditions and when actual weather conditions are lower than reported.

Note.— Some States do not distinguish between ILS critical and ILS sensitive areas as defined in Annex 10. These States define an area larger than that defined in Annex 10 but it is still called the “ILS critical area”. The protection to the ILS guidance signal as described in 3.2.5.5 applies.

3.2.5.8 Various facilities of suitable quality are routinely used to provide automatic approach and landing experience in visibility conditions permitting visual monitoring of the operation by the pilot. They should therefore be protected, by interlocks, from interference due to the simultaneous radiation of opposite-direction localizer beams (Annex 10, Volume I). Where this is impracticable for technical or operational reasons and both localizers radiate simultaneously, pilots should be notified by the appropriate ATS unit, by automatic terminal information service (ATIS) broadcast, by NOTAM or in the relevant part of the AIP. Similar harmful interference can occur if aircraft in the final phase of approach or roll-out pass closely in front of the ILS localizer antenna serving another runway. The provisions listed above should therefore be applied to any such facilities where experience shows this to be necessary.

3.2.5.9 It is possible for signals-in-space (SIS) to be affected by the presence of signals from radio and television transmitters, citizen band radios, industrial plastic welders, intentional jammers, etc. Periodic measurements should be made, and the level of any signals detected should then be compared with an accepted maximum. Such measurements can be made by positioning a wide frequency band receiver in the vicinity of the middle marker. Complaints by flight crews of signal disturbances should be investigated, and special flight checks should be made when there is reason to believe that serious interference is occurring. Every effort should be made to identify and eliminate the cause of the interference.

3.2.5.10 Terminology used and protection criteria for critical and sensitive areas may vary among States. For example, some States use the term “critical area” to refer to both ICAO critical and sensitive areas as specified in Annex 10. Thus, when terms used or protection provided requires clarification or explanation, such clarifying information should be made available to relevant operators or States.

3.2.6 Secondary power supplies

Requirements for the provision of secondary power supplies for visual and non-visual aids are specified in Annex 14, Volume I, and Annex 10, Volume I, respectively. Guidance material in Doc 9157, Part 5 – *Electrical Systems*, and Annex 10, Volume I, Attachment C, describes how to achieve the changeover times specified. Secondary power should also be required for essential communications and for other associated facilities, such as visibility measuring systems. Changeover times for the latter facilities should be commensurate with the operations conducted.

3.2.7 Movement area safety

For LVO, additional precautions should be in place to ensure the safety of aircraft operations, vehicle movement and personnel. The aerodrome authority should complete a comprehensive safety assessment of the aerodrome movement area and its operations to facilitate the development of procedures to exclude unwanted vehicles and personnel from the movement area. Guidance material is contained in Doc 9476 and Doc 9830.

3.3 SERVICES AT AERODROMES

3.3.1 General

3.3.1.1 Aerodrome services provide the essential ground support elements required for all-weather operations. Lower aerodrome minima and greater traffic volume in bad weather require more complex and extensive aerodrome services to support the operation. However, regardless of traffic volume and the frequency of operations, there are basic services which should be provided for aerodromes where operations in limited visibility are permitted, including an ATS, a meteorological service and an aeronautical information service.

3.3.1.2 Certain aerodrome management functions relate to the safety of conducting limited visibility operations. Of particular importance is inspection and maintenance of the visual and non-visual aids provided. Maintenance practices for visual aids are contained in Annex 14, Volume I, and Doc 9476. Guidance material on establishing a preventive maintenance programme for aerodrome lighting is contained in Doc 9137, Part 9 – *Airport Maintenance Practices*.

3.3.1.3 Aerodrome operators should also be responsible for making available to AIS or ATS, as appropriate, information on the status of the aerodrome facilities. These requirements are detailed in Annex 14, Volume I. Aerodrome operators should have procedures that provide for timely availability of such information.

3.3.2 Air traffic services

3.3.2.1 The criteria for the establishment of ATS are given in Annex 11 – *Air Traffic Services* and the *Procedures for Air Navigation Services – Air Traffic Management* (PANS-ATM, Doc 4444). For all-weather operations, additional guidance is also available in the *European Guidance Material on All Weather Operations at Aerodromes* (EUR Doc 013) and the *European Guidance Material on Management of ILS Critical and Sensitive Areas* (EUR Doc 040). The objectives of ATS are to:

- a) prevent collisions between aircraft;
- b) prevent collisions between aircraft and obstructions on the manoeuvring area;
- c) expedite and maintain an orderly flow of air traffic; and
- d) provide advice and information for the safe and efficient conduct of flights.

3.3.2.2 When establishing ATS, account should be taken of the need to provide:

- a) reports of meteorological information, including altimeter settings, visibility/RVR and winds;
- b) the status of operational facilities, including navigation aids, aerodrome lighting, signs and markings;
- c) protection of ILS/MLS critical and sensitive areas, if applicable (for more details see EUR Doc 040);
- d) surface movement control and surveillance;
- e) NOTAMs:
 - 1) navigation facility status;
 - 2) snow removal, etc.;
 - 3) lighting system status; and