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Manual of All-Weather Operations

Approved by the Secretary General
and published under his authority

Third Edition — 2013

International Civil Aviation Organization

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AMENDMENTS

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

RECORD OF AMENDMENTS AND CORRIGENDA

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FOREWORD

This third edition of the manual was produced by ICAO with assistance from the Operations Panel, the All-Weather Operations Harmonization Working Group (AWOHWG), and the All-Weather Operations Subgroup of the former Joint Aviation Authorities (JAA). This edition incorporates updates to reflect internationally harmonized procedures for all-weather operations.

Annex 6 — *Operation of Aircraft, Part I — International Commercial Air Transport — Aeroplanes* 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 shall 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 shall take responsibility for supervising the operator in the establishment of its operating minima. To assist States in fulfilling that role, the Operations Panel developed the guidance material contained in this manual related 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 experience and the resolution of differences by negotiation.

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 Category I, II and III operations, to the lowest minima. The information can be applied by the State of the Operator to its operators conducting international commercial air transport operations.

The material in this manual is of a general nature and has been prepared in a form convenient for use as guidance material by national civil aviation authorities in the development of their own requirements in their role as State of the Operator and State of the Aerodrome.

In this manual numerous references are made to ICAO Annexes, Procedures for Air Navigation Services (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 Standards, Recommended Practices 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 would be 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:

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Canada H3C 5H7

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GLOSSARY

ABBREVIATIONS/ACRONYMS

AFCS	Automatic flight control system
AFM	Aeroplane flight manual
AIC	Aeronautical information circular
AIP	Aeronautical information publication
AIREP	Air report
AIS	Aeronautical information service
AOC	Air operator certificate
AOM	Aerodrome operating minima
APV	Approach procedure with vertical guidance
A-SMGCS	Advanced surface movement guidance and control system
ATC	Air traffic control
ATIS	Automatic terminal information service
ATS	Air traffic services
BALS	Basic approach lighting system
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
CS	Certification specifications (EASA)
DA	Decision altitude
DA/H	Decision altitude/height
DDM	Difference in depth of modulation
DH	Decision height
DME	Distance measuring equipment
EASA	European Aviation Safety Agency
EVS	Enhanced vision system
FAA	Federal Aviation Administration
FAF	Final approach fix
FALS	Full approach lighting system
FMS	Flight management system
FSTD	Flight simulation training device
GBAS	Ground-based augmentation system
GLS	GBAS landing system
GMC	Ground movement control
GNSS	Global navigation satellite system
GS	Glide slope
HATh	Height above threshold
HIALS	High intensity approach lighting system
HUD	Head-up display
HUDLS	Head-up display landing system
IALS	Intermediate approach lighting system
IAS	Indicated airspeed

IFR	Instrument flight rules
ILS	Instrument landing system
IMC	Instrument meteorological conditions
JAA	Joint Aviation Authorities
JAR	Joint Aviation Requirements
LOC	Localizer
LNAV	Lateral navigation
LVP	Low visibility procedures
MAPt	Missed approach point
MDA	Minimum descent altitude
MDA/H	Minimum descent altitude/height
MDH	Minimum descent height
MET	Meteorological
METAR	Aviation routine weather report
MIALS	Medium intensity approach and lighting system
MID	Midpoint
MLS	Microwave landing system
MOC	Minimum obstacle clearance
MTBO	Mean time between outages
NALS	No approach lighting system
NDB	Non-directional beacon
NOTAM	Notice to airmen
OCA	Obstacle clearance altitude
OCA/H	Obstacle clearance altitude/height
OCH	Obstacle clearance height
OFZ	Obstacle-free zone
OLS	Obstacle limitation surface
PAR	Precision approach radar
RCLL	Runway centre line lights
RNAV	Area navigation
RNP	Required navigation performance
RTZL	Runway touchdown zone lights
RVR	Runway visual range
SID	Standard instrument departure
SIGMET	Significant weather report
SMGCS	Surface movement guidance and control system
SRA	Surveillance radar approach
STAR	Standard instrument arrival
SVR	Slant visual range
TDZ	Touchdown zone
TERPs	Terminal Instrument Procedures
THR	Threshold
VDF	Very high frequency direction-finding station
VFR	Visual flight rules
VIS	Visibility
VMC	Visual meteorological conditions
VNAV	Vertical navigation
VOR	Very high frequency omnidirectional radio range
VSS	Visual segment surface

EXPLANATION OF TERMS

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

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

- a) take-off, expressed in terms of runway visual range and/or visibility and, if necessary, cloud conditions;
- b) landing in precision approach and landing operations, expressed in terms of visibility and/or runway visual range and decision altitude/height (DA/H) as appropriate to the category of the operation;
- c) landing in approach and landing operations with vertical guidance, expressed in terms of visibility and/or runway visual range and decision altitude/height (DA/H); and
- d) landing in non-precision approach and landing operations, expressed in terms of visibility and/or runway visual range, minimum descent altitude/height (MDA/H) and, if necessary, cloud conditions.

Alert height. A height above the runway threshold based on the characteristics of the aeroplane and its fail operational landing system, above which a Category 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 and landing operations using instrument approach procedures. Instrument approach and landing operations are classified as follows:

Non-precision approach and landing operations. An instrument approach and landing which utilizes lateral guidance but does not utilize vertical guidance.

Approach and landing operations with vertical guidance. An instrument approach and landing which utilizes lateral and vertical guidance but does not meet the requirements established for precision approach and landing operations.

Precision approach and landing operations. An instrument approach and landing using precision lateral and vertical guidance with minima as determined by the category of operation.

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

- a) a ground-based navigation aid; or
- b) computer generated navigation data.

Categories of precision approach and landing operations:

Category I (CAT I) operation. A precision instrument approach and landing with:

- a) a decision height not lower than 60 m (200 ft); and
- b) with either a visibility not less than 800 m or a runway visual range not less than 550 m.

Category II (CAT II) operation. A precision instrument approach and landing with:

- a) a decision height lower than 60 m (200 ft), but not lower than 30 m (100 ft); and
- b) a runway visual range not less than 300 m.

Category IIIA (CAT IIIA) operation. A precision instrument approach and landing with:

- a) a decision height lower than 30 m (100 ft) or no decision height; and
- b) a runway visual range not less than 175 m.

Category IIIB (CAT IIIB) operation. A precision instrument approach and landing with:

- a) a decision height lower than 15 m (50 ft), or no decision height; and
- b) a runway visual range less than 175 m but not less than 50 m.

Category IIIC (CAT IIIC) operation. A precision instrument approach and landing with no decision height and no runway visual range limitations.

Note.— Where decision height (DH) and runway visual range (RVR) fall into different categories of operation, the instrument approach and landing operation would be conducted in accordance with the requirements of the most demanding category (e.g. an operation with a DH in the range of CAT IIIA but with an RVR in the range of CAT IIIB would be considered a CAT IIIB operation or an operation with a DH in the range of CAT II but with an RVR in the range of CAT I would be considered a CAT II operation).

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 above the aerodrome operating minima.

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

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

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.

Categories of approach operations. (See *Approach and landing operations using instrument approach procedures.*)

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.

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

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 the precision approach or approach with vertical guidance at which a missed approach must be initiated if the required visual reference to continue the approach has not been established.

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

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

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

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

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 head-up display 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 aeroplane 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 final approach fix 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. That segment of an instrument approach procedure in which alignment and descent for landing are accomplished.

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

GLS. An instrument approach operation that is based on GBAS.

Ground-based augmentation system (GBAS). An augmentation system in which the user receives augmentation information directly from a ground-based transmitter.

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

Head-up display (HUD) 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.

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.

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 to provide protection against interference caused by large moving objects outside the critical area but still normally within the airfield boundary.

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

Non-precision approach (NPA) procedure. An instrument approach procedure which utilizes lateral guidance but does not utilize vertical guidance.

Approach procedure with vertical guidance (APV). An instrument approach procedure which utilizes lateral and vertical guidance but does not meet the requirements established for precision approach and landing operations.

Precision approach (PA) procedure. An instrument approach procedure using precision lateral and vertical guidance with minima as determined by the category of operation.

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

- a) a ground-based navigation aid; or
- b) computer-generated navigation data.

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. Instrument flight rules may be followed in both IMC and VMC.

Instrument meteorological conditions (IMC). Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling,¹ less than the minima specified for visual meteorological conditions.

Note.— The specified minima for visual meteorological conditions are contained in Chapter 4 of Annex 2.

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

Low visibility take-off (LVTO). A term used by the European authorities in relation to flight operations referring to a take-off on a runway where the RVR is less than 400 m.

1. As defined in Annex 2.

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

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

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

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

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

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

MLS critical area. An area of defined dimensions about the azimuth and elevation antennas where vehicles, including aircraft, are excluded during all 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.

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

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

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, availability and functionality needed for the proposed operation in the context of a particular airspace concept.

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/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.

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 50 feet above the threshold 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.

Touchdown zone (TDZ). The portion of a runway, beyond the threshold, where it is intended landing aeroplanes 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. Visibility for aeronautical purposes 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 visibility.

Visual approach. An approach by an IFR flight when either part or all of an instrument approach procedure 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 visual meteorological conditions.

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,² equal to or better than specified minima.

Note.— The specified minima for visual meteorological conditions are contained in Chapter 4 of Annex 2.

2. As defined in Annex 2.

PUBLICATIONS

(referred to in this manual)

ICAO PUBLICATIONS

Convention on International Civil Aviation (Chicago Convention) (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

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

Procedures for Air Navigation Services (PANS)

ATM — Air Traffic Management (Doc 4444)

OPS — Aircraft Operations (Doc 8168)

Volume I — Flight Procedures

Volume II — Construction of Visual and Instrument Flight Procedures

Manuals

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

*Aerodrome Design Manual (Doc 9157)**Part 2 — Taxiways, Aprons and Holding Bays**Part 3 — Pavements**Part 4 — Visual Aids**Part 5 — Electrical Systems**Aeronautical Chart Manual (Doc 8697)**Aeronautical Information Services Manual (Doc 8126)**Airport Services Manual (Doc 9137)**Part 6 — Control of Obstacles**Part 9 — Airport Maintenance Practices**Air Traffic Services Planning Manual (Doc 9426)**Manual of Aeronautical Meteorological Practice (Doc 8896)**Manual of Criteria for the Qualification of Flight Simulation Training Devices (Doc 9625)**Volume I — Aeroplanes**Manual of Procedures for Operations Inspection, Certification and Continued Surveillance (Doc 8335)**Manual of Runway Visual Range Observing and Reporting Practices (Doc 9328)**Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476)**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**Performance-based Navigation (PBN) Manual (Doc 9613)**Preparation of an Operations Manual (Doc 9376)**Safety Management Manual (SMM) (Doc 9859)***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 Aviation Safety Agency (EASA) Certification Specifications (CS)

European Guidance Material on Aerodrome Operations under Limited Visibility Conditions (EUR Doc 013)

Joint Aviation Authorities (JAA), JAR-OPS 1, Subpart E — *All Weather Operations*

United States

Code of Federal Regulations (CFRs).

Federal Aviation Administration (FAA) Order 8260.3B — *United States Standard for Terminal Instrument Procedures (TERPS)*

Chapter 1

INTRODUCTION

PURPOSE, SCOPE AND USE OF THE MANUAL

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/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, Part I, in respect of aerodrome operating minima. 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 method to satisfy this obligation.

1.2 Because of the complex nature of aeroplane 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 aeroplane and its systems, flight crew capabilities and flight procedures, which fall under the jurisdiction of the State of the Operator/State of Registry.

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 aerodrome operating minima;
- 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 aerodrome operating minima 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.

1.4 A State may play a dual role, i.e. as State of the Operator, responsible for the approval and monitoring of operations conducted by operators subject to its oversight (State of Registry for general aviation operators), and as State of the Aerodrome, responsible for the authorization of the use of the aerodrome and 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;

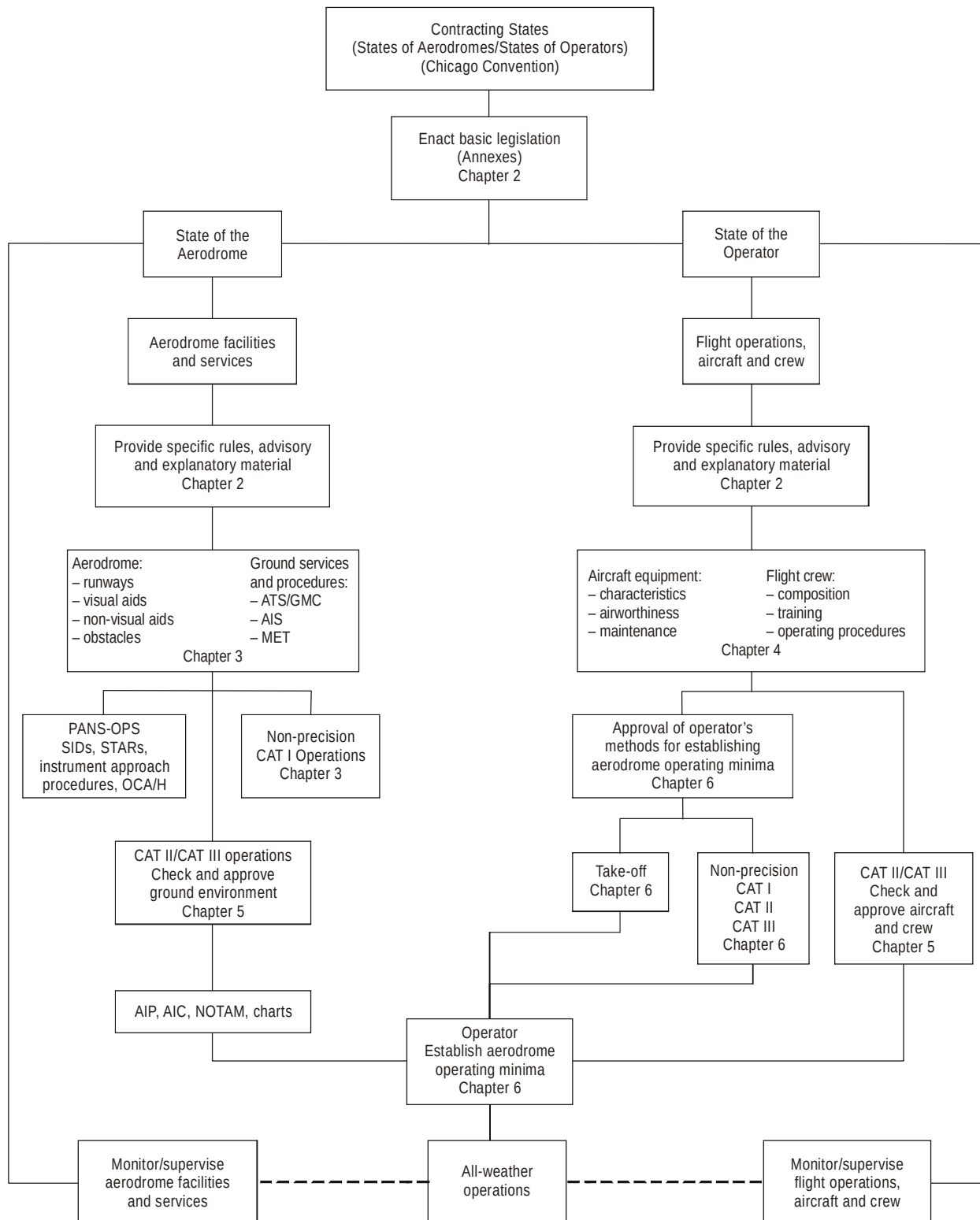


Figure 1-1. Diagram of the relevant State responsibilities contained in this manual and cross-references to the relevant chapters

- b) the provisions relevant to the State of the Aerodrome are contained in Chapter 3 and Chapter 5, 5.2 to 5.4; 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, and Chapter 6.

A diagram of the relevant State responsibilities contained in this manual as well as cross-references to relevant chapters is provided in Figure 1-1.



Chapter 2

GENERAL CONCEPTS

2.1 AERODROME OPERATING MINIMA

General

2.1.1 In limited visibility, the visual references necessary for aeroplane operations solely by visual means may not be available and the aeroplane will have to be operated by reference to instruments or by reference to a combination of instrument and visual information. Aerodrome operating minima are established in order to ensure a desired level of safety for aeroplane operations at an aerodrome by limiting these operations in specified weather conditions. Such minima are generally expressed differently for take-off and for landing. For take-off, which commences with the aeroplane at rest, limitations are usually stated in terms of horizontal visibility, but in instances where there is a need for obstacle identification during take-off, limitations may be stated in terms of horizontal visibility and cloud base. For the approach to landing, a limit on the instrument approach, called decision altitude/height (DA/H) or minimum descent altitude/height (MDA/H), is established together with a horizontal visibility limitation. The use of horizontal visibility is common to both take-off and landing minima, but it should be noted that if a vertical component is included in take-off minima, it is fundamentally different from the vertical component in landing minima. If it is necessary to specify such a vertical component for take-off, it will be a meteorological condition, i.e. cloud base or vertical visibility, whereas for landing, an approach may be continued safely without the required visual reference down to a minimum altitude or height. A ceiling or vertical visibility limitation for the decision to continue the approach to land is normally not applied since a safe flight path to DA/H or MDA/H is assured by procedure design.

Factors to be considered for the determination of aerodrome operating minima

2.1.2 The values of aerodrome operating minima for a particular operation should ensure that the combination of information available from external sources and the aeroplane instruments and equipment is sufficient to enable the aeroplane to be operated along the required flight path. As the amount and quality of external visual information decreases, the quality and quantity of instrument and equipment information, as well as the proficiency of the flight crew, should increase in order to maintain the desired level of safety. In determining the values of aerodrome operating minima, a large number of factors are involved which fall primarily into three groups as follows:

- a) the ground environment and the design, maintenance and operation of ground equipment;
- b) the characteristics of the aeroplane and its equipment; and
- c) the operator's procedures, flight crew training and experience.

The way in which these factors interact is described in this manual.

Flight phases to be considered

2.1.3 The flight phases to be considered in the determination of aerodrome operating minima are:

- a) surface movement from the aeroplane stand to the start of take-off, and from the end of the landing roll to the aeroplane stand;
- b) take-off and initial climb; and
- c) final approach, landing and roll-out.

The minimum visibility required for take-off and landing is, in most cases, greater than that necessary for surface movement.

Determining factors for surface movement

2.1.4 There are no minimum visibility requirements for taxi. The pilot-in-command is ultimately responsible for ensuring clearance from other aircraft, vehicles and obstacles. For low visibility operations, it is common that aerodromes are required, directly or indirectly, to have low visibility procedures 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 policies and procedures for low visibility taxi operations.

Determining factors for take-off and initial climb minima

2.1.5 For take-off, the visual reference available should be sufficient to enable the pilot to keep the aeroplane 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. The guidance available should enable the pilot to judge the aeroplane lateral position and rate of change of position. This is normally provided by external visual cues, such as runway edge lighting, runway centre line lighting and runway marking, but these may be supplemented by instrument-derived guidance (e.g. head-up display guidance). 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 aeroplane systems such as an engine failure. It also should be ensured that once the aeroplane is airborne, sufficient instrument guidance is available to enable a flight path to remain clear of obstacles. However, at some locations, the on-board 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. In cases where the take-off phase is guided or supplemented by instrumental means, the required visibility/RVR may be reduced.

Determining factors for final approach, landing and roll-out minima

2.1.6 For approach and landing the specific considerations involved in the determination of aerodrome operating minima are:

- a) the accuracy with which the aeroplane 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 aeroplane (e.g. size, speed, missed approach performance) and of the ground environment (e.g. obstacles in the approach or missed approach areas, availability of visual and non-visual aids);

- c) the proficiency of the flight crew in the operation of the aeroplane;
- d) the flight technique applied: whether the final approach is flown applying a continuous descent final approach (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.

2.1.7 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 has been seen as sufficient to control the aircraft during the deceleration phase of landing. Where use is made of a roll-out guidance system meeting the required accuracy and integrity, 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 additional airport infrastructure to support operations at visibilities below about 150 m, as discussed in Chapter 5, 5.3.6.

Effect of navigation performance on landing minima

2.1.8 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 more accurate system will require a smaller area. As a general rule, a smaller area means fewer obstacles need to be considered, which generally results in lower obstacle clearance height and lower landing minima (i.e. lower DA/H or MDA/H and visibility/RVR). 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, and 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. Ground-based systems, such as NDB, VOR and ILS, are still in use. However, newer systems have emerged, such as MLS and GLS, as replacements for ILS. 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 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.

2.1.9 Precision approach and landing operations optimize required protection in the vertical dimension. Approaches designed without vertical guidance require larger horizontal protected airspace. With vertical guidance, the protected airspace more closely follows the vertical flight path, eliminating potential obstacles.

2.1.10 The final approach track may not be in line 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.

Visibility/RVR requirement

2.1.11 The visibility element for landing minima is determined by the task the pilot is required to carry out below DA/H or MDA/H in order to complete the landing safely and depends on the extent of the visual reference that the pilot requires. As a general rule, a higher DA/H or MDA/H, or visual reference requirements result in a greater visibility/RVR minima.

Continuous descent final approach (CDFA)

2.1.12 Utilization of a CDFA flight technique is recommended to reduce the risk of CFIT. Where a CDFA technique is not applied, e.g. if a stepdown approach technique has been used, there is 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. When executing an approach without using a CDFA technique, the visibility/RVR minima should be increased by 200 m for CAT A and B aircraft and by 400 m in the case of CAT C and D to aid the visual transition to landing.

Approach ban policy

2.1.13 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. This approach ban limits aircraft from proceeding beyond a point on an instrument approach procedure, 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.

2.2 THE NEED FOR BASIC LEGISLATION

2.2.1 The responsibility of the State for ensuring the safe conduct of operations is implicit in its acceptance of the International Standards and Recommended Practices for the safety of air navigation required by Article 37 of the Convention on International Civil Aviation. These specifications appear in Annex 6, Part I, with respect to the operation of international commercial air transport. 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.

2.2.2 In order to safely conduct 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 or provide aerodrome facilities and services (State of the Aerodrome).

The State of the Operator should ensure that it has the basic legislation to provide for certification of operators, determination of operating minima 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 aeroplane airworthiness. Likewise, as State of the Aerodrome, it should have regulations concerning the installation and maintenance of the necessary ground facilities, the development of appropriate procedures and the timely dissemination of information. Appendix A contains tables which describe the division of responsibilities and tasks between the State of the Operator and the State of the Aerodrome.

2.3 THE NEED FOR SPECIFIC RULES

2.3.1 The need for specific rules and regulations is implied by the provisions of Annex 6, Part I. 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;
- 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.

2.3.2 In establishing aerodrome operating minima as part of a State's regulatory system, two basic prerequisites, as outlined in 2.2 above, 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 a State of an appropriate entity with the necessary powers to ensure compliance with the regulations.

2.3.3 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 States' obligations 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 provision and maintenance of facilities and services and meteorological information, and promulgation, in AIPs and NOTAMS, of information concerning instrument procedures together with obstacle information. The principal aim of these rules is to ensure an adequate level of safety, but they also establish the legal requirements and provide specific guidance to operators and aerodrome authorities proposing to participate 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) aerodrome operating minima;
 - 2) airworthiness requirements;
 - 3) flight crew qualification and training;
 - 4) operating procedures and their validation.
- b) The aerodrome, taking into account:
 - 1) adequacy of runways and taxiways;
 - 2) availability of visual and non-visual aids;

- 3) control of obstacles;
 - 4) meteorological service and assessment and dissemination of RVR; and
 - 5) air traffic services, including surface movement control.
- c) Certification and/or authorization in relation to:
- 1) the aeroplane;
 - 2) the aerodrome; and
 - 3) the operator.
- d) Requirements for compliance with operating minima.

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

2.4.1 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 aeroplane 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.

2.4.2 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., serves 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.

2.4.3 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 amongst all parties;
- b) assist in the achievement of sound operational practices; and
- c) disseminate knowledge gained from experience.