MANUAL OF
ALL-WEATHER OPERATIONS

SECOND EDITION — 1991

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and published under his authority

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FOREWORD

This manual was developed by the Operations Panel of the Air Navigation Commission to replace Circular 121, Implementation of All-Weather Operations, published in 1974. The first edition of the Manual of All-Weather Operations was published in 1982. In 1985, the Air Navigation Commission, after consultation with Contracting States and concerned international organizations, considered there was a need to revise and update the manual. This task was given to the Operations Panel in January 1986.

In noting that Annex 6, Part I, requires the State of the Operator to take responsibility for supervising that operator in the establishment of its operating minima, the panel developed material to assist States in fulfilling that role. The guidance material contained in this manual is related to taxi, take-off 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 co-operate in the sharing of experience and resolution of differences by negotiation.

In this context, all-weather operations are:

Any taxi, take-off or landing operations in conditions where visual reference is limited by weather conditions.

This Manual of All-Weather Operations describes the technical and operational factors associated with methods of determining, and supervising aerodrome operating minima for take-off, non-precision and precision approaches, including ILS operations and MLS operations equivalent to ILS Category I, and can be applied by the State of the Operator to its operators in respect of 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, both in their role as State of the Operator and that of State of the Aerodrome.

In this manual numerous references have been made to Annexes, PANS, manuals and circulars. Since these ICAO documents are frequently amended, it is recommended that for up-to-date information, reference be made to the current editions in question. Nothing in this manual should be construed as contradicting or conflicting with Standards and 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, particularly with respect to its application and usefulness, would be appreciated from all States, international organizations and ICAO Technical Co-operation field missions. These comments will be taken into account in the preparation of subsequent editions. Comments concerning the manual should be addressed to:

The Secretary General
International Civil Aviation Organization
1000 Sherbrooke Street West, Suite 400
Montreal, Quebec
Canada H3A 2R2

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Chapter 1
INTRODUCTION

1.1 PURPOSE, SCOPE AND USE OF THE MANUAL

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

Note.—A State of the Operator has an obligation under Annex 6, Part I, in respect of aerodrome operating minima. States can meet this obligation either by supervising the determination of operating minima by operators or by directly determining minima for their use. The guidelines contained herein describe one option that will enable either method to satisfy this obligation.

1.1.2 In the context of this manual "all-weather operations" means any taxi, take-off and landing operations in conditions where visual reference is limited by weather conditions.

1.1.3 Because of the complex nature of aeroplane operations there is a need to approach the subject of all-weather operations with the concept of a total system in mind. The major sub-systems are the ground and airborne elements. The ground elements comprise facilities, services and obstacles; these relate in principle to the State of the Aerodrome. The airborne elements comprise the aeroplane and its equipment, flight crew capabilities, and flight procedures which fall under the jurisdiction of the State of the Operator. As the international character of aircraft operation will mean that these could be different States, it is important that there is a clear differentiation of their respective responsibilities when consulting the various sections of this manual.

1.1.4 With the foregoing distinction in mind, this manual provides guidance:

a) to States of the Operator in the supervision of their operators in the establishment, implementation, and use of their operating minima leading towards standardization of methods used in the establishment of aerodrome operating minima;

b) to States and their operators on suitable requirements for the progression from the lower limits of Category I to Categories II and III;

c) to States of the Aerodrome to assist in understanding the development of aerodrome operating minima and the need for the provision of ground facilities and services when planning to implement all-weather operations; and

d) to pilots and other personnel who need to understand these operations.

1.1.5 Usually a State will 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 supervision, and as State of the Aerodrome responsible for the authorization and supervision of the aerodromes, 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, the provisions relevant to the State of the Aerodrome are contained in Chapter 3 and Chapter 5, 5.2 to 5.4, whereas those addressed to the State of the Operator are contained in Chapter 4, Chapter 5, 5.5 to 5.7, and Chapter 6. Chapter 2 contains material related to the general concepts of legislation, application, and promulgation of information on the subject of all-weather operations.

Figure 1-1 gives a diagrammatic illustration of the general structure and cross-references to the relevant chapters.
Figure 1-1. Steps in the development of all-weather operations
1.2 GLOSSARY OF TERMS, ABBREVIATIONS AND REFERENCES

Glossary of terms

Aerodrome operating minima. The limits of usability of an aerodrome for either take-off or landing, usually expressed in terms of visibility or runway visual range, decision altitude/height (DA/H) or minimum descent altitude/height (MDA/H) and cloud conditions.

Alert height. An alert height is a height above the runway based on the characteristics of the aeroplane and its fail operational automatic landing system, above which a Category III approach would be discontinued and a missed approach initiated if a failure occurred in one of the redundant parts of the automatic landing system, or in the relevant ground equipment.

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 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.

Automatic flight control system (AFCS) with ILS coupled approach mode. Airborne equipment which provides automatic control of the flight path of the aeroplane by reference to the ILS. (See Airworthiness Technical Manual, Part III, Section 6, Chapter 3.)

Automatic landing system. The airborne equipment which provides automatic control of the aeroplane during the approach and landing. (See Airworthiness Technical Manual, Part III, Section 6, Chapter 4.)

Categories of aeroplanes. The following five categories of typical 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 precision approach operations. (See under Instrument Approach Operations.)

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.

Decision altitude/height (DA/H). A specified altitude or height (A/H) in the precision approach 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 (MSL) 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 the pilot to have made an assessment of the aircraft position and rate of change of position, in relation to the desired flight path.

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. (See Airworthiness Technical Manual, Part III, Section 6, Chapter 4.)
Fall-operational hybrid landing system. A system which consists of a primary fail-passive automatic landing system and a secondary independent guidance system. In the event of failure of the primary system, guidance is provided by the secondary system to permit completion of the landing manually.

Note.—A fall-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. (See Airworthiness Technical Manual, Part III, Section 6, Chapter 4.)

Fall-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. (See Airworthiness Technical Manual, Part III, Section 6, Chapter 4.)

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.

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

Head-up display approach and landing guidance system. A head-up display approach and landing guidance system is 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 and which permits the pilot to manoeuvre the aircraft manually by reference to that information and guidance alone to at least the same degree of performance and reliability as that required for the automatic flight control system 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. 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. 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 and landing operations. Instrument approach and landing operations using instrument approach procedures are classified as follows:

Non-precision approach and landing operations. An instrument approach and landing which does not utilize electronic glide path guidance.

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

Categories of precision approach and landing operations

Category I (Cat I) operation. A precision instrument approach and landing with a decision height not lower than 60 m (200 ft) and 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 decision height lower than 60 m (200 ft) but not lower than 30 m (100 ft), and a runway visual range not less than 350 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 200 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 200 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 the decision height (DH) and runway visual range (RVR) do not fall within the same Category, either the decision height or the RVR may determine in which Category the operation is to be considered. The operation will be in the Category with the lower minima.

**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 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 visual meteorological conditions are contained in Chapter 4 of Annex 2.

**Minimum descent altitude/height (MDA/H).** A specified altitude/height in a non-precision approach or circling approach below which descent may not be made without visual reference.

**Missed approach point (MAP).** 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. 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.

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

**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.

**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.

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

**State of the Operator.** The State in which the operator has his principal place of business or, if he has no such place of business, his permanent residence.

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

**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.

Visibility. The ability, as determined by atmospheric conditions and expressed in units of distance, to see and identify prominent unlighted objects by day and prominent lighted objects by night.

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 in visual reference to terrain.

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 are contained in Chapter 4 of Annex 2.

Wide-body aeroplanes. Wide-body aeroplanes are the following or similar types:

- Boeing 747 — B 747
- Douglas DC-10 — DC 10
- Lockheed L 1011 — L 1011
- Airbus 300/310 — A 300/310
- Boeing 767 — B 767
- Ilyushin 86 — IL 86

Abbreviations

1.2.2 The abbreviations used in this manual have the following meanings:

- AFCS: Automatic flight control system
- AIC: Aeronautical information circular
- AIP: Aeronautical information publication
- AIREP: Air report
- AIS: Aeronautical information service
- ALS: Automatic landing system
- ATC: Air traffic control
- ATIS: Automatic terminal information service
- ATS: Air traffic services
- Cat I: Category I
- Cat II: Category II
- Cat III: Category III
- DA: Decision altitude
- DA/H: Decision altitude/height
- DH: Decision height
- DME: Distance measuring equipment
- ECAC: European Civil Aviation Conference
- FAF: Final approach fix
- FAR: Federal Aviation Regulations
- FDS: Flight director system
- GMC: Ground movement control
- GPWS: Ground proximity warning system
- HI: High intensity
- HUD: Head-up display
- IAP: Instrument approach procedure
- IAS: Indicated airspeed
- IFR: Instrument flight rules
- ILS: Instrument landing system
- IMC: Instrument meteorological conditions
- JAR: Joint Aviation Requirements
- LI: Low intensity
- LLZ: Localizer
- 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
- MLS: Microwave landing system
- MM: Middle marker
- MOTNE: Meteorological operational telecommunications network Europe
- MSL: Mean sea level
- NDB: Non-directional beacon
- NOTAM: Notices to airmen
- OAS: Obstacle assessment surface
- OCA: Obstacle clearance altitude
- OCA/H: Obstacle clearance altitude/height
- OCH: Obstacle clearance height
- OFZ: Obstacle free zone
- PAR: Precision approach radar
- RESA: Runway end safety area
- RFF: Rescue and fire fighting
- R/T: Radiotelephony
- RVR: Runway visual range
- RWA: Runway
- SID: Standard instrument departure
- SIGMET: Significant weather report
- SMGS: Surface movement guidance and control system
- STAR: Standard instrument arrival
- SVR: Slant visual range
- TDZ: Touchdown zone
- THR: Threshold
- VDF: Very high frequency direction finding station
- VDP: Visual descent point
Chapter I — Introduction

VFR  Visual flight rules
VMC  Visual meteorological conditions
VOR  Very high frequency omnidirectional radio range
WMO  World Meteorological Organization

References

Convention on International Civil Aviation (Chicago Convention) (Doc 7300)

Annexes to the Convention:

Annex 1 — Personnel Licensing
Annex 2 — Rules of the Air
Annex 3 — Meteorological Service for International Air Navigation
Annex 5 — Units of Measurement to be Used in Air and Ground Operations
Annex 6 — Operation of Aircraft, Part I — International Commercial Air Transport
Annex 8 — Airworthiness of Aircraft
Annex 10 — Aeronautical Telecommunications, Volume I, Part I — Equipment and Systems; Part II — Radio Frequencies
Annex 11 — Air Traffic Services
Annex 14 — Aerodromes, Volume I — Aerodrome Design and Operations

Procedures for Air Navigation Services:

Aircraft Operations (PANS-OPS) (Doc 8168)
  Volume I — Flight Procedures
  Volume II — Construction of Visual and Instrument Flight Procedures

Rules of the Air and Air Traffic Services (PANS-RAC) (Doc 4444)

Manuals:

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)

Air Traffic Services Planning Manual (Doc 9426)

Airport Services Manual (Doc 9137)
  Part 6 — Control of Obstacles
  Part 9 — Airport Maintenance Practices

Airworthiness Technical Manual (Doc 9051)

Manual of Aeronautical Meteorological Practice (Doc 8896)

Manual of Procedures for Operations Certification and Inspection (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 (General)
  Volume II — ILS (Instrument Landing System)

Preparation of an Operations Manual (Doc 9376)

Documents of other States or organizations:

European Civil Aviation Conference (ECAC) Document No. 17, Common European Procedures for the Authorization of Category II and III Operations

Federal Aviation Regulations (United States)

Joint Aviation Requirements (Europe)

Joint Airworthiness Regulations of the Union of Soviet Socialist Republics
Chapter 2
GENERAL CONCEPTS

2.1 AERODROME OPERATING MINIMA

2.1.1 In limited visibility the visual reference 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, and in some instances by both horizontal visibility and cloud base. For the approach to landing where the aeroplane is already in flight generally a limit on the instrument approach is established, called decision altitude/height (DA/H) or minimum descent altitude/height (MDA/H) 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 the vertical element is a minimum altitude or height to which an approach may be continued without the required visual reference.

2.1.2 The values of aerodrome operating minima for a particular operation must ensure that at all times 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. It will be apparent that as the amount and quality of external, visual information decreases because of reduced visibility, so the quality and quantity of instrument and equipment information as well as the proficiency of the flight crew must be increased 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 with each other is described in this manual.

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

a) take-off and initial climb;

b) final approach and landing; and

c) ground movement from the aeroplane stand to the start of take-off, and from the end of the landing roll to the aeroplane stand.

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

2.1.4 In the take-off case the information available must 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 basic information required by the pilot must enable the pilot to judge the aeroplane lateral position and rate of change of position. This is normally provided by external visual cues but these may be supplemented by instrument derived information. In establishing take-off minima due consideration must be given to the need for the pilot to continue to have adequate information
2.1.5 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 ground based navigation aids;

- b) the characteristics of the aeroplane (e.g. size, speed, missed approach performance, etc.) and of the ground environment (e.g. obstacles in the approach or missed approach areas, safeguarding of ILS/MLS critical and sensitive areas and lighting aids, etc.);

- c) the proficiency of the flight crew in the operation of the aeroplane;

- d) the extent to which external visual information is required for use by the pilot in controlling the aircraft; and

- e) the interaction of all these factors in demonstrating satisfactory total system performance.

2.1.6 The accuracy of the airborne and ground based guidance and control systems generally determines the size of the area in which obstacles need to be considered and the more accurate the system, the smaller the area. As a general rule the smaller the area, the lesser the number of obstacles to be considered and this generally results in lower minima (i.e. lower DA/H or MDA/H). Where obstacles are not limiting, the minimum height to which an approach may be continued without external visual reference will be determined by the accuracy and the reliability of the total system, and again the general rule is that the better the accuracy and reliability, the lower the minimum height element.

2.1.7 The visibility element in minima for approach and landing is determined by the task the pilot is required to carry out at and below DA/H or MDA/H in order to complete the landing. It depends on the extent of the visual reference that the pilot requires. As a general rule, the higher the aeroplane or the more the pilot needs to see as a visual reference the greater will be the visibility/RVR required.

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 to which Article 37 of the Convention on International Civil Aviation refers. These specifications appear in the Annexes of which Annex 6, Part I, has been developed in respect to the operation of international commercial air transport. Although the methods for discharging its responsibility may vary, 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 acceptance of the Annexes. Some guidance to States on basic legislation is contained in the Manual of Procedures for Operations Certification and Inspection (Doc 8335).

2.2.2 Safe conduct of all-weather operations requires that States fulfil the dual roles of State of the Operator and State of the Aerodrome as:

- a) regulator of all-weather operations by its national operators (State of the Operator); and

- b) regulator or provider of aerodrome facilities and services (State of the Aerodrome).

The State of the Operator must ensure it has the basic legislation to provide for certification of operators, determination of minima and for inspection and revision as needed. For the supervision of all-weather operations there must 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 take-off and landing minima, flight crew qualifications and aeroplane airworthiness. Likewise, as State of the Aerodrome it must have regulations concerning the installation and maintenance of the necessary ground facilities, the development of appropriate procedures, and the timely dissemination of information.
2.2.3 Appendix A to this manual is an example of how one State has put into effect the necessary means of regulating its civil aviation activity. Only those aspects which have a particular bearing on take-off and landing minima have been shown.

2.3 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 the operating regulations and rules.

2.3.2 In the establishment of aerodrome operating minima as part of a State's regulatory system it is assumed that two basic prerequisites, as outlined in 2.2 above, are understood and accepted. These are:

a) the provision exists in the basic aviation law of the State for a code of operating regulation and the promulgation thereof; and

b) the State establishes an appropriate entity with the necessary powers to ensure compliance with the regulations.

2.3.3 In accordance with these concepts of basic aviation law, a State's administration is empowered to formulate specific rules for the implementation of all-weather operations within its area of jurisdiction. These rules should apply to its own operators. While such requirements may also apply to foreign operators to the extent necessary to fulfill a State's obligation in respect of the Convention on International Civil Aviation, it should be noted that 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, provision of meteorological information, and promulgation in AIPs and NOTAM of information concerning instrument procedures together with obstacle information. The principle 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 such operations. The specific rules relating to all-weather operations form part of those which generally relate to the authorization and control of flight operations. The rules should cover:

a) The operation, taking account of:

1) airworthiness requirements;

2) flight crew qualification and training;

3) operating procedures and their validation; and

4) aerodrome operating minima.

b) The aerodrome, taking account of:

1) adequacy of runways and taxiways;

2) visual and non-visual aids;

3) control of obstacles;

4) meteorological service and assessment and dissemination of RVR; and

5) air traffic service, including surface movement control.

c) Certification and/or authorization in relation to:

1) the aeroplane;

2) the aerodrome; and

3) the operator.

d) Requirement for compliance with operating minima.

2.3.4 Examples of the specific rules which have been developed by one State and a bibliography of the rules
developed in two States as they relate to the areas of interest listed at 2.3.3 above are given in Appendix B to this manual.

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 will probably be needed to sufficiently detail performance standards, assist compliance with specific rules and regularly update operational information. This material may directly specify a means to satisfy the criteria for every aeroplane or aerodrome operation, or it may describe the end result to be achieved, and provide broad guidelines to be followed. Of the two methods, the latter is to be preferred. Material issued initially for informative or explanatory purposes may subsequently be upgraded to a 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 field organizations intended to implement national policies. The directive material in the form of "orders", "notices", "policy letters", "manuals", etc., serves to ensure that all elements of the organization are properly fulfilling the necessary functions related to all-weather operations. While directive material is primarily intended for use within the State aviation organization it may also have value as explanatory material to those outside the organization or in the international community for purposes of co-ordinating activities or as guidance in training. Information primarily intended for use outside of the aviation organization 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 must be clearly understood by the user community. All those who participate in the industry can be expected to carry out their professional responsibilities and the objective of such material is not to attempt to produce a description of every single facet of aviation. However, a State should be expected to publish sufficient information to enable a common basis of understanding to be achieved amongst all parties, to assist in the achievement of sound operational practices and to disseminate knowledge gained from experience in order to establish and maintain an over-all acceptable level of expertise.

2.4.4 The degree to which a State may need to use the above directives or advisory material to implement an all-weather operations programme would relate to the size of that State, the complexity of its civil aviation authority, numbers of aerodromes or operators, internal organization and other such factors.

2.4.5 Directive, explanatory, advisory and informative material used wholly or in part in the implementation of all-weather operations can take various forms. ICAO documents such as the Procedures for Air Navigation Services — Aircraft Operations (PANS-OPS) (Doc 8168) 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, possibly expanded in content. Some examples are given below:

a) material is required to be published in accordance with ICAO Standards and Recommended Practices:

1) a State's aeronautical information publication (AIP) will give details of services provided at aerodromes. It includes, for example, a description of the aerodrome, communications, air traffic services, navigation facilities and rescue and fire-fighting (RFF) services available at the aerodrome; and

2) notices to airmen (NOTAM) are used to promulgate airport facility status changes in the short or longer term. They may also be used to give details of an item such as a trial period for the introduction of a new air traffic procedure;

b) other material is published at the discretion of the State or 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) a booklet format may be used to describe, for example, the requirements to be satisfied for the issue of flight crew licences or for the introduction of various types of all-weather operations, e.g. United Kingdom civil aviation publications;

3) operations bulletins can give specific guidance to field offices or operators to highlight safety problems or to specify the necessary remedial actions. Safety bulletins may be used by operators to impart this type of information to flight crews; and

4) civil airworthiness requirements provide a means for airworthiness authorities to notify manufacturers and operators of the characteristics and performance standards required for aeroplanes and equipment, e.g. autoland systems.

2.4.6 A State should ensure that it has provided appropriate means to implement ICAO Standards and Recommended Practices with respect to material to be published. The State's system of directive and advisory material should, to the extent necessary, be able to cover any specific areas identified in Chapters 3, 4, 5 and 6. The material so produced must provide adequate coverage of the subject matter, be amended and updated as and when necessary, and be appropriate in terms of format and content to the personnel involved. These personnel may include pilots, air traffic controllers, aerodrome managers, meteorological observers, aeroplane maintenance staff, operator dispatchers and, finally, the regulatory inspectors who monitor the over-all safety of the operation.
Chapter 3

PROVISION OF FACILITIES AND SERVICES AT AERODROMES

3.1 INTRODUCTION

3.1.1 Operations with limited visual reference need facilities, services and procedures at an aerodrome additional to those required for operations in good weather. The runways and taxiways must meet more stringent criteria; an instrument approach aid with associated instrument approach procedures will be required; and visual aids will be needed to assist the flight crew to transition from instrument to visual reference. Meteorological and aeronautical information is needed to provide details of the weather conditions and the availability of the facilities, and an air traffic control service is required in order to provide safe separation between aeroplanes both in the air and on the ground. Finally, standard instrument departure routes and standard instrument arrival routes, with associated procedures (SIDs and STARS) may be needed. Where such procedures are required they should be in accordance with Annex 11 and the Air Traffic Services Planning Manual (Doc 9426).

3.1.2 This section describes the aerodrome facilities, visual aids, non-visual aids, aerodrome services and departure, arrival and instrument approach procedures.

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

3.1.4 When such facilities, aids, services and procedures are provided, details must be included in a publication issued by the aeronautical information service (AIS) described in 3.3.4 and it is a requirement that up-to-date information on any unserviceability or change of status of any of these be immediately made available to pilots through ATS and/or AIS.

3.2 AERODROME FACILITIES AND REQUIREMENTS

General

3.2.1 The following guidance assumes that basic VFR facilities, services and procedures are provided. The extension of basic facilities to provide for all-weather operations at aerodromes is covered. 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.

3.2.2 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 include both precision and non-precision guidance systems. The secondary power supply includes a reserve source and changeover time specifications.

3.2.3 The terms Category I, II and III are limited to the description of categories of instrument approach and landing operations as defined in Chapter 1 and are not associated with the description of ground facilities such as runways, visual and non-visual aids.
Physical characteristics

3.2.4 Specifications for runways, taxiways and holding bays at an aerodrome are given in Annex 14, Volume I, with guidance on design in the Aerodrome Design Manual (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) together with a comprehensive listing of appropriate aids and references to Annex 14, Volume I, and other relevant ICAO documents.

3.2.5 Sufficient taxiways should be provided so as to minimize the occupancy of an active runway for taxiing in limited visibility. Appropriate facilities and procedures must be provided so as to protect an active runway against intrusion during take-off and landing operations. The layout of the taxiway system should be such that during operation in limited visibility the flow of traffic is simplified so as to minimize the possibility of loss of orientation and to avoid ground movement conflicts.

3.2.6 The characteristics of the approach terrain are not covered specifically in ICAO documents, but the topography of the approach terrain can be important in all-weather operations. Radio altimeter(s) are required in Category II and III operations and are becoming widely used in Category I. The ground below the last part of the final approach should at least be regular and preferably level. This is important to ensure correct radio altimeter operation for pilot use as well as for ground proximity warning system (GPWS) and automatic landing system operation. When underlying terrain is irregular, consideration should be given to use of radar reflectors to stabilize the radio altimeter signals in the area preceding the runway threshold. Isolated buildings or projections which do not materially disturb radio altimeter indications are usually acceptable (see also 5.2.5).

Obstacle limitation surfaces

3.2.7 Obstacle limitation surfaces and requirements are defined in Annex 14, Volume I. Control of obstacles should be established and maintained. For precision approach runways the inner approach surface, inner transitional surfaces and balked landing surface define the obstacle free zone. Only essential equipment and installations that cannot be located elsewhere should be placed on the runway strip (e.g. ILS glide path transmitter antenna) or in the runway end safety area (RESA) and even these should be of minimum mass and frangible.

3.2.8 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 new construction if this would have an adverse effect on operations. Guidance on the control of obstacles is contained in the Airport Services Manual (Doc 9137), Part 6.

Visual aids

General

3.2.9 The criteria for approach lighting, runway lighting and runway markings are contained in Annex 14, Volume I.

3.2.10 Visual aids are designed to increase the conspicuity of the runway, provide visual reference in the final stages of the approach and landing, and to expedite ground movement. Their importance increases as visibility becomes limited. Approach lighting and runway centre line and runway edge lighting and markings provide a reference for the pilot to assess lateral position and cross track velocity. The approach lighting and threshold lighting and markings provide a roll reference. Touchdown zone (TDZ) lighting and markings indicate the plane of the runway surface and show the touchdown area providing vertical and longitudinal reference.

3.2.11 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, such as head-up displays, may enhance the safety of the operation, reference to visual aids is a primary requirement even when some form of ground run monitor and displays based on the use of external non-visual guidance are being used.

3.2.12 Visual aids are also important for the safe and expeditious guidance and control of taxiing aeroplanes. Annex 14, Volume I, contains specifications for markings, lights, signs and markers. Requirements may vary, but they may for example consist of markings and signs supplemented by taxi holding position lights to denote holding positions, taxiing guidance signs and
markings on the centre lines and edges of taxiways. Centre line lights and stop bars may be selectively operated to indicate the assigned routing as well as for the control of aeroplanes. The *Manual of Surface Movement Guidance and Control Systems (SMGCS)* (Doc 9476) contains guidance on the selection of SMGCS aids and procedures.

**Non-precision approach and landing operations**

3.2.13 For non-precision approach and landing operations the visual aids for paved instrument runways required by Annex 14, Volume I, are:

a) **Markings**

- runway designation
- runway centre line
- threshold
- fixed distance, where the runway code number is 4
- runway side stripe, where there is a lack of contrast
- taxiway centre line markings, from the runway centre line, where the runway code number is 3 or 4
- taxi-holding position marking.

b) **Lights**

- visual approach slope indicator system
- simple approach lighting system
- runway edge lights, where the runway is intended for use at night
- stopway lights, where a stopway is provided.

3.2.14 For non-precision approach and landing operations the following visual aids are also recommended by Annex 14, Volume I:

**Markings**

- Taxiway centre line marking from the runway centre line where the runway code number is 1 or 2.

3.2.15 There may also be requirements for circling guidance lights or a runway lead-in lighting system depending upon conditions around the aerodrome.

**Category I precision approach and landing operations**

3.2.16 For Category I precision approach and landing operations the visual aids for paved instrument runways required by Annex 14, Volume I, are:

a) **Markings**

- runway designation
- runway centre line
- threshold
- fixed distance, where the runway code number is 4
- touchdown zone
- runway side stripe, where there is a lack of contrast
- taxiway centre line markings, from the runway centre line, where the runway code number is 3 or 4
- taxi-holding position marking.

b) **Lights**

- visual approach slope indicator system
- precision approach Category I lighting system
- runway edge, threshold and end lights
- stopway lights, where a stopway is provided.

3.2.17 For Category I precision approach and landing operations the following visual aids are also recommended by Annex 14, Volume I:

a) **Markings**

- runway side stripe
- taxiway centre line marking, from the runway centre line, where the runway code number is 1 or 2.

b) **Lights**

- runway centre line lights, under specified conditions
- taxi-holding position lights, where there is a need to improve the conspicuity of the holding position.

3.2.18 The requirements for the lower limits of Category I and for Category II and III operations are more demanding.
Non-visual aids

General

3.2.19 The term “non-visual aids” refers to the approved radio and radar aids used to assist the pilot in carrying out an approach and landing under conditions of cloud or limited visibility which preclude having sight of the runway throughout the approach phase. In conditions of moderate cloud base and visibility the purpose of the aid is to establish the aeroplane in a position from which the pilot can safely complete the approach and landing by visual means, and in such conditions a relatively simple aid may well suffice. In very low cloud base and/or visibility conditions visual contact may not be available to the pilot and a much more accurate and reliable system will be required to locate the aeroplane precisely in a vertical and lateral sense on the nominal approach path. Specifications for radio and radar aids are given in Annex 10, Volume I. The criteria for terminal area fixes and information on the construction of instrument approach procedures are given in PANS-OPS (Doc 8168), Volume II.

3.2.20 Non-precision approach aids are the facilities which provide azimuth and/or distance information only. Precision approach aids provide vertical (i.e. glide path) information in addition to azimuth guidance and, possibly, distance information. The non-visual aids for which standards have been defined range from non-precision aids such as VDF, NDB, VOR, surveillance radar, ILS localizer only and MLS azimuth only to the precision approach aids PAR and complete ILS/MLS. In general terms the non-visual aids can support operations in decreasing cloud base and visibility conditions in the order listed.

Non-visual aids — non-precision approach

3.2.21 When using a single non-precision aid for an instrument approach, the position of the aeroplane can only be fixed by overflying the facility. Position fixes may also be obtained by an intersection of bearings or radials from more than one navigational facility, or by the use of DME or marker beacons in association with azimuth guidance. En-route surveillance radar generally may be used to provide fixes prior to the final approach fix. Terminal area radars may be used to identify any terminal area fix including step down fixes after the final approach fix. It is essential that all non-precision aids be ground- and flight-checked at the time of commissioning and at regular intervals thereafter.

Non-visual aids — precision approach

3.2.22 The ICAO standard non-visual precision approach aids are ILS and MLS. ILS is the aid in common use whilst MLS is in the process of introduction. PAR is also recognized as a precision approach aid. ILS ground equipment comprises a localizer, glide path and at least two marker beacons, or, where the siting of marker beacons is impracticable, a suitably sited DME, provided that the distance information so obtained is operationally equivalent to that furnished by marker beacons. ILS may be used for all categories of operations, but the beam structure specifications, monitoring requirements and continuity of service requirements are more stringent for Category II and III operations. MLS ground equipment comprises azimuth and elevation transmitters, DME and for some installations, a back azimuth capability.

3.2.23 The weather conditions experienced at some airports may be such that low minima may not be required. In some cases relatively high OCA/H may preclude low decision altitudes/heights. Notwithstanding these considerations it is desirable to provide for coupled approaches to low height, with provision for automatic landings and roll-outs, by ensuring that the ILS/MLS installation meets the applicable ICAO standards referred to above.

3.2.24 It is essential that all ILS/MLS installations be ground- and flight-checked at the time of commissioning and at regular intervals in accordance with the requirements of Annex 10, Volume I, Part 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 routine flight test cannot be completed within the appropriate time interval, its status must be reviewed and the facility downgraded as necessary. Users should be advised of changes in ILS/MLS status through the AIS. Guidance material on flight testing is contained in the Manual on Testing of Radio Navigation Aids (Doc 8071).

3.2.25 To ensure that the integrity of the guidance signal radiated by the ILS/MLS is maintained during aeroplane approaches, all vehicles and aircraft on the ground must remain outside the ILS/MLS critical areas as described in Annex 10, Volume I, Attachment C to Part I. If a vehicle or aircraft is within the critical area it will cause reflection and/or diffraction of the ILS/MLS signals which may result in significant disturbances to the guidance signals on the approach path.
3.2.26 Diffraction and/or reflection may also be caused by one or more large aeroplanes or vehicles in the vicinity of the runway which may affect both the glide path elevation and localizer azimuth signals. This additional area, outside the critical area, is called the sensitive area. The extent of the sensitive areas will vary with the characteristics of the ILS/MLS and the category of operations. It is essential to establish the level of interference caused by aeroplanes and vehicles at various positions on the aerodrome so that the boundaries of the sensitive areas may be determined.

3.2.27 Critical areas must be protected if the weather conditions are less than 250 m (800 ft) cloud base or 3,000 m visibility when instrument approach operations are being carried out. ILS critical and sensitive areas must always be protected if the weather conditions are lower than 60 m (200 ft) cloud base or 600 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 is reported.

3.2.28 Various ILS ground installations of suitable quality are routinely used to gain 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, Part 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 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 installations where experience shows this to be necessary.

3.2.29 The interim policy for MLS protection should be as for that outlined for ILS in 3.2.27 and 3.2.28 until such time as more definite information is available and has been operationally validated.

3.2.30 It is possible for ILS signals in space to be affected by the presence of signals from radio and television transmitters, citizen band radios, industrial plastic welders, etc. The MLS system design and signal spectrum protection has been selected to protect against interference. Periodic measurements should be made and the level of any signals detected, then 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.

3.2.31 Terminology used and protection criteria for ILS/MLS critical and sensitive areas may vary between 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 require clarification or explanation, such clarifying information should be made available to relevant operators or States.

Secondary power supplies

3.2.32 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, Part I, respectively. Guidance material in the Aerodrome Design Manual (Doc 9157), Part 5, and in Annex 10, Volume I, Attachments C to Part I, describes how to achieve the changeover times specified. Secondary power is also required for essential communications and for other associated facilities, such as visibility measuring systems. Changeover times for these latter facilities will be commensurate with the operations conducted.

Movement area safety

3.2.33 For low visibility operations additional precautions are usually needed to assure safety of aircraft operations, vehicle movement, and personnel. The aerodrome authority will need to complete a comprehensive safety assessment of the aerodrome.
movement area and its operations to facilitate the
development of procedures to enable unwanted vehicles
and personnel to be excluded from the movement area.
Guidance material is contained in the Manual of
Surface Movement Guidance and Control Systems
(SMGCS) (Doc 9476).

3.3 SERVICES AT AERODROMES

General

3.3.1 Aerodrome services provide the essential
ground support elements required for all-weather
operations. The lower the limits and the greater the
traffic volume in bad weather, the more complex and
extensive are the aerodrome services required to support
the operation. However, regardless of traffic volume
and the frequency of operations, there are basic services
which should be provided for every aerodrome where
operations in limited visibilities are permitted. These
services comprise an air traffic service, a meteorological
service, and an aeronautical information service.

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

3.3.3 Aerodrome management is also 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.
It is important for the aerodrome management to have
procedures that provide for the timely availability of
such information.

Air traffic services

3.3.4 The criteria for the establishment of an air
traffic service are given in Annex 11. The objectives of
the air traffic services are to:

a) prevent collisions between aircraft;

b) prevent collisions between aircraft on the
manoeuvring area and obstructions on that area;

c) expedite and maintain an orderly flow of air
traffic; and

d) provide advice and information useful for the safe
and efficient conduct of flights.

3.3.5 When establishing air traffic services, account
should be taken of the need to provide:

a) reports of meteorological information including
altimeter settings, RVR, winds;

b) status of operational facilities including
navigation aids, aerodrome lighting, signs,
makings;

c) protection of ILS/MLS critical and sensitive
areas;

d) surface movement control and surveillance;

e) NOTAM:

1) navigation facilities status;
2) snow removal, etc.;
3) closed runways, construction, etc.;
4) lighting system status;

f) monitoring of instrument approach procedures in
use;

g) approach and departure obstacle clearance
criteria;

h) runway selection criteria including, where
applicable, noise abatement procedures;

i) alerting emergency services — liaison with rescue
and fire fighting; and

j) service to aircraft in emergency.

3.3.6 Air traffic control service is provided at
aerodromes used for international aeroplane operations
and equipped with navigation aids for instrument
approach and landing, except where the type and
density of traffic clearly do not justify the provision of
such a service. Airspace designation, in the form of
terminal control areas, control zones, etc., is
recommended in regional planning criteria to encompass at least the climb to cruising level of departing aeroplanes and the descent from cruising level of arriving aeroplanes.

3.3.7 The provision of information to the aeroplane by the air traffic service becomes increasingly important as the weather conditions deteriorate. The provisions of Annex 11 and PANS-RAC (Doc 4444) define the stages at which the relevant information on weather conditions should be passed to the aeroplane. For efficient operations during adverse weather conditions it is essential that this information be up to date, particularly in regard to the visibility conditions, a major element in operating minima. When an RVR assessment system is available, RVR should be reported to the pilot whenever either the horizontal visibility or the RVR is observed to be less than 1 500 m.

3.3.8 The Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476) provides information on appropriate combinations of visual aids, non-visual aids, radiotelephony communications, procedures, control and information facilities. The system to be adopted at a particular aerodrome should be designed to meet the operational requirements for guidance and control of all relevant traffic in reduced visibility conditions.

3.3.9 As a general rule, extraneous communications from ATC to arriving and departing aircraft should be avoided during critical phases of flight. Typically this period is that from slightly before minimum descent altitude/height, decision altitude/height or alert height to late stages of landing roll. For aircraft on visual approaches, this period typically starts at least 100 ft above ground level. For departing aircraft this period covers from the beginning of the take-off roll at least through the initial stage of departure. For cases where emergencies on the aircraft exist, this period may be considerably greater. Examples of extraneous communications could include such items as requests by ATC for taxiway exit intentions, requests for pilot reports, or information on equipment failures not operationally relevant, and facility status changes such as taxiway closures not immediately affecting the operation.

Meteorological service

3.3.10 The accurate and timely reporting of meteorological conditions is essential. Current meteorological information must be available to the pilot prior to dispatch, en route and in sufficient time for adequate planning of the approach and landing. During the approach significant changes in weather and particularly relevant SIGMETs should be transmitted to the pilot immediately. The primary elements of meteorological reports affecting pilot decisions on approach include RVR, visibility, cloud conditions, obscurations, surface wind, runway condition, thunderstorm and wind shear reports. (The addition of a “runway state group” to a meteorological report is an agreed European region practice for selected aerodromes whose METARs are carried on the MOTNE and it is not part of the WMO METAR code.)

3.3.11 The meteorological services required to support all-weather operations are specified in Annex 3 and in the Manual of Aeronautical Meteorological Practice (Doc 8896). Guidance material in respect of RVR is given in the Manual of Runway Visual Range Observing and Reporting Practices (Doc 9328).

3.3.12 Slant visual range (SVR) addresses the measurement of the visibility available to the pilot along the final approach path. However, a practical method of measuring SVR has not been developed. Thus, it is important that RVR assessment systems be installed which have a high degree of reliability and integrity.

Aeronautical information service

3.3.13 One of the principal functions of the AIS is to ensure the timely dissemination of information on the availability and serviceability of aerodrome facilities, services and procedures. This information should be available to pilots during pre-flight planning and in flight.

3.3.14 Depending upon the nature of the information and the period of notice available, dissemination may be made by:

a) publication of relatively static basic information in an AIP;

b) when adequate notice is available, by publication of Class II NOTAM, aeronautical information circulars or amendment to the AIP;

c) when notice is short, by Class I NOTAM; and

d) when changes occur too late for the NOTAM to be received by the pilot or are of short duration, by ATS transmission.
3.3.15 The Standards and Recommended Practices for an aeronautical information service are contained in Annex 15 and further guidance is given in the *Aeronautical Information Services Manual* (Doc 8126).

3.3.16 At an aerodrome with relatively few movements it may well be possible for those persons in charge of particular equipment or functions to arrange for the relevant information to be published. For a busy aerodrome a specialist staffed AIS may be required both to receive information from those in charge of facilities and to arrange for its dissemination to users.

### 3.4 INSTRUMENT DEPARTURE, ARRIVAL AND INSTRUMENT APPROACH PROCEDURES

3.4.1 Material relating to the establishment of standard instrument departure and arrival routes and associated procedures is contained in Annex 11 and the *Air Traffic Services Planning Manual* (Doc 9426). Criteria for the design of standard instrument departures (SID), standard instrument arrivals (STAR) and instrument approach procedures, with the means of determining obstacle clearance, are given in PANS-OPS (Doc 8168), Volume II. Adequate information on obstacles must be promulgated so as to permit operators to discharge their obligation, under Annex 6, Part I, relating to the development of departure contingency procedures. Guidance on the control and survey of obstacles is given in the *Airport Services Manual* (Doc 9137), Part 6. Specifications for the production of instrument procedure charts and obstacle charts are given in Annex 4. Further guidance is contained in the *Aeronautical Chart Manual* (Doc 8697).

3.4.2 The purpose of such an instrument approach procedure is to provide for the orderly progress of an aeroplane under instrument flight conditions from the beginning of the initial approach to a landing on the runway, or to a point from which a landing may be made visually or the missed approach segment of the procedure is completed. Whenever an instrument approach aid is provided to serve a runway, the provision of an instrument approach procedure is required. This procedure must define the tracks to be flown with the associated altitudes or heights and must include the minimum altitudes or heights at which an aeroplane may be flown in order to ensure that the required obstacle clearance is maintained.

3.4.3 A missed approach procedure, designed to provide protection from obstacles throughout the missed approach manoeuvre, is established for each instrument approach procedure. It specifies a point where the missed approach begins and a point or an altitude/height where it ends. The missed approach is assumed to be initiated not lower than the DA/H in precision approach procedures, or at a specified point in non-precision approach procedures not lower than the MDA/H. The missed approach point (MAPt) in a procedure may be:

- a) the point of intersection of an electronic glide path with the applicable DA/H; or
- b) a navigational facility; or
- c) a fix; or
- d) a specified distance from the final approach fix (FAF).

If upon reaching the MAPt, the required visual reference is not established, the procedure requires that a missed approach be initiated at once in order for protection from obstacles to be maintained. Only one missed approach procedure is published for each approach procedure. It is expected that the pilot will fly the missed approach procedure as published. In the event a missed approach is initiated prior to arriving at the missed approach point, it is expected that the pilot will normally proceed to the missed approach point and then follow the missed approach procedure in order to remain within the protected airspace.

*Note.*—This does not preclude flying over the missed approach point (MAPt) at an altitude/height greater than that required by the procedure.

3.4.4 For non-precision approaches, a visual descent point (VDP) concept has been developed by one State to minimize early or late descents from minimum descent altitude/height. This State's criteria for establishing a visual descent point are contained in Appendix C.

3.4.5 Standard departure and arrival procedures have the effect of facilitating air traffic flow and management. They also simplify clearance delivery procedures. This is particularly beneficial at aerodromes with high movement rates. A further benefit may be the avoidance of restricted or populated areas. However, prior to the implementation of such routes, it is important to ensure that terrain, obstacle clearance, navigation and communication requirements can be met by aeroplanes likely to use the standard routes.
Chapter 3 — Provision of Facilities and Services at Aerodromes

3.4.6 The obstacle environment should be monitored to ensure that new obstacles such as building construction and growing trees do not affect the obstacle limitation surfaces. It may be necessary for the State to ensure that proposals for construction in the vicinity of the approach and departure paths are brought to the attention of the aerodrome authority.

3.4.7 Each instrument approach procedure, SID and STAR should be established and published as an integral procedure designed to permit aeroplanes to navigate without radar vectoring. When radar vectoring is an essential part of the instrument approach procedure, SID or STAR, then this requirement should be clearly stated in the procedure.

3.4.8 Instrument approach procedures, SIDs and STARs should be based on the availability and the characteristics of the facilities used. It should be realized that the manoeuvrability of certain aeroplane types may also be a limiting factor (PANS-OPS (Doc 8168), Volume I and II). Therefore, when instrument approach procedures, SIDs and STARs are established they should be flight-checked for their validity as appropriate.

3.4.9 PANS-OPS (Doc 8168), Volume I, contains information concerning instrument approach procedures that should be brought to the attention of flight operations personnel, including flight crews. This may be summarized as:

a) the parameters on which the instrument approach procedures are based;

b) the flight manoeuvres which the areas are designed to contain;

c) the procedures that have been developed;

d) the need for strict adherence to the procedures in order for aeroplanes to remain within the designated areas and thereby achieve and maintain safety in operation; and

e) the fact that the procedures have been developed for normal operating conditions.

In developing the instrument approach procedures, obstacle clearance has been closely related to the effective performance of the approach facilities in use and the operational performance and size of modern aeroplanes. However, flight crews should be trained to make allowance for abnormal operating conditions such as low level wind shear or severe turbulence when they are likely to be encountered.
Chapter 4
BASIC REQUIREMENTS FOR THE AEROPLANE
AND FLIGHT CREW

4.1 INTRODUCTION

When an aeroplane is to be operated under instrument flight rules (IFR) it must be equipped with the flight instruments and the communication and navigation equipment which will enable the flight crew to carry out the required procedures for instrument departure, arrival or instrument approach appropriate to the operation. The flight crew must be licensed in accordance with Annex 1, qualified to operate the aeroplane under instrument flight rules and trained in the use of the particular flight deck procedures required. This chapter describes a means of compliance with these requirements and also shows where the criteria can be found.

4.2 THE AEROPLANE AND ITS EQUIPMENT

4.2.1 The provisions of Annex 6, Part I, require that the aeroplane be operated under a current certificate of airworthiness and be maintained in a serviceable condition in accordance with an approved maintenance programme. It must also be able to achieve the level of performance necessary to make all the manoeuvres required to complete the take-off and approach and landing safely at all aerodromes of intended operations. Any adverse conditions which are likely to be encountered during such operations should be considered in making the performance assessment.

4.2.2 The basic requirements for aeroplane flight instruments, radio communication and navigation equipment are contained in Annex 6, Part I, but they are not specific in respect of requirements for instrument departure, arrival and approach operations. As a consequence some States supplement Annex 6 by specifying the minimum requirement for aeroplane equipment needed for particular flight operations. The equipment listed in 4.2.4 below is an example of the minimum requirements of some States for the equipment which must be functioning in the aeroplane for Category I operations. This is a minimum requirement and experience in these States has shown that some duplication of equipment is necessary to ensure that this minimum will be available when it is needed. Detailed information on airworthiness requirements can be found in the Airworthiness Technical Manual (Doc 9051), in Joint Aviation Requirements (JARs — Europe) and in operations and airworthiness requirements of the Federal Aviation Regulations (FARs — United States), and Joint Aviation Requirements of the USSR (JARs — Union of Soviet Socialist Republics).

4.2.3 Additional requirements are appropriate for Category II and III operations. Specific details are given in Chapter 5 of this manual.

4.2.4 The following are minimum equipment combinations acceptable for Category I operations by multi-engine aeroplanes using ILS or MLS for either manual or automatic approaches:

- Equipment type/specification
- ILS or MLS receiver
- ILS or MLS raw data display
- 75 MHz marker beacon receiver and indicator (certain MLS operations require DME)
- Flight director — single with single display (prescribed by some States for turbine-powered aeroplanes)
   or
- Automatic flight control system with ILS/MLS coupled approach mode.
Chapter 4 — Basic Requirements for the Aeroplane and Flight Crew

4.3 THE FLIGHT CREW

General

4.3.1 It is essential that flight crews are trained and qualified in aspects of all-weather operations appropriate to the intended instrument operations. This process is divided into two parts:

a) ground instruction in the background and philosophy of all-weather operations including description of the characteristics, limitations and use of instrument approach and departure procedures and those of the airborne equipment and ground facilities; and

b) flight training in procedures and techniques specific to the aeroplane, which may be carried out in an approved flight simulator and/or during airborne training.

4.3.2 Before flight crews are authorized to carry out take-offs in limited visibility conditions or instrument approaches it is necessary to take into account the following factors:

a) composition of the flight crew;
b) qualifications and experience required;
c) initial and recurrent training;
d) need for special procedures; and
e) any operating limitations.  

As approval for lower aerodrome operating minima is sought, increasing emphasis on these factors will be required.

Crew composition and training

4.3.3 The minimum composition of the flight crew shall be in accordance with Annex 6, Part I, and the relevant associated documents. Information on the allocation of crew duties and responsibilities must be fully described in the operations manual. The composition of the flight crew and the distribution of duties should be such that each crew member is able to devote the necessary time to assigned tasks, i.e.:

a) operation of the aeroplane and monitoring of flight progress;
b) operation and monitoring of aeroplane systems; and
c) decision making.

4.3.4 For a period after initial qualification, including pilots newly appointed as pilots-in-command, until sufficient experience is gained on a particular aeroplane type a margin should be added to the minima approved for fully qualified crews. The required margin and the required experience should be determined by the State of the Operator following consultation with the operator.

4.3.5 A ground training programme should provide instruction for all flight crew members as appropriate to their duties. The specific format of any training programme should be designed to fit the particular operation. It should cover the following items where applicable:

a) the characteristics of the visual and non-visual approach aids;
b) the particular aeroplane flight system, instrumentation and display systems and their limitations, the effect on aerodrome operating minima of any limitations necessitated by inoperable or unserviceable instruments or systems;
c) the approach and missed approach procedures and techniques;
d) the use of visibility and RVR reports, including the various methods of assessing RVR, and the limitations associated with each method, the structure of fog and its effect on the relationship of RVR to the pilot's visual segment and the problems of visual illusions;
e) the influence of wind shear, turbulence and precipitation;
f) the pilot task at DA/H or MDA/H, the use of visual cues, their availability and limitations in reduced RVR and various glide path angles, pitch attitudes and cockpit cut-off angles, the heights at which various cues may be expected to become visible in actual operations, procedures and techniques for transition from instrument to
visual reference, including the geometry of eye-height, wheel height, antenna position and pitch attitude with reference to various pitch attitudes;

g) action to be taken if the visibility deteriorates when the aeroplane is below DA/H or MDA/H, and the techniques to be adopted for transition from visual to instrument flight;

h) action in the event of equipment failure above and below DA/H or MDA/H;

i) significant factors in the calculation or determination of aerodrome operating minima, including height loss during the missed approach manoeuvre and obstacle clearance;

j) effect of system malfunction on auto-throttle or autopilot performance (e.g. engine failure, pitch trim failure);

k) procedures and techniques for reduced visibility take-offs including abandoned take-off and action to be taken if the visibility deteriorates during take-off run; and

l) such other factors as are considered to be necessary by the State of the Operator.

4.3.6 The programme for initial and recurrent training should provide simulator and/or in-flight training on the particular aeroplane type for all members of the flight crew. The State of the Operator, in consultation with the operator, should decide which elements of a training programme:

a) may or may not be performed in a flight simulator;

b) may or may not be performed in the aeroplane.

4.3.7 Training should cover the following items as appropriate:

a) instrument approaches with all engines operating, and with the critical engine inoperative, using the various flight guidance and control systems installed in the aeroplane, down to the specified operating minima, followed by a missed approach, all without external visual reference;

c) instrument approaches using the aeroplane's automatic flight control system, followed by reversion to manual control for flare and landing;

d) procedures and techniques for reversion to instrument flight and the execution of a balked landing and a subsequent missed approach resulting from loss of visual reference below DA/H or MDA/H;

e) practice in the handling of system failures during the approach, landing and missed approach; and

f) take-offs in reduced visibility, including system failures, engine failures and rejected take-off.

4.3.8 The frequency of system malfunctions introduced in the training programme should not be such as to undermine the confidence of flight crews in the over-all integrity and reliability of the systems used.

4.3.9 The recurrent training required by Annex 6, Part I, to maintain pilot proficiency on an aeroplane type together with that required to maintain and renew the instrument rating will normally be sufficient to ensure continued qualification to conduct instrument approaches. However, as a minimum the recurrent training should include take-offs in reduced visibility and all types of instrument approaches which the pilot is authorized to carry out. These approaches should be flown to the specified operating minima and the pilot should demonstrate the level of proficiency required by the State of the Operator. Consideration should be given to a recency requirement, i.e. that pilots should carry out a minimum number of practice or actual instrument approaches each month (or other suitable period) to maintain their instrument flying qualification. This recency requirement is in no way a substitute for recurrent training.

4.4 OPERATING PROCEDURES

4.4.1 Operations in adverse weather call for special procedures and instructions which must be included in the operations manual. Guidance as to the form and content of an operations manual is given in Annex 6, Part 1, the Manual of Procedures for Operations
Chapter 4 — Basic Requirements for the Aeroplane and Flight Crew

Certification and Inspection (Doc 8335) and the manual on the Preparation of an Operations Manual (Doc 9376). Further guidance relative to Category II and III operations is given in Chapter 5 of this manual.

4.4.2 The precise nature and scope of the operations manual with respect to all-weather operations will vary from operator to operator with differences between aeroplanes and their equipment. The following items should always be included:

a) a standard flight crew procedure for instrument approaches applicable to the aeroplane in question including callouts and responses, the allocation of flight crew duties in the operation of aeroplane equipment, and allocation of responsibility for cross-monitoring during approach and landing. The procedure should ensure that one pilot continues to monitor the instruments during the visual phase at and below DA/H or MDA/H;

b) minima for take-off;

c) minima for each type of approach;

d) any increments to be added to the minima in the event of airborne or ground system deficiencies or failures;

e) any increments to be added to the minima for use by the pilot-in-command recently converted to type, together with the period during which this limitation should apply;

f) authority for the pilot-in-command to apply higher values of minima as judged to be required by circumstances;

g) action to be taken when weather conditions deteriorate below minima;

h) guidance on the visual reference required for continuation of the approach below DA/H or MDA/H;

i) requirements for a take-off alternate when conditions at the departure aerodrome are below landing minima;

j) checks for satisfactory functioning of equipment both on the ground and in the air;

k) a list of aeroplane equipment allowable deficiencies; and

l) identification of aeroplane system or equipment failures requiring abnormal or emergency actions.
Chapter 5
ADDITIONAL REQUIREMENTS FOR CATEGORY II AND III ILS OPERATIONS

Note.—MLS Category II and III operations are not currently approved. As experience is gained, the material in this chapter will be amended as appropriate.

5.1 GENERAL

5.1.1 There are factors additional to those described in Chapters 3 and 4 to be considered for Category II and III operations. These include:

a) the need for additional and more reliable ground equipment and airborne systems capable of guiding the aeroplane with greater accuracy to the decision height and, when appropriate, through to a landing and subsequent roll-out;

b) special requirements for flight crew qualification, training, demonstration of proficiency and recency;

c) more stringent criteria for obstacle limitation surfaces;

d) nature of the pre-threshold terrain;

e) more stringent criteria for the protection of the ILS signal;

f) adequacy of runways and taxiways, approach, runway and taxiway lighting and marking for such operations;

g) the need for more comprehensive surface movement guidance and control in limited visibility conditions; and

h) rescue and fire-fighting deployment.

5.1.2 Detailed guidance on the above aspects is provided in this chapter.

5.2 AERODROME FACILITIES

5.2.1 The setting up and conduct of Category II and III operations involve extensive initial study, planning, management, administration and control, in addition to large capital expenditure and high maintenance costs. For these operations the standards of the equipment required and all the associated features will be more demanding—specifications, which are more costly to provide and to operate. Studies may be necessary in the initial planning stages which will consider such factors as the incidence of low visibility conditions, present and forecast traffic volumes, the proximity of alternate aerodromes and their facilities, and the potential enhancement of regularity of service and safety standards. Clearly, there would be little merit in an expensive development which could not be justified in terms of the incidence of low cloud base or visibility conditions and traffic volume. However, where a case can be made for the initial introduction of precision approach operations it may be worth considering from the outset the installation of higher standards of equipment, against the likelihood of future traffic increases and operators' aeroplane re-equipment plans. Guidance material is contained in the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476).

5.2.2 There are national differences in methods of licensing aerodromes and authorizing operations. However, it is desirable that there be an inter-State understanding that no State will promulgate a runway as available for Category II or III operations until the facilities and services meet ICAO specifications. Where the State of the Aerodrome has additional requirements it is implicit that these are provided before promulgation.
Runways and taxiways

5.2.3 Specifications and guidance on physical characteristics of runways and taxiways are contained in Annex 14, Volume I, and the Aerodrome Design Manual (Doc 9157), Parts 2 and 3. When considering the design aspects for a new runway, or major changes to an existing one, due consideration should be given to the need to provide, for the category of operations intended at each such runway. For example, limitations may need to be placed on the ground movement of vehicles and aircraft to ensure that ILS critical and sensitive areas are avoided. In general, the requirements for Category II and III operations are no more demanding than those for Category I. However, the separation distance between a holding bay or taxi-holding position and the centre line of the runway may be significantly greater for Category II and III operations. Also the dimensions for the critical and sensitive areas may be greater for Category II and III operations.

Obstacle limitation criteria

5.2.4 Criteria for obstacle limitation surfaces are specified in Annex 14, Volume I. Guidance on obstacle limitation surfaces for precision approach runways is given in the Airport Services Manual (Doc 9137), Part 6. The limitation of obstacles in, and the dimensions of, an obstacle free zone are prescribed in Annex 14, Volume I. For Category II and III operations, the obstacle-free zone, extended when appropriate to the appropriate Category II obstacle clearance height, must not be penetrated by any obstacle except those specifically permitted in Annex 14, Volume I.

Pre-threshold terrain

5.2.5 Annex 4 requires that a terrain profile chart be published by States providing facilities for Category II and III operations and the Aeronautical Chart Manual (Doc 8697) provides guidance on the production of suitable charts. The operation of some automatic landing systems is dependent among other things on the radio altimeter(s). The flare profile, the rate of descent at touchdown, and the distance of the touchdown point from the runway threshold can, therefore, be affected by the profile of the terrain immediately prior to the threshold. The terrain which is most critical lies in an area 60 m either side of the runway centre line extending into the approach area to the distance of at least 300 m before the threshold. The guidance material in Annex 14, Volume I, makes reference to the maximum slopes of pre-threshold terrain which are normally acceptable when planning a new runway on which operations are to include auto-coupled approaches and automatic landing. However, radio altimeter inputs may also be required when the aeroplane is on final approach as much as 8 km (5 NM) from touchdown and, at aerodromes where the terrain beneath the approach flight path is not approximately level, abnormal autopilot behaviour may result as follows:

a) where the terrain under the approach is markedly lower than the threshold, the radio altimeter input for a particular stage of the approach may be signalled sooner than required;

b) where the terrain is markedly higher than the threshold, the radio altimeter input for a particular stage of the approach may be signalled sooner than required; and

c) where the terrain consists of a series of ridges and valleys either the situation in a) or that in b) may arise.

Where the characteristics of the terrain are considered marginal for a particular aeroplane type, a demonstration should be made to determine that the performance or function of the automatic flight control system is not adversely affected. The demonstration may take the form of flight trials or a suitable analysis. Any additions or alterations to existing structures or terrain in the pre-threshold area must be monitored to determine any effect on published information. In the event that an alteration has a significant effect on radio altimeters then the amended data relating to the terrain profile must be rapidly disseminated.

5.2.6 The determination of decision height by means of the radio altimeter may require consideration of the approach terrain out to 1 000 m from the threshold.

Visual aids

5.2.7 Approach, threshold, touchdown zone, runway edge, centre line, runway end and other aerodrome lights are required in compliance with Annex 14, Volume I, appropriate to the category of operation for which a runway is intended. Wherever feasible, and particularly in instances where the runway may in future be upgraded so as to be suitable for Category II and III operations, it is advantageous to provide the necessary improved lighting during the
initial construction or resurfacing of precision approach runways. This would eliminate the need for extensive modifications to the lighting system in future upgrading of the runway for Category II and III operations.

5.2.8 For daylight operations experience has shown that surface markings are an effective means of indicating the centre lines of taxiways and holding positions. A holding position sign is required at all Category II and III holding positions. Signs may be needed to identify taxiways. Taxiway centre line lights or taxiway edge lights and centre line markings providing adequate guidance are required for Category II and III operations. The conspicuity of runway markings and taxiway markings deteriorates rapidly, particularly at aerodromes having high movement rates. The need to inspect frequently and maintain the markings cannot be over-emphasized, especially for Category II and III operations.

5.2.9 Stop bars can make a valuable contribution to safety and ground traffic flow control in low visibility operations. The primary safety function of the stop bar is the prevention of inadvertent penetrations of active runways and OFZ by aircraft and vehicles in such conditions. Stop bars should be provided at all taxiways giving access to active runways during limited visibility conditions unless the aerodrome layout, traffic density and applied procedures enable protection by other means at the discretion of the responsible authority. Stop bars when provided should be used at least in visibility conditions corresponding to RVRs of less than 400 metres. They also may contribute, in conjunction with other elements of the SMGCS, to effective traffic flow when low visibility prevents ATC from effecting optimum flow and ground separation by visual reference. It may also be advantageous to partly automate the operation of selected stop bars so that the air traffic controller will not be required to operate them manually every time, thus avoiding possible human errors; for example a manual switch-off of a stop bar after issue of a movement clearance would be followed by an automatic reillumination by the crossing aeroplane, or a “limited visibility” setting on the control panel would automatically illuminate stop bars across taxiways which are not to be used in limited visibilities.

5.2.10 It will be appreciated that some lights in a particular system may fail, but if such failures are distributed in a manner which does not confuse the lighting pattern, the system may be regarded as serviceable. It is both difficult and expensive to provide inspection of all sections of the lighting system, and consideration may, therefore, be given to monitoring only the lighting circuits. To help safeguard recognizable patterns in the event of failure of a single circuit, circuits should be interleaved so that the failure of adjacent lights or clusters of lights will be avoided. Requirements and guidance on the design, maintenance and monitoring of lighting circuits is contained in Annex 14, Volume I, and the Aerodrome Design Manual (Doc 9157), Part 4.

Non-visual aids

5.2.11 The ILS ground equipment must meet the facility performance requirements specified in Annex 10, Volume I, Part I. The guidance material in Annex C to Part I of that document also provides information for the planning and implementation of the ILS. The Manual of Testing of Radio Navigation Aids (Doc 8071) provides guidance on ground and flight testing of radio navigation aids; Volume II of the manual is concerned with ILS facilities. The quality of the ILS signals in space is not determined solely by the quality of the ground equipment; the suitability of the site, including the influence of reflection from objects illuminated by the ILS signals and the manner in which the ground equipment is adjusted and maintained has a significant effect on the quality of the signal received at the aeroplane. It is essential that the ILS signal in space is flight-checked in order to confirm that it meets in all respects the appropriate standards of Annex 10, Volume I, Part I.

5.2.12 All facilities associated with the ILS ground equipment must be monitored in accordance with the requirements of Annex 10, Volume I, Part I. Guidance material on monitoring is contained in Attachment C to Part I of Annex 10, Volume I.

5.2.13 To ensure that the integrity of the guidance signal radiated by the ILS is maintained during aeroplane approaches, all vehicles and aircraft on the ground must remain outside the ILS critical and sensitive areas as described in Annex 10, Volume I, Attachment C to Part I, when the aeroplane on final approach has passed the outer marker. If a vehicle or aircraft is within the critical area it will cause reflection and/or diffraction of the ILS signals which may result in significant disturbances to the guidance signals on the approach path. Additional longitudinal separation between successive landing aeroplanes contributes to the integrity of ILS guidance signals.
5.2.14 Diffraction and/or reflection may also be caused by large aeroplanes in the vicinity of the runway which may affect both the glide path and the localizer signals. This additional area, outside the critical area, is called the sensitive area. The extent of the sensitive areas will vary with the characteristics of the ILS and the category of operations. It is essential to establish the level of interference caused by aircraft and vehicles at various positions on the aerodrome so that the boundaries of the sensitive areas may be determined. Since it is obviously not practicable to develop precise criteria covering all cases, the size and shape of the sensitive areas for a particular category of operation must be determined by the State concerned.

Note.—Some States do not distinguish between critical and sensitive areas as defined in Annex 10. These States define instead an area, larger than that defined in Annex 10 but still called the critical area. In addition, this area is protected when an arriving aircraft is within the middle marker, when cloud and visibility conditions are below specified values. This affords protection equivalent to that described above.

5.2.15 The reliability of the ILS ground equipment is a measure of the frequency of unscheduled outages which may be experienced. Reliability will be increased by providing on-line standby equipment and by duplication or triplication of key functions, including power supplies. The lowest value of operating minima can only be achieved with ILS that have high standards of reliability. The specifications in Annex 10, Volume I, Part I, indicate the total maximum periods of time allowed outside the specified performance limits for each ILS facility performance requirement.

Secondary power supplies

5.2.16 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, Part I, respectively. Guidance material in the Aerodrome Design Manual (Doc 9157), Part 4, and in Annex 10, Volume I, Attachment C to Part I, describes how to achieve the changeover times specified. Secondary power is also required for essential communications and for other associated facilities, such as visibility measuring systems. Changeover times for these latter facilities will be commensurate with the operations conducted.

5.3 AERODROME SERVICES

Aerodrome safety assessment

5.3.1 In some conditions of limited visibility, air traffic controllers may no longer be able to see the whole movement area of the aerodrome but pilots will still have the capability to see other traffic in their vicinity and to avoid it if necessary. In worse conditions it may well be that neither the controller nor the pilot will be able to see the other traffic, and it may then become essential to have a system which effectively ensures the separation of aeroplane from aeroplane or aeroplane from vehicles. Guidance on such systems is given in the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476). The first practical step towards achieving this involves a comprehensive safety assessment of the aerodrome which requires examination of all the relevant factors such as layout of the movement area and aeroplane and vehicle routings, relevant existing instructions and rules, meteorological records, movement statistics, records of runway intrusions, existing security procedures, etc. The action arising from such an assessment will be dependant upon the characteristics of the movement area and the type of operation and will need to include consideration of the following:

a) training of ground personnel;

b) maintenance of records by ATS of persons and vehicles on the manoeuvring area;

c) non-essential personnel and vehicles to be withdrawn from movement areas when limited visibility weather conditions prevail or are impending;

d) essential vehicles permitted to enter the movement area in limited visibility conditions to have R/T communication with ATS;

e) patrols where necessary in areas of intensive vehicle movement where there is no traffic control point between those areas and the runway;

f) unguarded aerodrome entrances to be locked and inspected at frequent intervals;

g) procedures to warn airlines and other organizations with movement area access of the commencement of the more restricted measures; and
h) development of appropriate emergency procedures.

In some States these actions are a by-product of the normal security procedures but in others they are part of special procedures which are implemented in a worsening weather situation when the RVR falls below a predetermined value, typically 800 m. Guidance on low visibility operations and examples of low visibility procedures are given in the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476).

5.3.2 A number of European States have jointly agreed upon a method of carrying out a safety assessment for Category II or III operations at aerodromes in those States and detailed guidance on this method is contained in ECAC Document No. 17.

Ground movement control of aeroplanes and vehicles

General

5.3.3 The Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476) provides information on appropriate combinations of visual aids, non-visual aids, radiotelephony communications, procedures, control and information facilities. The system to be adopted at a particular aerodrome should be designed to meet the operational requirements for guidance and control of all relevant traffic in limited visibility conditions.

5.3.4 Ground movement control procedures should ensure that runway incursions are prevented during any period when the runway is required for take-off and landing operations.

5.3.5 Procedures and aids which facilitate movements on a busy aerodrome are adequate in visibility conditions down to about 150 m. In visibilities below this, aids specifically designed for movement of aerodrome traffic may be necessary. Control, surveillance and safety will be enhanced by the use of supplementary facilities, such as an aerodrome surface movement radar, controllable taxiway lights, stop bars, signs and local detectors such as induction loops, intrusion alarm devices, etc. Essential vehicles must be able to manoeuvre in limited visibility conditions and they should be strategically located during these operations so that their services will be available in a minimum of time.

Security and surveillance

5.3.6 When no special surveillance equipment is employed and control over traffic on the movement area is maintained by procedures and visual aids, unauthorized traffic must be restricted by local security measures. Normally, it may be expected that routine measures for restricting unauthorized traffic on an aerodrome will be adequate for limited visibility operations (i.e. security fences around the airport, signs restricting unauthorized access and limiting access only to those vehicle operators who are familiar with essential precautions and procedures). When the local situation is such that routine measures may not be adequate, special measures should be taken to provide surveillance and control, particularly for the ILS critical and sensitive areas and active runways. For example, when construction or maintenance vehicles are engaged in mobile activities on the aerodrome at the onset of Category II or III operations it may be necessary to terminate their activities and remove them from the manoeuvring area until the visibility improves. Alternatively, it may be appropriate to accompany such vehicles with a radio-controlled escort while the limited visibility condition prevails.

Air traffic services

5.3.7 The provision of an air traffic control service is essential at aerodromes planned for Category II and III operations. The essential information to be provided to pilots is specified in Annex 11 and in Part IV of PANS-RAC (Doc 4444). Guidance on the responsibilities of the ATS is given in the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476).

5.3.8 Information on the status of relevant ground systems should be promptly passed to flight crews conducting instrument approaches. This is particularly critical for Category II and III operations. Although the general recommendation found in 3.3.9, which encourages ATC to minimize transmission of extraneous communication to flight crews during critical phases of flight is valid, care must be taken to not filter information which may seem unimportant to ATC, but which in fact may be operationally relevant. Accordingly, the following principles should be applied to radio communications between ATC and Category II and III arrivals, or for aircraft departing in low visibility:
Chapter 5 — Additional Requirements for Category II and III ILS Operations

a) As a minimum, information should be provided in accordance with the PANS-RAC (Doc 4444), Section 4.

b) ATC, operators and authorities should reach prior agreement on deficiencies, failures or anomalies that may occur which could affect Category II and III operations or low visibility take-offs, particularly if they are site specific or unique.

c) Commonly agreed terminology should be devised to be applied by ATC for transmission to flight crews when the above occurrences take place.

d) Understanding should be reached on any situations which may occur for which ATC does not, or will not, advise landing aircraft.

e) As a general rule, if doubt exists regarding the operational relevance of information, ATC will pass that information to flight crews for flight crews to decide its operational application and significance.

5.3.9 Because ILS signals can be disturbed by reflections caused by aeroplanes overflying the localizer antenna, ATC units must exercise the necessary control to ensure that, at least during Category II and III operations a departing aeroplane has overflown the ILS localizer antenna before the arriving aeroplane has descended to 60 m (200 ft). This is necessary to preserve the integrity of the precision guidance system during the time when the landing aeroplane is critically dependent on the quality of the signal in space. For the same reason, additional longitudinal separation may be required between successive landing aeroplanes; this may affect the capacity of the aerodrome. Appropriate air traffic control procedures should be developed at those locations where Category II or III operations are planned, based on experience gained during Category I operations.

5.3.10 It is desirable to arrange the traffic flow whereby aeroplanes equipped for limited visibility operations will not be unnecessarily delayed by aeroplanes not so equipped. This may require discrete flow control, flow management procedures, or special radar procedures.

5.3.11 ATC units should recognize the need for aeroplanes to simulate low minima approaches in good weather conditions so that flight crews can gain practical experience and equipment can be proved in service. Where necessary, because of the need for long finals, etc., approval to conduct such an exercise may be requested by the pilot and ATC units should agree to such a request whenever traffic will permit. ILS critical and sensitive area protection should be provided to the greatest extent possible at all times, however, this is not always possible. While a requested exercise is being conducted ATC units should, as feasible, apply restrictions to take-offs and landings and taxiing holding positions as if low minima conditions actually existed. When this is not feasible ATC should advise the pilot accordingly.

Meteorological services

5.3.12 The meteorological information required to support Category II and III operations is specified in Annex 3 and amplified in the guidance in the Manual of Aeronautical Meteorological Practice (Doc 8896). Further guidance on RVR assessment and reporting, particularly on the increase in the number of reporting positions from one for Category I operations, to two or three for Category II operations, and to three for Category III operations, is given in the Manual of Runway Visual Range Observing and Reporting Practices (Doc 9328).

Aeronautical Information services

5.3.13 The requirements of the AIS are given in 3.3.4 of Chapter 3.

Minimum ground system requirements for particular Category II and III operations

5.3.14 Under normal circumstances it can be expected that all the facilities detailed in ICAO Standards and Recommended Practices and described in this manual will be available for operations on a particular runway. Operations to aerodromes with temporarily reduced facilities require re-assessment and approval of revised minima. It is the responsibility of the operator to develop adequate operating instructions dealing with deficiencies of ground equipment, and to disseminate this to flight crews.

5.4 INSTRUMENT APPROACH PROCEDURES

Instrument approach procedures design criteria are contained in PANS-OPS (Doc 8168), Volume II which
5.5 THE AEROPLANE AND ITS EQUIPMENT

General

5.5.1 The physical characteristics of the aeroplane have to be taken into account in the determination of aerodrome operating minima; they include the over-all size, the cockpit cut-off angle, the geometrical relationship during the approach of the guidance system glide path receiver antenna to the lowest point of the extended undercarriage, and to the position of the pilot's eyes. This is dealt with in Chapter 6.

5.5.2 The instruments and equipment for Category II or III operations must comply with the airworthiness requirements of the State of Registry of the aeroplane. In addition, the aeroplane performance must enable a missed approach to be carried out with an engine inoperative and without outside visual reference, from any height down to the decision height in Category II operations and down to touchdown in Category III operations while remaining clear of obstacles. Guidance material on the certification of automatic flight control systems and automatic landing systems is contained in the Airworthiness Technical Manual (Doc 9051). The instruments and equipment appropriate to various precision operations, as required by some States, are given in this chapter. The degree of redundancy required and the methods employed for monitoring and warning may vary according to the category and type of operation.

5.5.3 The target level of safety and the acceptable frequency of missed approaches, in conjunction with the intended operating minima, determine the airborne equipment design requirements with regard to:

a) system accuracy;

b) reliability;

c) characteristics in case of failures;

d) monitoring procedures and equipment; and

e) degree of redundancy.

Reporting system

5.5.4 A reporting system will need to be instituted to enable continual checks and periodic reviews to be made during the operational evaluation period before the operator is authorized to conduct Category II and III operations. Furthermore, it is particularly important that the reporting system continues to be used for an agreed period to ensure that the required standard of performance is maintained in service. The reporting system should cover all successful and unsuccessful approaches, with reasons for the latter, and include a record of system component failures.

5.5.5 For Category II operations it may be sufficient to differentiate between successful and unsuccessful approaches and to provide a questionnaire to be completed by the flight crew to obtain data on actual or practice approaches which are not successful. For example, the following data may be useful to a State or operator in evaluating a Category II system: the aerodrome and runway used; weather conditions; time; reason for failure leading to an aborted approach; adequacy of speed control; trim at time of automatic flight control system disengage; compatibility of automatic flight control system, flight director and raw data; an indication of the aeroplane's position relative to the ILS centre line and glide path when descending through 30 m (100 ft). The number of approaches made during initial operational evaluation will vary widely depending on the background of the system and the operator's experience. It should be sufficient to demonstrate that the performance of the system in airline service is such that an adequate approach success rate will result. When determining the success rate, failures due to external factors, such as ATC instructions or ground equipment faults, should be taken into account.

5.5.6 For Category III operations a similar but more stringent procedure should be followed. Use may be made of recording equipment such as a sophisticated flight data recorder to obtain the necessary data. Any landing irregularity should be fully investigated using all available data to determine its cause. Failure to positively identify and correct the cause of any landing reported to be unsatisfactory may jeopardize the future of the particular operation.
Chapter 5 — Additional Requirements for Category II and III ILS Operations

Aeroplane equipment requirements

5.5.7 Developments in the field of aeroplane flight control and guidance systems make it possible to conduct operations using various combinations of equipment and there may be considerable variation in equipment used as is shown in Tables 5-1 and 5-2. These tables are not exhaustive but show the levels of equipment required by several States. The accompanying notes are indicative of these variations. It should be borne in mind, however, that the situation is dynamic. Requirements change in the light of the accumulation of experience and those technical developments which lead to improved aeroplane and system performance and better reliability.

Performance requirements for initial approval of airborne systems

5.5.8 Criteria for automatic flight control systems and automatic landing systems are contained in the Airworthiness Technical Manual (Doc 9051), Part III, Section 6. The automatic systems concept is described and the criteria include requirements for system minimum performance including failure conditions, flight demonstration during the certification and information to be included in the aeroplane flight manual. The material provides guidance for the airworthiness certification of the systems, but it should be noted that, in the case of automatic flight control systems, it does not include any special requirements for certification of the system in restricted visibility conditions. In the case of the certification of automatic landing systems, the acceptability of the system may be dependent on the weather conditions of which visibility is only one factor. There are additional considerations appropriate to the certification of the aeroplane as a whole for approach and landing in restricted visibility (i.e. for Category II and III operations).

Airborne system approval

5.5.9 ILS glide path and localizer tracking performance standards should be laid down in the form of a required standard deviation of guidance signal error. The accuracy of the airborne system should be shown to be met by sufficient numbers of approaches during certification or operational evaluation. More detailed consideration of failure cases is required than for Category I conditions, a statistical failure analysis being preferred by some States. Sufficient experience and use of the system should be gained before approval of Category II operations.

Category III

5.5.10 During the certification or operational evaluation programme it should be shown by a sufficient number of landings supported by a simulator test programme that the touchdown performance requirements have been satisfied. The probability of system failures and their consequences should be shown to be acceptable based on an appropriate failure analysis and a demonstration of selected failures by simulation or in flight. Before approval of Category III operations, sufficient operational experience and use of the system should be gained to verify system reliability and performance in day-to-day operations.

Maintenance

5.5.11 The operator should establish a maintenance programme to ensure that the airborne equipment continues to operate in service to the required performance level. This programme should be capable of detecting any deterioration in the over-all level of performance as described in 5.5.4 to 5.5.6 above. The importance of maintenance in the following areas should be emphasized:

a) maintenance procedures;
b) maintenance and calibration of test equipment;
c) initial and recurrent training of maintenance staff; and
d) recording and analysis of airborne equipment failures.

5.6 OPERATING PROCEDURES

5.6.1 Operating procedures follow the basic format described in Chapter 4. Guidance on aspects of particular importance when operating to low aerodrome operating minima is given below.

5.6.2 Low weather minima operations call for special procedures and instructions to be included in the
Table 5-1. Examples of airborne equipment combinations required by several States with respect to their operators for Category II operations by multi-engine aeroplanes

<table>
<thead>
<tr>
<th>Equipment type/specifications</th>
<th>Manual mode</th>
<th>Automatic mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw data display</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>ILS receiver</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dual with dual displays</td>
<td>x(^1)</td>
<td>x(^1)</td>
</tr>
<tr>
<td>Excess deviation warning</td>
<td>x(^2)</td>
<td>x(^2)</td>
</tr>
<tr>
<td>Radio altimeters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single self monitored with dual display</td>
<td>x(^5)</td>
<td>x</td>
</tr>
<tr>
<td>Flight director systems (FDS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single self monitored with dual displays</td>
<td></td>
<td>x(^4)</td>
</tr>
<tr>
<td>Dual with dual displays</td>
<td>x(^4)</td>
<td></td>
</tr>
<tr>
<td>Go-around mode</td>
<td>x(^5)</td>
<td>x(^3)</td>
</tr>
<tr>
<td>Automatic flight control system with ILS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>coupled approach mode</td>
<td></td>
<td>x(^8)</td>
</tr>
<tr>
<td>Auto throttle</td>
<td>x(^7)</td>
<td>x(^7)</td>
</tr>
</tbody>
</table>

Notes to Tables 5-1 and 5-2

1. The United Kingdom will accept a single adequately self-monitored receiver but two are normally fitted.

2. Not required by Germany for Category II operations. The United States may consider procedural means as satisfying this intent.

3. The United Kingdom does not require an FDS for automatic approaches; United States does not require it for automatic approaches for small propeller aeroplanes, United States will accept a single FDS with a single display for manual approaches in small aeroplanes.

4. A head-up display approach and landing guidance system may be substituted for one of the two FDS for manual operation or for the single FDS acceptable for automatic operations.

5. Germany, France and the United States will accept attitude gyro's with calibrated pitch markings.

6. Fail-passive auto couplers required in aeroplanes registered in the United Kingdom.

7. Most States require auto-throttle if workload is unacceptable without it. The United States requires auto-throttle on all turbo-jets if operations are based on dual FDS.
### Table 5-2. Examples of airborne equipment combinations required by several States with respect to their operators for Category III operations by multi-engine turbo-jet aeroplanes

<table>
<thead>
<tr>
<th>Equipment type/specifications</th>
<th>Cat IIIA operations</th>
<th>Cat IIIB operations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DH 15 m (50 ft) or more</td>
<td>DH less than 15 m (50 ft) or no DH</td>
</tr>
<tr>
<td>Raw data display</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>ILS receiver</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dual with dual display</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Excess deviation warning</td>
<td>x^2</td>
<td>x^2</td>
</tr>
<tr>
<td>Radio altimeters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dual with dual display</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Flight director systems (FDS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dual with dual displays</td>
<td>x^3</td>
<td>x^3</td>
</tr>
<tr>
<td>Go-around mode</td>
<td>x^5</td>
<td>x^8</td>
</tr>
<tr>
<td>Automatic landing system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fail passive</td>
<td>x^9</td>
<td>-</td>
</tr>
<tr>
<td>Fail operational</td>
<td>-</td>
<td>x^10</td>
</tr>
<tr>
<td>Fail operational with automatic roll-out mode</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Automatic go-around mode</td>
<td>-</td>
<td>x^12</td>
</tr>
<tr>
<td>Auto-throttle mode</td>
<td>x^14</td>
<td>x</td>
</tr>
</tbody>
</table>

8. Missed approach FDS guidance not required by France.

9. The United States has approved certain operations which substitute a head-up display for an automatic landing system.

10. A fail operational hybrid system with head-up display as a secondary independent guidance system may be substituted for a fail operational automatic landing system.

11. A fail operational hybrid system with head-up display as the secondary independent guidance system with roll-out guidance from either a head-up display or automatic system may be substituted for a fail operational automatic landing system with automatic roll-out mode.

12. Automatic go-around mode is not required by France and the United States.

13. A fail-passive automatic system supplemented by dual FDS with computed go-around mode acceptable.

14. The United States may accept operation without auto-throttle if satisfactory performance and workload can be demonstrated.
operations manual, but it is desirable that any such procedures should also be used as the basis for all operations given below, in order to provide the same operating philosophy for all categories of operations. These procedures cover all foreseeable circumstances so that flight crews are fully informed as to the correct course of action which must be followed. This is particularly true for the last part of the approach and landing where only a limited time is available for decision making. Possible modes of operation include:

a) manual take-off;
b) manual approach and landing;
c) coupled approach down to DH, manual landing thereafter;
d) coupled approach to below DH, but manual flare and landing;
e) coupled approach followed by auto-flare and auto-landing; and
f) coupled approach followed by auto-flare, auto-landing and auto-rollout.

5.6.3 The precise nature and scope of procedures and instructions is a function of the airborne equipment used and the flight deck procedure applied. Flight crew member duties during take-off, approach, flare, rollout and missed approach are to be clearly delineated in the operations manual. Particular emphasis should be placed on flight crew responsibilities when transitioning from non-visual conditions to visual conditions, and on procedures to be used in deteriorating visibility or when failures occur. Special attention should be paid to the distribution of flight deck duties so as to ensure that the workload of the pilot making the decision to land or to execute a missed approach, enables the pilot to concentrate on supervision and the decision-making process.

5.6.4 The following points are particularly important:

a) checks for satisfactory functioning of equipment, both on the ground and in flight;
b) effect on minima caused by changes in the status of the ground installations;
c) use and application of multiple position RVR reports;
d) pilot assessment of aircraft position and monitoring of the performance of the automatic flight control system, the effects of the failure of any required portion of the automatic flight control system or instruments used with the systems, and action to be taken in the event of inadequate performance or failure of any portion of either the system or the associated instruments;
e) action to be taken in case of failures, such as engines, electrical system, hydraulics and flight control systems;
f) a list of aeroplane equipment allowable deficiencies;
g) the precautions necessary when making practice approaches where full ATC procedures to support Category III operations are not in force, or when an ILS ground equipment of a lower standard is used for Category II or III practice;
h) operating limitations resulting from airworthiness certification; and
i) information on the maximum deviation allowed from the ILS glide path and/or localizer from the region of the decision height down to touchdown as well as guidance regarding the visual reference required.

5.6.5 It has been found useful to establish procedures for the gradual introduction of low weather minima operations by operators. This suggests a conservative approach to the implementation of all-weather operations through a gradual reduction in meteorological criteria commensurate with the confidence gained by experience. In some States this is a firm requirement associated with authorization of the operations. Such procedures are normally aimed at:

a) the practical evaluation of airborne equipment before commencing actual operations. This may be of particular interest to States relying on the certification by another State of Manufacture;
b) accumulation of experience with the procedures discussed above before commencing actual operations and, if necessary, the adjustment of those procedures;
c) accumulation of actual operating experience with aerodrome operating minima within the authorized category of operation, but not as low as the lowest limit of the category;
Chapter 5 — Additional Requirements for Category II and III ILS Operations

5.7 FLIGHT CREW QUALIFICATION AND TRAINING

General

5.7.1 The basic requirements for flight crew qualification and training are set out in Chapter 4. Additional factors pertinent to Category II and III operations are discussed below.

5.7.2 Before operations in Category II or III conditions it will be necessary for the flight crew to undergo a comprehensive programme of training and education. The particular programme of training will, of necessity, be related to the aeroplane type and the operating procedures adopted, which are discussed under 5.6 above.

5.7.3 The increased dependence on the use of automatic systems requires that there should be more emphasis on the role of the pilot as a supervisor of their operation and on the decision-making process involved. This emphasis should include pilot assessment of the position of the aeroplane and monitoring of the automatic flight control system performance throughout all phases of the approach, flare, touchdown, and roll-out.

5.7.4 Following completion of training, flight crews must demonstrate their competency to the appropriate authorities. They should have gained sufficient flight experience on the aeroplane type before being authorized to apply Category II or III operating minima under actual conditions. The operator should demonstrate that the training programme, operating procedures, and instructions result in a standard of operation that is acceptable to the State of the Operator and should produce evidence that the operational techniques proposed have been satisfactorily used in weather conditions above the proposed minima.

Ground training

5.7.5 Flight crews must be able to make full use of ground and airborne equipment intended for use during Category II and III operations. They must, therefore, be instructed in how to obtain maximum benefit from redundancy provided in the airborne equipment and to understand fully the limitations of the total system, including both ground and airborne elements. It is suggested that the ground instruction should cover at least:

a) the characteristics, capabilities and limitations of the ILS, including the effect on aeroplane systems performance of interference to the ILS signal caused by other landing, taking-off, or overflying aeroplanes, and the effect of the infringement of ILS critical and sensitive areas by aeroplanes or vehicles in the manoeuvring area;

b) the characteristics of the visual aids (e.g. approach lighting, touchdown zone lighting, centre line lighting), and the limitations on their use as visual cues in reduced RVRs with various glide path angles and cockpit cut-off angles, and the heights at which various cues may be expected to become visible in actual operations;

c) the operation, capabilities and limitations of the airborne systems (e.g. the automatic flight controls systems, monitoring and warning devices, flight instruments — including altimetry systems, and the means the pilot has to assess the position of the aeroplane during the approach, touchdown and roll-out);

d) approach, including missed approach procedures and techniques including description of the factors affecting height loss during missed approach in normal and abnormal aeroplane configurations;

e) the use and limitations of RVR, including the applicability of RVR readings from different positions on the runway, the different methods of measuring and assessing RVR, and the limitations associated with each method;
f) the basic understanding of obstacle limitation and the obstacle-free zone, including missed approach design criteria and of obstacle clearance for Category II and III operations;

g) the effects of low level wind shear, turbulence and precipitation;

h) pilot task at decision height, procedures and techniques for transition from instrument to visual flight in low RVR conditions, including the geometry of eye, wheel and antenna positions with reference to ILS reference datum height;

i) action to be taken if the visual reference becomes inadequate when the aeroplane is below decision height, and the technique to be adopted for transition from visual to instrument flight should a go-around become necessary at these low heights;

j) action to be taken in the event of failure of approach and landing equipment above and below decision height;

k) recognition of and action to be taken in event of failure of ground equipment;

l) significant factors in the determination of decision height;

m) effect of specific aeroplane malfunctions (e.g. engine failure) on auto-throttle, auto-pilot performance, etc.; and

n) procedures and precautions to be followed while taxiing during limited visibility conditions.

5.7.6 Training aids may include films of approaches in actual conditions, or the use of an approved visual flight simulator. The training must ensure that all flight crew members understand their duties and responsibilities, those of the other flight crew members and the need for close crew co-ordination.

5.7.7 In actual operations some approaches may result in the aeroplane being off centre line or glide path at/before or after decision height, and, therefore, pilots should be given instruction to help with decision making for such occasions, which will illustrate the limitations of visual cues in reduced visibility. Pilots must also be made aware that they can be led into a premature transition to outside references for aeroplane control when available visual cues are not in fact adequate for control of pitch attitude and/or vertical flight path. They must, therefore, be cautioned against premature disengagement of the auto-pilot, and to continue monitoring flight instrumentation even when adequate visual contact with the runway and its environment can be maintained so as to complete an approach and landing safely.

**Flight training and proficiency programme**

5.7.8 Each member of the flight crew must be trained to carry out the duties appropriate to the particular airborne system, and must subsequently demonstrate the ability to carry out the duties as a member of the flight crew to an acceptable level of competency before being authorized to engage in the particular category of operations for which that flight crew member has been trained. Additionally, before a pilot is authorized to operate with Category II or III minima, that pilot must have gained experience as necessary in using the appropriate procedures in meteorological conditions better than the relevant minima. Flight crews should be given practical training and tests in the use of the system and associated procedures in conditions of the lowest minima to be specified.

5.7.9 Initial training can most effectively be carried out in an approved visual flight simulator. The training will depend upon the particular airborne system and on the operating procedures adopted. The initial training should at least include:

a) precision approaches, with all engines operating, or with an engine inoperative; using the appropriate flight guidance and control systems installed in the aeroplane down to the appropriate minimum height without external visual reference followed by transition to visual reference and landings;

b) precision approaches, with all engines operating, or with an engine inoperative; using the appropriate flight guidance and control systems installed in the aeroplane down to the appropriate minimum height followed by missed approaches, all without external visual reference;

c) precision approaches, utilizing the automatic flight control and landing system, followed by reversion to manual control for flare and landing after disconnection of the automatic system at low level, if appropriate;
Chapter 5 — Additional Requirements for Category II and III ILS Operations

5.7.10 The flight training programme should provide practice in handling system faults, particularly those which have an effect on the operating minima and/or subsequent conduct of the operation. However, the frequency of system malfunctions introduced should not be such as to undermine the confidence of flight crews in the over-all integrity and reliability of the systems used in low minima operations.

Simulation techniques

5.7.11 Simulation techniques are a valuable training aid for limited visibility operations. Use should be made of them for general training in the aeroplane system and the operating procedures to be used. However, their real value in training is that different RVR values can be simulated so that pilots, who may rarely meet limited visibility conditions in practice, can be given a realistic idea of what to expect in these conditions and can maintain their proficiency during recurrent training. To provide for missed approach training, it should be possible to simulate visibilities lower than the lowest authorized for the operator. An approved visual flight simulator can be used during initial and recurrent training, with various RVR values simulated, for:

a) approaches;

b) missed approaches;

c) landings;

d) relevant drills and procedures after experiencing malfunction of:

1) the aeroplane system; and

2) the ground system;

e) transition from instrument to visual flight; and

f) transition from visual to instrument flight at low level.

5.7.12 It is most important that the visibility simulated is a correct reflection of the RVR intended. A simple calibration check of the visual system can be made by relating the number of runway centre line lights which are visible with the simulator aligned for take-off, to the selected RVR. It is preferred, however, that checks also be made of the visual references with the simulator in the flying mode because the static and dynamic visual scenes may differ in some visual systems.

Recurrent proficiency checks

5.7.13 In conjunction with the normal checking of pilot proficiency at fixed intervals, a pilot's knowledge and ability to perform the tasks associated with the particular category of operation authorized must be demonstrated. Due to the low probability of encountering limited visibility conditions during actual operations, the use of an approved flight simulator for recurrent training, proficiency checking, and renewal of ratings assumes increased importance.

Reency requirements

5.7.14 Some States actively encourage or require operators and pilots to use procedures developed for Category II or III operations, during normal service, regardless of the weather conditions, whenever the necessary ground facilities are available and traffic conditions permit. This practice ensures flight crew familiarity with the procedures, builds confidence with the equipment and ensures appropriate maintenance of the Category II and III related systems. However, it is important to ensure that pilots maintain proficiency in manual flying skills. Experience has shown that this is particularly important where crews are engaged on a route structure having long stage lengths. Consideration should be given to a recency requirement, i.e. that crews should achieve a minimum number of automatic approaches, or approaches and landing as applicable, each month (or other suitable period) to maintain their Category II or III qualification. This recency requirement is in no way a substitute for recurrent training.
Chapter 6
APPROVAL AND IMPLEMENTATION OF AERODROME OPERATING MINIMA

6.1 METHODS OF APPROVAL AND COMPLIANCE

6.1.1 In accordance with the relevant Standard outlined in Annex 6, Part I, an operator shall establish aerodrome operating minima. In meeting this Standard an operator is responsible to the State of the Operator. This State will have responsibility for the approval of the method used to establish such minima, and for supervising compliance with those rules it may prescribe for the operation as a whole. In order that the operator may meet the foregoing obligations, the State of the Aerodrome is required to publish data (e.g. OCA/H, precise details of visual and electronic aids, pre-threshold terrain, obstacles, etc.) on which the operator may determine the appropriate aerodrome operating minima. Recognizing the need for an operator to be in conformity with rules laid down by its own State, the operator should also account for any restrictions which might be applied by the State of the Aerodrome. The State of the Aerodrome has responsibility for safety of air navigation within its own borders. It follows that it retains the authority to accept the minima approved by other States at its own aerodromes. It is not desirable, however, that this authority should necessarily be exercised by the determination and imposition of common minima for all operators. The general applicability of such minima would inevitably imply that in some conditions the minima would be unnecessarily demanding and in others inappropriately permissive. The acceptance or rejection by the State of the Aerodrome of minima approved by other States should consider the minima derivation and be resolved either directly between States or States and operators.

6.1.2 This chapter considers the documentation which may be used to establish the requirements of the State of the Operator relating to take-off, precision and non-precision instrument approaches, to indicate that those requirements have been met by its operators, and to ensure continuing compliance with those requirements. It reflects the practices of States already engaged in all aspects of all-weather operations and contains tables of commonly acceptable aerodrome operating minima. The need for States to establish basic legislation, specific rules, directives and explanatory, advisory and informative material is discussed in Chapter 2. Guidance material on the development of a State regulatory system is contained in the Manual of Procedures for Operations Certification and Inspection (Doc 8335).

6.1.3 The nature of all-weather operations necessitates a clear presentation of the requirements of the State of the Operator, and an agreed means of indicating authorization and approval will be helpful in achieving full utilization of facilities in international operations. There are four elements involved in the approval of an operation by the State of the Operator:

a) authorization of the aeroplane and its equipment;

b) authorization of the use of the aerodrome;

c) authorization of the flight crew; and

d) authorization of the operation.

Authorization of the aeroplane and its equipment

6.1.4 Authorization of the aeroplane and its equipment should be indicated by appropriate entries in the flight manual and the operations manual. Any limitations or procedures necessary for the safe use of the system must be identified, such as:

a) the DA/H or MDA/H limitations and any other relevant aerodrome operating minima with which the authorization is associated;

b) the minimum airborne equipment which must be available before an approach in limited visibility conditions may be planned and carried out;
Chapter 6 — Approval and Implementation of Aerodrome Operating Minima

6.1.7 To facilitate these procedures it is essential that up-to-date information be available on the facilities and procedures in use at each aerodrome. The State of the Aerodrome must promulgate the information through its aeronautical information service.

Authorization of the flight crew

6.1.8 In fulfilling the requirements of Annex 6, Part I, the State of the Operator should ensure, either directly or by delegated authority, that flight crews and individual flight crew members are qualified to operate to the applicable aerodrome operating minima.

This requires that:

a) the pilot-in-command and co-pilot must each hold an instrument rating as prescribed in Annex 1 and must each have met the requirement for recent experience established by the State issuing the rating;

b) flight crew members should be qualified and trained for take-off, non-precision and Category I approaches, as described in Chapter 4, 4.3, and where required for Category II or III as provided for in Chapter 5, 5.7;

c) flight crew members should have completed all required proficiency checks, including demonstration of proficiency using the relevant types of instrument approach; and

d) the pilot-in-command should have achieved the necessary experience in the relevant aeroplane type with restricted (higher) minima, before being authorized to use the lowest approved minima.

6.1.9 The operator should maintain a system of records to ensure that the necessary qualifications of the flight crew members are being met on a continuing basis.

Authorization of the operation

6.1.10 The precise method by which operational approvals are granted by the State of the Operator for operations in limited visibility conditions and the method by which compliance with established rules can be monitored may vary from State to State but should follow a basic sequence. The authorization procedure will normally take the sequence of:

c) the equipment operating procedures such as use of the automatic flight control and automatic landing systems, if installed, and use of the flight instrument systems, system operating sequences, etc.;

d) detailed performance data which may differ from or be additional to normal data, such as loss of height during missed approach procedure, etc.; and

e) any other factors affecting the use of the aeroplane in limited visibility conditions, such as the procedures to be followed if the aeroplane's climb performance after take-off, or during a missed approach, is seriously reduced with an engine inoperative.

6.1.5 When the airworthiness certification is effected by validating the certification of another State, such as the State of Manufacture of the aeroplane, as allowed for in Article 33 of the Convention and Annex 8, Part II, Chapter 5, this should be taken as acceptance of the original criteria for certification.

Authorization of the use of the aerodrome

6.1.6 There are national differences in the manner in which States ensure that their operators make proper allowance for the facilities available at an aerodrome when establishing operating minima. Some go as far as to carry out an inspection of the aerodromes used by their operators and give specific approval for the appropriate minima and some States delegate this responsibility to their operators by requiring them to fully account for the facilities available at the aerodrome they intend to use. In either case it could be expected that:

a) the State of the Aerodrome would only promulgate the facilities and services if they meet the relevant ICAO specifications;

b) the appropriate OCA/H will have been published by the State of the Aerodrome; and

c) where a State of the Aerodrome has established aerodrome operating minima, the minima authorized for the use of an operator by the State of the Operator will not be lower than the former, except where specifically authorized by the State of the Aerodrome.
6.1.11 An operator should satisfy the State of the Operator on at least the following:

a) the establishment of aerodrome operating minima for the use of flight crews for all types of approach to all aerodromes to be used in the operations;

b) the proficiency of flight crews;

c) operating procedures;

d) that the operations manual instructions are appropriate to the operation and reflect the mandatory procedures and/or limitations contained in the flight manual; and

e) that sufficient experience has been gained with the system in operational service in weather minima higher than those proposed.

6.1.12 The operator may be authorized to carry out operations in limited visibility by the issue of an approval indicating the aerodrome operating minima which may be applied.

6.2 COMMONLY ACCEPTABLE AERODROME OPERATING MINIMA

Introduction

6.2.1 Aerodrome operating minima are usually expressed as a minimum altitude or height and a minimum visibility or RVR. For take-off, they are an indication of the minimum visibility or RVR conditions in which the pilot of an aeroplane may be expected to have available the external visual reference required for the control of the aeroplane along the surface of the runway until it is airborne, or until the end of an abandoned take-off. For approach and landing, they are an expression of the minimum altitude or height by which the specified visual reference must be available and at which the decision to continue for landing or to execute a missed approach must be made. They are also an indication of the minimum visibility in which the pilot may be considered to have the visual information necessary for continued control of the flight path of the aeroplane during the visual phase of the approach and landing.

6.2.2 The transition from flight on instruments to flight using outside visual reference is not an instantaneous occurrence. Assuming a stable approach path in limiting visibility conditions, the first contact on the visual aids, or on identifiable features in the approach area in the case of a non-precision approach, will do no more than indicate to the pilot that the aeroplane is in the final approach area; a pilot will generally need to keep visual contact for a period of several seconds in order to assess the aeroplane position relative to the approach centre line as well as any cross track velocity, but of more importance is the assessment of the expansion of the visual scene that occurs during this period. Since this must occur before the pilot will be able to make a decision to continue the approach, it follows that visual contact normally should occur above decision height, or minimum descent height. The visual scene would normally be expected to expand as the aeroplane descends. The pilot's scan pattern may still include reference to the aeroplane instruments for a period well below decision height, or minimum descent height.

6.2.3 Minimum visibility values do not have meaning except when considered in association with the regulations that address the commencement and continuation of an approach. The minimum visibility specified by a State of the Operator, the operator or in some instances a State of the Aerodrome, may be used to prohibit commencement or continuation of an instrument approach, or prohibit take-off, if visibility is less than that specified.

6.2.4 The combination of instrument information and visual reference required varies with the type of operation and can be classified as follows:

a) for non-precision and for precision approach

Category I and II operations the requirement is
Chapter 6 — Approval and Implementation of Aerodrome Operating Minima

6.2.5 There is considerable agreement on the principles involved in the determination of aerodrome operating minima by those States having experience in low visibility operations. In current operations the aerodrome operating minima in use are remarkably similar for a particular aircraft and level of airborne equipment. The principles applied by States have enabled the development of the tables giving examples of applied minima contained in this chapter. These tables are intended for use as guidance to States of the Operator in the supervision of their operators in the determination of aerodrome operating minima. They are not intended to be taken as absolute values and the determination of lower values by a State is not precluded if such values result in an adequate level of safety. Conversely, it is not intended that these values will be approved for an operator's use at decision heights below the relevant OCH value published by the State of the Aerodrome, or below any other restricting minimum values that States might, in special circumstances, find it necessary to apply.

Take-off

6.2.6 Take-off minima are usually stated as visibility or RVR limits. Where there is a specific need to see and avoid obstacles on departure, take-off minima may, in cases, include cloud base limits. Where avoidance of such obstacles may be accomplished by alternate procedural means, such as use of climb gradients or specified departure paths, cloud base restrictions need not be applied. Take-off minima typically account for factors such as terrain and obstacle avoidance, aircraft controllability and performance, visual aids available, runway characteristics, navigation and guidance available, non-normal conditions such as engine failure, and adverse weather, such as runway contamination or winds.

6.2.7 Take-off minima should not be confused with departure weather minima required for flight initiation. Take-off minima concern the take-off manoeuvre itself as described above. For flight initiation, departure weather minima at an aerodrome should not be less than the applicable minima for landing at that aerodrome unless a suitable take-off alternate aerodrome is available. The take-off alternate aerodrome should have weather conditions and facilities suitable for landing the aeroplane in normal and non-normal configurations pertinent to the operation. In addition, in the non-normal configuration the aeroplane must be capable of climbing to and maintaining altitudes which provide suitable obstacle clearance and navigation signals en route to a take-off alternate aerodrome which should be located within the following distance from the aerodrome of departure:

a) aeroplanes having two power-units not more than a distance equivalent to a flight time of one hour at the single-engine cruise speed;
b) aeroplanes having three or more power-units not more than a distance equivalent to a flight time of two hours at the one-engine inoperative cruise speed.
Non-precision approach

Introduction

6.2.8 In the non-precision approach procedure, track guidance is provided and precise glide path information is not available. The term "non-precision" describes the relative imprecision of the guidance available as compared with precision approach equipment. Additionally, the pilot is required to predetermine the optimum rate of descent from the procedural information available.

6.2.9 The errors in position that may occur at MDA/H may be larger than those that would occur in a precision approach due to the characteristics of the track guidance, and the selected rate of descent. A large visual manoeuvre may be necessary in order to successfully complete the approach and landing. These considerations and the need to satisfy associated obstacle clearance requirements result in generally higher operating minima for non-precision approaches than for precision approach operations. The criteria for obstacle clearance for non-precision approach procedures are contained in PANS-OPS (Doc 8168), Volume II.

The height element of non-precision approach minima

6.2.10 The height element of non-precision approach minima is the minimum descent altitude/height. It is the altitude/height below which the aeroplane must not descend until the runway environment, i.e. the runway threshold, touchdown area, approach lighting or markings identifiable with the runway, is in sight and the aeroplane is in a position for a normal visual descent to land.

6.2.11 The MDA/H is based upon the OCA/H. It may be higher than but never lower than the OCA/H. The method of determining the OCA/H is given in PANS-OPS (Doc 8168), Volume II, the relationship between MDA/H and OCA/H is illustrated in Volume I, both for non-precision approaches having a straight-in final approach segment and for non-precision approaches leading to visual circling of the aerodrome prior to landing. Circling minima are normally higher than those for other non-precision approaches.

The visibility element of non-precision approach minima

6.2.12 The minimum visibility required for the pilot to establish visual reference in time to descend safely from the MDA/H and manoeuvre to the landing will vary with the aeroplane category, the MDA/H, the facilities available, and whether a straight-in or circling approach is used. In general, the minimum visibility required will be less for:

a) aeroplanes having slow approach speeds;

b) lower MDA/H; and

c) better visual aids.

6.2.13 The application of these criteria by States results in visibility minima varying from 5 km to 800 m. The wide range of these minima is an inevitable consequence of the permutation of the factors, some of which will tend to increase the required visibility and others to reduce it.

Precision approach — Category I operations

Introduction

6.2.14 A Category I operation has, in the past, been regarded as a precision approach operation using ILS or PAR with minima in the range of 100-60 m (300-200 ft) decision height, and an associated range of visibilities of 1 200-600 m. Currently, any precision approach operation with a decision height of 60 m (200 ft) or higher and with a minimum visibility of 800 m or 550 m RVR or greater will be termed a Category I operation.

Decision height

Note.— In some States the term decision height is used for barometric altimeter-based, minimum altitudes or minimum heights.

6.2.15 The decision height for an operation cannot be lower than:

a) the minimum height stated in the aeroplane airworthiness certification or operating requirements to which it can be flown solely by reference to instruments;
b) the minimum height to which the precision approach aid may be used solely by reference to instruments;

c) the obstacle clearance height; and

d) the decision height to which the flight crew is permitted to operate.

A decision height higher than the minimum stated above may be established where abnormal conditions prevail or are likely to be encountered. The following paragraphs discuss some of the effects on decision height of aeroplane geometry, aeroplane performance, offset final approach course and atmospheric turbulence.

6.2.16 In unusual cases there may be runways where the ILS/MLS reference datum height is less than the recommended 15 m (50 ft). In such cases it may be necessary to adjust minima and ensure that flight crews are trained to provide adequate wheel clearance over the threshold.

6.2.17 An increase in decision height may be required when an approach is carried out with an engine inoperative. A greater than normal height loss is likely to occur at the initiation of a go-around as the landing gear and flaps are retracted. Decision height in such a case should not be lower than any height contained in the aeroplane flight manual or equivalent document, which indicates the minimum height for committal to a landing following an approach with an engine inoperative.

6.2.18 When using an offset final approach course, the aeroplane will be displaced laterally from the extended runway centre line. Therefore, the decision height should be set high enough to permit a lateral alignment manoeuvre to be completed before reaching the landing threshold. The values of minima established in Tables 6-2, 6-3 and 6-5 do not necessarily provide for the visual manoeuvres required in approaches using an offset final approach course. In these cases, special provisions for decision height or visibilities are generally necessary.

6.2.19 A decision height higher than the minimum may also be established where it is known that abnormal flight conditions are likely to be met. For example, if it is known that topographical features in a particular runway environment frequently produce downdraughts in the approach area, then the decision height may be increased by 15 m (50 ft) or more for propeller driven aeroplanes, and by 30 m (100 ft) or more for turbo-jet aeroplanes; a larger increment may be used if the downdraught is likely to be severe. In addition, pilots should be trained to discontinue an approach prior to the decision height whenever adverse conditions such as severe turbulence are encountered or expected during an approach, or whenever the approach is de-stabilized, e.g. by malfunction of airborne or ground equipment.

Runway visual range/visibility

6.2.20 The minimum weather conditions in which the pilot may be considered to have the visual reference required at and below decision height may be specified as an RVR, or as a visibility. An additional parameter used by some States is the lowest cloud base. However, these are values measured on the ground and none of them, nor any combination of them, can indicate with accuracy whether or not the pilot will have the required visual reference when at decision height. This is due to a number of factors: for example, RVR is measured horizontally while the pilot will normally be looking along a slant path at approach lights from a position some distance from the runway; if the visibility is reduced by fog, it is probable that it will be less dense at ground level than it is above ground level and slant visibility will probably be less than the horizontal visibility at ground level; and when visibility is reduced by snow or blowing dust the slant visibility may be less than horizontal visibility because of the lack of contrast between the approach lighting and the snow-covered ground, or the lack of contrast in ground texture seen through dust. Conversely, there may be cases such as in shallow fog where the slant visual range is greater than horizontal visibility during the earlier phases of an approach. Visibility is even less likely to be representative of the slant visibility seen by a pilot since more often than not it is measured at some distance from the runway and possibly in a direction different from that of the runway.

6.2.21 A measurement of cloud base will not normally give a very good indication of the height at which a pilot will acquire visual contact with the ground for a number of reasons: the measurement is unlikely to be made underneath the position of the glide path where the pilot establishes visual contact; the cloud is likely to have an uneven base; the position on glide path may coincide with a break in the cloud; and the distance that a pilot can see while still in cloud will vary with the thickness of the cloud as well as with the visibility below the cloud.
6.2.22 To sum up, the difference between the distance that a pilot can see from a position on the approach and the measurements made on the ground is a variable that can only be expressed in statistical terms and no specific relationship for a particular approach can therefore be established. Nevertheless, there is still a need to determine minima so as to produce values that give a high probability that the pilot will see enough at and below decision height to carry out the task and there is also a need to specify the minimum visual reference required for descent below decision height.

6.2.23 The distance that a pilot needs to be able to see in order to have an adequate visual segment in sight at and below decision height depends on the eye position in space relative to the visual aids on the ground, the extent to which the view forward and downward is restricted by the aeroplane structure and also on the type of the visual aids. The higher the decision height and the larger the aeroplane, the higher will be the pilot’s eyes above the ground and the greater the required visibility to achieve an acceptable visual segment; conversely, the better the downward view over the nose and the greater the length of the approach lighting system, the less visibility will be required. Some factors, however, do tend to cancel each other out. For example, in large aeroplanes the pilot eye height above the main landing gear wheels is generally great; this undesirable feature is generally compensated for by equipping the aeroplane with accurate automatic approach equipment which makes the pilot’s task easier in poor visibility and by designing the flight deck to provide the pilots with a good forward and downward view. In small aeroplanes the pilot eye height above the wheels is generally small; this desirable feature is generally offset by a relatively poor forward and downward view provided to the pilots and the lack of accurate automatic approach equipment. As a rule, the minimum RVR for a Category I precision approach by large aeroplanes using automatic equipment will be the same as for small- to medium-sized aeroplanes that are flown manually. It follows that a greater RVR may be required for manual operation of large aeroplanes with high approach speeds.

6.2.25 Although the ICAO standard approach lighting for a precision approach runway is a system 900 m long, there are some runways where there is no approach lighting because it is physically impossible to install it, and other runways with approach lighting systems less than 900 m in length. The length and character of the approach lighting will have a significant effect on the visibility minima. For example, at a height of 60 m (200 ft) on a 3° glide slope, the touchdown zone is about 1 100 m ahead of the aeroplane. If there is no approach lighting the RVR would need to be not less than 1 200 m to give the pilot an adequate view of the touchdown zone. Conversely, with full approach, touchdown zone, runway threshold, edge, and centre line lighting, sufficient visual information may be available at and below decision height with RVRs as low as 550 m to enable the pilot to continue approach using a combination of instrument and visual information.

Precision approach — Category II operations

Introduction

6.2.26 Category II approaches are made to decision heights below 60 m (200 ft), but not lower than 30 m (100 ft), with associated RVRs of the order of 550 m — 350 m. In order to obtain the maximum benefit from improvements in ground facilities it is important to take account of all factors that might enable a safe reduction in minima to be made, e.g. the use of automatic approach equipment in the aeroplane, a suitable head-up display, etc. The factors considered in 6.2.4, Precision approach — Category I, are generally applicable to Category II operations.

Decision height

6.2.27 The decision height specified for a Category II operation will normally be the OCH promulgated for the procedure but, in any case, must not be less than 30 m (100 ft). Three methods for calculating the OCH are given in PANS-OPS (Doc 8168), Volume II. In general, the more comprehensive the assessment the lower will be the OCH for a given obstacle environment. If an aerodrome is located in an area with a large number of obstacles, the use of the ICAO collision risk model (CRM) facilitates obstacle assessment. If an aerodrome is located in an area where relatively few obstacles dictate that decision height must be in excess of 30 m (100 ft) the removal of obstacles to permit the lowering of decision height to 30 m (100 ft) should be considered. Except in unusual circumstances such as with irregular underlying terrain, decision heights are based on radio altimeter information. If other means of specifying decision height are used, such as an inner marker, or barometric altimeter, then obstacle clearance, training, minimum equipment list, and other factors may need special consideration.
Chapter 6 — Approval and Implementation of Aerodrome Operating Minima

Runway visual range/visibility

6.2.28 The RVRs specified for Category II operations consider that the first visual contact typically is made with the approach lighting system, and that by the time the aeroplane has descended to a wheel height of 15 m (50 ft), the TDZ should clearly be in view. Although manual Category II operations may be authorized, Category II approaches are normally carried out autocoupled. In addition, some large aeroplanes may use automatic landing equipment.

6.2.29 Category II visibility minima are normally specified in terms of RVR rather than visibility and accordingly an RVR assessment system is a requirement for a runway used for Category II operations.

Precision approach — Category III operations

Introduction

6.2.30 Although the original ICAO operational objective for Category III did not include or require the use of a decision height, current States' practices require the use of a decision height for all fail-passive operations and for some fail-operational operations. Certain operations require the specification of a decision height at or below 15 m (50 ft). Most Category III fail-operational operations specify an alert height at which the satisfactory operation of a fail-operational automatic landing system and relevant ground systems are confirmed. Visibilities range from a TDZ RVR not less than 200 m (700 ft) for Category IIIA to less than 50 m (150 ft) for Category IIIC operations.

Decision height

6.2.31 The obstacle environment in the precision segment of the approach must permit an aeroplane, coupled to the ILS by an automatic flight control system, to fly safely without visual reference to the ground, down to the TDZ, and carry out a missed approach. In Category III operations as in other operations, the aeroplane should be capable of executing a missed approach from any height prior to touchdown. The height loss allowance used in the determination of the decision height for a Category II operation is not applicable to a Category III operation using a fail-operational automatic or hybrid system because the fail-operational characteristics assure that the landing flare will occur. Moreover the missed approach height loss will become less as the height of missed approach initiation decreases. For Category III operations with landing systems which are less than fail operational (e.g. a fail-passive system), the flare is not assured and consequently a height loss allowance may be used in the determination of the decision height.

6.2.32 In those Category III operations where decision heights are used, specific decision heights are associated with RVRs. They are generally specified at or below 15 m (50 ft). Their purpose is to specify the lowest height at which a pilot must be assured that an aeroplane is being satisfactorily delivered to the runway and that adequate visual reference is available for control of the initial part of the landing roll.

6.2.33 For Category III fail-passive operations a decision height is used. For Category III fail-operational operations either a decision height or an alert height may be used. If a decision height is used, any necessary visual reference is specified.

Alert height

6.2.34 Alert height is defined in Chapter 1. Alert height is a height specified for operational use by pilots (100 ft or less above the highest elevation in the touchdown zone), above which a Category III approach would be discontinued and a missed approach initiated if a failure occurred in one of the required redundant operational systems in the aeroplane or in the relevant ground equipment. Below this height, the approach, flare, touchdown, and, if applicable, roll-out may be safely accomplished following any failure in the aircraft or associated Category III systems not shown to be extremely improbable. This height is based on characteristics of an aircraft and its particular fail-operational airborne Category III system.

6.2.35 During airworthiness certification alert heights are evaluated at or above 100 ft to assure sufficient system reliability and integrity. Operationally, alert heights are set at or below 100 ft to assure that conservative judgements are made when failure conditions occur.

Runway visual range

6.2.36 In Category III operations the entire approach down to the touchdown should be flown automatically except for those systems approved for manual control based on the use of head-up displays. For fail-
operational Category IIIA, RVR is used to establish that the visual reference will be adequate for initial roll-out. For fail-passive Category IIIA, RVR provides for the necessary visual reference to enable the pilot to verify that the aeroplane is in a position which will permit a successful landing in the TDZ. If the ground roll is to be manually controlled using visual reference then RVRs of the order of 200 m will be required.

6.2.37 For Category III minima discussed above, a fail-operational flight control system ensures that the pilot is extremely unlikely to have to revert to manual control of the aeroplane because of a system failure in the Category III regime. If the flight control system is fail-passive in operation, then, in specifying minima, consideration must be given to the ability of the pilot to continue safely with the landing or to carry out a missed approach manually and unless a mandatory missed approach is required following equipment failure, consideration must be given to establishing the RVR at a value which will enable the pilot to assess that sufficient visual reference exists for manual control of the flare.

6.2.38 In Category III operations, the need for specific minima in the form of visual reference or decision height requirements is determined by the reliability of the automatic systems. Where such minima are necessary, they will depend on the visual segment required, the pilot’s field of view and the probability of the automatic system failing.

6.3 TABLES OF AERODROME OPERATING MINIMA

6.3.1 Tables of operating minima on their own have no intrinsic meaning; they only have significance in conjunction with a set of operating policies, procedures and instructions. Since such policies are specified by the State of the Operator and vary widely, it is emphasized that imposition of operating minima by the State of the Aerodrome on operators from another State can lead to inconsistencies or be counter-productive. Tables of operating minima are intended primarily for use by States in regulating their own operators. The following Tables 6-1 to 6-7 contain values of minima which are commonly acceptable to States. They are not absolute values but are considered to be a reasonable balance between the need to maintain safe operation and the need to achieve regularity. The values of minima are given in units prescribed by Annex 5; operationally equivalent values in other units currently used by some States are given in Table 6-8. It is recognized that reduced visibility may be caused by different factors (e.g. fog, blowing snow, dust, heavy rain, etc.) and that the values in these tables may not be universally appropriate. States may accept values of operating minima which are lower than those in the tables if they are satisfied that the safety of operation can be maintained. Conversely, it is not intended that these values will be approved for an operator’s use in those cases where the State of the Aerodrome has established higher values unless specifically authorized by that State.

Take-off minima

Commonly accepted take-off minima (Table 6-1)

6.3.2 The take-off minima shown in Table 6-1 are appropriate for most international operations. Use of these minima are based on the following factors:

1) flight characteristics and cockpit instrumentation typical of multi-engine turbine aircraft;
2) comprehensive programmes for crew qualification which address use of the specified minima;
3) comprehensive programmes for airworthiness, with any necessary equipment operational (MEL);
4) availability of specified facilities for the respective minima, including programmes for assurance of the necessary reliability and integrity;
5) availability of air traffic services to ensure separation of aircraft and timely and accurate provision of weather, NOTAM, and other safety information;
6) standard runway, airport, obstruction clearance, surrounding terrain, and other characteristics typical of major facilities serving scheduled international operations;
7) routine low visibility weather conditions (e.g. fog, precipitation, haze, wind components, etc.) which do not require special consideration; and
8) availability of alternate courses of action in the event of emergency situations.
Other take-off minima

6.3.3 When one or more of the factors specified in 6.3.2 above do not apply, cannot be adequately addressed, or are uncertain, higher take-off minima than those shown in Table 6-1 may be necessary. In such situations, some States apply standard minima which are higher than the minima shown in Table 6-1 and which address most exceptions to the factors listed in 6.3.2 (e.g. standard minima of 800 m for 3- or 4-engine aircraft and 1 600 m for 1- or 2-engine aircraft). In other situations where even standard minima are not adequate to assure safety for particular circumstances, still higher minima may be necessary. When such minima are used, some method of evaluation or validation of the minima may be necessary to assure that the considerations addressed by the minima are properly applied to specific aircraft, crews, or operations. Examples of situations, circumstances, or factors in which minima higher than the minima shown in Table 6-1 may be necessary include:

1) existence of non-standard or unusual flight characteristics (e.g. due to configuration or critical MEL or configuration deviation list items such as anti-skid inoperative, thrust reverser inoperative, etc.);

2) crew qualification which does not address use of the specified minima, or use of crews who do not have sufficient experience;

3) separation from obstructions relevant to "all engine" or "engine out" performance cannot be assured by instrument procedures alone;

4) existence of limitations regarding facilities necessary for use of the respective minima (e.g. lights partially out of service, markings not visible due to snow cover or excessive rubber deposits, etc.);

5) limitations regarding air traffic services needed for lower minima, or when services are inadequate or not available (e.g. during tower closure during the night, etc.);

6) during temporary changes such as airport construction which affect facilities or standard procedures;

7) when airport characteristics are non-standard such as with significant runway gradients, non-paved surfaces, narrow runways, uncertain obstruction information, mountainous terrain, or where other non-standard situations exist;

8) during periods of non-routine adverse weather conditions (e.g. wind shear, slippery runways, runway contaminants, excessive wind components, high snow banks at runway edge, runways not plowed full width, etc.) which require special consideration;

Table 6-1. Commonly acceptable take-off minima

Commercial transport aeroplanes (multi-engine aeroplanes)

<table>
<thead>
<tr>
<th>Facilities</th>
<th>RVR/VIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Runway edge lights, runway centre line lights, centre line markings,</td>
<td>175 m</td>
</tr>
<tr>
<td>and touchdown, mid-point and stop-end RVR</td>
<td></td>
</tr>
<tr>
<td>Runway edge lights and either centre line lights or centre line markings</td>
<td>500 m</td>
</tr>
</tbody>
</table>

1. Minima are based on factors described in 6.3.2. If these factors do not apply, higher minima apply as described in 6.3.3.
2. In certain States where RVR increments are given in 50 m steps, 150 m may be acceptable for stop-end RVR.
3. RVR minima lower than the above figures have been accepted by some States who operate in accordance with the take-off minima guidance material tabulated in Chapter 6 of ECAC Doc 17, Issue 3. Although the ECAC table is substantially in accord with that above it does permit take-off in RVRs different to those listed in the table (under clearly defined special circumstances).
4. Where RVR reports are limited by RVR readout or where mid-point RVR is not available some States restrict RVR to 350 m.
9) when alternate courses of action in the event of emergency situations are not available (e.g. no take-off alternate aerodrome available, no acceptable way to accomplish an emergency return, etc.); and

10) other factors determined operationally relevant by the operator or the State of the Operator.

Approach and landing minima

Non-precision approach (Tables 6-2 and 6-3)

6.3.4 The MDH for a particular approach is the OCH promulgated for the procedure or the lowest MDH authorized for the aeroplane or the crew. The minimum visibility to be associated with the MDH can be determined from Table 6-2 when the MDH is 100 m (320 ft) or higher, and from Table 6-3 for MDH values between 75 m and 100 m (250 ft - 320 ft). Full facilities referred to in Table 6-3 are those currently described in Annex 14, Volume I, as a precision approach Category I lighting system, with runway edge lights, threshold lights, end lights and runway markings. Intermediate facilities consist of a high intensity simple approach lighting system, with runway edge lights, threshold lights, end lights and runway markings as described in Annex 14, Volume I. Basic facilities consist of a low intensity simple approach lighting system, with runway edge lights, threshold lights, end lights and runway markings, as described in Annex 14, Volume I, or no approach lights or approach lights not qualifying as simple approach lights. The visibility values in Table 6-2 are based on the availability of full facilities; if only intermediate facilities are available the visibility value extracted from the table should be increased by 400 m and if basic facilities are all that are available, it should be increased by 800 m.

Table 6-2. Commonly acceptable non-precision approach minima

<table>
<thead>
<tr>
<th>MDH</th>
<th>Visibility or RVR (metres)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aeroplane category</td>
</tr>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>100-120</td>
<td>320-390</td>
</tr>
<tr>
<td>121-140</td>
<td>391-460</td>
</tr>
<tr>
<td>141-160</td>
<td>461-530</td>
</tr>
<tr>
<td>161-180</td>
<td>531-600</td>
</tr>
<tr>
<td>181-205</td>
<td>601-670</td>
</tr>
<tr>
<td>206-225</td>
<td>671-740</td>
</tr>
<tr>
<td>226-250</td>
<td>741-810</td>
</tr>
<tr>
<td>251-270</td>
<td>811-880</td>
</tr>
</tbody>
</table>

Circling approach (Table 6-4)

6.3.5 The MDH for a visual circling approach is the OCH for a specified category of aeroplane promulgated for that approach or the MDH value given in Table 6-4, whichever is the higher. The minimum visibility (not RVR) for a circling approach should be that associated with the applicable MDH as shown in Tables 6-2 and 6-4. The visibility values for circling minima given in these tables are commonly accepted operating minima and should not be confused with the design criteria for visual manoeuvring (circling) approach areas contained in the PANS-OPS (Doc 8168). Some States impose a minimum RVR for landing from a circling approach even if the pilot expects that the visual reference will be maintained. This may prevent visual approaches being carried out with subsequent loss of visual reference in the flare, and reduce the probability of an undesirable mix of precision and circling approaches.
Chapter 6 — Approval and Implementation of Aerodrome Operating Minima

Table 6-3. Commonly acceptable non-precision approach minima
Commercial transport aeroplane (multi-engine aeroplanes)

<table>
<thead>
<tr>
<th>Aeroplane category</th>
<th>Visibility or RVR (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Full facilities</td>
<td>800(^1)</td>
</tr>
<tr>
<td>Intermediate facilities</td>
<td>1 200</td>
</tr>
<tr>
<td>Basic facilities</td>
<td>1 600</td>
</tr>
</tbody>
</table>

1. 1 200 m visibility/RVR for NDB.
2. 1 200 m visibility/RVR for localizer with final approach fix (FAF) and middle marker (MM).

Table 6-4. Commonly acceptable circling minima
Commercial transport aeroplanes (multi-engine aeroplanes)

<table>
<thead>
<tr>
<th>Aeroplane category(^1)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDH(^2)</td>
<td>120 m</td>
<td>150 m</td>
<td>180 m</td>
<td>210 m</td>
</tr>
<tr>
<td>(400 ft)</td>
<td>(500 ft)</td>
<td>(600 ft)</td>
<td>(700 ft)</td>
<td></td>
</tr>
<tr>
<td>Visibility(^3)</td>
<td>1 600 m</td>
<td>1 600 m</td>
<td>2 400 m</td>
<td>3 600 m</td>
</tr>
</tbody>
</table>

1. Some States apply circling minima for wide-bodied aeroplanes of MDH 300 m (1 000 ft) and visibility 5 km.
2. In those cases where the MDH is higher than the minimum MDH given in Table 6-4 the visibility value will be that associated with the higher MDH in Table 6-2.
3. Some States impose a minimum RVR for landing from a circling approach.

Precision approach Category I (Table 6-5)

6.3.6 The decision height for a particular operation should be the OCH promulgated for the procedure, or the minimum height authorized for the aeroplane and the crew, or 60 m (200 ft) whichever is the highest. The minimum RVR (or visibility if RVR is not reported) to be associated with this decision height can be determined from Table 6-5. If the decision height is more than 75 m (250 ft) but less than 90 m (300 ft) the minimum RVR/visibility in the table should be increased by 100 m; if it is 90 m (300 ft) or more the minimum RVR/visibility in the table should be increased by 200 m. Full facilities referred to in
Table 6-5 are those currently described in Annex 14, Volume I, for a precision approach runway Category I except that for determining minima a precision approach Category I lighting system which is not less than 740 m in length may be considered to be a full facility. The values included in the current definition of a precision approach runway Category I in Annex 14, Volume I, have no direct relevance to the determination of minima for a specific operation. Intermediate facilities consist of a high intensity simple approach lighting system, with runway edge lights, threshold lights and end lights as described in Annex 14, Volume I. Basic facilities consist of a low intensity simple approach lighting system, with runway edge lights, threshold lights, end lights and runway markings as described in Annex 14, Volume I, or no approach lights or approach lights not qualifying as simple approach lights.

**Precision approach Category II (Table 6-6)**

6.3.7 The decision height for a particular Category II operation should be the OCH or the decision height authorized for the aircraft or the crew, and should not be less than 30 m (100 ft). The visual aids available should be those currently described in Annex 14, Volume I, as a precision approach category II lighting system, including runway edge, threshold, centre line and touchdown zone lights plus runway markings. The RVR minimum of 350 m is applicable to Category II operations, however, the larger aeroplanes may necessitate a greater RVR.

Similarly, if it is necessary to increase decision height due to, for example, facility limitations, then a corresponding increase in minimum RVR will be required. Typically, a DH of 45 m (150 ft) should be associated with an RVR of 500 m. Standard visual aids appropriate to the category of operation should be provided. However, in certain specific circumstances such as temporary visual aid outages, for example failure of some TDZ lighting, it is necessary to increase the RVR for a specific DH. Each case must be evaluated on an individual basis. The values included in the current definition of a precision approach runway Category II which is in Annex 14, Volume I, have no direct relevance to the determination of operating minima for a specific Category II operation.

**Precision approach Category III (Table 6-7)**

6.3.8 The facilities required for operations with the RVR values shown in the table are those currently described in Annex 14, Volume I, as precision approach Category IIIA lighting system and runway edge, threshold, centre line and touchdown zone lighting except that the absence of approach lights may, in some circumstances, be acceptable for fail operational Category IIIA and IIIB operations. The minimum RVR for Category IIIA operations is the minimum TDZ and midpoint value which is acceptable. In some cases, a minimum value may be specified for the stop end of the runway. For Category IIIB operations the minimum RVR applies to all parts of the runway.

---

**Table 6-5. Commonly acceptable precision approach Category I minima**

*Commercial transport aeroplanes (multi-engine aeroplanes)*

<table>
<thead>
<tr>
<th></th>
<th>Full facilities</th>
<th>Intermediate facilities</th>
<th>Basic facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DH</strong></td>
<td>60 m (200 ft)</td>
<td>60 m (200 ft)</td>
<td>60 m (200 ft)</td>
</tr>
<tr>
<td><strong>RVR</strong></td>
<td>550 m</td>
<td>800 m</td>
<td>1 200 m</td>
</tr>
<tr>
<td><strong>Visibility</strong></td>
<td>800 m</td>
<td>800 m</td>
<td>1 200 m</td>
</tr>
</tbody>
</table>

1. DH is 60 m (200 ft) or OCH, whichever is higher.
2. DH may be increased for approaches made with one engine inoperative (see 6.2.17).
3. Increases in DH will require an appropriate increase in RVR/visibility.
### Table 6-6. Commonly acceptable precision approach Category II minima

*Commercial transport aeroplanes (multi-engine aeroplanes)*

<table>
<thead>
<tr>
<th></th>
<th>Basic Cat II minima</th>
<th>Restricted Cat II¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decision height (DH)</td>
<td>30 m (100 ft)</td>
<td>45 m (150 ft)</td>
</tr>
<tr>
<td>RVR²³</td>
<td>350 m</td>
<td>500 m</td>
</tr>
</tbody>
</table>

1. Restricted Category II minima are generally used for operational evaluation phases prior to authorization of Basic Category II minima.
2. Increases in DH may require an appropriate increase in RVR.
3. Certain facility outages may require increases of RVR for a specific decision height.

### Table 6-7. Commonly acceptable precision approach Category III minima

*Commercial transport aeroplanes (multi-engine aeroplanes)*

<table>
<thead>
<tr>
<th></th>
<th>Category IIIA</th>
<th>Category IIIB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fail passive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decision height (DH)</td>
<td>Not less than 15 m (50 ft)</td>
<td>Less than 15 m (50 ft) or no DH required</td>
</tr>
<tr>
<td>RVR</td>
<td>300 m¹</td>
<td>300 m²</td>
</tr>
</tbody>
</table>

1. Minima for fail-passive operations lower than 300 m but not less than 200 m RVR are restricted to operations conducted in accordance with specific criteria for these operations such as those specified in ECAC Doc 17 or United States Advisory Circular 120-28C.
2. For examples of airborne equipment combinations acceptable for Category III operations see Table 5-2.
Table 6-8. Table of operationally equivalent values

The following metres (m) to statute miles (mile (statute)) or feet (ft) values are deemed to be equivalent for operational purpose:

<table>
<thead>
<tr>
<th>Visibility</th>
<th>RVR</th>
</tr>
</thead>
<tbody>
<tr>
<td>400 m = ¼ mile (statute)</td>
<td>50 m = 150 ft</td>
</tr>
<tr>
<td>800 m = ½ mile (statute)</td>
<td>75 m = 250 ft</td>
</tr>
<tr>
<td>1 200 m = ¾ mile (statute)</td>
<td>100 m = 300 ft</td>
</tr>
<tr>
<td>1 600 m = 1 mile (statute)</td>
<td>150 m = 500 ft</td>
</tr>
<tr>
<td>2 000 m = 1¼ mile (statute)</td>
<td>175 m = 600 ft</td>
</tr>
<tr>
<td>2 400 m = 1½ mile (statute)</td>
<td>200 m = 700 ft</td>
</tr>
<tr>
<td>2 800 m = 1¾ mile (statute)</td>
<td>300 m = 1 000 ft</td>
</tr>
<tr>
<td>3 200 m = 2 mile (statute)</td>
<td>350 m = 1 200 ft</td>
</tr>
<tr>
<td>3 600 m = 2¼ mile (statute)</td>
<td>500 m = 1 600 ft</td>
</tr>
<tr>
<td>4 000 m = 2½ mile (statute)</td>
<td>550 m = 1 800 ft</td>
</tr>
<tr>
<td>4 400 m = 2¾ mile (statute)</td>
<td>600 m = 2 000 ft</td>
</tr>
<tr>
<td>4 800 m = 3 mile (statute)</td>
<td>800 m = 2 400 ft</td>
</tr>
<tr>
<td></td>
<td>1 000 m = 3 000 ft</td>
</tr>
<tr>
<td></td>
<td>1 200 m = 4 000 ft</td>
</tr>
<tr>
<td></td>
<td>1 600 m = 5 000 ft</td>
</tr>
</tbody>
</table>
Appendix A

EXTRACT FROM AERONAUTICAL STATUTES

Note.— This Appendix is an example of how one State has put into effect the necessary means of regulating its civil aviation activity. Only those aspects which have a particular bearing on take-off and landing minima have been shown.

"AN ACT

To continue the Civil Aeronautics Board as an agency of the United States, to create a Federal Aviation Agency, to provide for the regulation and promotion of civil aviation in such manner as to best foster its development and safety and to provide for the safe and efficient use of the airspace by both civil and military aircraft, and for other purposes.

TITLE III — ORGANIZATION OF AGENCY AND POWERS AND DUTIES OF ADMINISTRATOR

Section 307 Airspace control and facilities.

a) Use of airspace.
b) Air navigation facilities.
c) Air traffic rules.
d) Applicability of Administrative Procedure Act.
e) Exemptions.
f) Exception for military emergencies.

Section 310 Meteorological service.

Section 313 Other powers and duties of Administrator.

a) General.
b) Publications.
c) Power to conduct hearings and investigations.
d) Training schools.
e) Annual report.

Section 311 Collection and dissemination of information.

TITLE VI — SAFETY REGULATIONS OF CIVIL AERONAUTICS

Section 601 General safety powers and duties.

a) Minimum standards; rules and regulations.
b) Needs of service to be considered; classification of standards, etc.
c) Exemptions.

Section 602 Airman certificates.

a) Power to issue certificate.
b) Issuance of certificate.
c) Form and recording of certificate.

Section 603 Aircraft certificates.

a) Type certificates.
b) Production certificate.
c) Airworthiness certificate.

Section 604 Air carrier operating certificates.

a) Power to issue.
b) Issuance.

Section 605 Maintenance of equipment in air transportation.

a) Duty of carriers and airmen.
b) Inspection.

Section 606 Air navigation facility rating.

Section 607 Air agency rating.

Section 608 Form of applications.

Section 609 Amendment suspension, and revocation certificates.

a) Procedure.
b) Violation of certain laws.
Section 610  Prohibitions.
   a) Violations of title.
   b) Exemption of foreign aircraft and airmen.

Section 611  Control and abatement of aircraft noise and sonic boom.

Section 612  Airport operating certificates.
   a) Power to issue.
   b) Issuance.
   c) Exemption.

TITLE IX — PENALTIES

Section 901  Civil penalties.
   a) Safety, economic, and postal offenses.
   b) Liens.

Section 903  Venue and prosecution of offenses.
   b) Procedure in respect of civil penalties.
   c) Procedure in respect of penalty for aircraft piracy."
Appendix B

EXAMPLES OF SPECIFIC RULES PERTAINING TO ALL-WEATHER OPERATIONS

(See Chapter 2, 2.3.3)

In the United Kingdom, specific rules are contained in the Air Navigation Order 1985 and the Air Navigation (General) Regulations 1981, which are statutes, and in Civil Aviation Publications (CAP) which are issued by the Civil Aviation Authority. CAP are not devoted solely to specific rules and may also contain advisory or explanatory material. Those rules which are in the statutes are for the most part in the form of prohibition of actions which are beyond the legal limit, whereas the contents of the Civil Aviation Publications detail what conditions must be satisfied in order to obtain authority for particular flight operations.

Parts of the Air Navigation Order 1985 relate to the following points:

a) Issue of Air Operators' Certificates (Part II)
b) Composition of Crew of Aircraft (Part IV)
c) Operations of Aircraft (Part V)
d) Fatigue of Crew (Part VI)
e) Licensing of Aerodromes (Part IX)
f) General Provisions (Part X)
g) Public Transport: Operational Requirements (Schedule 11)

The Air Navigation (General) Regulations 1981 include a specification of minimum weather conditions for take-off and landing operations by certain groups of aircraft.

Civil Aviation Publications lay down the conditions which must be satisfied before an operator may commence public transport operations. "CAP 360 — Air Operators Certificate — Information on Requirements to be met by Applicants and Holders" contains details of the basic requirements which cover all aspects of an operation including bad weather operation to Category I limits. "CAP 359 — United Kingdom Operating Requirements for All-Weather Operations Categories II, IIIA and IIIB" describes the conditions which must be satisfied before these operations can be authorized.
### Specific references | Content
---|---
Air Navigation Order (ANO) and associated Air Navigation (General) Regulations: |  
ANO Article 18 | Composition of crew of aircraft. 
ANO Article 19 | Members of flight crew — requirement of licenses. 
ANO Article 26 | Training Manual requirements. 
ANO Article 30 | Aircraft registered in the United Kingdom — Aerodrome operating minima. 
ANO Article 31 | Aircraft not registered in the United Kingdom — Aerodrome operating minima. 
ANO Article 71 | Aerodromes: public transport of passengers and instruction in flying. 
ANO Article 86 | Power to prevent aeroplane flying. 
ANO Article 88 | Obstruction of persons in the performance of their duties under the Order. 
ANO Article 89 | Enforcement of directions given under the Order. 
ANO Article 91 | Extra-territorial effect of the Order. 
CAP 360, Air Operator’s Certificate. Information on Requirements to be met by Applicants and Holders | Non-precision approach and Category I precision approach operations, including aerodrome operating minima. Chapter 2.14 and Appendices D and E.
CAP 359, United Kingdom Operating Requirements for All-Weather Operations Categories II, IIIA and IIIB | Category II and III precision approach operations including aerodrome and ILS safeguarding and aerodrome operating minima.
CAP 168, Licensing of Aerodromes | Aerodrome aspects including obstacles, lighting and marking requirements relating to Category I, II and III operations. Chapters 4, 6 and 7.
British Civil Airworthiness Regulations (BCAR) BCAR Paper No. 742 | Requirements to be met for the certification of United Kingdom registered aeroplane in Categories II and III.
### Appendix B — Examples of Specific Rules Pertaining to All-Weather Operations

#### Bibliography

<table>
<thead>
<tr>
<th>BCAR = British Civil Airworthiness Requirements</th>
<th>AC = Advisory Circular</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANO = Air Navigation Order</td>
<td>FAR = Federal Aviation Regulations</td>
</tr>
<tr>
<td>CAP = Civil Aviation Publications</td>
<td>FAA = Federal Aviation Administration</td>
</tr>
</tbody>
</table>

#### All-Weather Operations — areas in which rules are required

<table>
<thead>
<tr>
<th>United Kingdom</th>
<th>United States</th>
</tr>
</thead>
</table>

#### The operation:

##### a) Airworthiness requirements

<table>
<thead>
<tr>
<th>Category II</th>
<th>BCAR Paper 742</th>
<th>AC 120-29, 120-28, 20-57A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category III</td>
<td>BCAR Paper 742</td>
<td>Standard Operations Specifications Part C, Category II and Category III</td>
</tr>
</tbody>
</table>

##### b) Flight crew qualifications and training

| ANO, Articles 19, 20 and Schedule 11. | FAR 121 Subparts N and O and qualifications and Appendices E and F |
| CAP 360, Chapter 2, paragraphs 2, 3 and 4 and Chapter 4. | FAR 61 Subpart F and Appendix A |
| CAP 359, Chapter 3. | AC 61-65A, 61-57A, 61-77 |

##### c) Operating procedures and in-service proving of procedures.

| ANO Article 25 and Schedule 11. | AC 120-28B, AC 120-29 |

##### d) Aerodrome operating minima

<table>
<thead>
<tr>
<th>Non-precision and Category I — CAP 360, Appendices C and D. Category II and Category III — CAP 359, Appendix.</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAR 97 and Standard Instrument Approach Procedures, FAR 91.2, 91.5, 91.34, 91 Appendix A, 91.116, 121.101, 121.651, 121.655, 135.225, 125.381</td>
</tr>
<tr>
<td>FAA Order 8260.3B (TERPS)</td>
</tr>
</tbody>
</table>

#### The aerodrome:

##### a) Adequacy of runways and taxiways


##### b) Visual and non-visual

- **1) Visual**
  - CAP 168, Chapters 5 and 7 | FAA Order 8200.1, 8260.3B (TERPS), 8260.19A, 6700.11, 6750.16A, 6750.24A |
- **2) Non-visual**
  - (ICAO Standards applied) | AC 150-5340-24, 150-5340-4C, 150-5340-19, 150-5345-48 |

##### c) Obstacle clearance criteria

| CAP 168, Chapter 4 | FAA Order 8260.3B (TERPS) |

##### d) Meteorological service and the assessment and dissemination of RVR

<table>
<thead>
<tr>
<th>UK Air Pilot (MET). Manual of Air Traffic Services.</th>
<th>AC 97-1A, 00-6A, 00-45C</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAA Order 7330.7L</td>
<td>FAA Order 7110.65C, 7930.1A</td>
</tr>
</tbody>
</table>

##### e) Air traffic service, including ground movement control

| Manual of Air Traffic Services. UK Air Pilot (RAC). | FAA Order 8430.6C, 8320.12, 8440.5A |

#### Certification and authorization:

##### a) The aircraft

| BCARs | AC 120-28C, 120-29 |
| FAA Order 8430.6C, 8110.8, 8110.4 & 8040.1A |

##### b) The aerodrome

| CAP 168 | FAR 139 |

##### c) The aircraft operator

| CAP 360 | FAA Order 8430.6C, 8320.12, 8440.5A |
Appendix C

CRITERIA FOR ESTABLISHING A VISUAL DESCENT POINT

(See Chapter 3, 3.4.3)

[extracted from United States Terminal Procedures (TERPS)]

"VISUAL PORTION OF THE FINAL APPROACH SEGMENT. The visual portion begins at the visual descent point and ends at the runway threshold. The visual descent point is a defined point on the final approach course of a non-precision straight-in approach procedure from which normal descent from the MDA to the runway touchdown point may be commenced, provided visual reference is established.

a) VISUAL DESCENT POINT (VDP). When an instrument approach procedure incorporates a VDP, the VDP shall be identified by an approved navigational fix. The fix error shall meet the specified fix accuracy, but in no case shall the fix error exceed 0.5 NM.

1) Where VASI is installed, the VDP shall be located at the point where the lowest VASI glide slope intersects the lowest MDA.

2) Where VASI is not installed, the VDP will be located at the point on the final approach course at the MDA where a descent gradient to the threshold of 300-400 ft per NM commences. If operational requirements dictate a 2° descent gradient, 212 ft per NM may be used.

b) Alignment. The VDP area is centered on the runway centre line extended.

c) Area. The VDP area is determined as follows:

1) When VASI is installed, the area shall begin at a point abeam the downwind VASI bar and splay 10° either side of the runway centre line.

2) When no VASI is installed, the area shall begin at a point 500 feet upwind from the runway threshold and splay 10° either side of the runway centre line.

3) Where the 10° splay does not encompass the width of the runway at the threshold, the area shall begin at the threshold at a width equal to the runway width and splay 10° from the runway edges.

4) The area shall terminate at the VDP or where the obstacle clearance surface elevation is equal to the MDA minus the Required Obstacle Clearance (ROC) whichever occurs first.

d) Surface. The surface is included upward and extends outward to the point where the VDP area terminates.

1) When VASI is installed, the surface shall extend from the downwind VASI bar at an angle 1° lower than the aiming angle of that bar (Figure B).

2) When no VASI is installed, the surface shall extend from the threshold at an angle 1½° lower than the angle resulting from the descent gradient from the VDP to the runway threshold (Figure C).

e) Obstacle limitations. No obstacle shall penetrate the surface overlying the area associated with the VDP (Figure A)."
Figure A. Visual descent point obstacle clearance area

Figure B. Visual descent point obstacle clearance surface (with VASI)

Figure C. Visual descent point obstacle clearance surface (without VASI)
ICAO TECHNICAL PUBLICATIONS

The following summary gives the status, and also describes in general terms the contents of the various series of technical publications issued by the International Civil Aviation Organization. It does not include specialized publications that do not fall specifically within one of the series, such as the Aeronautical Chart Catalogue or the Meteorological Tables for International Air Navigation.

International Standards and Recommended Practices are adopted by the Council in accordance with Articles 54, 37 and 90 of the Convention on International Civil Aviation and are designated, for convenience, as Annexes to the Convention. The uniform application by Contracting States of the specifications contained in the International Standards is recognized as necessary for the safety or regularity of international air navigation while the uniform application of the specifications in the Recommended Practices is regarded as desirable in the interest of safety, regularity or efficiency of international air navigation. Knowledge of any differences between the national regulations or practices of a State and those established by an International Standard is essential to the safety or regularity of international air navigation. In the event of non-compliance with an International Standard, a State has, in fact, an obligation, under Article 38 of the Convention, to notify the Council of any differences. Knowledge of differences from Recommended Practices may also be important for the safety of air navigation and, although the Convention does not impose any obligation with regard thereto, the Council has invited Contracting States to notify such differences in addition to those relating to International Standards.

Procedures for Air Navigation Services (PANS) are approved by the Council for world-wide application. They contain, for the most part, operating procedures regarded as not yet having attained a sufficient degree of maturity for adoption as International Standards and Recommended Practices, as well as material of a more permanent character which is considered too detailed for incorporation in an Annex, or is susceptible to frequent amendment, for which the processes of the Convention would be too cumbersome.

Regional Supplementary Procedures (SUPPS) have a status similar to that of PANS in that they are approved by the Council, but only for application in the respective regions. They are prepared in consolidated form, since certain of the procedures apply to overlapping regions or are common to two or more regions.

The following publications are prepared by authority of the Secretary General in accordance with the principles and policies approved by the Council.

Technical Manuals provide guidance and information in amplification of the International Standards, Recommended Practices and PANS, the implementation of which they are designed to facilitate.

Air Navigation Plans detail requirements for facilities and services for international air navigation in the respective ICAO Air Navigation Regions. They are prepared on the authority of the Secretary General on the basis of recommendations of regional air navigation meetings and of the Council action thereon. The plans are amended periodically to reflect changes in requirements and in the status of implementation of the recommended facilities and services.

ICAO Circulars make available specialized information of interest to Contracting States. This includes studies on technical subjects.