Bijlage I, behorende bij artikel 1, van de Regeling veilig gebruik luchtvaartterreinen

Bijlage I

AUA-AGA

AERODROME REGULATIONS

FOREWORD

(a) The Minister in charge of aviation affairs, through the Department of Civil Aviation of Aruba, is known in these regulations as the "Authority"

(b) AUA-AGA addresses the requirements for Aerodromes, safety-related aerodrome equipment and ground aides, the operation of aerodromes and the provision of AMS at aerodromes.

(c) The Authority has adopted associated Acceptable means of compliance or Guidance material (also incorporated as notes) wherever possible (and, unless specifically stated otherwise, clarification will be based on this material or other internationally acceptable documentation.

Note: The use of the male gender implies the female gender and vice versa.

REVISION HISTORY

Amendments/revision of this regulation are recorded below in order of the most recent first.

REVISION NO.	AMENDED OR REVISED PROVISIONS
Initial Issue *(based on Annex 14 vol I. Ninth Edition, July 2022 – Am. 17)*	All

CHAPTER 1 GENERAL

1.1 Definitions, abbreviations, symbols

1.1.1 Definitions

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

Acceptable Means of Compliance (AMC). Non-binding standards adopted by the Authority to illustrate means to establish compliance with AUA-AGA.

Aerodrome. A defined area on land or water (including any buildings, installations and equipment) intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft.

Aerodrome beacon. Aeronautical beacon used to indicate the location of an aerodrome from the air.

Aerodrome certificate. A certificate issued by the Minister in charge of Aviation under established regulations for the safe operation of an aerodrome within the Aruban Airspace.

Aerodrome elevation. The elevation of the highest point of the landing area.

Aerodrome identification sign. A sign placed on an aerodrome to aid in identifying the aerodrome from the air.

Aerodrome mapping data (AMD). Data collected for the purpose of compiling aerodrome mapping information for aeronautical uses.

Note.— Aerodrome mapping data are collected for purposes that include the improvement of the user's situational awareness, surface navigation operations, training, charting and planning.

Aerodrome mapping database (AMDB). A collection of aerodrome mapping data organized and arranged as a structured data set.

Aerodrome reference point. The designated geographical location of an aerodrome.

Aerodrome traffic density.

a) *Light.* Where the number of movements in the mean busy hour is not greater than 15 per runway or typically less than 20 total aerodrome movements.

b) *Medium*. Where the number of movements in the mean busy hour is of the order of 16 to 25 per runway or typically between 20 to 35 total aerodrome movements.

c) *Heavy.* Where the number of movements in the mean busy hour is of the order of 26 or more per runway or typically more than 35 total aerodrome movements.

Note 1. – The number of movements in the mean busy hour is the arithmetic mean over the year of the number of movements in the daily busiest hour.

Note 2. – Either a take-off or a landing constitutes a movement.

Aeronautical beacon. An aeronautical ground light visible at all azimuths, either continuously or intermittently, to designate a particular point on the surface of the earth.

Aeronautical ground light. Any light specially provided as an aid to air navigation, other than a light displayed on an aircraft.

Airplane reference field length. The minimum field length required for take-off at maximum certificated take-off mass, sea level, standard atmospheric conditions, still air and zero runway slope, as shown in the appropriate airplane flight manual prescribed by the certificating authority or equivalent data from the airplane manufacturer. Field length means balanced field length for airplanes, if applicable, or take-off distance in other cases.

Note. – Attachment A, Section 2 provides information on the concept of balanced field length and the Airworthiness Manual (Doc 9760) contains detailed guidance on matters related to take-off distance.

Aircraft Classification Number (ACN).† A number expressing the relative effect of an aircraft on a pavement for a specified standard subgrade category.

Note. – The aircraft classification number is calculated with respect to the centre of gravity (CG) position which yields the critical loading on the critical gear. Normally the aftmost CG position appropriate to the maximum gross apron (ramp) mass is used to calculate the ACN. In

† Applicable until 27 November 2024.

exceptional cases the forwardmost CG position may result in the nose gear loading being more critical.

Aircraft classification rating (ACR).⧺ A number expressing the relative effect of an aircraft on a pavement for a specified standard subgrade category.

Note.— The aircraft classification rating is calculated with respect to the centre of gravity (CG) position which yields the critical loading on the critical gear. Normally the aftmost CG position appropriate to the maximum gross apron (ramp) mass is used to calculate the ACR. In exceptional cases the forwardmost CG position may result in the nose gear loading being more critical.

Aircraft stand. A designated area on an apron intended to be used for parking an aircraft.

Apron. A defined area, on a land aerodrome, intended to accommodate aircraft for purposes of loading or unloading passengers, mail or cargo, fuelling, parking or maintenance.

Apron management service. A service provided to regulate the activities and the movement of aircraft and vehicles on an apron.

Arresting system. A system designed to decelerate an aeroplane overrunning the runway.

Autonomous runway incursion warning system (ARIWS). A system which provides autonomous detection of a potential incursion or of the occupancy of an active runway and a direct warning to a flight crew or a vehicle operator.

Balked landing. A landing manoeuvre that is unexpectedly discontinued at any point below the obstacle clearance altitude/height (OCA/H).

Barrette. Three or more aeronautical ground lights closely spaced in a transverse line so that from a distance they appear as a short bar of light.

Calendar. Discrete temporal reference system that provides the basis for defining temporal position to a resolution of one day (ISO 19108*).

Certified aerodrome. An aerodrome whose operator has been granted an aerodrome certificate.

⧺ Applicable as of 28 November 2024.

* ISO Standard 19108, Geographic information – Temporal schema.

Clearway. A defined rectangular area on the ground or water under the control of the appropriate authority, selected or prepared as a suitable area over which an airplane may make a portion of its initial climb to a specified height.

Cyclic Redundancy Check (CRC). A mathematical algorithm applied to the digital expression of data that provides a level of assurance against loss or alteration of data.

Data accuracy. A degree of conformance between the estimated or measured value and the true value.

Data integrity (assurance level). A degree of assurance that an aeronautical data and its value has not been lost or altered since the origination or authorized amendment.

Data quality. A degree or level of confidence that the data provided meet the requirements of the data user in terms of accuracy, resolution and integrity (or equivalent assurance level), traceability, timeliness, completeness and format.

Datum. Any quantity or set of quantities that may serve as a reference or basis for the calculation of other quantities (ISO 19104**).

Declared distances.

a) ***Take-Off Run Available (TORA).*** The length of runway declared available and suitable for the ground run of an airplane taking off.

b) ***Take-Off Distance Available (TODA).*** The length of the take-off run available plus the length of the clearway, if provided.

c) ***Accelerate-Stop Distance Available (ASDA).*** The length of the take-off run available plus the length of the stop way, if provided.

d) ***Landing Distance Available (LDA).*** The length of runway which is declared available and suitable for the ground run of an airplane landing.

Displaced threshold. A threshold not located at the extremity of a runway.

Effective intensity. The effective intensity of a flashing light is equal to the intensity of a fixed light of the same colour which will produce the same visual range under identical conditions of observation.

** ISO Standard 19104, *Geographic information - Terminology*

Ellipsoid height (Geodetic height). The height related to the reference ellipsoid, measured along the ellipsoidal outer normal through the point in question.

Fixed light. A light having constant luminous intensity when observed from a fixed point.

Foreign object debris (FOD). An inanimate object within the movement area which has no operational or aeronautical function and which has the potential to be a hazard to aircraft operations.

Frangible object. An object of low mass designed to break, distort or yield on impact so as to present the minimum hazard to aircraft.

Note. – Guidance on design for frangibility is contained in the Aerodrome Design Manual, Part 6 (in preparation).

Geodetic datum. A minimum set of parameters required to define location and orientation of the local reference system with respect to the global reference system/frame.

Geoid. The equipotential surface in the gravity field of the Earth which coincides with the undisturbed mean sea level (MSL) extended continuously through the continents.

Note. – The geoid is irregular in shape because of local gravitational disturbances (wind tides, salinity, current, etc.) and the direction of gravity is perpendicular to the geoid at every point.

Geoid undulation. The distance of the geoid above (positive) or below (negative) the mathematical reference ellipsoid.

Note. – In respect to the World Geodetic System – 1984 (WGS-84) defined ellipsoid, the difference between the WGS-84 ellipsoidal height and orthometric height represents WGS-84 geoid undulation.

Gregorian calendar. Calendar in general use; first introduced in 1582 to define a year that more closely approximates the tropical year than the Julian calendar (ISO 19108[***]).

Note. – In the Gregorian calendar, common years have 365 days and leap years 366 days divided into twelve sequential months.

Ground handling. Services necessary for an aircraft's arrival at, and departure from, an airport, other than air traffic services.

[***] ISO Standard 19108, Geographic information – Temporal schema.

Guidance Material (GM). Non-binding material developed by the Authority that helps to illustrate the meaning of a requirement or specification, and is used to support the interpretation of the AUA-AGA.

Hazard beacon. An aeronautical beacon used to designate a danger to air navigation.

Heliport. An aerodrome or a defined area on a structure intended to be used wholly or in part for the arrival, departure and surface movement of helicopters.

Holding bay. A defined area where aircraft can be held or bypassed, to facilitate efficient surface movement of aircraft.

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

Human Factors principles. Principles which apply to aeronautical design, certification, training, operations and maintenance and which seek safe interface between the human and other system components by proper consideration to human performance.

Human performance. Human capabilities and limitations which have an impact on the safety and efficiency of aeronautical operations.

Identification beacon. An aeronautical beacon emitting a coded signal by means of which a particular point of reference can be identified.

Instrument runway. One of the following types of runways intended for the operation of aircraft using instrument approach procedures:

a) ***Non-precision approach runway.*** A runway served by visual aids and a non-visual aid(s) intended for landing operations following instrument approach type A and a visibility not less than 1000m

b) ***Precision approach runway, category I***. A runway served by visual aids and non-visual aid(s) intended for landing operations following an instrument approach operation type B with a decision height (DH) not lower than 60 m (200 ft) and either a visibility not less than 800 m or a runway visual range not less than 550 m.

c) ***Precision approach runway, category II***. A runway served by visual aids and non-visual aid(s) intended for landing operations following an instrument approach operation type B with a decision height (DH) lower than 60 m (200 ft) but not lower than 30 m (100 ft) and a runway visual range not less than 300 m.

d) ***Precision approach runway, category III***. runway served by visual aids and non-visual aid(s) intended for landing operations following an instrument approach operation type B with a decision height (DH) lower than 30 m (100 ft), or no decision height and a runway visual range less than 300 m, or no runway visual range limitations.

Note 1.— Visual aids need not necessarily be matched to the scale of non-visual aids provided. The criterion for the selection of visual aids is the conditions in which operations are intended to be conducted.

Note 2.— Refer to Annex 6 — Operation of Aircraft for instrument approach operation types.

Integrity classification (aeronautical data). Classification based upon the potential risk resulting from the use of corrupted data. Aeronautical data is classified as:

a) routine data: there is a very low probability when using corrupted routine data that the continued safe flight and landing of an aircraft would be severely at risk with the potential for catastrophe;

b) essential data: there is a low probability when using corrupted essential data that the continued safe flight and landing of an aircraft would be severely at risk with the potential for catastrophe; and

c) critical data: there is a high probability when using corrupted critical data that the continued safe flight and landing of an aircraft would be severely at risk with the potential for catastrophe.

Intermediate holding position. A designated position intended for traffic control at which taxiing aircraft and vehicles shall stop and hold until further cleared to proceed, when so instructed by the aerodrome control tower.

Landing area. That part of a movement area intended for the landing or take-off of aircraft.

Landing direction indicator. A device to indicate visually the direction currently designated for landing and for take-off.

Lighting system reliability. The probability that the complete installation operates within the specified tolerances and that the system is operationally usable.

Maneuvering area. That part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, excluding aprons.

Marker. An object displayed above ground level in order to indicate an obstacle or delineate a boundary.

Marking. A symbol or group of symbols displayed on the surface of the movement area in order to convey aeronautical information.

Movement area. That part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, consisting of the maneuvering area and the apron(s).

Non-instrument runway. A runway intended for the operation of aircraft using visual approach procedures or an instrument approach procedure to a point beyond which the approach may continue in visual meteorological conditions.

Note.— Visual meteorological conditions (VMC) are described in Chapter 3 of Annex 2 — Rules of the Air.

Obstacle. All fixed (whether temporary or permanent) and mobile objects, or parts thereof, that:

a) are located on an area intended for the surface movement of aircraft; or
b) extend above a defined surface intended to protect aircraft in flight; or
c) stand outside those defined surfaces and that have been assessed as being a hazard to air navigation.

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

Orthometric height. Height of a point related to the geoid, generally presented as an MSL elevation.

Outer main gear wheel span (OMGWS). The distance between the outside edges of the main gear wheels.

Pavement Classification Number (PCN)†. A number expressing the bearing strength of a pavement for unrestricted operations.

Pavement classification rating (PCR)††. A number expressing the bearing strength of a pavement.

† Applicable until 27 November 2024.
†† Applicable as of 28 November 2024.

Precision approach runway, see Instrument runway.

Primary runway(s). Runway(s) used in preference to others whenever conditions permit.

Protected flight zones. Airspace specifically designated to mitigate the hazardous effects of laser radiation.

Road. An established surface route on the movement area meant for the exclusive use of vehicles.

Road-holding position. A designated position at which vehicles may be required to hold.

Runway. A defined rectangular area on a land aerodrome prepared for the landing and take-off of aircraft.

Runway condition assessment matrix (RCAM). A matrix allowing the assessment of the runway condition code, using associated procedures, from a set of observed runway surface condition(s) and pilot report of braking action.

Runway condition code (RWYCC). A number describing the runway surface condition to be used in the runway condition report.

Note.— The purpose of the runway condition code is to permit an operational aeroplane performance calculation by the flight crew. Procedures for the determination of the runway condition code are described in the PANS-Aerodromes (Doc 9981).

Runway condition report (RCR). A comprehensive standardized report relating to runway surface condition(s) and its effect on the aeroplane landing and take-off performance.

Runway End Safety Area (RESA). An area symmetrical about the extended runway centre line and adjacent to the end of the strip primarily intended to reduce the risk of damage to an airplane undershooting or overrunning the runway.

Runway guard lights. A light system intended to caution pilots or vehicle drivers that they are about to enter an active runway.

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

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

Runway strip. A defined area including the runway and stopway, if provided, intended:

a) to reduce the risk of damage to aircraft running off a runway; and

b) to protect aircraft flying over it during take-off or landing operations.

Runway surface condition(s). A description of the condition(s) of the runway surface used in the runway condition report which establishes the basis for the determination of the runway condition code for aeroplane performance purposes.

Note 1.— The runway surface conditions used in the runway condition report establish the performance requirements between the aerodrome operator, aeroplane manufacturer and aeroplane operator.

Note 2.— Procedures on determining runway surface conditions are available in the PANS-Aerodromes (Doc 9981).

a) ***Dry runway.*** A runway is considered dry if its surface is free of visible moisture and not contaminated within the area intended to be used.

b) ***Wet runway*****.** The runway surface is covered by any visible dampness or water up to and including 3 mm deep within the intended area of use.

c) ***Slippery wet runway*****.** A wet runway where the surface friction characteristics of a significant portion of the runway have been determined to be degraded.

d) ***Contaminated runway*****.** A runway is contaminated when a significant portion of the runway surface area (whether in isolated areas or not) within the length and width being used is covered by one or more of the substances listed in the runway surface condition descriptors.

Note.— Procedures on determination of contaminant coverage on runway are available in the PANS-Aerodromes (Doc 9981).

e) ***Runway surface condition descriptors*****.** The following element on the surface of the runway:

Standing water. Water of depth greater than 3 mm.

Note.— Running water of depth greater than 3 mm is reported as standing water by convention.

Runway turn pad. A defined area on a land aerodrome adjacent to a runway for the purpose of completing a 180-degree turn on a runway.

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.

Safety Management System (SMS). A systematic approach to managing safety including the necessary organizational structure, accountabilities, policies and procedures.

Shoulder. An area adjacent to the edge of a pavement so prepared as to provide a transition between the pavement and the adjacent surface.

Sign.

a) *Fixed message sign*. A sign presenting only one message.

b) *Variable message sign*. A sign capable of presenting several pre-determined messages or no message, as applicable.

Signal area. An area on an aerodrome used for the display of ground signals.

Station declination. An alignment variation between the zero-degree radial of a VOR and true north, determined at the time the VOR station is calibrated.

Stopway. A defined rectangular area on the ground at the end of take-off run available prepared as a suitable area in which an aircraft can be stopped in the case of an abandoned take off.

Switch-over time (light). The time required for the actual intensity of a light measured in a given direction to fall from 50 per cent and recover to 50 per cent during a power supply changeover, when the light is being operated at intensities of 25 per cent or above.

Take-off runway. A runway intended for take-off only.

Taxiway. A defined path on a land aerodrome established for the taxiing of aircraft and intended to provide a link between one part of the aerodrome and another, including:

a) ***Aircraft stand taxilane***. A portion of an apron designated as a taxiway and intended to provide access to aircraft stands only.

b) ***Apron taxiway***. A portion of a taxiway system located on an apron and intended to provide a through taxi route across the apron.

c) ***Rapid exit taxiway***. A taxiway connected to a runway at an acute angle and designed to allow landing airplanes to turn off at higher speeds than are achieved on other exit taxiways thereby minimizing runway occupancy times.

Taxiway intersection. A junction of two or more taxiways.

Taxiway strip. An area including a taxiway intended to protect an aircraft operating on the taxiway and to reduce the risk of damage to an aircraft accidentally running off the taxiway.

Terms of the certificate. Means the following:

— ICAO Location Indicators,

— conditions to operate (VFR/IFR, day/night),

— runway - declared distances,

— runway types and approaches provided,

— aerodrome reference code,

— scope of aircraft operations with higher aerodrome reference code letter,

— provision of apron management services (yes/no),

— rescue and firefighting level of protection;

Threshold. The beginning of that portion of the runway usable for landing.

Touchdown zone. The portion of a runway, beyond the threshold, where it is intended landing airplanes first contact the runway.

Organisation responsible for aeronautical information in Aruba. The subdivision Aeronautical Information affairs (Unit-AIA) of Air Navigation Services Aruba N.V. (ANSA).

Note.— The Unit AIA manages the aeronautical information and data on behalf of the Authority. Arrangements between the organisation and the aerodrome operator for the publication of aeronautical information requires prior acceptance of the authority. *See 2.13.2*.

Usability factor. The percentage of time during which the use of a runway or system of runways is not restricted because of the cross-wind component.

Note.– Crosswind component means the surface wind component at right angles to the runway centre line.

1.1.2 Abbreviations and symbols

Abbreviations

ACN[†]	Aircraft classification number
ACR[††]	Aircraft classification rating
ADP	Airside driver permit
AIP	Aeronautical information publication
APAPI	Abbreviated precision approach path indicator
aprx	Approximately
ARIWS	Autonomous runway incursion warning system
ASDA	Accelerate-stop distance available
ATS	Air traffic services
AT-VASIS	Abbreviated T visual approach slope indicator system
C	Degree Celsius
CBR	California bearing ratio
cd	Candela
CIE	Commission Internationale de l’Éclairage
cm	Centimetre
CRC	Cyclic redundancy check
DME	Distance measuring equipment
E	Modulus of elasticity
FOD	Foreign object debris
ft	Foot
ILS	Instrument landing system
IMC	Instrument meteorological conditions
K	Degree Kelvin
kg	Kilogram
km	Kilometre
km/h	Kilometre per hour
kt	Knot
L	Litre
LCFZ	Laser-beam critical flight zone
LDA	Landing distance available

[†] Applicable until 27 November 2024.
[††] Applicable as of 28 November 2024.

LFFZ	Laser-beam free flight zone
LSFZ	Laser-beam sensitive flight zone
m	Metre
max	Maximum
MLS	Microwave landing system
mm	Millimetre
mnm	Minimum
MN	Meganewton
MPa	Megapascal
MSL	Mean sea level
NFZ	Normal flight zone
NM	Nautical mile
NU	Not usable
OCA/H	Obstacle clearance altitude/height
OFZ	Obstacle free zone
OLS	Obstacle limitation surface
OMGWS	Outer main gear wheel span
PAPI	Precision approach path indicator
PCN†	Pavement classification number
PCR††	Pavement classification rating
RESA	Runway end safety area
RFF	Rescue and firefighting
RVR	Runway visual range
SMS	Safety management system
TODA	Take-off distance available
TORA	Take-off run available
T-VASIS	T visual approach slope indicator system
VMC	Visual meteorological conditions
VOR	Very high frequency omnidirectional radio range
WHMP	Wildlife hazard management programme
WIP	Work in progress

Symbols

°	Degree
=	Equals
‘	Minute of arc
µ	Friction coefficient
>	Greater than

† Applicable until 27 November 2024
†† Applicable as of 28 November 2024

<	Less than
%	Percentage
±	Plus or minus

1.2 Applicability & Deviations

1.2.1

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1.2.2 Applicability

The specifications, unless otherwise indicated in a particular context, shall apply to all aerodromes that fall under the "Landsbesluit Luchtvaartterreinen 2023".

The specifications of AUA-AGA, Chapter 3, shall apply only to land aerodromes. The specifications in AUA-AGA shall apply, where appropriate, to heliports but shall not apply to stolports.

Note.— Guidance material on stolports is given in the Stolport Manual (Doc 9150).

1.2.3 Colour applicability

Wherever a colour is referred to in AUA-AGA, the specifications for that colour given in Appendix 1 shall apply.

1.2.4 Exemption/ deviation

(a) The aerodrome operator may request an exemption or deviation for the standards or practices established in AUA-AGA.

(b) The request shall be accompanied by a detailed description of the aeronautical study/risk assessment carried out and the alternative measures that can guarantee a level of safety equivalent to that established in the relevant standard or practice.

(c) An exemption or deviation shall only be granted if:

(1) the compliance with the requirement may not be feasible due to special circumstances;

(2) the safety of the aerodromes and of air operations are not jeopardized by the granting of an exemption or deviation; and

(3) the authority has determined that the measures referred to in (b) are sufficient to compensate for the exemption or deviation.

(d) A deviation or exemption may be granted subject to limitations, conditions or restrictions.

GM1 1.2.4 Exemption / deviation

(a) An aeronautical study/ risk assessment should be conducted by the aerodrome operator to assess the impact of exemptions or deviations from the aerodrome standards specified in AUA-AGA and other national regulations and to present alternative means of ensuring the safety of aircraft operations, to estimate the effectiveness of each alternative and to recommend procedures to compensate for the deviation or exemption.

(b) An aeronautical study/ risk assessment is a study of an aeronautical problem to identify possible solutions and select a solution that is acceptable without degrading safety.

(c) When considering alternative procedures in the deviation or exemption approval process, the Authority will bear in mind the safety objective of the aerodrome certification regulations and the applicable standards so that the intent of the regulations is not circumvented.

(d) The authority will thoroughly review the aeronautical study/ risk assessment and the presented measures to determine if it they are acceptable.

1.3 Common reference systems

1.3.1 Horizontal reference system

For the purpose of air navigation, the aerodrome operator shall use the World Geodetic System — 1984 (WGS-84) as the horizontal (geodetic) reference system. Reported aeronautical geographical coordinates (indicating latitude and longitude) shall be expressed in terms of the WGS-84 geodetic reference datum.

GM1 1.3.1 Horizontal reference system

HORIZONTAL REFERENCE SYSTEM — WGS-84

(a) A reference system provides a definition of a coordinate system in terms of the position of an origin in space, the orientation of an orthogonal set of Cartesian axes, and a scale. A terrestrial reference system defines a spatial reference system in which positions of points anchored on the Earth's solid surface have coordinates. Examples are: WGS-84, ITRS/European Terrestrial Reference System (ETRS) and national reference systems.

(b) WGS-84 defines, inter alia, a conventional terrestrial reference system, a reference frame and a reference ellipsoid. WGS-84 is currently the reference system ICAO requires for georeferencing aeronautical information.

(c) Comprehensive guidance material concerning WGS-84 is contained in the World Geodetic System — 1984 (WGS-84) Manual (Doc 9674).

1.3.2 Vertical reference system

For the purpose of air navigation, the aerodrome operator shall use the Mean Sea level (MSL) datum, as the vertical reference system.

GM1 1.3.2 Vertical reference system

MEAN SEA LEVEL

(a) The geoid globally most closely approximates mean sea level (MSL). It is defined as the equipotential surface in the gravity field of the Earth which coincides with the undisturbed MSL extended continuously through the continents.

(b) Gravity-related heights (elevations) are also referred to as orthometric heights while distances of points above the ellipsoid are referred to as ellipsoidal heights.

1.3.3 Temporal reference system

For the purpose of air navigation, the aerodrome operator The Gregorian calendar and Coordinated Universal Time (UTC) as the temporal reference system.

1.4 Certification of aerodromes

1.4.1.1 Certification — General

(a) The authority certifies aerodromes in accordance with the specifications contained in AUA-AGA.

(b) Prior to commencing the operation of an aerodrome intended for international operations, the aerodrome operator shall obtain the Aerodrome Certification issued by the Authority.

Note.— Specific procedures on the stages of certifying an aerodrome are given in the PANS-Aerodromes (Doc 9981). Further guidance on aerodrome certification can be found in the Manual on Certification of Aerodromes (Doc 9774).

1.4.1.2 Certification — Application

(a) The application for a certificate or renewal of the certificate shall be made in a form and manner established by the Authority.

(b) The applicant for a certificate shall provide the Authority with the following:

(1) its official name and business name, address, and mailing address;

(2) information and data regarding:

(i) the location of the aerodrome;

(ii) the type of operations at the aerodrome and the associated airspace; and

(iii) the design and facilities of the aerodrome, in accordance with the applicable certification specifications established by the authority;

(3) any proposed deviations from the identified applicable specifications established in national regulations specifically AUA-AGA;

(4) documentation demonstrating how it will comply with the applicable requirements.

(5) evidence of adequacy of resources to operate the aerodrome in accordance with the applicable requirements;

(6) the name of and relevant information about the accountable manager and the other nominated persons required by 1.4.10; and

(8) a copy of the aerodrome manual required 1.4.2.

AMC1 1.4.1.2(a) Certification — Application

APPLICATION

The application should be made in writing and be signed by the applicant. If a standardised form is established by the Authority, application should be made using that form.

AMC1 1.4.1.2(b)(5) Certification — Application

ADEQUACY OF RESOURCES

The applicant should provide all necessary information needed in order to demonstrate to the Authority that its proposed organisation and management are suitable, and properly matched to the scale and scope of the operation.

The aerodrome operator should have the ability to discharge its responsibilities with regard to safety. The accountable manager should have access, as well as the authorisation, to the necessary resources to ensure that operations are carried out in accordance with the applicable requirements. The resources include, but are not limited to, personnel, tools and equipment, as well as financial resources.

GM1 1.4.1.2(b)(5) Certification — Application

ADEQUACY OF RESOURCES

(a) General

In demonstrating to the Authority, the suitability of its organisation and management, the applicant should, amongst others, take into account in its analysis the following:

(1) the size and complexity of the aerodrome;

(2) the type of traffic;

(3) the type of operations;

(4) the level and the density of the traffic;

(5) the operating hours of the aerodrome;

(6) the amount of full-time equivalents (FTEs) necessary for each activity;

(7) human factors principles;

(8) labour legislation; and

(9) the degree of subcontracting.

(b) Adequacy of financial resources

The financial resources required are linked to the overall objective for the safe operation and maintenance of the aerodrome, including the aerodrome operator's capability to implement the corrective actions needed, in a timely manner. Information that may be provided to the Authority includes audited accounts of the previous financial year, business plans etc.

1.4.4 Certification - Aerodrome manual

(a) The aerodrome operator shall establish and maintain an aerodrome manual. The aerodrome manual shall include all pertinent information on the aerodrome site, facilities, services, equipment, operating procedures, organization and management including a safety management system. The aerodrome manual shall be submitted by the applicant for approval/acceptance prior to granting the aerodrome certificate.

(b) The content of the aerodrome manual shall reflect the requirements set out in national regulation, as applicable, and shall not contravene the terms of the certificate. The aerodrome manual shall contain or refer to all necessary information for the safe use, operation and maintenance of the aerodrome, its equipment, as well as its obstacle limitation and protection surfaces and other areas associated with the aerodrome.

(c) The aerodrome manual may be issued in separate parts.

(d) The aerodrome operator shall ensure that all aerodrome personnel and all other relevant organisation's personnel have easy access to the portions of the aerodrome manual that are relevant to their duties and responsibilities.

(e) The aerodrome operator shall supply the Authority with the intended amendments and revisions of the aerodrome manual, in advance of the effective date and ensure that they do not become effective before obtaining the Authority's approval.

(f) Notwithstanding point (e), when amendments or revisions are required in the interest of safety, they may be published and applied immediately, provided that the approval required has been applied for with the Authority and the Authority has been informed of the immediate application.

(g) The aerodrome operator shall:

(1) review the content of the aerodrome manual, ensure that it is kept up to date and amended whenever necessary;

(2) incorporate all amendments and revisions required by the Authority; and

(3) make all aerodrome personnel and other relevant organisations aware of the changes that are relevant to their duties and responsibilities.

(h) The aerodrome operator shall ensure that any information taken from other approved documents, and any amendment thereof, is correctly reflected in the aerodrome manual. This does not prevent the aerodrome operator from publishing more conservative data and procedures in the aerodrome manual.

(i) The aerodrome operator shall ensure that:

(1) the aerodrome manual is written in English; and

(2) all personnel are able to read and understand the language in which those parts of the aerodrome manual and other operational documents pertaining to their duties and responsibilities are written.

(j) The aerodrome operator shall ensure that the aerodrome manual:

(1) is signed by the accountable manager of the aerodrome;

(2) is printed or is in electronic format and is easy to revise;

(3) has a system for version control management which is applied and made visible in the aerodrome manual; and

(4) observes human factors principles and is organised in a manner that facilitates its preparation, use and review.

(k) The aerodrome operator shall keep at least one complete and current copy of the aerodrome manual at the aerodrome and make it available for inspection by the Authority.

(l) The content of the aerodrome manual shall be as follows:

(1) General;

(2) Aerodrome management system, qualification and training requirements;

(3) Particulars of the aerodrome site;

(4) Particulars of the aerodrome required to be reported to the organisation responsible for aeronautical information in Aruba; and

(5) Particulars of the operating procedures of the aerodrome, its equipment and safety measures.

AMC1 1.4.2 Certification - Aerodrome manual

AERODROME MANUAL

The aerodrome manual and its amendments may be submitted to the Authority in electronic format if this is acceptable to the Authority. If the aerodrome manual is submitted in electronic format, the format should be such that allows the Authority to review, store, and reproduce it.

AMC2 1.4.2 Certification - Aerodrome manual

GENERAL

(a) The aerodrome manual may vary in detail according to the complexity of the operation, and the type of the aerodrome.

(b) The aerodrome manual or parts of it may be presented in any form, including electronic form.

In all cases, the accessibility, usability, and reliability should be assured.

(c) The aerodrome manual should be such that:

(1) all parts of the manual are consistent and compatible in form and content;

(2) the manual can be readily amended; and

(3) the content and amendment status of the manual is controlled and clearly indicated.

(d) The aerodrome manual should include a description of its amendment and revision process specifying:

(1) the person(s) who may approve amendments or revisions;

(2) the conditions for temporary revisions and/or immediate amendments, or revision required in the interest of safety; and

(3) the methods by which all personnel and organisations are advised of changes to the aerodrome manual.

(e) The aerodrome manual may contain parts of, or refer to other controlled documents, such as aerodrome equipment manual, which are available at the aerodrome for use by the personnel.

AMC3 1.4.2 Certification - Aerodrome manual

AERODROME MANUAL

(a) The aerodrome manual should have the following structure, and include, at least, the following information; if an item is not applicable, the indication 'Not applicable' or 'Intentionally blank' should be inserted, along with the relevant reason:

A. PART A — GENERAL

0. Administration and control of the aerodrome manual including the following:

0.1. Introduction:

0.1.1 a statement signed by the accountable manager that the aerodrome manual complies with all applicable requirements, and with the terms of the certificate;

0.1.2 a statement signed by the accountable manager that the aerodrome manual contains operational instructions that are to be complied with by the relevant personnel;

0.1.3 a list and brief description of the various parts, their contents, applicability, and use;

0.1.4 explanations, abbreviations, and definitions of terms needed for the use of the manual;

0.2 System of amendment and revision:

0.2.1 details of the person(s) responsible for the issuance and insertion of amendments and revisions;

0.2.2 a record of amendments and revisions with insertion dates, and effective dates;

0.2.3 a statement that handwritten amendments and revisions are not permitted, except in situations requiring immediate amendment, or revision in the interest of safety;

0.2.4 a description of the system for the annotation of pages, or paragraphs and their effective dates;

0.2.5 a list of effective pages or paragraphs;

0.2.6 annotation of changes (in the text and, as far as practicable, on charts and diagrams);

0.2.7 temporary revisions; and

0.2.8 description of the distribution system and a distribution list for the aerodrome manual, its amendments, and revisions.

1. General information

General information including the following:

1.1 purpose and scope of the aerodrome manual;

1.2 legal requirements for an aerodrome certificate and the aerodrome manual as prescribed in AUA-AGA;

1.3 conditions for use of the aerodrome by its users;

1.4 the obligations of the aerodrome operator; rights of the Authority and guidance to staff on how to facilitate audits/inspections by Authority personnel.

B. PART B — AERODROME MANAGEMENT SYSTEM, QUALIFICATION AND TRAINING REQUIREMENTS

2. A description of the management system, including the following:

2.1 Aerodrome organisation and responsibilities including the following: a description of the organisational structure, including the general organogram and other departments' organograms. The organogram should depict the relationship between the departments. Subordination and reporting lines of all levels of organisational structure (Departments, Sections, etc.) related to safety should be shown.

Names, authorities, responsibilities, and duties of management and nominated persons; responsibilities and duties of other operational, maintenance personnel, as well of the aerodrome safety committees and the Local Runway Safety Team and their functioning, should also be included.

2.2. A description of the safety management system, including:

2.2.1 scope of the safety management system;

2.2.2 safety policy and objectives;

2.2.3 safety responsibilities of key safety personnel;

2.2.4 documentation control procedures;

2.2.5 safety risk management process, including hazard identification and risk assessment schemes;

2.2.6 monitoring of implementation and effectiveness of safety actions, and risk mitigation measures;

2.2.7 safety performance monitoring;

2.2.8 safety reporting (including hazard reporting) and investigation;

2.2.9 emergency response planning;

2.2.10 management of change (including organisational changes with regard to safety responsibilities);

2.2.11 safety promotion; and

2.2.12 safety management system outputs.

2.3 A description of the compliance monitoring and related procedures.

2.4 A description of the quality management system for aeronautical data and aeronautical information provision activities and related procedures, including those for meeting the relevant safety, and security management objectives.

2.5 Procedures for reporting to the Authority including handling, notifying and reporting accidents, serious incidents, and occurrences. This section should include, at least, the following:

(a) definition of accident, serious incident and occurrence and of the relevant responsibilities of all persons involved;

(b) illustrations of forms to be used (or copies of the forms themselves), instructions on how they are to be completed, the addresses to which they should be sent and the time allowed for this to be done;

(c) procedures and arrangements for the preservation of evidence, including recordings, following a reportable event;

2.6 Procedures related to the use of alcohol, psychoactive substances and medicines.

2.7 Procedures for:

2.7.1 complying with safety directives;

2.7.2 reaction to safety problems; and

2.7.3 the implementation of safety recommendations issued by Safety Investigation Authority.

2.8 A description of the method and procedures for recording aircraft movements, including movement and aircraft type, dates, and number of passengers.

3. Required aerodrome personnel qualifications. Moreover, procedures related to:

3.1 the training programme, including the following:

3.1.1 responsibilities, frequencies, syllabi, duration of each type of training, method for delivery of training and competency assessment, minimum performance to be achieved by the trainees, and the identified training standards for all personnel involved in the operation, rescue and firefighting, maintenance and management of the aerodrome, and those persons operating unescorted on the movement area and other operational areas of the aerodrome.

3.1.2 procedures:

3.1.2.1 for training and competency assessment of the trainees;

3.1.2.2 to be applied in the event that personnel do not achieve the required standards.

3.1.3 description of documentation to be stored and storage periods.

3.2 the proficiency check programme, including responsibilities and frequencies of proficiency checks;

3.2.1 checking methods and procedures.

3.2.2 procedures to be applied in the event that personnel do not achieve the required standards.

3.2.3 the validation process to measure the effectiveness of the programme.

3.2.4 description of documentation to be stored and storage periods.

C. PART C — PARTICULARS OF THE AERODROME SITE

4. A description of the aerodrome site including in particular, the following information:

4.1 a plan showing the distance of the aerodrome from the nearest city, town, or other populous area;

4.2 detailed maps and charts of the aerodrome showing the aerodrome's location (longitude and latitude) and boundaries, major facilities, aerodrome reference point, layout of runways, taxiways and aprons, aerodrome visual and non-visual aids, and wind direction indicators;

4.3 a plan showing the location of any aerodrome facilities and equipment outside the boundaries of the aerodrome;

4.4 description of the physical characteristics of the aerodrome, elevations, visual and non-visual aids, as well as the information regarding the aerodrome reference temperature, strength of pavements, rescue and firefighting level of protection, ground aids and main obstacles;

4.5description of any cases of exemptions or derogations, equivalent level of safety, special conditions, and operating limitations; and

4.6 description of the types of operations that the aerodrome is approved to conduct.

D. PART D — PARTICULARS OF THE AERODROME REQUIRED TO BE REPORTED TO THE ORGANISATION RESPONSIBLE FOR AERONAUTICAL INFORMATION IN ARUBA

5. The aeronautical information services available and the procedures for the promulgation of general information, including the following:

   5.1 the name of the aerodrome;

   5.2 the location of the aerodrome;

   5.3 the geographical coordinates of the aerodrome reference point determined in terms of the World Geodetic System — 1984 (WGS-84) reference datum;

   5.4 the aerodrome elevation and geoid undulation;

   5.5 the elevation of each threshold and geoid undulation, the elevation of the runway end, and any significant high and low points along the runway, and the highest elevation of the touchdown zone of a precision approach runway;

   5.6 the aerodrome reference temperature;

   5.7 details of the aerodrome beacon; and

   5.8 the name of the aerodrome operator and contact details (including telephone numbers) of the aerodrome operator at which may be contacted at all times.

6. Aerodrome dimensions and related information, inducing the following:

   6.1 runway — true bearing, designation number, length, width, displaced threshold location, slope, surface type, type of runway and, for a precision approach runway, the existence of an obstacle free zone;

   6.2 length, width and surface type of strip, runway end safety areas, stopways; length, width and surface type of taxiways; apron surface type and aircraft stands; clearway length and ground profile;

   6.3 visual aids for approach procedures, approach lighting type and visual approach slope indicator system; marking and lighting of runways, taxiways, and aprons; other visual guidance and control aids on taxiways and aprons, location and type of visual docking guidance system; availability of standby power for lighting;

6.4 the location and radio frequency of VOR aerodrome checkpoints;

6.5 the location and designation of standard taxi routes;

6.6 the geographical coordinates of each threshold, appropriate taxiway centre line points, and aircraft stands;

6.7 the geographical coordinates, and the top elevation of significant obstacles in the approach and take-off areas, in the circling area and in the surroundings of the aerodrome (in the form of charts);

6.8 pavement surface type and bearing strength using the required method;;

6.9 pre-flight altimeter check locations established and their elevation;

6.10 declared distances;

6.11 contact details (telephone/telex/fax numbers and e-mail address) of the aerodrome coordinator for the removal of disabled aircraft, and information on the capability to remove disabled aircraft, expressed in terms of the largest aircraft type;

6.12 rescue and firefighting level of protection; types and amounts of extinguishing agents normally available at the aerodrome; and

6.13 exemptions or derogations from the applicable requirements, cases of equivalent level of safety, special conditions, and limitations.

E. PART E — PARTICULARS OF OPERATING PROCEDURES OF THE AERODROME, ITS EQUIPMENT, AND SAFETY MEASURES

7. Aerodrome reporting, including:

7.1 arrangements and procedures for reporting changes to the aerodrome information set out in the AIP and requesting the issue of NOTAM, including reporting changes to the Authority and recording of the reporting of changes;

7.2 procedures and frequencies for aeronautical data surveying, including areas to be surveyed.

8. Procedures for accessing the aerodrome movement area, including:

8.1 coordination with the security agencies;

8.2 prevention of unauthorised entry into the movement area;

9. Procedures for the inspection, assessment and reporting of the condition of the aerodrome movement area and other operational areas and facilities, (including runway surface friction characteristics assessments and water-depth measurements), including:

   9.1 arrangements and means of communicating with the air traffic services unit during inspections;

   9.2 inspection checklists, logbook, and record-keeping; and

   9.3 inspection intervals and times; reporting results and follow-up actions.

10. Procedures for the inspection, and routine and emergency maintenance of visual and non-visual aids, as appropriate, and the aerodrome electrical systems, including:

   10.1 inspection checklists, logbook, and record keeping; and

   10.2 inspection intervals and times; reporting results and follow-up actions.

11. Operating, maintenance and repair instructions, servicing information, troubleshooting and inspection procedures of aerodrome equipment.

12. Procedures for:

   12.1 maintenance of the movement area, including paved areas; unpaved runways and taxiways; runways and runway strips and aerodrome drainage;

   12.2 overload operations.

13. Procedures for aerodrome works, including:

   13.1 coordinating, planning, and carrying out construction and maintenance work; and

   13.2 arrangements and means of communicating with air traffic services unit during the progress of such work.

14. Procedures for apron management, including:

   14.1 transfer of the aircraft between air traffic services unit, and the apron management unit;

   14.2 allocation of aircraft parking positions;

14.3 engine start and aircraft push-back; and

14.4 marshalling and 'follow-me' service.

15. Procedures for apron safety management, including:

15.1 protection from jet blasts and downwash;

15.2 enforcement of safety precautions during aircraft refuelling operations;

15.3 FOD prevention, including apron cleaning/sweeping;

15.4 monitoring compliance of personnel on the apron with safety procedures; and

15.5 escorting, controlling and protecting passengers on the apron, from vehicular traffic and operating aircraft, use of predetermined routes, and avoiding interference with stationary aircraft ground servicing activities.

16. Procedures for the control and limitation of the number of vehicles operating on the movement area, issuance of authorisations and temporary permits of vehicles operating on or in the vicinity of the movement area, including driver's obligations, traffic rules, right of way, speed limits, and procedures for issuing driving authorisations and permits, and enforcement procedures. Procedures for escorting vehicles occasionally used in areas where radio and transponder or equivalent is required, as well as for vehicles temporarily permitted to operate on the movement area. Procedures and responsibilities for establishing and monitoring the implementation of the maintenance programme for vehicles operating on the movement area and other operating areas.

17. Procedures for wildlife hazard management, including assessing wildlife hazards and arrangements for implementation of the wildlife control programme, and promulgation of the organisation responsible for aeronautical information in Aruba; wildlife strike form.

18. Procedures for:

18.1 obstacle control and monitoring within and outside of the aerodrome boundaries, and notification to the Authority, of the nature and location of obstacles, and any subsequent addition, or removal of obstacles for action as necessary, including amendment of the AIS publications; and

18.2 monitoring and mitigating hazards related to human activities and land use, on the aerodrome and its surroundings. Relevant inspection checklists, logbook, and record keeping; inspection intervals and times; reporting results and follow-up actions.

19. Aerodrome emergency plan including:

    19.1 dealing with emergencies at the aerodrome or in its surroundings;

    19.2 tests for aerodrome facilities and equipment to be used in emergencies, including their frequency; and

    19.3 exercises to test emergency plans, including their frequency.

20. Rescue and firefighting, including description of facilities, equipment, personnel and procedures for meeting the firefighting requirements.

21. Removal plan of disabled aircraft, including relevant arrangements, equipment, and procedures for its implementation.

22. Procedures for ensuring the safe handling and storage of fuel and dangerous goods in the aerodrome, including:

    22.1 equipment, storage areas, delivery, dispensing, handling, and safety measures;

    22.2 quality and correct specification of aviation fuel; audit and inspection intervals, checklists, sampling and record keeping.

23. Reduced/low visibility operations: description of operational procedures, including coordination with air traffic services unit and apron management unit, standard taxiing routes, control of activities, and measurement and reporting of runway visual range.

24. Procedures for operations in adverse weather conditions.

25. Procedures for night operations.

26. Procedures for the protection of radar and other navigational aids, control of activities, and ground maintenance in the vicinity of these installations.

27. Procedures for the operation of aircraft with higher code letter at the aerodrome, including taxiing routes.

28. Procedures and measures for the prevention of fire at the aerodrome.

29. Communication procedures, including: frequencies; language and phraseology to be used when communicating with the air traffic services (English as established by ICAO in Annex 1); vehicle call signs; communication signals to be used in case

of radio communication failure; communication via the air traffic services provider; and dissemination of significant information.

30. Aircraft towing procedures, including: designated routes to be used; lights to be displayed by aircraft; communication procedures; guidance to be provided; measures for ensuring safety of towing operation in adverse weather conditions, including visibility and weather phenomena in which towing is limited or not permitted.

31. Procedures for the handover of activities between aerodrome personnel, including description of the system for the provision of operational information to other organisations operating at the aerodrome.

(b) All procedures contained in the aerodrome manual should include and clearly define the roles, responsibilities, and contact details of responsible aerodrome personnel, other persons or organisations, including the contracted ones, including the Authority and other state agencies involved, as appropriate, and take into account the need for establishing direct communication during non-working hours.

GM2 1.4.2 Certification - Aerodrome manual

CONTENTS

The numbering system described in AMC3 1.4.2 should be maintained even if there are sections that, because of the nature of the aerodrome or the types of operation, are not applicable.

GM1 1.4.2(j) Certification - Aerodrome manual

HUMAN FACTORS PRINCIPLES

Guidance material on the application of human factors principles may be found in the ICAO Human Factors Training Manual (Doc 9683).

1.4.3 Aerodrome operator responsibilities

(a) The aerodrome operator is responsible for the safe operation and maintenance of the aerodrome in accordance with:

(1) National regulations among which “Landsbesluit luchtvaartterreinen 2023” and “Regeling Veilig gebruik Luchtvaartterreinen”;

(2) the terms of its certificate;

(3) the content of the aerodrome manual; and

(4) any other manuals for the aerodrome equipment available at the aerodrome, as applicable.

(b) The aerodrome operator shall ensure directly, or coordinate through arrangements as required with the accountable entities providing the following services:

(1) the provision of air navigation services appropriate to the level of traffic and the operating conditions at the aerodrome; and

(2) the design and maintenance of the flight procedures, in accordance with the applicable requirements.

(b) If an unsafe condition develops at the aerodrome, the aerodrome operator shall, without undue delay, take all necessary measures to ensure that those parts of the aerodrome found to endanger safety are not used by aircraft.

(e) The aerodrome operator, in order to ensure the safe operation of aircraft at the aerodrome, shall provide and maintain, directly or through arrangements with third parties, visual and non-visual aids, meteorological equipment and any other equipment, commensurate with the type of operations conducted at the aerodrome.

(f) For the purpose of determining compliance with the relevant requirements in national regulations, the aerodrome operator shall grant access to any person authorised by the Authority to:

(1) any facility, document, records, data, procedures or any other material relevant to its activity subject to certification or declaration, whether it is contracted or not; and

(2) perform or witness any action, inspection, test, assessment or exercise the Authority finds is necessary.

1.4.4 Findings and corrective actions

After receipt of a notification of findings by the authority, the aerodrome operator shall:

(a) identify the root cause of the non-compliance;

(b) define a corrective action plan; and

(c) demonstrate the corrective action implementation to the satisfaction of the Authority within the period established by the authority.

AMC1 1.4.4 Findings

GENERAL

The corrective action plan defined by the aerodrome operator should address the effects of the non-compliance, as well as its root cause.

GM1 1.4.4 Findings

GENERAL

(a) Preventive action is the action to eliminate the cause of a potential non-compliance or other undesirable potential situation.

(b) Corrective action is the action to eliminate or mitigate the root cause(s), and prevent recurrence of an existing detected non-compliance, or other undesirable condition or situation. Proper determination of the root cause is crucial for defining effective corrective actions to prevent recurrence.

(c) Correction is the action to eliminate a detected non-compliance.

GM2 1.4.4 Findings

(a) A level 1 finding shall be issued by the Authority when any significant non-compliance which lowers safety or seriously endangers safety is detected with regards to:

- the certification requirements of the aerodrome;
- the applicable national law requirements;
- the aerodrome operator’s procedures and manuals;
- there is evidence of malpractice or fraudulent use of a certificate;
- the lack of an accountable manager.

(b) A level 2 finding shall be issued by the Authority when any non-compliance which could lower or possibly hazard safety is detected with regards to:

- the certification requirements of the aerodrome;
- the applicable requirements of national law;
- the aerodrome operator’s procedures and manuals.

(c) When a finding is detected, during oversight or by any other means, the Authority shall communicate the finding to the aerodrome operator in writing and request corrective action to address the non-compliance(s) identified.

(1) In the case of level 1 findings, the Authority shall take appropriate action, and may if appropriate, limit, suspend or revoke in whole or in part the certificate. Corrective actions shall be taken immediately or in a period not exceeding 15 days, by the aerodrome operator.

Note.— See article 6 and 7 "Landsbesluit Luchtvaartterreinen 2023".

(2) In the case of level 2 findings, the Authority will:

(a) grant the aerodrome operator a corrective action implementation period included in an action plan appropriate to the nature of the finding; and

(b) assess the corrective action and implementation plan proposed by the aerodrome operator and, if the assessment concludes that they are sufficient to address the non-compliance(s), accept these.

(3) Where the aerodrome operator fails to submit an acceptable corrective action plan, or to perform the corrective action within the time period established or extended by the Authority, the finding shall be raised to a level 1 finding, and the Authority shall take actions as laid down in point (c)(1).

(d) For those cases not requiring level 1 or level 2 findings, the Authority may issue observations. An observation is any item where it has been identified, by objective evidence, to contain potential problems that could lead to a non-compliance or safety issue.

1.4.5 Immediate reaction to a safety problem — Compliance with safety directives

The aerodrome operator shall implement any safety measures, including safety directives, taken by the Authority.

1.4.6 Occurrence reporting

(a) The Aerodrome operator shall inform the Authority and any other organisation as required by the national regulation immediately of any accidents and incidents related to aerodromes in the manner as established by the Authority.

(b) The aerodrome operator shall report to the Authority any accident, serious incident and occurrence related to aerodromes and ground services which may represent a significant risk to aviation safety.

(c) Reports as described in paragraph (b) shall be made in a form and manner established by the Authority and contain all pertinent information about the condition known to the aerodrome operator.

(d) Reports shall be made by the aerodrome operator within 72 hours of becoming aware of the occurrence to which the report relates, unless exceptional circumstances prevent this.

(e) Where relevant, the aerodrome operator shall produce a follow-up report to provide details of actions it intends to take to prevent similar occurrences in the future, as soon as those actions have been identified.

(d) Without prejudice to point (a) the operator shall report to the Authority and to the organisation responsible for the design of aerodrome equipment any malfunction, technical defect, exceeding of technical limitations, occurrence or other irregular circumstance that has or may have endangered safety and that has not resulted in an accident or serious incident.

AMC1 1.4.6(a) Occurrence reporting

The Aerodrome operator should immediately inform to the Authority through on-call number provided of any accidents and incidents, in order for the Authority to determine which Authority personnel should be present in these instances.

AMC1 1.4.6(b) Occurrence reporting

General

(a) The obligation to immediately inform the Authority of accidents and incidents does not relieve the aerodrome operator of reporting (written) these occurrences, in which comprehensive details are reported to the authority.

(b) The aerodrome operator should establish procedures to be used for reporting to the Authority, as required, which include:

   (a) the description of the applicable requirements for the purpose of reporting;

   (b) the description of the reporting mechanism, including reporting forms, means, and deadlines;

(c) the personnel responsible for reporting; and

(d) the description of the mechanism and personnel responsibilities for identifying root causes, and the actions that may be needed to be taken to prevent similar occurrences from happening in the future, as appropriate.

AMC2 1.4.6(b) Occurrence reporting

(a) This section is structured in such a way that the pertinent occurrences are linked with categories of activities in regards to aerodromes and ground services during which they are normally observed, according to experience, in order to facilitate the reporting of those occurrences.

However, this presentation must not be understood as meaning that occurrences must not be reported in case they take place outside the category of activities to which they are linked in the list.

(b) Occurrences that should be reported are among others:

1. SAFETY MANAGEMENT OF AN AERODROME

1.1 Aircraft- and obstacle-related occurrences

(1) A collision or near collision on the ground, between an aircraft and another aircraft, terrain or obstacle [1]

(2) Wildlife strike including bird strike.

(3) Taxiway or runway excursion.

(4) Actual or potential taxiway or runway incursion.

(5) Aircraft or vehicle failure to follow clearance, instruction or restriction while operating on the movement area of an aerodrome (for example: wrong runway, taxiway or restricted part of an aerodrome).

(6) Foreign object on the aerodrome movement area which has or could have endangered the aircraft, its occupants or any other person.

(7) Presence of obstacles on the aerodrome or in the vicinity of the aerodrome which are not published in the AIP (Aeronautical Information Publication)

[1] Obstacle includes vehicle.

or by NOTAM (Notice to Airmen) and/or that are not marked or lighted properly.

(8) Push-back, power-back or taxi interference by vehicle, equipment or person.

(9) Passengers or unauthorised person left unsupervised on apron.

(10) Jet blast, rotor down wash or propeller blast effect.

(11) Declaration of an emergency ('Mayday' or 'PAN' call).

1.2 Degradation or total loss of services or functions

(1) Loss or failure of communication between:

(a) aerodrome, vehicle or other ground personnel and air traffic services unit or apron management service unit;

(b) apron management service unit and aircraft, vehicle or air traffic services unit.

(2) Significant failure, malfunction or defect of aerodrome equipment or system which has or could have endangered the aircraft or its occupants.

(3) Significant deficiencies in aerodrome lighting, marking or signs.

(4) Failure of the aerodrome emergency alerting system.

(5) Rescue and firefighting services not available according to applicable requirements.

1.3 Other occurrences

(1) Fire, smoke, explosions in aerodrome facilities, vicinities and equipment which has or could have endangered the aircraft, its occupants or any other person.

(2) Aerodrome security related occurrences (for example: unlawful entry, sabotage, bomb threat).

(3) Absence of reporting of a significant change in aerodrome operating conditions which has or could have endangered the aircraft, its occupants or any other person.

(4) Spillage during fuelling operations.

(5) Loading of contaminated or incorrect type of fuel or other essential fluids (including oxygen, nitrogen, oil and potable water).

(6) Failure to handle poor runway surface conditions.

(7) Any occurrence where the human performance has directly contributed to or could have contributed to an accident or a serious incident.

2. GROUND HANDLING OF AN AIRCRAFT

2.1 Aircraft- and aerodrome-related occurrences

(1) A collision or near collision, on the ground between an aircraft and another aircraft, terrain or obstacle.[2]

(2) Runway or taxiway incursion.

(3) Runway or taxiway excursion.

(4) Significant contamination of aircraft structure, systems and equipment arising from the carriage of baggage, mail or cargo.

(5) Push-back, power-back or taxi interference by vehicle, equipment or person.

(6) Foreign object on the aerodrome movement area which has or could have endangered the aircraft, its occupants or any other person.

(7) Passengers or unauthorised person left unsupervised on apron.

(8) Fire, smoke, explosions in aerodrome facilities, vicinities and equipment which has or could have endangered the aircraft, its occupants or any other person.

(9) Aerodrome security-related occurrences (for example: unlawful entry, sabotage, bomb threat).

2.2 Degradation or total loss of services or functions

(1) Loss or failure of communication with aircraft, vehicle, air traffic services unit or apron management service unit.

(2) Significant failure, malfunction or defect of aerodrome equipment or system which has or could have endangered the aircraft or its occupants.

[2] Obstacle includes vehicle.

(3) Significant deficiencies in aerodrome lighting, marking, signs and pavement.

2.3 Ground handling specific occurrences

(1) Incorrect handling or loading of passengers, baggage, mail or cargo, likely to have a significant effect on aircraft mass and/or balance (including significant errors in loadsheet calculations).

(2) Boarding equipment removed leading to endangerment of aircraft occupants.

(3) Incorrect stowage or securing of baggage, mail or cargo likely in any way to endanger the aircraft, its equipment or occupants or to impede emergency evacuation.

(4) Transport, attempted transport or handling of dangerous goods which resulted or could have resulted in the safety of the operation being endangered or led to an unsafe condition (for example: dangerous goods incident or accident as defined in the ICAO Technical Instructions[3]).

(5) Non-compliance on baggage or passenger reconciliation.

(6) Non-compliance with required aircraft ground handling and servicing procedures, especially in refuelling or loading procedures, including incorrect positioning or removal of equipment.

(7) Spillage during fuelling operations.

(8) Loading of incorrect fuel quantities likely to have a significant effect on aircraft endurance, performance, balance or structural strength.

(9) Loading of contaminated or incorrect type of fuel or other essential fluids (including oxygen, nitrogen, oil and potable water).

(10) Failure, malfunction or defect of ground equipment used for ground handling, resulting into damage or potential damage to the aircraft (for example: tow bar or GPU (Ground Power Unit)).

(11) Damage to aircraft by ground handling equipment or vehicles including previously unreported damage.

[3] Technical Instructions For The Safe Transport of Dangerous Goods by Air (ICAO — Doc 9284).

(12) Any occurrence where the human performance has directly contributed to or could have contributed to an accident or a serious incident.

AMC1 1.4.6(c) Occurrence reporting

Reports to the Authority must be submitted through the Occurrence reporting link on the Authority's website:

http://dca.gov.aw/

If, reporting through the above stated means in not available, reports should be submitted through DCA Safety management email address:

safetymanagement@dca.gov.aw

1.4.7 Prevention of fire

The aerodrome operator shall establish procedures to prohibit:

(a) smoking within the movement area, other operational areas of the aerodrome, or areas of the aerodrome where fuel or other flammable material is stored;

(b) display of an open flame or undertaking of an activity that would create a fire hazard within:

(1) areas of the aerodrome where fuel or other flammable material is stored;

(2) the movement area or other operational areas of the aerodrome, unless authorised by the aerodrome operator.

1.4.8 Use of alcohol, psychoactive substances and medicines

(a) The aerodrome operator shall establish procedures on the level of consumption of alcohol, psychoactive substances and medicines by:

(1) personnel involved in the operation, rescue and firefighting, and maintenance of the aerodrome;

(2) unescorted persons operating on the movement area or other operational areas of the aerodrome.

(b) These procedures shall include the requirements that such persons shall:

(1) not consume alcohol during their duty period;

(2) not perform any duties under the influence:

(i) of alcohol, or any psychoactive substance; or

(ii) any medicine that may have an effect on his/her abilities in a manner contrary to safety.

GM1 1.4.8 Use of alcohol, psychoactive substances and medicines

(a) The procedures that the aerodrome operator should establish with respect to the level of consumption of alcohol, psychoactive substances and medicines are applicable to all persons referred to in paragraph (a) of 1.4.8. This includes the following:

(1) personnel involved in the operation, rescue and firefighting, and maintenance of the aerodrome, irrespectively of the relationship they have with the aerodrome operator (e.g. directly employed by the aerodrome operator or by organisations contracted by the aerodrome operator);

(2) unescorted persons operating on the movement area or other operational areas of the aerodrome. This category of persons includes:

(i) persons employed directly by the aerodrome operator, or by organisations contracted by the aerodrome operator, which are not involved in the operation, rescue and firefighting, and maintenance of the aerodrome (e.g. aerodrome security personnel);

(ii) persons employed by other organisations (e.g. ground handling companies).

(b) Notwithstanding the responsibilities of the organisations referred to in paragraph (a)(2)(ii), the aerodrome operator should ensure that these organisations establish appropriate procedures to comply with the provisions of 1.4.8 and the related requirements established by the aerodrome operator.

Note. —Further guidance on this issue may be found in the ICAO Manual on Prevention of Problematic Use of Substances in the Aviation Workplace (Doc 9654).

1.4.9 Management system

(a) The aerodrome operator shall implement and maintain a management system which a safety management system is part thereof.

(b) The management system shall include:

(1) clearly defined lines of responsibility and accountability throughout the aerodrome operator, including a direct accountability for safety on the part of senior management;

(2) a description of the overall philosophies and principles of the aerodrome operator with regard to safety, referred to as the safety policy, signed by the accountable manager;

(3) a formal process that ensures that hazards in operations are identified;

(4) a formal process that ensures analysis, assessment, control and mitigation of the safety risks associated with identified hazards in aerodrome operations;

(5) the means to verify the safety objectives and safety performance of the aerodrome operator's organisation in reference to the safety performance indicators and safety performance targets of the safety management system, and to validate the effectiveness of safety risk controls;

(6) a formal process to:

(i) identify changes within the aerodrome operator's organisation, management system, the aerodrome or its operation which may affect established processes, procedures and services;

(ii) describe the arrangements to ensure safety performance before implementing changes; and

(iii) eliminate or modify safety risk controls that are no longer needed or effective due to changes in the operational environment;

(7) a formal process to review the management system referred to in paragraph (a), identify the causes of substandard performance of the safety management system, determine the implications of such substandard performance in operations, and eliminate or mitigate such causes;

(8) a safety training programme that ensures that personnel involved in the operation, rescue and firefighting, maintenance and management of the

aerodrome are trained and competent to perform their safety management system duties;

(9) formal means for safety communication that ensures that personnel are fully aware of the safety management system, conveys safety critical information, and explains why particular safety actions are taken and why safety procedures are introduced or changed;

(10) coordination of the safety management system with the aerodrome emergency response plan; and coordination of the aerodrome emergency response plan with the emergency response plans of those organisations it must interface with during the provision of aerodrome services; and

(11) a formal process to monitor compliance of the organisation with the regulations and requirements established by the operator.

(c) The aerodrome operator shall document all management system key processes in a safety management manual.

(d) The aerodrome operator shall define its responsibilities with regards to external interfaces that fall under its operations.

AMC1 1.4.9 Management system

SAFETY MANAGEMENT SYSTEM

The safety management system of an aerodrome operator should encompass safety by establishing an organisational structure for the management of safety proportionate and appropriate to the size of the aerodrome operator, and the nature and type of operations. The organisational structure should include a Safety Review Board, and depending on its organisational complexity and structure, a Safety Services Office to assist the work of the safety manager, in accordance with paragraph (a) and (b) below:

(a) Safety Services Office

(1) The safety manager (see 1.4.10 and AMC1 1.4.10(c) should be responsible for the operation of the Safety Services Office which should be independent and neutral in terms of the processes and decisions made regarding the delivery of services by the line managers of operational units.

(2) The function of the Safety Services Office should be to:

(i) manage and oversee the hazard identification system;

(ii) monitor safety performance of operational units directly involved in aerodrome operations;

(iii) advise senior management on safety management matters; and

(iv) assist line managers with safety management matters.

(b) Safety Review Board

(1) The Safety Review Board should be a high level committee that considers matters of strategic safety in support of the accountable manager’s safety accountability.

(2) The Safety Review Board should be chaired by the accountable manager, and be composed of heads of functional areas.

(3) The Safety Review Board should monitor:

(i) safety performance against the safety policy and objectives;

(ii) that any safety action is taken in a timely manner; and

(iii) the effectiveness of the organisation’s safety management processes.

(4) The Safety Review Board should ensure that appropriate resources are allocated to achieve the established safety performance.

(5) The safety manager or any other relevant person may attend, as appropriate, Safety Review Board meetings. He/she may communicate to the accountable manager all information, as necessary, to allow decision making based on safety data.

In less complex aerodrome organisations/operations, the aerodrome operator should nominate a person who fulfils the role of safety manager, and who is responsible for coordinating the safety management system.

AMC1 1.4.9(b)(2) Management system

SAFETY POLICY

(a) The safety policy should:

(1) be endorsed by the accountable manager;

(2) clearly identify safety as the highest organisational priority over commercial, operational, environmental, or social pressures;

(3) reflect organisational commitments regarding safety and its proactive and systematic management;

(4) be communicated, with visible endorsement, throughout the organisation;

(5) include safety reporting principles; and

(6) be periodically reviewed to ensure it remains relevant and appropriate to the organisation.

(b) The safety policy should:

(1) include a commitment:

(i) to improve towards the highest safety standards;

(ii) to comply with all applicable legal requirements, meet all applicable standards, and consider best practices;

(iii) to provide appropriate resources;

(iv) to enforce safety as one primary responsibility of all managers and staff;

(2) include the safety reporting procedures;

(3) with reference to a just culture, clearly indicate which types of operational behaviours are unacceptable, and include the conditions under which disciplinary action would not apply; and

(4) be periodically reviewed to ensure it remains relevant and appropriate.

(c) Senior management should:

(1) continually promote the safety policy to all personnel, and demonstrate their commitment to it;

(2) provide necessary human and financial resources for its implementation; and

(3) establish safety objectives and performance standards.

AMC1 1.4.9(b)(3) Management system

HAZARD IDENTIFICATION PROCESS

(a) Hazard identification should be based on a combination of reactive, proactive, and predictive methods of safety data collection. Reactive, proactive, and predictive schemes for hazard identification should be the formal means of collecting, recording, analysing, acting on, and generating feedback about hazards and the associated risks that affect safety.

(b) All reporting systems, including confidential reporting schemes, should include an effective feedback process.

AMC1 1.4.9(b)(4) Management system

SAFETY RISK ASSESSMENT AND MITIGATION

(a) A formal safety (risk) assessment and mitigation process should be developed and maintained that ensures analysis (in terms of probability and severity of occurrence), assessment (in terms of tolerability), and control (in terms of mitigation) of risks.

(b) The levels of management who have the authority to make decisions regarding the tolerability of safety risks, in accordance with (a) above, should be specified in the aerodrome manual.

AMC1 1.4.9(b)(5) Management system

SAFETY PERFORMANCE MONITORING AND MEASUREMENT

(a) Safety performance monitoring and measurement should be the process by which the safety performance of the aerodrome operator is verified in comparison to the safety policy and objectives, identified safety risks and the mitigation measures.

(b) This process should include the setting of safety performance indicators and safety performance targets and measuring the aerodrome operator’s safety performance against them. The safety performance indicators and safety performance targets of the aerodrome operator shall be made acceptable to the Authority.

AMC1 1.4.9(b)(6) Management system

THE MANAGEMENT OF CHANGE

The aerodrome operator should manage safety risks related to a change. The management of change should be a documented process to identify external and internal change that may have an adverse effect on safety.

It should make use of the aerodrome operator’s existing hazard identification, safety (risk) assessment, and mitigation processes.

AMC1 1.4.9(b)(8) Management system

SAFETY MANAGEMENT SYSTEM TRAINING

(a) The aerodrome operator should establish a safety management system training programme for all aerodrome operations, rescue and firefighting, and maintenance personnel, including all management personnel of the aerodrome (e.g. supervisors, managers, senior managers, and the accountable manager), regardless of their level in the aerodrome operator's organisation.

(b) The amount and level of detail of safety training should be proportionate and appropriate to the individual's responsibility and involvement in the safety management system.

(c) The safety management system training programme should be developed in accordance with AMC 1.4.11(a)(b) and be incorporated in the training programme foreseen therein.

GM1 1.4.9(b)(8) Management system

STAFF SAFETY MANAGEMENT SYSTEM TRAINING REQUIREMENTS

(a) Operations, rescue and firefighting, and maintenance personnel

(1) Safety training should address safety responsibilities, including adherence to all operating and safety procedures, and recognising and reporting hazards;

(2) The training objectives should include the organisation's safety policy and safety management system fundamentals, and overview;

(3) The contents should include:

(i) definition of hazards;

(ii) consequences and risks;

(iii) the safety risk management process, including roles and responsibilities; and

(iv) safety reporting and the organisation's safety reporting system(s) .

(b) Managers and supervisors

(1) Safety training should address safety responsibilities, including promoting the SMS and engaging operational personnel in hazard reporting;

(2) In addition to the training objectives established for operational personnel, training objectives for managers and supervisors should include a detailed knowledge of the safety process, hazard identification and safety risk management and mitigation, and change management;

(3) In addition to the contents specified for operational personnel, the training contents for supervisors and managers should include safety data analysis.

(c) Senior managers

(1) Safety training should include safety responsibilities, including compliance with national regulations and the organisation's own safety requirements, allocation of resources, ensuring effective inter-departmental safety communication, and active promotion of the safety management system;

(2) In addition to the objectives of the two previous employee groups, safety training should include safety assurance and safety promotion, safety roles and responsibilities, and establishing acceptable levels of safety.

(d) Accountable manager

The training should provide the accountable manager with a general awareness of the organisation's safety management system, including safety management system roles and responsibilities, safety policy and objectives, safety risk management, and safety assurance.

AMC1 1.4.9(b)(9) Management system

SAFETY COMMUNICATION

(a) The aerodrome operator should communicate safety management system objectives and procedures to all operational personnel, and the safety management system and its application should be evident in all aspects of operations.

(b) Communication should flow between the safety manager and operational personnel throughout the organisation. The safety manager should communicate the performance of the organisation's safety management system through suitable means. The safety manager should, also, ensure that lessons learned from investigations, safety related events, or other safety related experiences, both internally and from other organisations, are distributed widely.

(c) Safety communication should aim to:

(1) ensure that all staff are fully aware of the safety management system;

(2) convey safety-critical information;

(3) explain why particular actions are taken; and

(4) explain why safety procedures are introduced or changed.

(d) Identify safety information that should be communicated to external stakeholders.

AMC1 1.4.9(c) Management system

AERODROME OPERATOR SAFETY MANAGEMENT MANUAL

(a) The safety management manual should be the key instrument for communicating the approach to safety for the aerodrome operator. The Safety Management Manual should document all aspects of safety management, including the safety policy, objectives, procedures, and individual safety responsibilities.

(b) The contents of the Safety Management Manual should include:

(1) scope of the safety management system;

(2) safety policy and objectives;

(3) safety responsibilities of key safety personnel;

(4) documentation control procedures;

(5) safety assessment process, including hazard identification and risk management schemes;

(6) monitoring of implementation and effectiveness of safety actions, and risk mitigation measures;

(7) safety performance monitoring;

(8) safety reporting (including hazard reporting) and investigation;

(9) coordination of emergency response planning;

(10) management of change (including organisational changes with regard to safety responsibilities);

(11) safety promotion; and

(12) safety management system outputs.

GM1 1.4.9(c) Management system

AERODROME OPERATOR MANAGEMENT SYSTEM DOCUMENTATION

It is not required to duplicate information in several manuals. The Safety Management Manual is considered to be a part of the aerodrome manual.

1.4.10 Personnel requirements

(a) The aerodrome operator shall appoint an accountable manager, who has the authority for ensuring that all activities can be financed and carried out in accordance with the applicable requirements. The accountable manager shall be responsible for establishing and maintaining an effective management system.

(b) The aerodrome operator shall nominate persons responsible for the management and supervision of the following areas to be accepted by the authority:

(1) operational services of the aerodrome;

(2) maintenance of the aerodrome.

(c) The aerodrome operator shall nominate a person or group of persons to be accepted by the authority, which is responsible for the development, maintenance, and day-to-day management of the safety management system.

The person(s) shall act independently of other managers within the organisation, shall have direct access to the accountable manager and to appropriate management for safety matters and shall be responsible to the accountable manager.

(d) The aerodrome operator shall have sufficient and qualified personnel for the planned tasks and activities to be performed in accordance with the applicable requirements.

(e) The aerodrome operator shall assign a sufficient number of personnel supervisors to defined duties and responsibilities, taking into account the structure of the organisation and the number of personnel employed.

(f) The aerodrome operator shall ensure that personnel involved in the operation, maintenance and management of the aerodrome are adequately trained in accordance with the training programme.

AMC1 1.4.10(a) Personnel requirements

ACCOUNTABLE MANAGER

(a) Accountable Manager — General

(1) The accountable manager should:

(i) ensure that all necessary resources are available to operate the aerodrome in accordance with the applicable requirements and the aerodrome manual;

(ii) ensure that if there is a reduction in the level of resources or abnormal circumstances which may affect safety, the required reduction in the level of operations at the aerodrome is implemented;

(iii) establish, implement, and promote the safety policy; and

(iv) ensure compliance with relevant applicable requirements, certification basis, and the organisation’s safety management system, as well as its quality management system with regard to aeronautical data and aeronautical information provision activities.

(2) The accountable manager should have:

(i) an appropriate level of authority within the aerodrome operator’s organisation to ensure that activities are financed and carried out to the standard required;

(ii) knowledge and understanding of the documents that prescribe relevant aerodrome safety standards;

(iii) understanding of the requirements for competence of aerodrome management personnel, so as to ensure that competent persons are in place;

(iv) knowledge and understanding of safety, quality, and security management systems related principles and practices, and how these are applied within the organisation;

(v) knowledge of the role of the accountable manager; and

(vi) knowledge and understanding of the key issues of risk management within the aerodrome.

(b) Accountable manager — Delegation of responsibilities

(1) The technical knowledge and understanding expected by an accountable manager is high level, with particular reference to his/her own role in ensuring that standards are maintained.

(2) During periods of absence, the day-to-day responsibilities of the accountable manager may be delegated; however, the accountability ultimately remains with the accountable manager.

(3) Depending on the size and the complexity of operations, the accountable manager may delegate his/her responsibilities in the area of training, by nominating a training manager whose responsibilities should be the establishment, coordination, implementation of training programmes, and relevant record keeping of personnel training, as well as of the proficiency check programmes. However, the accountability ultimately remains with the accountable manager.

GM1 1.4.10(a) Personnel requirements

ACCOUNTABLE MANAGER

Depending on the size, structure and complexity of the organisation, the accountable manager may be:

(a) the chief executive officer (CEO);

(b) the chief operating officer (COO);

(c) the chairperson of the board of directors;

(d) a partner; or

(e) the proprietor.

The appointment of an accountable manager who is given the required authorities and responsibilities, requires that the individual has the necessary attributes to fulfil the role. The accountable manager may have more than one function in the organisation. Nonetheless, the accountable manager's role is to instil safety as a core organisational value, and to ensure that the safety management system is properly implemented and maintained through the allocation of resources and tasks.

AMC1 1.4.10(b) Personnel requirements

NOMINATED PERSONS

(a) General

(1) A description of the functions of the nominated persons, including their names, as well as clearly defined responsibilities and authorisations, should be contained in the aerodrome manual. Nominated persons should have adequate resources available to perform their duties.

(2) The aerodrome operator should make arrangements to ensure adequate continuity of supervision in the absence of nominated persons.

(3) The nominated should be accepted by to the authority before they fulfil the function. A nominated person cannot be nominated by another aerodrome operator, unless agreed with the Authority.

(4) Persons nominated should be foreseen to work sufficient hours to fulfil the management functions associated with the scale and complexity of the operation.

(5) A nominated person may hold more than one of the nominated posts if such an arrangement is considered suitable and properly matched to the aerodrome operator's organisation, and the complexity of its operations.

(b) Competence of nominated persons

The manager of Operational Services and the Maintenance manager should have:

(1) adequate practical experience and expertise in aerodrome operations or maintenance (or similar area) respectively;

(2) comprehensive knowledge of the applicable requirements in the area of aerodromes;

(3) appropriate level of knowledge of safety and quality management; and

(4) knowledge of the aerodrome manual.

GM1 1.4.10(b)Personnel requirements

NOMINATED PERSONS

When an aerodrome operator submits the name of a nominee for the nominated persons, the Authority will assess his/her qualifications and may interview the nominee or call for additional evidence of his/her suitability, before accepting their nomination.

PURPOSE OF THE MEETING

The aim of the interview and exchange of information between the intended nominated persons and the Authority is, for the latter to acquire information on the intended work areas of the nominated persons and their respective competence level so as to verify their suitability for the posts.

The purpose of the information exchange is to create good contact and understanding between both parties, and to come to a mutual conclusion on, if necessary, possible solutions for training and personal development over time.

POSSIBLE AGENDA ITEMS:

(a) information from the Authority on organisation and mission of the Authority, the regulatory framework, and specifically Safety Management System requirements;

(b) information from the nominated person concerning the intended work area;

(c) enforcement methodology of the Authority;

(d) the role and responsibility of the accountable manager/operational services manager/maintenance manager/ safety manager or other nominated persons;

(e) expected competence requirement of the nominated person in relation to present personal status and experience presented in a CV or equivalent documentation.

(f) interview/discussion concerning depth of knowledge, and understanding of the applicable legislation;

(g) the role and responsibility of the Authority and of the nominated person;

(h) understanding of aviation in general and for the specific nominated post, how operators/activities at the aerodrome including Air Navigation Service Providers, and other aviation activities can impact aircraft safety; and

(i) distribution of delegated powers depending on the organisational situation.

AMC1 1.4.10(c) Personnel requirements

SAFETY MANAGER

(a) The nominated safety manager should be accepted by to the authority before he fulfils the function. A nominated person cannot be nominated by another aerodrome operator, unless agreed with the Authority.

(b) The safety manager should be the focal point and responsible for the development, administration, and maintenance of an effective safety management system, on behalf of the accountable manager.

(c) The role of the safety manager should be to:

(1) facilitate hazard identification, risk analysis, and management;

(2) monitor the implementation and functioning of the safety management system, including the necessary safety actions;

(3) manage the safety reporting system of the aerodrome;

(4) provide periodic reports on safety performance;

(5) ensure maintenance of safety management documentation and records;

(6) ensure that there is safety management training available, and that it meets acceptable standards;

(7) provide advice on safety matters; and

(8) initiate and participate in internal occurrence/accident investigations;

(9) coordinate and communicate (on behalf of the accountable executive) with the Authority as necessary on issues relating to safety.

(d) The safety manager should have:

(1) adequate practical experience and expertise in aerodrome operations, or aerodrome maintenance, or similar area;

(2) adequate knowledge of safety and quality management;

(3) adequate knowledge of the aerodrome manual; and

(4) comprehensive knowledge of the applicable requirements in the area of aerodromes.

(e) The safety manager should not be one of the persons referred to in 1.4.10(b).

However, in the case of less complex aerodrome organisations/operations, the safety manager may be the accountable manager, or one of the persons referred to in 1.4.10(b), or any other person at appropriate management level, provided that he/she can act independently of other managers within the organisation of the aerodrome operator, and has direct access to the accountable manager and to appropriate management for safety matters.

(f) The Authority will assess his/her qualifications and may interview the nominee or call for additional evidence of his/her suitability, before accepting their nomination.

1.4.11 Training and proficiency check programmes

(a) The aerodrome operator shall establish and implement a training programme for personnel involved in the operation, maintenance and management of the aerodrome, to ensure their continued competence, and that they are aware of the rules and procedures relevant to operation of the aerodrome and the relationship of their functions and tasks to the aerodrome operation as a whole.

(b) The training referred to in point (a) shall:

(1) include initial, recurrent, refresher and continuation training;

(2) be appropriate to the functions and tasks for the personnel;

(3) include the applicable operational procedures and requirements of the aerodrome, as well as driving.

(c) The aerodrome operator shall ensure that any other personnel, including personnel of other organisations that operate or provide services at the aerodrome, allowed unescorted access to the movement area and other operational areas of the aerodrome, is adequately trained and qualified for such unescorted access.

(d) The training referred to in point (c) shall:

(1) include initial, recurrent, refresher and continuation training;

(2) include the applicable operational procedures and requirements of the aerodrome, as well as driving.

(e) The aerodrome operator shall ensure that personnel referred to in points (a) and (c) have successfully completed the necessary initial training prior to being allowed:

(1) to perform their duties unattended;

(2) unescorted access to the movement area and other operational areas of the aerodrome.

The initial training shall include theoretical and practical training of adequate duration and competence assessments of the personnel following the provision of the training.

(f) In order to continue to perform their duties unattended and being allowed unescorted access to the movement area and other operational areas of the aerodrome and unless otherwise specified in AUA-AGA, the aerodrome operator shall ensure that personnel referred to in points (a) and (c) have been trained on the rules and procedures relevant to operation of the aerodrome by successfully completing:

(1) recurrent training, at intervals not exceeding 24 months since the completion of their initial training. If the recurrent training is undertaken within the last 3 calendar months of the interval, the new interval period shall be counted from the expiry date of the original interval;

(2) refresher training, prior to performing their duties unattended or being allowed unescorted access to the movement area or other operational area of the aerodrome, when they are absent from their duties for a period not less than 3 and not more than 12 consecutive months. In case of absence beyond 12 consecutive months, such personnel shall undergo initial training in accordance with point (c);

(3) continuation training due to changes to their operating environment or assigned tasks, as necessary.

(g) The aerodrome operator shall establish and implement a proficiency check programme for personnel referred to in point (a), and ensure for personnel referred to in point (c) that they have demonstrated their capabilities in the performance of their tasks, in accordance with a proficiency check programme, in order to ensure:

(1) their continued competence;

(2) that they are aware of the rules and procedures relevant to their functions and tasks.

Unless otherwise specified in AUA-AGA, the aerodrome operator shall ensure that persons referred to in points (a) and (c) undergo proficiency checks at intervals not exceeding 24 months since the completion of their initial training.

(h) The aerodrome operator shall ensure that:

(1) adequately qualified and experienced instructors for the provision of training and assessors for the assessments and the proficiency checks are used;

(2) suitable facilities, means and equipment are used for the provision of the training and, where applicable, for the conduct of the proficiency checks.

(i) The aerodrome operator shall establish and implement procedures for the implementation of the training and proficiency check programmes and shall:

(1) maintain appropriate qualification, training and proficiency check records to demonstrate compliance with this requirement;

(2) upon request, make such records available to its personnel concerned;

(3) if a person is employed by another employer, upon request, make such records of that person available to that new employer.

AMC1 1.4.11(a);(b) Training and proficiency check programmes

TRAINING OF AERODROME PERSONNEL — GENERAL

(a) The training programme should cover all personnel:

(1) involved in the operation, maintenance, and management of the aerodrome (supervisors, managers, senior managers, and the accountable manager); and

(2) operating unescorted on the movement area, and other operational areas of the aerodrome, and which are related to the aerodrome operator regardless of their level in the organisation.

(b) The training programme should include safety management system training whose level of detail should be appropriate to the individual's responsibility and involvement in the safety management system and should also include human and organisational factors.

(c) The training programme should consist of the following:

(1) a process to identify training standards, including:

(i) syllabi, duration, and frequency for each type of training and area of activity for the persons mentioned in point (a), including for the instructors and assessors;

(ii) method(s) for delivery of training and competency assessment; minimum performance to be achieved by trainees; and

(iii) track completion of required training;

(2) a validation process that measures the effectiveness of training;

(3) initial job-specific training;

(4) practical training;

(5) recurrent training;

(6) refresher training; and

(7) continuation training.

(d) The training programme should identify training responsibilities and contain procedures:

(1) for training and competency assessment of the trainees;

(2) to be applied in the event that personnel do not achieve or maintain the required standards.

(e) Training contents, syllabi and duration should comply with the requirements prescribed in AUA-AGA.

(f) A training file should be developed for each employee, including management, and a system should be in place to assist in identifying and tracking employee training requirements, and verifying that personnel have received the required/planned training.

(g) Information related to points (c) and (d), including the identified training standards and the related syllabi and frequency, should be included in the aerodrome manual.

AMC1 1.4.11(c);(d) Training and proficiency check programmes

TRAINING OF PERSONNEL OF OTHER ORGANISATIONS — GENERAL

With regard to the training of the personnel employed by other organisations which operate or provide services at the aerodrome, and which are allowed unescorted access to the movement area or other operational areas of the aerodrome, the provisions of AMC1 1.4.11(a);(b) apply, except that the safety management system training may cover only the necessary elements (e.g.

relevant procedures, safety reporting system, aerodrome safety programmes, etc.).

AMC1 1.4.11(h) Training and proficiency check programmes

INSTRUCTORS — ASSESSORS

(a) The aerodrome operator should nominate instructors and assessors to be used for the implementation of the training and proficiency check programmes. The personnel to be nominated may also include contracted instructors or organisations for individual subjects.

The aerodrome operator may also nominate personnel proposed by organisations operating or providing services at the aerodrome to be used as instructors and assessors for the implementation of the respective part of the training and proficiency check programmes of these organisations' personnel. Irrespective of the solution chosen, the aerodrome operator remains responsible for the proper implementation of the training programme and the proficiency check programme in a consistent manner, and according to the relevant procedures and standards established by the aerodrome operator.

(b) A person may be qualified and nominated both as an instructor and as an assessor by the aerodrome operator. However, such a person may not provide assessment for own instruction, courses, or material.

(c) Instructors

(1) Theoretical instruction should be given by appropriately qualified instructors. They should have:

(i) appropriate level and depth of knowledge in the field where instruction is to be given;

(ii) successfully completed an instructional technique course;

(iii) documented ability to use appropriate instructional techniques;

(iv) adequate experience in the subject where instruction is to be given; and

(v) accepted by the authority.

(2) Instruction on practical skills should be given by appropriately qualified instructors who:

(i) meet the theoretical knowledge, and the working experience requirements appropriate to the instruction being given;

(ii) successfully completed an instructional techniques course

(iii) have demonstrated the ability to instruct, and to use appropriate instructional techniques;

(iv) are proficient in instructional techniques in the areas in which it is intended to provide instruction;

(v) receive relevant training, in accordance with the training programme, to ensure that the instructional competencies are maintained; and

(vi) accepted by the Authority.

(d) Assessors

The persons who are responsible for assessing the competence and skills of the personnel should:

(1) have demonstrated the ability to assess the performance of, and conduct tests and checks in the areas covered by the training;

(2) receive relevant training, in accordance with the training programme, to ensure that the assessment standards are maintained up to date;

(3) meet the theoretical knowledge requirements appropriate to the instruction being given and have adequate working experience in the area of instruction;

(4) accepted by the Authority.

AMC1 1.4.11(i) Training and proficiency check programmes

PERSONNEL RECORDS

(a) The aerodrome operator should use its record keeping system to record the following information for each person:

(1) starting date of employment/ending date of employment (if applicable);

(2) area of activity;

(3) previous working experience;

(4) qualifications;

(5) training (before entry and subsequent); and

(6) proficiency checks, including language proficiency as appropriate;

(b) Latest changes should be reflected into personnel records.

AMC2 1.4.11(i) Training and proficiency check programmes

TRAINING RECORDS

(a) Training programme — general

The records of the training sessions provided, should include as a minimum the following:

(1) type of training, area of training and subjects covered;

(2) names of participants/signed list of participants;

(3) date and duration of training; and

(4) names of the instructor and assessor.

(b) Training records of individuals

The training records maintained for each individual should include as a minimum:

(1) the name of the trainee;

(2) the date(s) and the duration of the training;

(3) the place where the training was received;

(4) the name of the organisation that provided the training;

(5) the subjects covered, and the methodology of the course;

(6) any comments made by the instructor, if applicable;

(7) the performance assessment of the trainee, as applicable; and

(8) the name and signature of the instructor.

1.4.12 Safety Programmes

The aerodrome operator shall:

(a) establish, lead and implement programmes to promote safety and the exchange of safety-relevant information; and

(b) encourage organisations operating or providing services at the aerodrome to be involved in such programmes.

AMC1 1.4.12 Safety programmes

SAFETY PROGRAMMES — AERODROME SAFETY COMMITTEES

(a) The aerodrome operator should:

(1) organise, coordinate and implement programmes to promote safety at the aerodrome. Such programmes should include, but are not limited to:

(i) runway safety, including runway incursion and excursion prevention;

(ii) apron safety; and

(iii) FOD prevention;

(2) coordinate and promote the exchange of information, and the joint investigation of occurrences, serious incidents, and accidents.

(b) The aerodrome operator should establish, coordinate, and lead local aerodrome safety committees, and a Local Runway Safety Team, dealing with runway safety, apron safety, and the safety of the operations at the aerodrome in general. All relevant organisations operating or providing services at the aerodrome should participate to such aerodrome safety committees and the Local Runway Safety Team.

The local aerodrome safety committees and the Local Runway Safety Team should convene regularly, at least once every 6 months, to identify and review local safety issues, and examine possible solutions, and need for action. Minutes of such meetings should be kept. Procedures relevant to the functioning of local aerodrome safety committees and the Local Runway Safety Team should be included in the aerodrome manual.

GM1 1.4.12 Safety programmes

AERODROME SAFETY COMMITTEES

(a) Manoeuvring area/Apron Safety Committee

(1) The aerodrome operator should establish a Manoeuvring area/Apron Safety Committee(s);

(2) The Manoeuvring area/Apron Safety Committee(s) should have an advisory role to the aerodrome operator;

(b) Management of Manoeuvring area /Apron Safety Committee(s)

(1) The Manoeuvring area /Apron Safety Committee(s) should be chaired by an aerodrome operator’s official, responsible for aerodrome operations; and

(2) The aerodrome operator’s safety manager should act as the secretary of the Committee(s).

(c) Composition of Manoeuvring area /Apron Safety Committee(s)

Participation should include, but not limited to representatives of:

(1) aerodrome users active in flight operations;

(2) aircraft ground handling services providers;

(3) aerodrome rescue and firefighting services;

(4) aerodrome operations;

(5) aerodrome wildlife management;

(6) aerodrome maintenance; and

(7) air navigation service provider(s).

(d) Tasks

The tasks of the Manoeuvring area /Apron Safety Committee(s) should be:

(1) to receive and evaluate reports on operational safety issues;

(2) to receive reports and statistical information on accidents and incidents, and propose solutions;

(3) to advise on manoeuvring area/apron safety issues such as:

(i) promotion of apron safety discipline;

(ii) FOD prevention;

(iii) developing measures for safe operations;

(iv) considering actions to resolve manoeuvring area/apron safety problems;

(v) apron equipment issues;

(vi) adherence to vehicle traffic issues;

(vii) new and/or updated safety instructions;

(viii) personal protective clothing/equipment issues;

(ix) methods to develop and promote apron safety awareness initiatives,

(x) proposed aerodrome works;

(xi) proposed changes/developments to the movement area;

(xiii) standard operating procedures, etc.

AMC2 1.4.12 Safety programmes

LOCAL RUNWAY SAFETY TEAM

(a) Context

As part of its runway safety programme, the aerodrome operator should establish and lead a Local Runway Safety Team and act on local runway safety issues, including runway incursion (including runway confusion) and excursion prevention.

A runway incursion is defined as 'Any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle, or person on the protected area of a surface designated for the landing and take-off of aircraft[4].'

A runway excursion occurs when 'An aircraft veers off or overruns the runway surface during either take-off or landing'.

(b) Local Runway Safety Team composition

Participation should include representatives from all interested parties with direct involvement in runway operations at the aerodrome, including, but is not limited, to:

(1) aerodrome operations;

(2) aerodrome engineering and maintenance;

(3) air navigation service providers;

(4) aircraft operators that operate of the aerodrome;

(5) aerodrome rescue and firefighting services;

(6) drivers having access on the manoeuvring area.

[4] The 'protected area of a surface designated for the landing and take-off of aircraft' is to be interpreted as the physical surface of a runway, from the centreline to the holding point appropriate to the type of runway. Where operations are being conducted during low visibility operations this should be the holding point appropriate to the procedures in force. The 'protected surface' includes the ILS glide-path and localiser critical areas at all times, and the ILS sensitive areas during low visibility procedures.

(c) Role

The role of the Local Runway Safety Team should be to advise the appropriate management on potential runway safety issues, and to recommend mitigating measures.

(d) Tasks

The Local Runway Safety Team may have the following tasks:

(1) identification of potential runway safety issues, including the need for establishment of hot spots or other problem areas at the aerodrome and the review of the relevant entries of the AIP for accuracy;

(2) developing and running local awareness campaigns, at suitable periods, including at the start of a busy season or before an unusual event, that focus on local issues, for example, producing and distributing local hot spot maps, or other guidance material considered as necessary; local awareness campaigns should be periodically refreshed to maintain interest and operational awareness of the relevant personnel;

(3) monitoring the number, type and, the severity of runway incursions and excursions; disseminating safety recommendations delivered from accident and incident investigation findings as well as other relevant lessons learned e.g. from operational experience and best risk mitigation practices; sharing good practices to prevent runway incursions and excursions;

(4) assisting in verifying that communications between air traffic controllers, or other Air Traffic Services personnel, pilots, and vehicle drivers are satisfactory, or if any improvements could be suggested;

(5) making observations on a regular basis in different weather and light conditions to assess whether all runway entrances and visual aids are adequate, correctly located and understandable by all parties concerned, with no possible ambiguity of their meaning, or identify potential aerodrome design issues;

(6) understanding the operating difficulties of personnel working in other areas, and recommending areas for improvement; when reviewing operating procedures it is necessary to ensure that the procedures employed by different companies at the aerodrome are integrated and effective, so as to minimise the risk of runway incursions. Care should be taken when examining existing or proposed runway capacity enhancing procedures or noise abatement schemes involving runway preferential systems;

(7) development of joint, initial and recurrent, training programmes and familiarisation on runway incursion and excursion prevention, for all relevant personnel (vehicle drivers and other personnel operating on the manoeuvring area, pilots, Air Traffic Services personnel); this may include visits to the manoeuvring area to increase awareness of the aerodrome layout, markings, signs, position of anemometers etc., where this is considered necessary;

(8) providing advice prior to the implementation of changes to the aerodrome, practices and procedures to identify potential for runway incursion or excursion; and

(9) assessing the effectiveness of implemented operational solutions periodically.

1.4.13 Safety reporting system

(a) The aerodrome operator shall establish and implement a safety reporting system for all personnel and organisations operating or providing services at the aerodrome, in order to promote safety at, and the safe use of, the aerodrome.

(b) The aerodrome operator, in accordance with 1.4.9(b)(3), shall:

(1) require that the personnel and organisations mentioned in point (a) use the safety reporting system for the mandatory reporting of any accident, serious incident and occurrence; and

(2) ensure that the safety reporting system may be used for the voluntary reporting of any defect, fault and safety hazard which could impact safety.

(c) The safety reporting system shall protect the identity of the reporter, encourage voluntary reporting and include the possibility that reports may be submitted anonymously.

(d) The aerodrome operator shall:

(1) record all reports submitted;

(2) analyse and assess the reports, as appropriate, in order to address safety deficiencies and identify trends;

(3) ensure that all organisations operating or providing services at the aerodrome which are relevant to the safety concern, participate in the analysis of such reports and that any corrective and/or preventive measures identified are implemented;

(4) conduct investigations of reports, as appropriate; and

(5) refrain from attribution of blame in line with the 'just culture' principles.

AMC1 1.4.13 Safety reporting system

SAFETY REPORTING SYSTEM

(a) Safety reporting system — General

(1) An effective safety reporting system should include, apart from aerodrome operator's personnel, aircraft operators, ground handling service providers, air navigation service providers, and any other organisation operating on the aerodrome, or providing services at the aerodrome.

(2) The safety reporting system should include voluntary reporting possibilities intended for safety hazards identified by the reporter, and that may have potential safety consequences.

(3) The aerodrome operator should identify which events are mandatory to be reported.

(4) The aerodrome operator should provide the means and the format for reporting which should be such that meets the existing reporting requirements foreseen in the applicable legislation in terms of time, format, and required information to be reported.

(5) The safety reporting system should include an acknowledgement to the reporter for the submission of the report.

(6) The reporting process should be as simple as possible, and well documented, including details as to what, how, where, whom, and when to report;

(7) Regardless of the source or method of submission, once the information is received, it should be stored in a manner suitable for easy retrieval and analysis;

(8) Access to the submitted reports should be restricted to persons responsible for storing and analysing them;

(9) Protection of the identity of the reporter should be ensured, and the procedures established by the aerodrome operator to gather additional information for analyses, or investigations should respect this principle;

(10) The safety reporting system should include a feedback system to the reporting person, on the outcome of the occurrence analysis.

(b) Wildlife hazard reporting

(1) The aerodrome operator should ensure that its safety reporting system specifically addresses the requirement for all third parties (aircraft operators, aircraft mechanics, air traffic controllers, and other Air Traffic Services personnel, etc.) and all aerodrome personnel, to report to the aerodrome operator wildlife strikes, and relevant identified hazards.

(2) The reporting of such third parties should be done irrespectively of any other requirements according to which they have to report to the Authority of the aerodrome, or the state of registry of the aircraft involved, or any other Competent Authority in the context of the national occurrence reporting programme.

GM1 1.4.13 Safety reporting system

NEED FOR SAFETY REPORTING

(a) The overall purpose of the safety reporting system is to use reported information to improve the level of safety performance of the aerodrome, and not to attribute blame.

(b) The objectives of the safety reporting system should be:

(1) to enable an assessment to be made of the safety implications of each relevant occurrence, serious incident and accident, including previous similar events, so that any necessary action can be initiated; and

(2) to ensure that knowledge of relevant occurrences, serious incidents and accidents is disseminated, so that other persons and organisations may learn from them.

1.4.14 Record keeping

(a) The aerodrome operator shall establish an adequate system of record keeping, covering all its activities undertaken under national regulation and AUA-AGA.

(b) The format of the records shall be specified in the aerodrome manual.

(c) Records shall be stored in a manner that ensures protection from damage, alteration and theft.

(d) Records shall be kept for a minimum of five years, except that the below records shall be kept as follows:

(1) the aerodrome certification basis, the alternative means of compliance in use and the current aerodrome or aerodrome operator certificate(s), for the lifespan of the certificate;

(2) arrangements with other organisations, for as long as such arrangements are in effect;

(3) manuals of aerodrome equipment or systems employed at the aerodrome, for as long as they are used at the aerodrome;

(4) safety assessment reports for the lifetime of the system/procedure/activity;

(5) personnel training, qualifications, and medical records as well as their proficiency checks, as appropriate, for at least four years after the end of their employment, or until the area of their employment has been audited by the Authority; and

(6) the current version of the hazard register;

(7) driving authorisations and, if appropriate, language proficiency certificates, for at least four years after the end of a person's employment, or the revocation or cancelation of a driving authorisation, or until this area of activity has been audited by the authority;

(8) vehicle authorisations and aerodrome operator's vehicle maintenance records, for at least four years after a vehicle is removed from operations, or until this area has been audited by the authority.

1.4.15 Origination of NOTAM

(a) The aerodrome operator shall:

(1) establish and implement procedures in accordance with which it originates a NOTAM in coordination with the organisation responsible for aeronautical information in Aruba:

(i) that contains information on the establishment, condition, or change of any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel involved with flight operations;

(ii) that contains information of a temporary nature and of short duration or that concerns operationally significant permanent changes or temporary changes of long duration that are made at short notice, except for extensive text or graphics, or both;

(2) designate aerodrome personnel, who have successfully completed relevant training and demonstrated their competence, to originate NOTAM and provide relevant information to the organisation responsible for aeronautical information in Aruba with which it has arrangements;

(3) ensure that all other aerodrome personnel whose duties involve the use of NOTAM have successfully completed relevant training and demonstrated their competence to do so.

(b) The aerodrome operator shall originate a NOTAM when it is necessary to provide the among other the following information:

(1) establishment of, closure of, or significant changes in the operation of aerodromes or heliports or runways;

(2) establishment of, withdrawal of, or significant changes in the operation of the aerodrome services;

(3) establishment of, withdrawal of, or significant changes in the operational capability of radio navigation and air-ground communication services for which the aerodrome operator is responsible;

(4) unavailability of backup and secondary systems, having a direct operational impact;

(5) establishment of, withdrawal of, or significant changes to visual aids;

(6) interruption of, or return to operation of, major components of aerodrome lighting systems;

(7) establishment of, withdrawal of, or significant changes to procedures for air navigation services for which the aerodrome operator is responsible;

(8) occurrence or correction of major defects or impediments in the manoeuvring area;

(9) changes to, and limitations on, the availability of fuel, oil and oxygen;

(10) establishment of, withdrawal of, or return to, operation of hazard beacons marking obstacles to air navigation;

(11) planned laser emissions, laser displays and search lights in the aerodrome surroundings, if pilots' night vision is likely to be impaired;

(12) erecting or removal of, or changes to, obstacles to air navigation in the takeoff, climb, missed approach, approach areas, as well as on the runway strip;

(13) changes in aerodrome or heliport rescue and firefighting category;

(14) presence of, removal of, or significant changes in, hazardous conditions due to radioactive material, toxic chemicals, volcanic ash deposition or water on the movement area;

(15) presence of a runway or portion thereof which is slippery wet;

(16) presence of a runway which is not available due to runway marking works; or information about the time lag required for making the runway available, if the equipment used for such works can be removed, when necessary;

(17) presence of hazards that affect air navigation, including presence of wildlife, obstacles, displays and major events.

(c) For the purposes of point (b), the aerodrome operator shall ensure that:

(1) NOTAM is originated with sufficient lead time for the affected parties to take any required action, except in the case of unserviceability, release of radioactive material, toxic chemicals and other events that cannot be foreseen;

(2) a NOTAM notifying unserviceability of associated facilities, services and navigation aids at the aerodrome, provides an estimate of the unserviceability period or of the time at which restoration of service is expected;

(3) within three months from the issuance of a permanent NOTAM, the information contained in the NOTAM is included in the aeronautical information products affected;

(4) within three months from the issuance of a temporary NOTAM of long duration, the information contained in the NOTAM is included in an AIP supplement;

(5) when a NOTAM with an estimated end of validity unexpectedly exceeds the three-month period, a replacement NOTAM is originated unless the condition is expected to last for a further period of more than three months; in that case, the aerodrome operator shall ensure that the information is published in an AIP supplement.

(d) In addition, the aerodrome operator shall ensure that:

(1) except as provided for in point (d)(4), each NOTAM it originates contains the applicable information in the order as required by ICAO in its established NOTAM Format;

(2) NOTAM text is composed of the significations or uniform abbreviated phraseology assigned to the ICAO NOTAM Code, complemented by ICAO abbreviations, indicators, identifiers, designators, call signs, frequencies, figures and plain language;

(3) a NOTAM is originated in the English language;

(4) information concerning standing water on the movement area is disseminated by means of SNOWTAM and contains the information in the order as required by ICAO in its established NOTAM Format;

(5) when an error has occurred in a NOTAM, a NOTAM with a new number is originated to replace the erroneous NOTAM or the erroneous NOTAM is cancelled and a new NOTAM is originated;

(6) when a NOTAM is originated to cancel or replace a previous NOTAM:

(a) the series and number/year of the previous NOTAM are indicated;

(b) the Location Indicators and subject of both NOTAM are the same;

(7) only one NOTAM is cancelled or replaced by a new NOTAM;

(8) each originated NOTAM deals with only one subject and one condition of the subject;

(9) each originated NOTAM is as brief as possible and compiled so that its meaning is clear without the need to refer to another document;

(10) an originated NOTAM containing permanent or temporary information of long duration includes appropriate references to the AIP or AIP supplement;

(11) the ICAO Location Indicator included in the text of an originated NOTAM for the aerodrome is the one contained in the Location Indicators. A curtailed form of such indicators shall not be used.

(e) The aerodrome operator shall, following the publication of a NOTAM that it has originated, review its content to ensure its accuracy, and ensure the dissemination of the information to all relevant aerodrome personnel and organisations at the aerodrome.

(f) The aerodrome operator shall maintain records:

(1) of the NOTAM it originated and those that were issued;

(2) regarding the implementation of points (a)(2) and (3).

AMC1 1.4.15(a)(1) Origination of NOTAM

GENERAL

The procedures should as a minimum:

(a) define the ways and means that the aerodrome operator may use to request the issuance of a NOTAM, in accordance with the arrangements that the aerodrome operator has with the organisation responsible for aeronautical information in Aruba. The procedures should clearly indicate the names of the aerodrome operator's personnel that have the authority to originate a NOTAM, and which should be included in the arrangements with the organisation responsible for aeronautical information in Aruba.

(b) contain instructions regarding the:

(1) cases when a NOTAM should be originated by the aerodrome operator;

(2) cases when a NOTAM should not be originated by the aerodrome operator; and

(3) completion of the NOTAM form (including the use of relevant electronic applications, if applicable) by the personnel designated by the aerodrome operator as NOTAM originators; and

(c) specify the cases in which coordination with the Authority is needed prior to the origination of the NOTAM, and the way to inform the Authority about the issuance of a NOTAM.

AMC1 1.4.15(a)(2);(3) Origination of NOTAM

INITIAL TRAINING FOR AERODROME PERSONNEL INVOLVED IN NOTAM ORIGINATION AND OTHER AERODROME PERSONNEL

(a) The theoretical part of the training of a person to be designated as a NOTAM originator should, as a minimum, cover the following areas:

(1) regulatory framework governing NOTAM origination and issuance, and its relationship with other aeronautical data products, including:

(i) cases when the origination of a NOTAM is required;

(ii) cases when a NOTAM should not be originated.

(2) NOTAM form completion, including word abbreviations and phrase contractions applicable to NOTAMs;

(3) NOTAM types and understanding of NOTAM;

(4) use of electronic applications for initiating a NOTAM (if applicable); and

(5) aerodrome procedures for origination and internal dissemination of a NOTAM.

The theoretical training should be followed by an assessment of the trainees.

(b) Following the successful completion of the theoretical training, the practical part of the training should, as a minimum, include familiarisation with the origination of NOTAM and implementation of the relevant aerodrome operating procedures for the persons to be designated as NOTAM originators. Upon completion of the practical training, and the successful competency assessment of the trainee in practical terms, the person may be designated as a NOTAM originator.

(c) For other aerodrome personnel, whose duties require only the understanding of a NOTAM, the theoretical part of the training should be adjusted to their needs and need not include (a)(4) and (a)(5) above, while the practical training should include practical examples to assess the level of their understanding. Both the theoretical and the practical training should be followed by an assessment of the person concerned.

GM1 1.4.15 Origination of NOTAM

Further information regarding NOTAM and SNOTAM format can be found in Doc 10066 PANS-AIM

1.4.16 Fuel quality

(a) The aerodrome operator shall verify that organisations involved in storing and dispensing of fuel to aircraft have procedures to ensure that aircraft are provided with uncontaminated fuel and of the correct specification.

(b) The aerodrome operator shall ensure that any person authorised by the Authority shall have access to the any facility regarding fuelling.

AMC1 1.4.16 Fuel quality

GENERAL

The aerodrome operator should verify, either by itself or through arrangements with third parties, that organisations involved in storing and dispensing of fuel to aircraft, implement procedures to:

(a) maintain the installations and equipment for storing and dispensing the fuel in such condition so as not to render unfit for use in aircraft;

(b) mark such installations and equipment in a manner appropriate to the grade of the fuel;

(c) take fuel samples at appropriate stages during the storing and dispensing of fuel to aircraft, and maintain records of such samples; and

(d) use adequately qualified and trained staff in storing, dispensing, and otherwise handling fuel on the aerodrome.

GM1 1.4.16 Fuel quality

COMPLIANCE

The aerodrome operator, in order to ensure compliance, could use audit reports to organisations involved in storing and dispensing of fuel to aircraft.

1.4.17 Changes

a) Any change:

(1) affecting the certification and safety-critical aerodrome equipment; or

(2) significantly affecting elements of the aerodrome operator's management system as required in 1.4.9

shall require prior approval by the Authority.

(b) The application for a change in accordance with point (a) shall be submitted before any such change takes place, in order to enable the Authority to determine continued compliance with National regulations and the certificate.

The change shall only be implemented upon receipt of formal approval by the Authority.

During the changes, the aerodrome operator shall operate under the conditions approved by the Authority.

(c) The aerodrome operator shall provide the Authority with the relevant documentation.

(d) As part of its management system, as defined in 1.4.9, the aerodrome operator proposing a change to the aerodrome, its operation, its organisation or its management system shall:

(1) determine the interdependencies with any affected parties, plan and conduct a safety assessment in coordination with these organisations;

(2) align assumptions and mitigations with any affected parties, in a systematic way;

(3) ensure a comprehensive assessment of the change including any necessary interactions; and

(4) ensure that complete and valid arguments, evidence and safety criteria are established and documented to support the safety assessment, and that the change supports the improvement of safety whenever reasonably practicable.

1.5 Airport design and master plan

Introductory Note.— A master plan for the long-term development of an aerodrome conveys the ultimate development in a phased manner and reports the data and logic upon which the plan is based. Master plans are prepared to support modernization of existing aerodromes and creation of new aerodromes, regardless of size, complexity or role. It is important to note that a master plan does not constitute a confirmed implementation programme. It provides information on the types of improvements to be undertaken in a phased manner. Guidance on all aspects of the planning of aerodromes is contained in the Airport Planning Manual (Doc 9184), Part 1.

1.5.1 Aerodrome master plan

The aerodrome operators shall establish a master plan containing detailed plans for the development of aerodrome infrastructure.

Note .— A master plan represents the development plan of a specific aerodrome . It is developed by the aerodrome operator based on economic feasibility, traffic forecasts, and current and future requirements provided by, among others, aircraft operators (see 1.5.3).

1.5.2 Aerodrome master plan- requirements

The master plan shall:

a) contain a schedule of priorities including a phased implementation plan; and

b) be reviewed periodically to take into account current and future aerodrome traffic.

1.5.3 Consultation with stakeholders

The aerodrome operator shall consult with aerodrome stakeholders, particularly aircraft operators, in order to facilitate the master planning process using a consultative and collaborative approach.

Note 1.— Provision of advanced planning data to facilitate the planning process includes future aircraft types, characteristics and numbers of aircraft expected to be used, anticipated growth of aircraft movements, and number of passengers and amount of cargo projected to be handled.

Note 2.— See Annex 9, Chapter 6 on the need for aircraft operators to inform aerodrome operators concerning the former's service, schedule and fleet plans to enable rational planning of facilities and services in relation to the traffic anticipated.

Note 3.— See ICAO's Policies on Charges for Airports and Air Navigation Services (Doc 9082), Section 1, regarding consultation with users concerning provision of advance planning data and protection of commercially sensitive data.

1.5.4 Airport design

Architectural and infrastructure-related requirements for the optimum implementation of international civil aviation security measures shall be integrated into the design and construction of new facilities and alterations to existing facilities at an aerodrome.

1.5.5 Airport design (cont.)

The design of aerodromes shall take into account land-use and environmental control measures.

Note.— Guidance on land-use planning and environmental control measures is contained in the Airport Planning Manual (Doc 9184), Part 2.

1.6 Aerodrome reference code

1.6.1 Aerodrome reference code (ARC)

An aerodrome reference code — consisting of a code number and letter — which is selected for aerodrome planning purposes shall be determined by the aerodrome operator in accordance with the characteristics of the aeroplane for which an aerodrome facility is intended.

1.6.2 Aerodrome reference code (ARC) (cont.)

The aerodrome reference code numbers and letters shall have the meanings assigned to them in Table 1-1.

1.6.3 Aerodrome reference code (ARC) (cont.)

The code number for element 1 shall be determined from Table 1-1 selecting the code number corresponding to the highest value of the aeroplane reference field lengths of the aeroplanes for which the runway is intended.

GM1 1.6.3 Aerodrome reference code (ARC) – (cont.)

(a) The determination of the aeroplane reference field length is solely for the selection of a code number and is not intended to influence the actual runway length provided.

(b) Guidance on determining the runway length is given in the Aerodrome Design Manual (Doc 9157), Part 1.

1.6.4 Aerodrome reference code (ARC) (cont.)

The code letter for element 2 shall be determined from Table 1-1 by selecting the code letter which corresponds to the greatest wingspan of the aeroplanes for which the facility is intended.

GM1 1.6.4 Aerodrome reference code (ARC) (cont.)

(a) Guidance on determining the aerodrome reference code is given in the Aerodrome Design Manual (Doc 9157), Parts 1 and 2.

(b) Guidance on planning for aeroplanes with wingspans greater than 80 m is given in the Aerodrome Design Manual (Doc 9157), Parts 1 and 2.

(c) In the case of an aeroplane equipped with folding wing tips, its reference code letter may change as a result of the folding/extending of the wing tips. Consideration will be given to the wingspan configuration and resultant operations of the aeroplane at an aerodrome. Procedures on conducting an aerodrome compatibility study to accommodate aeroplanes with folding wing tips spanning two code letters are given in the PANS-Aerodromes (Doc 9981). Further guidance can be found in the manufacturer's manual on aircraft characteristics for airport planning.

Table 1-1. Aerodrome reference code
(see 1.6.2 to 1.6.4)

Code element 1	
Code number	**Aeroplane reference field length**
1	Less than 800 m
2	800 m up to but not including 1 200 m
3	1 200 m up to but not including 1 800 m
4	1 800 m and over

Code element 2	
Code letter	**Wingspan**
A	Up to but not including 15 m
B	15 m up to but not including 24 m
C	24 m up to but not including 36 m
D	36 m up to but not including 52 m
E	52 m up to but not including 65 m
F	65 m up to but not including 80 m

1.7 Use of the aerodrome by higher code letter aircraft

1.7.1 Use of the aerodrome by higher code letter aircraft

When the aerodrome operator accommodates an aeroplane that exceeds the certificated characteristics of the aerodrome, the compatibility between the operation of the aeroplane and aerodrome infrastructure and operations shall be assessed and appropriate measures developed and implemented in order to maintain an acceptable level of safety during operations.

AMC1 1.7.1 Use of the aerodrome by higher code letter aircraft

ELEMENTS TO BE ASSESSED

When assessing the possibility of operation of aircraft whose code letter is higher than the code letter of the aerodrome reference code, the aerodrome operator should, amongst other issues, assess the impact of the characteristics of the aircraft on the aerodrome, its facilities, equipment and its operation, and vice versa.

Aircraft characteristics to be assessed include, but are not limited to:

(a) fuselage length;

(b) fuselage width;

(c) fuselage height;

(d) tail height;

(e) wingspan;

(f) wing tip vertical clearance;

(g) cockpit view;

(h) distance from the pilot’s eye position to the nose landing gear and to the main landing gear;

(i) outer main gear wheel span;

(j) wheelbase;

(k) main gear steering system;

(l) landing gear geometry;

(m) engine data;

(n) flight performance; and

(o) technology evolution.

GM1 1.7 Use of the aerodrome by higher code letter aircraft

(a) This section introduces PANS-Aerodromes (Doc 9981) for use by an aerodrome undertaking an assessment of its compatibility with the type of traffic or operation it is intending to accommodate. The material in the PANS-Aerodromes addresses operational issues faced by existing aerodromes and provides the necessary procedures to ensure the continued safety of operations. Where alternative measures, operational procedures and operating restrictions have been developed, these are detailed in the aerodrome manual and reviewed periodically to assess their continued validity. The PANS-Aerodromes does not substitute nor circumvent the provisions contained in AUA-AGA. It is required that infrastructure on an existing aerodrome or a new aerodrome will fully comply with the requirements in AUA-AGA.

(b) Procedures to assess the compatibility of the operation of a new aeroplane with an existing aerodrome can be found in the PANS-Aerodromes (Doc 9981).

(c) See PANS-AIM (Doc 10066), Appendix 2, AD 2.20, on the provision of a detailed description of local traffic regulations.

(d) See PANS-Aerodromes (Doc 9981), Chapter 3, section 3.6, on promulgation of safety information.

1.7.2 Use of the aerodrome by higher code letter aircraft — Prior approval

Prior approval by the authority is necessary for operations as stated in 1.7.1.

CHAPTER 2. AERODROME DATA

2.1 Aeronautical data

2.1.1 Management of aeronautical data and aeronautical information

(a) As part of its managements system, the aerodrome operator shall implement and maintain a quality management system covering the following activities:

(1) its aeronautical data activity

(2) its aeronautical information provision activities.

(b) The aerodrome operator shall, as part of its management system, establish a security management system to ensure the security of operational data it receives, or produces, or otherwise employs, so that access to that operational data is restricted only to those authorised.

(c) The security management system of the aerodrome operator shall define the following elements:

(1) the procedures relating to data security risk assessment and mitigation, security monitoring and improvement, security reviews and lesson dissemination;

(2) the means designed to detect security breaches and to alert personnel with appropriate security warnings;

(3) the means of controlling the effects of security breaches and of identifying recovery action and mitigation procedures to prevent reoccurrence.

(d) The aerodrome operator shall ensure the security clearance of its personnel with respect to aeronautical data security.

(e) The aerodrome operator shall take the necessary measures to protect its aeronautical data against cyber security threats.

(f) The aerodrome operator shall have formal arrangements with the organisations with which it exchanges aeronautical data or aeronautical information and shall ensure the following:

(1) all data relevant to the aerodrome and available services is provided with the required quality; data quality requirements are complied with at data origination and maintained during data transmission;

(2) the accuracy of aeronautical data as required in PANS-AIM (Doc 10066), Appendix 1;

(3) the integrity of aeronautical data is maintained throughout the data process from origination to transmission, based on the integrity classification as required in PANS-AIM (Doc 10066), Appendix 1. In addition, procedures shall be put in place so that:

(i) for routine data, corruption is avoided throughout the processing of the data;

(ii) for essential data, corruption does not occur at any stage of the entire process and additional processes are included, as needed, to address potential risks in the overall system architecture to ensure data integrity at that level;

(iii) for critical data, corruption does not occur at any stage of the entire process and additional integrity assurance processes are included to fully mitigate the effects of faults identified by thorough analysis of the overall system architecture as potential data integrity risks;

(4) the resolution of the aeronautical data is commensurate with the actual data accuracy;

(5) the traceability of the aeronautical data;

(6) the timeliness of the aeronautical data, including any limits on the effective period;

(7) the completeness of the aeronautical data;

(8) the format of the delivered data meets the specified requirements.

2.1.2 Aerodrome mapping data

The aerodrome operator shall make available the aerodrome mapping data to the organisation responsible for aeronautical information in Aruba.

Note 1.— Aerodrome mapping databases related provisions are contained in Annex 15, Chapter 5 and PANS-AIM (Doc 10066), Chapter 5.

Note 2.— Guidance material concerning the application of aerodrome mapping databases is provided in Attachment A, Section 22.

2.1.3 Selection of the aerodrome mapping data features

Where made available in accordance with 2.1.2, the selection of the aerodrome mapping data features to be collected shall be made with consideration of the intended applications.

Note 1.— It is intended that the selection of the features to be collected match a defined operational need.

Note 2.— Aerodrome mapping databases can be provided at one of two levels of quality — fine or medium. These levels and the corresponding numerical requirements are defined in RTCA Document DO-272B and European Organization for Civil Aviation Equipment (EUROCAE) Document ED-99C — User Requirements for Aerodrome Mapping Information.

2.1.4 Data error detection and authentication

When originating, processing or transmitting data to the organisation responsible for aeronautical information, the aerodrome operator shall:

(a) ensure that digital data error detection techniques are used during the transmission and storage of aeronautical data, in order to support the applicable data integrity levels;

(b) ensure that the transfer of aeronautical data is subject to a suitable authentication process such that recipients are able to confirm that the data or information has been transmitted by an authorised source.

Note.— Detailed specifications concerning digital data error detection techniques are contained in PANS-AIM (Doc 10066).

2.2 Aerodrome reference point

2.2.1 Aerodrome reference point - General

The aerodrome operator shall determine, document, maintain an aerodrome reference point for the aerodrome.

2.2.2 Aerodrome reference point - Location

The aerodrome reference point shall be located near the initial or planned geometric centre of the aerodrome and shall normally remain where first established.

2.2.3 Aerodrome reference point - Measurement

The position of the aerodrome reference point shall be measured and reported to the organisation responsible for aeronautical information in Aruba in degrees, minutes and seconds.

2.3 Aerodrome and runway elevations

2.3.1 Aerodrome and runway elevations - measurement

The aerodrome operator shall measure the aerodrome elevation and geoid undulation at the aerodrome elevation position to the accuracy of one-half metre or foot and reported to the organisation responsible for aeronautical information in Aruba.

2.3.2 Aerodrome and runway elevations - non-precision approaches

For an aerodrome used by international civil aviation for non-precision approaches, the aerodrome operator shall measure the elevation and geoid undulation of each threshold, the elevation of the runway end and any significant high and low intermediate points along the runway to the accuracy of one-half metre or foot and reported to the organisation responsible for aeronautical information in Aruba.

2.3.3 Aerodrome and runway elevations - precision approaches

For precision approach runway, the aerodrome operator shall measure the elevation and geoid undulation of the threshold, the elevation of the runway end and the highest elevation of the touchdown zone to the accuracy of one-quarter metre or foot and reported to the organisation responsible for aeronautical information in Aruba.

2.4 Aerodrome reference temperature

2.4.1 Aerodrome reference temperature - general

The aerodrome operator shall determine the aerodrome reference temperature for an aerodrome in degrees Celsius.

2.4.2 Aerodrome reference temperature - measurement

The aerodrome reference temperature shall be the monthly mean of the daily maximum temperatures for the hottest month of the year (the hottest month being that which has the highest monthly mean temperature).

This temperature shall be averaged over a 5-year period.

2.5 Aerodrome dimensions and related information

2.5.1 Aerodrome dimensions and related information

The following data shall be measured or described by the aerodrome operator for each facility provided on an aerodrome:

a) runway

(1) true bearing to one-hundredth of a degree;

(2) designation number;

(3) length;

(4) width;

(5) displaced threshold location to the nearest metre or foot;

(6) slope;

(7) surface type;

(8) type of runway and,

(9) for a precision approach runway category I, the existence of an obstacle free zone when provided;

b) strip/ runway end safety area /stopway

(1) length, width to the nearest metre or foot;

(2) surface type; and

(3) arresting system — location (which runway end) and description;

c) taxiway

(1) designation;

(2) width; and

(3) surface type.

d) apron

(1) surface type; and

(2) aircraft stands;

e) the boundaries of the air traffic control service;

f) clearway

(1) length to the nearest metre or foot; and

(2) ground profile;

g) visual aids for approach procedures, marking and lighting of runways, taxiways and aprons, other visual guidance and control aids on taxiways and aprons, including taxi-holding positions and stopbars, and location and type of visual docking guidance systems;

h) location and radio frequency of any VOR aerodrome checkpoint;

i) location and designation of standard taxi-routes; and

j) distances to the nearest metre or foot of localizer and glide path elements comprising an instrument landing system (ILS) or azimuth and elevation antenna of a microwave landing system (MLS) in relation to the associated runway extremities.

2.5.2 Geographical coordinates of each threshold

The geographical coordinates of each threshold shall be measured and reported by the aerodrome operator to the organisation responsible for aeronautical information in Aruba in degrees, minutes, seconds and hundredths of seconds.

2.5.3 Geographical coordinates of appropriate taxiway centre line points

The geographical coordinates of appropriate taxiway centre line points shall be measured and reported by the aerodrome operator to the organisation responsible for aeronautical information in Aruba in degrees, minutes, seconds and hundredths of seconds.

2.5.4 Geographical coordinates of each aircraft stan

The geographical coordinates of each aircraft stand shall be measured and reported by the aerodrome operator to the organisation responsible for aeronautical information in Aruba in degrees, minutes, seconds and hundredths of seconds.

2.5.5 Geographical coordinates of obstacles in Area 2 and in Area 3

The geographical coordinates of obstacles in Area 2 (the part within the aerodrome boundary) and in Area 3 shall be measured and reported by the aerodrome operator to the organisation responsible for aeronautical information in Aruba in degrees, minutes, seconds and tenths of seconds. In addition, the top elevation, type, marking and lighting (if any) of obstacles shall be reported to the organisation responsible for aeronautical information in Aruba.

Note.— PANS-AIM (Doc 10066), Appendix 8, provides requirements for obstacle data determination in Areas 2 and 3.

2.6 Strength of pavements — Applicable until 27 November 2024

2.6.1 Strength of pavements — Applicable until 27 November 2024

(a) The bearing strength of a pavement shall be determined, documented and maintained by the aerodrome operator in accordance with this paragraph.

(b) The aerodrome operator shall provide the data to the users and the relevant air traffic services and organisation responsible for aeronautical information in Aruba.

2.6.2 Strength of pavements — Applicable until 27 November 2024 (cont.)

The bearing strength of a pavement intended for aircraft of apron (ramp) mass greater than 5 700 kg shall be made available using the aircraft classification number-pavement classification number (ACN-PCN) method by reporting all of the following information:

a) pavement classification number (PCN);

b) pavement type for ACN-PCN determination;

c) subgrade strength category;

d) maximum allowable tire pressure category or maximum allowable tire pressure value; and

e) evaluation method.

Note.— If necessary, PCNs may be published to an accuracy of one-tenth of a whole number.

2.6.3 Strength of pavements — Applicable until 27 November 2024 (cont.)

The PCN reported shall indicate that aircraft with an aircraft classification number (ACN) equal to or less than the reported PCN can operate on the pavement subject to any limitation on the tire pressure or aircraft all-up mass for specified aircraft type(s).

Note.— Different PCNs may be reported if the strength of the pavement is subject to significant seasonal variation.

2.6.4 Strength of pavements — Applicable until 27 November 2024 (cont.)

The ACN of an aircraft shall be determined in accordance with the standard procedures associated with the ACN-PCN method.

Note.— The standard procedures for determining the ACN of an aircraft are given in the Aerodrome Design Manual (Doc 9157), Part 3. For convenience, several aircraft types currently in use have been evaluated on rigid and flexible pavements founded on the four subgrade categories in 2.6.6 b) below and the results tabulated in that manual.

2.6.5 Strength of pavements — Applicable until 27 November 2024 (cont.)

For the purposes of determining the ACN, the behaviour of a pavement shall be classified as equivalent to a rigid or flexible construction.

2.6.6 Strength of pavements — Applicable until 27 November 2024 (cont.)

Information on pavement type for ACN-PCN determination, subgrade strength category, maximum allowable tire pressure category and evaluation method shall be reported using the following codes:

a) Pavement type for ACN-PCN determination:

	Code
Rigid pavement	R
Flexible pavement	F

Note.— If the actual construction is composite or non-standard, include a note to that effect.

b) *Subgrade strength category:*

	Code
High strength: characterized by K = 150 MN/m3 and representing all K values above 120 MN/m3 for rigid pavements, and by CBR = 15 and representing all CBR values above 13 for flexible pavements.	A
Medium strength: characterized by K = 80 MN/m3 and representing a range in K of 60 to 120 MN/m3 for rigid pavements, and by CBR = 10 and representing a range in CBR of 8 to 13 for flexible pavements.	B

Low strength: characterized by K = 40 MN/m3 and representing a range in K of 25 to 60 MN/m3 for rigid pavements, and by CBR = 6 and representing a range in CBR of 4 to 8 for flexible pavements.	C
Ultra-low strength: characterized by K = 20 MN/m3 and representing all K values below 25 MN/m3 for rigid pavements, and by CBR = 3 and representing all CBR values below 4 for flexible pavements.	D

c) *Maximum allowable tire pressure category:*

	Code
Unlimited: no pressure limit	W
High: pressure limited to 1.75 MPa	X
Medium: pressure limited to 1.25 MPa	Y
Low: pressure limited to 0.50 MPa	Z

Note.— See Note 5 to 10.2.1 where the pavement is used by aircraft with tire pressures in the upper categories.

d) *Evaluation method:*

	Code
Technical evaluation: representing a specific study of the pavement characteristics and application of pavement behaviour technology.	T
Using aircraft experience: representing a knowledge of the specific type and mass of aircraft satisfactorily being supported under regular use.	U

2.6.7 Strength of pavements — Applicable until 27 November 2024 (cont.)

Except for aircraft emergency situation, an aerodrome operator may, subject to prior approval of the Authority, permit the use of a pavement by an aircraft with an ACN higher than the PCN reported for that pavement in accordance with 2.6.2 and 2.6.3.

Note.— Attachment A, Section 19, details a simple method for regulating overload operations while the Aerodrome Design Manual (Doc 9157), Part 3, includes the descriptions of more detailed procedures for evaluation of pavements and their suitability for restricted overload operations.

2.6.8 Strength of pavements — Applicable until 27 November 2024 (cont.)

The bearing strength of a pavement intended for aircraft of apron (ramp) mass equal to or less than 5 700 kg shall be made available by reporting the following information:

a) maximum allowable aircraft mass; and

b) maximum allowable tire pressure.

Example: 4 000 kg/0.50 MPa

2.6 Strength of pavements - Applicable as of 28 November 2024.

2.6.1 Strength of pavements - Applicable as of 28 November 2024

(a) The bearing strength of a pavement shall be determined, documented and maintained by the aerodrome operator in accordance with this paragraph.

(b) The aerodrome operator shall provide the data to the users and the relevant air traffic services and organisation responsible for aeronautical information in Aruba.

2.6.2 Strength of pavements - Applicable as of 28 November 2024 (cont.)

The bearing strength of a pavement intended for aircraft of apron (ramp) mass greater than 5 700 kg shall be made available using the aircraft classification rating-pavement classification rating (ACR-PCR) method by reporting all of the following information:

a) pavement classification rating (PCR) and numerical value;

b) pavement type for ACR-PCR determination;

c) subgrade strength category;

d) maximum allowable tire pressure category or maximum allowable tire pressure value; and

e) evaluation method.

Note.— Guidance on reporting and publishing of PCRs is contained in the Aerodrome Design Manual (Doc 9157, Part 3).

2.6.3 Strength of pavements - Applicable as of 28 November 2024 (cont.)

The PCR reported shall indicate that aircraft with an aircraft classification rating (ACR) equal to or less than the reported PCR may operate on the pavement subject to any limitation on the tire pressure or aircraft all-up mass for specified aircraft type(s).

Note.— Different PCRs may be reported if the strength of the pavement is subject to significant seasonal variation.

2.6.4 Strength of pavements - Applicable as of 28 November 2024 (cont.)

The ACR of an aircraft shall be determined in accordance with the standard procedures associated with the ACR-PCR method.

Note.— The standard procedures for determining the ACR of an aircraft are given in the Aerodrome Design Manual (Doc 9157), Part 3. For convenience, dedicated software is available on the ICAO website for computing any aircraft ACR at any mass on rigid and flexible pavements for the four standard subgrade strength categories detailed in 2.6.6 b) below.

2.6.5 Strength of pavements - Applicable as of 28 November 2024 (cont.)

For the purposes of determining the ACR, the behaviour of a pavement shall be classified as equivalent to a rigid or flexible construction.

2.6.6 Strength of pavements - Applicable as of 28 November 2024 (cont.)

Information on pavement type for ACR-PCR determination, subgrade strength category, maximum allowable tire pressure category and evaluation method shall be reported using the following codes:

a) *Pavement type for ACR-PCR determination:*

	Code
Rigid pavement	R
Flexible pavement	F

Note.— If the actual construction is composite or non-standard, include a note to that effect.

b) *Subgrade strength category:*

	Code
High strength: characterized by E = 200 MPa and representing all E values equal to or above 150 MPa, for rigid and flexible pavements.	A

Medium strength: characterized by E = 120 MPa and representing a range in E values equal to or above 100 MPa and strictly less than 150 MPa, for rigid and flexible pavements.	B
Low strength: characterized by E = 80 MPa and representing a range in E values equal to or above 60 MPa and strictly less than 100 MPa, for rigid and flexible pavements.	C
Ultra-low strength: characterized by E = 50 MPa and representing all E values strictly less than 60 MPa, for rigid and flexible pavements.	D

c) *Maximum allowable tire pressure category:*

	Code
Unlimited: no pressure limit	W
High: pressure limited to 1.75 MPa	X
Medium: pressure limited to 1.25 MPa	Y
Low: pressure limited to 0.50 MPa *Note.— See Note 5 to 10.2.1 where the pavement is used by aircraft with tire pressures in the upper categories*.	Z

d) *Evaluation method:*

	Code
Technical evaluation: representing a specific study of the pavement characteristics and the types of aircraft which the pavement is intended to serve.	T
Using aircraft experience: representing a knowledge of the specific type and mass of aircraft satisfactorily being supported under regular use.	U

2.6.7 Strength of pavements - Applicable as of 28 November 2024 (cont.)

Except for aircraft emergency situation, an aerodrome operator may, subject to prior approval of the Authority, permit the use of a pavement by an aircraft with an ACR higher than the PCR reported for that pavement in accordance with 2.6.2 and 2.6.3.

Note.— Attachment A, Section 19, details a simple method for regulating overload operations while the Aerodrome Design Manual (Doc 9157), Part 3, includes the descriptions of more detailed procedures for evaluation of pavements and their suitability for restricted overload operations.

2.6.8 Strength of pavements - Applicable as of 28 November 2024 (cont.)

The bearing strength of a pavement intended for aircraft of apron (ramp) mass equal to or less than 5 700 kg shall be made available by reporting the following information:

a) maximum allowable aircraft mass; and

b) maximum allowable tire pressure.

Example: 4 800 kg/0.60 MPa.

2.7 Pre-flight altimeter check location

2.7.1 Pre-flight altimeter check location

One or more pre-flight altimeter check locations shall be established for an aerodrome by the aerodrome operator.

2.7.2 Pre-flight altimeter check location (cont.)

A pre-flight check location shall be located on an apron.

Note 1.— Locating a pre-flight altimeter check location on an apron enables an altimeter check to be made prior to obtaining taxi clearance and eliminates the need for stopping for that purpose after leaving the apron.

Note 2.— Normally an entire apron can serve as a satisfactory altimeter check location.

2.7.3 Pre-flight altimeter check location (cont.)

The elevation of a pre-flight altimeter check location shall be given as the average elevation, rounded to the nearest metre or foot, of the area on which it is located. The elevation of any portion of a pre-flight altimeter check location shall be within 3 m (10 ft) of the average elevation for that location.

2.8 Declared distances

2.8 Declared distances

The following distances shall be calculated by the aerodrome operator to the nearest metre or foot for a runway intended for use by international commercial air transport:

a) take-off run available (TORA);

b) take-off distance available (TODA);

c) accelerate-stop distance available (ASDA); and

d) landing distance available (LDA).

GM1 2.8 Declared Distances

Guidance on calculation of declared distances is given in Attachment A, Section 3.

2.9 Condition of the movement area and related facilities

2.9.1 Coordination

Information on the condition of the movement area and the operational status of related facilities shall be monitored and reported by the aerodrome operator to the organisation responsible for aeronautical information in Aruba, and similar information of operational significance to the air traffic services units, to enable those units to provide the necessary information to arriving and departing aircraft. The information shall be kept up to date by the aerodrome operator and changes in conditions shall be reported without delay.

Note.— The nature, format and conditions of the information to be provided are specified in the PANS-AIM (Doc 10066) and the PANS-ATM (Doc 4444). Specific procedures pertaining to works in progress on the movement area and to the reporting of such works are included in the PANS-Aerodromes (Doc 9981).

2.9.2 Reporting

The condition of the movement area and the operational status of related facilities shall be monitored, and reports on matters of operational significance affecting aircraft and aerodrome operations shall be provided by the aerodrome operator in order to take appropriate action, particularly in respect of the following:

a) construction or maintenance work;

b) rough or broken surfaces on a runway, a taxiway or an apron;

c) water, on a runway, a taxiway or an apron;

d) other temporary hazards, including parked aircraft;

e) failure or irregular operation of part or all of the aerodrome visual aids; and

f) failure of the normal or secondary power supply.

Note 1.— Other contaminants may include mud, dust, sand, volcanic ash, oil and rubber. Procedures for monitoring and reporting the conditions of the movement area are included in the PANS-Aerodromes (Doc 9981).

Note 2.— The Aeroplane Performance Manual (Doc 10064) provides guidance on aircraft performance calculation requirements regarding the description of runway surface condition in 2.9.2 c).

Note 3.— Origin and evolution of data, assessment process and the procedures are prescribed in the PANS-Aerodromes (Doc 9981). These procedures are intended to fulfil the requirements to achieve the desired level of safety for aeroplane operations prescribed by Annex 6 and Annex 8 and to provide the information fulfilling the syntax requirements for dissemination specified in Annex 15, PANS-AIM (Doc 10066) and the PANS-ATM (Doc 4444).

2.9.3 Aerodrome operator inspections

To facilitate compliance with 2.9.1 and 2.9.2, the following inspections shall be carried out each day by the aerodrome operator:

a) for the movement area, at least once where the aerodrome reference code number is 1 or 2 and at least twice where the aerodrome reference code number is 3 or 4; and

b) for the runway(s), inspections in addition to a) whenever the runway surface conditions may have changed significantly due to meteorological conditions.

Note 1.— Procedures on carrying out daily inspections of the movement area are given in the PANS-Aerodromes (Doc 9981). Further guidance is available in the Airport Services Manual (Doc 9137), Part 8, in the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476) and in the Advanced Surface Movement Guidance and Control Systems (A-SMGCS) Manual (Doc 9830).

Note 2.— The PANS-Aerodromes (Doc 9981) contains clarifications on the scope of a significant change in the runway surface conditions.

2.9.4 Training personnel

(a) The aerodrome operator shall establish and implement a training programme for the designated personnel involved in the assessing and reporting of runway surface conditions as required in 2.9.2 and 2.9.5 and ensure that they are aware of the rules and procedures relevant to operation of the aerodrome and the relationship of their functions and tasks to the aerodrome operation as a whole.

(b) The aerodrome operator shall ensure that personnel conducting movement area inspections shall be trained in, at least, the areas given in Attachment A, Section 6.

Note.— Information on training for personnel assessing and reporting runway surface conditions is available in the PANS-Aerodromes (Doc 9981).

Runway surface condition(s) for use in the runway condition report

Note.— The philosophy of the runway condition report is that the aerodrome operator shall assess the runway surface conditions whenever water is present on an operational runway. From this assessment, a runway condition code (RWYCC) and a description of the runway surface are reported which can be used by the flight crew for aeroplane performance calculations. See Attachment A, Section 6, for further details. The PANS-Aerodromes (Doc 9981) contains procedures on the use of the runway condition report and assignment of the RWYCC in accordance with the runway condition assessment matrix (RCAM).

2.9.5 Runway condition code (RWYCC)

The runway surface condition shall be assessed and reported by the aerodrome operator through a runway condition code (RWYCC) and a description using the following terms:

STANDING WATER

SLIPPERY WET

WET

CHEMICALLY TREATED

LOOSE SAND

Note 1.— The runway surface conditions are those conditions for which, by means of the methods described in the PANS-Aerodromes (Doc 9981), the flight crew can derive appropriate aeroplane performance.

Note 2.— The conditions, either singly or in combination with other observations, are criteria for which the effect on aeroplane performance is sufficiently deterministic to allow assignment of a specific runway condition code.

Note 3.— The terms CHEMICALLY TREATED and LOOSE SAND do not appear in the aeroplane performance section but are used in the situational awareness section of the runway condition report.

2.9.6 Assessment of the contaminant

Whenever an operational runway is contaminated, an assessment of the contaminant depth and coverage over each third of the runway shall be made and reported by the aerodrome operator.

Note.— Procedures on depth and coverage reporting are found in the PANS-Aerodromes (Doc 9981).

2.9.7

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2.9.8

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2.9.9 Slippery wet condition

The aerodrome operator shall make available information that a runway or portion thereof is slippery wet.

Note 1.— The surface friction characteristics of a runway or a portion thereof can be degraded due to rubber deposits, surface polishing, poor drainage or other factors. The determination that a runway or portion thereof is slippery wet stems from various methods used solely or in combination. These methods may be functional friction measurements, using a continuous friction measuring device, that fall below a minimum standard as defined by the Authority, observations by aerodrome maintenance personnel, repeated reports by pilots and aircraft operators based on flight crew experience, or through analysis of aeroplane stopping performance that indicates a substandard surface. Supplementary tools to undertake this assessment are described in the PANS-Aerodromes (Doc 9981).

Note 2.— See 2.9.1 and 2.13 concerning the provision of information to, and coordination between, appropriate organisations.

2.9.10 Notification to aerodrome users - NOTAM

Notification shall be given by the aerodrome operator to relevant aerodrome users when the friction level of a paved runway or portion thereof is less than the minimum friction level specified by the Authority in accordance with 10.2.3.

Note 1.— Procedures on conducting a runway surface friction characteristics evaluation programme are provided in the PANS-Aerodromes (Doc 9981).

Note 2.— The information to be promulgated in a NOTAM includes specifying which portion of the runway is below the minimum friction level and its location on the runway.

2.10 Disabled aircraft removal

2.10.1 Contact details

The contact details (telephone/telex number(s), email address etc.) of the office of the aerodrome coordinator of operations for the removal of an aircraft disabled on or adjacent to the movement area shall be made available, on request, by the aerodrome operator to aircraft operators.

Note.— See 9.3 for information on disabled aircraft removal services.

2.10.2 Information concerning capability

(1) Information concerning the capability to remove an aircraft disabled on or adjacent to the movement area shall be made available by the aerodrome operator.

(2) The capability to remove a disabled aircraft may be expressed in terms of the largest type of aircraft which the aerodrome is equipped to remove.

2.11 Rescue and firefighting

Note.— See.9.2 for information on rescue and firefighting services.

2.11.1 Availability of Information concerning the level of protection

Information concerning the level of protection provided at an aerodrome for aircraft rescue and firefighting purposes shall be made available by the aerodrome operator.

2.11.2 Categories of level of protection

The level of protection normally available at an aerodrome shall be expressed in terms of the category of the rescue and firefighting services as described in 9.2 and in accordance with the types and amounts of extinguishing agents normally available at the aerodrome.

2.11.3 Changes in the level of protection

Changes in the level of protection normally available at an aerodrome for rescue and firefighting shall be notified by the aerodrome operator to the Authority, the appropriate air traffic services units and organisation responsible for aeronautical information in Aruba to enable those units to provide the necessary information to arriving and departing aircraft. When such a change has been corrected, the above units shall be advised accordingly.

Note.— Changes in the level of protection from that normally available at the aerodrome could result from a change in the availability of extinguishing agents, equipment to deliver the agents or personnel to operate the equipment, etc.

2.11.4 Reporting of changes

A change shall be expressed in terms of the new category of the rescue and firefighting service available at the aerodrome.

2.12 Visual approach slope indicator systems

2.12 Visual approach slope indicator systems

The following information concerning a visual approach slope indicator system installation shall be made available by the aerodrome operator:

a) associated runway designation number;

b) type of system according to 5.3.5.2.

For an AT-VASIS, PAPI or APAPI installation, the side of the runway on which the lights are installed, i.e. left or right, shall be given;

c) where the axis of the system is not parallel to the runway centre line, the angle of displacement and the direction of displacement, i.e. left or right, shall be indicated;

d) nominal approach slope angle(s).

For a T-VASIS or an AT-VASIS this shall be angle ϴ according to the formula in Figure 5-18 and for a PAPI and an APAPI this shall be angle (B + C) ÷ 2 and (A + B) ÷ 2, respectively as in Figure 5-20; and

e) minimum eye height(s) over the threshold of the on-slope signal(s).

For a T-VASIS or an AT-VASIS this shall be the lowest height at which only the wing bar(s) are visible; however, the additional heights at which the wing bar(s) plus one, two or three fly-down light units come into view may also be reported if such information would be of benefit to aircraft using the approach.

For a PAPI this shall be the setting angle of the third unit from the runway minus 2', i.e. angle B minus 2', and for an APAPI this shall be the setting angle of the unit farther from the runway minus 2', i.e. angle A minus 2'.

2.13 Coordination between organisation responsible for aeronautical information in Aruba and aerodrome authorities

2.13.1 Coordination between aerodrome operator and organisation responsible for aeronautical information services in Aruba – General

To ensure that organisation responsible for aeronautical information in Aruba obtain information to enable them to provide up-to-date pre-flight information and to meet the need for in-flight information, arrangements shall be made between organisation responsible for aeronautical information in Aruba and aerodrome operator responsible for aerodrome services to report to the responsible aeronautical information services organisation, with a minimum of delay:

a) information on the status of certification of aerodromes and aerodrome conditions (ref.1.4, 2.9, 2.10, 2.11 and 2.12);

b) the operational status of associated facilities, services and navigation aids within their area of responsibility;

c) any other information considered to be of operational significance.

2.13.2 Formal arrangement

Before introducing changes to the air navigation system, the aerodrome operator shall take due account of the time needed by the organisation responsible for aeronautical information in Aruba for the preparation, production and issue of relevant material for promulgation. To ensure timely provision of the information to this organisation, close coordination between those services concerned is therefore required.

A formal arrangement must be presented to the authority for acceptance.

2.13.3 AIRAC system

Of a particular importance are changes to aeronautical information that affect charts and/or computer-based navigation systems which qualify to be notified by the aeronautical information regulation and control (AIRAC) system, as specified in Annex 15, Chapter 6. The predetermined, internationally agreed AIRAC effective dates shall be observed by the aerodrome operator when submitting the raw information/data to aeronautical information services.

Note.— Detailed specifications concerning the AIRAC system are contained in PANS-AIM (Doc 10066), Chapter 6.

2.13.4 Accuracy and integrity of raw data

The aerodrome operator shall provide the raw aeronautical information/data to the organisation responsible for aeronautical information in Aruba while taking into account accuracy and integrity requirements necessary to meet the needs of the end-user of aeronautical data.

Note 1.— Specifications concerning the accuracy and integrity classification of aerodrome-related aeronautical data are contained in PANS-AIM (Doc 10066), Appendix 1.

Note 2.— Specifications for the issue of NOTAM and SNOWTAM are contained in Annex 15, Chapter 6 and PANS-AIM (Doc 10066), Appendices 3 and 4, respectively.

Note 3.— AIRAC information is distributed by the AIS at least 42 days in advance of the AIRAC effective dates with the objective of reaching recipients at least 28 days in advance of the effective date.

Note 4.— The schedule of the predetermined internationally agreed AIRAC common effective dates at intervals of 28 days and guidance for the AIRAC use are contained in the Aeronautical Information Services Manual (Doc 8126, Chapter 2).

CHAPTER 3 PHYSICAL CHARACTERISTICS

3.1 Runways

3.1.1 Number and orientation of runways

The number and orientation of runways at an aerodrome shall be such that the usability factor of the aerodrome is not less than 95 per cent for the aeroplanes that the aerodrome is intended to serve.

GM1 3.1.1 Number and orientation of runways

(a) Many factors affect the determination of the orientation, siting and number of runways. One important factor is the usability factor, as determined by the wind distribution, which is specified hereunder. Another important factor is the alignment of the runway to facilitate the provision of approaches conforming to the approach surface specifications of Chapter 4. In Attachment A, Section 1, information is given concerning these and other factors.

(b) When a new instrument runway is being located, particular attention needs to be given to areas over which aeroplanes will be required to fly when following instrument approach and missed approach procedures, so as to ensure that obstacles in these areas or other factors will not restrict the operation of the aeroplanes for which the runway is intended.

3.1.2 Siting and orientation of runways

The siting and orientation of runways at an aerodrome shall, where possible, be such that the arrival and departure tracks minimize interference with areas approved for residential use and other noise-sensitive areas close to the aerodrome in order to avoid future noise problems.

Note.— Guidance on how to address noise problems is provided in the Airport Planning Manual (Doc 9184), Part 2, and in Guidance on the Balanced Approach to Aircraft Noise Management (Doc 9829).

3.1.3 Choice of maximum permissible crosswind components

In the application of 3.1.1 it shall be assumed that landing or take-off of aeroplanes is, in normal circumstances, precluded when the crosswind component exceeds:

— 37 km/h (20 kt) in the case of aeroplanes whose reference field length is 1 500 m or over, except that when poor runway braking action owing to an insufficient longitudinal coefficient of friction is experienced with some frequency, a crosswind component not exceeding 24 km/h (13 kt) shall be assumed;

— 24 km/h (13 kt) in the case of aeroplanes whose reference field length is 1 200 m or up to but not including 1 500 m; and

— 19 km/h (10 kt) in the case of aeroplanes whose reference field length is less than 1 200 m.

Note.— In Attachment A, Section 1, guidance is given on factors affecting the calculation of the estimate of the usability factor and allowances which may have to be made to take account of the effect of unusual circumstances.

3.1.4 Data to be used

The selection of data to be used for the calculation of the usability factor shall be based on reliable wind distribution statistics that extend over as long a period as possible, preferably of not less than five years. The observations used shall be made at least eight times daily and spaced at equal intervals of time.

Note.— These winds are mean winds. Reference to the need for some allowance for gusty conditions is made in Attachment A, Section 1.

3.1.5 Location of runway threshold

A threshold shall normally be located at the extremity of a runway unless operational considerations justify the choice of another location.

Note.— Guidance on the siting of the threshold is given in Attachment A, Section 10.

3.1.6 Displace of a threshold

When it is necessary to displace a threshold, either permanently or temporarily, from its normal location, account shall be taken of the various factors which may have a bearing on the location of the threshold. Where this displacement is due to an unserviceable runway condition, a cleared and graded area of at least 60 m in length shall be available between the unserviceable area and the displaced threshold. Additional distance shall also be provided to meet the requirements of the runway end safety area as appropriate.

Note.— Guidance on factors which may be considered in the determination of the location of a displaced threshold is given in Attachment A, Section 10.

3.1.7 Actual length of runways - Primary runway

Except as provided in 3.1.9, the actual runway length to be provided for a primary runway shall be adequate to meet the operational requirements of the aeroplanes for which the runway is intended and shall be not less than the longest length determined by applying the corrections for local conditions to the operations and performance characteristics of the relevant aeroplanes.

Note 1.— This specification does not necessarily mean providing for operations by the critical aeroplane at its maximum mass.

Note 2.— Both take-off and landing requirements need to be considered when determining the length of runway to be provided and the need for operations to be conducted in both directions of the runway.

Note 3.— Local conditions that may need to be considered include elevation, temperature, runway slope, humidity and the runway surface characteristics.

Note 4.— When performance data on aeroplanes for which the runway is intended are not known, guidance on the determination of the actual length of a primary runway by application of general correction factors is given in the Aerodrome Design Manual (Doc 9157), Part 1.

3.1.8 Actual length of runways - Secondary runway

If applicable, the length of a secondary runway shall be determined similarly to primary runways except that it needs only to be adequate for those aeroplanes which require to use that secondary runway in addition to the other runway or runways in order to obtain a usability factor of at least 95 per cent.

3.1.9 Actual length of runways - Runways with stopways or clearways

Where a runway is associated with a stopway or clearway, an actual runway length less than that resulting from application of 3.1.7 or 3.1.8, as appropriate, may be considered satisfactory, but in such a case any combination of runway, stopway and clearway provided shall permit compliance with the operational requirements for take-off and landing of the aeroplanes the runway is intended to serve.

Note.— Guidance on use of stopways and clearways is given in Attachment A, Section 2.

3.1.10 Width of runways

The width of a runway shall be not less than the appropriate dimension specified in the following tabulation:

Code Number	Outer Main Gear Wheel Span (OMGWS)			
	Up to but not including 4.5 m	4.5 m up to but not including 6 m	6 m up to but not including 9m	9 m up to but not including 15 m
1[a]	18 m	18 m	23 m	-
2[a]	23 m	23 m	30 m	-
3	30 m	30 m	30 m	45 m
4	-	-	45 m	45 m
[a] The width of a precision approach runway shall be not less than 30 m where the code number is 1 or 2.				

GM1 3.1.10 Width of runways

(a) The combinations of code numbers and OMGWS for which widths are specified have been developed for typical aeroplane characteristics.

(b) Factors affecting runway width are given in the Aerodrome Design Manual (Doc 9157), Part 1.

(c) See 3.2 concerning the provision of runway shoulders, in particular for Code F aeroplanes with four (or more) engines.

3.1.11 Minimum distance between parallel non-instrument runways

Where parallel non-instrument runways are intended for simultaneous use, the minimum distance between their centre lines shall be:

— 210 m where the higher code number is 3 or 4;

— 150 m where the higher code number is 2; and

— 120 m where the higher code number is 1.

GM1 3.1.11 Minimum distance between parallel non-instrument runways

Procedures for wake turbulence categorization of aircraft and wake turbulence separation minima are contained in the PANS-ATM (Doc 4444), Chapter 4, 4.9, and Chapter 5, 5.8, respectively.

3.1.12 Minimum distance between parallel instrument runways

Where parallel instrument runways are intended for simultaneous use subject to conditions specified in the PANS-ATM (Doc 4444) and the PANS-OPS (Doc 8168), Volume I, the minimum distance between their centre lines shall be:

— 1 035 m for independent parallel approaches;

— 915 m for dependent parallel approaches;

— 760 m for independent parallel departures;

— 760 m for segregated parallel operations;

except that:

a) for segregated parallel operations the specified minimum distance:

1) may be decreased by 30 m for each 150 m that the arrival runway is staggered toward the arriving aircraft, to a minimum of 300 m; and

2) shall be increased by 30 m for each 150 m that the arrival runway is staggered away from the arriving aircraft;

b) for independent parallel approaches, combinations of minimum distances and associated conditions other than those specified in the PANS-ATM (Doc 4444) may be applied when it is determined that such combinations would not adversely affect the safety of aircraft operations.

GM1 3.1.12 Minimum distance between parallel instrument runways

Procedures and facilities requirements for simultaneous operations on parallel or near-parallel instrument runways are contained in the PANS-ATM (Doc 4444), Chapter 6 and the PANS-OPS (Doc 8168), Volume I, Part III, Section 2, and Volume II, Part I, Section 3; Part II, Section 1; and Part III, Section 3, and relevant guidance is contained in the Manual on Simultaneous Operations on Parallel or Near-Parallel Instrument Runways (SOIR) (Doc 9643).

3.1.13 Longitudinal slopes on runways

The slope computed by dividing the difference between the maximum and minimum elevation along the runway centre line by the runway length shall not exceed:

— 1 per cent where the code number is 3 or 4; and

— 2 per cent where the code number is 1 or 2.

Note. — The safety objective of limiting the longitudinal runway slope is to enable stabilized and safe use of runway by an aircraft.

3.1.14 Longitudinal slopes on runways (cont.)

Along no portion of a runway shall the longitudinal slope exceed:

— 1.25 per cent where the code number is 4, except that for the first and last quarter of the length of the runway the longitudinal slope shall not exceed 0.8 per cent;

— 1.5 per cent where the code number is 3, except that for the first and last quarter of the length of a precision approach runway category II or III the longitudinal slope shall not exceed 0.8 per cent; and

— 2 per cent where the code number is 1 or 2.

3.1.15 Longitudinal slope changes on runways (cont.)

Where slope changes cannot be avoided, a slope change between two consecutive slopes shall not exceed:

— 1.5 per cent where the code number is 3 or 4; and

— 2 per cent where the code number is 1 or 2.

Note 1.— The safety objective of limiting the longitudinal runway slope changes is to avoid damage of aircraft and to enable safe use of runway by an aircraft.

Note 2.— Guidance on slope changes before a runway is given in Attachment A, Section 4.

3.1.16 Longitudinal slope changes on runways (cont.)

The transition from one slope to another shall be accomplished by a curved surface with a rate of change not exceeding:

— 0.1 per cent per 30 m (minimum radius of curvature of 30 000 m) where the code number is 4;

— 0.2 per cent per 30 m (minimum radius of curvature of 15 000 m) where the code number is 3; and

— 0.4 per cent per 30 m (minimum radius of curvature of 7 500 m) where the code number is 1 or 2.

GM1 3.1.6 Longitudinal slopes changes on runways

(a) Slope changes are so designed as to reduce dynamic loads on the undercarriage system of the aeroplane. Minimising slope changes is especially important on runways where aircraft move at high speeds.

(b) For precision approach runways, slopes in a specified area from the runway end, and including the touchdown area, are so designed that they should correspond to the characteristics needed for such type of approach.

3.1.17 Sight distance for slopes on runways

Where slope changes cannot be avoided, they shall be such that there will be an unobstructed line of sight from:

— any point 3 m above a runway to all other points 3 m above the runway within a distance of at least half the length of the runway where the code letter is C, D, E or F;

— any point 2 m above a runway to all other points 2 m above the runway within a distance of at least half the length of the runway where the code letter is B; and

— any point 1.5 m above a runway to all other points 1.5 m above the runway within a distance of at least half the length of the runway where the code letter is A.

Note.— The safety objective of minimum runway sight distance values is to achieve the necessary visibility to enable safe use of runway by an aircraft.

GM1 3.1.17 Sight distance for slopes on runways

(a) Runway longitudinal slopes and slopes changes are so designed that the pilot in the aircraft has an unobstructed line of sight over all or as much of the runway as possible, thereby enabling him to see aircraft or vehicles on the runway, and to be able to manoeuvre and take avoiding action

(b) Consideration will have to be given to providing an unobstructed line of sight over the entire length of a single runway where a full-length parallel taxiway is not available. Where an aerodrome has intersecting runways, additional criteria on the line of sight of the intersection area would need to be considered for operational safety. See the Aerodrome Design Manual (Doc 9157), Part 1.

3.1.18 Distance between slope changes on runways

Undulations or appreciable changes in slopes located close together along a runway shall be avoided. The distance between the points of intersection of two successive curves shall not be less than:

a) the sum of the absolute numerical values of the corresponding slope changes multiplied by the appropriate value as follows:

— 30 000 m where the code number is 4;

— 15 000 m where the code number is 3; and

— 5 000 m where the code number is 1 or 2; or

b) 45 m;

whichever is greater.

Note.— Guidance on implementing this specification is given in Attachment A, Section 4.

3.1.19 Transverse slopes on runways

To promote the most rapid drainage of water, the runway surface should, if practicable, be cambered except where a single crossfall from high to low in the direction of the wind most frequently associated with rain would ensure rapid drainage. The transverse slope shall ideally be:

— 1.5 per cent where the code letter is C, D, E or F; and

— 2 per cent where the code letter is A or B;

but in any event shall not exceed 1.5 per cent or 2 per cent, as applicable, nor be less than 1 per cent except at runway or taxiway intersections where flatter slopes may be necessary.

For a cambered surface the transverse slope on each side of the centre line shall be symmetrical.

Note 1.— The safety objective of runway transverse slopes is to promote the most rapid drainage of water from the runway.

Note 2.— On wet runways with crosswind conditions the problem of aquaplaning from poor drainage is apt to be accentuated. Additional guidance is included in the Aerodrome Design Manual (Doc 9157), Parts 1 and 3.

3.1.20 Transverse slopes on runways (cont.)

The transverse slope shall be substantially the same throughout the length of a runway except at an intersection with another runway or a taxiway where an even transition shall be provided taking account of the need for adequate drainage.

Note.— Guidance on transverse slope is given in the Aerodrome Design Manual (Doc 9157), Part 3.

3.1.21 Strength of runways

The runway shall be of sufficient strength to support normal operations of the most demanding aircraft without risk of damage either to the aeroplane or the runway.

GM1 3.1.21 Strength of runways

Additional information on the bearing strength, the design and evaluation of pavements is given in ICAO Doc 9157, Aerodrome Design Manual, Part 3, Pavements.

3.1.22 Surface of runways

The surface of a runway shall be constructed without irregularities that would impair the runway surface friction characteristics or otherwise adversely affect the take-off or landing of an aeroplane.

GM1 3.1.22 Surface of runways

(a) Surface irregularities may adversely affect the take-off or landing of an aeroplane by causing excessive bouncing, pitching, vibration, or other difficulties in the control of an aeroplane.

(b) Guidance on design tolerances and other information is given in Attachment A, Section 5. Additional guidance is included in the Aerodrome Design Manual (Doc 9157), Part 3.

3.1.23 Surface of runways (cont.)

A paved runway shall be so constructed or resurfaced as to provide surface friction characteristics at or above the minimum friction level set by the Authority.

3.1.24 Surface of runways (cont.)

(a) The surface of a paved runway shall be evaluated by the aerodrome operator when constructed or resurfaced to determine that the surface friction characteristics achieve the design objectives established.

(b) The surface friction characteristics design objectives for paved runway when constructed or resurfaced shall meet the following criteria:

Runway surface condition levels – Design objective for new surface

Test equipment	65 km/h	95 km/h
Mu-meter Trailer	0.72	0.66
Skiddometer Trailer	0.82	0.74
Surface Friction Tester Vehicle	0.82	0.74
Runway Friction Tester Vehicle	0.82	0.74
TATRA Friction Tester Vehicle	0.76	0.67
RUNAR Trailer	0.69	0.63
GRIPTESTER Trailer	0.74	0.64

(c) Other friction measuring devices can be used, provided they have been correlated with, at least, one test equipment mentioned in the table above.

(d) A complete survey shall ensure that the runway surface is able to create enough grip by the aeroplane tyre to ensure adequate aeroplane stopping and crosswind capability for the desired operation on a wet runway. This is achieved by ensuring that:

- (1) exposed texture can indent the tyre rubber; and
- (2) water drains from the runway pavement.

(e) In order to achieve the objectives of point (d), an inspection of the surface friction characteristics shall, as a minimum, ensure:

- (1) the presence of exposed microtexture by touching the aggregates, if the polished or rubber coated extends to 100 m in the zone used by aeroplanes;
- (2) the presence of macrotexture;
- (3) that grooves, if present, are open and within set limits according to their design;
- (4) that porous friction course, if present, drains according to its design; and
- (5) that slopes are above minimum design specifications.

3.1.25 Surface of runways (cont.) - Measurements of the surface friction characteristics

Measurements of the surface friction characteristics of a new or resurfaced paved runway shall be made with a continuous friction measuring device using self-wetting features.

GM 3.1.25 Surface of runways (cont.) - Measurements of the surface friction characteristics

Additional guidance is included in the Airport Services Manual (Doc 9137), Part 2.

3.1.26 Surface of runways (cont.) - Surface texture depth

The average depth of a new surface shall be not less than 1.0 mm.

GM1 3.1.26 Surface of runways (cont.) - Surface texture depth

(a) Macrotexture and microtexture are taken into consideration in order to provide the required surface friction characteristics. Guidance on surface design is given in Attachment A, Section 7.

(b) Guidance on methods used to measure surface texture is given in the Airport Services Manual (Doc 9137), Part 2.

(c) Guidance on design and methods for improving surface texture is given in the Aerodrome Design Manual (Doc 9157), Part 3.

3.1.27 Surface of runways (cont.) - Surface that is grooved or scored

When the surface is grooved or scored, the grooves or scorings shall be either perpendicular to the runway centre line or parallel to non-perpendicular transverse joints, where applicable.

GM1 3.1.27 Surface of runways (cont.) - Surface that is grooved or scored

Guidance on methods for improving the runway surface texture is given in the Aerodrome Design Manual (Doc 9157), Part 3.

3.2 Runway shoulders

3.2.1 Runway shoulders – General

(a) The safety objective of a runway shoulder is that it shall be so constructed as to mitigate any hazard to an aircraft running off the runway or stopway or to avoid the ingestion of loose stones or other objects by turbine engines.

(b) Runway shoulders shall be provided for a runway where the code letter is D, E or F.

GM1 3.2.1 Runway shoulders – General

Guidance on characteristics and treatment of runway shoulders is given in Attachment A, Section 8, and in the Aerodrome Design Manual (Doc 9157), Part 1.

3.2.2 Width of runway shoulders

For aeroplanes with OMGWS from 9 m up to but not including 15 m, the runway shoulders shall extend symmetrically on each side of the runway so that the overall width of the runway and its shoulders is not less than:

— 60 m where the code letter is D or E;

— 60 m where the code letter is F with two- or three-engined aeroplanes; and

— 75 m where the code letter is F with four (or more)-engined aeroplanes.

3.2.3 Slopes on runway shoulders

(a) The safety objective of runway shoulder transverse slopes is to promote the most rapid drainage of water from the runway and runway shoulder.

(b) The surface of the shoulder that abuts the runway shall be flush with the surface of the runway and its transverse slope shall not exceed 2.5 per cent.

3.2.4 Strength of runway shoulders

The portion of a runway shoulder between the runway edge and a distance of 30 m from the runway centre line shall be prepared or constructed so as to be capable, in the event of an aeroplane running off the runway, of supporting the aeroplane without inducing structural damage to the aeroplane and of supporting ground vehicles which may operate on the shoulder.

Note.— Guidance on strength of runway shoulders is given in the Aerodrome Design Manual (Doc 9157), Part 1.

3.2.5 Surface of runway shoulders

A runway shoulder shall be prepared or constructed so as to resist erosion and the ingestion of the surface material by aeroplane engines.

3.2.6 Runway shoulders for code letter F aeroplanes

Runway shoulders for code letter F aeroplanes shall be paved to a minimum overall width of runway and shoulder of not less than 60 m.

Note.— Guidance on surface of runway shoulders is given in the Aerodrome Design Manual, (Doc 9157), Part 1.

3.3 Runway turn pads

3.3.1 Runway turn pads - general

(a) The safety objective of the runway turn pad is to facilitate a safe 180-degree turn by aeroplanes on runway ends that are not served by a taxiway or taxiway turnaround.

(b) Where the end of a runway is not served by a taxiway or a taxiway turnaround and where the code letter is D, E or F, a runway turn pad shall be provided to facilitate a 180-degree turn of aeroplanes. (See Figure 3-1.)

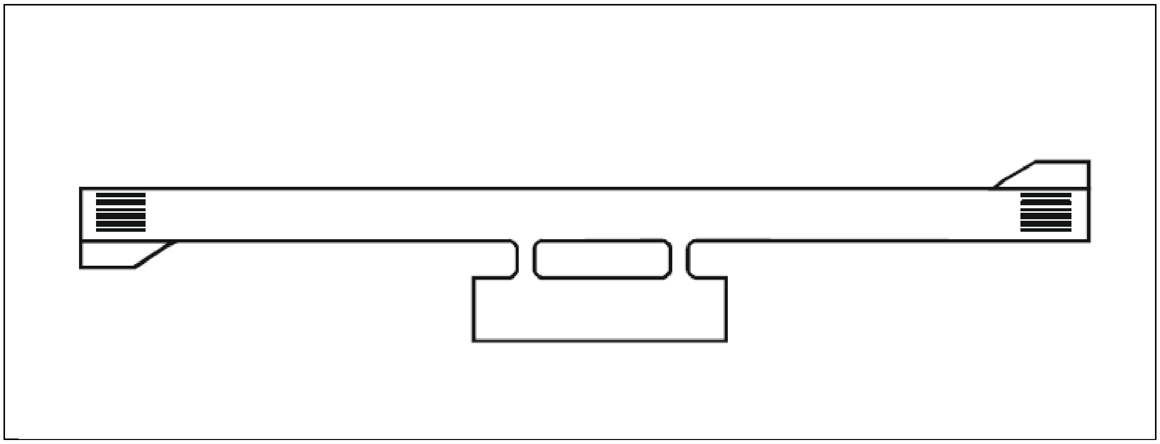

Figure 3-1. Typical turn pad layout

3.3.2 Runway turn pads - general (cont.)

Where the end of a runway is not served by a taxiway or a taxiway turnaround and where the code letter is A, B or C, a runway turn pad shall be provided to facilitate a 180-degree turn of aeroplanes.

Note 1.— Such areas may also be useful if provided along a runway to reduce taxiing time and distance for aeroplanes which may not require the full length of the runway.

Note 2.— Guidance on the design of the runway turn pads is available in the Aerodrome Design Manual (Doc 9157), Part 1. Guidance on taxiway turnaround as an alternate facility is available in the Aerodrome Design Manual (Doc 9157), Part 2.

3.3.3 Runway turn pads - location

The runway turn pad may be located on either the left or right side of the runway and adjoining the runway pavement at both ends of the runway and at some intermediate locations where deemed necessary.

Note.— The initiation of the turn would be facilitated by locating the turn pad on the left side of the runway, since the left seat is the normal position of the pilot-in-command.

3.3.4 Intersection angle of the runway turn pad

The intersection angle of the runway turn pad with the runway shall not exceed 30 degrees.

3.3.5 Runway turn pad - nose wheel steering angle to be

The nose wheel steering angle to be used in the design of the runway turn pad shall not exceed 45 degrees.

3.3.6 Design of a runway turn pad

The design of a runway turn pad shall be such that, when the cockpit of the aeroplane for which the turn pad is intended remains over the turn pad marking, the clearance distance between any wheel of the aeroplane landing gear and the edge of the turn pad shall be not less than that given by the following tabulation:

	Outer Main Gear Wheel Span (OMGWS)			
	Up to but not including 4.5 m	**4.5 m up to but not including 6 m**	**6 m up to but not including 9 m**	**9 m up to but not including 15 m**
Clearance	1.50 m	2.25 m	3 m[a] or 4 m[b]	4 m

a. *If the turn pad is intended to be used by aeroplanes with a wheel base less than 18 m.*
b. *If the turn pad is intended to be used by aeroplanes with a wheel base equal to or greater than 18 m.*

Note: Wheel base means the distance from the nose gear to the geometric centre of the main gear.

3.3.7 Slopes on runway turn pads

The longitudinal and transverse slopes on a runway turn pad shall be sufficient to prevent the accumulation of water on the surface and facilitate rapid drainage of surface water. The slopes shall be the same as those on the adjacent runway pavement surface.

GM1 3.3.7 Slopes on runway turn pads

Slopes should be so designed as to minimise impact on aircraft and so not to hamper the operation of aircraft.

3.3.8 Strength of runway turn pads

The strength of a runway turn pad shall be at least equal to that of the adjoining runway which it serves, due consideration being given to the fact that the turn pad will be subjected to slow-moving traffic making hard turns and consequent higher stresses on the pavement.

Note.— Where a runway turn pad is provided with flexible pavement, the surface would need to be capable of withstanding the horizontal shear forces exerted by the main landing gear tires during turning manoeuvres.

3.3.9 Surface of runway turn pads

The surface of a runway turn pad shall not have surface irregularities that may cause damage to an aeroplane using the turn pad.

3.3.10 Surface of runway turn pads - provide surface friction characteristics

The surface of a runway turn pad shall be so constructed or resurfaced as to provide surface friction characteristics at least equal to that of the adjoining runway.

3.3.11 Width of shoulders for runway turn pads

The runway turn pads shall be provided with shoulders of such width as is necessary to prevent surface erosion by the jet blast of the most demanding aeroplane for which the turn pad is intended, and any possible foreign object damage to the aeroplane engines.

GM1 3.3.11 Width of shoulders for runway turn pads

As a minimum, the width of the shoulders would need to cover the outer engine of the most demanding aeroplane and thus may be wider than the associated runway shoulders.

3.3.12 Strength of shoulders for runway turn pads

The strength of runway turn pad shoulders shall be capable of withstanding the occasional passage of the aeroplane it is designed to serve without inducing structural damage to the aeroplane and to the supporting ground vehicles that may operate on the shoulder.

3.4 Runway strips

3.4.1 Runway strip to be provided

(a) The safety objective of the runway strip is to reduce the risk of damage to an aircraft accidentally running off the runway, to protect aircraft flying over it when taking-off or landing, and to enable safe use by rescue and firefighting (RFF) vehicles.

(b) A runway and any associated stopways shall be included in a strip.

3.4.2 Length of runway strips

A strip shall extend before the threshold and beyond the end of the runway or stopway for a distance of at least:

— 60 m where the code number is 2, 3 or 4;

— 60 m where the code number is 1 and the runway is an instrument one; and

— 30 m where the code number is 1 and the runway is a non-instrument one.

3.4.3 Width of runway strips - precision approach runway

A strip including a precision approach runway shall, wherever practicable, extend laterally to a distance of at least:

— 140 m where the code number is 3 or 4; and

— 70 m where the code number is 1 or 2;

on each side of the centre line of the runway and its extended centre line throughout the length of the strip.

3.4.4 Width of runway strips – non-precision approach runway

A strip including a non-precision approach runway shall extend laterally to a distance of at least:

— 140 m where the code number is 3 or 4; and

— 70 m where the code number is 1 or 2;

on each side of the centre line of the runway and its extended centre line throughout the length of the strip.

3.4.5 Width of runway strips – non-instrument runway

A strip including a non-instrument runway shall extend on each side of the centre line of the runway and its extended centre line throughout the length of the strip, to a distance of at least:

— 75 m where the code number is 3 or 4;

— 40 m where the code number is 2; and

— 30 m where the code number is 1.

3.4.6 Objects on runway strips

An object situated on a runway strip which may endanger aeroplanes shall be regarded as an obstacle and shall, as far as practicable, be removed.

GM1 3.4.6 Objects on runway strips

(a) See 9.9 for information regarding siting of equipment and installations on runway strips.

(b) Consideration will have to be given to the location and design of drains on a runway strip to prevent damage to an aeroplane accidentally running off a runway. Suitably designed drain covers may be required. For further guidance, see the Aerodrome Design Manual (Doc 9157), Part 1.

(c) Where open-air or covered storm water conveyances are installed, consideration will have to be given to ensure that their structure does not extend above the surrounding ground so as not to be considered an obstacle. See also GM1 3.1.15 & 3.4.16.

(d) Particular attention needs to be given to the design and maintenance of an open-air storm water conveyance in order to prevent wildlife attraction, notably birds. If needed, it can be covered by a net. Procedures on wildlife management are specified in the PANS-Aerodromes (Doc 9981). Further guidance can be found in the Airport Services Manual (Doc 9137), Part 3.

3.4.7 Objects on runway strips (cont.)

No fixed object, other than visual aids required for air navigation or those required for aircraft safety purposes and which must be sited on the runway strip, and satisfying the relevant frangibility requirement in Chapter 5, shall be permitted on any part of a runway strip of a precision approach runway delineated by the lower edges of the inner transitional surfaces. No mobile object shall be permitted on this part of the runway strip during the use of the runway for landing or take-off.

Note.— See Chapter 4, 4.1, for characteristics of inner transitional surfaces.

3.4.8 Grading of runway strips - instrument runway

That portion of a strip of an instrument runway within a distance of at least:

— 75 m where the code number is 3 or 4; and

— 40 m where the code number is 1 or 2;

from the centre line of the runway and its extended centre line shall provide a graded area for aeroplanes which the runway is intended to serve in the event of an aeroplane running off the runway.

GM1 3.4.8 Grading of runway strips - instrument runway

Guidance on grading of a greater area of a strip including a precision approach runway where the code number is 3 or 4 is given in Attachment A, Section 8.

3.4.9 Grading of runway strips – non-instrument runway

That portion of a strip of a non-instrument runway within a distance of at least:

— 75 m where the code number is 3 or 4;

— 40 m where the code number is 2; and

— 30 m where the code number is 1;

from the centre line of the runway and its extended centre line shall provide a graded area for aeroplanes which the runway is intended to serve in the event of an aeroplane running off the runway.

3.4.10 Strip that abuts a runway, shoulder or stopway

The surface of that portion of a strip that abuts a runway, shoulder or stopway shall be flush with the surface of the runway, shoulder or stopway.

3.4.11 Strip before the start of a runway

That portion of a strip to at least 30 m before the start of a runway shall be prepared against blast erosion in order to protect a landing aeroplane from the danger of an exposed edge.

GM1 3.4.11 Strip before the start of a runway

(a) The area provided to reduce the erosive effects of jet blast and propeller wash may be referred to as a blast pad.

(b) Guidance on protection against aeroplane engine blast is available in the Aerodrome Design Manual (Doc 9157), Part 2.

3.4.12 Paved strip before the start of a runway

Where the areas in 3.4.11 have paved surfaces, they shall be able to withstand the occasional passage of the critical aeroplane for runway pavement design.

3.4.13 Longitudinal slopes on runway strips

(a) The safety objective of longitudinal runway strip slope is to define maximum gradient values that shall not interfere with the safe use of the runway strip by an aircraft.

(b) A longitudinal slope along that portion of a strip to be graded shall not exceed:

— 1.5 per cent where the code number is 4;

— 1.75 per cent where the code number is 3; and

— 2 per cent where the code number is 1 or 2.

3.4.14 Graded longitudinal slope changes

Slope changes on that portion of a strip to be graded shall be as gradual as practicable and abrupt changes or sudden reversals of slopes avoided.

3.4.15 Transverse slopes on runway strips

Transverse slopes on that portion of a strip to be graded shall be adequate to prevent the accumulation of water on the surface but shall not exceed:

— 2.5 per cent where the code number is 3 or 4; and

— 3 per cent where the code number is 1 or 2;

except that to facilitate drainage the slope for the first 3 m outward from the runway, shoulder or stopway edge shall be negative as measured in the direction away from the runway and may be as great as 5 per cent.

3.4.16 Graded transverse slopes on runway strips

The transverse slopes of any portion of a strip beyond that to be graded shall not exceed an upward slope of 5 per cent as measured in the direction away from the runway.

GM1 3.4.15 & 3.4.16 Transverse slopes on runway strips

(a) Where deemed necessary for proper drainage, an open-air storm water conveyance may be allowed in the non-graded portion of a runway strip and would be placed as far as practicable from the runway.

(b) The aerodrome rescue and firefighting (RFF) procedure would need to take into account the location of open-air water conveyances within the non-graded portion of a runway strip.

3.4.17 Strength of runway strips – instrument runway

That portion of a strip of an instrument runway within a distance of at least:

— 75 m where the code number is 3 or 4; and

— 40 m where the code number is 1 or 2;

from the centre line of the runway and its extended centre line shall be so prepared or constructed as to minimize hazards arising from differences in load-bearing capacity to aeroplanes which the runway is intended to serve in the event of an aeroplane running off the runway.

Note.— Guidance on preparation of runway strips is given in the Aerodrome Design Manual (Doc 9157), Part 1.

3.4.18 Strength of runway strips – non-instrument runway

That portion of a strip containing a non-instrument runway within a distance of at least:

— 75 m where the code number is 3 or 4;

— 40 m where the code number is 2; and

— 30 m where the code number is 1;

from the centre line of the runway and its extended centre line shall be so prepared or constructed as to minimize hazards arising from differences in load-bearing capacity to aeroplanes which the runway is intended to serve in the event of an aeroplane running off the runway.

GM1 3.4.17 & 3.4.18 Strength of runway strips

Since the graded portion of a strip is provided to minimise the hazard to an aircraft running off the runway, it should grant sufficient strength in such a manner as to prevent the collapse of the nose landing gear of the aircraft. The surface should be prepared in such a manner as to provide drag to an aircraft and below the surface, it should have sufficient bearing strength to avoid damage to the aircraft. To meet these divergent needs, the following guidelines are provided for preparing the strip. It is noted, that a depth of 15 cm is a depth to which the nose gear may sink without collapsing. Therefore, it is recommended that the soil at a depth of 15 cm below the finished strip surface should be prepared to have a sufficient stability, demonstrated by bearing strength of California Bearing Ratio (CBR) value of 15 to 20. The intention of this is to prevent the nose gear from damage. The top 15 cm may be of lesser strength which would facilitate deceleration of aircraft. There are also other methods for soil investigation. In case of a deeper sinking than 15 cm, the maximum wheel sinking without collapsing should be examined by using different methods of soil investigation.

3.5 Runway end safety areas (RESA)

3.5.1 Runway end safety areas (RESA)

(a) The safety objective of the runway end safety area (RESA) is to minimise risks to aircraft and their occupants when an aeroplane overruns or undershoots a runway

(b) A runway end safety area shall be provided at each end of a runway strip where:

— the code number is 3 or 4; and

— the code number is 1 or 2 and the runway is an instrument one.

GM1 3.5.1 Runway end safety areas (RESA)

Guidance on runway end safety areas is given in Attachment A, Section 9.

3.5.2 Runway end safety areas (RESA) (cont.)

A runway end safety area shall be provided at each end of a runway strip where the code number is 1 or 2 and the runway is a non-instrument one.

3.5.3 Length of runway end safety areas (RESA)

A runway end safety area shall extend from the end of a runway strip to a distance of at least 90 m where:

— the code number is 3 or 4; and

— the code number is 1 or 2 and the runway is an instrument one.

If an arresting system is installed, the above length may be reduced, based on the design specification of the system, subject to acceptance by the Authority.

Note.— Guidance on arresting systems is given in *Attachment A, Section 9.*

3.5.4 Dimensions of runway end safety areas

A runway end safety area shall, as far as practicable, extend from the end of a runway strip to a distance of at least:

— 240 m where the code number is 3 or 4; or a reduced length when an arresting system is installed;

— 120 m where the code number is 1 or 2 and the runway is an instrument one; or a reduced length when an arresting system is installed; and

— 30 m where the code number is 1 or 2 and the runway is a non-instrument one.

GM1 3.5.4 Dimensions of runway end safety areas

It is accepted that many aerodromes were constructed before requirements for RESAs were introduced. For applicable runways where the RESA does not extend to the recommended distance, as part of their Safety Management System, aerodromes should assess the risk and implement appropriate and suitable mitigation measures as necessary. The risk assessment and the mitigation measures must be submitted for acceptance to the Authority. See 1.2.4.

3.5.5 Width of runway end safety area

The width of a runway end safety area shall be at least twice that of the associated runway.

3.5.6 Width of runway end safety area (cont.)

The width of a runway end safety area shall, wherever practicable, be equal to that of the graded portion of the associated runway strip.

3.5.7 Objects on runway end safety areas

An object situated on a runway end safety area which may endanger aeroplanes shall be regarded as an obstacle and should, as far as practicable, be removed.

GM1 3.5.7 Objects on runway end safety areas

Information regarding siting of equipment and installations on runway end safety areas is detailed in 9.9.

3.5.8 Clearing and grading of runway end safety areas

A runway end safety area shall provide a cleared and graded area for aeroplanes which the runway is intended to serve in the event of an aeroplane undershooting or overrunning the runway.

GM1 3.5.8 Clearing and grading of runway end safety areas

(a) The surface of the ground in the runway end safety area does not need to be prepared to the same quality as the runway strip. See, however, 3.5.12.

(b) Guidance on clearing and grading of runway end safety areas is given in ICAO Doc 9157, Aerodrome Design Manual, Part 1, Runways.

3.5.9 Slopes on runway end safety areas - General

The slopes of a runway end safety area shall be such that no part of the runway end safety area penetrates the approach or take-off climb surface.

3.5.10 Longitudinal slopes on runway end safety areas

The longitudinal slopes of a runway end safety area shall not exceed a downward slope of 5 per cent. Longitudinal slope changes shall be as gradual as practicable and abrupt changes or sudden reversals of slopes avoided.

3.5.11 Transverse slopes on runway end safety areas

The transverse slopes of a runway end safety area shall not exceed an upward or downward slope of 5 per cent. Transitions between differing slopes shall be as gradual as practicable.

3.5.12 Strength of runway end safety areas

A runway end safety area shall be so prepared or constructed as to reduce the risk of damage to an aeroplane undershooting or overrunning the runway, enhance aeroplane deceleration and facilitate the movement of rescue and firefighting vehicles as required in 9.2.33 to 9.2.35.

GM1 3.5.12 Strength of runway end safety areas

Guidance on the strength of a runway end safety area is given in the Aerodrome Design Manual (Doc 9157), Part 1.

3.6 Clearways

3.6.1 Location

(a) The inclusion of detailed specifications for clearways in this section is not intended to imply that a clearway has to be provided. Attachment A, Section 2, provides information on the use of clearways.

(b) The origin of a clearway shall be at the end of the take-off run available.

3.6.2 Length of clearways

The length of a clearway shall not exceed half the length of the take-off run available.

3.6.3 Width of clearways

A clearway shall extend laterally on each side of the extended centre line of the runway, to a distance of at least:

a) 75 m for instrument runways; and

b) half of the width of the runway strip for non-instrument runways.

3.6.4 Slopes on clearways

The ground in a clearway shall not project above a plane having an upward slope of 1.25 per cent, the lower limit of this plane being a horizontal line which:

a) is perpendicular to the vertical plane containing the runway centre line; and

b) passes through a point located on the runway centre line at the end of the take-off run available.

GM1 3.6.4 Slopes on clearways

Because of transverse or longitudinal slopes on a runway, shoulder or strip, in certain cases the lower limit of the clearway plane specified above may be below the corresponding elevation of the runway, shoulder or strip. It is not intended that these surfaces be graded to conform with the lower limit of the clearway plane nor is it intended that terrain or objects which are above the clearway plane beyond the end of the strip but below the level of the strip be removed unless it is considered they may endanger aeroplanes.

3.6.5 Slopes on clearways (cont.)

Abrupt upward changes in slope shall be avoided when the slope on the ground in a clearway is relatively small or when the mean slope is upward. In such situations, in that portion of the clearway within a distance of 22.5 m or half the runway width whichever is greater on each side of the extended centre line, the slopes, slope changes and the transition from runway to clearway shall generally conform with those of the runway with which the clearway is associated.

3.6.6 Objects on clearways

An object situated on a clearway which may endanger aeroplanes in the air shall be regarded as an obstacle and shall be removed.

Note.— See 9.9 for information regarding siting of equipment and installations on clearways.

3.7 Stopways

3.7.0 Stopways — general

The inclusion of detailed specifications for stopways in this section is not intended to imply that a stopway has to be provided. Attachment A, Section 2, provides information on the use of stopways.

3.7.1 Width of stopways

A stopway shall have the same width as the runway with which it is associated.

3.7.2 Slopes on stopways

Slopes and changes in slope on a stopway, and the transition from a runway to a stopway, shall comply with the specifications of 3.1.13 to 3.1.19 for the runway with which the stopway is associated except that:

a) the limitation in 3.1.14 of a 0.8 per cent slope for the first and last quarter of the length of a runway need not be applied to the stopway; and

b) at the junction of the stopway and runway and along the stopway the maximum rate of slope change may be 0.3 per cent per 30 m (minimum radius of curvature of 10 000 m) for a runway where the code number is 3 or 4.

3.7.3 Strength of stopways

A stopway shall be prepared or constructed so as to be capable, in the event of an abandoned take-off, of supporting the aeroplane which the stopway is intended to serve without inducing structural damage to the aeroplane.

Note.— Attachment A, Section 2, presents guidance relative to the support capability of a stopway.

3.7.4 Surface of stopways

The surface of a paved stopway shall be so constructed or resurfaced as to provide surface friction characteristics at or above those of the associated runway.

3.8 Radio altimeter operating area

3.8.1 General

A radio altimeter operating area shall be established in the pre-threshold area of a precision approach runway.

3.8.2 Length of the area

A radio altimeter operating area shall extend before the threshold for a distance of at least 300 m.

3.8.3 Width of the area

A radio altimeter operating area shall extend laterally, on each side of the extended centre line of the runway, to a distance of 60 m, except that, when special circumstances so warrant, the distance may be reduced to no less than 30 m if an aeronautical study indicates that such reduction would not affect the safety of operations of aircraft.

3.8.4 Longitudinal slope changes

On a radio altimeter operating area, slope changes shall be avoided or kept to a minimum. Where slope changes cannot be avoided, the slope changes shall be as gradual as practicable and abrupt changes or sudden reversals of slopes avoided. The rate of change between two consecutive slopes shall not exceed 2 per cent per 30 m.

Note.— Guidance on radio altimeter operating area is given in Attachment A, Section 4.3, and in the Manual of All- Weather Operations, (Doc 9365), Section 5.2. Guidance on the use of radio altimeter is given in the PANS-OPS, Volume II, Part II, Section 1.

3.9 Taxiways

3.9.0 Applicability

Unless otherwise indicated, the requirements in this section are applicable to all types of taxiways.

GM1 3.9.0 Applicability

(a) See section 5.4.3 for a standardized scheme for the nomenclature of taxiways which may be used to improve situational awareness and as a part of an effective runway incursion prevention measure.

(b) See Attachment A, Section 21, for specific taxiway design guidance which may assist in the prevention of runway incursions when developing a new taxiway or improving existing ones with known runway incursion safety risks.

3.9.1 General

Taxiways shall be provided to permit the safe and expeditious surface movement of aircraft.

Note.— Guidance on layout and standardized nomenclature of taxiways is given in the Aerodrome Design Manual (Doc 9157), Part 2.

3.9.2 Sufficient entrance and exit

Sufficient entrance and exit taxiways for a runway shall be provided to expedite the movement of aeroplanes to and from the runway and provision of rapid exit taxiways considered when traffic volumes are high.

3.9.3 Design of a taxiway

The design of a taxiway shall be such that, when the cockpit of the aeroplane for which the taxiway is intended remains over the taxiway centre line markings, the clearance distance between the outer main wheel of the aeroplane and the edge of the taxiway shall be not less than that given by the following tabulation:

Outer Main Gear Wheel Span (OMGWS)				
	Up to but not including 4.5 m	4.5 m up to but not including 6 m	6 m up to but not including 9 m	9 m up to but not including 15 m
Clearance	1.50 m	2.25 m	3 m[a,b] or 4 m[c]	4 m

[a] On straight portions.

[b] On curved portions if the taxiway is intended to be used by aeroplanes with a wheel base of less than 18 m.

[c] On curved portions if the taxiway is intended to be used by aeroplanes with a wheel base equal to or greater than 18 m.

Note.— Wheel base means the distance from the nose gear to the geometric centre of the main gear.

3.9.4 Width of taxiways

A straight portion of a taxiway shall have a width of not less than that given by the following tabulation:

Outer Main Gear Wheel Span (OMGWS)				
	Up to but not including 4.5 m	4.5 m up to but not including 6 m	6 m up to but not including 9 m	9 m up to but not including 15 m
Taxiway width	7.5 m	10.5 m	15	23 m

GM1 3.9.4 Width of taxiways

(a) The width of the taxiway should be measured at the edge of the paved surface, or where the taxiway edge is marked, at the outside edge of the taxiway edge marking

(b) Guidance on width of taxiways is given in the Aerodrome Design Manual (Doc 9157), Part 2.

3.9.5 Taxiway curves

Changes in direction of taxiways shall be as few and small as possible. The radii of the curves shall be compatible with the manoeuvring capability and normal taxiing speeds of the aeroplanes for which the taxiway is intended.

The design of the curve shall be such that, when the cockpit of the aeroplane remains over the taxiway centre line markings, the clearance distance between the outer main wheels of the aeroplane and the edge of the taxiway shall not be less than those specified in 3.9.3.

GM1 3.9.5 Taxiway curves

(a) An example of widening taxiways to achieve the wheel clearance specified is illustrated in Figure 3-2. Guidance on the values of suitable dimensions is given in the Aerodrome Design Manual (Doc 9157), Part 2.

(b) The location of taxiway centre line markings and lights is specified in 5.2.8.6 and 5.3.17.12.

(c) Compound curves may reduce or eliminate the need for extra taxiway width.

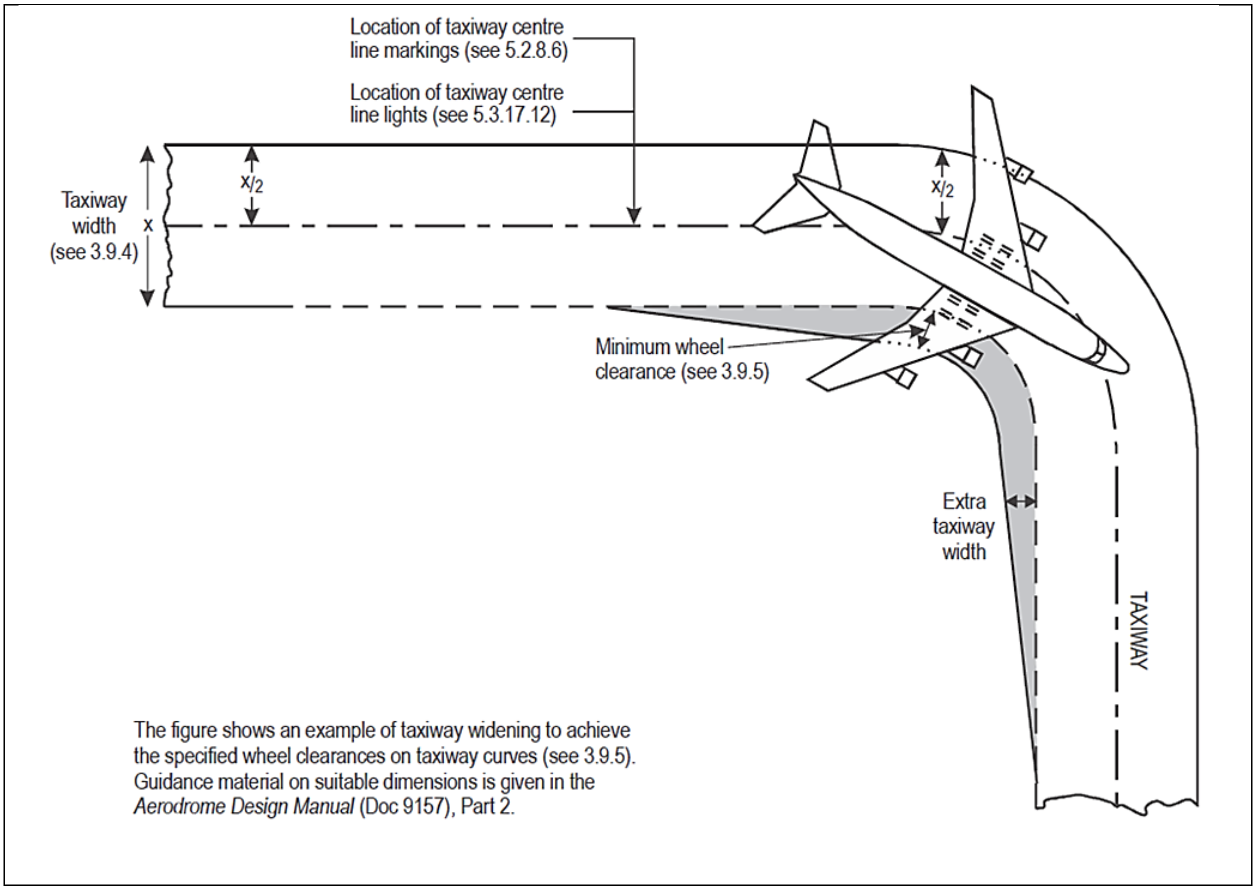

Figure 3-2. Taxiway curve

3.9.6 Junctions and intersections of taxiways

(a) To facilitate the movement of aeroplanes, fillets shall be provided at junctions and intersections of taxiways with runways, aprons and other taxiways.

(b) The design of the fillets shall ensure that the minimum wheel clearances specified in 3.9.3 are maintained when aeroplanes are manoeuvring through the junctions or intersections.

GM1 3.9.6 Junctions and intersections of taxiways

Consideration will have to be given to the aeroplane datum length when designing fillets. Guidance on the design of fillets and the definition of the term aeroplane datum length are given in the Aerodrome Design Manual (Doc 9157), Part 2.

3.9.7 Taxiway minimum separation distances

(a) The safety objective of minimum taxi separation distances is to allow safe use of taxiways and aircraft stand taxilanes to prevent possible collision with other aeroplanes operating on adjacent runways or taxiways, or collision with adjacent objects

(b) The separation distance between the centre line of a taxiway and the centre line of a runway, the centre line of a parallel taxiway or an object shall not be less than the appropriate dimension specified in Table 3-1, except that it may be permissible to operate with lower separation distances at an existing aerodrome if an aeronautical study indicates that such lower separation distances would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

GM1 3.9.7 Taxiway minimum separation distances

(a) Guidance on factors which may be considered in the aeronautical study is given in the Aerodrome Design Manual (Doc 9157), Part 2.

(b) ILS and MLS installations may also influence the location of taxiways due to interferences to ILS and MLS signals by a taxiing or stopped aircraft. Information on critical and sensitive areas surrounding ILS and MLS installations is contained in Annex 10 — Aeronautical Telecommunications, Volume I — Radio Navigation Aids, Attachments C and G (respectively).

(c) The separation distances of Table 3-1, column 10, do not necessarily provide the capability of making a normal turn from one taxiway to another parallel taxiway. Guidance for this condition is given in the Aerodrome Design Manual (Doc 9157), Part 2.

(d) The separation distance between the centre line of an aircraft stand taxilane and an object shown in Table 3-1, column 13, may need to be increased when jet exhaust wake velocity may cause hazardous conditions for ground servicing.

Table 3-1 Taxiway minimum separation distances

	Distance between taxiway centre line and runway centre line (metres)								Taxiway centre line to taxiway centre line (metres)	Taxiway, other than aircraft stand taxilane, centre line to object (metres)	Aircraft stand taxilane centre line to aircraft stand taxilane centre line (metres)	Aircraft stand taxilane centre line to object (metres)
	Instrument runways Code number				Non-instrument runways Code number							
Code letter	1	2	3	4	1	2	3	4				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
A	77.5	77.5	-	-	37.5	47.5	-	-	23	15.5	19.5	12
B	82	82	152	-	42	52	87	-	32	20	28.5	16.5
C	88	88	158	158	48	58	93	93	44	26	40.5	22.5
D	-	-	166	166	-	-	101	101	63	37	59.5	33.5
E	-	-	172.5	172.5	-	-	107.5	107.5	76	43.5	72.5	40
F	-	-	180	180	-	-	115	115	91	51	87.5	47.5

Note 1.— The separation distances shown in columns (2) to (9) represent ordinary combinations of runways and taxiways. The basis for development of these distances is given in the Aerodrome Design Manual (Doc 9157), Part 2.

Note 2.— The distances in columns (2) to (9) do not guarantee sufficient clearance behind a holding aeroplane to permit the passing of another aeroplane on a parallel taxiway. See the Aerodrome Design Manual (Doc 9157), Part 2.

3.9.8 Longitudinal slopes on taxiways

The longitudinal slope of a taxiway shall not exceed:

— 1.5 per cent where the code letter is C, D, E or F; and

— 3 per cent where the code letter is A or B.

3.9.9 Longitudinal slope changes on taxiways

(a) The safety objective of limiting the longitudinal taxiway slope changes is to avoid damage of aircraft and to enable safe use of taxiway by an aircraft.

(b) Where slope changes on a taxiway cannot be avoided, the transition from one slope to another slope shall be accomplished by a curved surface with a rate of change not exceeding:

— 1 per cent per 30 m (minimum radius of curvature of 3 000 m) where the code letter is C, D, E or F; and

— 1 per cent per 25 m (minimum radius of curvature of 2 500 m) where the code letter is A or B.

3.9.10 Sight distance of taxiways

(a) The safety objective of minimum taxiway sight distance values is to achieve the necessary visibility to enable safe use of taxiway by an aircraft.

(b) Where a change in slope on a taxiway cannot be avoided, the change shall be such that, from any point:

— 3 m above the taxiway, it will be possible to see the whole surface of the taxiway for a distance of at least 300 m from that point, where the code letter is C, D, E or F;

— 2 m above the taxiway, it will be possible to see the whole surface of the taxiway for a distance of at least 200 m from that point, where the code letter is B; and

— 1.5 m above the taxiway, it will be possible to see the whole surface of the taxiway for a distance of at least 150 m from that point, where the code letter is A.

3.9.11 Transverse slopes on taxiways

(a) The safety objective of taxiway transverse slopes is to promote the most rapid drainage of water from the taxiway.

(b) The transverse slopes of a taxiway shall be sufficient to prevent the accumulation of water on the surface of the taxiway but shall not exceed:

— 1.5 per cent where the code letter is C, D, E or F; and

— 2 per cent where the code letter is A or B.

Note.— See 3.13.4 regarding transverse slopes on an aircraft stand taxilane.

GM1 3.9.11 Transverse slopes on taxiways

The slopes on a taxiway are intended to prevent the accumulation of water (or possible fluid contaminant) on the surface and to facilitate rapid drainage of surface water (or possible fluid contaminant). Slopes should be so designed as to minimise impact on aircraft and so not to hamper the operation of aircraft.

3.9.12 Strength of taxiways

The strength of a taxiway shall be at least equal to that of the runway it serves.

GM1 3.9.12 Strength of taxiways

(a) Due consideration is to be given to the fact that a taxiway is subjected to a greater density of traffic and, as a result of slow moving and stationary aeroplanes, to higher stresses than the runway it serves.

(b) Guidance on the relation of the strength of taxiways to the strength of runways is given in the Aerodrome Design Manual (Doc 9157), Part 3.

3.9.13 Surface of taxiways

The surface of a taxiway shall not have irregularities that cause damage to aeroplane structures.

3.9.14 Surface of taxiways (cont.)

The surface of a paved taxiway shall be so constructed or resurfaced as to provide suitable surface friction characteristics.

Note.— Suitable surface friction characteristics are those surface properties required on taxiways that assure safe operation of aeroplanes.

3.9.15 Rapid exit taxiways

(a) The safety objective of rapid exit taxiway is to facilitate safe rapid exit of aeroplanes from a runway.

(b) A rapid exit taxiway shall be designed with a radius of turn-off curve of at least:

— 550 m where the code number is 3 or 4; and

— 275 m where the code number is 1 or 2;

to enable exit speeds under wet conditions of:

— 93 km/h where the code number is 3 or 4; and

— 65 km/h where the code number is 1 or 2.

GM1 3.9.15 Rapid exit taxiways

(a) The specifications detail requirements particular to rapid exit taxiways. See Figure 3-3. General requirements for taxiways also apply to this type of taxiway. Guidance on the provision, location and design of rapid exit taxiways is included in the Aerodrome Design Manual (Doc 9157), Part 2.

(b) The locations of rapid exit taxiways along a runway are based on several criteria described in the Aerodrome Design Manual (Doc 9157), Part 2, in addition to different speed criteria.

3.9.16 Rapid exit taxiways (cont.)

The radius of the fillet on the inside of the curve at a rapid exit taxiway shall be sufficient to provide a widened taxiway throat in order to facilitate early recognition of the entrance and turn-off onto the taxiway.

3.9.17 Rapid exit taxiways (cont.)

A rapid exit taxiway shall include a straight distance after the turn-off curve sufficient for an exiting aircraft to come to a full stop clear of any intersecting taxiway.

3.9.18 Rapid exit taxiways (cont.)

The intersection angle of a rapid exit taxiway with the runway shall not be greater than 45° nor less than 25° and preferably shall be 30°.

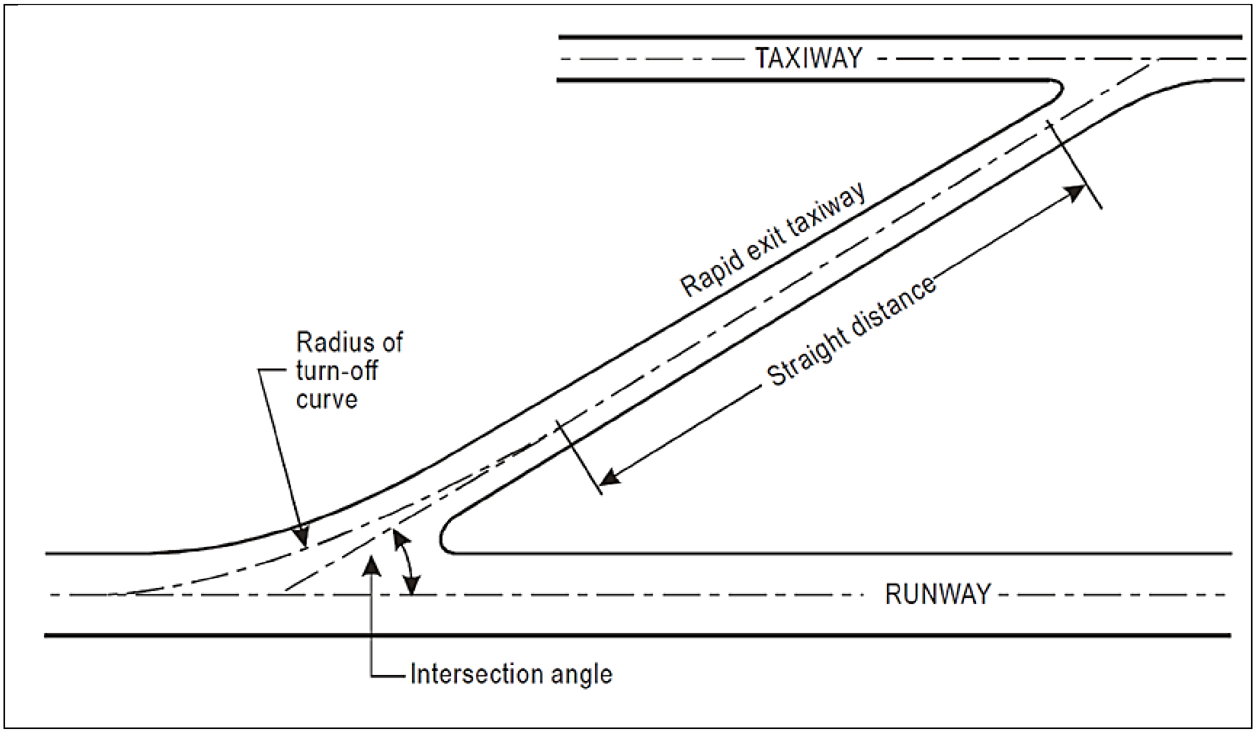

Figure 3-3. Rapid exit taxiway

3.9.19 Taxiways on bridges - width

The width of that portion of a taxiway bridge capable of supporting aeroplanes, as measured perpendicularly to the taxiway centre line, shall not be less than the width of the graded area of the strip provided for that taxiway, unless a proven method of lateral restraint is provided which shall not be hazardous for aeroplanes for which the taxiway is intended.

3.9.20 Taxiways on bridges – access

Access shall be provided to allow rescue and firefighting vehicles to intervene in both directions within the specified response time to the largest aeroplane for which the taxiway bridge is intended.

Note.— If aeroplane engines overhang the bridge structure, protection of adjacent areas below the bridge from engine blast may be required.

3.9.21 Taxiways on bridges - construction

A bridge shall be constructed on a straight section of the taxiway with a straight section on both ends of the bridge to facilitate the alignment of aeroplanes approaching the bridge.

3.10 Taxiway shoulders

3.10.1 Taxiway shoulders

Straight portions of a taxiway where the code letter is C, D, E or F shall be provided with shoulders which extend symmetrically on each side of the taxiway so that the overall width of the taxiway and its shoulders on straight portions is not less than:

— 44 m where the code letter is F;

— 38 m where the code letter is E;

— 34 m where the code letter is D; and

— 25 m where the code letter is C.

On taxiway curves and on junctions or intersections where increased pavement is provided, the shoulder width shall be not less than that on the adjacent straight portions of the taxiway.

3.10.2 Taxiway shoulders used by turbine-engined aeroplanes

When a taxiway is intended to be used by turbine-engined aeroplanes, the surface of the taxiway shoulder shall be so prepared as to resist erosion and the ingestion of the surface material by aeroplane engines.

GM1 3.10 Taxiway shoulders

Guidance on characteristics of taxiway shoulders and on shoulder treatment is given in the Aerodrome Design Manual (Doc 9157), Part 2.

3.11 Taxiway strips

3.11.1 Taxiway strips

A taxiway, other than an aircraft stand taxilane, shall be included in a strip.

GM1 3.11.1 Taxiway strips

A taxiway strip should be so prepared or constructed as to minimise hazards arising from differences in load bearing capacity to aeroplanes which the taxiway is intended to serve in the event of an aeroplane accidentally running off the taxiway.

Guidance on characteristics of taxiway strips is given in the Aerodrome Design Manual (Doc 9157), Part 2.

3.11.2 Width of taxiway strips

(a) The safety objective of the width of taxiway strips is to allow safe use of taxiways in relation to adjacent objects.

(b) A taxiway strip shall extend symmetrically on each side of the centre line of the taxiway throughout the length of the taxiway to at least the distance from the centre line given in Table 3-1, column 11.

3.11.3 Objects on taxiway strips

The taxiway strip shall provide an area clear of objects which may endanger taxiing aeroplanes.

GM1 3.11.3 Objects on taxiway strip

(a) See 9.9 for information regarding siting of equipment and installations on taxiway strips.

(b) Consideration will have to be given to the location and design of drains on a taxiway strip to prevent damage to an aeroplane accidentally running off a taxiway. Suitably designed drain covers may be required. For further guidance, see the Aerodrome Design Manual (Doc 9157), Part 2.

(c) Where open-air or covered storm water conveyances are installed, consideration will have to be given to ensure that their structure does not extend above the surrounding ground so as not to be considered an obstacle. See also Note 1 to 3.11.6.

(d) Particular attention needs to be given to the design and maintenance of an open-air storm water conveyance in order to prevent wildlife attraction, notably birds. If needed, it can be covered by a net. Guidance on wildlife control and reduction can be found in the Airport Services Manual (Doc 9137), Part 3.

3.11.4 Grading of taxiway strips

(a) The safety objective of the grading of a taxiway strip is to reduce the risk of damage to an aircraft accidentally running off the taxiway.

(b) The centre portion of a taxiway strip shall provide a graded area to a distance from the centre line of the taxiway of not less than that given by the following tabulation:

(1) 10.25 m where the OMGWS is up to but not including 4.5 m;

(2) 11 m where the OMGWS is 4.5 m up to but not including 6 m;

(3) 12.50 m where the OMGWS is 6 m up to but not including 9 m;

(4) 18.50 m where the OMGWS is 9 m up to but not including 15 m, where the code letter is D;

(5) 19 m where the OMGWS is 9 m up to but not including 15 m, where the code letter is E;

(6) 22 m where the OMGWS is 9 m up to but not including 15 m, where the code letter is F.

GM1 3.11.4 Grading of taxiway strips

Further guidance on width of the graded portion of a taxiway is given in the Aerodrome Design Manual (Doc 9157), Part 2.

3.11.5 Slopes on taxiway strips - general

(a) The safety objective of limiting the longitudinal taxiway strip slopes and slope changes and of minimum sight distances values is to reduce the probability of damage to an aircraft accidentally running off the taxiway and to enable safe use of these areas by rescue and firefighting vehicles

(b) The surface of the strip shall be flush at the edge of the taxiway or shoulder, if provided, and the graded portion shall not have an upward transverse slope exceeding:

— 2.5 per cent for strips where the code letter is C, D, E or F; and

— 3 per cent for strips of taxiways where the code letter is A or B;

the upward slope being measured with reference to the transverse slope of the adjacent taxiway surface and not the horizontal. The downward transverse slope shall not exceed 5 per cent measured with reference to the horizontal.

3.11.6 Transverse slopes

The transverse slopes on any portion of a taxiway strip beyond that to be graded shall not exceed an upward or downward slope of 5 per cent as measured in the direction away from the taxiway.

GM1 3.11.5 & 3.11.6 Slopes on taxiway

(a) Where required for proper drainage, an open-air storm water conveyance may be allowed in the non-graded portion of a taxiway strip and would be placed as far as practicable from the taxiway.

(b) The locations of open-air storm water conveyances within the non-graded portion of a taxiway strip should be so designed to permit unobstructed access for rescue and firefighting services (RFFS).

3.12 Holding bays, runway-holding positions, intermediate holding positions and road-holding positions

3.12.1 Holding bay(s)

Holding bay(s) shall be provided when the traffic density is medium or heavy.

3.12.2 Runway-holding position

A runway-holding position or positions shall be established:

a) on the taxiway, at the intersection of a taxiway and a runway; and

b) at an intersection of a runway with another runway when the former runway is part of a standard taxi-route.

GM1 3.12.2 Runway-holding positions

a) At low levels of aerodrome activity (less than approximately 50 000 annual operations), there is normally little need to make deviations in the departure sequence. However, for higher activity levels, aerodromes with single taxiways and no holding bays or other bypasses provide aerodrome control units with no opportunity to change the sequence of departures once the aircraft have left the apron. In particular, at aerodromes with large apron areas, it is often difficult to arrange for aircraft to leave the apron in such a way that they should arrive at the end of the runway in the sequence required by air traffic services units.

(b) The provision of an adequate number of holding bay spaces or other bypasses, based upon an analysis of the current and near-term hourly aircraft departure demand, should allow a large degree of flexibility in generating the departure sequence.

(c) The space required for a holding bay depends on the number of aircraft positions to be provided, the size of the aircraft to be accommodated, and the frequency of their utilisation. The dimensions should allow for sufficient space between aircraft to enable them to manoeuvre independently.

(d) Emergency access roads are not intended for use for the functions of aerodrome service roads. However, they should be provided by different access controls which should be clearly visible for all service ground traffic.

(e) Further guidance is given in ICAO Doc 9157, Aerodrome Design Manual, Part 2, Taxiways, Aprons and Holding Bays and ICAO Doc 4444, Procedures for Air Navigation Services — Air Traffic Management.

3.12.3 Runway-holding position on a taxiway

A runway-holding position shall be established on a taxiway if the location or alignment of the taxiway is such that a taxiing aircraft or vehicle can infringe an obstacle limitation surface or interfere with the operation of radio navigation aids.

3.12.4 Intermediate holding position

An intermediate holding position shall be established on a taxiway at any point other than a runway-holding position where it is desirable to define a specific holding limit.

3.12.5 Road-holding position

A road-holding position shall be established at an intersection of a road with a runway.

3.12.6 Location

The distance between a holding bay, runway-holding position established at a taxiway/runway intersection or road-holding position and the centre line of a runway shall be in accordance with Table 3-2 and, in the case of a precision approach runway, such that a holding aircraft or vehicle will not interfere with the operation of radio navigation aids or penetrate the inner transitional surface.

Note.— Guidance for the positioning of runway-holding positions is given in the Aerodrome Design Manual (Doc 9157), Part 2.

3.12.7 Location (cont.)

At elevations greater than 700 m (2 300 ft) the distance of 90 m specified in Table 3-2 for a precision approach runway code number 4 shall be increased as follows:

a) up to an elevation of 2 000 m (6 600 ft); 1 m for every 100 m (330 ft) in excess of 700 m (2 300 ft);

b) elevation in excess of 2 000 m (6 600 ft) and up to 4 000 m (13 320 ft); 13 m plus 1.5 m for every 100 m (330 ft) in excess of 2 000 m (6 600 ft); and

c) elevation in excess of 4 000 m (13 320 ft) and up to 5 000 m (16 650 ft); 43 m plus 2 m for every 100 m (330 ft) in excess of 4 000 m (13 320 ft).

3.12.8 Location (cont.)

If a holding bay, runway-holding position or road-holding position for a precision approach runway code number 4 is at a greater elevation compared to the threshold, the distance specified in Table 3-2 shall be further increased 5 m for every metre the bay or position is higher than the threshold.

3.12.9 Location (cont.)

The location of a runway-holding position established in accordance with 3.12.3 shall be such that a holding aircraft or vehicle will not infringe the obstacle free zone, approach surface, take-off climb surface or ILS/MLS critical/sensitive area or interfere with the operation of radio navigation aids.

Table 3-2 Minimum distance from the runway centre line to a holding bay, runway-holding position or road-holding position

Type of runway	Code number			
	1	2	3	4
Non-instrument	30 m	40 m	75 m	75 m
Non-precision approach	40 m	40 m	75 m	75 m
Precision approach Category I	60 m[b]	60 m[b]	90m[a,b]	90m[a,b]
Precision approach Categories II and III	-	-	90m[a,b]	90m[a,b]
Take-off runway	30 m	40 m	75 m	75 m

a. If a holding bay, runway-holding position or road-holding position is at a lower elevation compared to the threshold, the distance may be decreased 5 m for every metre the bay or holding position is lower than the threshold, contingent upon not infringing the inner transitional surface.

b. This distance may need to be increased to avoid interference with radio navigation aids, particularly the glide path and localizer facilities. Information on critical and sensitive areas of ILS and MLS is contained in Annex 10, Volume I, Attachments C and G, respectively (see also 3.12.6).

Note 1.— The distance of 90 m for code number 3 or 4 is based on an aircraft with a tail height of 20 m, a distance from the nose to the highest part of the tail of 52.7 m and a nose height of 10 m holding at an angle of 45° or more with respect to the runway centre line, being clear of the obstacle free zone and not accountable for the calculation of OCA/H.

Note 2.— The distance of 60 m for code number 2 is based on an aircraft with a tail height of 8 m, a distance from the nose to the highest part of the tail of 24.6 m and a nose height of 5.2 m holding at an angle of 45° or more with respect to the runway centre line, being clear of the obstacle free zone.

Note 3.— For code number 4 where the width of the inner edge of the inner approach surface is more than 120 m, a distance greater than 90 m may be necessary to ensure that a holding aircraft is clear of the obstacle free zone. For example, a distance of 100 m is based on an aircraft with a tail height of 24 m, a distance from the nose to the highest part of the tail of 62.2 m and a nose height of 10 m holding at an angle of 45° or more with respect to the runway centre line, being clear of the obstacle free zone.

3.13 Aprons

3.13.1 General

Aprons shall be provided where necessary to permit the on- and off-loading of passengers, cargo or mail as well as the servicing of aircraft without interfering with the aerodrome traffic.

3.13.2 Size of aprons

The total apron area shall be adequate to permit expeditious handling of the aerodrome traffic at its maximum anticipated density.

GM1 3.13.2 Size of aprons

(a) The amount of area required for a particular apron layout depends upon the following factors:

(1) the size and manoeuvrability characteristics of the aircraft using the apron;

(2) the volume of traffic using the apron;

(3) clearance requirements;

(4) type of ingress and egress to the aircraft stand;

(5) basic terminal layout or other aerodrome use;

(6) aircraft ground activity requirements; and

(7) taxiways and apron service roads.

(b) Passenger aircraft services that are carried out during the time the aircraft is parked in a stand position include: galley; toilet and potable water service; baggage handling; fuelling; provision of air conditioning, oxygen, electrical power supply and starting air; and aircraft towing. Most of these functions have a vehicle and/or equipment associated with them, or have some type of fixed installation established to conduct these services. Further guidance is given in ICAO Doc 9157, Aerodrome Design Manual, Part 2, Taxiways, Aprons and Holding Bays, paragraph 3.4.6.

(c) Consideration should be given to providing sufficient area on the starboard side of the aircraft to support the level of activity that take place in the turnaround operation.

Further guidance is given in ICAO Doc 9157, Aerodrome Design Manual, Part 2, Taxiways, Aprons and Holding Bays, paragraph 3.4.6.

3.13.3 Strength of aprons

Each part of an apron shall be capable of withstanding the traffic of the aircraft it is intended to serve, due consideration being given to the fact that some portions of the apron will be subjected to a higher density of traffic and, as a result of slow moving or stationary aircraft, to higher stresses than a runway.

GM1 3.13.3 Strength of aprons

(a) Apron pavement protection against fuel: On aircraft stands, pavement surface in bituminous concrete and joints between concrete slabs should be protected from fuel effects.

(b) Fuel on bituminous concrete provokes a disintegration of the concrete which becomes a kind of dark powder. On aircraft stands, it is not rare to have fuel on the pavement surface, due to leakage from aircraft or refuelling devices or due to a wrong move during refuelling. Therefore, if the aircraft stand pavement is in bituminous concrete, a specific protection is considered. Such protection is:

(1) a surface protection consisting in an overlay with a material inert against fuel; or

(2) a product incorporated in the mass of the bituminous concrete during its fabrication, protecting aggregates and binder.

(c) The first solution has the disadvantages to be fragile against stamping effects due to aircraft at the stand but is very useful for existing pavement protection.

(d) Taking into account the stamping due to aircraft at stands and the weakness of bituminous concrete against fuel, the aircraft stand pavements are often in cement concrete, which offers a much better resistance to stamping and to fuel. Nevertheless, joints between cement concrete slabs could be also damaged by fuel. According to the location of such joints regarding aircraft location and refuelling devices location, it is preferable to manufacture such joints in a material resistant to the fuel.

3.13.4 Slopes on aprons

Slopes on an apron, including those on an aircraft stand taxilane, shall be sufficient to prevent accumulation of water on the surface of the apron but shall be kept as level as drainage requirements permit.

3.13.5 Slopes on aircraft stand

On an aircraft stand the maximum slope shall not exceed 1 per cent.

GM1 3.13.4 & 3.13.5 Slopes on aprons

(a) The design of slopes should direct spilled fuel away from building and apron service areas. Where such slopes are unavoidable, special measures should be taken to reduce the fire hazard resulting from fuel spillage.

(b) Slopes on apron have the same purpose as other pavement slopes, meaning to prevent the accumulation of water (or possible fluid contaminant) on the surface and to facilitate rapid drainage of surface water (or possible fluid contaminant). Nevertheless, the design of the apron, especially for the parts containing aircraft stands, should specifically take into account the impact of the slopes on the aircraft during its braking at the stand and during its start for departure (with push-back or with its own engines). The aims are, on the one hand, to avoid that an aircraft passes its stop point and goes on the apron service road or to the closest building and on the other hand, to save fuel and optimise the manoeuvrability of the aircraft or of the push-back device.

(c) Where the slope limitation of 1 % on the stands cannot be achieved, the slope should be kept as shallow as possible and should be such that the operation of the aircraft and vehicles is not compromised.

3.13.6 Clearance distances on aircraft stands

(a) The safety objective of clearance distances on aircraft stands is to provide safe separation between an aircraft using the stand and any adjacent building, aircraft on another stand and other objects.

(b) An aircraft stand shall provide the following minimum clearances between an aircraft entering or exiting the stand and any adjacent building, aircraft on another stand and other objects:

Code letter	Clearance
A	3 m
B	3 m
C	4.5 m
D	7.5 m
E	7.5 m
F	7.5 m

(c) When special circumstances so warrant, these clearances may be reduced at a nose-in aircraft stand, where the code letter is D, E or F:

1) between the terminal, including any fixed passenger bridge, and the nose of an aircraft; and

2) over any portion of the stand provided with azimuth guidance by a visual docking guidance system.

Note.— On aprons, consideration also has to be given to the provision of service roads and to manoeuvring and storage area for ground equipment (see the Aerodrome Design Manual (Doc 9157), Part 2, for guidance on storage of ground equipment).

GM1 3.13.6 Clearance distances on aircraft stands

(a) Reduced separation at the gate is possible where azimuth guidance by a visual docking guidance system is provided, in combination with additional mitigation measures, such as:

(1) good condition of marking and signage;

(2) maintenance of visual docking systems.

(b) On aircraft stands, where reduced clearance distances are applied:

(1) Guidance by a visual docking guidance system should be provided.

(2) All objects for which reduced clearances apply should be properly marked or lighted.

(3) Aircraft stands where reduced clearance distances apply should be identified and the information published in the AIP.

(4) For code letters D, E or F, an aircraft stand equipped with a visual docking guidance system the minimum clearance of 4.5 metres may be applied between an aircraft

entering or exiting the stand and any adjacent building, aircraft on another stand or other objects.

(5) For code letter C an aircraft stand equipped with a visual docking guidance system the minimum clearance of 3 metres may be applied between an aircraft entering or exiting the stand and any adjacent building, aircraft on another stand or other objects if a safety assessment indicates that such reduction would not affect the safety of operations of aircraft.

(c) Any aircraft passing behind an aircraft parked on an aircraft stand should keep the required clearance distances defined in Table 3-1.

3.14 Isolated aircraft parking position

3.14.1 Isolated aircraft parking position - general

(a) The safety objective of the isolated aircraft parking position is to provide safe separation between aircraft that need isolation and other aerodrome activities.

(b) An isolated aircraft parking position shall be designated or the aerodrome control tower shall be advised of an area or areas suitable for the parking of an aircraft which is known or believed to be the subject of unlawful interference, or which for other reasons needs isolation from normal aerodrome activities.

3.14.2 Isolated aircraft parking position - location

The isolated aircraft parking position shall be located at the maximum distance practicable and in any case never less than 100 m from other parking positions, buildings or public areas, etc. Care shall be taken to ensure that the position is not located over underground utilities such as gas and aviation fuel and, to the extent feasible, electrical or communication cables.

3.15

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CHAPTER 4. OBSTACLE RESTRICTION AND REMOVAL

4.0 Applicability

(a) The objectives of the specifications in this chapter are to define the airspace around aerodromes to be maintained free from obstacles so as to permit the intended aeroplane operations at the aerodromes to be conducted safely and to prevent the aerodromes from becoming unusable by the growth of obstacles around the aerodromes.

This is achieved by establishing a series of obstacle limitation surfaces that define the limits to which objects may project into the airspace.

(b) The establishment of, and requirements for, an obstacle protection surface for visual approach slope indicator systems are specified in 5.3.5.42 to 5.3.5.46.

GM1 4.0 Applicability

(a) The obstacle limitation surfaces define the limits to which objects may project into the airspace. Each surface is related to one or more phases of a flight, and provides protection to aircraft during that phase.

(b) The OLS also help to prevent the aerodromes from becoming unusable by the growth of obstacles around the aerodromes.

(c) The effective utilisation of an aerodrome may be considerably influenced by natural features and man-made constructions outside its boundary. These may result in limitations on the distance available for take-off and landing and on the range of meteorological conditions in which take-off and landing can be undertaken. For these reasons, certain areas of the local airspace should be regarded as integral parts of the aerodrome environment.

(d) Objects which penetrate the obstacle limitation surfaces may in certain circumstances cause an increase in the obstacle clearance altitude/height for an instrument approach procedure or any associated visual circling procedure or have other operational impact on flight procedure design. Criteria for flight procedure design are contained in the Procedures for Air Navigation Services — Aircraft Operations (ICAO, PANS-OPS, Doc 8168).

(e) In ideal circumstances all the surfaces should be free from obstacles but when a surface is infringed, any safety measures required should have regard to:

(1) the nature of the obstacle and its location relative to the surface origin, to the extended centre line of the runway or normal approach and departure paths, and to existing obstructions;

(2) the amount by which the surface is infringed;

(3) the gradient presented by the obstacle to the surface origin;

(4) the type of air traffic at the aerodrome; and

(5) the instrument approach procedures published for the aerodrome.

(f) Safety measures could be as follows:

(1) promulgation in the NOTAM, AIP etc. of appropriate information;

(2) marking and/or lighting of the obstacle;

(3) variation of the runway distances declared as available;

(4) limitation of the use of the runway to visual approaches only.

4.1 Obstacle limitation surfaces - *Outer horizontal surface*

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Note.— Guidance on the need to provide an outer horizontal surface and its characteristics is contained in the Airport Services Manual (Doc 9137), Part 6.

4.1.1 Conical surface – Description

(a) The purpose of the conical surface is to facilitate safe visual manoeuvring in the vicinity of the aerodrome.

(b) A surface sloping upwards and outwards from the periphery of the inner horizontal surface.

4.1.2 Conical surface – Characteristics

The limits of the conical surface shall comprise:

a) a lower edge coincident with the periphery of the inner horizontal surface; and

b) an upper edge located at a specified height above the inner horizontal surface.

4.1.3 Conical surface – Characteristics (cont.)

The slope of the conical surface shall be measured in a vertical plane perpendicular to the periphery of the inner horizontal surface.

4.1.4 Inner horizontal surface – Description

(a) The purpose of the inner horizontal surface is to protect airspace for visual manoeuvring prior to landing.

(b) A surface located in a horizontal plane above an aerodrome and its environs.

4.1.5 Inner horizontal surface – Characteristics

The radius or outer limits of the inner horizontal surface shall be measured from a reference point or points established for such purpose.

4.1.6 Inner horizontal surface – Characteristics (cont.)

The height of the inner horizontal surface shall be measured above an elevation datum established for such purpose.

GM1 4.1.5 & 4.1.6 Inner horizontal surface – Characteristics

(a) The shape of the inner horizontal surface need not necessarily be circular. Guidance on determining the extent of the inner horizontal surface is contained in the Airport Services Manual (Doc 9137), Part 6.

(b) Further guidance on determining the elevation datum is contained in the Airport Services Manual (Doc 9137), Part 6.

4.1.7 Approach surface Applicability and Description

(a) Applicability: The purpose of the approach surface is to protect an aircraft during the final approach to the runway by defining the area that shall be kept free from obstacles to protect an aeroplane in the final phase of the approach-to-land manoeuvre.

(b) Description: Approach surface. An inclined plane or combination of planes preceding the threshold.

4.1.8 Approach surface Characteristics

The limits of the approach surface shall comprise:

a) an inner edge of specified length, horizontal and perpendicular to the extended centre line of the runway and located at a specified distance before the threshold;

b) two sides originating at the ends of the inner edge and diverging uniformly at a specified rate from the extended centre line of the runway;

c) an outer edge parallel to the inner edge; and

d) the above surfaces shall be varied when lateral offset, offset or curved approaches are utilized, specifically, two sides originating at the ends of the inner edge and diverging uniformly at a specified rate from the extended centre line of the lateral offset, offset or curved ground track.

4.1.9 Approach surface Characteristics (cont.)

The elevation of the inner edge shall be equal to the elevation of the midpoint of the threshold.

4.1.10 Approach surface Characteristics (cont.)

The slope(s) of the approach surface shall be measured in the vertical plane containing the centre line of the runway and shall continue containing the centre line of any lateral offset or curved ground track.

Note.— See Figure 4-2.

4.1.11 Inner approach surface – Applicability and Description

Applicability. The purpose of the inner approach surface is to protect final precision approaches.

Description. A rectangular portion of the approach surface immediately preceding the threshold.

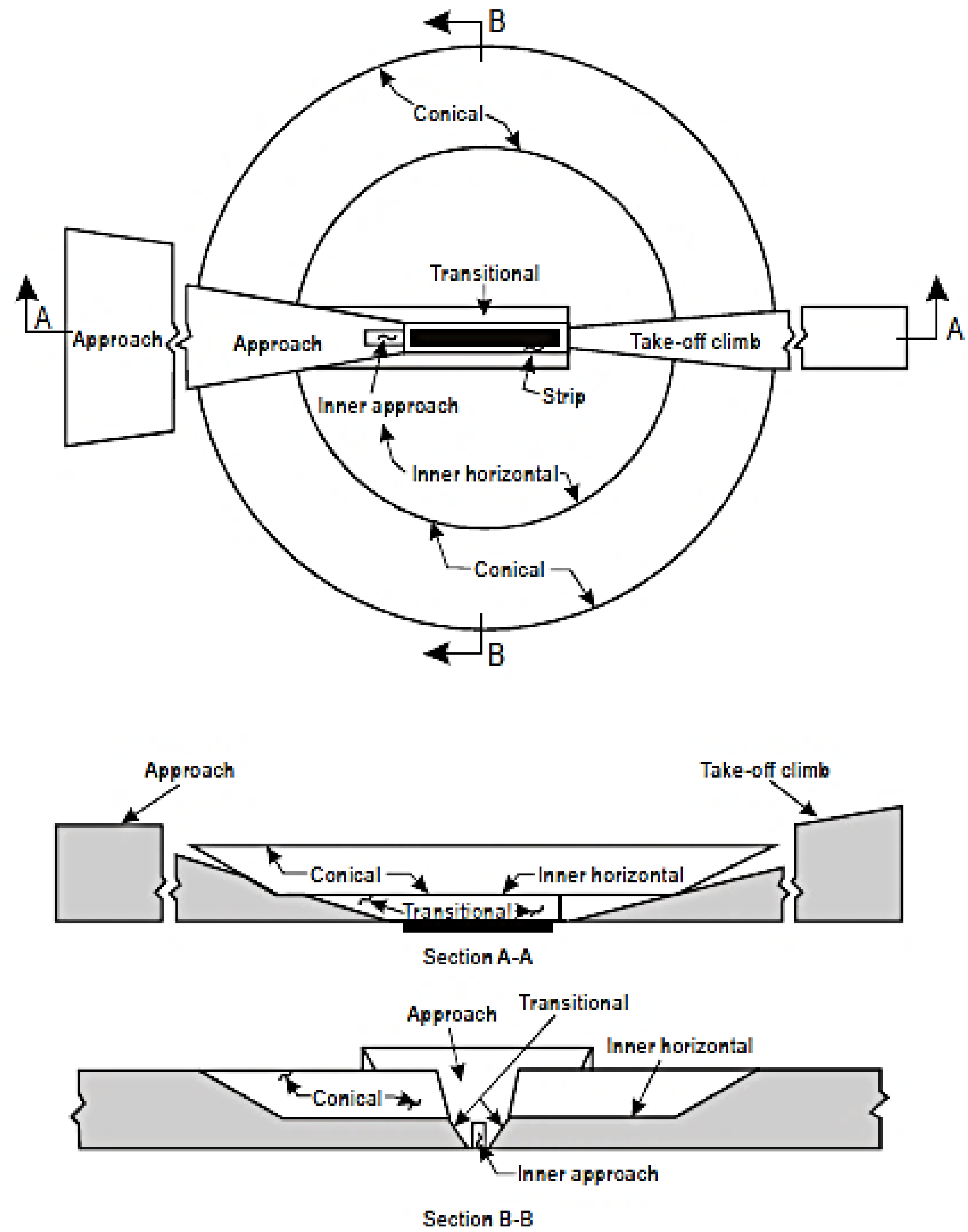
4.1.12 Inner approach surface - Characteristics

The limits of the inner approach surface shall comprise:

a) an inner edge coincident with the location of the inner edge of the approach surface but of its own specified length;

b) two sides originating at the ends of the inner edge and extending parallel to the vertical plane containing the centre line of the runway; and

c) an outer edge parallel to the inner edge.



See Figure 4-2 for inner transitional and balked landing obstacle limitation surfaces and Attachment B for a three-dimensional view

Figure 4-1. Obstacle limitation surfaces

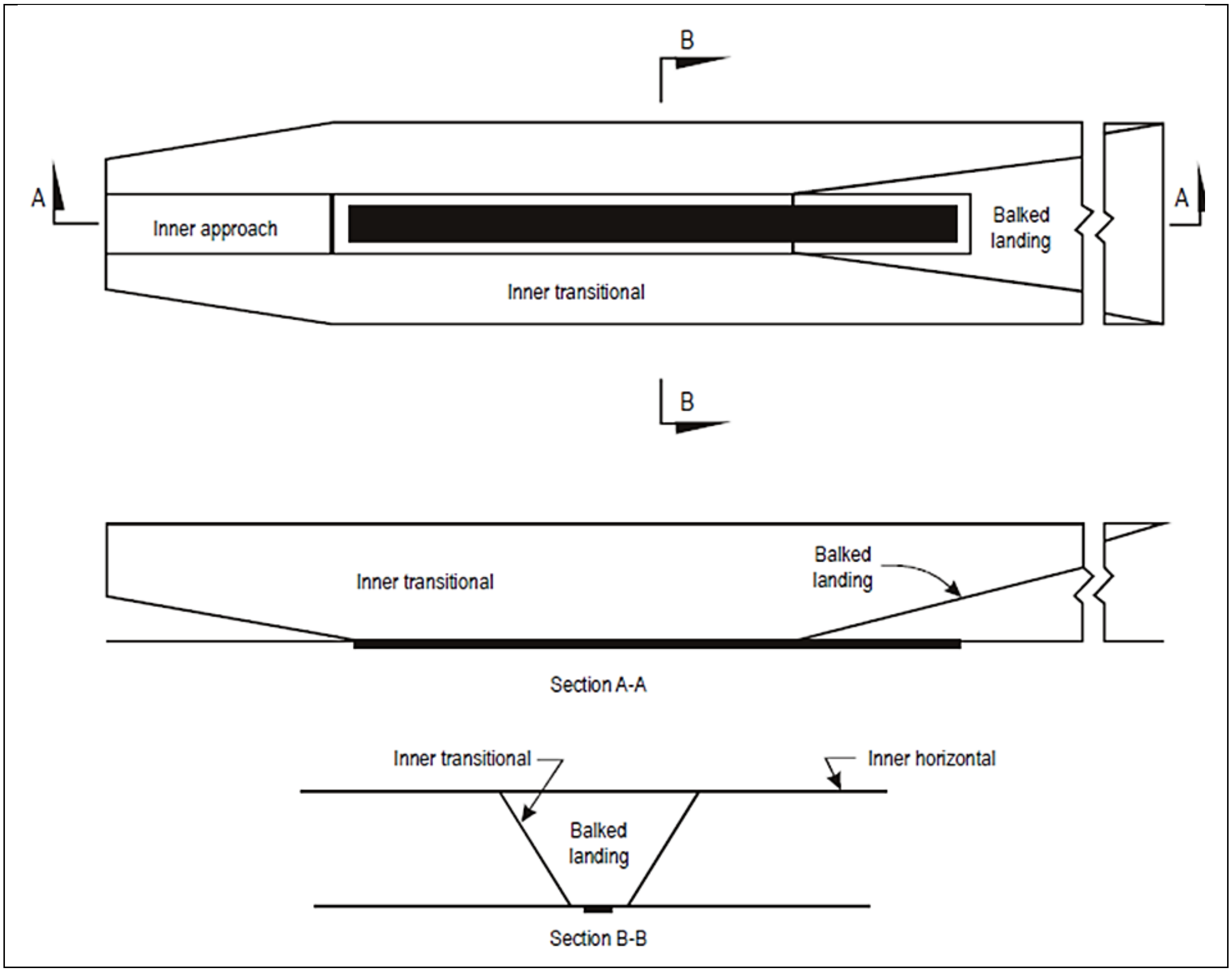


Figure 4-2. Inner approach, inner transitional and balked landing obstacle limitation surfaces

4.1.13 Transitional surface — Applicability and Description

Applicability: The purpose of the transitional surface is to define the limit of the area available for buildings, other structures or natural obstructions, such as trees.

Description: A complex surface along the side of the strip and part of the side of the approach surface, that slopes upwards and outwards to the inner horizontal surface.

4.1.14 Transitional surface — Characteristics

The limits of a transitional surface shall comprise:

a) a lower edge beginning at the intersection of the side of the approach surface with the inner horizontal surface and extending down the side of the approach surface to the inner edge of the approach surface and from there along the length of the strip parallel to the runway centre line; and

b) an upper edge located in the plane of the inner horizontal surface.

4.1.15 Transitional surface — Characteristics (cont.)

The elevation of a point on the lower edge shall be:

a) along the side of the approach surface — equal to the elevation of the approach surface at that point; and

b) along the strip — equal to the elevation of the nearest point on the centre line of the runway or its extension.

GM1 4.1.15 Transitional surface — Characteristics (cont.)

As a result of b) the transitional surface along the strip will be curved if the runway profile is curved, or a plane if the runway profile is a straight line. The intersection of the transitional surface with the inner horizontal surface will also be a curved or a straight line depending on the runway profile.

4.1.16 Transitional surface — Characteristics (cont.)

The slope of the transitional surface shall be measured in a vertical plane at right angles to the center line of the runway.

Note.— It is intended that the inner transitional surface be the controlling obstacle limitation surface for navigation aids, aircraft and other vehicles that must be near the runway and which is not to be penetrated except for frangible objects. The transitional surface described in 4.1.13 is intended to remain as the controlling obstacle limitation surface for buildings, etc.

4.1.17 Inner transitional surface — Applicability and Description

(a) Applicability. The purpose of the inner transitional surface is to protect aeroplanes during precision approaches and balked landing.

(b) Description. A surface similar to the transitional surface but closer to the runway.

4.1.18 Inner transitional surface — Characteristics

The limits of an inner transitional surface shall comprise:

a) a lower edge beginning at the end of the inner approach surface and extending down the side of the inner approach surface to the inner edge of that surface, from there along the strip parallel to the runway centre line to the inner edge of the balked landing surface and from there up the side of the balked landing surface to the point where the side intersects the inner horizontal surface; and

b) an upper edge located in the plane of the inner horizontal surface.

4.1.19 Inner transitional surface — Characteristics (cont.)

The elevation of a point on the lower edge shall be:

a) along the side of the inner approach surface and balked landing surface — equal to the elevation of the particular surface at that point; and

b) along the strip — equal to the elevation of the nearest point on the centre line of the runway or its extension.

4.1.20 Inner transitional surface — Characteristics (cont.)

The slope of the inner transitional surface shall be measured in a vertical plane at right angles to the centre line of the runway.

GM1 4.1.18 - 4.1.20 Inner transitional surface — Characteristics

(a) It is intended that the inner transitional surface be the controlling obstacle limitation surface for navigation aids, aircraft, and other vehicles that should be near the runway, and which is not to be penetrated except for frangible objects. The transitional surface is intended to remain as the controlling obstacle limitation surface for buildings, etc.

(b) The inner transitional surface along the strip should be curved if the runway profile is curved or a plane if the runway profile is a straight line. The intersection of the inner transitional surface with the inner horizontal surface should also be a curved or straight line depending on the runway profile.

4.1.21 Balked landing surface — Applicability and Description

(a) Applicability: The purpose of the balked landing surface is to protect balked landing.

(b) Description: An inclined plane located at a specified distance after the threshold, extending between the inner transitional surface.

4.1.22 Balked landing surface — Characteristics

The limits of the balked landing surface shall comprise:

a) an inner edge horizontal and perpendicular to the centre line of the runway and located at a specified distance after the threshold;

b) two sides originating at the ends of the inner edge and diverging uniformly at a specified rate from the vertical plane containing the centre line of the runway; and

c) an outer edge parallel to the inner edge and located in the plane of the inner horizontal surface.

4.1.23 Balked landing surface — Characteristics (cont.)

The elevation of the inner edge shall be equal to the elevation of the runway centre line at the location of the inner edge.

4.1.24 Balked landing surface — Characteristics (cont.)

The slope of the balked landing surface shall be measured in the vertical plane containing the centre line of the runway.

4.1.25 Take-off climb surface — Applicability and Description

(a) Applicability: The purpose of the take-off climb surface is to protect an aircraft on take-off and during climb-out.

(b) Description: An inclined plane or other specified surface beyond the end of a runway or clearway.

4.1.26 Take-off climb surface — Characteristics

The limits of the take-off climb surface shall comprise:

a) an inner edge horizontal and perpendicular to the centre line of the runway and located either at a specified distance beyond the end of the runway or at the end of the clearway when such is provided and its length exceeds the specified distance;

b) two sides originating at the ends of the inner edge, diverging uniformly at a specified rate from the take-off track to a specified final width and continuing thereafter at that width for the remainder of the length of the take-off climb surface; and

c) an outer edge horizontal and perpendicular to the specified take-off track.

4.1.27 Take-off climb surface — Characteristics (cont.)

The elevation of the inner edge shall be equal to the highest point on the extended runway centre line between the end of the runway and the inner edge, except that when a clearway is provided the elevation shall be equal to the highest point on the ground on the centre line of the clearway.

4.1.28 Take-off climb surface — Characteristics (cont.)

In the case of a straight take-off flight path, the slope of the take-off climb surface shall be measured in the vertical plane containing the centre line of the runway.

4.1.29 Take-off climb surface — Characteristics (cont.)

In the case of a take-off flight path involving a turn, the take-off climb surface shall be a complex surface containing the horizontal normals to its centre line, and the slope of the centre line shall be the same as that for a straight take-off flight path.

4.2 Obstacle limitation requirements

4.2.0 General

Obstacle limitation requirements shall be distinguished between:

(a) non-instrument runways;

(b) non-precision approach runways;

(c) precision approach runways; and

(d) runways meant for take-off.

GM1 4.2.0 General

The requirements for obstacle limitation surfaces are specified on the basis of the intended use of a runway, i.e. take-off or landing and type of approach, and are intended to be applied when such use is made of the runway. In cases where operations are conducted to or from both directions of a runway, then the function of certain surfaces may be nullified because of more stringent requirements of another lower surface.

4.2.1 Non-instrument runways

The following obstacle limitation surfaces shall be established for a non-instrument runway:

— conical surface;

— inner horizontal surface;

— approach surface; and

— transitional surfaces.

4.2.2 Non-instrument runways — heights and slopes

The heights and slopes of the surfaces shall not be greater than, and their other dimensions not less than, those specified in Table 4-1.

4.2.3 Non-instrument runways — New objects or extensions of existing objects

New objects or extensions of existing objects shall not be permitted above an approach or transitional surface except when, in the opinion of the appropriate authority, the new object or extension would be shielded by an existing immovable object.

4.2.4 Non-instrument runways — New objects or extensions of existing objects (cont.)

New objects or extensions of existing objects shall not be permitted above the conical surface or inner horizontal surface except when, in the opinion of the appropriate authority, the object would be shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

4.2.5 Non-instrument runways — New objects or extensions of existing objects (cont.)

Existing objects above any of the surfaces required by 4.2.1 shall as far as practicable be removed except when, in the opinion of the appropriate authority, the object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

4.2.6 Non-instrument runways — proposed construction

In considering proposed construction, account shall be taken of the possible future development of an instrument runway and consequent requirement for more stringent obstacle limitation surfaces.

GM1 4.2.1 – 4.2.6 Non-instrument runways

(a) Circumstances in which the shielding principle may reasonably be applied are described in the Airport Services Manual (Doc 9137), Part 6.

(b) Because of transverse or longitudinal slopes on a strip, in certain cases the inner edge or portions of the inner edge of the approach surface may be below the corresponding elevation of the strip. It is not intended that the strip be graded to conform with the inner edge of the approach surface, nor is it intended that terrain or objects which are above the approach surface beyond the end of the strip, but below the level of the strip, be removed unless it is considered they may endanger aeroplanes.

4.2.7 Non-precision approach runways

The following obstacle limitation surfaces shall be established for a non-precision approach runway:

— conical surface;

— inner horizontal surface;

— approach surface; and

— transitional surfaces.

4.2.8 Non-precision approach runways — heights and slopes

The heights and slopes of the surfaces shall not be greater than, and their other dimensions not less than, those specified in Table 4-1, except in the case of the horizontal section of the approach surface (see 4.2.9).

4.2.9 Non-precision approach runways — approach surface

The approach surface shall be horizontal beyond the point at which the 2.5 per cent slope intersects:

a) a horizontal plane 150 m above the threshold elevation; or

b) the horizontal plane passing through the top of any object that governs the obstacle clearance altitude/height (OCA/H);

whichever is the higher.

4.2.10 Non-precision approach runways — New objects or extensions of existing objects

New objects or extensions of existing objects shall not be permitted above an approach surface within 3 000 m of the inner edge or above a transitional surface except when, in the opinion of the appropriate authority, the new object or extension would be shielded by an existing immovable object.

4.2.11 Non-precision approach runways — New objects or extensions of existing objects (cont.)

New objects or extensions of existing objects shall not be permitted above the approach surface beyond 3 000 m from the inner edge, the conical surface or inner horizontal surface except when, in the opinion of the appropriate authority, the object would be shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

4.2.12 Non-precision approach runways — New objects or extensions of existing objects (cont.)

Existing objects above any of the surfaces required by 4.2.7 shall as far as practicable be removed except when, in the opinion of the appropriate authority, the object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

GM 1 4.2.7 - 4.2.12 Non-precision approach runways

(a) If it is of particular importance for safe operation on circuits, arrival routes towards the aerodrome or on departure or missed approach climb-paths, an outer horizontal surface for non-precision approach runways should be established.

(b) Circumstances in which the shielding principle may reasonably be applied are described in the Airport Services Manual (Doc 9137), Part 6.

(c) Because of transverse or longitudinal slopes on a strip, in certain cases the inner edge or portions of the inner edge of the approach surface may be below the corresponding elevation of the strip. It is not intended that the strip be graded to conform with the inner edge of the approach surface, nor is it intended that terrain or objects which are above the approach surface beyond the end of the strip, but below the level of the strip, be removed unless it is considered they may endanger aeroplanes.

Table 4-1. Dimensions and slopes of obstacle limitation surfaces — Approach runways

APPROACH RUNWAYS										
RUNWAY CLASSIFICATION										
Surface and dimensions[a]	Non-instrument Code number				Non-precision approach Code number			Precision approach category		
								I Code number		II or III Code number
	1	2	3	4	1,2	3	4	1, 2	3, 4	3, 4
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
CONICAL										
Slope	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Height	35 m	55 m	75 m	100 m	60 m	75 m	100 m	60 m	100 m	100 m
INNER HORIZONTAL										
Height	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m
Radius	2000 m	2500 m	4000 m	4000 m	3500 m	4000 m	4000 m	3500 m	4000 m	4000 m
INNER APPROACH										
Width	-	-	-	-	-	-	-	90 m	120 m[e]	120 m[e]
Distance from Threshold	-	-	-	-	-	-	-	60 m	60 m	60 m
Length	-	-	-	-	-	-	-	900 m	900 m	900 m
slope								2.5 %	2 %	2 %
APPROACH										
Length of inner edge	60 m	80 m	150 m	150 m	140 m	280 m	280 m	140 m	280 m	280 m
Distance from threshold	30 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m
Divergence (each side)	10 %	10 %	10 %	10 %	15 %	15 %	15 %	15 %	15 %	15 %
First section										
Length	1600 m	2500 m	3000 m	3000 m	2500 m	3000 m	3000 m	3000 m	3000 m	3000 m
Slope	5 %	4 %	3.33 %	2.5 %	3.33 %	2%	2 %	2.5 %	2 %	2 %
Second section										
Length	-	-	-	-	-	3600 m[b]	3600 m[b]	12000 m	3600 m[b]	3600 m[b]
Slope	-	-	-	-	-	2.5 %	2.5 %	3 %	2.5 %	2.5 %
Horizontal section										
Length	-	-	-	-	-	8400 m[b]	8400 m[b]	-	8400 m[b]	8400 m[b]
Total length	-	-	-	-	-	15000 m	15000 m	15000 m	15000 m	15000 m
TRANSITIONAL										
Slope	20 %	20 %	14.3 %	14.3 %	20%	14.3 %	14.3 %	14.3 %	14.3 %	14.3 %
INNER TRANSITIONAL										
Slope	-	-	-	-	-	-	-	40 %	33.3 %	33.3 %
BALKED LANDING SURFACE										
Length of inner edge	-	-	-	-	-	-	-	90 m	120 m[e]	120 m[e]
Distance from threshold	-	-	-	-	-	-	-	c	1800 m[d]	1800 m[d]
Divergence (each side)	-	-	-	-	-	-	-	10 %	10 %	10 %
Slope	-	-	-	-	-	-	-	4 %	3.33 %	3.33 %

a. All dimensions are measured horizontally unless specified otherwise.
b. Variable length (see 4.2.9 or 4.2.17).
c. Distance to the end of strip.
d. Or end of runway whichever is less.
e. Where the code letter is F (Table 1-1), the width is increased to 140 m except for those aerodromes that accommodate a code letter F aeroplane equipped with digital avionics that provide steering commands to maintain an established track during the go-around manoeuvre.

Note.— See Circulars 301 and 345 (forthcoming), and Chapter 4 of the PANS-Aerodromes, Part I (Doc 9981) for further information.

4.2.13

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4.2.14 Precision approach runways — category I

The following obstacle limitation surfaces shall be established for a precision approach runway category I:

— inner approach surface;

— inner transitional surfaces; and

— balked landing surface.

4.2.15 Precision approach runways — category II or III

The following obstacle limitation surfaces shall be established for a precision approach runway category II or III:

— conical surface;

— inner horizontal surface;

— approach surface and inner approach surface;

— transitional surfaces;

— inner transitional surfaces; and

— balked landing surface.

4.2.16 Precision approach runways — heights and slopes

The heights and slopes of the surfaces shall not be greater than, and their other dimensions not less than, those specified in Table 4-1, except in the case of the horizontal section of the approach surface (see 4.2.17).

4.2.17 Precision approach runways — heights and slopes (cont.)

The approach surface shall be horizontal beyond the point at which the 2.5 per cent slope intersects:

a) a horizontal plane 150 m above the threshold elevation; or

b) the horizontal plane passing through the top of any object that governs the obstacle clearance limit;

whichever is the higher.

4.2.18 Precision approach runways — Fixed objects

Fixed objects shall not be permitted above the inner approach surface, the inner transitional surface or the balked landing surface, except for frangible objects which because of their function must be located on the strip. Mobile objects shall not be permitted above these surfaces during the use of the runway for landing.

4.2.19 Precision approach runways — New objects or extensions of existing objects

New objects or extensions of existing objects shall not be permitted above an approach surface or a transitional surface except when, in the opinion of the appropriate authority, the new object or extension would be shielded by an existing immovable object.

4.2.20 Precision approach runways — New objects or extensions of existing objects (cont.)

New objects or extensions of existing objects shall not be permitted above the conical surface and the inner horizontal surface except when, in the opinion of the appropriate authority, an object would be shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

4.2.21 Precision approach runways — New objects or extensions of existing objects (cont.)

Existing objects above an approach surface, a transitional surface, the conical surface and inner horizontal surface shall as far as practicable be removed except when, in the opinion of the authority, an object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

GM1 4.2.13 – 4.2.21 Precision approach runways

(a) See 9.9 for information regarding siting of equipment and installations on operational areas.

(b) Guidance on obstacle limitation surfaces for precision approach runways is given in the Airport Services Manual (Doc 9137), Part 6.

(c) Circumstances in which the shielding principle may reasonably be applied are described in the Airport Services Manual (Doc 9137), Part 6.

(d) Because of transverse or longitudinal slopes on a strip, in certain cases the inner edge or portions of the inner edge of the approach surface may be below the corresponding elevation of the strip. It is not intended that the strip be graded to conform with the inner edge of the approach surface, nor is it intended that terrain or objects which are above the approach surface beyond the end of the strip, but below the level of the strip, be removed unless it is considered they may endanger aeroplanes.

4.2.22 Runways meant for take-off

(a) The safety objective of the take-off climb surface slopes and dimensions is to allow safe take-off operations by defining the limits above which new obstacles shall not be permitted unless shielded by an existing immoveable object.

(b) The following obstacle limitation surface shall be established for a runway meant for take-off:

— take-off climb surface.

4.2.23 Runways meant for take-off — dimensions of the surface

The dimensions of the surface shall be not less than the dimensions specified in Table 4-2, except that a lesser length may be adopted for the take-off climb surface where such lesser length would be consistent with procedural measures adopted to govern the outward flight of aeroplanes.

4.2.24 Runways meant for take-off — slope

The operational characteristics of aeroplanes for which the runway is intended shall be examined to see if it is desirable to reduce the slope specified in Table 4-2 when critical operating conditions are to be catered to. If the specified slope is reduced, corresponding adjustment in the length of the take-off climb surface shall be made so as to provide protection to a height of 300 m.

4.2.25 Runways meant for take-off — New objects or extensions of existing objects

New objects or extensions of existing objects shall not be permitted above a take-off climb surface except when, in the opinion of the authority, the new object or extension would be shielded by an existing immovable object.

4.2.26 Runways meant for take-off — New objects

If no object reaches the 2 per cent (1:50) take-off climb surface, new objects shall be limited to preserve the existing obstacle free surface or a surface down to a slope of 1.6 per cent (1:62.5).

4.2.27 Runways meant for take-off — Existing objects that extend above a take-off climb surface

Existing objects that extend above a take-off climb surface shall as far as practicable be removed except when, in the opinion of the appropriate authority, an object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

GM1 4.2.22 – 4.2.26 Runways meant for take-off

(a) When local conditions differ widely from sea level standard atmospheric conditions, it may be advisable for the slope specified in Table 4-2 to be reduced. The degree of this reduction depends on the divergence between local conditions and sea level standard atmospheric conditions, and on the performance characteristics and operational requirements of the aeroplanes for which the runway is intended.

(b) Circumstances in which the shielding principle may reasonably be applied are described in the Airport Services Manual (Doc 9137), Part 6.

(C) Because of transverse slopes on a strip or clearway, in certain cases portions of the inner edge of the take-off climb surface may be below the corresponding elevation of the strip or clearway. It is not intended that the strip or clearway be graded to conform with the inner edge of the take-off climb surface, nor is it intended that terrain or objects which are above the take-off climb surface beyond the end of the strip or clearway, but below the level of the strip or clearway, be removed unless it is considered they may endanger aeroplanes. Similar considerations apply at the junction of a clearway and strip where differences in transverse slopes exist.

Table 4-2 Dimension and slopes of obstacle limitation surfaces

RUNWAYS MEANT FOR TAKE-OFF			
Surface and dimensions[a]	Code number		
	1	2	3 or 4
(1)	(2)	(3)	(4)
TAKE-OFF CLIMB			
Length of inner edge	60[e] m	80[e] m	180 m
Distance from runway end[b]	30 m	60 m	60 m
Divergence (each side)	10 %	10 %	12.5 %
Final width	380 m	580 m	1200 m 1800 m[c]
Length	1600 m	2500 m	15000 m
Slope	5 %	4 %	2 % [d]

a. All dimensions are measured horizontally unless specified otherwise.
b. The take-off climb surface starts at the end of the clearway if the clearway length exceeds the specified distance.
c. 1 800 m when the intended track includes changes of heading greater than 15° for operations conducted in IMC, VMC by night.
d. See 4.2.24 and 4.2.26,

4.3 Objects outside the obstacle limitation surfaces

4.3.1

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4.3.2 Objects outside the obstacle limitation surfaces

(a) Applicability: The specifications in paragraph (b) below apply only to the area under control of the aerodrome operator.

(b) In areas beyond the limits of the obstacle limitation surfaces, at least those objects which extend to a height of 150 m or more above ground elevation shall be regarded as obstacles, unless a special aeronautical study indicates that they do not constitute a hazard to aeroplanes.

GM1 4.3.2 Objects outside the obstacle limitation surfaces

(a) Beyond the limits of the obstacle limitation surfaces the safety assessment should be conducted for the proposed constructions that extend above the established limits in order to protect safe operation of aircraft.

(b) The safety assessment may have regard to the nature of operations concerned and may distinguish between day and night operations.

4.4 Other objects

4.4.1 Other objects which do not project through the approach surface

Objects which do not project through the approach surface but which would nevertheless adversely affect the optimum siting or performance of visual or non-visual aids should, as far as practicable, be removed.

4.4.2 Other objects with potential to endanger aeroplanes

Anything which may, in the opinion of the authority after aeronautical study, endanger aeroplanes on the movement area or in the air within the limits of the inner horizontal and conical surfaces shall be regarded as an obstacle and shall be removed, in so far as practicable.

GM1 4.41 & 4.4.2 Other objects

In certain circumstances, objects that do not project above any of the surfaces enumerated in 4.1 may constitute a hazard to aeroplanes as, for example, where there are one or more isolated objects in the vicinity of an aerodrome.

CHAPTER 5. VISUAL AIDS FOR NAVIGATION

5.1 Indicators and signalling devices

5.1.1 Wind direction indicator

5.1.1.1 Wind direction indicator — Application

An aerodrome shall be equipped with at least one wind direction indicator.

AMC1 5.1.1.1 Wind direction indicator – Application

A wind direction indicator should be at the beginning of each runway in use.

5.1.1.2 Wind direction indicator — Location

A wind direction indicator shall be located so as to be visible from aircraft in flight or on the movement area and in such a way as to be free from the effects of air disturbances caused by nearby objects.

5.1.1.3 Wind direction indicator — Characteristics

A wind direction indicator shall be in the form of a truncated cone made of fabric and shall have a length of not less than 3.6 m and a diameter, at the larger end, of not less than 0.9 m. It shall be constructed so that it gives a clear indication of the direction of the surface wind and a general indication of the wind speed.

The colour or colours shall be so selected as to make the wind direction indicator clearly visible and understandable from a height of at least 300 m, having regard to background. Where practicable, a single colour, preferably white or orange, shall be used. Where a combination of two colours is required to give adequate conspicuity against changing backgrounds, they shall preferably be orange and white, red and white, or black and white, and shall be arranged in five alternate bands, the first and last bands being the darker colour.

5.1.1.4 Wind direction indicator — Marking

The location of at least one wind direction indicator shall be marked by a circular band 15 m in diameter and 1.2 m wide. The band shall be centred about the wind direction indicator support and shall be in a colour chosen to give adequate conspicuity, preferably white.

5.1.1.5 Wind direction indicator — Night

Provision shall be made for illuminating at least one wind indicator at an aerodrome intended for use at night.

5.1.2 Landing direction indicator

5.1.2.1 Landing direction indicator — Location

Where provided, a landing direction indicator shall be located in a conspicuous place on the aerodrome.

5.1.2.2 Landing direction indicator — Characteristics

The landing direction indicator shall be in the form of a "T".

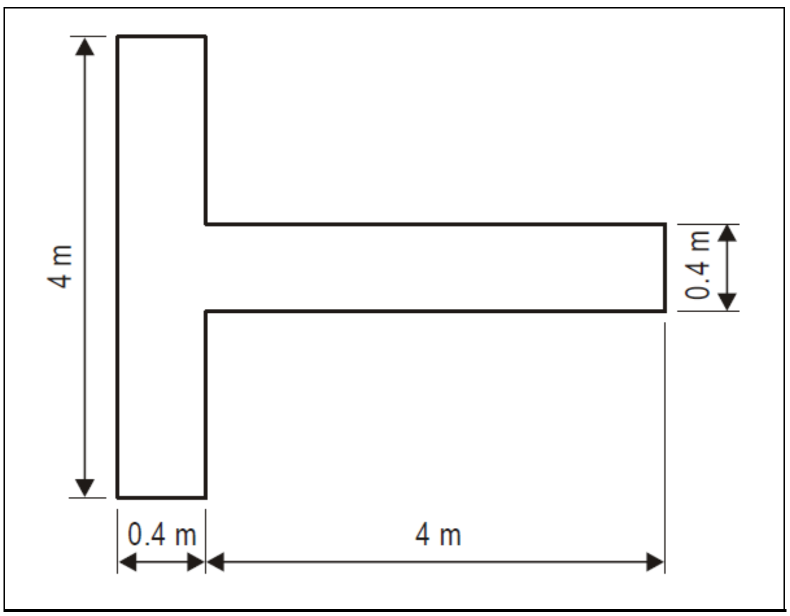


Figure 5-1. Landing direction indicator

5.1.2.3 Landing direction indicator — Characteristics (cont.)

(a) The shape and minimum dimensions of a landing "T" shall be as shown in Figure 5-1.

(b) The colour of the landing "T" shall be either white or orange, the choice being dependent on the colour that contrasts best with the background against which the indicator will be viewed.

(C) Where required for use at night the landing "T" shall either be illuminated or outlined by white lights.

5.1.3 Signalling lamp

5.1.3.1 Signalling lamp — Application

A signalling lamp shall be provided at a controlled aerodrome in the aerodrome control tower.

5.1.3.2 Signalling lamp — Characteristics

A signalling lamp shall be capable of producing red, green and white signals, and of:

- a) being aimed manually at any target as required;
- b) giving a signal in any one colour followed by a signal in either of the two other colours; and
- c) transmitting a message in any one of the three colours by Morse Code up to a speed of at least four words per minute.

When selecting the green light, use shall be made of the restricted boundary of green as specified in Appendix 1, 2.1.2.

5.1.3.3 Signalling lamp — Characteristics (cont.)

The beam spread shall be not less than 1° nor greater than 3°, with negligible light beyond 3°. When the signalling lamp is intended for use in the daytime the intensity of the coloured light shall be not less than 6 000 cd.

5.1.4 Signal panels and signal area

5.1.4.0 Applicability

The inclusion of the provisions for a signal area in this section is not intended to imply that one has to be provided. Attachment A, Section 16, provides guidance on the need to provide ground signals. Annex 2, Appendix 1, specifies the shape, colour and use of visual ground signals. The Aerodrome Design Manual (Doc 9157), Part 4, provides guidance on their design.

5.1.4.1 Location of signal area

The signal area shall be located so as to be visible for all angles of azimuth above an angle of 10° above the horizontal when viewed from a height of 300 m.

5.1.4.2 Characteristics of signal area

The signal area shall be an even horizontal surface at least 9 m square.

5.1.4.3 Characteristics of signal area (cont.)

The colour of the signal area shall be chosen to contrast with the colours of the signal panels used, and it shall be surrounded by a white border not less than 0.3 m wide.

5.2 Markings

5.2.1 General

5.2.1.1 Interruption of runway markings

At an intersection of two (or more) runways the markings of the more important runway, except for the runway side stripe marking, shall be displayed and the markings of the other runway(s) shall be interrupted. The runway side stripe marking of the more important runway may be either continued across the intersection or interrupted.

5.2.1.2 Interruption of runway markings (cont.)

The order of importance of runways for the display of runway markings shall be as follows:

1st — precision approach runway;

2nd — non-precision approach runway; and

3rd — non-instrument runway.

5.2.1.3 Interruption of runway markings (cont.)

At an intersection of a runway and taxiway the markings of the runway shall be displayed and the markings of the taxiway interrupted, except that runway side stripe markings may be interrupted.

Note.— See 5.2.8.7 regarding the manner of connecting runway and taxiway centre line markings.

5.2.1.4 Colour and conspicuity – Runway markings

Runway markings shall be white.

5.2.1.5 Colour and conspicuity – Taxiway markings, runway turn pad markings

Taxiway markings, runway turn pad markings and aircraft stand markings shall be yellow.

5.2.1.6 Colour and conspicuity – Apron safety lines

Apron safety lines shall be of a conspicuous colour which shall contrast with that used for aircraft stand markings.

5.2.1.7 Colour and conspicuity – aerodromes with night operations

At aerodromes where operations take place at night, pavement markings shall be made with reflective materials designed to enhance the visibility of the markings.

GM1 5.2.1.4 – 5.2.1.7 Colour and conspicuity

Where there is insufficient contrast between the marking and the pavement surface, the marking should include an appropriate border.

(1) This border should be white or black;

(2) It is preferable that the risk of uneven friction characteristics on markings be reduced in so far as practicable by the use of a suitable kind of paint.

(3) Markings may consist of solid areas or a series of longitudinal stripes providing an effect equivalent to the solid areas.

(4) Guidance on reflective materials is given in the Aerodrome Design Manual (Doc 9157), Part 4.

5.2.1.8 Unpaved taxiways

An unpaved taxiway shall be provided, so far as practicable, with the markings prescribed for paved taxiways.

5.2.2 Runway designation marking

5.2.2.1 Runway designation marking — Applicability paved runway

A runway designation marking shall be provided at the thresholds of a paved runway.

5.2.2.2 Runway designation marking — Applicability unpaved runway

A runway designation marking shall be provided, so far as practicable, at the thresholds of an unpaved runway.

5.2.2.3 Runway designation marking — Location

A runway designation marking shall be located at a threshold as shown in Figure 5-2 as appropriate.

Note.— If the runway threshold is displaced from the extremity of the runway, a sign showing the designation of the runway may be provided for aeroplanes taking off.

5.2.2.4 Runway designation marking — Characteristics

A runway designation marking shall consist of a two-digit number and on parallel runways shall be supplemented with a letter.

(1) On a single runway, dual parallel runways and triple parallel runways the two-digit number shall be the whole number nearest the one-tenth of the magnetic North when viewed from the direction of approach.

(2) On four or more parallel runways, one set of adjacent runways shall be numbered to the nearest one-tenth magnetic azimuth and the other set of adjacent runways numbered to the next nearest one-tenth of the magnetic azimuth.

(3) When the above rule would give a single digit number, it shall be preceded by a zero.

5.2.2.5 Runway designation marking — Characteristics parallel runway

In the case of parallel runways, each runway designation number shall be supplemented by a letter as follows, in the order shown from left to right when viewed from the direction of approach:

— for two parallel runways: “L” “R”;

— for three parallel runways: “L” “C” “R”;

— for four parallel runways: “L” “R” “L” “R”;

— for five parallel runways: “L” “C” “R” “L” “R” or “L” “R” “L” “C” “R”; and

— for six parallel runways: “L” “C” “R” “L” “C” “R”.

5.2.2.6 Runway designation marking — number and letters form and proportion

The numbers and letters shall be in the form and proportion shown in Figure 5-3. The dimensions shall be not less than those shown in Figure 5-3, but where the numbers are incorporated in the threshold marking, larger dimensions shall be used in order to fill adequately the gap between the stripes of the threshold marking.

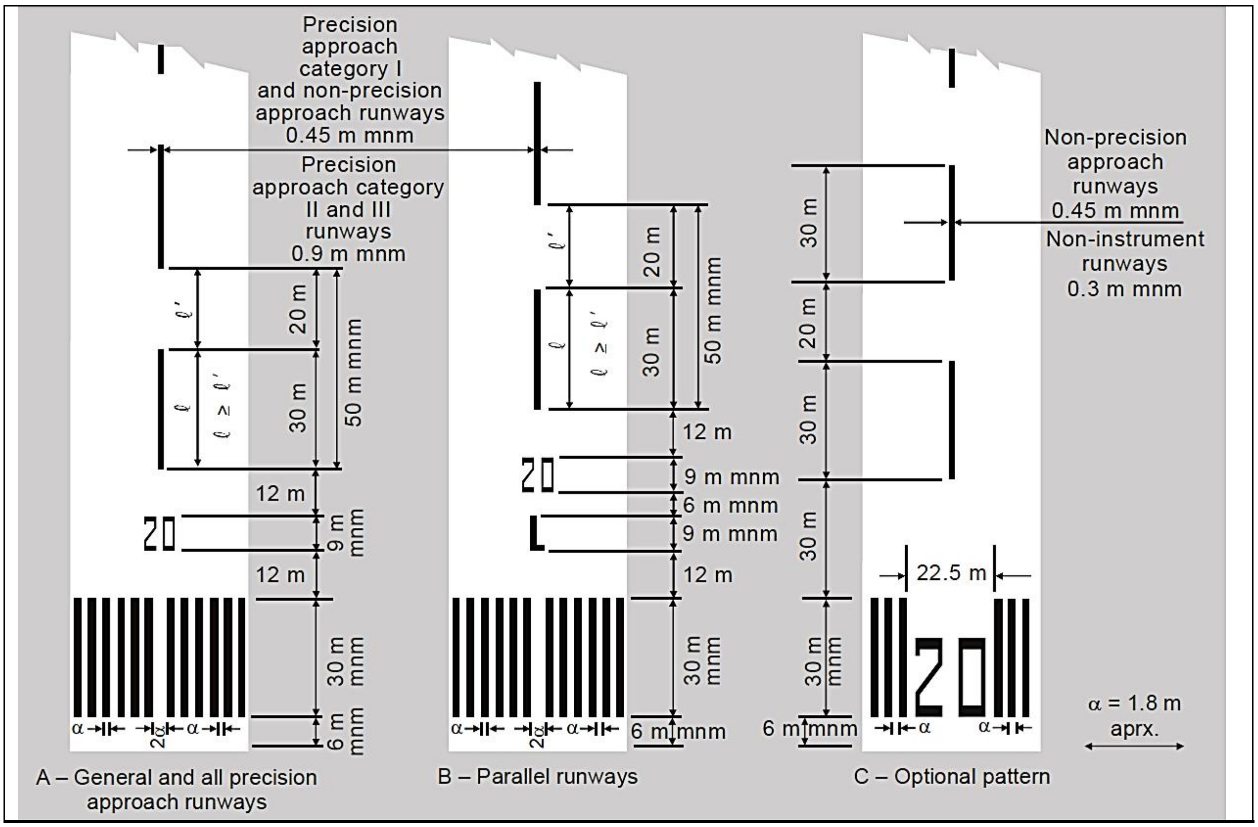
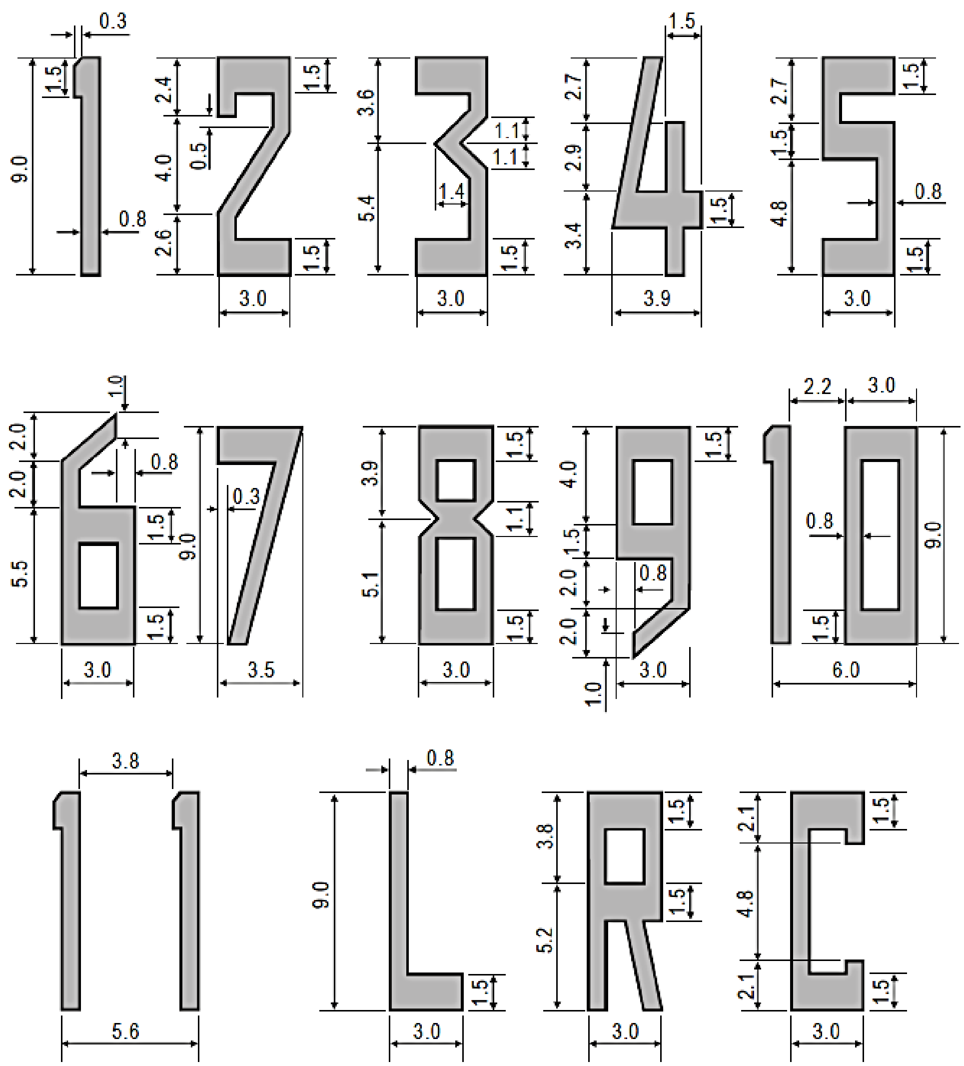


Figure 5-2. Runway designation, centre line and threshold markings



Note.— All units are expressed in metres.

Figure 5-3. Form and proportions of numbers and letters for runway designation markings

5.2.3 Runway centre line marking

5.2.3.1 Runway centre line marking — Applicability

A runway centre line marking shall be provided on a paved runway.

5.2.3.2 Runway centre line marking — Location

A runway centre line marking shall be located along the centre line of the runway between the runway designation markings as shown in Figure 5-2, except when interrupted in compliance with 5.2.1.1.

5.2.3.3 Runway centre line marking — Characteristics

A runway centre line marking shall consist of a line of uniformly spaced stripes and gaps. The length of a stripe plus a gap shall be not less than 50 m or more than 75 m. The length of each stripe shall be at least equal to the length of the gap or 30 m, whichever is greater.

5.2.3.4 Runway centre line marking — Characteristics (cont.)

The width of the stripes shall be not less than:

— 0.90 m on precision approach category II and III runways;

— 0.45 m on non-precision approach runways where the code number is 3 or 4, and precision approach category I runways; and

— 0.30 m on non-precision approach runways where the code number is 1 or 2, and on non-instrument runways.

5.2.4 Threshold marking

5.2.4.1 Threshold marking — Applicability

A threshold marking shall be provided at the threshold of a paved instrument runway, and of a paved non-instrument runway where the code number is 3 or 4 and the runway is intended for use by international commercial air transport.

5.2.4.2 Threshold marking — Applicability (cont.)

A threshold marking shall be provided at the threshold of a paved non-instrument runway where the code number is 3 or 4 and the runway is intended for use by other than international commercial air transport.

5.2.4.3 Threshold marking — Applicability (cont.)

A threshold marking shall be provided, so far as practicable, at the thresholds of an unpaved runway.

Note.— The Aerodrome Design Manual (Doc 9157), Part 4, shows a form of marking which has been found satisfactory for the marking of downward slopes immediately before the threshold.

5.2.4.4 Threshold marking — Location

The stripes of the threshold marking shall commence 6 m from the threshold.

5.2.4.5 Threshold marking — Characteristics

A runway threshold marking shall consist of a pattern of longitudinal stripes of uniform dimensions disposed symmetrically about the centre line of a runway as shown in Figure 5-2 (A) and (B) for a runway width of 45 m. The number of stripes shall be in accordance with the runway width as follows:

Runway width	Number of stripes
18 m	4
23 m	6
30 m	8
45 m	12
60 m	16

except that on non-precision approach and non-instrument runways 45 m or greater in width, they may be as shown in Figure 5-2 (C).

5.2.4.6 Threshold marking — Characteristics (cont.)

The stripes shall extend laterally to within 3 m of the edge of a runway or to a distance of 27 m on either side of a runway centre line, whichever results in the smaller lateral distance. Where a runway designation marking is placed within a threshold marking there shall be a minimum of three stripes on each side of the centre line of the runway. Where a runway designation marking is placed above a threshold marking, the stripes shall be continued across the runway. The stripes shall be at least 30 m long and approximately 1.80 m wide with spacings of approximately 1.80

m between them except that, where the stripes are continued across a runway, a double spacing shall be used to separate the two stripes nearest the centre line of the runway, and in the case where the designation marking is included within the threshold marking this spacing shall be 22.5 m.

5.2.4.7 Displaces threshold – Transverse stripe

Where a threshold is displaced from the extremity of a runway or where the extremity of a runway is not square with the runway centre line, a transverse stripe as shown in Figure 5-4 (B) shall be added to the threshold marking.

5.2.4.8 Displaces threshold – Transverse stripe characteristics

A transverse stripe shall be not less than 1.80 m wide.

5.2.4.9 Displaces threshold – Arrows

Where a runway threshold is permanently displaced, arrows conforming to Figure 5-4 (B) shall be provided on the portion of the runway before the displaced threshold.

5.2.4.10 Displaces threshold – Arrows

When a runway threshold is temporarily displaced from the normal position, it shall be marked as shown in Figure 5-4 (A) or 5-4 (B) and all markings prior to the displaced threshold shall be obscured except the runway centre line marking, which shall be converted to arrows.

Note 1.— In the case where a threshold is temporarily displaced for only a short period of time, it has been found satisfactory to use markers in the form and colour of a displaced threshold marking rather than attempting to paint this marking on the runway.

Note 2.— When the runway before a displaced threshold is unfit for the surface movement of aircraft, closed markings, as described in 7.1.4, are required to be provided.

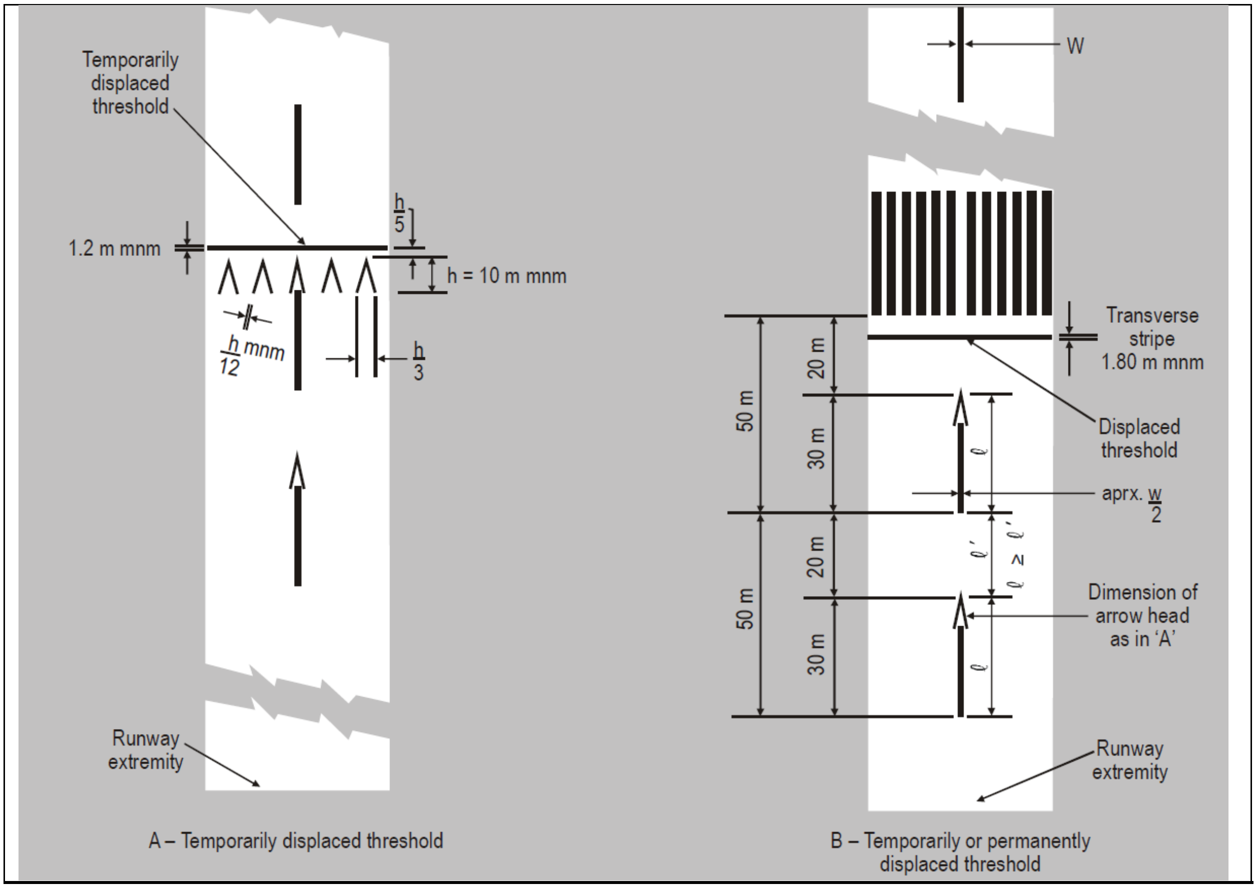


Figure 5-4. Displaced threshold markings

5.2.5 Aiming point marking

5.2.5.1 Aiming point marking — Application

An aiming point marking shall be provided at each approach end of a paved instrument runway where the code number is 2, 3 or 4.

5.2.5.2 Aiming point marking — Application

An aiming point marking shall be provided at each approach end of:

a) a paved non-instrument runway where the code number is 3 or 4;

b) a paved instrument runway where the code number is 1;

when additional conspicuity of the aiming point is desirable.

5.2.5.3 Aiming point marking — Location

The aiming point marking shall commence no closer to the threshold than the distance indicated in the appropriate column of Table 5-1, except that, on a runway equipped with a visual approach slope indicator system, the beginning of the marking shall be coincident with the visual approach slope origin.

5.2.5.4 Aiming point marking — Characteristics

An aiming point marking shall consist of two conspicuous stripes. The dimensions of the stripes and the lateral spacing between their inner sides shall be in accordance with the provisions of the appropriate column of Table 5-1. Where a touchdown zone marking is provided, the lateral spacing between the markings shall be the same as that of the touchdown zone marking.

Table 5-1. Location and dimensions of aiming point marking

Location and dimensions	Landing distance available			
	Less than 800 m	800 m up to but not including 1200 m	1200 m up to but not including 24000 m	2400 m and above
(1)	(2)	(3)	(4)	(5)
Distance from threshold to beginning of marking[a]	150 m	250 m	300 m	400 m
Length of stripe[b]	30-45 m	30-45 m	45-60 m	45-60 m
Width of stripe	4 m	6 m	6-10 m[c]	6-10 m[c]
Lateral spacing between inner sides of stripes	6-10 m[d]	9 m[d]	18-22.5 m	18-22.5 m

a. Where a PAPI system is provided for the runway, the beginning of the marking should be coincident with the visual approach slope origin.
b. Where greater dimensions of the specified ranges are intended to be used where increased conspicuity is required.
c. Where lateral spacing may be varied within these limits to 258inimize the contamination of the marking by rubber deposits.
d. These figures were deduced by reference to the outer main gear wheel span which is element 2 of the aerodrome reference code.

5.2.6 Touchdown zone marking

5.2.6.1 Touchdown zone marking — Applicability

A touchdown zone marking shall be provided in the touchdown zone of a paved precision approach runway where the code number is 2, 3 or 4.

5.2.6.2 Touchdown zone marking — Applicability (cont.)

A touchdown zone marking shall be provided in the touchdown zone of a paved non-precision approach or non-instrument runway where the code number is 3 or 4 and additional conspicuity of the touchdown zone is desirable.

5.2.6.3 Touchdown zone marking — Location

A touchdown zone marking shall consist of pairs of rectangular markings symmetrically disposed about the runway centre line with the number of such pairs related to the landing distance available and, where the marking is to be displayed at both the approach directions of a runway, the distance between the thresholds, as follows:

Landing distance available or the distance between thresholds	Pair(s) of markings
less than 900 m	1
900 m up to but not including 1 200 m	2
1 200 m up to but not including 1 500 m	3
1 500 m up to but not including 2 400 m	4
2 400 m or more	6

5.2.6.4 Touchdown zone marking — Characteristics

(a) A touchdown zone marking shall conform to either of the two patterns shown in Figure 5-5. For the pattern shown in Figure 5-5 (A), the markings shall be not less than 22.5 m long and 3 m wide. For the pattern shown in Figure 5-5 (B), each stripe of each marking shall be not less than 22.5 m long and 1.8 m wide with a spacing of 1.5 m between adjacent stripes.

(b) The lateral spacing between the inner sides of the rectangles shall be equal to that of the aiming point marking where provided. Where an aiming point marking is not provided, the lateral spacing between the inner sides of the rectangles shall correspond to the lateral spacing specified for the aiming point marking in Table 5-1 (columns 2, 3, 4 or 5, as appropriate). The pairs of markings shall be provided at longitudinal spacings of 150 m beginning from the threshold, except that pairs of touchdown zone markings coincident with or located within 50 m of an aiming point marking shall be deleted from the pattern.

5.2.6.5 Touchdown zone marking — Characteristics (cont.)

On a non-precision approach runway where the code number is 2, an additional pair of touchdown zone marking stripes shall be provided 150 m beyond the beginning of the aiming point marking.

5.2.7 Runway side stripe marking

5.2.7.1 Runway side stripe marking — Applicability

A runway side stripe marking shall be provided between the thresholds of a paved runway where there is a lack of contrast between the runway edges and the shoulders or the surrounding terrain.

5.2.7.2 Runway side stripe marking — Applicability (cont.)

A runway side stripe marking shall be provided on a precision approach runway irrespective of the contrast between the runway edges and the shoulders or the surrounding terrain.

5.2.7.3 Runway side stripe marking — Location

A runway side stripe marking shall consist of two stripes, one placed along each edge of the runway with the outer edge of each stripe approximately on the edge of the runway, except that, where the runway is greater than 60 m in width, the stripes shall be located 30 m from the runway centre line.

5.2.7.4 Runway side stripe marking — Location (cont.)

Where a runway turn pad is provided, the runway side stripe marking shall be continued between the runway and the runway turn pad.

5.2.7.5 Runway side stripe marking — Characteristics

A runway side stripe shall have an overall width of at least 0.9 m on runways 30 m or more in width and at least 0.45 m on narrower runways.

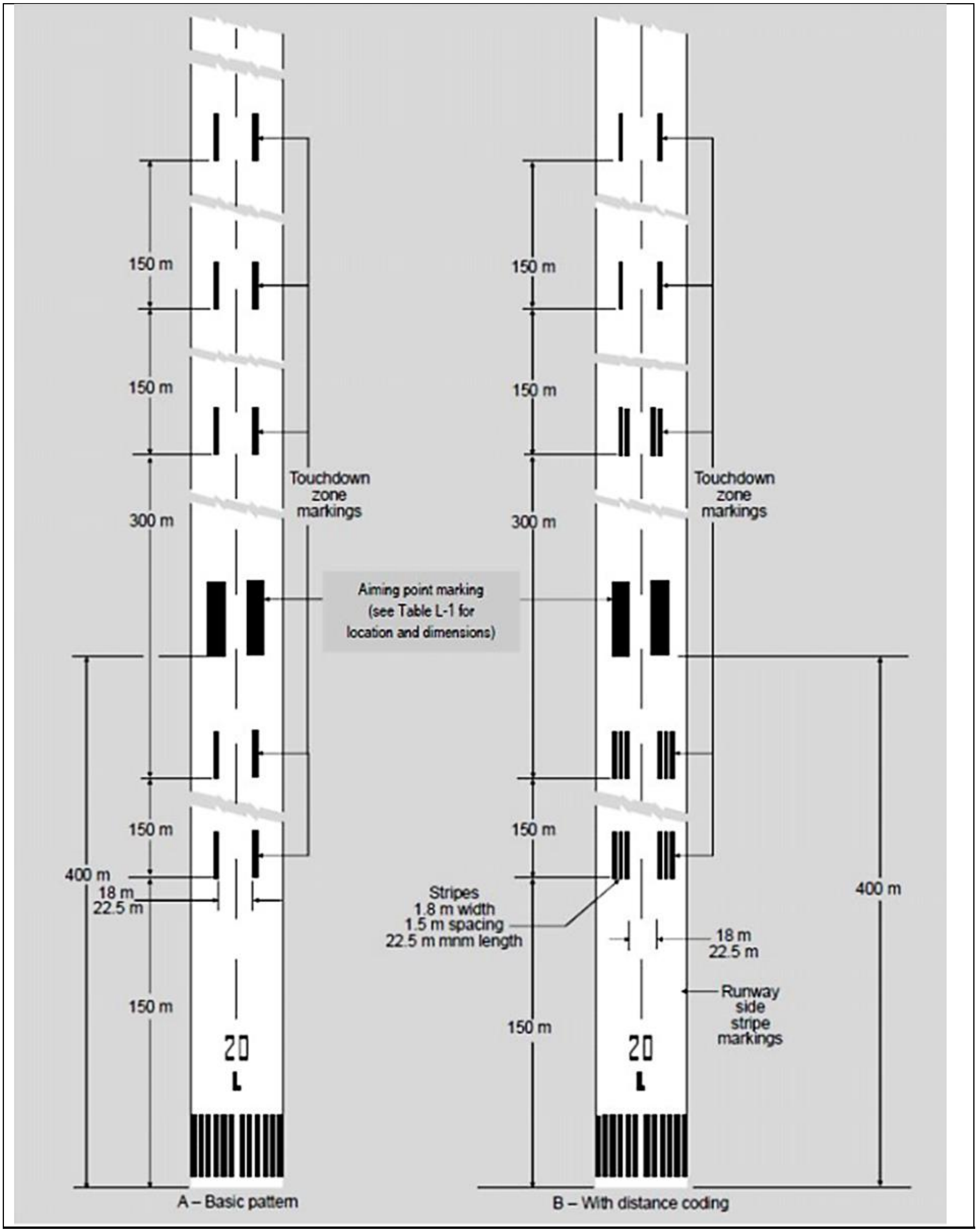


Figure 5-5. Aiming point and touchdown zone markings (illustrated for a runway with a length of 2 400 m or more)

5.2.8 Taxiway centre line marking

5.2.8.1 Taxiway centre line marking — Applicability

Taxiway centre line marking shall be provided on a paved taxiway, de-icing/anti-icing facility and apron where the code number is 3 or 4 in such a way as to provide continuous guidance between the runway centre line and aircraft stands.

5.2.8.2 Taxiway centre line marking — Applicability (cont.)

Taxiway centre line marking shall be provided on a paved taxiway and apron where the code number is 1 or 2 in such a way as to provide continuous guidance between the runway centre line and aircraft stands.

5.2.8.3 Taxiway centre line marking — Applicability (cont.)

Taxiway centre line marking shall be provided on a paved runway when the runway is part of a standard taxiroute and:

a) there is no runway centre line marking; or

b) where the taxiway centre line is not coincident with the runway centre line.

5.2.8.4 Taxiway centre line marking — Applicability (cont.)

Where it is necessary to denote the proximity of a runway-holding position, enhanced taxiway centre line marking shall be provided.

Note.— The provision of enhanced taxiway centre line marking may form part of runway incursion prevention measures.

5.2.8.5 Taxiway centre line marking — Applicability (cont.)

Where provided, enhanced taxiway centre line marking shall be installed at each taxiway/runway intersection.

5.2.8.6 Taxiway centre line marking — Location

On a straight section of a taxiway the taxiway centre line marking shall be located along the taxiway centre line. On a taxiway curve the marking shall continue from the straight portion of the taxiway at a constant distance from the outside edge of the curve.

Note.— See 3.9.5 and Figure 3-2.

5.2.8.7 Taxiway centre line marking — Location (cont.)

At an intersection of a taxiway with a runway where the taxiway serves as an exit from the runway, the taxiway centre line marking shall be curved into the runway centre line marking as shown in Figures 5-6 and 5-26. The taxiway centre line marking shall be extended parallel to the runway centre line marking for a distance of at least 60 m beyond the point of tangency where the code number is 3 or 4, and for a distance of at least 30 m where the code number is 1 or 2.

5.2.8.8 Taxiway centre line marking — Location (cont.)

Where taxiway centre line marking is provided on a runway in accordance with 5.2.8.3, the marking shall be located on the centre line of the designated taxiway.

5.2.8.9 Taxiway centre line marking — Location (cont.)

Where provided:

a) An enhanced taxiway centre line marking shall extend from the runway-holding position Pattern A (as defined in Figure 5-6, Taxiway markings) to a distance of up to 47 m in the direction of travel away from the runway. See Figure 5-7 (a).

b) If the enhanced taxiway centre line marking intersects another runway-holding position marking, such as for a precision approach category II or III runway, that is located within 47 m of the first runway-holding position marking, the enhanced taxiway centre line marking shall be interrupted 0.9 m prior to and after the intersected runway-holding position marking. The enhanced taxiway centre line marking shall continue beyond the intersected runway-holding position marking for at least three dashed line segments or 47 m from start to finish, whichever is greater. See Figure 5-7 (b).

c) If the enhanced taxiway centre line marking continues through a taxiway/taxiway intersection that is located within 47 m of the runway-holding position marking, the enhanced taxiway centre line marking shall be interrupted 1.5 m prior to and after the point where the intersected taxiway centre line crosses the enhanced taxiway centre line. The enhanced taxiway centre line marking shall continue beyond the taxiway/taxiway intersection for at least three dashed line segments or 47 m from start to finish, whichever is greater. See Figure 5-7 (c).

d) Where two taxiway centre lines converge at or before the runway-holding position marking, the inner dashed line shall not be less than 3 m in length. See Figure 5-7 (d).

e) Where there are two opposing runway-holding position markings and the distance between the markings is less than 94 m, the enhanced taxiway centre line markings shall extend over this entire distance. The enhanced taxiway centre line markings shall not extend beyond either runway-holding position marking. See Figure 5-7 (e).

5.2.8.10 Taxiway centre line marking — Characteristics

A taxiway centre line marking shall be at least 15 cm in width and continuous in length except where it intersects with a runway-holding position marking or an intermediate holding position marking as shown in Figure 5-6.

5.2.8.11 Taxiway centre line marking — Characteristics (cont.)

Enhanced taxiway centre line marking shall be as shown in Figure 5-7.

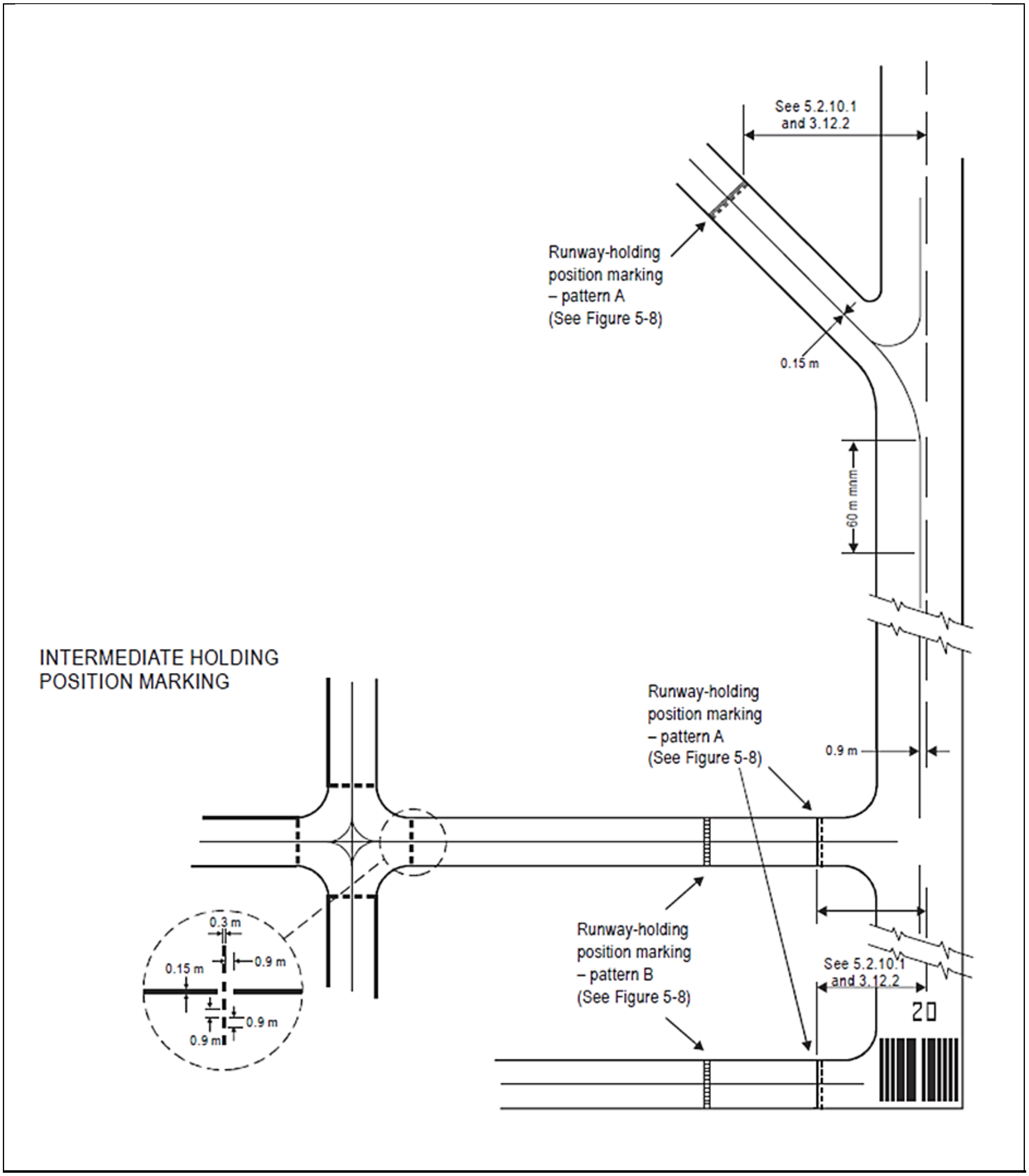


Figure 5-6. Taxiway markings
(shown with basic runway markings)

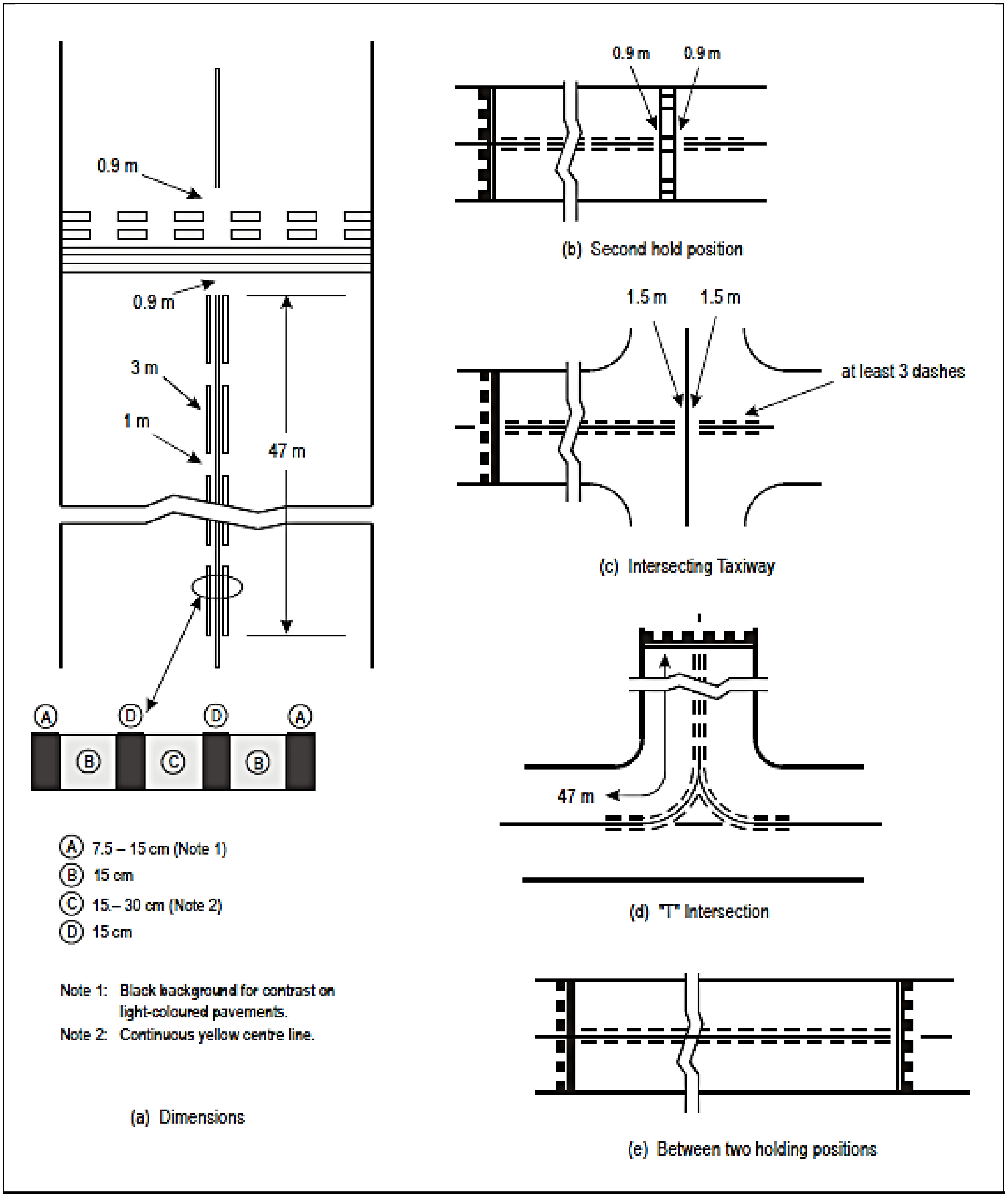


Figure 5-7. Enhanced taxiway centre line marking

5.2.9 Runway turn pad marking

5.2.9.1 Runway turn pad marking — Applicability

Where a runway turn pad is provided, a runway turn pad marking shall be provided for continuous guidance to enable an aeroplane to complete a 180-degree turn and align with the runway centre line.

5.2.9.2 Runway turn pad marking — Location

The runway turn pad marking shall be curved from the runway centre line into the turn pad. The radius of the curve shall be compatible with the manoeuvring capability and normal taxiing speeds of the aeroplanes for which the runway turn pad is intended. The intersection angle of the runway turn pad marking with the runway centre line shall not be greater than 30 degrees.

5.2.9.3 Runway turn pad marking — Location (cont.)

The runway turn pad marking shall be extended parallel to the runway centre line marking for a distance of at least 60 m beyond the point of tangency where the code number is 3 or 4, and for a distance of at least 30 m where the code number is 1 or 2.

5.2.9.4 Runway turn pad marking — Location (cont.)

A runway turn pad marking shall guide the aeroplane in such a way as to allow a straight portion of taxiing before the point where a 180-degree turn is to be made. The straight portion of the runway turn pad marking shall be parallel to the outer edge of the runway turn pad.

5.2.9.5 Runway turn pad marking — Location (cont.)

The design of the curve allowing the aeroplane to negotiate a 180-degree turn shall be based on a nose wheel steering angle not exceeding 45 degrees.

5.2.9.6 Runway turn pad marking — Location (cont.)

The design of the turn pad marking shall be such that, when the cockpit of the aeroplane remains over the runway turn pad marking, the clearance distance between any wheel of the aeroplane landing gear and the edge of the runway turn pad shall be not less than those specified in 3.3.6.

Note.— For ease of manoeuvring, consideration may be given to providing a larger wheel-to-edge clearance for codes E and F aeroplanes.

5.2.9.7 Runway turn pad marking — Characteristics

A runway turn pad marking shall be at least 15 cm in width and continuous in length.

5.2.10 Runway-holding position marking

5.2.10.1 Runway-holding position marking — Application and location

A runway-holding position marking shall be displayed along a runway-holding position.

Note.— See 5.4.2 concerning the provision of signs at runway-holding positions.

5.2.10.2 Runway-holding position marking — Characteristics

At an intersection of a taxiway and a non-instrument, non-precision approach or take-off runway, the runway-holding position marking shall be as shown in Figure 5-6, pattern A.

5.2.10.3 Runway-holding position marking — Characteristics (cont.)

Where a single runway-holding position is provided at an intersection of a taxiway and a precision approach category I, II or III runway, the runway-holding position marking shall be as shown in Figure 5-6, pattern A. Where two or three runway-holding positions are provided at such an intersection, the runway-holding position marking closer (closest) to the runway shall be as shown in Figure 5-6, pattern A and the markings farther from the runway shall be as shown in Figure 5-6, pattern B.

5.2.10.4 Runway-holding position marking — Characteristics (cont.)

The runway-holding position marking displayed at a runway-holding position established in accordance with 3.12.3 shall be as shown in Figure 5-6, pattern A.

5.2.10.5 Runway-holding position marking — Characteristics Applicable until 25 November 2026

The dimensions of runway-holding position markings shall be as shown in Figure 5-8, pattern A1 (or A2) or pattern B1 (or B2), as appropriate.

5.2.10.6 Runway-holding position marking — Characteristics (cont.) Applicable as of 26 November 2026

The dimensions of runway-holding position markings shall be as shown in Figure 5-8, pattern A2 or pattern B2, as appropriate.

5.2.10.7 Runway-holding position marking — Characteristics (cont.)

Where increased conspicuity of the runway-holding position is required, the dimensions of runway-holding position marking shall be as shown in Figure 5-8, pattern A2 or pattern B2, as appropriate.

Note.— An increased conspicuity of the runway-holding position can be required, notably to avoid incursion risks.

5.2.10.8 Runway-holding position marking — Characteristics (cont.)

Where a pattern B runway-holding position marking is located on an area where it would exceed 60 m in length, the term “CAT II” or “CAT III” as appropriate shall be marked on the surface at the ends of the runway-holding position marking and at equal intervals of 45 m maximum between successive marks. The letters shall be not less than 1.8 m high and shall be placed not more than 0.9 m beyond the holding position marking.

5.2.10.9 Runway-holding position marking — Characteristics (cont.)

The runway-holding position marking displayed at a runway/runway intersection shall be perpendicular to the centre line of the runway forming part of the standard taxi-route. The pattern of the marking shall be as shown in Figure 5-8, pattern A2.

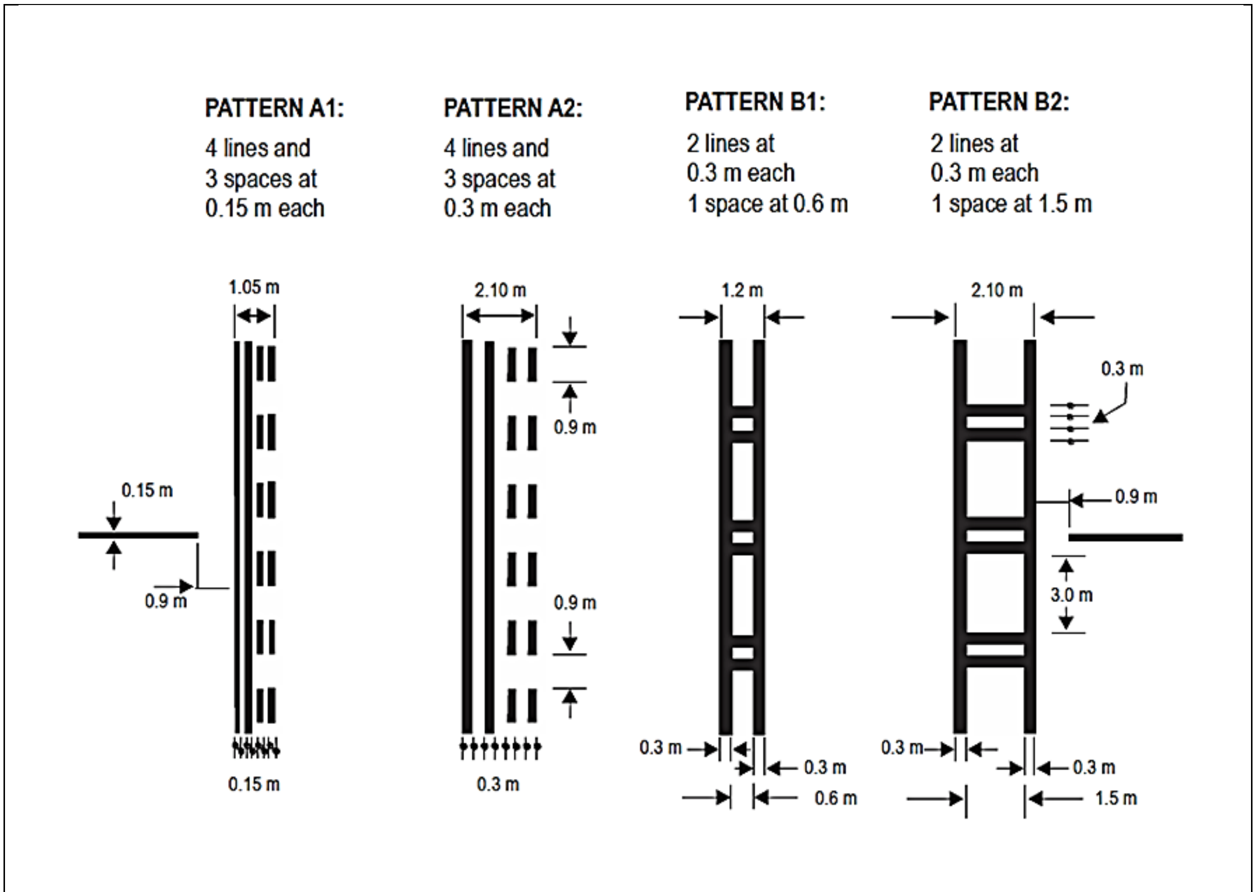


Figure 5-8. Runway-holding position markings

Note.— Patterns A1 and B1 are no longer valid after 2026.

5.2.11 Intermediate holding position marking

5.2.11.1 Intermediate holding position marking — Application and location

An intermediate holding position marking shall be displayed along an intermediate holding position.

5.2.11.2

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5.2.11.3 Intermediate holding position marking — Application and location (cont.)

Where an intermediate holding position marking is displayed at an intersection of two paved taxiways, it shall be located across the taxiway at sufficient distance from the near edge of the intersecting taxiway to ensure safe clearance between taxiing aircraft. It shall be coincident with a stop bar or intermediate holding position lights, where provided.

5.2.11.4

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5.2.11.5 Intermediate holding position marking — Characteristics

An intermediate holding position marking shall consist of a single broken line as shown in Figure 5-6.

5.2.12 VOR aerodrome checkpoint marking

5.2.12.1 VOR aerodrome checkpoint marking — Application

When a VOR aerodrome checkpoint is established, it shall be indicated by a VOR aerodrome checkpoint marking and sign.

Note.— See 5.4.4 for VOR aerodrome checkpoint sign.

5.2.12.2 VOR aerodrome checkpoint marking — Site selection

The aerodrome operator in coordination with the air navigation provider, shall follow the guidance on the selection of sites for VOR aerodrome checkpoints is given in Annex 10, Volume I, Attachment E.

5.2.12.3 VOR aerodrome checkpoint marking — Location

A VOR aerodrome checkpoint marking shall be centred on the spot at which an aircraft is to be parked to receive the correct VOR signal.

5.2.12.4 VOR aerodrome checkpoint marking — Characteristics

A VOR aerodrome checkpoint marking shall consist of a circle 6 m in diameter and have a line width of 15 cm (see Figure 5-9 (A)).

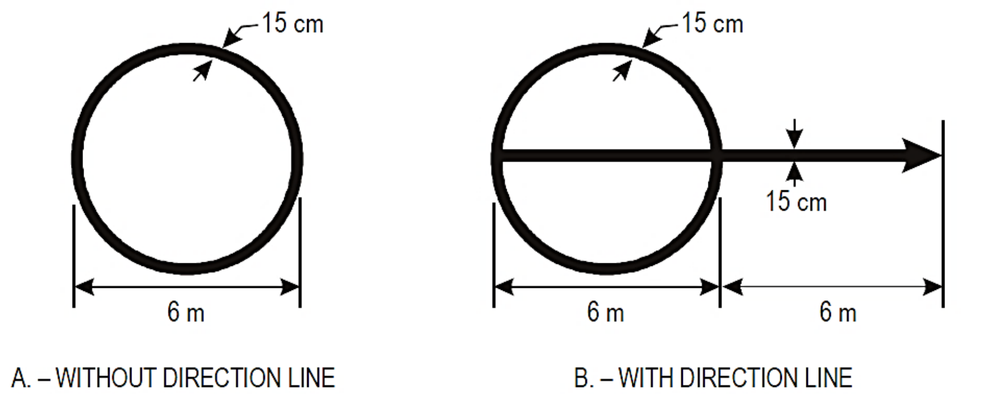
5.2.12.5 VOR aerodrome checkpoint marking — Characteristics (cont.)

When it is preferable for an aircraft to be aligned in a specific direction, a line shall be provided that passes through the centre of the circle on the desired azimuth. The line shall extend 6 m outside the circle in the desired direction of heading and terminate in an arrowhead. The width of the line shall be 15 cm (see Figure 5-9 (B)).

5.2.12.6 VOR aerodrome checkpoint marking — Characteristics (cont.)

A VOR aerodrome checkpoint marking shall preferably be white in colour but shall differ from the colour used for the taxiway markings.

Note.— To provide contrast, markings may be bordered with black.



Note.— A direction line need only be provided when an aircraft must be aligned in a specific direction.

Figure 5-9. VOR aerodrome checkpoint marking

5.2.13 Aircraft stand marking

Note.— Guidance on the layout of aircraft stand markings is contained in the Aerodrome Design Manual (Doc 9157), Part 4.

5.2.13.1 Aircraft stand marking — Application

Aircraft stand markings shall be provided for designated parking positions on a paved apron.

5.2.13.2 Aircraft stand marking — Location

Aircraft stand markings on a paved apron shall be located so as to provide the clearances specified in 3.13.6, respectively, when the nose wheel follows the stand marking.

5.2.13.3 Aircraft stand marking — Characteristics

Aircraft stand markings shall include such elements as stand identification, lead-in line, turn bar, turning line, alignment bar, stop line and lead-out line, as are required by the parking configuration and to complement other parking aids.

5.2.13.4 Aircraft stand marking — Aircraft stand identification

An aircraft stand identification (letter and/or number) shall be included in the lead-in line a short distance after the beginning of the lead-in line. The height of the identification shall be adequate to be readable from the cockpit of aircraft using the stand.

5.2.13.5 Aircraft stand marking — Aircraft stand identification (cont.)

Where two sets of aircraft stand markings are superimposed on each other in order to permit more flexible use of the apron and it is difficult to identify which stand marking shall be followed, or safety would be impaired if the wrong marking was followed, then identification of the aircraft for which each set of markings is intended shall be added to the stand identification.

Note.— Example: 2A-B747, 2B-F28.

5.2.13.6 Aircraft stand marking — Lead-in, turning, and lead-out lines

Lead-in, turning and lead-out lines shall normally be continuous in length and have a width of not less than 15 cm. Where one or more sets of stand markings are superimposed on a stand marking, the lines shall be continuous for the most demanding aircraft and broken for other aircraft.

5.2.13.7 Aircraft stand marking — Lead-in, turning, and lead-out lines (cont.)

The curved portions of lead-in, turning and lead-out lines shall have radii appropriate to the most demanding aircraft type for which the markings are intended.

5.2.13.8 Aircraft stand marking — Lead-in, turning, and lead-out lines (cont.)

Where it is intended that an aircraft proceed in one direction only, arrows pointing in the direction to be followed shall be added as part of the lead-in and lead-out lines.

5.2.13.9 Aircraft stand marking — Turn bar and stop line

A turn bar shall be located at right angles to the lead-in line, abeam the left pilot position at the point of initiation of any intended turn. It shall have a length and width of not less than 6 m and 15 cm, respectively, and include an arrowhead to indicate the direction of turn.

Note.— The distances to be maintained between the turn bar and the lead-in line may vary according to different aircraft types, taking into account the pilot's field of view.

5.2.13.10 Aircraft stand marking — Turn bar and stop line (cont.)

If more than one turn bar and/or stop line is required, they shall be coded.

5.2.13.11 Aircraft stand marking — Alignment bar

An alignment bar shall be placed so as to be coincident with the extended centre line of the aircraft in the specified parking position and visible to the pilot during the final part of the parking manoeuvre. It shall have a width of not less than 15 cm.

5.2.13.12 Aircraft stand marking — Stop line

A stop line shall be located at right angles to the alignment bar, abeam the left pilot position at the intended point of stop. It shall have a length and width of not less than 6 m and 15 cm, respectively.

Note.— The distances to be maintained between the stop line and the lead-in line may vary according to different aircraft types, taking into account the pilot's field of view.

5.2.14 Apron safety lines

Note.— Guidance on apron safety lines is contained in the Aerodrome Design Manual (Doc 9157), Part 4.

5.2.14.1 Apron safety lines — Application

Apron safety lines shall be provided on a paved apron as required by the parking configurations and ground facilities.

5.2.14.2 Apron safety lines — Location

Apron safety lines shall be located so as to define the areas intended for use by ground vehicles and other aircraft servicing equipment, etc., to provide safe separation from aircraft.

5.2.14.3 Apron safety lines — Characteristics

Apron safety lines shall include such elements as wing tip clearance lines and service road boundary lines as required by the parking configurations and ground facilities.

5.2.14.4 Apron safety lines — Characteristics (cont.)

An apron safety line shall be continuous in length and at least 10 cm in width.

5.2.15 Road-holding position marking

5.2.15.1 Road-holding position marking — Application

A road-holding position marking shall be provided at all road entrances to a runway.

5.2.15.2 Road-holding position marking — Location

The road-holding position marking shall be located across the road at the holding position.

5.2.15.3 Road-holding position marking — Characteristics

The road-holding position marking shall be in accordance with the local road traffic regulations.

5.2.16 Mandatory instruction marking

Note.— Guidance on mandatory instruction marking is given in the Aerodrome Design Manual (Doc 9157), Part 4.

5.2.16.1 Mandatory instruction marking — Application

Where a mandatory instruction sign in accordance with 5.4.2.1 is not installed, a mandatory instruction marking shall be provided on the surface of the pavement.

5.2.16.2 Mandatory instruction marking — Application (cont.)

On taxiways exceeding 60 m in width, or to assist in the prevention of a runway incursion, a mandatory instruction sign shall be supplemented by a mandatory instruction marking.

5.2.16.3 Mandatory instruction marking — Location

The mandatory instruction marking on taxiways where the code letter is A, B, C or D shall be located across the taxiway equally placed about the taxiway centre line and on the holding side of the runway-holding position marking as shown in Figure 5-10 (A). The distance between the nearest edge of the marking and the runway-holding position marking or the taxiway centre line marking shall be not less than 1 m.

5.2.16.4 Mandatory instruction marking — Location (cont.)

The mandatory instruction marking on taxiways where the code letter is E or F shall be located on both sides of the taxiway centre line marking and on the holding side of the runway-holding position marking as shown in Figure 5-10 (B). The distance between the nearest edge of the marking and the runway-holding position marking or the taxiway centre line marking shall be not less than 1 m.

5.2.16.5 Mandatory instruction marking — Location (cont.)

Except where operationally required, a mandatory instruction marking shall not be located on a runway.

5.2.16.6 Mandatory instruction marking — Characteristics

A mandatory instruction marking shall consist of an inscription in white on a red background. Except for a NO ENTRY marking, the inscription shall provide information identical to that of the associated mandatory instruction sign.

5.2.16.7 Mandatory instruction marking — Characteristics (cont.)

A NO ENTRY marking shall consist of an inscription in white reading NO ENTRY on a red background.

5.2.16.8 Mandatory instruction marking — Characteristics (cont.)

Where there is insufficient contrast between the marking and the pavement surface, the mandatory instruction marking shall include an appropriate border, preferably white or black.

5.2.16.9 Mandatory instruction marking — Characteristics (cont.)

The character height shall be 4 m for inscriptions where the code letter is C, D, E or F, and 2 m where the code letter is A or B. The inscriptions shall be in the form and proportions shown in Appendix 3.

5.2.16.10 Mandatory instruction marking — Characteristics (cont.)

The background shall be rectangular and extend a minimum of 0.5 m laterally and vertically beyond the extremities of the inscription.

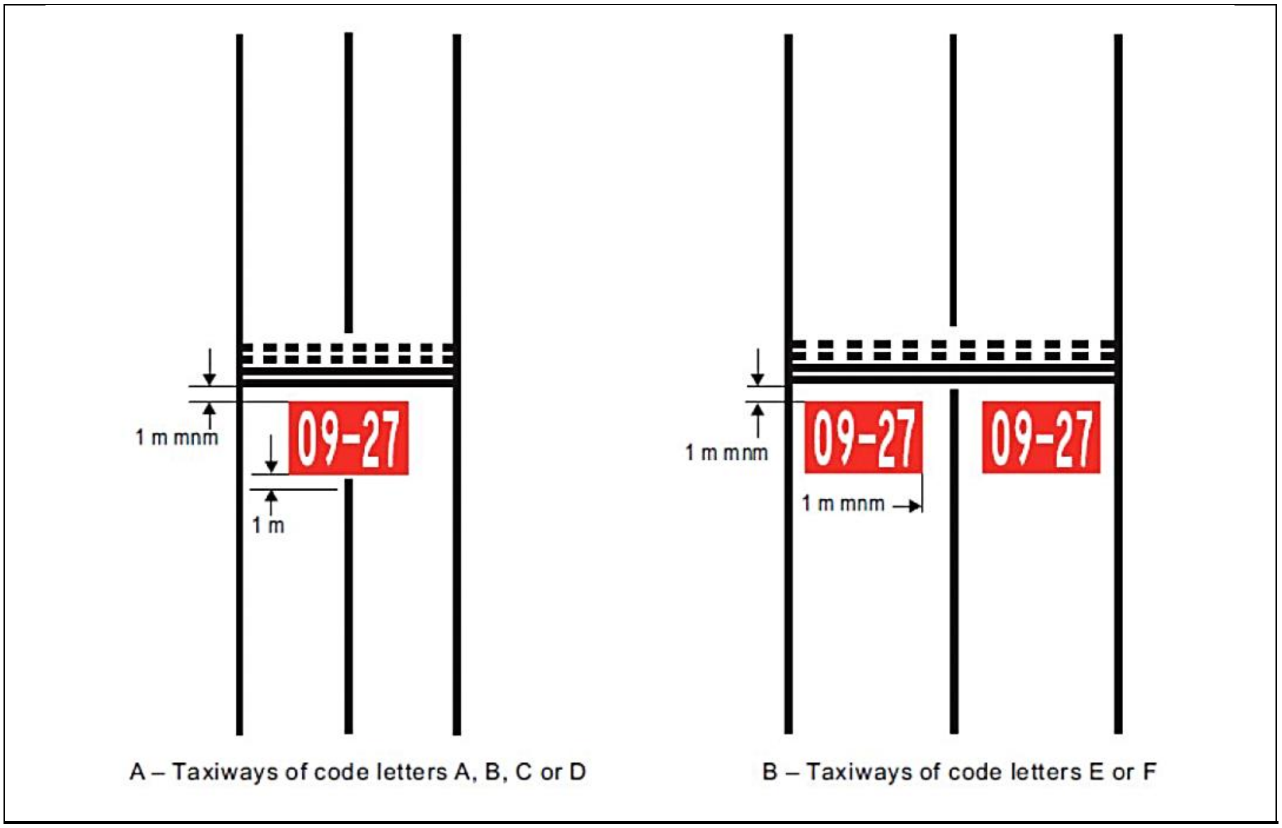


Figure 5-10. Mandatory instruction marking

5.2.17 Information marking

Note.— Guidance on information marking is contained in the Aerodrome Design Manual (Doc 9157), Part 4.

5.2.17.1 Information marking — Application

Where an information sign in accordance with 5.4.3 is not installed, an information marking shall be displayed on the surface of the pavement.

5.2.17.2 Information marking — Application (cont.)

Where operationally required an information sign shall be supplemented by an information marking.

5.2.17.3 Information marking — Application (cont.)

An information (location/direction) marking shall be displayed prior to and following complex taxiway intersections and where operational experience has indicated the addition of a taxiway location marking could assist flight crew ground navigation.

5.2.17.4 Information marking — Application (cont.)

An information (location) marking shall be displayed on the pavement surface at regular intervals along taxiways of great length.

5.2.17.5 Information marking — Location

The information marking shall be displayed across the surface of the taxiway or apron where necessary and positioned so as to be legible from the cockpit of an approaching aircraft.

5.2.17.6 Information marking — Characteristics

An information marking shall consist of:

a) an inscription in yellow upon a black background, when it replaces or supplements a location sign; and

b) an inscription in black upon a yellow background, when it replaces or supplements a direction or destination sign.

5.2.17.7 Information marking — Characteristics (cont.)

Where there is insufficient contrast between the marking background and the pavement surface, the marking shall include:

a) a black border where the inscriptions are in black; and

b) a yellow border where the inscriptions are in yellow.

5.2.17.8 Information marking — Characteristics (cont.)

The character height shall be 4 m. The inscriptions shall be in the form and proportions shown in Appendix 3.

5.3 Lights

5.3.1 General

5.3.1.1 to 5.3.1.3

Intentionally left open.

Note.— See article 16 and 17 "Landsbesluit Luchtvaartterreinen 2023".

5.3.1.4 Elevated approach lights

Elevated approach lights and their supporting structures shall be frangible except that, in that portion of the approach lighting system beyond 300 m from the threshold:

a) where the height of a supporting structure exceeds 12 m, the frangibility requirement shall apply to the top 12 m only; and

b) where a supporting structure is surrounded by non-frangible objects, only that part of the structure that extends above the surrounding objects shall be frangible.

5.3.1.5 Elevated approach lights (cont.)

When an approach light fixture or supporting structure is not in itself sufficiently conspicuous, it shall be suitably marked.

5.3.1.6 Elevated lights

Elevated runway, stopway and taxiway lights shall be frangible. Their height shall be sufficiently low to preserve clearance for propellers and for the engine pods of jet aircraft.

5.3.1.7 Surface lights

Light fixtures inset in the surface of runways, stopways, taxiways and aprons shall be so designed and fitted as to withstand being run over by the wheels of an aircraft without damage either to the aircraft or to the lights themselves.

5.3.1.8 Surface lights (cont.)

The temperature produced by conduction or radiation at the interface between an installed inset light and an aircraft tire shalld not exceed 160°C during a 10-minute period of exposure.

Note.— Guidance on measuring the temperature of inset lights is given in the Aerodrome Design Manual (Doc 9157), Part 4.

5.3.1.9 Light intensity and control

The intensity of runway lighting shall be adequate for the minimum conditions of visibility and ambient light in which use of the runway is intended, and compatible with that of the nearest section of the approach lighting system when provided.

5.3.1.10 Light intensity and control (cont.)

Where a high-intensity lighting system is provided, a suitable intensity control shall be incorporated to allow for adjustment of the light intensity to meet the prevailing conditions. Separate intensity controls or other suitable methods shall be provided to ensure that the following systems, when installed, can be operated at compatible intensities:

— approach lighting system;

— runway edge lights;

— runway threshold lights;

— runway end lights;

— runway centre line lights;

— runway touchdown zone lights; and

— taxiway centre line lights.

GM1 5.3.1.9 & 5.3.1.10 Light intensity and control

(1) In dusk or poor visibility conditions by day, lighting can be more effective than marking. For lights to be effective in such conditions or in poor visibility by night, they must be of adequate intensity. To obtain the required intensity, it will usually be necessary to make the light directional, in which case the arcs over which the light shows will have to be

adequate and so orientated as to meet the operational requirements. The runway lighting system will have to be considered as a whole, to ensure that the relative light intensities are suitably matched to the same end. (See Attachment A, Section 15, and the Aerodrome Design Manual (Doc 9157), Part 4).

(2) While the lights of an approach lighting system may be of higher intensity than the runway lighting, it is good practice to avoid abrupt changes in intensity as these could give a pilot a false impression that the visibility is changing during approach.

5.3.1.11 Light intensity and control (cont.)

On the perimeter of and within the ellipse defining the main beam in Appendix 2, Figures A2-1 to A2-10, the maximum light intensity value shall not be greater than three times the minimum light intensity value measured in accordance with Appendix 2, collective notes for Figures A2-1 to A2-11 and A2-26, Note 2.

5.3.1.12 Light intensity and control (cont.)

On the perimeter of and within the rectangle defining the main beam in Appendix 2, Figures A2-12 to A2-20, the maximum light intensity value shall not be greater than three times the minimum light intensity value measured in accordance with Appendix 2, collective notes for Figures A2-12 to A2-21, Note 2.

5.3.2 Emergency lighting

5.3.2.1 Emergency lighting — Application

At an aerodrome provided with runway lighting and without a secondary power supply, sufficient emergency lights shall be conveniently available for installation on at least the primary runway in the event of failure of the normal lighting system.

Note.— Emergency lighting may also be useful to mark obstacles or delineate taxiways and apron areas.

5.3.2.2 Emergency lighting — Location

When installed on a runway the emergency lights should, as a minimum, conform to the configuration required for a non-instrument runway.

5.3.2.3 Emergency lighting — Characteristics

The colour of the emergency lights shall conform to the colour requirements for runway lighting, except that, where the provision of coloured lights at the threshold and the runway end is not practicable, all lights may be variable white or as close to variable white as practicable.

5.3.3 Aeronautical beacons

5.3.3.1 Aeronautical beacons — Application

Where operationally necessary an aerodrome beacon or an identification beacon shall be provided at each aerodrome intended for use at night.

5.3.3.2 Aeronautical beacons — Application (cont.)

The operational requirement shall be determined having regard to the requirements of the air traffic using the aerodrome, the conspicuity of the aerodrome features in relation to its surroundings and the installation of other visual and non-visual aids useful in locating the aerodrome.

5.3.3.3 Aerodrome beacon — Application

An aerodrome beacon shall be provided at an aerodrome intended for use at night if one or more of the following conditions exist:

a) aircraft navigate predominantly by visual means;

b) reduced visibilities are frequent; or

c) it is difficult to locate the aerodrome from the air due to surrounding lights or terrain.

5.3.3.4 Aerodrome beacon — Location

The aerodrome beacon shall be located on or adjacent to the aerodrome in an area of low ambient background lighting.

5.3.3.5 Aerodrome beacon — Location

The location of the beacon shall be such that the beacon is not shielded by objects in significant directions and does not dazzle a pilot approaching to land.

5.3.3.6 Aerodrome beacon — Characteristics

The aerodrome beacon shall show either coloured flashes alternating with white flashes, or white flashes only.

The frequency of total flashes shall be from 20 to 30 per minute. Where used, the coloured flashes emitted by beacons at land aerodromes shall be green, and coloured flashes emitted by beacons at water aerodromes shall be yellow. In the case of a combined water and land aerodrome, coloured flashes, if used, shall have the colour characteristics of whichever section of the aerodrome is designated as the principal facility.

5.3.3.7 Aerodrome beacon — Characteristics (cont.)

The light from the beacon shall show at all angles of azimuth. The vertical light distribution shall extend upwards from an elevation of not more than 1° to an elevation determined by the appropriate authority to be sufficient to provide guidance at the maximum elevation at which the beacon is intended to be used, and the effective intensity of the flash shall be not less than 2 000 cd.

Note.— At locations where a high ambient background lighting level cannot be avoided, the effective intensity of the flash may be required to be increased by a factor up to a value of 10.

5.3.3.8 Identification beacon — Application

An identification beacon shall be provided at an aerodrome which is intended for use at night and cannot be easily identified from the air by other means.

5.3.3.9 Identification beacon — Location

The identification beacon shall be located on the aerodrome in an area of low ambient background lighting.

5.3.3.10 Identification beacon — Location

The location of the beacon shall be such that the beacon is not shielded by objects in significant directions and does not dazzle a pilot approaching to land.

5.3.3.11 Identification beacon — Characteristics

An identification beacon at a land aerodrome shall show at all angles of azimuth. The vertical light distribution shall extend upwards from an elevation of not more than 1° to an elevation determined by the appropriate authority to be sufficient to provide guidance at the maximum elevation at which the beacon is intended to be used, and the effective intensity of the flash shall be not less than 2 000 cd.

Note.— At locations where a high ambient background lighting level cannot be avoided, the effective intensity of the flash may be required to be increased by a factor up to a value of 10.

5.3.3.12 Identification beacon — Characteristics (cont.)

An identification beacon shall show flashing-green at a land aerodrome and flashing-yellow at a water aerodrome.

5.3.3.13 Identification beacon — Characteristics (cont.)

The identification characters shall be transmitted in the International Morse Code.

5.3.3.14 Identification beacon — Characteristics (cont.)

The speed of transmission shall be between six and eight words per minute, the corresponding range of duration of the Morse dots being from 0.15 to 0.2 seconds per dot.

5.3.4 Approach lighting systems

5.3.4.1 Approach lighting systems — Application

Note —. The safety objective of the approach lighting system is to provide alignment and roll guidance, and limited distance-to-go information to enable safe approach to a runway

A.— Non-instrument runway

Where physically practicable, a simple approach lighting system as specified in 5.3.4.2 to 5.3.4.9 shall be provided to serve a non-instrument runway where the code number is 3 or 4 and intended for use at night, except when the runway is used only in conditions of good visibility and sufficient guidance is provided by other visual aids.

Note.— A simple approach lighting system can also provide visual guidance by day.

B.— Non-precision approach runway

Where physically practicable, a simple approach lighting system as specified in 5.3.4.2 to 5.3.4.9 shall be provided to serve a non-precision approach runway, except when the runway is used only in conditions of good visibility or sufficient guidance is provided by other visual aids.

Note.— It is advisable to give consideration to the installation of a precision approach category I lighting system or to the addition of a runway lead-in lighting system.

C.— Precision approach runway category I

Where physically practicable, a precision approach category I lighting system as specified in 5.3.4.10 to 5.3.4.21 shall be provided to serve a precision approach runway category I.

D.— Precision approach runway categories II and III

A precision approach category II and III lighting system as specified in 5.3.4.22 to 5.3.4.39 shall be provided to serve a precision approach runway category II or III.

5.3.4.2 Simple approach lighting system — Location

A simple approach lighting system shall consist of a row of lights on the extended centre line of the runway extending, whenever possible, over a distance of not less than 420 m from the threshold with a row of lights forming a crossbar 18 m or 30 m in length at a distance of 300 m from the threshold.

5.3.4.3 Simple approach lighting system — Crossbar

The lights forming the crossbar shall be as nearly as practicable in a horizontal straight line at right angles to, and bisected by, the line of the centre line lights. The lights of the crossbar shall be spaced so as to produce a linear effect, except that, when a crossbar of 30 m is used, gaps may be left on each side of the centre line. These gaps shall be kept to a minimum to meet local requirements and each shall not exceed 6 m.

Note 1.— Spacings for the crossbar lights between 1 m and 4 m are in use. Gaps on each side of the centre line may improve directional guidance when approaches are made with a lateral error, and facilitate the movement of rescue and firefighting vehicles.

Note 2.— See Attachment A, Section 11, for guidance on installation tolerances.

5.3.4.4 Simple approach lighting system — Centre Line Lights

The lights forming the centre line shall be placed at longitudinal intervals of 60 m, except that, when it is desired to improve the guidance, an interval of 30 m may be used. The innermost light shall be located either 60 m or 30 m from the threshold, depending on the longitudinal interval selected for the centre line lights.

5.3.4.5 Simple approach lighting system — Centre Line Lights (cont.)

If it is not physically possible to provide a centre line extending for a distance of 420 m from the threshold, it shall be extended to 300 m so as to include the crossbar. If this is not possible, the centre line lights shall be extended as far as practicable, and each centre line light shall then consist of a barrette at least 3 m in length. Subject to the approach system having a crossbar at 300 m from the threshold, an additional crossbar may be provided at 150 m from the threshold.

5.3.4.6 Simple approach lighting system — Centre Line Lights (cont.)

The system shall lie as nearly as practicable in the horizontal plane passing through the threshold, provided that:

a) no object other than an ILS or MLS azimuth antenna shall protrude through the plane of the approach lights within a distance of 60 m from the centre line of the system; and

b) no light other than a light located within the central part of a crossbar or a centre line barrette (not their extremities) shall be screened from an approaching aircraft.

Any ILS or MLS azimuth antenna protruding through the plane of the lights shall be treated as an obstacle and marked and lighted accordingly.

5.3.4.7 Simple approach lighting system — Characteristics

The lights of a simple approach lighting system shall be fixed lights and the colour of the lights shall be such as to ensure that the system is readily distinguishable from other aeronautical ground lights, and from extraneous lighting if present. Each centre line light shall consist of either:

a) a single source; or

b) a barrette at least 3 m in length.

Note 1.— When the barrette as in b) is composed of lights approximating to point sources, a spacing of 1.5 m between adjacent lights in the barrette has been found satisfactory.

Note 2.— It may be advisable to use barrettes 4 m in length if it is anticipated that the simple approach lighting system will be developed into a precision approach lighting system.

Note 3.— At locations where identification of the simple approach lighting system is difficult at night due to surrounding lights, sequence flashing lights installed in the outer portion of the system may resolve this problem.

5.3.4.8 Simple approach lighting system — Characteristics (cont.)

Where provided for a non-instrument runway, the lights shall show at all angles in azimuth necessary to a pilot on base leg and final approach. The intensity of the lights shall be adequate for all conditions of visibility and ambient light for which the system has been provided.

5.3.4.9 Simple approach lighting system — Characteristics (cont.)

Where provided for a non-precision approach runway, the lights shall show at all angles in azimuth necessary to the pilot of an aircraft which on final approach does not deviate by an abnormal amount from the path defined by the non-visual aid. The lights shall be designed to provide guidance during both day and night in the most adverse conditions of visibility and ambient light for which it is intended that the system shall remain usable.

5.3.4.10 Precision approach category I lighting system — Location

(a) The safety objective of the approach lighting system is to provide alignment and roll guidance, and limited distance-to-go information to enable safe approach to a runway

(b) A precision approach category I lighting system shall consist of a row of lights on the extended centre line of the runway extending, wherever possible, over a distance of 900 m from the runway threshold with a row of lights forming a crossbar 30 m in length at a distance of 300 m from the runway threshold.

Note.— The installation of an approach lighting system of less than 900 m in length may result in operational limitations on the use of the runway. See Attachment A, Section 11.

5.3.4.11 Precision approach category I lighting system — Crossbar

The lights forming the crossbar shall be as nearly as practicable in a horizontal straight line at right angles to, and bisected by, the line of the centre line lights. The lights of the crossbar shall be spaced so as to produce a linear effect, except that gaps may be left on each side of the centre line. These gaps shall be kept to a minimum to meet local requirements and each shall not exceed 6 m.

Note 1.— Spacings for the crossbar lights between 1 m and 4 m are in use. Gaps on each side of the centre line may improve directional guidance when approaches are made with a lateral error, and facilitate the movement of rescue and firefighting vehicles.

Note 2.— See Attachment A, Section 11, for guidance on installation tolerances.

5.3.4.12 Precision approach category I lighting system — Centre line

The lights forming the centre line shall be placed at longitudinal intervals of 30 m with the innermost light located 30 m from the threshold.

5.3.4.13 Precision approach category I lighting system — System

The system shall lie as nearly as practicable in the horizontal plane passing through the threshold, provided that:

a) no object other than an ILS or MLS azimuth antenna shall protrude through the plane of the approach lights within a distance of 60 m from the centre line of the system; and

b) no light other than a light located within the central part of a crossbar or a centre line barrette (not their extremities)

shall be screened from an approaching aircraft.

Any ILS or MLS azimuth antenna protruding through the plane of the lights shall be treated as an obstacle and marked and lighted accordingly.

5.3.4.14 Precision approach category I lighting system — Characteristics

The centre line and crossbar lights of a precision approach category I lighting system shall be fixed lights showing variable white. Each centre line light position shall consist of either:

a) a single light source in the innermost 300 m of the centre line, two light sources in the central 300 m of the centre line and three light sources in the outer 300 m of the centre line to provide distance information; or

b) a barrette.

5.3.4.15 Precision approach category I lighting system — Characteristics (cont.)

Where the serviceability level of the approach lights specified as a maintenance objective in 10.5.10 can be demonstrated, each centre line light position may consist of either:

a) a single light source; or

b) a barrette.

5.3.4.16 Precision approach category I lighting system — Characteristics (cont.)

The barrettes shall be at least 4 m in length. When barrettes are composed of lights approximating to point sources, the lights shall be uniformly spaced at intervals of not more than 1.5 m.

5.3.4.17 Precision approach category I lighting system — Characteristics (cont.)

If the centre line consists of barrettes as described in 5.3.4.14 b) or 5.3.4.15 b), each barrette shall be supplemented by a flashing light, except where such lighting is considered unnecessary taking into account the characteristics of the system and the nature of the meteorological conditions.

5.3.4.18 Precision approach category I lighting system — Characteristics (cont.)

Each flashing light as described in 5.3.4.17 shall be flashed twice a second in sequence, beginning with the outermost light and progressing toward the threshold to the innermost light of the system. The design of the electrical circuit shall be such that these lights can be operated independently of the other lights of the approach lighting system.

5.3.4.19 Precision approach category I lighting system — Characteristics (cont.)

If the centre line consists of lights as described in 5.3.4.14 a) or 5.3.4.15 a), additional crossbars of lights to the crossbar provided at 300 m from the threshold shall be provided at 150 m, 450 m, 600 m and 750 m from the threshold. The lights forming each crossbar shall be as nearly as practicable in a horizontal straight line at right angles to, and bisected by, the line of the centre line lights. The lights shall be spaced so as to produce a linear effect, except that gaps may be left on each side of the centre line. These gaps shall be kept to a minimum to meet local requirements and each shall not exceed 6 m.

Note.— See Attachment A, Section 11, for detailed configuration.

5.3.4.20 Precision approach category I lighting system — Characteristics (cont.)

Where the additional crossbars described in 5.3.4.19 are incorporated in the system, the outer ends of the crossbars shall lie on two straight lines that either are parallel to the line of the centre line lights or converge to meet the runway centre line 300 m from threshold.

5.3.4.21 Precision approach category I lighting system — Characteristics (cont.)

The lights shall be in accordance with the specifications of Appendix 2, Figure A2-1.

Note.— The flight path envelopes used in the design of these lights are given in Attachment A, Figure A-6.

5.3.4.22 Precision approach category II and III lighting system — Location

The approach lighting system shall consist of a row of lights on the extended centre line of the runway, extending, wherever possible, over a distance of 900 m from the runway threshold. In addition, the system shall have two side rows of lights, extending 270 m from the threshold, and two crossbars, one at 150 m and one at 300 m from the threshold, all as shown in Figure 5-14. Where the serviceability level of the approach lights specified as maintenance objectives in 10.5.7 can be demonstrated, the system may have two side rows of lights, extending 240 m from the threshold, and two crossbars, one at 150 m and one at 300 m from the threshold, all as shown in Figure 5-15.

Note.— The length of 900 m is based on providing guidance for operations under category I, II and III conditions. Reduced lengths may support category II and III operations but may impose limitations on category I operations. See Attachment A, Section 11.

5.3.4.23 Precision approach category II and III lighting system — Location (cont.)

The lights forming the centre line shall be placed at longitudinal intervals of 30 m with the innermost lights located 30 m from the threshold.

5.3.4.24 Precision approach category II and III lighting system — Location (cont.)

The lights forming the side rows shall be placed on each side of the centre line, at a longitudinal spacing equal to that of the centre line lights and with the first light located 30 m from the threshold. Where the serviceability level of the approach lights specified as maintenance objectives in 10.5.7 can be demonstrated, lights forming the side rows may be placed on each side of the centre line, at a longitudinal spacing of 60 m with the first light located 60 m from the threshold. The lateral spacing (or gauge) between the innermost lights of the side rows shall be not less than 18 m nor more than 22.5 m, and preferably 18 m, but in any event shall be equal to that of the touchdown zone lights.

5.3.4.25 Precision approach category II and III lighting system — Location and composition

The crossbar provided at 150 m from the threshold shall fill in the gaps between the centre line and side row lights.

5.3.4.26 Precision approach category II and III lighting system — Location and composition (cont.)

The crossbar provided at 300 m from the threshold shall extend on both sides of the centre line lights to a distance of 15 m from the centre line.

5.3.4.27 Precision approach category II and III lighting system — Location and composition (cont.)

If the centre line beyond a distance of 300 m from the threshold consists of lights as described in 5.3.4.31 b) or 5.3.4.32 b), additional crossbars of lights shall be provided at 450 m, 600 m and 750 m from the threshold.

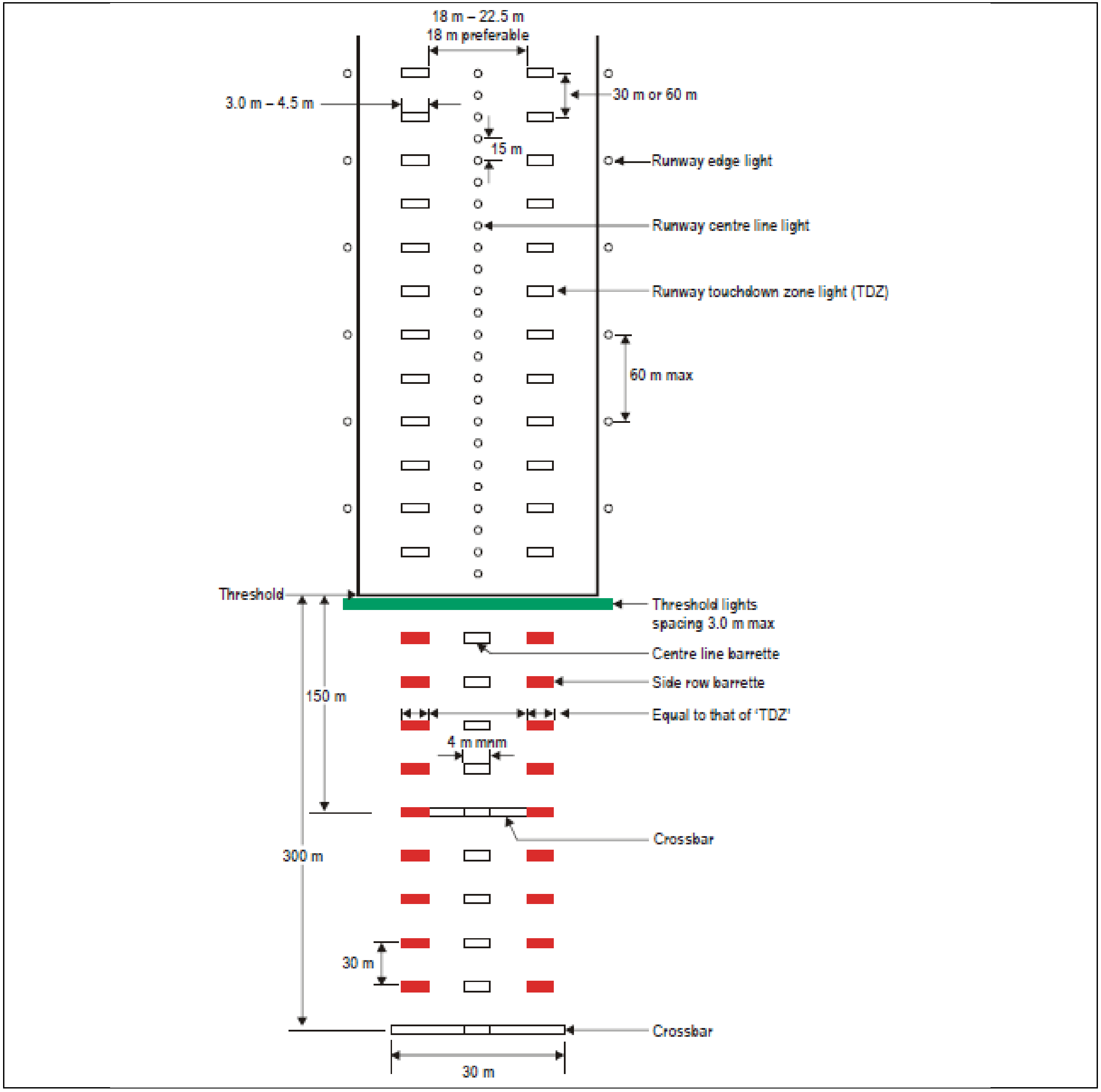


Figure 5-14. Inner 300 m approach and runway lighting for precision approach runways, categories II and III

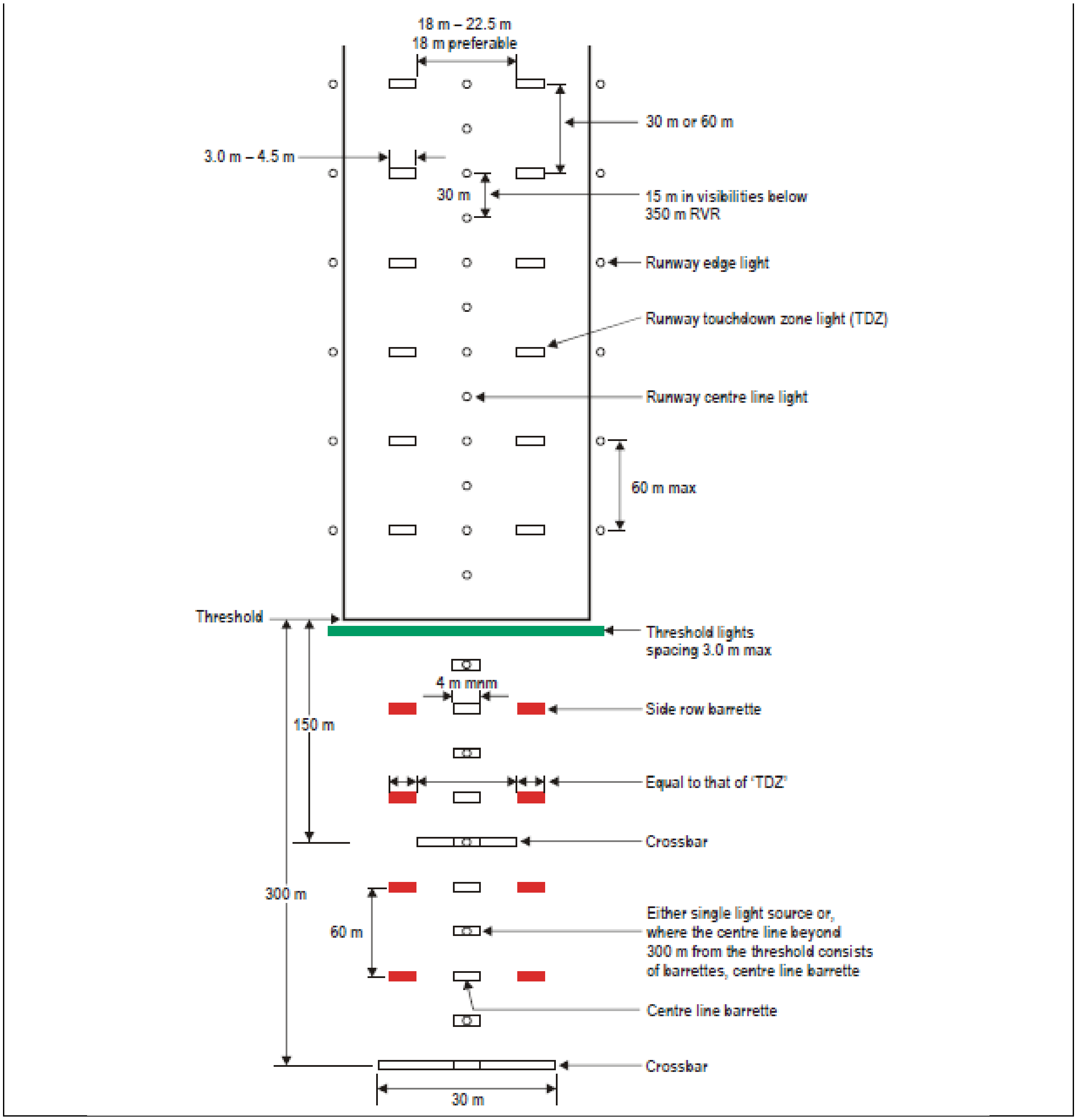


Figure 5-15. Inner 300 m approach and runway lighting for precision approach runways, categories II and III, where the serviceability levels of the lights specified as maintenance objectives in Chapter 10 can be demonstrated

5.3.4.28 Precision approach category II and III lighting system — Location and composition (cont.)

Where the additional crossbars described in 5.3.4.27 are incorporated in the system, the outer ends of these crossbars shall lie on two straight lines that either are parallel to the centre line or converge to meet the runway centre line 300 m from the threshold.

5.3.4.29 Precision approach category II and III lighting system — Location and composition (cont.)

The system shall lie as nearly as practicable in the horizontal plane passing through the threshold, provided that:

a) no object other than an ILS or MLS azimuth antenna shall protrude through the plane of the approach lights within a distance of 60 m from the centre line of the system; and

b) no light other than a light located within the central part of a crossbar or a centre line barrette (not their extremities) shall be screened from an approaching aircraft.

Any ILS or MLS azimuth antenna protruding through the plane of the lights shall be treated as an obstacle and marked and lighted accordingly.

5.3.4.30 Precision approach category II and III lighting system — Characteristics

The centre line of a precision approach category II and III lighting system for the first 300 m from the threshold shall consist of barrettes showing variable white, except that, where the threshold is displaced 300 m or more, the centre line may consist of single light sources showing variable white. Where the serviceability level of the approach lights specified as maintenance objectives in 10.5.7 can be demonstrated, the centre line of a precision approach category II and III lighting system for the first 300 m from the threshold may consist of either:

a) barrettes, where the centre line beyond 300 m from the threshold consists of barrettes as described in 5.3.4.32 a); or

b) alternate single light sources and barrettes, where the centre line beyond 300 m from the threshold consists of single light sources as described in 5.3.4.32 b), with the innermost single light source located 30 m and the innermost barrette located 60 m from the threshold; or

c) single light sources where the threshold is displaced 300 m or more;

all of which shall show variable white.

5.3.4.31 Precision approach category II and III lighting system — Characteristics (cont.)

Beyond 300 m from the threshold each centre line light position shall consist of either:

a) a barrette as used on the inner 300 m; or

b) two light sources in the central 300 m of the centre line and three light sources in the outer 300 m of the centre line;

all of which shall show variable white.

5.3.4.32 Precision approach category II and III lighting system — Characteristics (cont.)

Where the serviceability level of the approach lights specified as maintenance objectives in 10.5.7 can be demonstrated, beyond 300 m from the threshold each centre line light position may consist of either:

a) a barrette; or

b) a single light source;

all of which shall show variable white.

5.3.4.33 Precision approach category II and III lighting system — Characteristics (cont.)

The barrettes shall be at least 4 m in length. When barrettes are composed of lights approximating to point sources, the lights shall be uniformly spaced at intervals of not more than 1.5 m.

5.3.4.34 Precision approach category II and III lighting system — Characteristics (cont.)

If the centre line beyond 300 m from the threshold consists of barrettes as described in 5.3.4.31 a) or 5.3.4.32 a), each barrette beyond 300 m shall be supplemented by a flashing light, except where such lighting is considered unnecessary taking into account the characteristics of the system and the nature of the meteorological conditions.

5.3.4.35 Precision approach category II and III lighting system — Characteristics (cont.)

Each flashing light as described in 5.3.4.34 shall be flashed twice a second in sequence, beginning with the outermost light and progressing toward the threshold to the innermost light of the system. The design of the electrical circuit shall be such that these lights can be operated independently of the other lights of the approach lighting system.

5.3.4.36 Precision approach category II and III lighting system — Characteristics (cont.)

The side row shall consist of barrettes showing red. The length of a side row barrette and the spacing of its lights shall be equal to those of the touchdown zone light barrettes.

5.3.4.37 Precision approach category II and III lighting system — Characteristics (cont.)

The lights forming the crossbars shall be fixed lights showing variable white. The lights shall be uniformly spaced at intervals of not more than 2.7 m.

5.3.4.38 Precision approach category II and III lighting system — Characteristics (cont.)

The intensity of the red lights shall be compatible with the intensity of the white lights.

5.3.4.39 Precision approach category II and III lighting system — Characteristics (cont.)

The lights shall be in accordance with the specifications of Appendix 2, Figures A2-1 and A2-2.

Note.— The flight path envelopes used in the design of these lights are given in Attachment A, Figure A-6.

5.3.5 Visual approach slope indicator systems

5.3.5.1 Visual approach slope indicator systems — Application

The safety objective of visual approach slope indicators is to provide information on the approach angle necessary to maintain a safe height over obstacles and threshold

A visual approach slope indicator system shall be provided to serve the approach to a runway whether or not the runway is served by other visual approach aids or by non-visual aids, where one or more of the following conditions exist:

a) the runway is used by turbojet or other aeroplanes with similar approach guidance requirements;

b) the pilot of any type of aeroplane may have difficulty in judging the approach due to:

   1) inadequate visual guidance such as is experienced during an approach over water or featureless terrain by day or in the absence of sufficient extraneous lights in the approach area by night; or

   2) misleading information such as is produced by deceptive surrounding terrain or runway slopes;

c) the presence of objects in the approach area may involve serious hazard if an aeroplane descends below the normal approach path, particularly if there are no non-visual or other visual aids to give warning of such objects;

d) physical conditions at either end of the runway present a serious hazard in the event of an aeroplane undershooting or overrunning the runway; and

e) terrain or prevalent meteorological conditions are such that the aeroplane may be subjected to unusual turbulence during approach.

Note.— Guidance on the priority of installation of visual approach slope indicator systems is contained in Attachment A, Section 12.

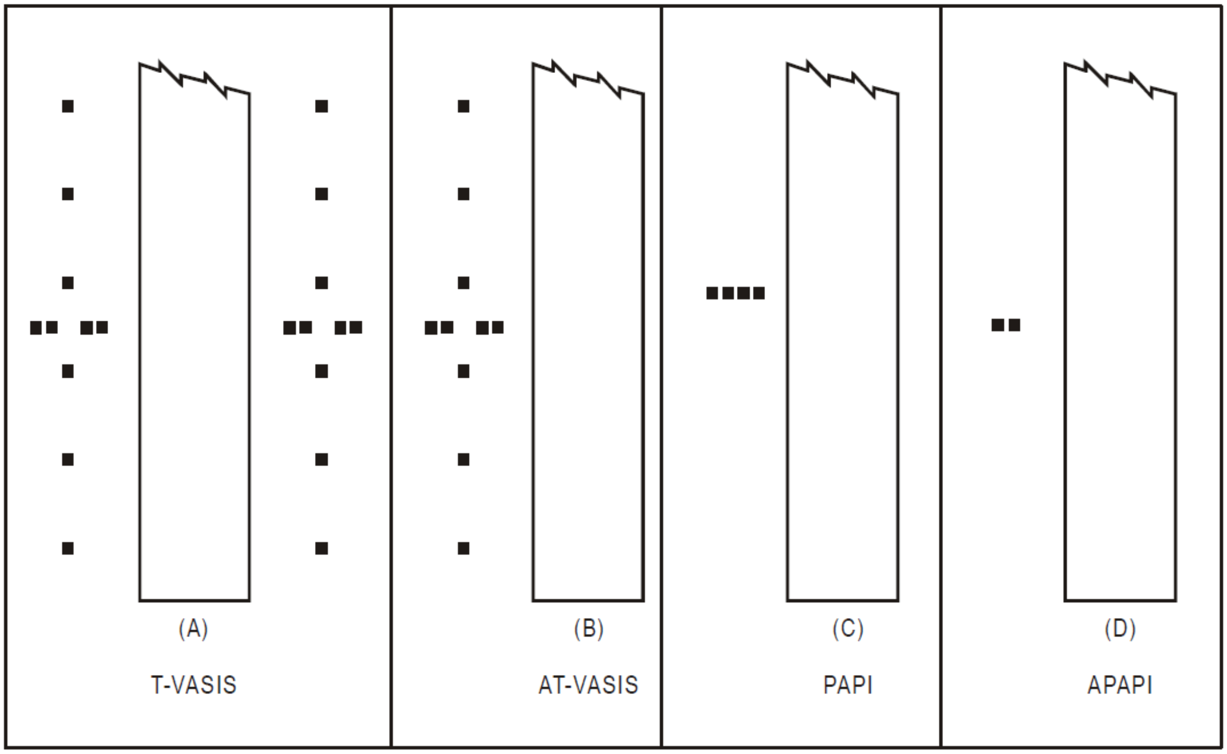


Figure 5-16. Visual approach slope indicator systems

5.3.5.2 Visual approach slope indicator systems

The standard visual approach slope indicator systems shall consist of the following:

a) T-VASIS and AT-VASIS conforming to the specifications contained in 5.3.5.7 to 5.3.5.23 inclusive;

b) PAPI and APAPI systems conforming to the specifications contained in 5.3.5.24 to 5.3.5.41 inclusive; as shown in Figure 5-16.

5.3.5.3 Visual approach slope indicator systems (cont.)

PAPI, T-VASIS or AT-VASIS shall be provided where the code number is 3 or 4 when one or more of the conditions specified in 5.3.5.1 exist.

5.3.5.4 Visual approach slope indicator systems (cont.)

As of 1 January 2020, the use of T-VASIS and AT-VASIS as standard visual approach slope indicator systems shall be discontinued.

5.3.5.5 Visual approach slope indicator systems (cont.)

PAPI or APAPI shall be provided where the code number is 1 or 2 when one or more of the conditions specified in 5.3.5.1 exist.

5.3.5.6 Visual approach slope indicator systems (cont.)

Where a runway threshold is temporarily displaced from the normal position and one or more of the conditions specified in 5.3.5.1 exist, a PAPI shall be provided except that where the code number is 1 or 2 an APAPI may be provided.

5.3.5.7 T-VASIS and AT-VASIS — Description

The T-VASIS shall consist of twenty light units symmetrically disposed about the runway centre line in the form of two wing bars of four light units each, with bisecting longitudinal lines of six lights, as shown in Figure 5-17.

5.3.5.8 VASIS and AT-VASIS — Description (cont.)

The AT-VASIS shall consist of ten light units arranged on one side of the runway in the form of a single wing bar of four light units with a bisecting longitudinal line of six lights.

5.3.5.9 VASIS and AT-VASIS — Description (cont.)

The light units shall be constructed and arranged in such a manner that the pilot of an aeroplane during an approach will:

a) when above the approach slope, see the wing bar(s) white, and one, two or three fly-down lights, the more fly-down lights being visible the higher the pilot is above the approach slope;

b) when on the approach slope, see the wing bar(s) white; and

c) when below the approach slope, see the wing bar(s) and one, two or three fly-up lights white, the more fly-up lights being visible the lower the pilot is below the approach slope; and when well below the approach slope, see the wing bar(s) and the three fly-up lights red.

When on or above the approach slope, no light shall be visible from the fly-up light units; when on or below the approach slope, no light shall be visible from the fly-down light units.

5.3.5.10 VASIS and AT-VASIS — Siting

The light units shall be located as shown in Figure 5-17, subject to the installation tolerances given therein.

Note.— The siting of T-VASIS will provide, for a 3° slope and a nominal eye height over the threshold of 15 m (see 5.3.5.7 and 5.3.5.20), a pilot's eye height over threshold of 13 m to 17 m when only the wing bar lights are visible. If increased eye height at the threshold is required (to provide adequate wheel clearance), then the approaches may be flown with one or more fly-down lights visible. The pilot's eye height over the threshold is then of the following order:

Wing bar lights and one fly-down light visible	*17 m to 22 m*
Wing bar lights and two fly-down lights visible	*22 m to 28 m*
Wing bar lights and three fly-down lights visible	*28 m to 54 m.*

5.3.5.11 VASIS and AT-VASIS — Characteristics of the light units

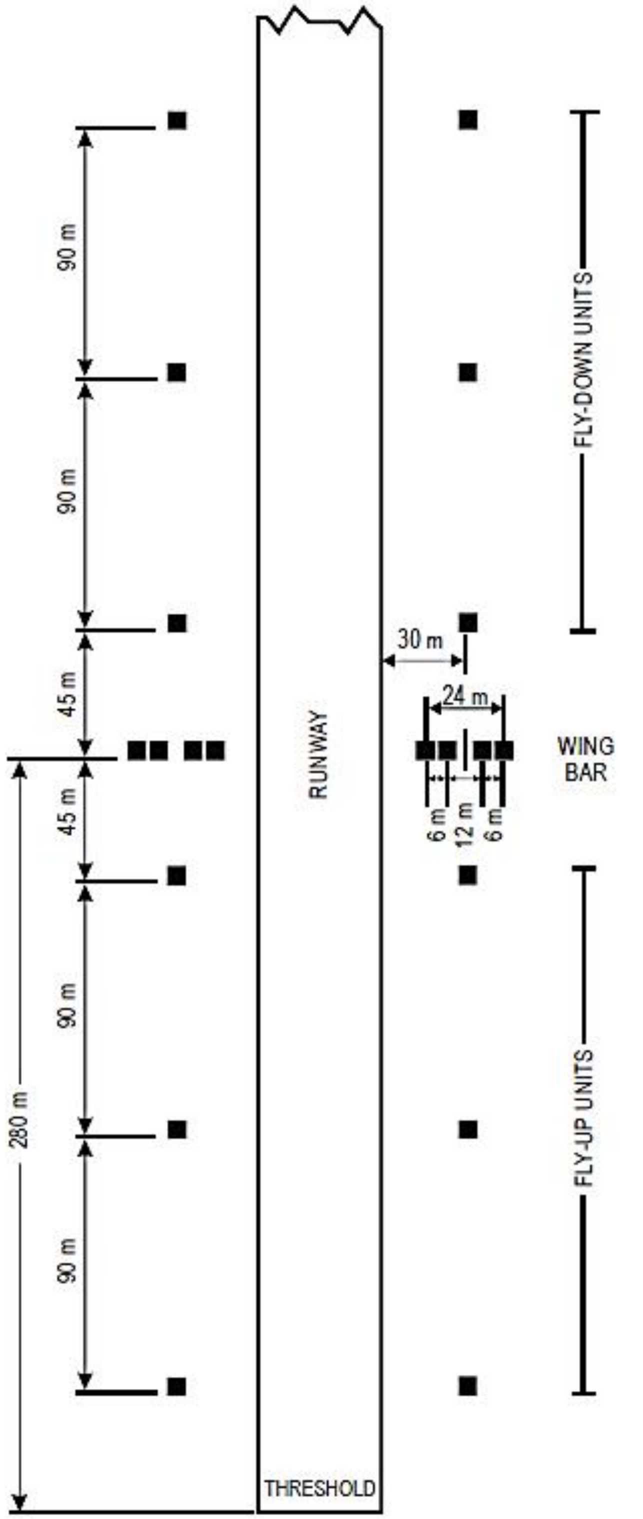
The systems shall be suitable for both day and night operations.

5.3.5.12 VASIS and AT-VASIS — Characteristics of the light units (cont.)

The light distribution of the beam of each light unit shall be of fan shape showing over a wide arc in azimuth in the approach direction. The wing bar light units shall produce a beam of white light from 1°54' vertical angle up to 6° vertical angle and a beam of red light from 0° to 1°54' vertical angle. The fly-down light units shall produce a white beam extending from an elevation of 6° down to approximately the approach slope, where it shall have a sharp cut-off. The fly-up light units shall produce a white beam from approximately the approach slope down to 1°54' vertical angle and a red beam below a 1°54' vertical angle. The angle of the top of the red beam in the wing bar units and fly-up units may be increased to comply with 5.3.5.22.

5.3.5.13 VASIS and AT-VASIS — Characteristics of the light units (cont.)

The light intensity distribution of the fly-down, wing bar and fly-up light units shall be as shown in Appendix 2, Figure A2-22.



INSTALLATION TOLERANCES

The appropriate authority may:

a) vary the nominal eye height over the threshold of the on-slope signal between the limits of 12 m and 16 m, except in cases where a standard ILS glide path and/or MLS minimum glide path is available; the height over threshold should be varied to avoid any conflict between the visual approach slope indications and the usable portion of the ILS glide path and/or MLS minimum glide path indications;

b) vary the longitudinal distance between individual light units or the overall length of the system by not more than 10 per cent;

c) vary the lateral displacement of the system from the runway edge by not more than ±3 m;

Note.— The system must be symmetrically displaced about the runway centre line.

d) where there is a longitudinal slope of the ground, adjust the longitudinal distance of a light unit to compensate for its difference in level from that of the threshold; and

e) where there is a transverse slope in the ground, adjust the longitudinal distance of two light units or two wing bars to compensate for the difference in level between them as necessary to meet the requirements of 5.3.5.17.

The distance between the wing bar and the threshold is based on an approach slope of 3° to a level runway with a nominal eye height over the threshold of 15 m. In practice, the threshold to wing bar distance is determined by:

a) the selected approach slope;

b) the longitudinal slope of the runway; and

c) the selected nominal eye height over the threshold.

Figure 5-17. Siting of light units for T-VASIS

5.3.5.14 VASIS and AT-VASIS — Characteristics of the light units (cont.)

The colour transition from red to white in the vertical plane shall be such as to appear to an observer, at a distance of not less than 300 m, to occur over a vertical angle of not more than 15’.

5.3.5.15 VASIS and AT-VASIS — Characteristics of the light units (cont.)

At full intensity the red light shall have a Y coordinate not exceeding 0.320.

5.3.5.16 VASIS and AT-VASIS — Characteristics of the light units (cont.)

A suitable intensity control shall be provided to allow adjustments to meet the prevailing conditions and to avoid dazzling the pilot during approach and landing.

5.3.5.17 VASIS and AT-VASIS — Characteristics of the light units (cont.)

The light units forming the wing bars, or the light units forming a fly-down or a fly-up matched pair, shall be mounted so as to appear to the pilot of an approaching aeroplane to be substantially in a horizontal line. The light units shall be mounted as low as possible and shall be frangible.

5.3.5.18 VASIS and AT-VASIS — Characteristics of the light units (cont.)

The light units shall be so designed that deposits of condensation, dirt, etc., on optically transmitting or reflecting surfaces shall interfere to the least possible extent with the light signals and shall in no way affect the elevation of the beams or the contrast between the red and white signals. The construction of the light units shall be such as to minimize the probability of the slots being wholly or partially blocked by snow or ice where these conditions are likely to be encountered.

5.3.5.19 Approach slope and elevation setting of light beams

The approach slope shall be appropriate for use by the aeroplanes using the approach.

5.3.5.20 Approach slope and elevation setting of light beams (cont.)

When the runway on which a T-VASIS is provided is equipped with an ILS and/or MLS, the siting and elevations of the light units shall be such that the visual approach slope conforms as closely as possible with the glide path of the ILS and/or the minimum glide path of the MLS, as appropriate.

5.3.5.21 Approach slope and elevation setting of light beams (cont.)

The elevation of the beams of the wing bar light units on both sides of the runway shall be the same. The elevation of the top of the beam of the fly-up light unit nearest to each wing bar, and that of the bottom of the beam of the flydown light unit nearest to each wing bar, shall be equal and shall correspond to the approach slope. The cut-off angle of the top of the beams of successive fly-up light units shall decrease by 5’ of arc in angle of elevation at each successive unit away from the wing bar. The cut-in angle of the bottom of the beam of the fly-down light units shall increase by 7’ of arc at each successive unit away from the wing bar (see Figure 5-18).

5.3.5.22 Approach slope and elevation setting of light beams (cont.)

The elevation setting of the top of the red light beams of the wing bar and fly-up light units shall be such that, during an approach, the pilot of an aeroplane to whom the wing bar and three fly-up light units are visible would clear all objects in the approach area by a safe margin if any such light did not appear red.

5.3.5.23 Approach slope and elevation setting of light beams (cont.)

The azimuth spread of the light beam shall be suitably restricted where an object located outside the obstacle protection surface of the system, but within the lateral limits of its light beam, is found to extend above the plane of the obstacle protection surface and an aeronautical study indicates that the object could adversely affect the safety of operations.

The extent of the restriction shall be such that the object remains outside the confines of the light beam.

Note.— See 5.3.5.42 to 5.3.5.46 concerning the related obstacle protection surface.

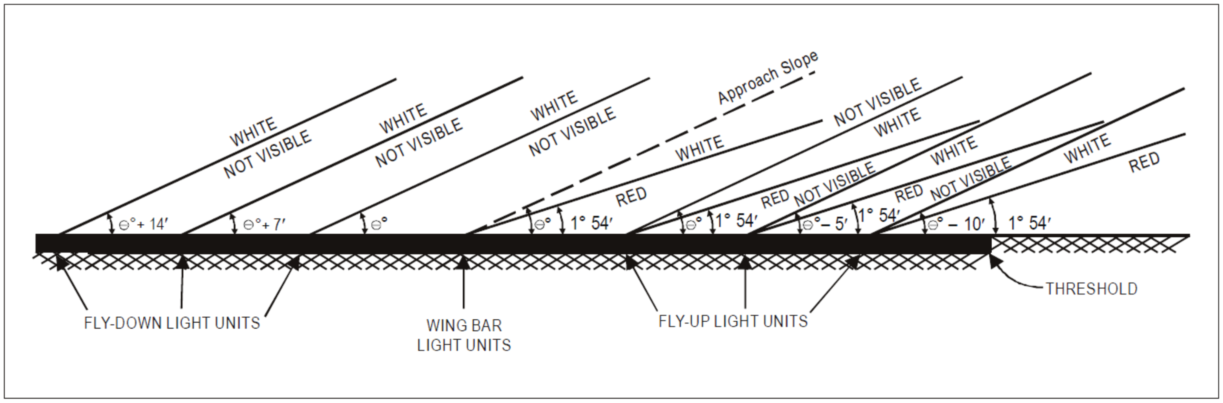


Figure 5-18. Light beams and elevation settings of T-VASIS and AT-VASIS

5.3.5.24 PAPI and APAPI — Description

The PAPI system shall consist of a wing bar of four sharp transition multi-lamp (or paired single lamp) units equally spaced. The system shall be located on the left side of the runway unless it is physically impracticable to do so.

Note.— Where a runway is used by aircraft requiring visual roll guidance which is not provided by other external means, then a second wing bar may be provided on the opposite side of the runway.

5.3.5.25 PAPI and APAPI — Description (cont.)

The APAPI system shall consist of a wing bar of two sharp transition multi-lamp (or paired single lamp) units. The system shall be located on the left side of the runway unless it is physically impracticable to do so.

Note.— Where a runway is used by aircraft requiring visual roll guidance which is not provided by other external means, then a second wing bar may be provided on the opposite side of the runway.

5.3.5.26 PAPI and APAPI — Description (cont.)

The wing bar of a PAPI shall be constructed and arranged in such a manner that a pilot making an approach will:

a) when on or close to the approach slope, see the two units nearest the runway as red and the two units farthest from the runway as white;

b) when above the approach slope, see the one unit nearest the runway as red and the three units farthest from the runway as white; and when further above the approach slope, see all the units as white; and

c) when below the approach slope, see the three units nearest the runway as red and the unit farthest from the runway as white; and when further below the approach slope, see all the units as red.

5.3.5.27 PAPI and APAPI — Description (cont.)

The wing bar of an APAPI shall be constructed and arranged in such a manner that a pilot making an approach will:

a) when on or close to the approach slope, see the unit nearer the runway as red and the unit farther from the runway as white;

b) when above the approach slope, see both the units as white; and

c) when below the approach slope, see both the units as red.

5.3.5.28 PAPI and APAPI — Siting

The light units shall be located as in the basic configuration illustrated in Figure 5-19, subject to the installation tolerances given therein. The units forming a wing bar shall be mounted so as to appear to the pilot of an approaching aeroplane to be substantially in a horizontal line. The light units shall be mounted as low as possible and shall be frangible.

5.3.5.29 PAPI and APAPI — Characteristics of the light units

The system shall be suitable for both day and night operations.

5.3.5.30 PAPI and APAPI — Characteristics of the light units (cont.)

The colour transition from red to white in the vertical plane shall be such as to appear to an observer, at a distance of not less than 300 m, to occur within a vertical angle of not more than 3’.

5.3.5.31 PAPI and APAPI — Characteristics of the light units (cont.)

At full intensity the red light shall have a Y coordinate not exceeding 0.320.

5.3.5.32 PAPI and APAPI — Characteristics of the light units (cont.)

The light intensity distribution of the light units shall be as shown in Appendix 2, Figure A2-23.

Note.— See the Aerodrome Design Manual (Doc 9157), Part 4, for additional guidance on the characteristics of light units.

5.3.5.33 PAPI and APAPI — Characteristics of the light units (cont.)

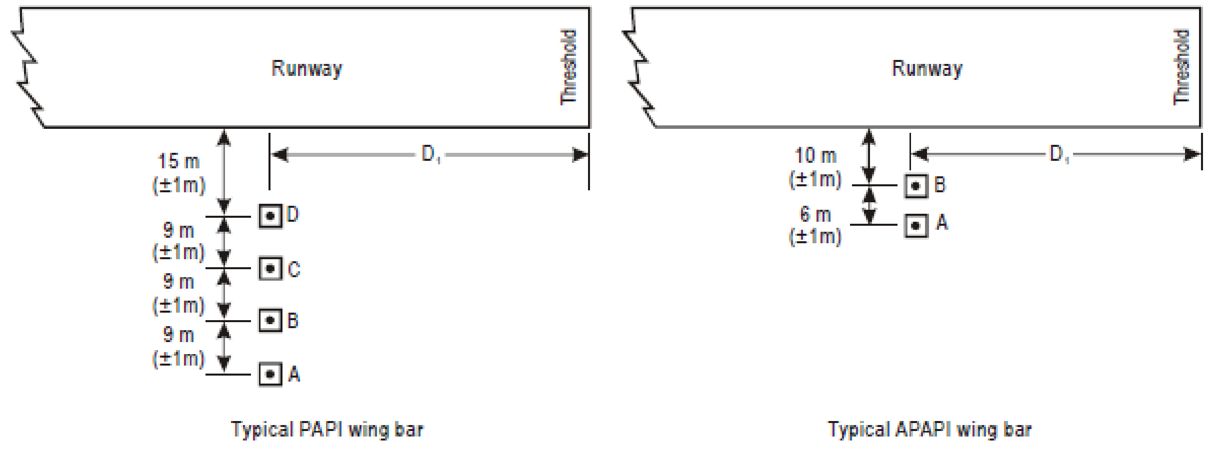
Suitable intensity control shall be provided so as to allow adjustment to meet the prevailing conditions and to avoid dazzling the pilot during approach and landing.

5.3.5.34 PAPI and APAPI — Characteristics of the light units (cont.)

Each light unit shall be capable of adjustment in elevation so that the lower limit of the white part of the beam may be fixed at any desired angle of elevation between 1°30’ and at least 4°30’ above the horizontal.

5.3.5.35 PAPI and APAPI — Characteristics of the light units (cont.)

The light units shall be so designed that deposits of condensation, snow, ice, dirt, etc., on optically transmitting or reflecting surfaces shall interfere to the least possible extent with the light signals and shall not affect the contrast between the red and white signals and the elevation of the transition sector.



INSTALLATION TOLERANCES

a) Where a PAPI or APAPI is installed on a runway not equipped with an ILS or MLS, the distance D1 shall be calculated to ensure that the lowest height at which a pilot will see a correct approach path indication (Figure 5-20, angle B for a PAPI and angle A for an APAPI) provides the wheel clearance over the threshold specified in Table 5-2 for the most demanding amongst aeroplanes regularly using the runway.

b) Where a PAPI or APAPI is installed on a runway equipped with an ILS and/or MLS, the distance D1 shall be calculated to provide the optimum compatibility between the visual and non-visual aids for the range of eye-to-antenna heights of the aeroplanes regularly using the runway. The distance shall be equal to that between the threshold and the effective origin of the ILS glide path or MLS minimum glide path, as appropriate, plus a correction factor for the variation of eye-to- antenna heights of the aeroplanes concerned. The correction factor is obtained by multiplying the average eye-to- antenna height of those aeroplanes by the cotangent of the approach angle. However, the distance shall be such that in no case will the wheel clearance over the threshold be lower than that specified in column (3) of Table 5-2.

Note.— See Section 5.2.5 for specifications on aiming point marking. Guidance on the harmonization of PAPI, ILS and/or MLS signals is contained in the Aerodrome Design Manual (Doc 9157), Part 4.

c) If a wheel clearance, greater than that specified in a) above is required for specific aircraft, this can be achieved by increasing D1.

d) Distance D1 shall be adjusted to compensate for differences in elevation between the lens centres of the light units and the threshold.

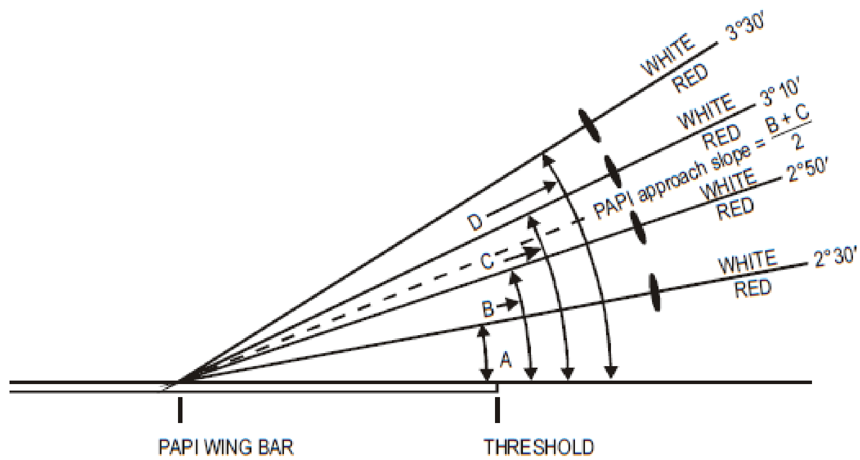
e) To ensure that units are mounted as low as possible and to allow for any transverse slope, small height adjustments of up to 5 cm between units are acceptable. A lateral gradient not greater than 1.25 per cent can be accepted provided it is uniformly applied across the units.

f) A spacing of 6 m (±1 m) between PAPI units should be used on code numbers 1 and 2. In such an event, the inner PAPI unit shall be located not less than 10 m (±1 m) from the runway edge.

Note.— Reducing the spacing between light units results in a reduction in usable range of the system.

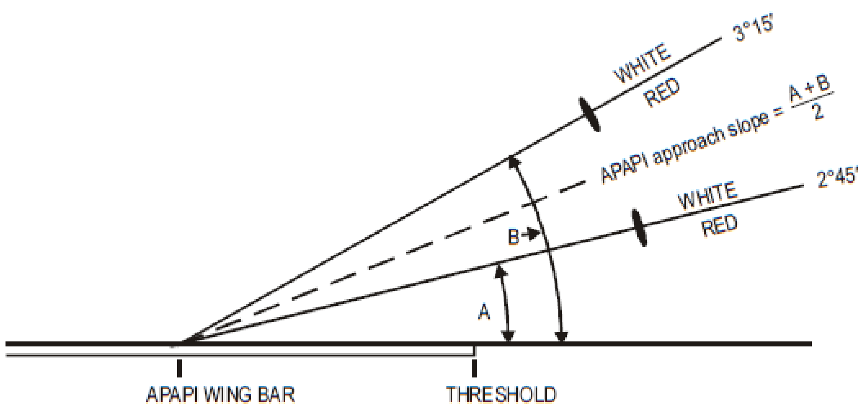
g) The lateral spacing between APAPI units may be increased to 9 m (±1 m) if greater range is required or later conversion to a full PAPI is anticipated. In the latter case, the inner APAPI unit shall be located 15 m (±1 m) from the runway edge.

Figure 5-19. Siting of PAPI and APAPI



The height of the pilot's eye above the aircraft's ILS glide path/MLS antenna varies with the type of aeroplane and approach attitude. Harmonization of the PAPI signal and ILS glide path and/or MLS minimum glide path to a point closer to the threshold may be achieved by increasing the on-course sector from 20′ to 30′. The setting angles for a 3° glide slope would then be 2°25′, 2°45′, 3°15′ and 3°35′.

A — 3° PAPI ILLUSTRATED



B — 3° APAPI ILLUSTRATED

Figure 5-20. Light beams and angle of elevation setting of PAPI and APAPI

Table 5-2. Wheel clearance over threshold for PAPI and APAPI

Eye-to-wheel height of aeroplane in the approach configuration[a] (1)	Desired wheel clearance (metres)[b,c] (2)	Minimum wheel clearance (metres)[d] (3)
up to but not including 3 m	6	3[e]
3 m up to but not including 5 m	9	4
5 m up to but not including 8 m	9	5
8 m up to but not including 14 m	9	6

a. In selecting the eye-to-wheel height group, only aeroplanes meant to use the system on a regular basis shall be considered. The most demanding amongst such aeroplanes shall determine the eye-to-wheel height group.

b. Where practicable the desired wheel clearances shown in column (2) shall be provided.

c. The wheel clearances in column (2) may be reduced to no less than those in column (3) where an aeronautical study indicates that such reduced wheel clearances are acceptable.

d. When a reduced wheel clearance is provided at a displaced threshold it shall be ensured that the corresponding desired wheel clearance specified in column (2) will be available when an aeroplane at the top end of the eye-to-wheel height group chosen overflies the extremity of the runway.

e. This wheel clearance may be reduced to 1.5 m on runways used mainly by light-weight non-turbojet aeroplanes.

5.3.5.36 Approach slope and elevation setting of light units

The approach slope as defined in Figure 5-20 shall be appropriate for use by the aeroplanes using the approach.

5.3.5.37 Approach slope and elevation setting of light units (cont.)

When the runway is equipped with an ILS and/or MLS, the siting and the angle of elevation of the light units shall be such that the visual approach slope conforms as closely as possible with the glide path of the ILS and/or the minimum glide path of the MLS, as appropriate.

5.3.5.38 Approach slope and elevation setting of light units (cont.)

The angle of elevation settings of the light units in a PAPI wing bar shall be such that, during an approach, the pilot of an aeroplane observing a signal of one white and three reds will clear all objects in the approach area by a safe margin (see Table 5-2).

5.3.5.39 Approach slope and elevation setting of light units (cont.)

The angle of elevation settings of the light units in an APAPI wing bar shall be such that, during an approach, the pilot of an aeroplane observing the lowest onslope signal, i.e. one white and one red, will clear all objects in the approach area by a safe margin (see Table 5-2).

5.3.5.40 Approach slope and elevation setting of light units (cont.)

The azimuth spread of the light beam shall be suitably restricted where an object located outside the obstacle protection surface of the PAPI or APAPI system, but within the lateral limits of its light beam, is found to extend above the plane of the obstacle protection surface and an aeronautical study indicates that the object could adversely affect the safety of operations. The extent of the restriction shall be such that the object remains outside the confines of the light beam.

Note.— See 5.3.5.42 to 5.3.5.46 concerning the related obstacle protection surface.

5.3.5.41 Approach slope and elevation setting of light units (cont.)

Where wing bars are installed on each side of the runway to provide roll guidance, corresponding units shall be set at the same angle so that the signals of each wing bar change symmetrically at the same time.

5.3.5.42 Obstacle protection surface

(a) The following specifications apply to T-VASIS, AT-VASIS, PAPI and APAPI.

(b) An obstacle protection surface shall be established when it is intended to provide a visual approach slope indicator system.

5.3.5.43 Obstacle protection surface (cont.)

The characteristics of the obstacle protection surface, i.e. origin, divergence, length and slope, shall correspond to those specified in the relevant column of Table 5-3 and in Figure 5-21.

5.3.5.44 Obstacle protection surface (cont.)

New objects or extensions of existing objects shall not be permitted above an obstacle protection surface except when, in the opinion of the appropriate authority, the new object or extension would be shielded by an existing immovable object.

Note.— Circumstances in which the shielding principle may reasonably be applied are described in the Airport Services Manual (Doc 9137), Part 6.

5.3.5.45 Obstacle protection surface (cont.)

Existing objects above an obstacle protection surface shall be removed except when, in the opinion of the appropriate authority, the object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety of operations of aeroplanes.

Table 5-3. Dimensions and slopes of the obstacle protection surface

Surface dimensions	Runway type/code number							
	Non-instrument Code number				Instrument Code number			
	1	2	3	4	1	2	3	4
Length of inner edge	60 m	80 m[a]	150 m	150 m	150 m	150 m	300 m	300 m
Distance from the visual approach slope indicator system[e]	D1+30 m	D1+60 m	D1+60 m	D1+60 m	D1+60 m	D1+60 m	D1+60 m	D1+60 m
Divergence (each side)	10%	10%	10%	10%	15%	15%	15%	15%
Total length	7 500 m	7 500 m[b]	15 000 m	15 000 m	7 500 m	7 500 m[b]	15 000 m	15 000 m
Slope								
a) T-VASIS and AT-VASIS	–[c]	1.9°	1.9°	1.9°	-	1.9°	1.9°	1.9°
b) PAPI[d]	-	A–0.57°	A–0.57°	A–0.57°	A–0.57°	A–0.57°	A–0.57°	A–0.57°
c) APAPI[d]	A–0.9°	A–0.9°	-	-	A–0.9°	A–0.9°	-	-

a. This length is to be increased to 150 m for a T-VASIS or AT-VASIS.
b. This length is to be increased to 15 000 m for a T-VASIS or AT-VASIS.
c. No slope has been specified if a system is unlikely to be used on runway type/code number indicated.
d. Angles as indicated in Figure 5-20.
b. D1 is the distance of the visual approach slope indicator system from threshold prior to any displacement to remedy object penetration of the OPS (refer Figure 5-19). The start of the OPS is fixed to the visual approach slope indicator system location, such that displacement of the PAPI results in an equal displacement of the start of the OPS. See See 5.3.5.46 e).).

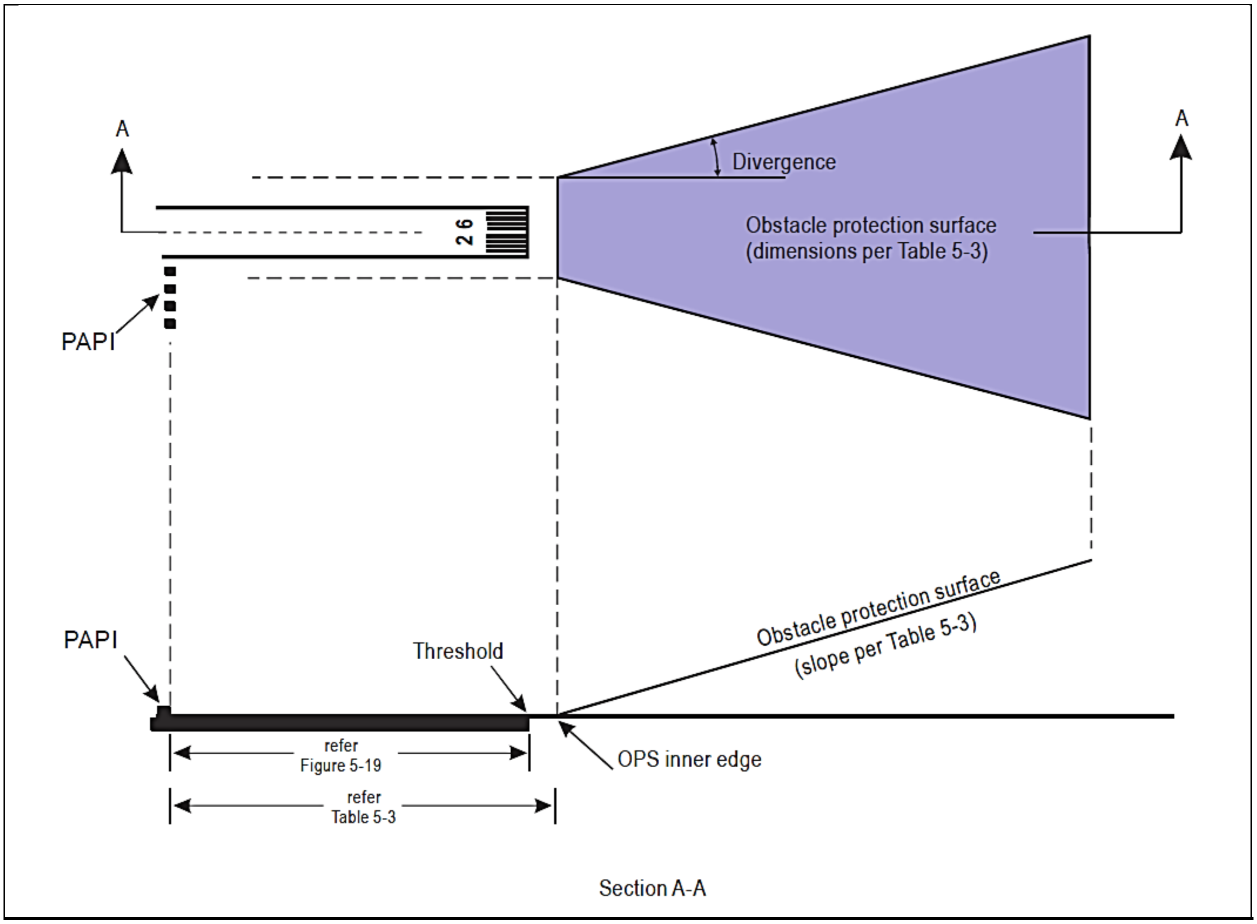


Figure 5-21. Obstacle protection surface for visual approach slope indicator systems

5.3.5.46 Obstacle protection surface (cont.)

Where an aeronautical study indicates that an existing object extending above an obstacle protection surface (OPS) could adversely affect the safety of operations of aeroplanes, one or more of the following measures shall be taken:

a) remove the object;

b) suitably raise the approach slope of the system;

c) reduce the azimuth spread of the system so that the object is outside the confines of the beam;

d) displace the axis of the system and its associated obstacle protection surface by no more than 5°; and

e) suitably displace the system upwind of the threshold such that the object no longer penetrates the OPS.

Note 1.— Guidance on this issue is contained in the Aerodrome Design Manual (Doc 9157), Part 4.

Note 2.— The displacement of the system upwind of the threshold reduces the operational landing distance.

5.3.6 Circling guidance lights

5.3.6.1 Circling guidance lights — Application

Circling guidance lights shall be provided when existing approach and runway lighting systems do not satisfactorily permit identification of the runway and/or approach area to a circling aircraft in the conditions for which it is intended the runway be used for circling approaches.

5.3.6.2 Circling guidance lights — Location

The location and number of circling guidance lights shall be adequate to enable a pilot, as appropriate, to:

a) join the downwind leg or align and adjust the aircraft's track to the runway at a required distance from it and to distinguish the threshold in passing; and

b) keep in sight the runway threshold and/or other features which will make it possible to judge the turn on to base leg and final approach, taking into account the guidance provided by other visual aids.

5.3.6.3 Circling guidance lights — Location (cont.)

Circling guidance lights shall consist of:

a) lights indicating the extended centre line of the runway and/or parts of any approach lighting system; or

b) lights indicating the position of the runway threshold; or

c) lights indicating the direction or location of the runway;

or a combination of such lights as is appropriate to the runway under consideration.

Note.— Guidance on installation of circling guidance lights is given in the Aerodrome Design Manual (Doc 9157), Part 4.

5.3.6.4 Circling guidance lights — Characteristics

Circling guidance lights shall be fixed or flashing lights of an intensity and beam spread adequate for the conditions of visibility and ambient light in which it is intended to make visual circling approaches. The flashing lights shall be white, and the steady lights either white or gaseous discharge lights.

5.3.6.5 Circling guidance lights — Characteristics (cont.)

The lights shall be designed and be installed in such a manner that they will not dazzle or confuse a pilot when approaching to land, taking off or taxiing.

5.3.7 Runway lead-in lighting systems

5.3.7.1 Runway lead-in lighting systems — Application

A runway lead-in lighting system shall be provided where it is desired to provide visual guidance along a specific approach path, for reasons such as avoiding hazardous terrain or for purposes of noise abatement.

Note.— Guidance on providing lead-in lighting systems is given in the Aerodrome Design Manual (Doc 9157), Part 4.

5.3.7.2 Runway lead-in lighting systems — Location

A runway lead-in lighting system shall consist of groups of lights positioned so as to define the desired approach path and so that one group may be sighted from the preceding group. The interval between adjacent groups shall not exceed approximately 1 600 m.

Note.— Runway lead-in lighting systems may be curved, straight or a combination thereof.

5.3.7.3 Runway lead-in lighting systems — Location (cont.)

A runway lead-in lighting system shall extend from a point as determined by the appropriate authority, up to a point where the approach lighting system, if provided, or the runway or the runway lighting system is in view.

5.3.7.4 Runway lead-in lighting systems —Characteristics

Each group of lights of a runway lead-in lighting system shall consist of at least three flashing lights in a linear or cluster configuration. The system may be augmented by steady burning lights where such lights would assist in identifying the system.

5.3.7.5 Runway lead-in lighting systems —Characteristics (cont.)

The flashing lights and the steady burning lights shall be white.

5.3.7.6 Runway lead-in lighting systems — Characteristics (cont.)

Where practicable, the flashing lights in each group shall flash in sequence towards the runway.

5.3.8 Runway threshold identification lights

5.3.8.1 Runway threshold identification lights — Application

Runway threshold identification lights shall be installed:

a) at the threshold of a non-precision approach runway when additional threshold conspicuity is necessary or where it is not practicable to provide other approach lighting aids; and

b) where a runway threshold is permanently displaced from the runway extremity or temporarily displaced from the normal position and additional threshold conspicuity is necessary.

5.3.8.2 Runway threshold identification lights — Location

Runway threshold identification lights shall be located symmetrically about the runway centre line, in line with the threshold and approximately 10 m outside each line of runway edge lights.

5.3.8.3 Runway threshold identification lights — Characteristics

Runway threshold identification lights shall be flashing white lights with a flash frequency between 60 and 120 per minute.

5.3.8.4 Runway threshold identification lights — Characteristics (cont.)

The lights shall be visible only in the direction of approach to the runway.

5.3.9 Runway edge lights

5.3.9.1 Runway edge lights — Application

Runway edge lights shall be provided for a runway intended for use at night or for a precision approach runway intended for use by day or night.

5.3.9.2 Runway edge lights — Application (cont.)

Runway edge lights shall be provided on a runway intended for take-off with an operating minimum below an RVR of the order of 800 m by day.

5.3.9.3 Runway edge lights — Location

Runway edge lights shall be placed along the full length of the runway and shall be in two parallel rows equidistant from the centre line.

5.3.9.4 Runway edge lights — Location (cont.)

Runway edge lights shall be placed along the edges of the area declared for use as the runway or outside the edges of the area at a distance of not more than 3 m.

5.3.9.5 Runway edge lights — Location (cont.)

Where the width of the area which could be declared as runway exceeds 60 m, the distance between the rows of lights shall be determined taking into account the nature of the operations, the light distribution characteristics of the runway edge lights, and other visual aids serving the runway.

5.3.9.6 Runway edge lights — Location (cont.)

The lights shall be uniformly spaced in rows at intervals of not more than 60 m for an instrument runway, and at intervals of not more than 100 m for a non-instrument runway. The lights on opposite sides of the runway axis shall be on lines at right angles to that axis. At intersections of runways, lights may be spaced irregularly or omitted, provided that adequate guidance remains available to the pilot.

5.3.9.7 Runway edge lights — Characteristics

Runway edge lights shall be fixed lights showing variable white, except that:

a) in the case of a displaced threshold, the lights between the beginning of the runway and the displaced threshold shall show red in the approach direction; and

b) a section of the lights 600 m or one-third of the runway length, whichever is the less, at the remote end of the runway from the end at which the take-off run is started, may show yellow.

5.3.9.8 Runway edge lights — Characteristics (cont.)

The runway edge lights shall show at all angles in azimuth necessary to provide guidance to a pilot landing or taking off in either direction. When the runway edge lights are intended to provide circling guidance, they shall show at all angles in azimuth (see 5.3.6.1).

5.3.9.9 Runway edge lights — Characteristics (cont.)

In all angles of azimuth required in 5.3.9.8, runway edge lights shall show at angles up to 15° above the horizontal with an intensity adequate for the conditions of visibility and ambient light in which use of the runway for take-off or landing is intended. In any case, the intensity shall be at least 50 cd except that at an aerodrome without extraneous lighting, the intensity of the lights may be reduced to not less than 25 cd to avoid dazzling the pilot.

5.3.9.10 Runway edge lights — Characteristics (cont.)

Runway edge lights on a precision approach runway shall be in accordance with the specifications of Appendix 2, Figure A2-9 or A2-10.

5.3.10 Runway threshold and wing bar lights

5.3.10.1 Runway threshold and wing bar lights — Application of runway threshold lights

Runway threshold lights shall be provided for a runway equipped with runway edge lights, except on a non-instrument or non-precision approach runway where the threshold is displaced and wing bar lights are provided.

Note. —See Figure 5-22

5.3.10.2 Runway threshold and wing bar lights — Location of runway threshold lights

When a threshold is at the extremity of a runway, the threshold lights shall be placed in a row at right angles to the runway axis as near to the extremity of the runway as possible and, in any case, not more than 3 m outside the extremity.

5.3.10.3 Runway threshold and wing bar lights — Location of runway threshold lights (cont.)

When a threshold is displaced from the extremity of a runway, threshold lights shall be placed in a row at right angles to the runway axis at the displaced threshold.

5.3.10.4 Runway threshold and wing bar lights — Location of runway threshold lights (cont.)

Threshold lighting shall consist of:

a) on a non-instrument or non-precision approach runway, at least six lights;

b) on a precision approach runway category I, at least the number of lights that would be required if the lights were uniformly spaced at intervals of 3 m between the rows of runway edge lights; and

c) on a precision approach runway category II or III, lights uniformly spaced between the rows of runway edge lights

at intervals of not more than 3 m.

5.3.10.5 Runway threshold and wing bar lights — Location of runway threshold lights (cont.)

The lights prescribed in 5.3.10.4 a) and b) shall be either:

a) equally spaced between the rows of runway edge lights; or

b) symmetrically disposed about the runway centre line in two groups, with the lights uniformly spaced in each group

and with a gap between the groups equal to the gauge of the touchdown zone marking or lighting, where such is provided, or otherwise not more than half the distance between the rows of runway edge lights.

5.3.10.6 Runway threshold and wing bar lights — Application of wing bar lights

Wing bar lights shall be provided on a precision approach runway when additional conspicuity is considered desirable.

5.3.10.7 Runway threshold and wing bar lights — Application of wing bar lights (cont.)

Wing bar lights shall be provided on a non-instrument or non-precision approach runway where the threshold is displaced and runway threshold lights are required, but are not provided.

5.3.10.8 Runway threshold and wing bar lights — Location of wing bar lights

Wing bar lights shall be symmetrically disposed about the runway centre line at the threshold in two groups, i.e. wing bars. Each wing bar shall be formed by at least five lights extending at least 10 m outward from, and at right angles to, the line of the runway edge lights, with the innermost light of each wing bar in the line of the runway edge lights.

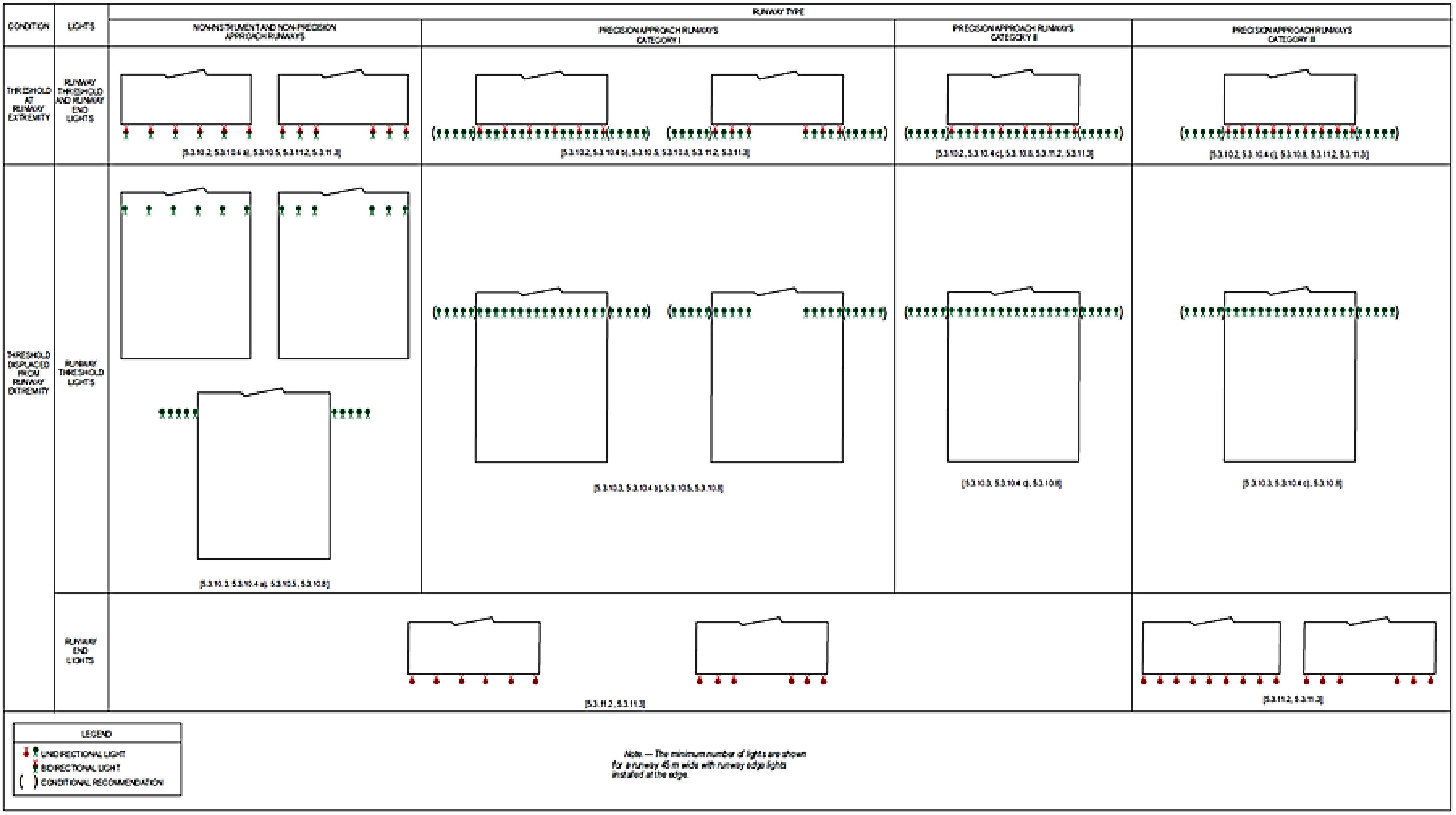


Figure 5-22. Arrangement of runway threshold and runway end lights

5.3.10.9 Runway threshold and wing bar lights — Characteristics of runway threshold and wing bar lights

Runway threshold and wing bar lights shall be fixed unidirectional lights showing green in the direction of approach to the runway. The intensity and beam spread of the lights shall be adequate for the conditions of visibility and ambient light in which use of the runway is intended.

5.3.10.10 Runway threshold and wing bar lights — Characteristics of runway threshold and wing bar lights (cont.)

Runway threshold lights on a precision approach runway shall be in accordance with the specifications of Appendix 2, Figure A2-3.

5.3.10.11 Runway threshold and wing bar lights — Characteristics of runway threshold and wing bar lights (cont.)

Threshold wing bar lights on a precision approach runway shall be in accordance with the specifications of Appendix 2, Figure A2-4.

5.3.11 Runway end lights

5.3.11.1 Runway end lights — Application

Runway end lights shall be provided for a runway equipped with runway edge lights.

Note 1.— see Figure 5-22.

Note 2.— When the threshold is at the runway extremity, fittings serving as threshold lights may be used as runway end lights.

5.3.11.2 Runway end lights — Location

Runway end lights shall be placed on a line at right angles to the runway axis as near to the end of the runway as possible and, in any case, not more than 3 m outside the end.

5.3.11.3 Runway end lights — Location (cont.)

Runway end lighting shall consist of at least six lights. The lights shall be either:

a) equally spaced between the rows of runway edge lights; or

b) symmetrically disposed about the runway centre line in two groups with the lights uniformly spaced in each group and with a gap between the groups of not more than half the distance between the rows of runway edge lights.

For a precision approach runway category III, the spacing between runway end lights, except between the two innermost lights if a gap is used, shall not exceed 6 m.

5.3.11.4 Runway end lights — Characteristics

Runway end lights shall be fixed unidirectional lights showing red in the direction of the runway. The intensity and beam spread of the lights shall be adequate for the conditions of visibility and ambient light in which use of the runway is intended.

5.3.11.5 Runway end lights — Characteristics (cont.)

Runway end lights on a precision approach runway shall be in accordance with the specifications of Appendix 2, Figure A2-8.

5.3.12 Runway centre line lights

5.3.12.1 Runway centre line lights — Application

(a) The safety objective of runway centre line lights is to facilitate safe take-off and landing

(b) Runway centre line lights shall be provided on a precision approach runway category II or III.

5.3.12.2 Runway centre line lights — Application (cont.)

Runway centre line lights shall be provided on a precision approach runway category I, particularly when the runway is used by aircraft with high landing speeds or where the width between the runway edge lights is greater than 50 m.

5.3.12.3 Runway centre line lights — Application (cont.)

Runway centre line lights shall be provided on a runway intended to be used for take-off with an operating minimum below an RVR of the order of 400 m.

5.3.12.4 Runway centre line lights — Application (cont.)

Runway centre line lights shall be provided on a runway intended to be used for takeoff with an operating minimum of an RVR of the order of 400 m or higher when used by aeroplanes with a very high take-off speed, particularly where the width between the runway edge lights is greater than 50 m.

5.3.12.5 Runway centre line lights — Location

Runway centre line lights shall be located along the centre line of the runway, except that the lights may be uniformly offset to the same side of the runway centre line by not more than 60 cm where it is not practicable to locate them along the centre line. The lights shall be located from the threshold to the end at longitudinal spacing of approximately 15 m. Where the serviceability level of the runway centre line lights specified as maintenance objectives in 10.5.7 or 10.5.11, as appropriate, can be demonstrated and the runway is intended for use in runway visual range conditions of 350 m or greater, the longitudinal spacing shall be approximately 30 m.

Note.— Existing centre line lighting where lights are spaced at 7.5 m need not be replaced.

5.3.12.6 Runway centre line lights — Location (cont.)

Centre line guidance for take-off from the beginning of a runway to a displaced threshold shall be provided by:

a) an approach lighting system if its characteristics and intensity settings afford the guidance required during take-off and it does not dazzle the pilot of an aircraft taking off; or

b) runway centre line lights; or

c) barrettes of at least 3 m in length and spaced at uniform intervals of 30 m, as shown in Figure 5-23, designed so

that their photometric characteristics and intensity setting afford the guidance required during take-off without dazzling the pilot of an aircraft taking off.

Where necessary, provision shall be made to extinguish those centre line lights specified in b) or reset the intensity of the approach lighting system or barrettes when the runway is being used for landing. In no case shall only the single source runway centre line lights show from the beginning of the runway to a displaced threshold when the runway is being used for landing.

5.3.12.7 Runway centre line lights — Characteristics

Runway centre line lights shall be fixed lights showing variable white from the threshold to the point 900 m from the runway end; alternate red and variable white from 900 m to 300 m from the runway end; and red from 300 m to the runway end, except that for runways less than 1 800 m in length, the alternate red and variable white lights shall extend from the midpoint of the runway usable for landing to 300 m from the runway end.

Note.— Care is required in the design of the electrical system to ensure that failure of part of the electrical system will not result in a false indication of the runway distance remaining.

5.3.12.8 Runway centre line lights — Characteristics (cont.)

Runway centre line lights shall be in accordance with the specifications of Appendix 2, Figure A2-6 or A2-7.

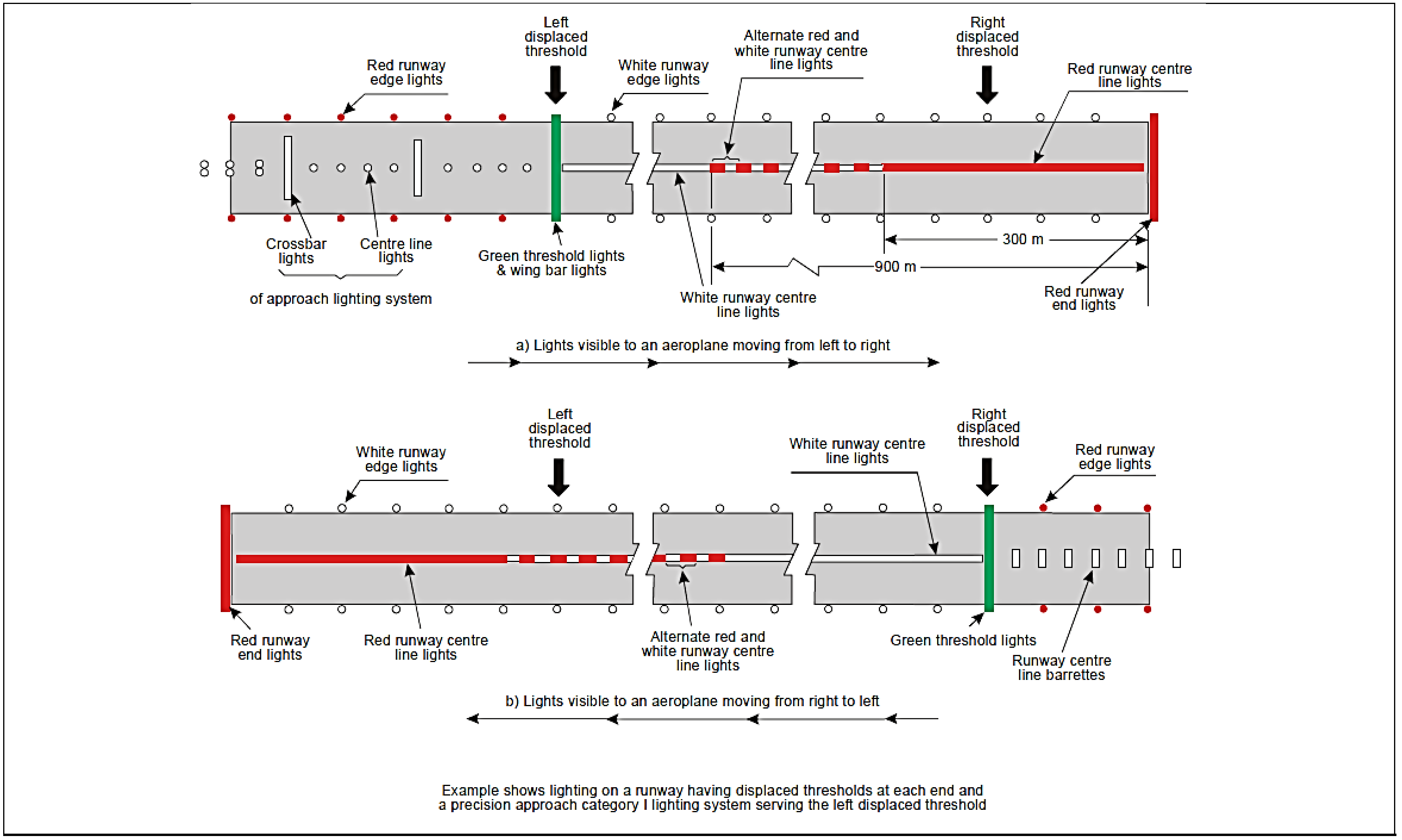


Figure 5-23. Example of approach and runway lighting for runway with displaced thresholds

5.3.13 Runway touchdown zone lights

5.3.13.1 Runway touchdown zone lights — Application

Touchdown zone (TDZ) lights shall be provided in the touchdown zone of a precision approach runway category II or III.

5.3.13.2 Runway touchdown zone lights — Location

Touchdown zone lights shall extend from the threshold for a longitudinal distance of 900 m, except that, on runways less than 1 800 m in length, the system shall be shortened so that it does not extend beyond the midpoint of the runway. The pattern shall be formed by pairs of barrettes symmetrically located about the runway centre line. The lateral spacing between the innermost lights of a pair of barrettes shall be equal to the lateral spacing selected for the touchdown zone marking. The longitudinal spacing between pairs of barrettes shall be either 30 m or 60 m.

Note.— To allow for operations at lower visibility minima, it may be advisable to use a 30 m longitudinal spacing between barrettes.

5.3.13.3 Runway touchdown zone lights — Characteristics

A barrette shall be composed of at least three lights with a spacing between the lights of not more than 1.5 m.

5.3.13.4 Runway touchdown zone lights — Characteristics (cont.)

A barrette shall be not less than 3 m nor more than 4.5 m in length.

5.3.13.5 Runway touchdown zone lights — Characteristics (cont.)

Touchdown zone lights shall be fixed unidirectional lights showing variable white.

5.3.13.6 Runway touchdown zone lights — Characteristics (cont.)

Touchdown zone lights shall be in accordance with the specifications of Appendix 2, Figure A2-5.

5.3.14 Simple touchdown zone lights

5.3.14.1 Simple touchdown zone lights — Application

The purpose of simple touchdown zone lights is to provide pilots with enhanced situational awareness in all visibility conditions and to help enable pilots to decide whether to commence a go-around if the aircraft has not landed by a certain point on the runway. It is essential that pilots operating at aerodromes with simple touchdown zone lights be familiar with the purpose of these lights.

Except where TDZ lights are provided in accordance with paragraph 5.3.13, at an aerodrome where the approach angle is greater than 3.5 degrees and/or the Landing Distance Available combined with other factors increases the risk of an overrun, simple touchdown zone lights shall be provided.

5.3.14.2 Simple touchdown zone lights — Location

Simple touchdown zone lights shall be a pair of lights located on each side of the runway centre line 0.3 m beyond the upwind edge of the final touchdown zone marking. The lateral spacing between the inner lights of the two pairs of lights shall be equal to the lateral spacing selected for the touchdown zone marking. The spacing between the lights of the same pair shall not be more than 1.5 m or half the width of the touchdown zone marking, whichever is greater. (See Figure 5-24.)

5.3.14.3 Simple touchdown zone lights — Location (cont.)

Where provided on a runway without TDZ markings, simple touchdown zone lights shall be installed in such a position that provides the equivalent TDZ information.

5.3.14.4 Simple touchdown zone lights — Characteristics

Simple touchdown zone lights shall be fixed unidirectional lights showing variable white, aligned so as to be visible to the pilot of a landing aeroplane in the direction of approach to the runway.

5.3.14.5 Simple touchdown zone lights — Characteristics (cont.)

Simple touchdown zone lights shall be in accordance with the specifications in Appendix 2, Figure A2-5.

Note.— As a good operating practice, simple touchdown zone lights are supplied with power on a separate circuit to other runway lighting so that they may be used when other lighting is switched off.

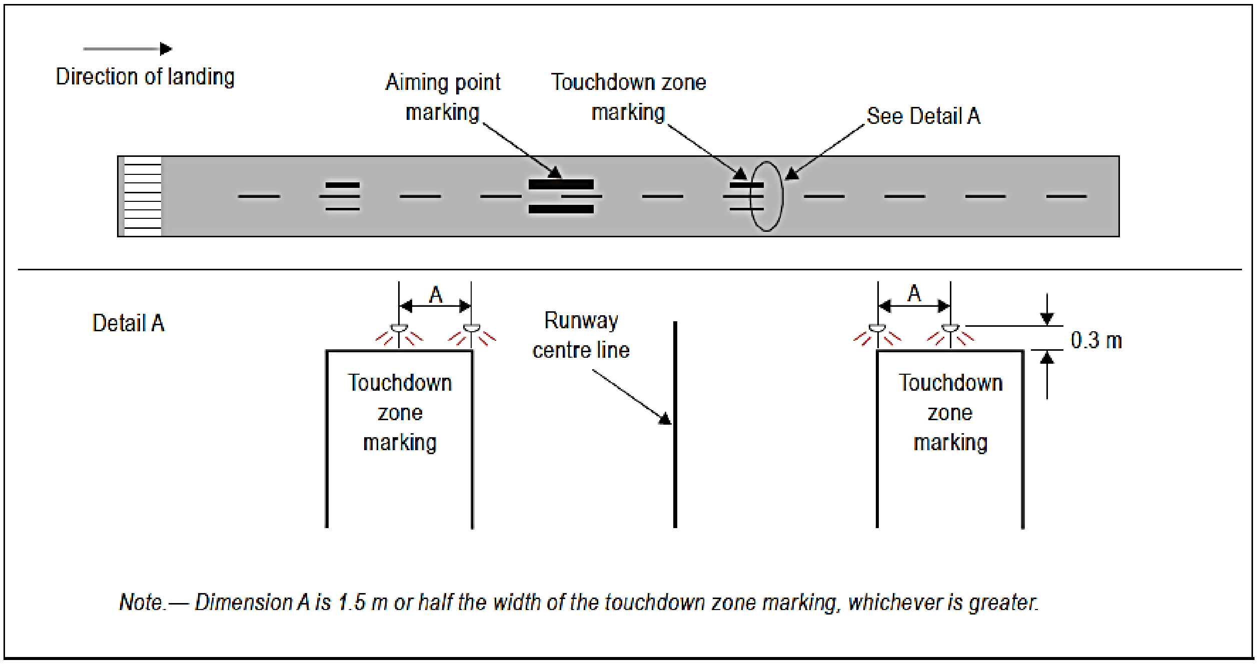


Figure 5-24. Simple touchdown zone lighting

5.3.15 Rapid exit taxiway indicator lights

5.3.15.1 Rapid exit taxiway indicator lights — Application

The purpose of rapid exit taxiway indicator lights (RETILs) is to provide pilots with distance-to-go information to the nearest rapid exit taxiway on the runway, to enhance situational awareness in low visibility conditions and enable pilots to apply braking action for more efficient roll-out and runway exit speeds. It is essential that pilots operating at aerodromes with runway(s) displaying rapid exit taxiway indicator lights be familiar with the purpose of these lights.

Rapid exit taxiway indicator lights shall be provided on a runway intended for use in runway visual range conditions less than a value of 350 m and/or where the traffic density is heavy.

Note.— See Attachment A, Section 14.

5.3.15.2 Rapid exit taxiway indicator lights — Application (cont.)

Rapid exit taxiway indicator lights shall not be displayed in the event of any lamp failure or other failure that prevents the display of the light pattern depicted in Figure 5-25, in full.

5.3.15.3 Rapid exit taxiway indicator lights — Location

A set of rapid exit taxiway indicator lights shall be located on the runway on the same side of the runway centre line as the associated rapid exit taxiway, in the configuration shown in Figure 5-25. In each set, the lights shall be located 2 m apart and the light nearest to the runway centre line shall be displaced 2 m from the runway centre line.

5.3.15.4 Rapid exit taxiway indicator lights — Location (cont.)

Where more than one rapid exit taxiway exists on a runway, the set of rapid exit taxiway indicator lights for each exit shall not overlap when displayed.

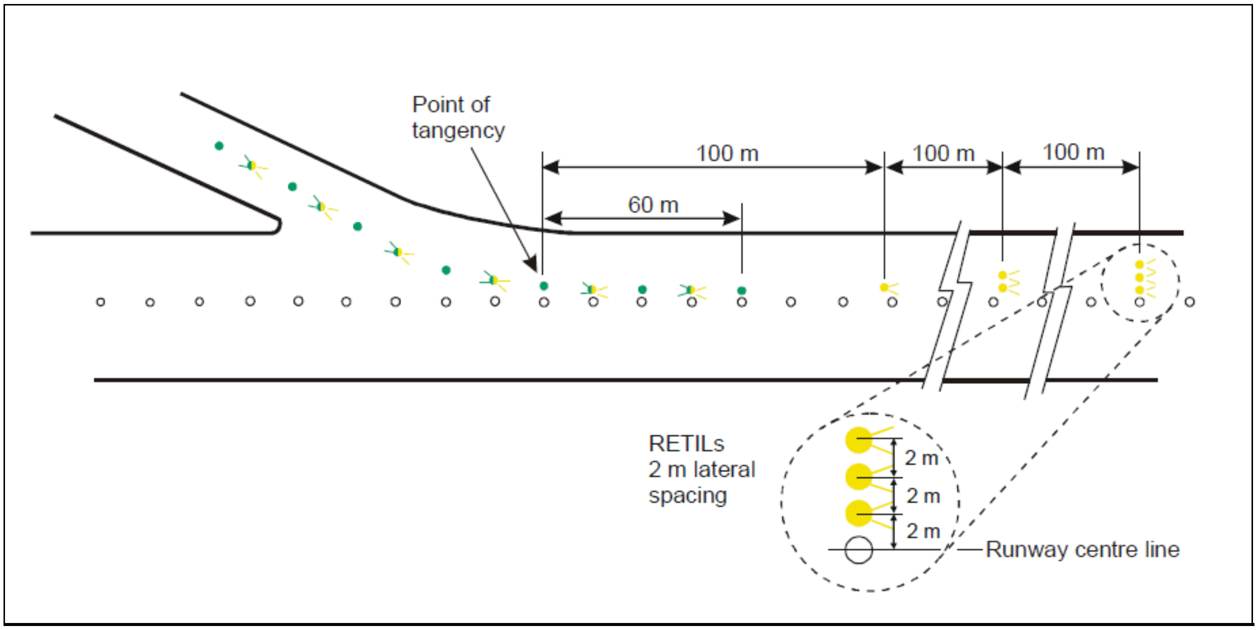


Figure 5-25. Rapid exit taxiway indicator lights (RETILS)

5.3.15.5 Rapid exit taxiway indicator lights — Characteristics

Rapid exit taxiway indicator lights shall be fixed unidirectional yellow lights, aligned so as to be visible to the pilot of a landing aeroplane in the direction of approach to the runway.

5.3.15.6 Rapid exit taxiway indicator lights — Characteristics (cont.)

Rapid exit taxiway indicator lights shall be in accordance with the specifications in Appendix 2, Figure A2-6 or Figure A2-7, as appropriate.

5.3.15.7 Rapid exit taxiway indicator lights — Characteristics (cont.)

Rapid exit taxiway indicator lights shall be supplied with power on a separate circuit to other runway lighting so that they may be used when other lighting is switched off.

5.3.16 Stopway lights

5.3.16.1 Stopway lights— Application

Stopway lights shall be provided for a stopway intended for use at night.

5.3.16.2 Stopway lights— Location

Stopway lights shall be placed along the full length of the stopway and shall be in two parallel rows that are equidistant from the centre line and coincident with the rows of the runway edge lights. Stopway lights shall also be provided across the end of a stopway on a line at right angles to the stopway axis as near to the end of the stopway as possible and, in any case, not more than 3 m outside the end.

5.3.16.3 Stopway lights — Characteristics

Stopway lights shall be fixed unidirectional lights showing red in the direction of the runway.

5.3.17 Taxiway centre line lights

5.3.17.1 Taxiway centre line lights — Application

Taxiway centre line lights shall be provided on an exit taxiway, taxiway, de-icing/anti-icing facility and apron intended for use in runway visual range conditions less than a value of 350 m in such a manner as to provide continuous guidance between the runway centre line and aircraft stands, except that these lights need not be provided where the traffic density is light and taxiway edge lights and centre line marking provide adequate guidance.

5.3.17.2 Taxiway centre line lights — Application (cont.)

Taxiway centre line lights shall be provided on a taxiway intended for use at night in runway visual range conditions of 350 m or greater, and particularly on complex taxiway intersections and exit taxiways, except that these lights need not be provided where the traffic density is light and taxiway edge lights and centre line marking provide adequate guidance.

Note.— Where there may be a need to delineate the edges of a taxiway, e.g. on a rapid exit taxiway, narrow taxiway or in snow conditions, this may be done with taxiway edge lights or markers.

5.3.17.3 Taxiway centre line lights — Application (cont.)

Taxiway centre line lights shall be provided on an exit taxiway, taxiway, and apron in all visibility conditions where specified as components of an advanced surface movement guidance and control system in such a manner as to provide continuous guidance between the runway centre line and aircraft stands.

5.3.17.4 Taxiway centre line lights — Application (cont.)

Taxiway centre line lights shall be provided on a runway forming part of a standard taxi-route and intended for taxiing in runway visual range conditions less than a value of 350 m, except that these lights need not be provided where the traffic density is light and taxiway edge lights and centre line marking provide adequate guidance.

Note.— See 8.2.3 for provisions concerning the interlocking of runway and taxiway lighting systems.

5.3.17.5 Taxiway centre line lights — Application (cont.)

Taxiway centre line lights shall be provided in all visibility conditions on a runway forming part of a standard taxi-route where specified as components of an advanced surface movement guidance and control system.

5.3.17.6 Taxiway centre line lights — Characteristics

Except as provided for in 5.3.17.8, taxiway centre line lights on a taxiway other than an exit taxiway and on a runway forming part of a standard taxi-route shall be fixed lights showing green with beam dimensions such that the light is visible only from aeroplanes on or in the vicinity of the taxiway.

5.3.17.7 Taxiway centre line lights — Characteristics (cont.)

Taxiway centre line lights on an exit taxiway shall be fixed lights. Alternate taxiway centre line lights shall show green and yellow from their beginning near the runway centre line to the perimeter of the ILS/MLS critical/sensitive area or the lower edge of the inner transitional surface, whichever is farthest from the runway; and thereafter all lights shall show green (Figure 5-26). The first light in the exit centre line shall always show green, and the light nearest to the perimeter shall always show yellow.

Note 1.— Care is necessary to limit the light distribution of green lights on or near a runway so as to avoid possible confusion with threshold lights.

Note 2.— For yellow filter characteristics see Appendix 1, 2.2.

Note 3.— The size of the ILS/MLS critical/sensitive area depends on the characteristics of the associated ILS/MLS and other factors. Guidance is provided in Annex 10, Volume I, Attachments C and G.

Note 4.— See 5.4.3 for specifications on runway vacated signs.

5.3.17.8 Taxiway centre line lights — Characteristics (cont.)

Where it is necessary to denote the proximity to a runway, taxiway centre line lights shall be fixed lights showing alternating green and yellow from the perimeter of the ILS/MLS critical/sensitive area or the lower edge of the inner transitional surface, whichever is farthest from the runway, to the runway and continue alternating green and yellow until:

a) their end point near the runway centre line; or

b) in the case of the taxiway centre line lights crossing the runway, to the opposite perimeter of the ILS/MLS critical/sensitive area or the lower edge of the inner transitional surface, whichever is farthest from the runway.

Note 1.— Care is necessary to limit the light distribution of green lights on or near a runway so as to avoid possible confusion with threshold lights.

Note 2.— The provisions of 5.3.17.8 can form part of effective runway incursion prevention measures.

5.3.17.9 Taxiway centre line lights — Characteristics (cont.)

Taxiway centre line lights shall be in accordance with the specifications of:

a) Appendix 2, Figure A2-12, A2-13, or A2-14, for taxiways intended for use in runway visual range conditions of less than a value of 350 m; and

b) Appendix 2, Figure A2-15 or A2-16, for other taxiways.

5.3.17.10 Taxiway centre line lights — Characteristics (cont.)

Where higher intensities are required, from an operational point of view, taxiway centre line lights on rapid exit taxiways intended for use in runway visual range conditions less than a value of 350 m shall be in accordance with the specifications of Appendix 2, Figure A2-12. The number of levels of brilliancy settings for these lights shall be the same as that for the runway centre line lights.

5.3.17.11 Taxiway centre line lights — Characteristics (cont.)

Where taxiway centre line lights are specified as components of an advanced surface movement guidance and control system and where, from an operational point of view, higher intensities are required to maintain ground movements at a certain speed in very low visibilities or in bright daytime conditions, taxiway centre line lights shall be in accordance with the specifications of Appendix 2, Figure A2-17, A2-18 or A2-19.

Note.— High-intensity centre line lights should only be used in case of an absolute necessity and following a specific study.

5.3.17.12 Taxiway centre line lights — Location

Taxiway centre line lights shall normally be located on the taxiway centre line marking, except that they may be offset by not more than 30 cm where it is not practicable to locate them on the marking.

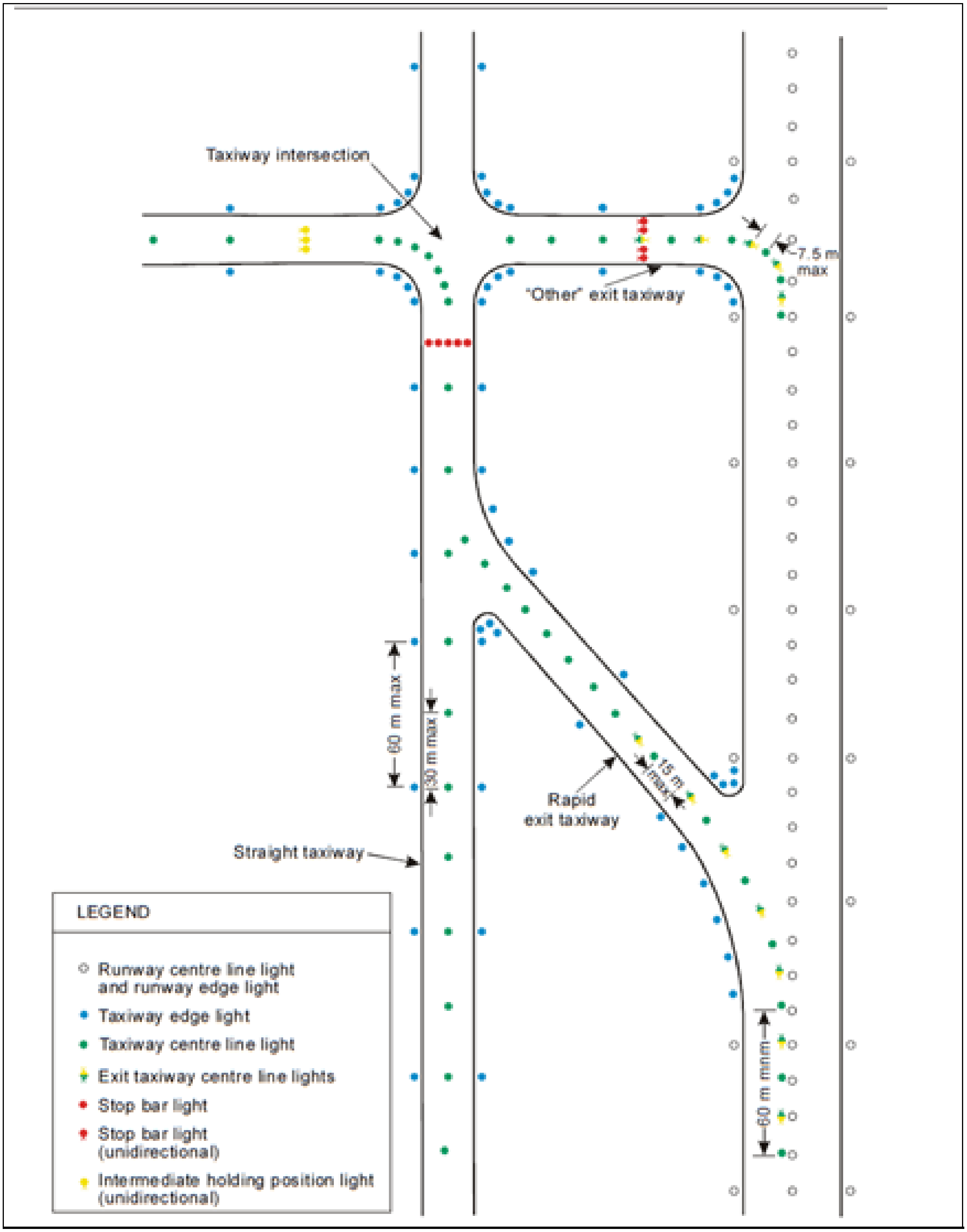


Figure 5-26. Taxiway lighting

5.3.17.13 Taxiway centre line lights on taxiways— Location

The safety objective of taxiway centre line lights is to provide guidance for the safe taxi of aircraft as described below.

Taxiway centre line lights on a straight section of a taxiway shall be spaced at longitudinal intervals of not more than 30 m, except that:

a) larger intervals not exceeding 60 m may be used where, because of the prevailing meteorological conditions, adequate guidance is provided by such spacing;

b) intervals less than 30 m shall be provided on short straight sections; and

c) on a taxiway intended for use in RVR conditions of less than a value of 350 m, the longitudinal spacing shall not exceed 15 m.

5.3.17.14 Taxiway centre line lights on taxiways — Location (cont.)

Taxiway centre line lights on a taxiway curve shall continue from the straight portion of the taxiway at a constant distance from the outside edge of the taxiway curve. The lights shall be spaced at intervals such that a clear indication of the curve is provided.

5.3.17.15 Taxiway centre line lights on taxiways — Location (cont.)

On a taxiway intended for use in RVR conditions of less than a value of 350 m, the lights on a curve shall not exceed a spacing of 15 m, and on a curve of less than 400 m radius the lights shall be spaced at intervals of not greater than 7.5 m. This spacing shall extend for 60 m before and after the curve.

Note 1.— Spacings on curves that have been found suitable for a taxiway intended for use in RVR conditions of 350 m or greater are:

Curve radius	Light spacing
up to 400 m	7.5 m
401 m to 899 m	15 m
900 m or greater	30 m.

Note 2.— See 3.9.5 and Figure 3-2.

5.3.17.16 Taxiway centre line lights on rapid exit taxiways — Location

Taxiway centre line lights on a rapid exit taxiway should commence at a point at least 60 m before the beginning of the taxiway centre line curve and continue beyond the end of the curve to a point on the centre line of the taxiway where an aeroplane can be expected to reach normal taxiing speed. The lights on that portion parallel to the runway centre line shall always be at least 60 cm from any row of runway centre line lights, as shown in Figure 5-27.

5.3.17.17 Taxiway centre line lights on rapid exit taxiways — Location (cont.)

The lights shall be spaced at longitudinal intervals of not more than 15 m, except that, where runway centre line lights are not provided, a greater interval not exceeding 30 m may be used.

5.3.17.18 Taxiway centre line lights on other exit taxiways — Location (cont.)

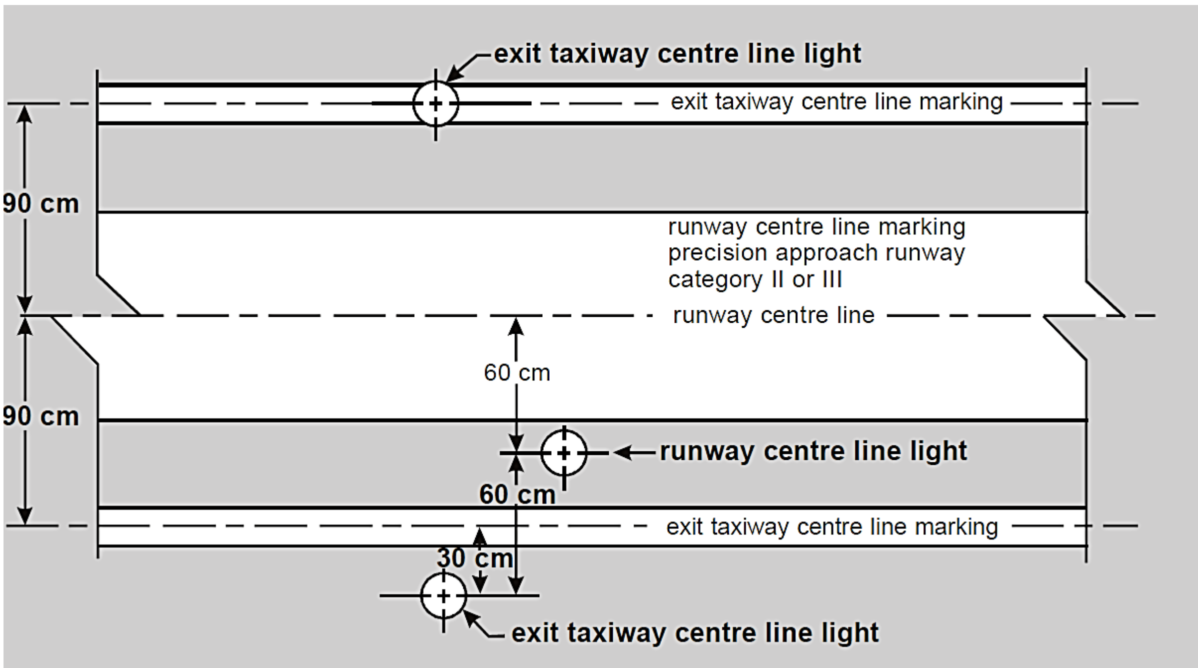
Taxiway centre line lights on exit taxiways other than rapid exit taxiways shall commence at the point where the taxiway centre line marking begins to curve from the runway centre line, and follow the curved taxiway centre line marking at least to the point where the marking leaves the runway. The first light shall be at least 60 cm from any row of runway centre line lights, as shown in Figure 5-27.

5.3.17.19 Taxiway centre line lights on other exit taxiways — Location (cont.)

The lights shall be spaced at longitudinal intervals of not more than 7.5 m.

5.3.17.20 Taxiway centre line lights on runways — Location

Taxiway centre line lights on a runway forming part of a standard taxi-route and intended for taxiing in runway visual range conditions less than a value of 350 m shall be spaced at longitudinal intervals not exceeding 15 m.



Tolerances for offset runway centre line lights and
taxiway centre line lights to maintain 60 cm separation.

Figure 5-27. Offset runway and taxiway centre line lights

5.3.18 Taxiway edge lights

5.3.18.1 Taxiway edge lights — Application

Taxiway edge lights shall be provided at the edges of a runway turn pad, holding bay, apron, etc., intended for use at night and on a taxiway not provided with taxiway centre line lights and intended for use at night, except that taxiway edge lights need not be provided where, considering the nature of the operations, adequate guidance can be achieved by surface illumination or other means.

Note.— See 5.5.5 for taxiway edge markers.

5.3.18.2 Taxiway edge lights — Application (cont.)

Taxiway edge lights shall be provided on a runway forming part of a standard taxi-route and intended for taxiing at night where the runway is not provided with taxiway centre line lights.

Note.— See 8.2.3 for provisions concerning the interlocking of runway and taxiway lighting systems.

5.3.18.3 Taxiway edge lights — Location

Taxiway edge lights on a straight section of a taxiway and on a runway forming part of a standard taxi-route shall be spaced at uniform longitudinal intervals of not more than 60 m. The lights on a curve shall be spaced at intervals less than 60 m so that a clear indication of the curve is provided.

Note.— Guidance on the spacing of taxiway edge lights on curves is given in the Aerodrome Design Manual (Doc 9157), Part 4.

5.3.18.4 Taxiway edge lights — Location (cont.)

Taxiway edge lights on a holding bay, de-icing/anti-icing facility, apron, etc., shall be spaced at uniform longitudinal intervals of not more than 60 m.

5.3.18.5 Taxiway edge lights — Location (cont.)

Taxiway edge lights on a runway turn pad shall be spaced at uniform longitudinal intervals of not more than 30 m.

5.3.18.6 Taxiway edge lights — Location (cont.)

The lights shall be located as near as practicable to the edges of the taxiway, runway turn pad, holding bay, de-icing/anti-icing facility, apron or runway, etc., or outside the edges at a distance of not more than 3 m.

5.3.18.7 Taxiway edge lights — Characteristics

Taxiway edge lights shall be fixed lights showing blue. The lights shall show up to at least 75° above the horizontal and at all angles in azimuth necessary to provide guidance to a pilot taxiing in either direction. At an intersection, exit or curve the lights shall be shielded as far as practicable so that they cannot be seen in angles of azimuth in which they may be confused with other lights.

5.3.18.8 Taxiway edge lights — Characteristics (cont.)

The intensity of taxiway edge lights shall be at least 2 cd from 0° to 6° vertical, and 0.2 cd at any vertical angles between 6° and 75°.

5.3.19 Runway turn pad lights

5.3.19.1 Runway turn pad lights — Application

Runway turn pad lights shall be provided for continuous guidance on a runway turn pad intended for use in runway visual range conditions less than a value of 350 m, to enable an aeroplane to complete a 180-degree turn and align with the runway centre line.

5.3.19.2 Runway turn pad lights — Application (cont.)

Runway turn pad lights shall be provided on a runway turn pad intended for use at night.

5.3.19.3 Runway turn pad lights — Location

Runway turn pad lights shall normally be located on the runway turn pad marking, except that they may be offset by not more than 30 cm where it is not practicable to locate them on the marking.

5.3.19.4 Runway turn pad lights — Location (cont.)

Runway turn pad lights on a straight section of the runway turn pad marking shall be spaced at longitudinal intervals of not more than 15 m.

5.3.19.5 Runway turn pad lights — Location (cont.)

Runway turn pad lights on a curved section of the runway turn pad marking shall not exceed a spacing of 7.5 m.

5.3.19.6 Runway turn pad lights — Characteristics

Runway turn pad lights shall be unidirectional fixed lights showing green with beam dimensions such that the light is visible only from aeroplanes on or approaching the runway turn pad.

5.3.19.7 Runway turn pad lights — Characteristics (cont.)

Runway turn pad lights shall be in accordance with the specifications of Appendix 2, Figure A2-13, A2-14 or A2-15, as appropriate.

5.3.20 Stop bars

5.3.20.1 Stop bars — Application

The safety objective of runway turn pad lights is to provide additional guidance on a runway turn pad to enable an aeroplane to complete a safe 180-degree turn, and align with the runway centre line.

A stop bar shall be provided at every runway-holding position serving a runway when it is intended that the runway will be used in runway visual range conditions less than a value of 550 m, except where:

a) appropriate aids and procedures are available to assist in preventing inadvertent incursions of traffic onto the runway; or

b) operational procedures exist to limit, in runway visual range conditions less than a value of 550 m, the number of:

   1) aircraft on the manoeuvring area to one at a time; and

   2) vehicles on the manoeuvring area to the essential minimum.

Note 1.— A stop bar is intended to be controlled either manually or automatically by air traffic services.

Note 2.— Runway incursions may take place in all visibility or weather conditions. The provision of stop bars at runway holding positions and their use at night and in visibility *conditions greater than 550 m runway visual range can form part of effective runway incursion prevention measures.*

5.3.20.2 Stop bars — Application (cont.)

Where there is more than one stop bar associated with a taxiway/runway intersection, only one shall be illuminated at any given time.

5.3.20.3 Stop bars — Application (cont.)

A stop bar shall be provided at an intermediate holding position when it is desired to supplement markings with lights and to provide traffic control by visual means.

5.3.20.4 Stop bars — Location

Stop bars shall be located across the taxiway at the point where it is desired that traffic stop. Where the additional lights specified in 5.3.20.6 are provided, these lights shall be located not less than 3 m from the taxiway edge.

5.3.20.5 Stop bars — Characteristics

Stop bars shall consist of lights spaced at uniform intervals of no more than 3 m across the taxiway, showing red in the intended direction(s) of approach to the intersection or runway-holding position.

Note.— Where necessary to enhance conspicuity of an existing stop bar, extra lights are installed uniformly.

5.3.20.6 Stop bars — Characteristics (cont.)

A pair of elevated lights shall be added to each end of the stop bar where the inpavement stop bar lights might be obscured from a pilot’s view, for example, by snow or rain, or where a pilot may be required to stop the aircraft in a position so close to the lights that they are blocked from view by the structure of the aircraft.

5.3.20.7 Stop bars — Characteristics (cont.)

Stop bars installed at a runway-holding position shall be unidirectional and shall show red in the direction of approach to the runway.

5.3.20.8 Stop bars — Characteristics (cont.)

Where the additional lights specified in 5.3.20.6 are provided, these lights shall have the same characteristics as the lights in the stop bar, but shall be visible to approaching aircraft up to the stop bar position.

5.3.20.9 Stop bars — Characteristics (cont.)

The intensity in red light and beam spreads of stop bar lights shall be in accordance with the specifications in Appendix 2, Figures A2-12 through A2-16, as appropriate.

5.3.20.10 Stop bars — Characteristics (cont.)

Where stop bars are specified as components of an advanced surface movement guidance and control system and where, from an operational point of view, higher intensities are required to maintain ground movements at a certain speed in very low visibilities or in bright daytime conditions, the intensity in red light and beam spreads of stop bar lights shall be in accordance with the specifications of Appendix 2, Figure A2-17, A2-18 or A2-19.

Note.— High-intensity stop bars should only be used in case of an absolute necessity and following a specific study.

5.3.20.11 Stop bars — Characteristics (cont.)

Where a wide beam fixture is required, the intensity in red light and beam spreads of stop bar lights shall be in accordance with the specifications of Appendix 2, Figure A2-17 or A2-19.

5.3.20.12 Stop bars — Characteristics (cont.)

The lighting circuit shall be designed so that:

a) stop bars located across entrance taxiways are selectively switchable;

b) stop bars located across taxiways intended to be used only as exit taxiways are switchable selectively or in groups;

c) when a stop bar is illuminated, any taxiway centre line lights installed beyond the stop bar shall be extinguished for a distance of at least 90 m; and

d) stop bars are interlocked with the taxiway centre line lights so that when the centre line lights beyond the stop bar are illuminated the stop bar is extinguished and vice versa.

Note.— Care is required in the design of the electrical system to ensure that all of the lights of a stop bar will not fail at the same time. Guidance on this issue is given in the Aerodrome Design Manual (Doc 9157), Part 5.

5.3.21 Intermediate holding position lights

Note.— See 5.2.11 for specifications on intermediate holding position marking.

5.3.21.1 Intermediate holding position lights — Application

Except where a stop bar has been installed, intermediate holding position lights shall be provided at an intermediate holding position intended for use in runway visual range conditions less than a value of 350 m.

5.3.21.2 Intermediate holding position lights — Application (cont.)

Intermediate holding position lights shall be provided at an intermediate holding position where there is no need for stop-and-go signals as provided by a stop bar.

5.3.21.3 Intermediate holding position lights — Location

Intermediate holding position lights shall be located along the intermediate holding position marking at a distance of 0.3 m prior to the marking.

5.3.21.4 Intermediate holding position lights — Characteristics

Intermediate holding position lights shall consist of three fixed unidirectional lights showing yellow in the direction of approach to the intermediate holding position with a light distribution similar to taxiway centre line lights if provided. The lights shall be disposed symmetrically about and at right angle to the taxiway centre line, with individual lights spaced 1.5 m apart.

5.3.22

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5.3.23 Runway guard lights

Note.— Runway incursions may take place in all visibility or weather conditions. The use of runway guard lights at runway-holding positions can form part of effective runway incursion prevention measures. Runway guard lights warn pilots and drivers of vehicles, when operating on taxiways, that they are about to enter a runway. There are two standard configurations of runway guard lights as illustrated in Figure 5-29.

5.3.23.1 Runway guard lights — Application

The safety objective of the runway guard lights is to warn pilots and drivers of vehicles, when operating on taxiways, that they are about to enter a runway.

Runway guard lights, Configuration A, shall be provided at each taxiway/runway intersection associated with a runway intended for use in:

a) runway visual range conditions less than a value of 550 m where a stop bar is not installed; and

b) runway visual range conditions of values between 550 m and 1 200 m where the traffic density is heavy.

Note 1.— Runway guard lights, Configuration B, may supplement runway guard lights, Configuration A, when deemed necessary.

Note 2.— Guidance on the design, operation and location of runway guard lights, Configuration B, is given in the Aerodrome Design Manual (Doc 9157), Part 4.

5.3.23.2 Runway guard lights — Application (cont.)

As part of runway incursion prevention measures, runway guard lights, Configuration A or B, shall be provided at each taxiway/runway intersection where runway incursion hot spots have been identified, and used under all weather conditions during day and night.

5.3.23.3 Runway guard lights — Application (cont.)

Configuration B runway guard lights shall not be collocated with a stop bar.

5.3.23.4 Runway guard lights — Application (cont.)

Where more than one runway-holding positions exist at a runway/taxiway intersection, only the set of runway guard lights associated with the operational runway-holding position shall be illuminated.

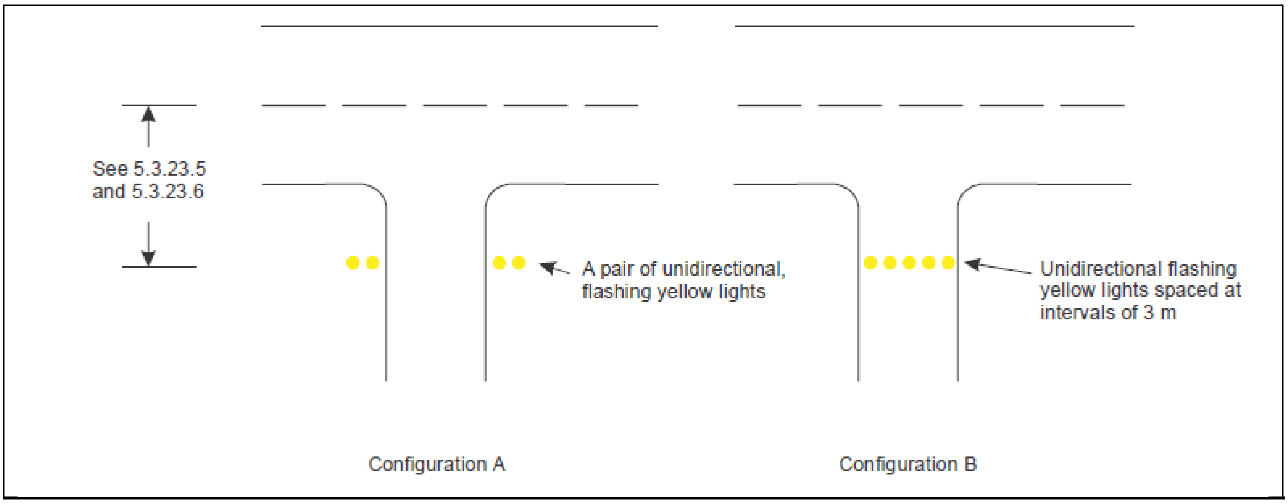


Figure 5-29. Runway guard lights

5.3.23.5 Runway guard lights — Location

Runway guard lights, Configuration A, shall be located at each side of the taxiway on the holding side of the runway-holding position marking.

5.3.23.6 Runway guard lights — Location (cont.)

Runway guard lights, Configuration B, shall be located across the taxiway on the holding side of the runway holding position marking.

5.3.23.7 Runway guard lights — Characteristics

Runway guard lights, Configuration A, shall consist of two pairs of yellow lights.

5.3.23.8 Runway guard lights — Characteristics (cont.)

Where there is a need to enhance the contrast between the on and off state of runway guard lights, Configuration A, intended for use during the day, a visor of sufficient size to prevent sunlight from entering the lens without interfering with the function of the fixture shall be located above each lamp.

Note.— Some other device or design, e.g. specially designed optics, may be used in lieu of the visor.

5.3.23.9 Runway guard lights — Characteristics (cont.)

Runway guard lights, Configuration B, shall consist of yellow lights spaced at intervals of 3 m across the taxiway.

5.3.23.10 Runway guard lights — Characteristics (cont.)

The light beam shall be unidirectional and shall show yellow in the direction of approach to the runway holding position.

Note.— For guidance on orientation and aiming of runway guard lights, see the Aerodrome Design Manual (Doc 9157), Part 4.

5.3.23.11 Runway guard lights — Characteristics (cont.)

The intensity in yellow light and beam spreads of lights of Configuration A shall be in accordance with the specifications in Appendix 2, Figure A2-24.

5.3.23.12 Runway guard lights — Characteristics (cont.)

Where runway guard lights are intended for use during the day, the intensity in yellow light and beam spreads of lights of Configuration A shall be in accordance with the specifications in Appendix 2, Figure A2-25.

5.3.23.13 Runway guard lights — Characteristics (cont.)

Where runway guard lights are specified as components of an advanced surface movement guidance and control system where higher light intensities are required, the intensity in yellow light and beam spreads of lights of Configuration A shall be in accordance with the specifications in Appendix 2, Figure A2-25.

Note.— Higher light intensities may be required to maintain ground movement at a certain speed in low visibilities.

5.3.23.14 Runway guard lights — Characteristics (cont.)

The intensity in yellow light and beam spreads of lights of Configuration B shall be in accordance with the specifications in Appendix 2, Figure A2-12.

5.3.23.15 Runway guard lights — Characteristics (cont.)

Where runway guard lights are intended for use during the day, the intensity in yellow light and beam spreads of lights of Configuration B shall be in accordance with the specifications in Appendix 2, Figure A2-20.

5.3.23.16 Runway guard lights — Characteristics (cont.)

Where runway guard lights are specified as components of an advanced surface movement guidance and control system where higher light intensities are required, the intensity in yellow light and beam spreads of lights of Configuration B shall be in accordance with the specifications in Appendix 2, Figure A2-20.

5.3.23.17 Runway guard lights — Characteristics (cont.)

The lights in each unit of Configuration A shall be illuminated alternately.

5.3.23.18 Runway guard lights — Characteristics (cont.)

For Configuration B, adjacent lights shall be alternately illuminated and alternative lights shall be illuminated in unison.

5.3.23.19 Runway guard lights — Characteristics (cont.)

The lights shall be illuminated between 30 and 60 cycles per minute and the light suppression and illumination periods shall be equal and opposite in each light.

Note.— The optimum flash rate is dependent on the rise and fall times of the lamps used. Runway guard lights, Configuration A, installed on 6.6 ampere series circuits have been found to look best when operated at 45 to 50 flashes per minute per lamp. Runway guard lights, Configuration B, installed on 6.6 ampere series circuits have been found to look best when operated at 30 to 32 flashes per minute per lamp.

5.3.24 Apron floodlighting

(see also 5.3.17.1 and 5.3.18.1)

5.3.24.1 Apron floodlighting — Application

Apron floodlighting shall be provided on an apron and on a designated isolated aircraft parking position intended to be used at night.

Note 1.— Where a de-icing/anti-icing facility is located in close proximity to the runway and permanent floodlighting could be confusing to pilots, other means of illumination of the facility may be required.

Note 2.— The designation of an isolated aircraft parking position is specified in 3.14.

Note 3.— Guidance on apron floodlighting is given in the Aerodrome Design Manual (Doc 9157), Part 4.

5.3.24.2 Apron floodlighting — Location

Apron floodlights shall be located so as to provide adequate illumination on all apron service areas, with a minimum of glare to pilots of aircraft in flight and on the ground, aerodrome and apron controllers, and personnel on the apron. The arrangement and aiming of floodlights shall be such that an aircraft stand receives light from two or more directions to minimize shadows.

5.3.24.3 Apron floodlighting — Characteristics

The spectral distribution of apron floodlights shall be such that the colours used for aircraft marking connected with routine servicing, and for surface and obstacle marking, can be correctly identified.

5.3.24.4 Apron floodlighting — Characteristics (cont.)

The average illuminance shall be at least the following:

Aircraft stand:

— horizontal illuminance — 20 lux with a uniformity ratio (average to minimum) of not more than 4 to 1; and

— vertical illuminance — 20 lux at a height of 2 m above the apron in relevant directions.

Other apron areas:

— horizontal illuminance — 50 per cent of the average illuminance on the aircraft stands with a uniformity ratio (average to minimum) of not more than 4 to 1.

5.3.25 Visual docking guidance system

5.3.25.1 Visual docking guidance system — Application

A visual docking guidance system shall be provided when it is intended to indicate, by a visual aid, the precise positioning of an aircraft on an aircraft stand and other alternative means, such as marshallers, are not practicable.

Note.— The factors to be considered in evaluating the need for a visual docking guidance system are in particular: the number and type(s) of aircraft using the aircraft stand, weather conditions, space available on the apron and the precision required for manoeuvring into the parking position due to aircraft servicing installation, passenger loading bridges, etc. See the Aerodrome Design Manual (Doc 9157), Part 4 — Visual Aids for guidance on the selection of suitable systems.

5.3.25.2 Visual docking guidance system — Characteristics

The system shall provide both azimuth and stopping guidance.

5.3.25.3 Visual docking guidance system — Characteristics (cont.)

The azimuth guidance unit and the stopping position indicator shall be adequate for use in all weather, visibility, background lighting and pavement conditions for which the system is intended, both by day and night, but shall not dazzle the pilot.

Note.— Care is required in both the design and on-site installation of the system to ensure that reflection of sunlight, or other light in the vicinity, does not degrade the clarity and conspicuity of the visual cues provided by the system.

5.3.25.4 Visual docking guidance system — Characteristics (cont.)

The azimuth guidance unit and the stopping position indicator shall be of a design such that:

a) a clear indication of malfunction of either or both is available to the pilot; and

b) they can be turned off.

5.3.25.5 Visual docking guidance system — Characteristics (cont.)

The azimuth guidance unit and the stopping position indicator shall be located in such a way that there is continuity of guidance between the aircraft stand markings, the aircraft stand manoeuvring guidance lights, if present, and the visual docking guidance system.

5.3.25.6 Visual docking guidance system — Characteristics (cont.)

The accuracy of the system shall be adequate for the type of loading bridge and fixed aircraft servicing installations with which it is to be used.

5.3.25.7 Visual docking guidance system — Characteristics (cont.)

The system shall be usable by all types of aircraft for which the aircraft stand is intended, preferably without selective operation.

5.3.25.8 Visual docking guidance system — Characteristics (cont.)

If selective operation is required to prepare the system for use by a particular type of aircraft, then the system shall provide an identification of the selected aircraft type to both the pilot and the system operator as a means of ensuring that the system has been set properly.

5.3.25.9 Azimuth guidance unit — Location

The azimuth guidance unit shall be located on or close to the extension of the stand centre line ahead of the aircraft so that its signals are visible from the cockpit of an aircraft throughout the docking manoeuvre and aligned for use at least by the pilot occupying the left seat.

5.3.25.10 Azimuth guidance unit — Location (cont.)

The azimuth guidance unit shall be aligned for use by the pilots occupying both the left and right seats.

5.3.25.11 Azimuth guidance unit — Characteristics

The azimuth guidance unit shall provide unambiguous left/right guidance which enables the pilot to acquire and maintain the lead-in line without over-controlling.

5.3.25.12 Azimuth guidance unit — Characteristics (cont.)

When azimuth guidance is indicated by colour change, green shall be used to identify the centre line and red for deviations from the centre line.

5.3.25.13 Stopping position indicator — Location

The stopping position indicator shall be located in conjunction with, or sufficiently close to, the azimuth guidance unit so that a pilot can observe both the azimuth and stop signals without turning the head.

5.3.25.14 Stopping position indicator — Location (cont.)

The stopping position indicator shall be usable at least by the pilot occupying the left seat.

5.3.25.15 Stopping position indicator — Location (cont.)

The stopping position indicator shall be usable by the pilots occupying both the left and right seats.

5.3.25.16 Stopping position indicator — Characteristics

The stopping position information provided by the indicator for a particular aircraft type shall account for the anticipated range of variations in pilot eye height and/or viewing angle.

5.3.25.17 Stopping position indicator — Characteristics (cont.)

The stopping position indicator shall show the stopping position for the aircraft for which guidance is being provided and shall provide closing rate information to enable the pilot to gradually decelerate the aircraft to a full stop at the intended stopping position.

5.3.25.18 Stopping position indicator — Characteristics (cont.)

The stopping position indicator shall provide closing rate information over a distance of at least 10 m.

5.3.25.19 Stopping position indicator — Characteristics (cont.)

When stopping guidance is indicated by colour change, green shall be used to show that the aircraft can proceed and red to show that the stop point has been reached ,except that for a short distance prior to the stop point a third colour may be used to warn that the stopping point is close.

5.3.26 Advanced visual docking guidance system

5.3.26.1 Advanced visual docking guidance system — Application

Note 1.— Advanced visual docking guidance systems (A-VDGS) include those systems that, in addition to basic and passive azimuth and stop position information, provide pilots with active (usually sensor-based) guidance information, such as aircraft type indication (in accordance with Doc 8643 — Aircraft Type Designators), distance-to-go information and closing speed. Docking guidance information is usually provided on a single display unit.

Note 2.— An A-VDGS may provide docking guidance information in three stages: the acquisition of the aircraft by the system, the azimuth alignment of the aircraft, and the stopping position information

An A-VDGS shall be provided where it is operationally desirable to confirm the correct aircraft type for which guidance is being provided and/or to indicate the stand centre line in use, where more than one is provided for.

5.3.26.2 Advanced visual docking guidance system — Application (cont.)

The A-VDGS shall be suitable for use by all types of aircraft for which the aircraft stand is intended.

5.3.26.3 Advanced visual docking guidance system — Application (cont.)

The A-VDGS shall be used only in conditions in which its operational performance is specified.

Note 1.— The use of the A-VDGS in conditions such as weather, visibility and background lighting, both by day and night, would need to be specified.

Note 2.— Care is required in both the design and on-site installation of the system to ensure that glare, reflection of sunlight, or other light in the vicinity, does not degrade the clarity and conspicuity of the visual cues provided by the system.

5.3.26.4 Advanced visual docking guidance system — Application (cont.)

The docking guidance information provided by an A-VDGS shall not conflict with that provided by a conventional visual docking guidance system on an aircraft stand if both types are provided and are in operational use. A method of indicating that the A-VDGS is not in operational use or is unserviceable shall be provided.

5.3.26.5 Advanced visual docking guidance system — Location

The A-VDGS shall be located such that unobstructed and unambiguous guidance is provided to the person responsible for, and persons assisting, the docking of the aircraft throughout the docking manoeuvre.

Note.— Usually the pilot-in-command is responsible for the docking of the aircraft. However, in some circumstances, another person could be responsible and this person may be the driver of a vehicle that is towing the aircraft.

5.3.26.6 Advanced visual docking guidance system — Characteristics

The A-VDGS shall provide, at minimum, the following guidance information at the appropriate stage of the docking manoeuvre:

a) an emergency stop indication;

b) the aircraft type and model for which the guidance is provided;

c) an indication of the lateral displacement of the aircraft relative to the stand centre line;

d) the direction of azimuth correction needed to correct a displacement from the stand centre line;

e) an indication of the distance to the stop position;

f) an indication when the aircraft has reached the correct stopping position; and

g) a warning indication if the aircraft goes beyond the appropriate stop position.

5.3.26.7 Advanced visual docking guidance system — Characteristics (cont.)

The A-VDGS shall be capable of providing docking guidance information for all aircraft taxi speeds encountered during the docking manoeuvre.

Note.— See the Aerodrome Design Manual (Doc 9157), Part 4, for an indication of the maximum aircraft speeds relative to distance to the stopping position.

5.3.26.8 Advanced visual docking guidance system — Characteristics (cont.)

The time taken from the determination of the lateral displacement to its display shall not result in a deviation of the aircraft, when operated in normal conditions, from the stand centre line greater than 1 m.

5.3.26.9 Advanced visual docking guidance system — Characteristics (cont.)

The information on displacement of the aircraft relative to the stand centre line and distance to the stopping position, when displayed, shall be provided with the accuracy specified in Table 5-4.

5.3.26.10 Advanced visual docking guidance system — Characteristics (cont.)

Symbols and graphics used to depict guidance information shall be intuitively representative of the type of information provided.

Note.— The use of colour would need to be appropriate and need to follow signal convention, i.e. red, yellow and green mean hazard, caution and normal/correct conditions, respectively. The effects of colour contrasts would also need to be considered.

5.3.26.11 Advanced visual docking guidance system — Characteristics (cont.)

Information on the lateral displacement of the aircraft relative to the stand centre line shall be provided at least 25 m prior to the stop position.

Note.— The indication of the distance of the aircraft from the stop position may be colour-coded and presented at a rate and distance proportional to the actual closure rate and distance of the aircraft approaching the stop point.

5.3.26.12 Advanced visual docking guidance system — Characteristics (cont.)

Continuous closure distance and closure rate shall be provided from at least 15 m prior to the stop position.

5.3.26.13 Advanced visual docking guidance system — Characteristics (cont.)

Where provided, closure distance displayed in numerals shall be provided in metre integers to the stop position and displayed to 1 decimal place at least 3 m prior to the stop position.

Table 5-4. A-VDGS recommended displacement accuracy

Guidance information	Maximum deviation at stop position (stop area)	Maximum deviation at 9 m from stop position	Maximum deviation at 15 m from stop position	Maximum deviation at 25 m from stop position
Azimuth	±250 mm	±340 mm	±400 mm	±500 mm
Distance	±500 mm	±1 000 mm	±1 300 mm	Not specified

5.3.26.14 Advanced visual docking guidance system — Characteristics (cont.)

Throughout the docking manoeuvre, an appropriate means shall be provided on the A-VDGS to indicate the need to bring the aircraft to an immediate halt. In such an event, which includes a failure of the A-VDGS, no other information shall be displayed.

5.3.26.15 Advanced visual docking guidance system — Characteristics (cont.)

Provision to initiate an immediate halt to the docking procedure shall be made available to personnel responsible for the operational safety of the stand.

5.3.26.16 Advanced visual docking guidance system — Characteristics (cont.)

The word “stop” in red characters shall be displayed when an immediate cessation of the docking manoeuvre is required.

5.3.27 Aircraft stand manoeuvring guidance lights

5.3.27.1 Aircraft stand manoeuvring guidance lights — Application

Aircraft stand manoeuvring guidance lights shall be provided to facilitate the positioning of an aircraft on an aircraft stand on a paved apron intended for use in poor visibility conditions, unless adequate guidance is provided by other means.

5.3.27.2 Aircraft stand manoeuvring guidance lights — Location

Aircraft stand manoeuvring guidance lights shall be collocated with the aircraft stand markings.

5.3.27.3 Aircraft stand manoeuvring guidance lights — Characteristics

Aircraft stand manoeuvring guidance lights, other than those indicating a stop position, shall be fixed yellow lights, visible throughout the segments within which they are intended to provide guidance.

5.3.27.4 Aircraft stand manoeuvring guidance lights — Characteristics (cont.)

The lights used to delineate lead-in, turning and lead-out lines shall be spaced at intervals of not more than 7.5 m on curves and 15 m on straight sections.

5.3.27.5 Aircraft stand manoeuvring guidance lights — Characteristics (cont.)

The lights indicating a stop position shall be fixed unidirectional lights showing red.

5.3.27.6 Aircraft stand manoeuvring guidance lights — Characteristics (cont.)

The intensity of the lights shall be adequate for the condition of visibility and ambient light in which the use of the aircraft stand is intended.

5.3.27.7 Aircraft stand manoeuvring guidance lights — Characteristics (cont.)

The lighting circuit shall be designed so that the lights may be switched on to indicate that an aircraft stand is to be used and switched off to indicate that it is not to be used.

5.3.28 Road-holding position light

5.3.28.1 Road-holding position light — Application

A road-holding position light shall be provided at each road-holding position serving a runway when it is intended that the runway will be used in runway visual range conditions less than a value of 350 m.

5.3.28.2 Road-holding position light — Application (cont.)

A road-holding position light shall be provided at each road-holding position serving a runway when it is intended that the runway will be used in runway visual range conditions of values between 350 m and 550 m.

5.3.28.3 Road-holding position light — Location

A road-holding position light shall be located adjacent to the holding position marking 1.5 m (±0.5 m) from one edge of the road, i.e. left or right as appropriate to the local traffic regulations.

Note.— See 9.9 for the mass and height limitations and frangibility requirements of navigation aids located on runway strips.

5.3.28.4 Road-holding position light — Characteristics

The road-holding position light shall comprise:

a) a controllable red (stop)/green (go) traffic light; or

b) a flashing-red light.

Note.— It is intended that the lights specified in sub-paragraph a) be controlled by the air traffic services.

5.3.28.5 Road-holding position light — Characteristics (cont.)

The road-holding position light beam shall be unidirectional and aligned so as to be visible to the driver of a vehicle approaching the holding position.

5.3.28.6 Road-holding position light — Characteristics (cont.)

The intensity of the light beam shall be adequate for the conditions of visibility and ambient light in which the use of the holding position is intended, but shall not dazzle the driver.

Note.— The commonly used traffic lights are likely to meet the requirements in 5.3.28.5 and 5.3.28.6.

5.3.28.7 Road-holding position light — Characteristics (cont.)

The flash frequency of the flashing-red light shall be between 30 and 60 flashes per minute.

5.3.29 No-entry bar

Note.— Runway incursions may take place in all visibility or weather conditions. The use of no-entry bars can form part of effective runway incursion prevention measures.

5.3.29.1 No-entry bar — Application

A no-entry bar shall be provided across a taxiway which is intended to be used as an exit only taxiway to assist in preventing inadvertent access of traffic to that taxiway.

5.3.29.2 No-entry bar — Location

A no-entry bar shall be located across the taxiway at the end of an exit only taxiway where it is desired to prevent traffic from entering the taxiway in the wrong direction.

5.3.29.3 No-entry bar — Location (cont.)

A no-entry bar shall be collocated with a no-entry sign and/or a no-entry marking.

5.3.29.4 No-entry bar — Characteristics

A no-entry bar shall consist of unidirectional lights spaced at uniform intervals of no more than 3 m showing red in the intended direction(s) of approach to the runway.

Note.— Where necessary to enhance conspicuity, extra lights are installed uniformly.

5.3.29.5 No-entry bar — Characteristics (cont.)

A pair of elevated lights shall be added to each end of the no-entry bar where the in pavement no entry bar lights might be obscured from a pilot's view, for example, by snow or rain, or where a pilot may be required to stop the aircraft in a position so close to the lights that they are blocked from view by the structure of the aircraft.

5.3.29.6 No-entry bar — Characteristics (cont.)

The intensity in red light and beam spreads of no-entry bar lights shall be in accordance with the specifications in Appendix 2, Figures A2-12 through A2-16, as appropriate.

5.3.29.7 No-entry bar — Characteristics (cont.)

Where no-entry bars are specified as components of an advanced surface movement guidance and control system and where, from an operational point of view, higher intensities are required to maintain ground movements at a certain speed in very low visibilities or in bright daytime conditions, the intensity in red light and beam spreads of no-entry bar lights shall be in accordance with the specifications of Appendix 2, Figure A2-17, A2-18 or A2-19.

Note.— High-intensity no-entry bars are typically used only in case of an absolute necessity and following a specific study.

5.3.29.8 No-entry bar — Characteristics (cont.)

Where a wide beam fixture is required, the intensity in red light and beam spreads of no-entry bar lights shall be in accordance with the specifications of Appendix 2, Figure A2-17 or A2-19.

5.3.29.9 No-entry bar — Characteristics (cont.)

Taxiway centre line lights installed beyond the no-entry bar, looking in the direction of the runway, shall not be visible when viewed from the taxiway.

5.3.30 Runway status lights

Introductory Note.— Runway status lights (RWSL) is a type of autonomous runway incursion warning system (ARIWS). The two basic visual components of RWSL are runway entrance lights (RELs) and take-off hold lights (THLs). Either component may be installed by itself, but the two components are designed to be complementary to each other.

5.3.30.1 Runway status lights— Location

Where provided, RELs shall be offset 0.6 m from the taxiway centre line on the opposite side to the taxiway centre line lights and begin 0.6 m before the runway-holding position extending to the edge of the runway. An additional single light shall be placed on the runway 0.6 m from the runway centre line and aligned with the last two taxiway RELs.

Note.— Where two or more runway-holding positions are provided, the runway-holding position referred is that closest to the runway.

5.3.30.2 Runway status lights— Location (cont.)

RELs shall consist of at least five light units and shall be spaced at a minimum of 3.8 m and a maximum of 15.2 m longitudinally, depending upon the taxiway length involved, except for a single light installed near the runway centre line.

5.3.30.3 Runway status lights— Location (cont.)

Where provided, THLs shall be offset 1.8 m on each side of the runway centre line lights and extend, in pairs, starting at a point 115 m from the beginning of the runway and, thereafter, every 30 m for at least 450 m.

Note.— Additional THLs may be similarly provided at the starting point of the take-off roll.

5.3.30.4 Runway status lights— Characteristics

Where provided, RELs shall consist of a single line of fixed in pavement lights showing red in the direction of aircraft approaching the runway.

5.3.30.5 Runway status lights— Characteristics (cont.)

RELs shall illuminate as an array at each taxiway/runway intersection where they are installed less than two seconds after the system determines a warning is needed.

5.3.30.6 Runway status lights— Characteristics (cont.)

Intensity and beam spread of RELs shall be in accordance with the specifications of Appendix 2, Figures A2-12 and A2-14.

Note.— Consideration for reduced beam width may be required for some REL lights at acute angled runway/taxiway intersections to ensure the RELs are not visible to aircraft on the runway.

5.3.30.7 Runway status lights— Characteristics (cont.)

Where provided, THLs shall consist of two rows of fixed in pavement lights showing red facing the aircraft taking off.

5.3.30.8 Runway status lights— Characteristics (cont.)

THLs shall illuminate as an array on the runway less than two seconds after the system determines a warning is needed.

5.3.30.9 Runway status lights— Characteristics (cont.)

Intensity and beam spread of THLs shall be in accordance with the specifications of Appendix 2, Figure A2-26.

5.3.30.10 Runway status lights— Characteristics (cont.)

RELs and THLs shall be automated to the extent that the only control over each system will be to disable one or both systems.

5.4 Signs

5.4.1 General

Note.— Signs shall be either fixed message signs or variable message signs. Guidance on signs is contained in the Aerodrome Design Manual (Doc 9157), Part 4.

5.4.1.1 Signs — Application

Signs shall be provided to convey a mandatory instruction, information on a specific location or destination on a movement area or to provide other information to meet the requirements of 9.8.1.

Note.— See 5.2.17 for specifications on information marking.

5.4.1.2 Signs — Application (cont.)

A variable message sign shall be provided where:

a) the instruction or information displayed on the sign is relevant only during a certain period of time; and/or

b) there is a need for variable predetermined information to be displayed on the sign to meet the requirements of 9.8.1.

5.4.1.3 Signs — Characteristics

Signs shall be frangible. Those located near a runway or taxiway shall be sufficiently low to preserve clearance for propellers and the engine pods of jet aircraft. The installed height of the sign shall not exceed the dimension shown in the appropriate column of Table 5-5.

Table 5-5. Location distances for taxiing guidance signs including runway exit signs

Sign height (mm)				Perpendicular distance from defined taxiway pavement edge to near side of sign	Perpendicular distance from defined runway pavement edge to near side of sign
Code number	Legend	Face (min.)	Installed (max.)		
1 or 2	200	300	700	5- 11 m	3 -10 m
1 or 2	300	450	900	5 -11 m	3- 10 m
3 or 4	300	450	900	11-21 m	8-15 m
3 or 4	400	600	1100	11- 21 m	8-15 m

5.4.1.4 Signs — Characteristics (cont.)

Signs shall be rectangular, as shown in Figures 5-30 and 5-31 with the longer side horizontal.

5.4.1.5 Signs — Characteristics (cont.)

The only signs on the movement area utilizing red shall be mandatory instruction signs.

5.4.1.6 Signs — Characteristics (cont.)

The inscriptions on a sign shall be in accordance with the provisions of Appendix 4.

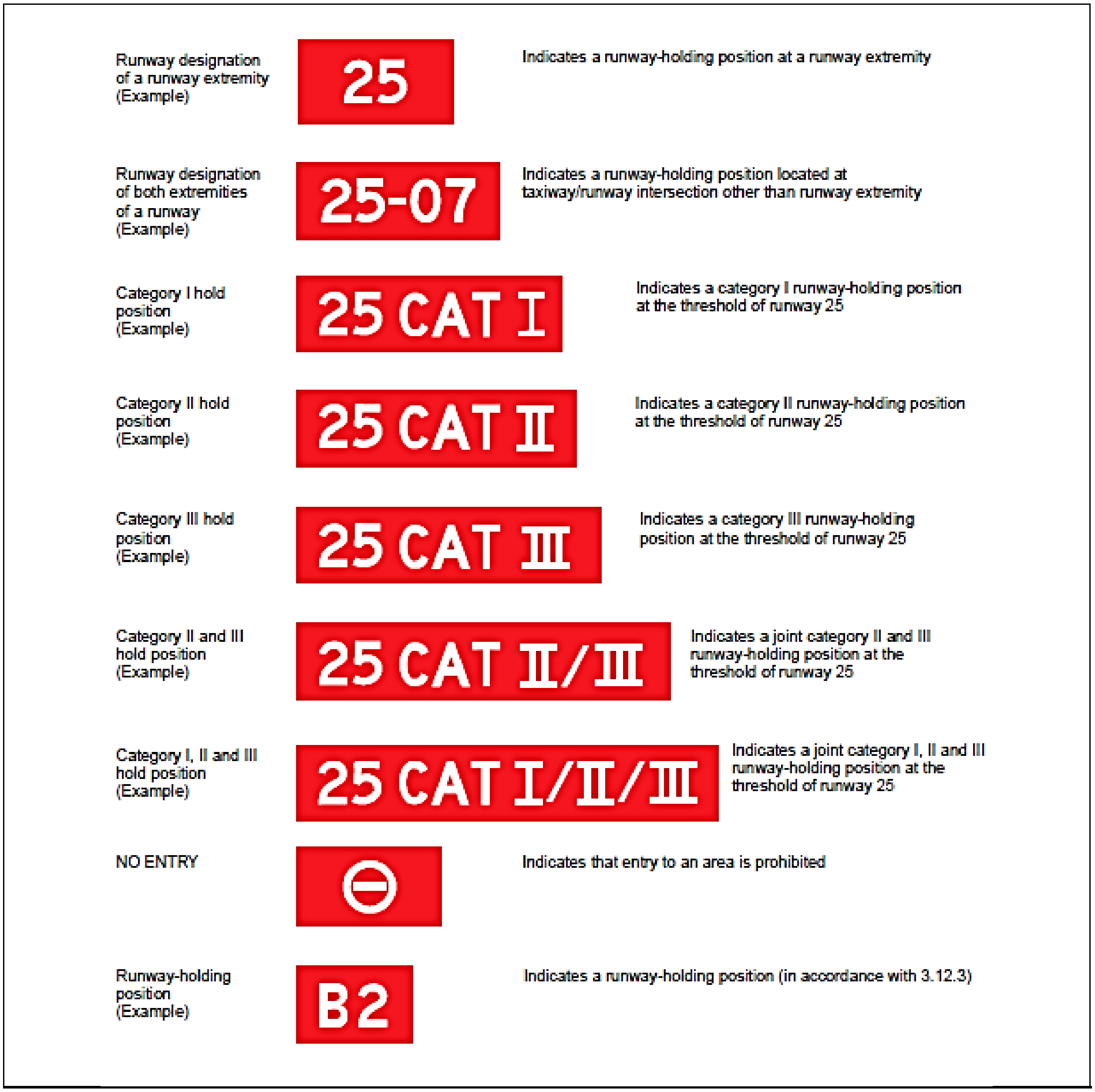


Figure 5-30. Mandatory instruction signs

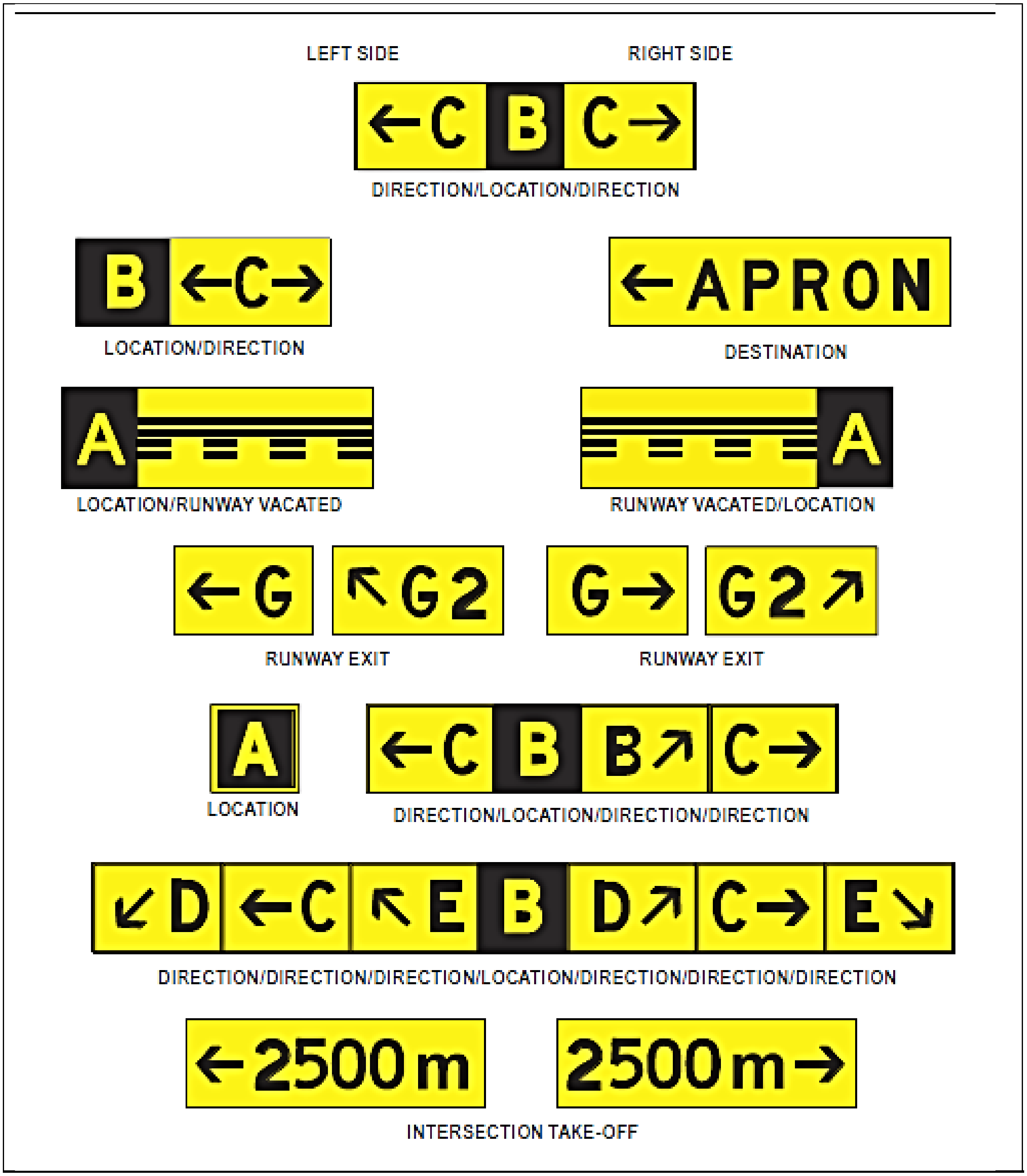


Figure 5-31. Information signs

5.4.1.7 Signs — Characteristics (cont.)

Signs shall be illuminated in accordance with the provisions of Appendix 4 when intended for use:

a) in runway visual range conditions less than a value of 800 m; or

b) at night in association with instrument runways; or

c) at night in association with non-instrument runways where the code number is 3 or 4.

5.4.1.8 Signs — Characteristics (cont.)

Signs shall be retroreflective and/or illuminated in accordance with the provisions of Appendix 4 when intended for use at night in association with non-instrument runways where the code number is 1 or 2.

5.4.1.9 Signs — Characteristics (cont.)

A variable message sign shall show a blank face when not in use.

5.4.1.10 Signs — Characteristics (cont.)

In case of failure, a variable message sign shall not provide information that could lead to unsafe action from a pilot or a vehicle driver.

5.4.1.11 Signs — Characteristics (cont.)

The time interval to change from one message to another on a variable message sign shall be as short as practicable and shall not exceed 5 seconds.

5.4.2 Mandatory instruction signs

Note.— See Figure 5-30 for pictorial representation of mandatory instruction signs and Figure 5-32 for examples of locating signs at taxiway/runway intersections.

5.4.2.1 Mandatory instruction sign— Application

A mandatory instruction sign shall be provided to identify a location beyond which an aircraft taxiing or vehicle shall not proceed unless authorized by the aerodrome control tower.

5.4.2.2 Mandatory instruction sign— Application (cont.)

Mandatory instruction signs shall include runway designation signs, category I, II or III holding position signs, runway-holding position signs, road-holding position signs and NO ENTRY signs.

Note.— See 5.4.7 for specifications on road-holding position signs.

5.4.2.3 Mandatory instruction sign— Application (cont.)

A pattern "A" runway-holding position marking shall be supplemented at a taxiway/runway intersection or a runway/runway intersection with a runway designation sign.

5.4.2.4 Mandatory instruction sign— Application (cont.)

A pattern "B" runway-holding position marking shall be supplemented with a category I, II or III holding position sign.

5.4.2.5 Mandatory instruction sign— Application (cont.)

A pattern "A" runway-holding position marking at a runway-holding position established in accordance with 3.12.3 shall be supplemented with a runway-holding position sign.

Note.— See 5.2.10 for specifications on runway-holding position marking.

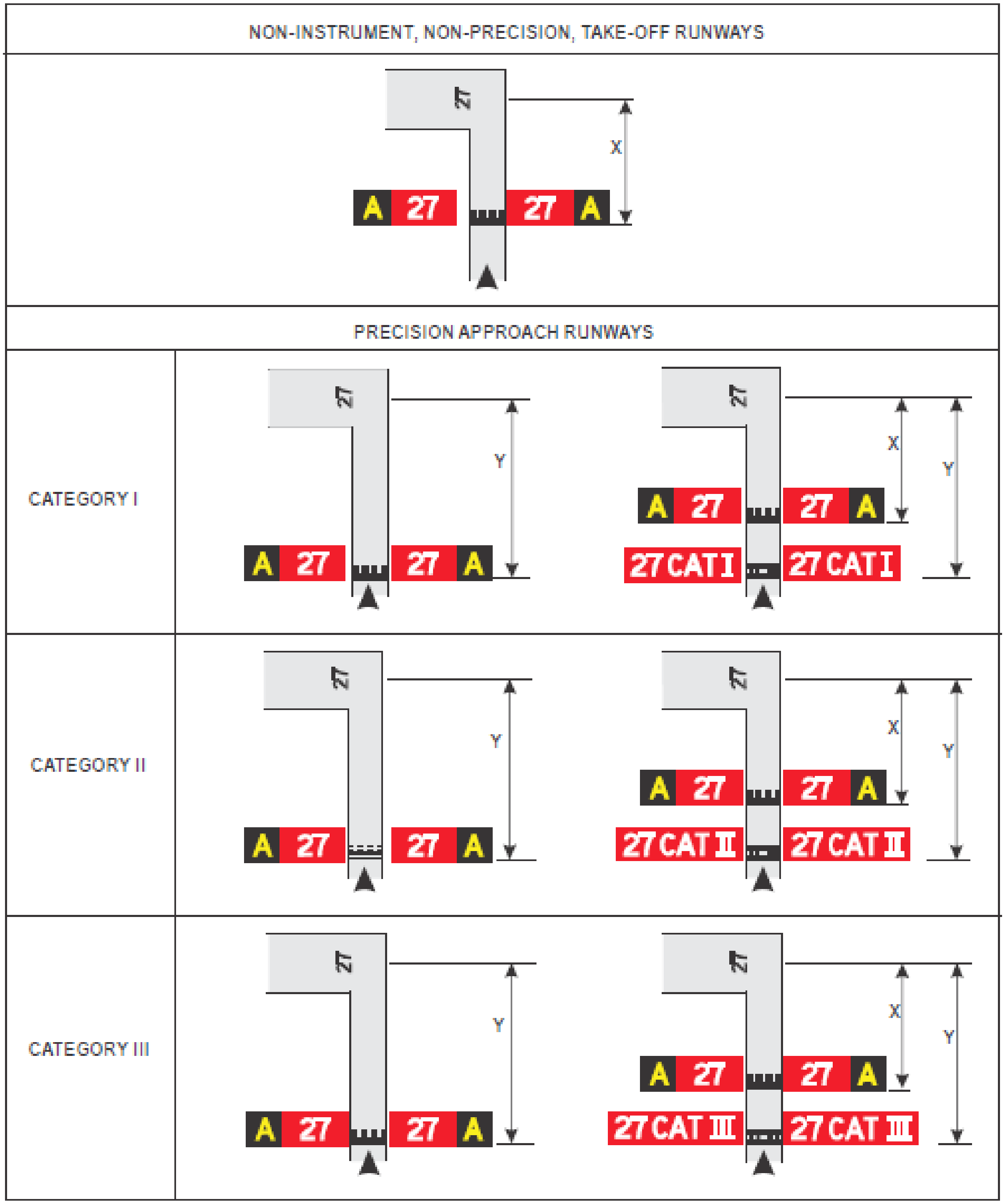
5.4.2.6 Mandatory instruction sign— Application (cont.)

A runway designation sign at a taxiway/runway intersection shall be supplemented with a location sign in the outboard (farthest from the taxiway) position, as appropriate.

Note.— See 5.4.3 for characteristics of location signs.

5.4.2.7 Mandatory instruction sign— Application (cont.)

A NO ENTRY sign shall be provided when entry into an area is prohibited.



Note.— Distance X is established in accordance with Table 3-2. Distance Y is established at the edge of the ILS/MLS critical/sensitive area.

Figure 5-32. Examples of sign positions at taxiway/runway intersections

5.4.2.8 Mandatory instruction sign — Location

A runway designation sign at a taxiway/runway intersection or a runway/runway intersection shall be located on each side of the runway-holding position marking facing the direction of approach to the runway.

5.4.2.9 Mandatory instruction sign— Location (cont.)

A category I, II or III holding position sign shall be located on each side of the runway-holding position marking facing the direction of the approach to the critical area.

5.4.2.10 Mandatory instruction sign— Location (cont.)

A NO ENTRY sign shall be located at the beginning of the area to which entrance is prohibited on each side of the taxiway as viewed by the pilot.

5.4.2.11 Mandatory instruction sign— Location (cont.)

A runway-holding position sign shall be located on each side of the runway-holding position established in accordance with 3.12.3, facing the approach to the obstacle limitation surface or ILS/MLS critical/sensitive area, as appropriate.

5.4.2.12 Mandatory instruction sign — Characteristics

A mandatory instruction sign shall consist of an inscription in white on a red background.

5.4.2.13 Mandatory instruction sign — Characteristics (cont.)

Where, owing to environmental or other factors, the conspicuity of the inscription on a mandatory instruction sign needs to be enhanced, the outside edge of the white inscription shall be supplemented by a black outline measuring 10 mm in width for runway code numbers 1 and 2, and 20 mm in width for runway code numbers 3 and 4.

5.4.2.14 Mandatory instruction sign — Characteristics (cont.)

The inscription on a runway designation sign shall consist of the runway designations of the intersecting runway properly oriented with respect to the viewing position of the sign, except that a runway designation sign installed in the vicinity of a runway extremity may show the runway designation of the concerned runway extremity only.

5.4.2.15 Mandatory instruction sign — Characteristics (cont.)

The inscription on a category I, II, III, joint II/III or joint I/II/III holding position sign shall consist of the runway designator followed by CAT I, CAT II, CAT III, CAT II/III or CAT I/II/III, as appropriate.

5.4.2.16 Mandatory instruction sign — Characteristics (cont.)

The inscription on a NO ENTRY sign shall be in accordance with Figure 5-30.

5.4.2.17 Mandatory instruction sign — Characteristics (cont.)

The inscription on a runway-holding position sign at a runway-holding position established in accordance with 3.12.3 shall consist of the taxiway designation and a number.

5.4.2.18 Mandatory instruction sign — Characteristics (cont.)

Where installed, the inscriptions/symbol of Figure 5-30 shall be used.

5.4.3 Information signs

Note.— See Figure 5-31 for pictorial representations of information signs.

5.4.3.1 Information signs — Application

An information sign shall be provided where there is an operational need to identify by a sign, a specific location, or routing (direction or destination) information.

5.4.3.2 Information signs — Application (cont.)

Information signs shall include: direction signs, location signs, destination signs, runway exit signs, runway vacated signs and intersection take-off signs.

5.4.3.3 Information signs — Application (cont.)

A runway exit sign shall be provided where there is an operational need to identify a runway exit.

5.4.3.4 Information signs — Application (cont.)

A runway vacated sign shall be provided where the exit taxiway is not provided with taxiway centre line lights and there is a need to indicate to a pilot leaving a runway the perimeter of the ILS/MLS critical/sensitive area or the lower edge of the inner transitional surface, whichever is farther from the runway centre line.

Note.— See 5.3.17 for specifications on colour coding taxiway centre line lights.

5.4.3.5 Information signs — Application (cont.)

An intersection take-off sign shall be provided when there is an operational need to indicate the remaining take-off run available (TORA) for intersection take-offs.

5.4.3.6 Information signs — Application (cont.)

Where necessary, a destination sign shall be provided to indicate the direction to a specific destination on the aerodrome, such as cargo area, general aviation, etc.

5.4.3.7 Information signs — Application (cont.)

A combined location and direction sign shall be provided when it is intended to indicate routing information prior to a taxiway intersection.

5.4.3.8 Information signs — Application (cont.)

A direction sign shall be provided when there is an operational need to identify the designation and direction of taxiways at an intersection.

5.4.3.9 Information signs — Application (cont.)

A location sign shall be provided at an intermediate holding position.

5.4.3.10 Information signs — Application (cont.)

A location sign shall be provided in conjunction with a runway designation sign except at a runway/runway intersection.

5.4.3.11 Information signs — Application (cont.)

A location sign shall be provided in conjunction with a direction sign, except that it may be omitted where an aeronautical study indicates that it is not needed.

5.4.3.12 Information signs — Application (cont.)

Where necessary, a location sign shall be provided to identify taxiways exiting an apron or taxiways beyond an intersection.

5.4.3.13 Information signs — Application (cont.)

Where a taxiway ends at an intersection such as a ''T'' and it is necessary to identify this, a barricade, direction sign and/or other appropriate visual aid shall be used.

5.4.3.14 Information signs — Location

Except as specified in 5.4.3.16 and 5.4.3.24 information signs shall, wherever practicable, be located on the left-hand side of the taxiway in accordance with Table 5-5.

5.4.3.15 Information signs — Location (cont.)

At a taxiway intersection, information signs shall be located prior to the intersection and in line with the intermediate holding position marking. Where there is no intermediate holding position marking, the signs shall be installed at least 60 m from the centre line of the intersecting taxiway where the code number is 3 or 4, and at least 40 m where the code number is 1 or 2.

Note.— A location sign installed beyond a taxiway intersection may be installed on either side of a taxiway.

5.4.3.16 Information signs — Location (cont.)

A runway exit sign shall be located on the same side of the runway as the exit is located (i.e. left or right) and positioned in accordance with Table 5-5.

5.4.3.18 Information signs — Location (cont.)

A runway vacated sign shall be located at least on one side of the taxiway. The distance between the sign and the centre line of a runway shall be not less than the greater of the following::

a) the distance between the centre line of the runway and the perimeter of the ILS/MLS critical/sensitive area; or

b) the distance between the centre line of the runway and the lower edge of the inner transitional surface.

5.4.3.19 Information signs — Location (cont.)

Where provided in conjunction with a runway vacated sign, the taxiway location sign shall be positioned outboard of the runway vacated sign.

5.4.3.20 Information signs — Location (cont.)

An intersection take-off sign shall be located at the left-hand side of the entry taxiway. The distance between the sign and the centre line of the runway shall be not less than 60 m where the code number is 3 or 4, and not less than 45 m where the code number is 1 or 2.

5.4.3.21 Information signs — Location (cont.)

A taxiway location sign installed in conjunction with a runway designation sign shall be positioned outboard of the runway designation sign.

5.4.3.22 Information signs — Location (cont.)

A destination sign shall not normally be collocated with a location or direction sign.

5.4.3.23 Information signs — Location (cont.)

An information sign other than a location sign shall not be collocated with a mandatory instruction sign.

5.4.3.24 Information signs — Location (cont.)

A direction sign, barricade and/or other appropriate visual aid used to identify a ‘‘T’’ intersection shall be located on the opposite side of the intersection facing the taxiway.

5.4.3.25 Information signs — Characteristics

An information sign other than a location sign shall consist of an inscription in black on a yellow background.

5.4.3.26 Information signs — Characteristics (cont.)

A location sign shall consist of an inscription in yellow on a black background and where it is a stand-alone sign shall have a yellow border.

5.4.3.27 Information signs — Characteristics (cont.)

The inscription on a runway exit sign shall consist of the designator of the exit taxiway and an arrow indicating the direction to follow.

5.4.3.28 Information signs — Characteristics (cont.)

The inscription on a runway vacated sign shall depict the pattern A runway-holding position marking as shown in Figure 5-31.

5.4.3.29 Information signs — Characteristics (cont.)

The inscription on an intersection take-off sign shall consist of a numerical message indicating the remaining take-off run available in metres plus an arrow, appropriately located and oriented, indicating the direction of the take-off as shown in Figure 5-31.

5.4.3.30 Information signs — Characteristics (cont.)

The inscription on a destination sign shall comprise an alpha, alphanumerical or numerical message identifying the destination plus an arrow indicating the direction to proceed as shown in Figure 5-31.

5.4.3.31 Information signs — Characteristics (cont.)

The inscription on a direction sign shall comprise an alpha or alphanumerical message identifying the taxiway(s) plus an arrow or arrows appropriately oriented as shown in Figure 5-31.

5.4.3.32 Information signs — Characteristics (cont.)

The inscription on a location sign shall comprise the designation of the location taxiway, runway or other pavement the aircraft is on or is entering and shall not contain arrows.

5.4.3.33 Information signs — Characteristics (cont.)

Where it is necessary to identify each of a series of intermediate holding positions on the same taxiway, the location sign shall consist of the taxiway designation and a number.

5.4.3.34 Information signs — Characteristics (cont.)

Where a location sign and direction signs are used in combination:

a) all direction signs related to left turns shall be placed on the left side of the location sign, and all direction signs related to right turns shall be placed on the right side of the location sign, except that where the junction consists of one intersecting taxiway, the location sign may alternatively be placed on the left-hand side;

b) the direction signs shall be placed such that the direction of the arrows departs increasingly from the vertical with increasing deviation of the corresponding taxiway;

c) an appropriate direction sign shall be placed next to the location sign where the direction of the location taxiway changes significantly beyond the intersection; and

d) adjacent direction signs shall be delineated by a vertical black line as shown in Figure 5-31.

5.4.3.35 Information signs — Characteristics (cont.)

A taxiway shall be identified by a designator that is used only once on an aerodrome and comprise a single letter, two letters, or a combination of a letter or letters followed by a number.

5.4.3.36 Information signs — Characteristics (cont.)

When designating taxiways, the use of words such as “inner” and “outer” shall be avoided wherever possible.

5.4.3.37 Information signs — Characteristics (cont.)

When designating taxiways, the letters I, O and X shall not be used to avoid confusion with the numerals 1 and 0, and the closed marking.

5.4.3.38 Information signs — Characteristics (cont.)

The use of numbers alone on the manoeuvring area shall be reserved for the designation of runways.

5.4.3.39 Information signs — Characteristics (cont.)

Apron stand designators shall not be the same as taxiway designators.

5.4.4 VOR aerodrome checkpoint sign

5.4.4.1 VOR aerodrome checkpoint sign — Application

When a VOR aerodrome checkpoint is established, it shall be indicated by a VOR aerodrome checkpoint marking and sign.

Note.— See 5.2.12 for VOR aerodrome checkpoint marking.

5.4.4.2 VOR aerodrome checkpoint sign — Location

A VOR aerodrome checkpoint sign shall be located as near as possible to the checkpoint and so that the inscriptions are visible from the cockpit of an aircraft properly positioned on the VOR aerodrome checkpoint marking.

5.4.4.3 VOR aerodrome checkpoint sign — Characteristics

A VOR aerodrome checkpoint sign shall consist of an inscription in black on a yellow background. alternatives shown in Figure 5-33 in which:

VOR	is an abbreviation identifying this as a VOR checkpoint;
116.3	is an example of the radio frequency of the VOR concerned;
147°	is an example of the VOR bearing, to the nearest degree, which shall be indicated at the VOR checkpoint; and
4.3	NM is an example of the distance in nautical miles to a DME collocated with the VOR concerned.

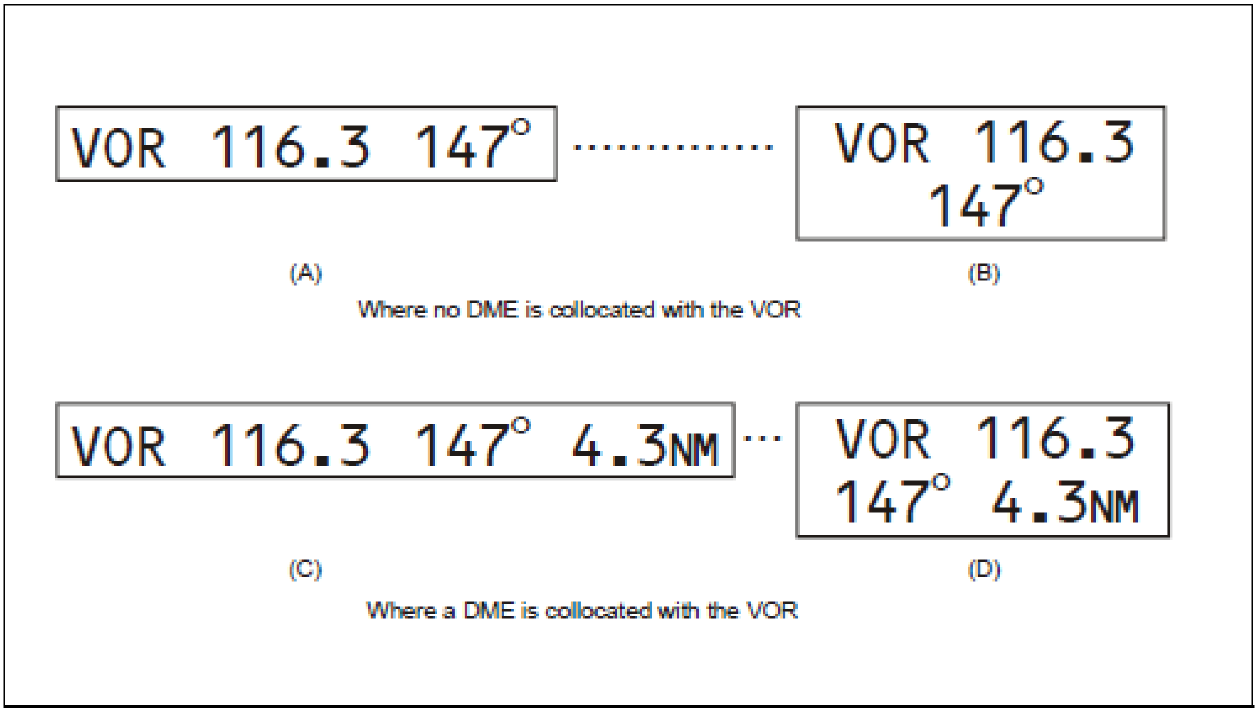


Figure 5-33. VOR aerodrome checkpoint sign

Note.— Tolerances for the bearing value shown on the sign are given in Annex 10, Volume I, Attachment E. It will be noted that a checkpoint can only be used operationally when periodic checks show it to be consistently within ±2 degrees of the stated bearing.

5.4.5 Aerodrome identification sign

5.4.5.1 Aerodrome identification sign — Application

An aerodrome identification sign shall be provided at an aerodrome where there is insufficient alternative means of visual identification.

5.4.5.2 Aerodrome identification sign — Location

The aerodrome identification sign shall be placed on the aerodrome so as to be legible, in so far as is practicable, at all angles above the horizontal.

5.4.5.3 Aerodrome identification sign — Characteristics

The aerodrome identification sign shall consist of the name of the aerodrome.

5.4.5.4 Aerodrome identification sign — Characteristics (cont.)

The colour selected for the sign shall give adequate conspicuity when viewed against its background.

5.4.5.5 Aerodrome identification sign — Characteristics (cont.)

The characters shall have a height of not less than 3 m.

5.4.6 Aircraft stand identification signs

5.4.6.1 Aircraft stand identification signs — Application

An aircraft stand identification marking shall be supplemented with an aircraft stand identification sign where feasible.

5.4.6.2 Aircraft stand identification signs — Location

An aircraft stand identification sign shall be located so as to be clearly visible from the cockpit of an aircraft prior to entering the aircraft stand.

5.4.6.3 Aircraft stand identification signs — Characteristics

An aircraft stand identification sign shall consist of an inscription in black on a yellow background.

5.4.7 Road-holding position sign

5.4.7.1 Road-holding position sign — Application

A road-holding position sign shall be provided at all road entrances to a runway.

5.4.7.2 Road-holding position sign — Location

The road-holding position sign shall be located 1.5 m from one edge of the road (left or right as appropriate to the local traffic regulations) at the holding position.

5.4.7.3 Road-holding position sign — Characteristics

A road-holding position sign shall consist of an inscription in white on a red background.

5.4.7.4 Road-holding position sign — Characteristics (cont.)

The inscription on a road-holding position sign shall be in the national language, be in conformity with the local traffic regulations and include the following:

a) a requirement to stop; and

b) where appropriate:

  1) a requirement to obtain ATC clearance; and

  2) location designator.

Note.— Examples of road-holding position signs are contained in the Aerodrome Design Manual (Doc 9157), Part 4.

5.4.7.5 Road-holding position sign — Characteristics (cont.)

A road-holding position sign intended for night use shall be retroreflective or illuminated.

5.5 Markers

5.5.1 General

5.5.1 General

Markers shall be frangible. Those located near a runway or taxiway shall be sufficiently low to preserve clearance for propellers and for the engine pods of jet aircraft.

Note 1.— Anchors or chains, to prevent markers which have broken from their mounting from blowing away, are sometimes used.

Note 2.— Guidance on frangibility of markers is given in the Aerodrome Design Manual (Doc 9157), Part 6.

5.5.2 Unpaved runway edge markers

5.5.2.1 Unpaved runway edge markers — Application

Markers shall be provided when the extent of an unpaved runway is not clearly indicated by the appearance of its surface compared with that of the surrounding ground.

5.5.2.2 Unpaved runway edge markers — Location

Where runway lights are provided, the markers shall be incorporated in the light fixtures. Where there are no lights, markers of flat rectangular or conical shape shall be placed so as to delimit the runway clearly.

5.5.2.3 Unpaved runway edge markers — Characteristics

The flat rectangular markers shall have a minimum size of 1 m by 3 m and shall be placed with their long dimension parallel to the runway centre line. The conical markers shall have a height not exceeding 50 cm.

5.5.3 Stopway edge markers

5.5.3.1 Stopway edge markers — Application

Stopway edge markers shall be provided when the extent of a stopway is not clearly indicated by its appearance compared with that of the surrounding ground.

5.5.3.2 Stopway edge markers — Characteristics

The stopway edge markers shall be sufficiently different from any runway edge markers used to ensure that the two types of markers cannot be confused.

Note.— Markers consisting of small vertical boards camouflaged on the reverse side, as viewed from the runway, have proved operationally acceptable.

5.5.4

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5.5.5 Taxiway edge markers

5.5.5.1 Taxiway edge markers — Application

Taxiway edge markers shall be provided on a taxiway where the code number is 1 or 2 and taxiway centre line or edge lights or taxiway centre line markers are not provided.

5.5.5.2 Taxiway edge markers — Location

Taxiway edge markers shall be installed at least at the same locations as would the taxiway edge lights had they been used.

5.5.5.3 Taxiway edge markers — Characteristics

A taxiway edge marker shall be retroreflective blue.

5.5.5.4 Taxiway edge markers — Characteristics (cont.)

The marked surface as viewed by the pilot shall be a rectangle and shall have a minimum viewing area of 150 cm2.

5.5.5.5 Taxiway edge markers — Characteristics (cont.)

Taxiway edge markers shall be frangible. Their height shall be sufficiently low to preserve clearance for propellers and for the engine pods of jet aircraft.

5.5.6 Taxiway centre line markers

5.5.6.1 Taxiway centre line markers— Application

Taxiway centre line markers shall be provided on a taxiway where the code number is 1 or 2 and taxiway centre line or edge lights or taxiway edge markers are not provided.

5.5.6.2 Taxiway centre line markers— Application (cont.)

Taxiway centre line markers shall be provided on a taxiway where the code number is 3 or 4 and taxiway centre line lights are not provided if there is a need to improve the guidance provided by the taxiway centre line marking.

5.5.6.3 Taxiway centre line markers— Location

Taxiway centre line markers shall be installed at least at the same location as would taxiway centre line lights had they been used.

Note.— See 5.3.17.12 for the spacing of taxiway centre line lights.

5.5.6.4 Taxiway centre line markers— Location (cont.)

Taxiway centre line markers shall normally be located on the taxiway centre line marking except that they may be offset by not more than 30 cm where it is not practicable to locate them on the marking.

5.5.6.5 Taxiway centre line markers — Characteristics

A taxiway centre line marker shall be retroreflective green.

5.5.6.6 Taxiway centre line markers — Characteristics (cont.)

The marked surface as viewed by the pilot shall be a rectangle and shall have a minimum viewing area of 20 cm^2.

5.5.6.7 Taxiway centre line markers — Characteristics (cont.)

Taxiway centre line markers shall be so designed and fitted as to withstand being run over by the wheels of an aircraft without damage either to the aircraft or to the markers themselves.

5.5.7 Unpaved taxiway edge markers

5.5.7.1 Unpaved taxiway edge markers — Application

Where the extent of an unpaved taxiway is not clearly indicated by its appearance compared with that of the surrounding ground, markers shall be provided.

5.5.7.2 Unpaved taxiway edge markers — Location

Where taxiway lights are provided, the markers shall be incorporated in the light fixtures. Where there are no lights, markers of conical shape shall be placed so as to delimit the taxiway clearly.

5.5.8 Boundary markers

5.5.8.1 Boundary markers — Application

Boundary markers shall be provided at an aerodrome where the landing area has no runway.

5.5.8.2 Boundary markers — Location

Boundary markers shall be spaced along the boundary of the landing area at intervals of not more than 200 m, if the type shown in Figure 5-34 is used, or approximately 90 m, if the conical type is used with a marker at any corner.

5.5.8.3 Boundary markers — Characteristics

Boundary markers shall be of a form similar to that shown in Figure 5-34, or in the form of a cone not less than 50 cm high and not less than 75 cm in diameter at the base. The markers shall be coloured to contrast with the background against which they will be seen. A single colour, orange or red, or two contrasting colours, orange and white or alternatively red and white, shall be used, except where such colours merge with the background.

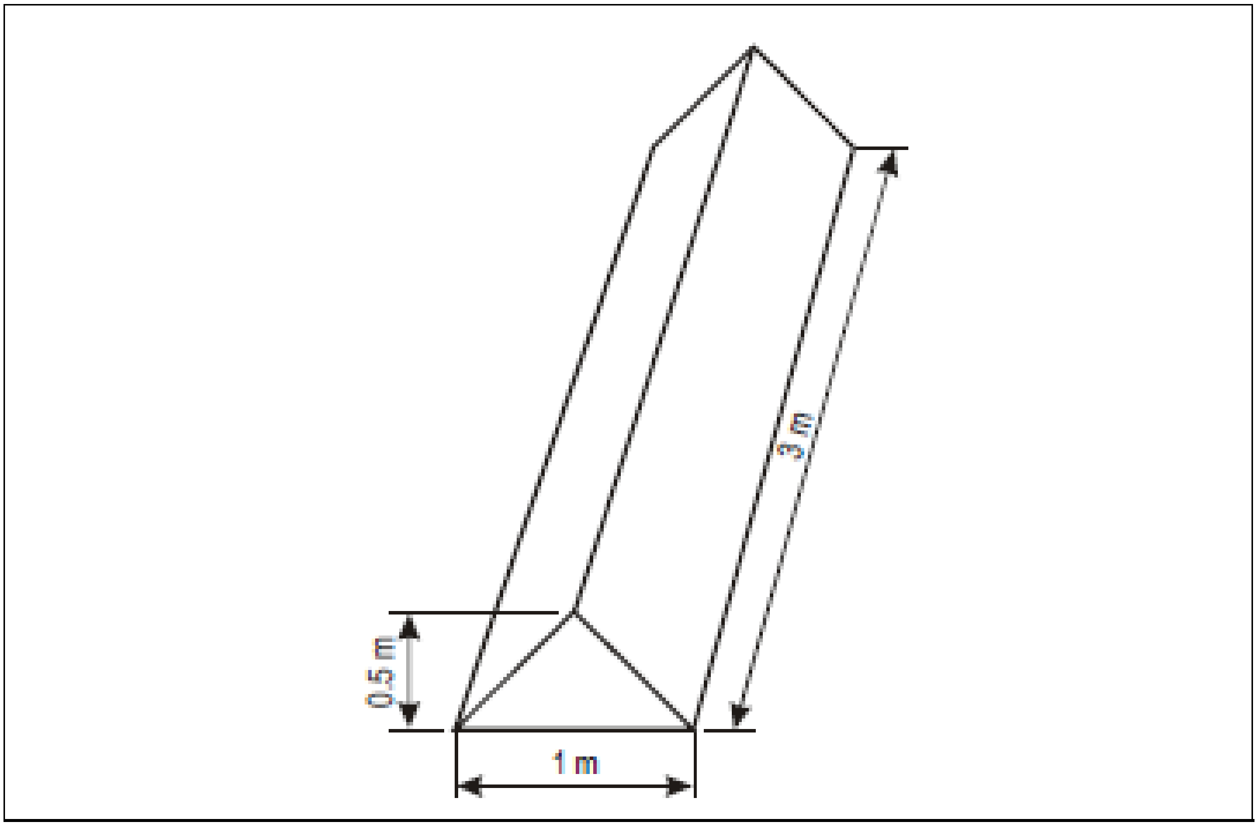

Figure 5-34. Boundary markers

CHAPTER 6. VISUAL AIDS FOR DENOTING OBSTACLES

6.1 Objects to be marked and/or lighted

Note 1.— The marking and/or lighting of obstacles is intended to reduce hazards to aircraft by indicating the presence of the obstacles. It does not necessarily reduce operating limitations which may be imposed by an obstacle.

Note 2.— An autonomous aircraft detection system may be installed on or near an obstacle (or group of obstacles such as wind farms), designed to operate the lighting only when the system detects an aircraft approaching the obstacle, in order to reduce light exposure to local residents. Guidance on the design and installation of an autonomous aircraft detection system is available in the Aerodrome Design Manual (Doc 9157), Part 4. The availability of such guidance is not intended to imply that such a system has to be provided.

6.1.1 Objects within the lateral boundaries of the obstacle limitation surfaces

6.1.1.1 Objects within the lateral boundaries of the obstacle limitation surfaces

Vehicles and other mobile objects, excluding aircraft, on the movement area of an aerodrome are obstacles and shall be marked and, if the vehicles and aerodrome are used at night or in conditions of low visibility, lighted, except that aircraft servicing equipment and vehicles used only on aprons may be exempt.

6.1.1.2 Objects within the lateral boundaries of the obstacle limitation surfaces (cont.)

Elevated aeronautical ground lights within the movement area shall be marked so as to be conspicuous by day. Obstacle lights shall not be installed on elevated ground lights or signs in the movement area.

6.1.1.3 Objects within the lateral boundaries of the obstacle limitation surfaces (cont.)

All obstacles within the distance specified in Table 3-1, column 11 or 12, from the centre line of a taxiway, an apron taxiway or aircraft stand taxilane shall be marked and, if the taxiway, apron taxiway or aircraft stand taxilane is used at night, lighted.

6.1.1.4 Objects within the lateral boundaries of the obstacle limitation surfaces (cont.)

A fixed obstacle that extends above a take-off climb surface within 3 000 m of the inner edge of the take-off climb surface shall be marked and, if the runway is used at night, lighted, except that:

a) such marking and lighting may be omitted when the obstacle is shielded by another fixed obstacle;

b) the marking may be omitted when the obstacle is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m;

c) the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day; and

d) the lighting may be omitted where the obstacle is a lighthouse and an aeronautical study indicates the lighthouse light to be sufficient.

6.1.1.5 Objects within the lateral boundaries of the obstacle limitation surfaces (cont.)

A fixed object, other than an obstacle, adjacent to a take-off climb surface shall be marked and, if the runway is used at night, lighted, if such marking and lighting is considered necessary to ensure its avoidance, except that the marking may be omitted when:

a) the object is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m; or

b) the object is lighted by high-intensity obstacle lights by day.

6.1.1.6 Objects within the lateral boundaries of the obstacle limitation surfaces (cont.)

A fixed obstacle that extends above an approach surface within 3 000 m of the inner edge or above a transitional surface shall be marked and, if the runway is used at night, lighted, except that:

a) such marking and lighting may be omitted when the obstacle is shielded by another fixed obstacle;

b) the marking may be omitted when the obstacle is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m;

c) the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day; and

d) the lighting may be omitted where the obstacle is a lighthouse and an aeronautical study indicates the lighthouse light to be sufficient.

6.1.1.7 Objects within the lateral boundaries of the obstacle limitation surfaces (cont.)

A fixed obstacle that extends above a horizontal surface shall be marked and, if the aerodrome is used at night, lighted, except that:

a) such marking and lighting may be omitted when:

  1) the obstacle is shielded by another fixed obstacle; or

  2) for a circuit extensively obstructed by immovable objects or terrain, procedures have been established to ensure safe vertical clearance below prescribed flight paths; or

  3) an aeronautical study shows the obstacle not to be of operational significance;

b) the marking may be omitted when the obstacle is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m;

c) the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day; and

d) the lighting may be omitted where the obstacle is a lighthouse and an aeronautical study indicates the lighthouse light to be sufficient.

6.1.1.8 Objects within the lateral boundaries of the obstacle limitation surfaces (cont.)

A fixed object that extends above an obstacle protection surface shall be marked and, if the runway is used at night, lighted.

Note.— See 5.3.5 for information on the obstacle protection surface.

6.1.1.9 Objects within the lateral boundaries of the obstacle limitation surfaces (cont.)

Other objects inside the obstacle limitation surfaces shall be marked and/or lighted if an aeronautical study indicates that the object could constitute a hazard to aircraft (this includes objects adjacent to visual routes e.g. waterway or highway).

Note.— See note accompanying 4.4.2.

6.1.1.10 Objects within the lateral boundaries of the obstacle limitation surfaces (cont.)

Overhead wires, cables, etc., crossing a river, waterway, valley or highway shall be marked and their supporting towers marked and lighted if an aeronautical study indicates that the wires or cables could constitute a hazard to aircraft.

6.1.2 Objects outside the lateral boundaries of the obstacle limitation surfaces

6.1.2.1 Objects outside the lateral boundaries of the obstacle limitation surfaces

Obstacles in accordance with 4.3.2 shall be marked and lighted, except that the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day.

6.1.2.2 Objects outside the lateral boundaries of the obstacle limitation surfaces (cont.)

Other objects outside the obstacle limitation surfaces shall be marked and/or lighted if an aeronautical study indicates that the object could constitute a hazard to aircraft (this includes objects adjacent to visual routes e.g. waterway, highway).

6.1.2.3 Objects outside the lateral boundaries of the obstacle limitation surfaces (cont.)

Overhead wires, cables, etc., crossing a river, waterway, valley or highway shall be marked and their supporting towers marked and lighted if an aeronautical study indicates that the wires or cables could constitute a hazard to aircraft.

6.2 Marking and/or lighting of objects

6.2.1 General

6.2.1.1 General

The presence of objects which must be lighted, as specified in 6.1, shall be indicated by low-, medium- or high intensity obstacle lights, or a combination of such lights.

6.2.1.2 General (cont.)

Low-intensity obstacle lights, Types A B, C, D and E, medium-intensity obstacle lights, Types A, B and C, high-intensity obstacle lights Type A and B, shall be in accordance with the specifications in Table 6-1 and Appendix 1.

6.2.1.3 General (cont.)

The number and arrangement of low-, medium- or high-intensity obstacle lights at each level to be marked shall be such that the object is indicated from every angle in azimuth. Where a light is shielded in any direction by another part of the object, or by an adjacent object, additional lights shall be provided on that adjacent object or the part of the object that is shielding the light, in such a way as to retain the general definition of the object to be lighted. If the shielded light does not contribute to the definition of the object to be lighted, it may be omitted.

6.2.2 Mobile objects

6.2.2.1 Mobile objects—Marking

All mobile objects to be marked shall be coloured or display flags.

6.2.2.2 Mobile objects—Marking by colour

When mobile objects are marked by colour, a single conspicuous colour, preferably red or yellowish green for emergency vehicles and yellow for service vehicles, shall be used.

6.2.2.3 Mobile objects— Marking by flags

Flags used to mark mobile objects shall be displayed around, on top of, or around the highest edge of the object. Flags shall not increase the hazard presented by the object they mark.

6.2.2.4 Mobile objects— Marking by flags (cont.)

Flags used to mark mobile objects shall not be less than 0.9 m on each side and shall consist of a chequered pattern, each square having sides of not less than 0.3 m. The colours of the pattern shall contrast each with the other and with the background against which they will be seen. Orange and white or alternatively red and white shall be used, except where such colours merge with the background.

Table 6-1. Characteristics of obstacle lights

1	2	3	4	5	6	7
			Peak intensity (cd) at given Background Luminance (b)			
Light Type	Colour	Signal type/ (flash rate)	Day (Above 500 cd/m²)	Twilight (50-500 cd/m²)	Night (Below 50 cd/m²)	Light Distribution Table
Low-intensity, Type A (fixed obstacle)	Red	Fixed	N/A	N/A	10	Table 6-2
Low-intensity, Type B (fixed obstacle)	Red	Fixed	N/A	N/A	32	Table 6-2
Low-intensity, Type C (mobile obstacle)	Yellow/Blue (a)	Flashing (60-90 fpm)	N/A	40	40	Table 6-2
Low-intensity, Type D (follow-me vehicle)	Yellow	Flashing (60-90 fpm)	N/A	200	200	Table 6-2
Low-intensity, Type E	Red	Flashing (c)	N/A	N/A	32	Table 6-2 (Type B)
Medium-intensity, Type A	White	Flashing (20–60 fpm)	20000	20000	2000	Table 6-3
Medium-intensity, Type B	Red	Flashing (20–60 fpm)	N/A	N/A	2000	Table 6-3
Medium-intensity, Type C	Red	Fixed	N/A	N/A	2000	Table 6-3
High-intensity, Type A	White	Flashing (40–60 fpm)	200000	20000	2000	Table 6-3
High-intensity, Type B	White	Flashing (40–60 fpm)	100000	20000	2000	Table 6-3

a)	See 6.2.2.6
b)	For flashing lights, effective intensity as determined in accordance with the Aerodrome Design Manual (Doc 9157), Part 4.
c)	For wind turbine application, to flash at the same rate as the lighting on the nacelle.

Table 6-2. Light distribution for low-intensity obstacle lights

	Minimum intensity (a)	Maximum intensity (a)	Vertical beam spread (f)	
			Minimum beam spread	Intensity
Type A	10 cd (b)	N/A	10°	5 cd
Type B	32 cd (b)	N/A	10°	16 cd
Type C	40 cd (b)	400 cd	12° (d)	20 cd
Type D	200 cd (b)	400 cd	N/A (e)	N/A

Note.— This table does not include recommended horizontal beam spreads. 6.2.1.3 requires 360° coverage around an obstacle. Therefore, the number of lights needed to meet this requirement will depend on the horizontal beam spreads of each light as well as the shape of the obstacle. Thus, with narrower beam spreads, more lights will be required.

a) 360° horizontal. For flashing lights, the intensity is read into effective intensity, as determined in accordance with the Aerodrome Design Manual (Doc 9157), Part 4.

b) Between 2 and 10° vertical. Elevation vertical angles are referenced to the horizontal when the light is levelled.

c) Between 2 and 20° vertical. Elevation vertical angles are referenced to the horizontal when the light is levelled.

d) Peak intensity shall be located at approximately 2.5° vertical.

e) Peak intensity shall be located at approximately 17° vertical.

f) Beam spread is defined as the angle between the horizontal plane and the directions for which the intensity exceeds that mentioned in the “intensity” column.

Table 6-3. Light distribution for medium- and high-intensity obstacle lights according to benchmark intensities of Table 6-1

Benchmark intensity	Minimum requirements					Recommendations				
	Vertical elevation angle (b)			Vertical beam spread (c)		Vertical elevation angle (b)			Vertical beam spread (c)	
	0°		-1°			0°	-1°	-10°		
	Minimum average intensity (a)	Minimum intensity (a)	Minimum intensity (a)	Minimum beam spread	Intensity (a)	Maximum intensity (a)	Maximum intensity (a)	Maximum intensity (a)	Maximum beam spread	Intensity (a)
200 000	200 000	150 000	75 000	3°	75 000	250 000	112 500	7 500	7°	75 000
100 000	100 000	75 000	37 500	3°	37 500	125 000	56 250	3 750	7°	37 500
20 000	20 000	15 000	7 500	3°	7 500	25 000	11 250	750	N/A	N/A
2 000	2 000	1 500	750	3°	750	2 500	1 125	75	N/A	N/A

Note.— This table does not include recommended horizontal beam spreads. 6.2.1.3 requires 360° coverage around an obstacle. Therefore, the number of lights needed to meet this requirement will depend on the horizontal beam spreads of each light as well as the shape of the obstacle. Thus, with narrower beam spreads, more lights will be required.

a) 360° horizontal. All intensities are expressed in Candela. For flashing lights, the intensity is read into effective intensity, as determined in accordance with the Aerodrome Design Manual (Doc 9157), Part 4.

b) Elevation vertical angles are referenced to the horizontal when the light unit is levelled.

c) Beam spread is defined as the angle between the horizontal plane and the directions for which the intensity exceeds that mentioned in the "intensity" column.

Note.— An extended beam spread may be necessary under specific configuration and justified by an aeronautical study.

6.2.2.5 Mobile objects— Lighting

Low-intensity obstacle lights, Type C, shall be displayed on vehicles and other mobile objects excluding aircraft.

Note.— See Annex 2 for lights to be displayed by aircraft.

6.2.2.6 Mobile objects— Lighting (cont.)

Low-intensity obstacle lights, Type C, displayed on vehicles associated with emergency or security shall be flashing-blue and those displayed on other vehicles shall be flashing-yellow.

6.2.2.7 Mobile objects— Lighting (cont.)

Low-intensity obstacle lights, Type D, shall be displayed on follow-me vehicles.

6.2.2.8 Mobile objects— Lighting (cont.)

Low-intensity obstacle lights on objects with limited mobility such as aerobridges shall be fixed-red, and as a minimum be in accordance with the specifications for low-intensity obstacle lights, Type A, in Table 6-1. The intensity of the lights shall be sufficient to ensure conspicuity considering the intensity of the adjacent lights and the general levels of illumination against which they would normally be viewed.

6.2.3 Fixed objects

Note.— The fixed objects of wind turbines are addressed separately in 6.2.4 and the fixed objects of overhead wires, cables, etc., and supporting towers are addressed separately in 6.2.5.

6.2.3.1 Fixed objects— Marking

All fixed objects to be marked shall, whenever practicable, be coloured, but if this is not practicable, markers or flags shall be displayed on or above them, except that objects that are sufficiently conspicuous by their shape, size or colour need not be otherwise marked.

6.2.3.2 Fixed objects— Marking by colour

An object shall be coloured to show a chequered pattern if it has essentially unbroken surfaces and its projection on any vertical plane equals or exceeds 4.5 m in both dimensions. The pattern shall consist of rectangles of not less than 1.5 m and not more than 3 m on a side, the corners being of the darker colour. The colours of the pattern shall contrast each with the other and with the background against which they will be seen. Orange and white or alternatively red and white shall be used, except where such colours merge with the background. (See Figure 6-1.)

6.2.3.3 Fixed objects— Marking by colour (cont.)

An object shall be coloured to show alternating contrasting bands if:

a) it has essentially unbroken surfaces and has one dimension, horizontal or vertical, greater than 1.5 m, and the other dimension, horizontal or vertical, less than 4.5 m; or

b) it is of skeletal type with either a vertical or a horizontal dimension greater than 1.5 m.

The bands shall be perpendicular to the longest dimension and have a width approximately 1/7 of the longest dimension or 30 m, whichever is less. The colours of the bands shall contrast with the background against which they will be seen. Orange and white shall be used, except where such colours are not conspicuous when viewed against the background. The bands on the extremities of the object shall be of the darker colour. (See Figures 6-1 and 6-2.)

Note.— Table 6-4 shows a formula for determining band widths and for having an odd number of bands, thus permitting both the top and bottom bands to be of the darker colour.

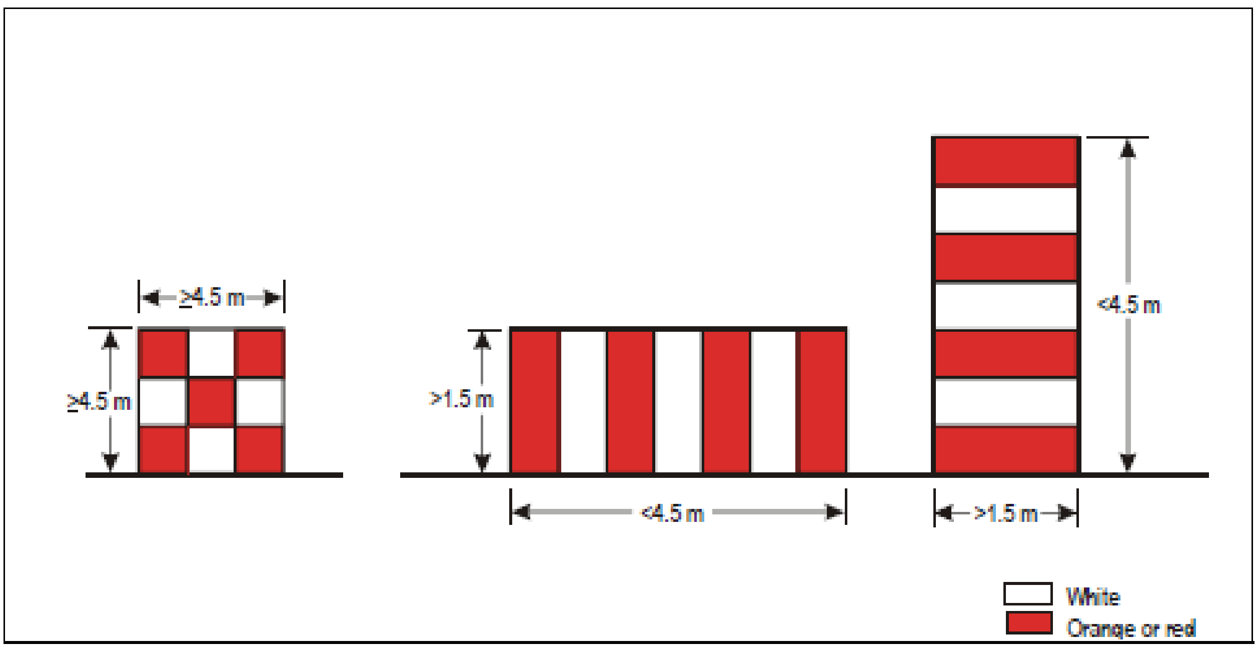

Figure 6-1. Basic marking patterns

Table 6-4. Marking band widths

Longest dimension		Band width
Greater than	Not exceeding	
1.5 m	210 m	1/7 of longest dimension
210 m	270 m	1/9 ″ ″ ″
270 m	330 m	1/11 ″ ″ ″
330 m	390 m	1/13 ″ ″ ″
390 m	450 m	1/15 ″ ″ ″
450 m	510 m	1/17 ″ ″ ″
510 m	570 m	1/19 ″ ″ ″
570 m	630 m	1/21 ″ ″ ″

6.2.3.4 Fixed objects— Marking by colour (cont.)

An object shall be coloured in a single conspicuous colour if its projection on any vertical plane has both dimensions less than 1.5 m. Orange or red shall be used, except where such colours merge with the background.

Note.— Against some backgrounds it may be found necessary to use a different colour from orange or red to obtain sufficient contrast.

6.2.3.5 Fixed objects — Marking by flags

Flags used to mark fixed objects shall be displayed around, on top of, or around the highest edge of, the object. When flags are used to mark extensive objects or groups of closely spaced objects, they shall be displayed at least every 15 m.

Flags shall not increase the hazard presented by the object they mark.

6.2.3.6 Fixed objects — Marking by flags (cont.)

Flags used to mark fixed objects shall not be less than 0.6 m on each side.

6.2.3.7 Fixed objects — Marking by flags (cont.)

Flags used to mark fixed objects shall be orange in colour or a combination of two triangular sections, one orange and the other white, or one red and the other white, except that where such colours merge with the background, other conspicuous colours shall be used.

6.2.3.8 Fixed objects — Marking by markers

Markers displayed on or adjacent to objects shall be located in conspicuous positions so as to retain the general definition of the object and shall be recognizable in clear weather from a distance of at least 1 000 m for an object to be viewed from the air and 300 m for an object to be viewed from the ground in all directions in which an aircraft is likely to approach the object. The shape of markers shall be distinctive to the extent necessary to ensure that they are not mistaken for markers employed to convey other information, and they shall be such that the hazard presented by the object they mark is not increased.

6.2.3.9 Fixed objects — Marking by markers (cont.)

A marker shall be of one colour. When installed, white and red, or white and orange markers shall be displayed alternately. The colour selected shall contrast with the background against which it will be seen.

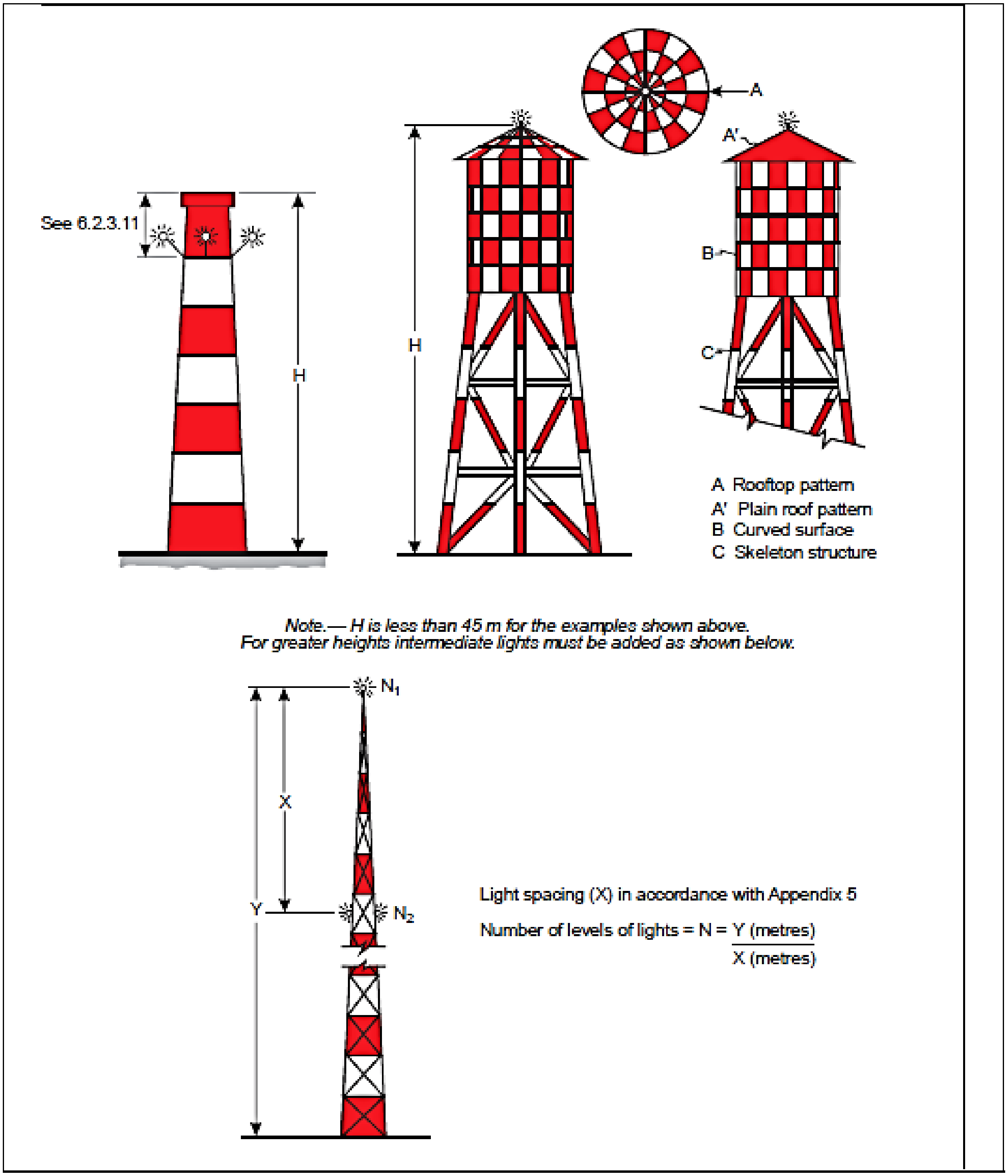

Figure 6-2. Examples of marking and lighting of tall structures

6.2.3.10 Fixed objects — Lighting

In the case of an object to be lighted, one or more low-, medium- or high-intensity obstacle lights shall be located as close as practicable to the top of the object.

Note.— Recommendations on how a combination of low-, medium- and/or high-intensity lights on obstacles should be displayed are given in Appendix 5.

6.2.3.11 Fixed objects — Lighting (cont.)

In the case of chimney or other structure of like function, the top lights shall be placed sufficiently below the top so as to minimize contamination by smoke, etc. (See Figure 6-2).

6.2.3.12 Fixed objects — Lighting (cont.)

In the case of a tower or antenna structure indicated by high-intensity obstacle lights by day with an appurtenance, such as a rod or an antenna, greater than 12 m where it is not practicable to locate a high-intensity obstacle light on the top of the appurtenance, such a light shall be located at the highest practicable point and, if practicable, a medium-intensity obstacle light, Type A, mounted on the top.

6.2.3.13 Fixed objects — Lighting (cont.)

In the case of an extensive object or of a group of closely spaced objects to be lighted that are:

a) penetrating a horizontal obstacle limitation surface (OLS) or located outside an OLS, the top lights shall be so arranged as to at least indicate the points or edges of the object highest in relation to the obstacle limitation surface or above the ground, and so as to indicate the general definition and the extent of the objects; and

b) penetrating a sloping OLS, the top lights shall be so arranged as to at least indicate the points or edges of the object highest in relation to the OLS, and so as to indicate the general definition and the extent of the objects. If two or more edges are of the same height, the edge nearest the landing area shall be marked.

6.2.3.14 Fixed objects — Lighting (cont.)

When the obstacle limitation surface concerned is sloping and the highest point above the OLS is not the highest point of the object, additional obstacle lights shall be placed on the highest point of the object.

6.2.3.15 Fixed objects — Lighting (cont.)

Where lights are applied to display the general definition of an extensive object or a group of closely spaced objects, and

a) low-intensity lights are used, they shall be spaced at longitudinal intervals not exceeding 45 m; and

b) medium-intensity lights are used, they shall be spaced at longitudinal intervals not exceeding 900 m.

6.2.3.16 Fixed objects — Lighting (cont.)

High-intensity obstacle lights, Type A, and medium-intensity obstacle lights, Types A and B, located on an object shall flash simultaneously.

6.2.3.17 Fixed objects — Lighting (cont.)

The installation setting angles for high-intensity obstacle lights, Type A, shall be in accordance with Table 6-5.

Note.— High-intensity obstacle lights are intended for day use as well as night use. Care is needed to ensure that these lights do not create disconcerting dazzle. Guidance on the design, location and operation of high-intensity obstacle lights is given in the Aerodrome Design Manual (Doc 9157), Part 4.

6.2.3.18 Fixed objects — Lighting (cont.)

Where, in the opinion of the appropriate authority, the use of high-intensity obstacle lights, Type A, or medium-intensity obstacle lights, Type A, at night may dazzle pilots in the vicinity of an aerodrome (within approximately 10 000 m radius) or cause significant environmental concerns, a dual obstacle lighting system shall be provided. This system shall be composed of high-intensity obstacle lights, Type A, or medium-intensity obstacle lights, Type A, as appropriate, for daytime and twilight use and medium-intensity obstacle lights, Type B or C, for night-time use.

6.2.3.19 Fixed objects — Lighting of objects with a height less than 45 m above ground level

Low-intensity obstacle lights, Type A or B, shall be used where the object is a less extensive one and its height above the surrounding ground is less than 45 m.

6.2.3.20 Fixed objects — Lighting of objects with a height less than 45 m above ground level (cont.)

Where the use of low-intensity obstacle lights, Type A or B, would be inadequate or an early special warning is required, then medium- or high-intensity obstacle lights shall be used.

6.2.3.21 Fixed objects — Lighting of objects with a height less than 45 m above ground level (cont.)

Low-intensity obstacle lights, Type B, shall be used either alone or in combination with medium-intensity obstacle lights, Type B, in accordance with 6.2.3.22.

6.2.3.22 Fixed objects — Lighting of objects with a height less than 45 m above ground level (cont.)

Medium-intensity obstacle lights, Type A, B or C, shall be used where the object is an extensive one. Medium-intensity obstacle lights, Types A and C, shall be used alone, whereas medium-intensity obstacle lights, Type B, shall be used either alone or in combination with low-intensity obstacle lights, Type B.

Note.— A group of buildings is regarded as an extensive object.

6.2.3.23 Fixed objects — Lighting of objects with a height 45 m to a height less than 150 m above ground level

Medium-intensity obstacle lights, Type A, B or C, shall be used. Medium-intensity obstacle lights, Types A and C, shall be used alone, whereas medium-intensity obstacle lights, Type B, shall be used either alone or in combination with low-intensity obstacle lights, Type B.

6.2.3.24 Fixed objects — Lighting of objects with a height 45 m to a height less than 150 m above ground level (cont.)

Where an object is indicated by medium-intensity obstacle lights, Type A, and the top of the object is more than 105 m above the level of the surrounding ground or the elevation of tops of nearby buildings (when the object to be marked is surrounded by buildings), additional lights shall be provided at intermediate levels. These additional intermediate lights shall be spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 105 m.

6.2.3.25 Fixed objects — Lighting of objects with a height 45 m to a height less than 150 m above ground level (cont.)

Where an object is indicated by medium-intensity obstacle lights, Type B, and the top of the object is more than 45 m above the level of the surrounding ground or the elevation of tops of nearby buildings (when the object to be marked is surrounded by buildings), additional lights shall be provided at intermediate levels. These additional intermediate lights shall be alternately low-intensity obstacle lights, Type B, and medium-intensity obstacle lights, Type B, and shall be spaced as equally as practicable between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 52 m.

6.2.3.26 Fixed objects — Lighting of objects with a height 45 m to a height less than 150 m above ground level (cont.)

Where an object is indicated by medium-intensity obstacle lights, Type C, and the top of the object is more than 45 m above the level of the surrounding ground or the elevation of tops of nearby buildings (when the object to be marked is surrounded by buildings), additional lights shall be provided at intermediate levels. These additional intermediate lights shall be spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 52 m.

6.2.3.27 Fixed objects — Lighting of objects with a height 45 m to a height less than 150 m above ground level (cont.)

Where high-intensity obstacle lights, Type A, are used, they shall be spaced at uniform intervals not exceeding 105 m between the ground level and the top light(s) specified in 6.2.3.10, except that where an object to be marked is surrounded by buildings, the elevation of the tops of the buildings may be used as the equivalent of the ground level when determining the number of light levels.

6.2.3.28 Fixed objects — Lighting of objects with a height 150 m or more above ground level

High-intensity obstacle lights, Type A, shall be used to indicate the presence of an object if its height above the level of the surrounding ground exceeds 150 m and an aeronautical study indicates such lights to be essential for the recognition of the object by day.

6.2.3.29 Fixed objects — Lighting of objects with a height 150 m or more above ground level (cont.)

Where high-intensity obstacle lights, Type A, are used, they shall be spaced at uniform intervals not exceeding 105 m between the ground level and the top light(s) specified in 6.2.3.10, except that where an object to be marked is surrounded by buildings, the elevation of the tops of the buildings may be used as the equivalent of the ground level when determining the number of light levels.

6.2.3.30 Fixed objects — Lighting of objects with a height 150 m or more above ground level (cont.)

Where, in the opinion of the authority, the use of high-intensity obstacle lights, Type A, at night may dazzle pilots in the vicinity of an aerodrome (within approximately 10 000 m radius) or cause significant environmental concerns, medium-intensity obstacle lights, Type C, shall be used alone, whereas medium intensity obstacle lights, Type B, shall be used either alone or in combination with low-intensity obstacle lights, Type B.

6.2.3.31 Fixed objects — Lighting of objects with a height 150 m or more above ground level (cont.)

Where an object is indicated by medium-intensity obstacle lights, Type A, additional lights shall be provided at intermediate levels. These additional intermediate lights shall be spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 105 m.

6.2.3.32 Fixed objects — Lighting of objects with a height 150 m or more above ground level (cont.)

Where an object is indicated by medium-intensity obstacle lights, Type B, additional lights shall be provided at intermediate levels. These additional intermediate lights shall be alternately low-intensity obstacle lights, Type B, and medium-intensity obstacle lights, Type B, and shall be spaced as equally as practicable between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 52 m.

6.2.3.33 Fixed objects — Lighting of objects with a height 150 m or more above ground level (cont.)

Where an object is indicated by medium-intensity obstacle lights, Type C, additional lights shall be provided at intermediate levels. These additional intermediate lights shall be spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 52 m.

6.2.4 Wind turbines

6.2.4.1 Wind turbines

When considered as an obstacle a wind turbine shall be marked and/or lighted.

Note 1.— Additional lighting or markings may be provided where in the opinion of the Authority such lighting or markings are deemed necessary.

Note 2.— See 4.3.2.

6.2.4.2 Wind turbines — Markings

The rotor blades, nacelle and upper 2/3 of the supporting mast of wind turbines shall be painted white, unless otherwise indicated by an aeronautical study.

6.2.4.3 Wind turbines — Lighting

When lighting is deemed necessary, in the case of a wind farm, i.e. a group of two or more wind turbines, the wind farm shall be regarded as an extensive object and the lights shall be installed:

a) to identify the perimeter of the wind farm;

b) respecting the maximum spacing, in accordance with 6.2.3.15, between the lights along the perimeter, unless a dedicated assessment shows that a greater spacing can be used;

c) so that, where flashing lights are used, they flash simultaneously throughout the wind farm;

d) so that, within a wind farm, any wind turbines of significantly higher elevation are also identified wherever they are located; and

e) at locations prescribed in a), b) and d), respecting the following criteria:

   i) for wind turbines of less than 150 m in overall height (hub height plus vertical blade height), medium-intensity lighting on the nacelle shall be provided;

   ii) for wind turbines from 150 m to 315 m in overall height, in addition to the medium-intensity light installed on the nacelle, a second light serving as an alternate shall be provided in case of failure of the operating light. The lights shall be installed to assure that the output of either light is not blocked by the other; and

   iii) in addition, for wind turbines from 150 m to 315 m in overall height, an intermediate level at half the nacelle height of at least three low-intensity Type E lights, as specified in 6.2.1.3, shall be provided. If an aeronautical study shows that low-intensity Type E lights are not suitable, low-intensity Type A or B lights may be used.

Note.— The above 6.2.4.3 e) does not address wind turbines of more than 315 m of overall height. For such wind turbines, additional marking and lighting may be required as determined by an aeronautical study.

6.2.4.4 Wind turbines — Lighting (cont.)

The obstacle lights shall be installed on the nacelle in such a manner as to provide an unobstructed view for aircraft approaching from any direction.

6.2.4.5 Wind turbines — Lighting (cont.)

Where lighting is deemed necessary for a single wind turbine or short line of wind turbines, the installation shall be in accordance with 6.2.4.3 e) or as determined by an aeronautical study.

6.2.5 Overhead wires, cables, etc., and supporting towers

6.2.5.1 Overhead wires, cables, etc., and supporting towers — Marking

The wires, cables, etc., to be marked shall be equipped with markers; the supporting tower shall be coloured.

6.2.5.2 Overhead wires, cables, etc., and supporting towers — Marking by colours

The supporting towers of overhead wires, cables, etc., that require marking shall be marked in accordance with 6.2.3.1 to 6.2.3.4, except that the marking of the supporting towers may be omitted when they are lighted by high-intensity obstacle lights by day.

6.2.5.3 Overhead wires, cables, etc., and supporting towers — Marking by markers

Markers displayed on or adjacent to objects shall be located in conspicuous positions so as to retain the general definition of the object and shall be recognizable in clear weather from a distance of at least 1 000 m for an object to be viewed from the air and 300 m for an object to be viewed from the ground in all directions in which an aircraft is likely to approach the object. The shape of markers shall be distinctive to the extent necessary to ensure that they are not mistaken for markers employed to convey other information, and they shall be such that the hazard presented by the object they mark is not increased.

6.2.5.4 Overhead wires, cables, etc., and supporting towers — Marking by markers (cont.)

A marker displayed on an overhead wire, cable, etc., shall be spherical and have a diameter of not less than 60 cm.

6.2.5.5 Overhead wires, cables, etc., and supporting towers — Marking by markers (cont.)

The spacing between two consecutive markers or between a marker and a supporting tower shall be appropriate to the diameter of the marker, but in no case shall the spacing exceed:

a) 30 m where the marker diameter is 60 cm progressively increasing with the diameter of the marker to

b) 35 m where the marker diameter is 80 cm and further progressively increasing to a maximum of

c) 40 m where the marker diameter is of at least 130 cm.

Where multiple wires, cables, etc., are involved, a marker shall be located not lower than the level of the highest wire at the point marked.

6.2.5.6 Overhead wires, cables, etc., and supporting towers — Marking by markers (cont.)

A marker shall be of one colour. When installed, white and red, or white and orange markers shall be displayed alternately. The colour selected shall contrast with the background against which it will be seen.

6.2.5.7 Overhead wires, cables, etc., and supporting towers — Marking by markers (cont.)

When it has been determined that an overhead wire, cable, etc., needs to be marked but it is not practicable to install markers on the wire, cable, etc., then high-intensity obstacle lights, Type B, shall be provided on their supporting towers.

6.2.5.8 Overhead wires, cables, etc., and supporting towers — Lighting

High-intensity obstacle lights, Type B, shall be used to indicate the presence of a tower supporting overhead wires, cables, etc., where:

a) an aeronautical study indicates such lights to be essential for the recognition of the presence of wires, cables, etc.;

or

b) it has not been found practicable to install markers on the wires, cables, etc.

6.2.5.9 Overhead wires, cables, etc., and supporting towers — Lighting (cont.)

Where high-intensity obstacle lights, Type B, are used, they shall be located at three levels:

— at the top of the tower;

— at the lowest level of the catenary of the wires or cables; and

— at approximately midway between these two levels.

Note.— In some cases, this may require locating the lights off the tower.

6.2.5.10 Overhead wires, cables, etc., and supporting towers — Lighting (cont.)

High-intensity obstacle lights, Type B, indicating the presence of a tower supporting overhead wires, cables, etc., shall flash sequentially; first the middle light, second the top light and last, the bottom light. The intervals between flashes of the lights shall approximate the following ratios:

Flash interval between	Ratio of cycle time
middle and top light	1/13
top and bottom light	2/13
bottom and middle light	10/13.

Note.— High-intensity obstacle lights are intended for day use as well as night use. Care is needed to ensure that these lights do not create disconcerting dazzle. Guidance on the design, operation and the location of high-intensity obstacle lights is given in the Aerodrome Design Manual (Doc 9157), Part 4.

6.2.5.11 Overhead wires, cables, etc., and supporting towers — Lighting (cont.)

Where, in the opinion of the authority, the use of high-intensity obstacle lights, Type B, at night may dazzle pilots in the vicinity of an aerodrome (within approximately 10 000 m radius) or cause significant environmental concerns, a dual obstacle lighting system shall be provided. This system shall be composed of high-intensity obstacle lights, Type B, for daytime and twilight use and medium-intensity obstacle lights, Type B, for nighttime use. Where medium-intensity lights are used they shall be installed at the same level as the high-intensity obstacle light Type B.

6.2.5.12 Overhead wires, cables, etc., and supporting towers — Lighting (cont.)

The installation setting angles for high-intensity obstacle lights, Type B, shall be in accordance with Table 6-5.

Table 6-5. Installation setting angles for high-intensity obstacle lights

Height of light unit above terrain (AGL)		Angle of the peak of the beam above the horizontal
Greater than	Not exceeding	
151 m		0°
122 m	151 m	1°
92 m	122 m	2°
	92 m	3°

CHAPTER 7. VISUAL AIDS FOR DENOTING RESTRICTED USE AREAS

7.1 Closed runways and taxiways, or parts thereof

7.1.1 Closed runways and taxiways, or parts thereof — Application

A closed marking shall be displayed on a runway or taxiway or portion thereof which is permanently closed to the use of all aircraft.

7.1.2 Closed runways and taxiways, or parts thereof — Application (cont.)

A closed marking shall be displayed on a temporarily closed runway or taxiway or portion thereof, except that such marking may be omitted when the closing is of short duration and adequate warning by air traffic services is provided.

7.1.3 Closed runways and taxiways, or parts thereof — Location

On a runway a closed marking shall be placed at each end of the runway, or portion thereof, declared closed, and additional markings shall be so placed that the maximum interval between markings does not exceed 300 m. On a taxiway a closed marking shall be placed at least at each end of the taxiway or portion thereof closed.

7.1.4 Closed runways and taxiways, or parts thereof — Characteristics

The closed marking shall be of the form and proportions as detailed in Figure 7-1, Illustration a), when displayed on a runway, and shall be of the form and proportions as detailed in Figure 7-1, Illustration b), when displayed on a taxiway. The marking shall be white when displayed on a runway and shall be yellow when displayed on a taxiway.

Note 1.— When an area is temporarily closed, frangible barriers or markings utilizing materials other than paint or other suitable means may be used to identify the closed area.

Note 2.— Procedures pertaining to the planning, coordination, monitoring and safety management of works in progress on the movement area are specified in the PANS-Aerodromes (Doc 9981).

7.1.5 Closed runways and taxiways, or parts thereof — Characteristics (cont.)

When a runway or taxiway or portion thereof is permanently closed, all normal runway and taxiway markings shall be obliterated.

7.1.6 Closed runways and taxiways, or parts thereof — Characteristics (cont.)

Lighting on a closed runway or taxiway or portion thereof shall not be operated, except as required for maintenance purposes.

7.1.7 Closed runways and taxiways, or parts thereof — Characteristics (cont.)

In addition to closed markings, when the runway or taxiway or portion thereof closed is intercepted by a usable runway or taxiway which is used at night, unserviceability lights shall be placed across the entrance to the closed area at intervals not exceeding 3 m (see 7.4.4).

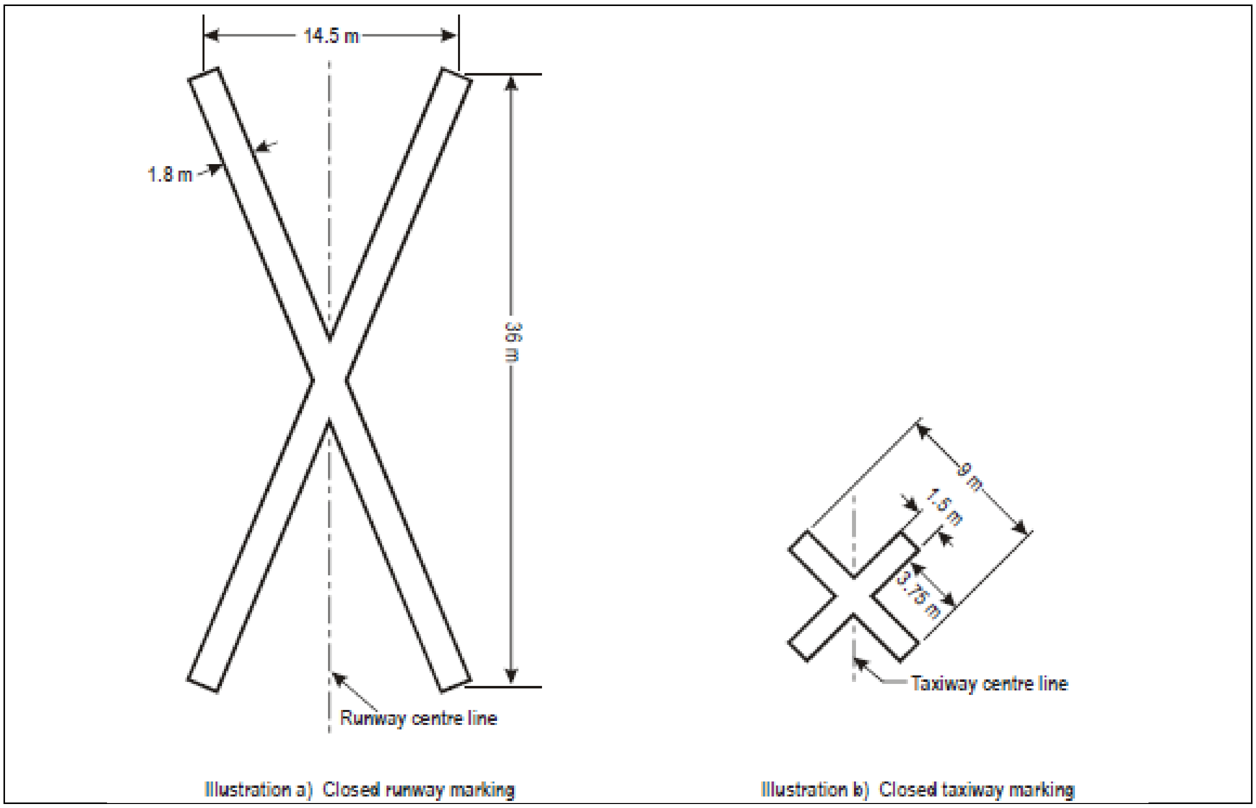

Figure 7-1. Closed runway and taxiway markings

7.2 Non-load-bearing surfaces

7.2.1 Non-load-bearing surfaces — Application

Shoulders for taxiways, runway turn pads, holding bays and aprons and other non-load-bearing surfaces which cannot readily be distinguished from load-bearing surfaces and which, if used by aircraft, might result in damage to the aircraft shall have the boundary between such areas and the load-bearing surface marked by a taxi side stripe marking.

Note.— The marking of runway sides is specified in 5.2.7.

7.2.2 Non-load-bearing surfaces — Location

A taxi side stripe marking shall be placed along the edge of the load-bearing pavement, with the outer edge of the marking approximately on the edge of the load-bearing pavement.

7.2.3 Non-load-bearing surfaces — Characteristics

A taxi side stripe marking shall consist of a pair of solid lines, each 15 cm wide and spaced 15 cm apart and the same colour as the taxiway centre line marking.

Note.— Guidance on providing additional transverse stripes at an intersection or a small area on the apron is given in the Aerodrome Design Manual (Doc 9157), Part 4.

7.3 Pre-threshold area

7.3.1 Pre-threshold area — Application

When the surface before a threshold is paved and exceeds 60 m in length and is not suitable for normal use by aircraft, the entire length before the threshold shall be marked with a chevron marking.

7.3.2 Pre-threshold area — Location

A chevron marking shall point in the direction of the runway and be placed as shown in Figure 7-2.

7.3.3 Pre-threshold area — Characteristics

A chevron marking shall be of conspicuous colour and contrast with the colour used for the runway markings; it shall preferably be yellow. It shall have an overall width of at least 0.9 m.

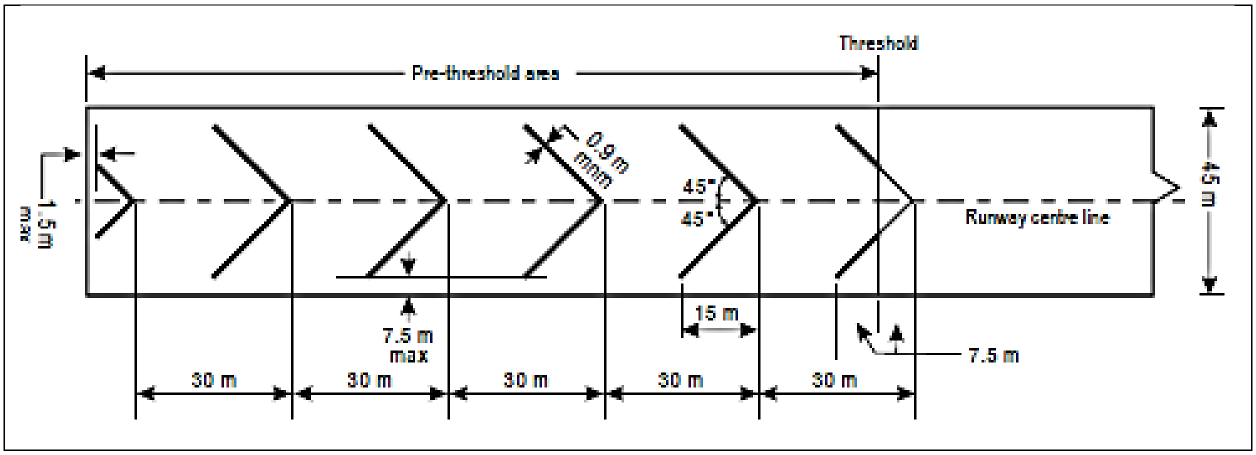

Figure 7-2. Pre-threshold marking

7.4 Unserviceable areas

7.4.1 Unserviceable areas — Application

Unserviceability markers shall be displayed wherever any portion of a taxiway, apron or holding bay is unfit for the movement of aircraft but it is still possible for aircraft to bypass the area safely. On a movement area used at night, unserviceability lights shall be used.

Note 1.— Unserviceability markers and lights are used for such purposes as warning pilots of a hole in a taxiway or apron pavement or outlining a portion of pavement, such as on an apron, that is under repair. They are not suitable for use when a portion of a runway becomes unserviceable, nor on a taxiway when a major portion of the width becomes unserviceable. In such instances, the runway or taxiway is normally closed.

Note 2.— Procedures pertaining to the planning, coordination, monitoring and safety management of works in progress on the movement area are specified in the PANS-Aerodromes (Doc 9981).

7.4.2 Unserviceable areas — Location

Unserviceability markers and lights shall be placed at intervals sufficiently close so as to delineate the unserviceable area.

Note.— Guidance on the location of unserviceability lights is given in Attachment A, Section 13.

7.4.3 Unserviceable areas — Characteristics of unserviceability markers

Unserviceability markers shall consist of conspicuous upstanding devices such as flags, cones or marker boards.

7.4.4 Unserviceable areas — Characteristics of unserviceability lights

An unserviceability light shall consist of a red fixed light. The light shall have an intensity sufficient to ensure conspicuity considering the intensity of the adjacent lights and the general level of illumination against which it would normally be viewed. In no case shall the intensity be less than 10 cd of red light.

7.4.5 Unserviceable areas — Characteristics of unserviceability cones

An unserviceability cone shall be at least 0.5 m in height and red, orange or yellow or any one of these colours in combination with white.

7.4.6 Unserviceable areas — Characteristics of unserviceability flags

An unserviceability flag shall be at least 0.5 m square and red, orange or yellow or any one of these colours in combination with white.

7.4.7 Unserviceable areas — Characteristics of unserviceability marker boards

An unserviceability marker board shall be at least 0.5 m in height and 0.9 m in length, with alternate red and white or orange and white vertical stripes.

CHAPTER 8. ELECTRICAL SYSTEMS

8.1 Electrical power supply systems for air navigation facilities

Introductory Note.— The safety of operations at aerodromes depends on the quality of the supplied power. The total electrical power supply system may include connections to one or more external sources of electric power supply, one or more local generating facilities and to a distribution network including transformers and switchgear. Many other aerodrome facilities supplied from the same system need to be taken into account while planning the electrical power system at aerodromes.

8.1.1 Electrical power supply systems for air navigation facilities

Adequate primary power supply shall be available at aerodromes for the safe functioning of air navigation facilities.

8.1.2 Electrical power supply systems for air navigation facilities (cont.)

The design and provision of electrical power systems for aerodrome visual and radio navigation aids shall be such that an equipment failure will not leave the pilot with inadequate visual and non-visual guidance or misleading information.

Note.— The design and installation of the electrical systems need to take into consideration factors that can lead to malfunction, such as electromagnetic disturbances, line losses, power quality, etc. Additional guidance is given in the Aerodrome Design Manual (Doc 9157), Part 5.

8.1.3 Electrical power supply systems for air navigation facilities (cont.)

Electric power supply connections to those facilities for which secondary power is required shall be so arranged that the facilities are automatically connected to the secondary power supply on failure of the primary source of power.

8.1.4 Electrical power supply systems for air navigation facilities (cont.)

The time interval between failure of the primary source of power and the complete restoration of the services required by 8.1.10 shall be as short as practicable, except that for visual aids associated with non-precision, precision approach or take-off runways the requirements of Table 8-1 for maximum switch-over times shall apply.

Note.— A definition of switch-over time is given in Chapter 1.

8.1.5 Electrical power supply systems for air navigation facilities (cont.)

The provision of a definition of switch-over time shall not require the replacement of an existing secondary power supply before 1 January 2010. However, for a secondary power supply installed after 4 November 1999, the electric power supply connections to those facilities for which secondary power is required shall be so arranged that the facilities are capable of meeting the requirements of Table 8-1 for maximum switch-over times as defined in Chapter 1.

8.1.6 Electrical power supply systems

For a precision approach runway, a secondary power supply capable of meeting the requirements of Table 8-1 for the appropriate category of precision approach runway shall be provided. Electric power supply connections to those facilities for which secondary power is required shall be so arranged that the facilities are automatically connected to the secondary power supply on failure of the primary source of power.

8.1.7 Electrical power supply systems (cont.)

For a runway meant for take-off in runway visual range conditions less than a value of 800 m, a secondary power supply capable of meeting the relevant requirements of Table 8-1 shall be provided.

8.1.8 Electrical power supply systems (cont.)

At an aerodrome where the primary runway is a non-precision approach runway, a secondary power supply capable of meeting the requirements of Table 8-1 shall be provided except that a secondary power supply for visual aids need not be provided for more than one non-precision approach runway.

8.1.9 Electrical power supply systems (cont.)

At an aerodrome where the primary runway is a non-instrument runway, a secondary power supply capable of meeting the requirements of 8.1.4 shall be provided, except that a secondary power supply for visual aids need not be provided when an emergency lighting system in accordance with the specification of 5.3.2 is provided and capable of being deployed in 15 minutes.

8.1.10 Electrical power supply systems (cont.)

The following aerodrome facilities shall be provided with a secondary power supply capable of supplying power when there is a failure of the primary power supply:

a) the signalling lamp and the minimum lighting necessary to enable air traffic services personnel to carry out their duties;

Note.— The requirement for minimum lighting may be met by other than electrical means.

b) all obstacle lights which, in the opinion of the appropriate authority, are essential to ensure the safe operation of aircraft;

c) approach, runway and taxiway lighting as specified in 8.1.6 to 8.1.9;

d) meteorological equipment;

e) essential security lighting, if provided in accordance with 9.11;

f) essential equipment and facilities for the aerodrome responding emergency agencies;

g) floodlighting on a designated isolated aircraft parking position if provided in accordance with 5.3.24.1; and

h) illumination of apron areas over which passengers may walk.

Note.— Specifications for secondary power supply for radio navigation aids and ground elements of communications systems are given in Annex 10, Volume I, Chapter 2.

8.1.11 Electrical power supply systems (cont.)

Requirements for a secondary power supply shall be met by either of the following:

— independent public power, which is a source of power supplying the aerodrome service from a substation other than the normal substation through a transmission line following a route different from the normal power supply route and such that the possibility of a simultaneous failure of the normal and independent public power supplies is extremely remote; or

— standby power unit(s), which are engine generators, batteries, etc., from which electric power can be obtained.

Note.— Guidance on electrical systems is included in the Aerodrome Design Manual (Doc 9157), Part 5.

Table 8-1. Secondary power supply requirements
(see 8.1.4)

Runway	Lighting aids requiring power	Maximum switch-over time
Non-instrument	Visual approach slope indicators[a] Runway edge[b] Runway threshold[b] Runway end[b] Obstacle[a]	See 8.1.4 and 8.1.9
Non-precision approach	Approach lighting system Visual approach slope indicators[a, d] Runway edge[d] Runway threshold[d] Runway end Obstacle[a]	15 seconds 15 seconds 15 seconds 15 seconds 15 seconds 15 seconds
Precision approach category I	Approach lighting system Runway edge[d] Visual approach slope indicators[a, d] Runway threshold[d] Runway end Essential taxiway[a] Obstacle[a]	15 seconds 15 seconds 15 seconds 15 seconds 15 seconds 15 seconds 15 seconds
Precision approach category II/III	Inner 300 m of the approach lighting system Other parts of the approach lighting system Obstacle[a] Runway edge Runway threshold Runway end Runway centre line Runway touchdown zone All stop bars Essential taxiway	1 second 15 seconds 15 seconds 15 seconds 1 second 1 second 1 second 1 second 1 second 15 seconds
Runway meant for take-off in runway visual range conditions less than a value of 800 m	Runway edge Runway end Runway centre line All stop bars Essential taxiway[a] Obstacle[a]	15 seconds[c] 1 second 1 second 1 second 15 seconds 15 seconds

a. Supplied with secondary power when their operation is essential to the safety of flight operation.
b. See Chapter 5, 5.3.2, regarding the use of emergency lighting.
c. One second where no runway centre line lights are provided.
d. One second where approaches are over hazardous or precipitous terrain.

8.2 System design

8.2.1 System design

For a runway meant for use in runway visual range conditions less than a value of 550 m, the electrical systems for the power supply, lighting and control of the lighting systems included in Table 8-1 shall be so designed that an equipment failure will not leave the pilot with inadequate visual guidance or misleading information.

Note.— Guidance on means of providing this protection is given in the Aerodrome Design Manual (Doc 9157), Part 5.

8.2.2 System design (cont.)

Where the secondary power supply of an aerodrome is provided by the use of duplicate feeders, such supplies shall be physically and electrically separate so as to ensure the required level of availability and independence.

8.2.3 System design (cont.)

Where a runway forming part of a standard taxi-route is provided with runway lighting and taxiway lighting, the lighting systems shall be interlocked to preclude the possibility of simultaneous operation of both forms of lighting.

8.3 Monitoring

Note.— Guidance on this subject is given in the Aerodrome Design Manual (Doc 9157), Part 5.

8.3.1 Monitoring

A system of monitoring shall be employed by the aerodrome operator to indicate the operational status of the lighting systems.

8.3.2 Monitoring (cont.)

Where lighting systems are used for aircraft control purposes, such systems shall be monitored automatically so as to provide an indication of any fault which may affect the control functions. This information shall be automatically relayed to the air traffic services unit.

8.3.3 Monitoring (cont.)

Where a change in the operational status of lights has occurred, an indication shall be provided within two seconds for a stop bar at a runway-holding position and within five seconds for all other types of visual aids.

8.3.4 Monitoring (cont.)

For a runway meant for use in runway visual range conditions less than a value of 550 m, the lighting systems detailed in Table 8-1 shall be monitored automatically so as to provide an indication when the serviceability level of any element falls below the minimum serviceability level specified in 10.5.7 to 10.5.11, as appropriate. This information shall be automatically relayed to the maintenance crew.

8.3.5 Monitoring (cont.)

For a runway meant for use in runway visual range conditions less than a value of 550 m, the lighting systems detailed in Table 8-1 shall be monitored automatically to provide an indication when the serviceability level of any element falls below the minimum level specified by the appropriate authority below which operations shall not continue. This information shall be automatically relayed to the air traffic services unit and displayed in a prominent position.

Note.— Guidance on air traffic control interface and visual aids monitoring is included in the Aerodrome Design Manual (Doc 9157), Part 5.

CHAPTER 9. AERODROME OPERATIONAL SERVICES, EQUIPMENT AND INSTALLATIONS

9.1 Aerodrome emergency planning

Introductory Note.— Aerodrome emergency planning is the process of preparing an aerodrome to cope with an emergency occurring at the aerodrome or in its vicinity. The objective of aerodrome emergency planning is to minimize the effects of an emergency, particularly in respect of saving lives and maintaining aircraft operations. The aerodrome emergency plan sets forth the procedures for coordinating the response of different aerodrome agencies (or services) and of those agencies in the surrounding community that could be of assistance in responding to the emergency. Guidance material to assist the operator in establishing aerodrome emergency planning is given in the Airport Services Manual (Doc 9137), Part 7.

9.1.1 Aerodrome emergency planning — General

(a) The aerodrome operator shall have and implement an aerodrome emergency plan that commensurate with the aircraft operations and other activities conducted at the aerodrome.

(b) The Aerodrome operator shall submit the aerodrome emergency plan for acceptance.

9.1.2 Aerodrome emergency planning — General (cont.)

The aerodrome emergency plan as required in 9.1.1 shall also provide for the coordination of the actions to be taken in an emergency occurring at an aerodrome or in its vicinity.

AMC1 9.1.2 Aerodrome emergency planning

AERODROME EMERGENCY PLAN DOCUMENT

The aerodrome operator should include, at least, the following in the aerodrome emergency plan document:

(a) Types of emergencies planned for;

(b) Agencies involved in the plan, and details of the aerodrome and local emergency planning arrangements and forums;

(c) Responsibility and role of each agency, the emergency operations centre, and the command post for each type of emergency;

(d) Information on names and telephone numbers of offices or people to be contacted in the case of a particular emergency; and

(e) A grid map of the aerodrome and its immediate surroundings, approximately at a distance of 8 km from the centre of the aerodrome.

GM1 9.1.2 Aerodrome emergency planning

AERODROME EMERGENCY PLAN DOCUMENT

(a) The aerodrome emergency plan of the aerodrome operator should observe human factors principles to ensure optimum response in emergency operations.

(b) In order to ensure that the aerodrome emergency plan document fully serves its purpose, it should include the following:

(1) plans for dealing with emergencies occurring at the aerodrome or in its surroundings, including the malfunction of aircraft in flight; structural fires; sabotage, including bomb threats (aircraft or structure); unlawful seizure of aircraft dangerous goods occurrences, building fires, natural disaster and public health emergencies; and incidents on the aerodrome covering 'during the emergency' and 'after the emergency' considerations;

(2) details of tests for aerodrome facilities and equipment to be used in emergencies such as emergency operations centre, mobile command post, fire fighting vehicles and equipment, communication means, first aid medical supplies, etc., including the frequency of those tests;

Note.— Examples of public health emergencies are increased risk of travellers or cargo spreading a serious communicable disease internationally through air transport and severe outbreak of a communicable disease potentially affecting a large proportion of aerodrome staff.

GM2 9.1.2 Aerodrome emergency planning

CONTENTS OF AN AERODROME EMERGENCY PLAN DOCUMENT

The purpose of the aerodrome Emergency Plan Document is to provide all the required information to agencies and staff involved in an emergency. The document should be structured in such a manner, that the required information is easily identifiable. For that purpose, the structure of the aerodrome emergency plan should be as follows:

Section 1 — Emergency telephone numbers

This section should be limited to essential telephone, numbers according to the aerodrome needs, including:

(a) air traffic services unit;

(b) rescue and firefighting services (fire departments);

(c) airfield operations department;

(d) police and security;

(e) medical services:

 (1) hospitals;

 (2) ambulances; and

 (3) doctors — business/residence;

(f) aircraft operators;

(g) ground handling agencies;

(h) government authorities, including the Department of Civil Aviation of Aruba;

(i) civil defence; and

(j) others.

Section 2 — Aircraft accident on the aerodrome

(a) Action by air traffic services unit;

(b) Action by rescue and firefighting services;

(c) Action by police and security services;

(d) Action by the aerodrome operator:

 (1) vehicle escort; and

 (2) maintenance;

(e) Action by medical services:

 (1) hospitals;

(2) ambulances;

(3) doctors; and

(4) medical personnel.

(f) Action by aircraft operator involved;

(g) Action by emergency operations centre and mobile command post;

(h) Action by government authorities;

(i) Communication network (emergency operations centre and mobile command post);

(j) Action by agencies organisations involved in mutual aid emergency agreements;

(k) Action by transportation authorities (land, sea, air);

(l) Action by public information officer(s);

(m) Action by local fire departments when structures involved; and

(n) Action by all other agencies.

Section 3 — Aircraft accident off the aerodrome

(a) Action by air traffic services unit;

(b) Action by rescue and firefighting services;

(c) Action by local fire departments;

(d) Action by police and security services;

(e) Action by aerodrome operator;

(f) Action by medical services;

(i) hospitals;

(ii) ambulances;

(iii) doctors; and

(iv) medical personnel.

(g) Action by agencies involved in mutual aid emergency agreements;

(h) Action by aircraft operator involved;

(i) Action by emergency operations centre and mobile command post;

(j) Action by government authorities;

(k) Action by communication networks (emergency operations centre and mobile command post);

(l) Action by transportation authorities (land, sea, air);

(m) Action by public information officer; and

(n) Action by all other agencies.

Section 4 — Malfunction of aircraft in flight (Full emergency or local standby)

(a) Action by air traffic services unit;

(b) Action by aerodrome rescue and firefighting services;

(c) Action by police and security services;

(d) Action by the aerodrome operator;

(e) Action by medical services:

(1) hospitals;

(2) ambulances;

(3) doctors; and

(4) medical personnel.

(f) Action by aircraft operator involved;

(g) Action by emergency operations centre and mobile command post; and

(h) Action by all other agencies.

Section 5 — Structural fires

(a) Action by air traffic services unit;

(b) Action by rescue and firefighting services (local fire department);

(c) Action by police and security services;

(d) Action by aerodrome authority;

(e) Evacuation of structure;

(f) Action by medical services:

(1) hospitals;

(2) ambulances;

(3) doctors; and

(4) medical personnel.

(g) Action by emergency operations centre and mobile command post;

(h) Action by public information officer; and

(i) Action by all other agencies.

Section 6 — Sabotage including bomb threat (aircraft or structure)

(a) Action by air traffic services unit;

(b) Action by emergency operations centre and mobile command post;

(c) Action by police and security services;

(d) Action by the aerodrome operator;

(e) Action by rescue and firefighting services;

(f) Action by medical services:

(1) hospitals;

(2) ambulances;

(3) doctors; and

(4) medical personnel.

(g) Action by aircraft operator involved;

(h) Action by government authorities;

(i) Isolated aircraft parking position;

(j) Evacuation;

(k) Searches by dogs and trained personnel;

(l) Handling and identification of luggage and cargo on board aircraft;

(m) Handling and disposal of suspected bomb;

(n) Action by public information officer; and

(o) Action by all other agencies.

Section 7 — Unlawful seizure of aircraft

(a) Action by air traffic services unit;

(b) Action by rescue and firefighting services;

(c) Action by police and security services;

(d) Action by the aerodrome operator;

(e) Action by medical services;

(1) hospitals;

(2) ambulances;

(3) doctors; and

(4) medical personnel.

(f) Action by aircraft operator involved;

(g) Action by government authorities;

(h) Action by emergency operations centre and mobile command post;

(i) Isolated aircraft parking position;

(j) Action by public information officer; and

(k) Action by all other agencies.

Section 8 — Incident on the aerodrome

An incident on the aerodrome could require any, or all of the actions detailed in Section 2, 'Aircraft accident on the aerodrome'. Examples of incidents the aerodrome operator should consider to include: fuel spills at the ramp, passenger loading bridge, and fuel storage area; dangerous goods occurrences at freight handling areas; collapse of structures; vehicle/aircraft collisions; etc.

Section 9 — Persons of authority — site roles

To include, but not limited to, the following, according to local requirements:

(a) On-aerodrome:

(1) Aerodrome chief fire officer;

(2) Aerodrome authority;

(3) Police and security — Officer-in-charge; and

(4) Medical coordinator.

(b) Off-aerodrome:

(1) Local chief fire officer;

(2) Government authority; and

(3) Police and security — officer-in-charge.

The on-the-scene commander will be designated as required from within the pre-arranged mutual aid emergency agreement.

9.1.3 Aerodrome emergency planning — General (cont.)

The plan shall coordinate the response or participation of all existing agencies which, in the opinion of the authority, could be of assistance in responding to an emergency.

Note 1.— Examples of agencies are:

— *on the aerodrome: air traffic control units, rescue and firefighting services, aerodrome administration, medical and ambulance services, aircraft operators, security services, and police;*

— *off the aerodrome: fire departments, police, health authorities (including medical, ambulance, hospital and public health services), military, and harbour patrol or coast guard.*

Note 2.— Public health services include planning to minimize adverse effects to the community from health-related events and deal with population health issues rather than provision of health services to individuals.

9.1.4 Aerodrome emergency planning — General (cont.)

The plan shall provide for cooperation and coordination with the rescue coordination centre, as necessary.

9.1.5 Aerodrome emergency planning — General (cont.)

The aerodrome emergency plan document shall include at least the following:

a) types of emergencies planned for;

b) agencies involved in the plan;

c) responsibility and role of each agency, the emergency operations centre and the command post, for each type of emergency;

d) information on names and telephone numbers of offices or people to be contacted in the case of a particular emergency; and

e) a grid map of the aerodrome and its immediate vicinity.

9.1.6 Aerodrome emergency planning — General (cont.)

The plan shall observe human factors principles to ensure optimum response by all existing agencies participating in emergency operations.

Note 1.— Guidance material on human factors principles can be found in the Human Factors Training Manual (Doc 9683).

Note 2.— General principles and procedures on the training of aerodrome personnel, including training programmes and competence checks, are specified in the PANS-Aerodromes (Doc 9981).

9.1.7 Aerodrome emergency planning — Emergency operations centre and command post

A fixed emergency operations centre and a mobile command post shall be available for use during an emergency.

9.1.8 Aerodrome emergency planning — Emergency operations centre and command post (cont.)

The emergency operations centre shall be a part of the aerodrome facilities and shall be responsible for the overall coordination and general direction of the response to an emergency.

9.1.9 Aerodrome emergency planning — Emergency operations centre and command post (cont.)

The command post shall be a facility capable of being moved rapidly to the site of an emergency, when required, and shall undertake the local coordination of those agencies responding to the emergency.

9.1.10 Aerodrome emergency planning — Emergency operations centre and command post (cont.)

A person shall be assigned to assume control of the emergency operations centre and, when appropriate, another person the command post.

9.1.11 Aerodrome emergency planning — Communication system

Adequate communication systems linking the command post and the emergency operations centre with each other and with the participating agencies shall be provided in accordance with the plan and consistent with the particular requirements of the aerodrome.

9.1.12 Aerodrome emergency planning — Aerodrome emergency exercise

The plan shall contain procedures for periodic testing of the adequacy of the plan and for reviewing the results in order to improve its effectiveness.

Note.— The plan includes all participating agencies and associated equipment.

9.1.13 Aerodrome emergency planning — Aerodrome emergency exercise (cont.)

The aerodrome operator shall ensure that the emergency plan as required in 9.1.1 is tested with:

a) a full-scale aerodrome emergency exercise at intervals not exceeding two years;

b) and partial emergency exercises in the intervening year to ensure that any deficiencies found during the full-scale aerodrome emergency exercise have been corrected; or

b) a series of modular tests commencing in the first year of certification and concluding at the last year of certification at intervals not exceeding four monts;

and reviewed thereafter, or after an actual emergency, so as to correct any deficiency found during such exercises or actual emergency.

GM1 9.1.13 Aerodrome emergency planning — Aerodrome emergency exercise (cont.)

PURPOSE OF THE AERODROME EMERGENCY PLAN

(a) The aerodrome emergency plan is part of a National Emergency Plan, but the aerodrome operator is responsible for its development.

The aerodrome operator shall prepare its own plan describing the actions that should be taken during an emergency, in cooperation with the authorities which are responsible for the National or Local Emergency Plan. The aerodrome operator shall submit the aerodrome emergency plan to the Authority for acceptance (see 9.1.1 (b))

(b) Irrespective of whose responsibility is the establishment and implementation of an emergency plan covering emergencies at or in the surroundings of an aerodrome, the emergency plan should ensure that there are provisions for:

(1) orderly and efficient transition from normal to emergency operations;

(2) delegation of authority;

(3) assignment of emergency responsibilities;

(4) authorising key personnel for actions contained in the plan;

(5) coordination of efforts to cope with the emergency; and

(6) safe continuation of aircraft operations or return to normal operations as soon as possible.

GM2 9.1.13 Aerodrome emergency planning— Aerodrome emergency exercise (cont.)

EMERGENCY EXERCISES

(a) Full-scale exercises

(1) The purpose of a full-scale exercise is to ensure the adequacy of the plan to cope with different types of emergencies.

(2) Full-scale emergency exercises should be supported by all aerodrome and community authorities concerned.

(3) Objectives of the exercise should be defined.

(4) Involved departments and agencies should be thoroughly familiar with the aerodrome emergency plan, and develop individual plans in coordination with the general plan.

(5) The emergency exercises should be held in locations which will provide maximum realism while ensuring minimum disruption of the aerodrome operations. Different scenarios, as described in the aerodrome emergency plan document, should be used. The exercise could be held either during the day or at night on the aerodrome, and at different times of the year when seasonal changes may present additional challenges. Exercises may take place both on or near the aerodrome to test different scenarios.

(6) In order to obtain the maximum benefit from a full-scale emergency exercise, the entire proceedings should be reviewed. An observer critique team should be organised, comprised of members who are familiar with mass casualty accident proceedings. Each member of the critique team should observe the entire exercise, and complete the appropriate emergency drill critique forms. As soon as convenient after the exercise, a critique meeting should be held so members of the team can present their observations and recommendations for improvement of the aerodrome emergency plan procedures and associated aerodrome emergency plan document.

(7) The exercise should be followed by a full debriefing, critique, and analysis. It is important that representatives of all organisations which participate in the exercise actively participate in the critique.

(b) Partial emergency exercises in combination with Tabletop exercises

(1) The purpose of a partial exercise is to ensure the adequacy of the response to individual participating agencies and components of the plan.

(2) Partial emergency exercises should involve, at least, one unit, such as rescue and firefighting services, or medical, or combination of several units, as appropriate.

(3) Partial emergency exercises should ensure that any deficiencies found during the full-scale aerodrome emergency exercise have been corrected.

(c) Tabletop exercises

Tabletop exercises should be held at regular intervals. The aim of these exercises should be to verify that roles and procedures are clear and understood. These exercises offer a good opportunity to test new or revised procedures, before implementation, or preparation for a full-scale emergency exercise.

Note. — Guidance material on airport emergency planning is available in the Airport Services Manual (Doc 9137), Part 7.

9.1.14 Aerodrome emergency planning — Emergencies in difficult environments

The plan shall include the ready availability of, and coordination with, appropriate specialist rescue services to be able to respond to emergencies where an aerodrome is located close to water and/or swampy areas and where a significant portion of approach or departure operations takes place over these areas.

9.1.15 Aerodrome emergency planning — Emergencies in difficult environments (cont.)

At those aerodromes located close to water and/or swampy areas, or difficult terrain, the aerodrome emergency plan shall include the establishment, testing and assessment at regular intervals of a predetermined response for the specialist rescue services.

9.1.16 Aerodrome emergency planning — Emergencies in difficult environments (cont.)

An assessment of the approach and departure areas within 1 000 m of the runway threshold shall be carried out to determine the options available for intervention.

Note.— Guidance material on assessing approach and departure areas within 1 000 m of runway thresholds can be found in Chapter 13 of the Airport Services Manual (Doc 9137), Part 1.

9.2 Rescue and firefighting

Introductory Note.— The principal objective of a rescue and firefighting service is to save lives in the event of an aircraft accident or incident occurring at, or in the immediate vicinity of, an aerodrome. The rescue and firefighting service is provided to create and maintain survivable conditions, to provide egress routes for occupants and to initiate the rescue of those occupants unable to make their escape without direct aid. The rescue may require the use of equipment and personnel other than those assessed primarily for rescue and firefighting purposes.

The most important factors bearing on effective rescue in a survivable aircraft accident are:

- *the training received,*
- *the effectiveness of the equipment and*
- *the speed with which personnel and equipment designated for rescue and firefighting purposes can be put into use.*

9.2.1 Rescue and firefighting — Application

(a) The aerodrome operator shall ensure that aerodrome rescue and firefighting facilities, equipment and services are provided at the aerodrome and comply with the requirements of 9.2 Rescue and firefighting. The aerodrome operator shall periodically assess its compliance with these requirements.

(b) Public or private organizations, suitably located and equipped, may be designated by the Aerodrome operator to provide the rescue and firefighting service. The Aerodrome operator shall be ultimately responsible for the organization he designated for the provision of rescue and firefighting. The aerodrome operator shall periodically assess the third party as required in paragraph (a)

(c) The aerodrome operator shall immediately inform the Authority if during its assessment it has been established that the aerodrome operator is in non-compliance with paragraph (a). The aerodrome operator shall inform the authority regarding the measures to be applied to promptly remedy this non-compliance.

GM1 9.2.1(c) Rescue and firefighting — Application

REDUCTION OF RFFS LEVEL OF PROTECTION

Contingency arrangements to limit the need for changes to the promulgated rescue and firefighting level of protection should be developed by the aerodrome operator. This may involve, for example, a maintenance plan to ensure the mechanical efficiency of equipment and vehicles for rescue and firefighting, and arrangements to cover unplanned absence of the minimum level of personnel including supervisory levels.

The following may be considered as unforeseen circumstances leading to temporary reduction of the level of protection of the aerodrome rescue and firefighting:

(a) breakdown of RFFS vehicles;

(b) staff shortage;

(c) unavailability of extinguishing agents; and

(d) RFFS response to an accident.

9.2.2 Rescue and firefighting — Application (cont.)

Where an aerodrome is located close to water/swampy areas, or difficult terrain, and where a significant portion of approach or departure operations takes place over these areas, specialist rescue services and firefighting equipment appropriate to the hazard and risk shall be available by the aerodrome operator.

Note 1.— Special firefighting equipment need not be provided for water areas; this does not prevent the provision of such equipment if it would be of practical use, such as when the areas concerned include reefs or islands.

Note 2.— The objective is to plan and deploy the necessary life-saving flotation equipment as expeditiously as possible in a number commensurate with the largest aeroplane normally using the aerodrome.

Note 3.— Additional guidance is available in Chapter 13 of the Airport Services Manual (Doc 9137), Part 1.

9.2.3 Rescue and firefighting — Level of protection to be provided

The level of protection provided at an aerodrome for rescue and firefighting shall be appropriate to the aerodrome category determined using the principles in 9.2.5 and 9.2.6, except that, where the number of movements of the aeroplanes in the highest category normally using the aerodrome is less than 700 in the busiest consecutive three months, the level of protection provided shall be not less than one category below the determined category.

Note.— Either a take-off or a landing constitutes a movement.

9.2.4

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9.2.5 Rescue and firefighting — Level of protection to be provided (cont.)

The aerodrome category shall be determined from Table 9-1 and shall be based on the longest aeroplanes normally using the aerodrome and their fuselage width.

Note.— To categorize the aeroplanes using the aerodrome, first evaluate their overall length and second, their fuselage width.

9.2.6 Rescue and firefighting — Level of protection to be provided (cont.)

If, after selecting the category appropriate to the longest aeroplane's overall length, that aeroplane's fuselage width is greater than the maximum width in Table 9-1, column 3, for that category, then the category for that aeroplane shall actually be one category higher.

Note.— See guidance in the Airport Services Manual (Doc 9137), Part 1, for categorizing aerodromes, including those for all-cargo aircraft operations, for rescue and firefighting purposes.

9.2.7 Rescue and firefighting — Level of protection to be provided (cont.)

During anticipated periods of reduced activity, the level of protection available shall be no less than that needed for the highest category of aeroplane planned to use the aerodrome during that time irrespective of the number of movements.

Table 9-1. Aerodrome category for rescue and firefighting

Aerodrome category (1)	Aeroplane overall length (2)	Maximum fuselage width (3)
1	0 m up to but not including 9 m	2 m
2	9 m up to but not including 12 m	2 m
3	12 m up to but not including 18 m	3 m
4	18 m up to but not including 24 m	4 m
5	24 m up to but not including 28 m	4 m
6	28 m up to but not including 39 m	5 m
7	39 m up to but not including 49 m	5 m
8	49 m up to but not including 61 m	7 m
9	61 m up to but not including 76 m	7 m
10	76 m up to but not including 90 m	8 m

9.2.8 Rescue and firefighting — Extinguishing agents

Both principal and complementary agents shall normally be provided at an aerodrome.

Note.— descriptions of the agents may be found in the airport services manual (doc 9137), part 1.

9.2.9 Rescue and firefighting — Extinguishing agents (cont.)

The principal extinguishing agent shall be:

a) a foam meeting the minimum performance level A; or

b) a foam meeting the minimum performance level B; or

c) a foam meeting the minimum performance level C; or

d) a combination of these agents;

except that the principal extinguishing agent for aerodromes in categories 1 to 3 shall preferably meet a performance level B or C foam.

Note.— Information on the required physical properties and fire extinguishing performance criteria needed for a foam to achieve an acceptable performance level A, B or C rating is given in the Airport Services Manual (Doc 9137), Part 1.

9.2.10 Rescue and firefighting — Extinguishing agents (cont.)

The complementary extinguishing agent shall be a dry chemical powder suitable for extinguishing hydrocarbon fires.

Note 1.— When selecting dry chemical powders for use with foam, care must be exercised to ensure compatibility.

Note 2.— Alternate complementary agents having equivalent firefighting capability may be utilized. Additional information on extinguishing agents is given in the Airport Services Manual (Doc 9137), Part 1.

9.2.11 Rescue and firefighting — Extinguishing agents (cont.)

The amounts of water for foam production and the complementary agents to be provided on the rescue and firefighting vehicles shall be in accordance with the aerodrome category determined under 9.2.3, 9.2.4, 9.2.5, 9.2.6 and Table 9-2, except that for aerodrome categories 1 and 2 up to 100 per cent of the water may be substituted with complementary agent.

For the purpose of agent substitution, 1 kg of complementary agent shall be taken as equivalent to 1.0 L of water for production of a foam meeting performance level A.

Note 1.— The amounts of water specified for foam production are predicated on an application rate of 8.2 L/min/m2 for a foam meeting performance level A, 5.5 L/min/m2 for a foam meeting performance level B and 3.75 L/min/m2 for a foam meeting performance level C.

Note 2.— When any other complementary agent is used, the substitution ratios need to be checked.

9.2.12 Rescue and firefighting — Extinguishing agents (cont.)

At aerodromes where operations by aeroplanes larger than the average size in a given category are planned, the quantities of water shall be recalculated and the amount of water for foam production and the discharge rates for foam solution shall be increased accordingly.

Note.— Guidance on the determination of quantities of water and discharge rates based on the largest overall length of aeroplane in a given category is available in Chapter 2 of the Airport Services Manual (Doc 9137), Part 1.

Table 9-2. Minimum usable amounts of extinguishing agents

	Foam meeting performance level A		Foam meeting performance level B		Foam meeting performance level C		Complementary agents	
Aerodrome Category	Water (L)	Discharge rate foam solution/ minute (L)	Water (L)	Discharge rate foam solution/ minute (L)	Water (L)	Discharge rate foam solution/ minute (L)	Dry chemical powders (kg)	Discharge Rate (kg/second)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	350	350	230	230	160	160	45	2.25
2	1 000	800	670	550	460	360	90	2.25
3	1 800	1 300	1 200	900	820	630	135	2.25
4	3 600	2 600	2 400	1 800	1 700	1 100	135	2.25
5	8 100	4 500	5 400	3 000	3 900	2 200	180	2.25
6	11 800	6 000	7 900	4 000	5 800	2 900	225	2.25
7	18 200	7 900	12 100	5 300	8 800	3 800	225	2.25
8	27 300	10 800	18 200	7 200	12 800	5 100	450	4.5
9	36 400	13 500	24 300	9 000	17 100	6 300	450	4.5
10	48 200	16 600	32 300	11 200	22 00	7 900	450	4.5

9.2.13 Rescue and firefighting — Extinguishing agents (cont.)

The quantity of foam concentrates separately provided on vehicles for foam production shall be in proportion to the quantity of water provided and the foam concentrate selected.

9.2.14 Rescue and firefighting — Extinguishing agents (cont.)

The amount of foam concentrate provided on a vehicle shall be sufficient to produce at least two loads of foam solution.

9.2.15 Rescue and firefighting — Extinguishing agents (cont.)

Supplementary water supplies, for the expeditious replenishment of rescue and firefighting vehicles at the scene of an aircraft accident, shall be provided.

9.2.16 Rescue and firefighting — Extinguishing agents (cont.)

When a combination of different performance level foams are provided at an aerodrome, the total amount of water to be provided for foam production shall be calculated for each foam type and the distribution of these quantities shall be documented for each vehicle and applied to the overall rescue and firefighting requirement.

9.2.17 Rescue and firefighting — Extinguishing agents (cont.)

The discharge rate of the foam solution shall not be less than the rates shown in Table 9-2.

9.2.18 Rescue and firefighting — Extinguishing agents (cont.)

The complementary agents shall comply with the appropriate specifications of the International Organization for Standardization (ISO).*

9.2.19 Rescue and firefighting — Extinguishing agents (cont.)

The discharge rate of complementary agents shall be no less than the values shown in Table 9-2.

9.2.20 Rescue and firefighting — Extinguishing agents (cont.)

Dry chemical powders shall only be substituted with an agent that has equivalent or better firefighting capabilities for all types of fires where complementary agent is expected to be used.

Note.— Guidance on the use of complementary agents can be found in the Airport Services Manual (Doc 9137), Part 1.

9.2.21 Rescue and firefighting — Extinguishing agents (cont.)

A reserve supply of foam concentrate, equivalent to 200 per cent of the quantities identified in Table 9-2, shall be maintained on the aerodrome for vehicle replenishment purposes.

Note.— Foam concentrate carried on fire vehicles in excess of the quantity identified in Table 9-2 can contribute to the reserve.

* See ISO Publication 7202 (Powder).

9.2.22 Rescue and firefighting — Extinguishing agents (cont.)

A reserve supply of complementary agent, equivalent to 100 per cent of the quantity identified in Table 9-2, shall be maintained on the aerodrome for vehicle replenishment purposes. Sufficient propellant gas shall be included to utilize this reserve complementary agent.

9.2.23 Rescue and firefighting — Extinguishing agents (cont.)

Category 1 and 2 aerodromes that have replaced up to 100 per cent of the water with complementary agent shall hold a reserve supply of complementary agent of 200 per cent.

9.2.24 Rescue and firefighting — Extinguishing agents (cont.)

Where a major delay in the replenishment of the supplies is anticipated, the amount of reserve supply in 9.2.21, 9.2.22 and 9.2.23 shall be increased as determined by a risk assessment.

Note.— See the Airport Services Manual (Doc 9137), Part 1 for guidance on the conduct of a risk analysis to determine the quantities of reserve extinguishing agents.

9.2.25 Rescue and firefighting — Rescue equipment

The aerodrome operator shall ensure that rescue equipment commensurate with the level of aircraft operations be provided on the rescue and firefighting vehicle(s).

Note.— Guidance on the rescue equipment to be provided at an aerodrome is given in the Airport Services Manual (Doc 9137), Part 1.

9.2.26 Rescue and firefighting — Response time

The operational objective of the rescue and firefighting service shall be to achieve a response time not exceeding three minutes to any point of each operational runway, in optimum visibility and surface conditions.

9.2.27

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9.2.28 Rescue and firefighting — Response time (cont.)

The operational objective of the rescue and firefighting service shall be to achieve a response time not exceeding three minutes to any other part of the movement area, in optimum visibility and surface conditions.

Note 1.— Response time is considered to be the time between the initial call to the rescue and firefighting service, and the time when the first responding vehicle(s) is (are) in position to apply foam at a rate of at least 50 per cent of the discharge rate specified in Table 9-2.

Note 2.— Optimum visibility and surface conditions are defined as daytime, good visibility, no precipitation with normal response route free of surface contamination, e.g. water.

9.2.29 Rescue and firefighting — Response time (cont.)

To meet the operational objective as nearly as possible in less than optimum conditions of visibility, especially during low visibility operations, suitable guidance, equipment and/or procedures for rescue and firefighting services shall be provided.

Note.— Additional guidance is available in the Airport Services Manual (Doc 9137), Part 1.

9.2.30 Rescue and firefighting — Response time (cont.)

Any vehicles, other than the first responding vehicle(s), required to deliver the amounts of extinguishing agents specified in Table 9-2 shall ensure continuous agent application and shall arrive no more than four minutes from the initial call.

9.2.31 Rescue and firefighting — Response time (cont.)

Any vehicles, other than the first responding vehicles(s), required to deliver the amounts of extinguishing agents specified in Table 9-2 shall ensure continuous agent application and shall arrive no more than three minutes from the initial call.

9.2.32 Rescue and firefighting — Response time (cont.)

A system of preventive maintenance of rescue and firefighting vehicles shall be employed to ensure effectiveness of the equipment and compliance with the specified response time throughout the life of the vehicle.

9.2.33 Rescue and firefighting — Emergency access roads

Emergency access roads shall be provided on an aerodrome where terrain conditions permit their construction, so as to facilitate achieving minimum response times. Particular attention shall be given to the provision of ready access to approach areas up to 1 000 m from the threshold, or at least within the aerodrome boundary. Where a fence is provided, the need for convenient access to outside areas shall be taken into account.

Note.— Aerodrome service roads may serve as emergency access roads when they are suitably located and constructed.

9.2.34 Rescue and firefighting — Emergency access roads (cont.)

Emergency access roads shall be capable of supporting the heaviest vehicles which will use them, and be usable in all weather conditions. Roads within 90 m of a runway shall be surfaced to prevent surface erosion and the transfer of debris to the runway. Sufficient vertical clearance shall be provided from overhead obstructions for the largest vehicles.

9.2.35 Rescue and firefighting — Emergency access roads (cont.)

When the surface of the road is indistinguishable from the surrounding area, edge markers shall be placed at intervals of about 10 m.

9.2.36 Rescue and firefighting — Fire stations

All rescue and firefighting vehicles shall be housed in a fire station. Satellite fire stations shall be provided whenever the response time cannot be achieved from a single fire station.

9.2.37 Rescue and firefighting — Fire stations (cont.)

The fire station shall be located so that the access for rescue and firefighting vehicles into the runway area is direct and clear, requiring a minimum number of turns.

9.2.38 Rescue and firefighting — Communication and alerting systems

A discrete communication system shall be provided linking a fire station with the control tower, any other fire station on the aerodrome and the rescue and firefighting vehicles.

9.2.39 Rescue and firefighting — Communication and alerting systems (cont.)

An alerting system for rescue and firefighting personnel, capable of being operated from that station, shall be provided at a fire station, any other fire station on the aerodrome and the aerodrome control tower.

9.2.40 Rescue and firefighting — Number of rescue and firefighting vehicles

The minimum number of rescue and firefighting vehicles provided at an aerodrome shall be in accordance with the following tabulation:

Aerodrome category	Rescue and firefighting vehicles
1	1
2	1
3	1
4	1
5	1
6	2
7	2
8	3
9	3
10	3

Note.— Guidance on minimum characteristics of rescue and firefighting vehicles is given in the Airport Services Manual (Doc 9137), Part 1.

9.2.41 Rescue and firefighting — Personnel

(a) The aerodrome operator shall ensure that

(1) rescue and firefighting personnel are properly trained, equipped and qualified to operate in the aerodrome environment; and

(2) rescue and firefighting personnel potentially required to act in aviation emergencies demonstrate their medical fitness to execute their functions satisfactorily, taking into account the type of activity.

(b) The aerodrome operator shall ensure that all rescue and firefighting personnel participate in live fire drills that commensurate with the types of aircraft and type of rescue and firefighting equipment in use at the aerodrome, including pressure-fed fuel fires.

Note 1.— Guidance to assist in providing proper training is given in Attachment A, Section 17, and the Airport Services Manual (Doc 9137), Part 1.

Note 2.— Fires associated with fuel discharged under very high pressure from a ruptured fuel tank are known as "pressure-fed fuel fires".

AMC1 9.2.41 Rescue and firefighting — Personnel

MEDICAL STANDARDS FOR RFFS PERSONNEL

The aerodrome operator should ensure that appropriate medical standards are met by RFFS personnel.

GM1 9.2.41 Rescue and firefighting — Personnel

MEDICAL ASSESSMENT

1. General

Rescue and firefighting personnel, when responding to an accident, need to be capable of withstanding physically aggressive conditions whilst performing efficiently. Additionally, managing life-threatening situations which put at risk aircraft occupants' safety requires also mental fitness. For this reason, decision-making and stress management should not be impaired.

The key fitness components for rescue and firefighting personnel are aerobic fitness, anaerobic fitness, flexibility and medical fitness. Optimum physical and medical fitness would mean that a firefighter is able to carry out rescue and firefighting activities safely, successfully and without unjustified fatigue.

In order to understand better the key fitness components, the following aspects may have to be considered:

Aerobic fitness refers to the ability to continue to exercise for prolonged periods of time at low to moderate or high intensity. This depends upon the capacity of the body's heart, lungs and blood to get the oxygen to the muscles (VO2) providing the sustained energy to maintain prolonged exercise.

Anaerobic fitness works differently to aerobic fitness. It is an activity that requires high levels of strength and is done for only a very short period of time at a high level of intensity. Anaerobic fitness may be defined as higher levels of muscular strength, speed and power.

Flexibility refers to the ability to move the limbs and joints into specific positions at the extreme of their normal range of movement. Flexibility is important as it will allow the body to work in cramped positions without unduly stressing the muscles, tendons and ligaments and may reduce the risk of injury.

2. Decrease in medical fitness

Rescue and firefighting personnel need to exercise a duty of care and not to perform their duties when they are aware of any decrease in their medical fitness, to the extent that this condition might render them unable to perform their duties. Furthermore, without undue delay, medical advice is needed when they:

(a) have undergone a surgical operation or invasive procedure;

(b) have commenced the regular use of any medication;

(c) have suffered any significant personal injury;

(d) have been suffering from any significant illness;

(e) are pregnant; and

(f) have been admitted to hospital or medical clinic.

In these cases, the medical fitness of the person is assessed by medical staff in order to decide whether the person is fit to resume duties. Additionally, following recovery from significant illness or injury, it may be necessary, after recommendation of the medical staff, to undergo any relevant physical fitness tests prior to a return to operational duty.

3. Medical assessment programme

A medical assessment programme is a tool to promote and facilitate that rescue and firefighting personnel are free of any physical or mental illness, which might lead to incapacitation or inability to perform their assigned duties and responsibilities.

The programme includes an initial assessment prior to employment and re-examinations at regular intervals. The frequency of the re-examinations may take into account the age of the person, the medical history, etc.

4. Medical assessment

(a) The objective of a medical assessment is to assess the physical and mental ability of the rescue and firefighting personnel to:

   (1) undergo the training which is necessary to acquire and maintain competence in the execution of their tasks related to rescue and firefighting, such as working in a high-temperature environment, using protective breathing equipment in a simulated smoke-filled environment, assisting trapped or injured passengers to escape the aircraft, etc.; and

   (2) perform their duties in psychologically demanding circumstances.

(b) Fit rescue and firefighting personnel will be free from any:

   (1) abnormality, congenital or acquired;

   (2) active, latent, acute or chronic disease or disability;

   (3) wound, injury or sequel from an operation;

   (4) effect or side effect of any prescribed or non-prescribed therapeutic, diagnostic or preventive medication taken, which entails a degree of functional incapacity that is likely to interfere with the performance of their duties or could render them likely to become suddenly unable to perform their duties.

(c) The initial medical assessment includes at least:

   (1) an assessment of the medical history; and

   (2) a clinical examination of the following:

      (i) cardiovascular system;

      (ii) respiratory system;

      (iii) musculoskeletal system;

(iv) otorhinolaryngology (ENT); and

(v) visual system.

(d) Each subsequent medical assessment includes:

(1) an assessment of the medical history; and

(2) a clinical examination (if deemed necessary) in accordance with best medical practices.

Nevertheless, if during any medical assessment there is a doubt or if clinically indicated, additional medical examinations, tests or investigations may also be conducted if considered necessary by the medical staff.

5. Physical Fitness Evaluation Programme

The physical fitness of rescue and firefighting personnel will be evaluated at regular intervals. For this reason, a physical fitness evaluation programme is necessary.

The evaluation should be anti-discriminatory, non-punitive or non-competitive. The results of the evaluation may be used to establish the person's baseline or measured against the person's previous assessments.

A physical fitness evaluation will also be considered following significant absence, illness or injury prior to a return to operational duty.

The physical fitness evaluation includes:

(a) a pre-evaluation health questionnaire;

(b) an evaluation of aerobic capacity; and

PRE-EVALUATION PROCEDURE

(a) Rescue and firefighting personnel complete a pre-assessment screening questionnaire to identify contraindications for participation in the fitness assessment.

(b) If rescue and firefighting personnel have an incapacitating medical problem or a newly acquired chronic medical condition, the physical fitness assessment will be postponed until the rescue and firefighting personnel have been assessed as fit by the medical staff. In such circumstances, the rescue and firefighting personnel are assessed as unfit.

FITNESS TESTS

Individual physical fitness is tested as follows:

(a) Operational fitness tests

Physical fitness is evaluated using appropriate standard protocols. The physical fitness test ensure that the rescue and firefighting personnel are able to effectively demonstrate the following representative operational competencies:

(1) Stair or ladder climbing while carrying an additional load;

(2) Ladder raise and extension;

(3) Equipment carry;

(4) Rescue drag;

(5) Operating in an enclosed space;

(6) Hose drill and operations;

(7) Operating in a high temperature environment with breathing apparatus; and

(8) Aerobic fitness assessment:

(i) For full operational duties, a VO2 Max of at least the firefighters' average or better for age and gender and not less than 35 ml/kg/min is recommended.

(ii) estimation of VO2 Max may be performed using the following tests

(A) Shuttle run;

(B) Validated step test, e.g. Cooper, Chester;

(C) Cycle ergometer;

(D) Treadmill; and

(E) Full spiro-ergometry

The above functions may be included as part of an operational exercise or carried out separately.

(b) Simulated operational physical fitness tests

Tests conducted in an appropriate facility may be used as an alternative for new recruits, untrained personnel or where the operational test is unavailable and where there is evidence that the simulated tests are a reasonable representation of operational tasks. The choice of the appropriate test depends on various aspects such as ease of administration, safety, cost and predictive value. The following methods may be used for the fitness evaluation of rescue and firefighting personnel:

(1) Muscular strength

(i) Handgrip dynamometer;

(ii) Static bicep curl with dynamometer;

(iii) Lat pull;

(iv) Static leg press with dynamometer;

(v) Bench press; and

(vi) Leg press.

(2) Muscular endurance

(i) Push-ups, modified push-ups;

(ii) Pull-ups;

(iii) Bent knee sit-ups; and

(iv) Crunches in a given time, crunches to cadence.

(3) Flexibility

(i) Sit and reach, modified sit and reach;

(ii) Trunk extension; and

(iii) Shoulder elevation.

9.2.42 Rescue and firefighting — Personnel (cont.)

The rescue and firefighting personnel training programme shall include training in human performance, including team coordination.

Note.— Guidance material to design training programmes on human performance and team coordination can be found in the Human Factors Training Manual (Doc 9683).

AMC1 9.2.42 Rescue and firefighting — Personnel (cont.)

RULES AND PROCEDURES

(a) The aerodrome operator should ensure that rescue and firefighting personnel are aware of the rules and procedures relevant to operation of the aerodrome and the relationship of their duties and responsibilities to the aerodrome operation as a whole.

(b) Proficiency checks should verify that rescue and firefighting personnel are aware of the rules and procedures relevant to their duties and responsibilities.

AMC2 9.2.42 Rescue and firefighting — Personnel (cont.)

TRAINING OF RESCUE AND FIREFIGHTING PERSONNEL

The training of rescue and firefighting personnel should include training in, at least, the following areas:

(a) aerodrome familiarisation;

(b) aircraft familiarisation;

(c) rescue and firefighting personnel safety;

(d) emergency communications systems on the aerodrome, including aircraft fire-related alarms;

(e) use of the fire hoses, nozzles, turrets, and other appliances;

(f) application of the types of extinguishing agents required;

(g) emergency aircraft evacuation assistance;

(h) firefighting operations;

(i) adaptation and use of structural rescue and firefighting equipment for aircraft rescue and firefighting;

(j) dangerous goods;

(k) familiarisation with fire fighters' duties under the aerodrome emergency plan;

(l) low visibility procedures;

(m) human performance, including team coordination;

(n) protective clothing and respiratory protection;

(o) composite materials; and

(p) recognition of aircraft ballistic parachute systems during emergency operations.

9.2.43 Rescue and firefighting — Personnel (cont.)

During flight operations, sufficient trained and competent personnel shall be designated to be readily available to ride the rescue and firefighting vehicles and to operate the equipment at maximum capacity.

These personnel shall be deployed in a way that ensures that minimum response times can be achieved and that continuous agent application at the appropriate rate can be fully maintained. Consideration shall also be given for personnel to use hand lines, ladders and other rescue and firefighting equipment normally associated with aircraft rescue and firefighting operations.

9.2.44 Rescue and firefighting — Personnel (cont.)

The minimum number of rescue and firefighting personnel required per category of aerodrome is as follow:

Aerodrome category	Officer on duty (Officier van dienst - OVD)	Commander (Bevelvoerder)	Staff (Manschap)	Total
1	-	-	2	2
2	-	-	2	2
3	-	-	3	3
4	-	1	3	4
5	-	1	3	4
6	-	1	6	7
7	-	1	6	7
8 , 9 en 10	1	1	6	8

9.2.45 Rescue and firefighting — Personnel (cont.)

All responding rescue and firefighting personnel shall be provided with protective clothing and respiratory equipment to enable them to perform their duties in an effective manner.

9.3 Disabled aircraft removal

Note.— Guidance on removal of a disabled aircraft, including recovery equipment, is given in the Airport Services Manual (Doc 9137), Part 5. See also Annex 13 — Aircraft Accident and Incident Investigation concerning protection of evidence, custody and removal of aircraft.

9.3.1 Disabled aircraft removal

The aerodrome operator shall establish a plan for the removal of an aircraft disabled on, or adjacent to, the movement area shall be established for an aerodrome, and a coordinator designated to implement the plan, when necessary.

9.3.2 Disabled aircraft removal (cont.)

The disabled aircraft removal plan shall be based on the characteristics of the aircraft that may normally be expected to operate at the aerodrome, and include among other things:

a) a list of equipment and personnel on, or in the vicinity of, the aerodrome which would be available for such purpose; and

b) arrangements for the rapid receipt of aircraft recovery equipment kits available from other aerodromes.

9.4 Wildlife strike hazard reduction

Note.— The presence of wildlife (birds and other animals) on, or in the vicinity of an aerodrome poses a serious threat to aircraft operational safety.

9.4.1 Wildlife strike hazard reduction

The aerodrome operator shall assess, at least every six (6) months, the wildlife hazard on, and in the surrounding, of the aerodrome and notify the authority if a wildlife assessment indicates conditions in the surroundings of the aerodrome are conducive to a wildlife hazard problem.

9.4.2

Intentionally left blank.

9.4.3 Wildlife strike hazard reduction (cont.)

The aerodrome operator shall establish and implement mitigation measures (means and procedures) to minimise the risk of collisions between wildlife and aircraft, at the aerodrome.

Note.— Procedures on the management of wildlife hazards on and in the vicinity of an aerodrome, including the establishment of a wildlife hazard management programme (WHMP), wildlife risk assessment, land-use management and personnel training, are specified in the PANS-Aerodromes (Doc 9981), Part II, Chapters 1 and 6. Further guidance is given in the Airport Services Manual (Doc 9137), Part 3.

9.4.4 Garbage disposal dumps or any other source

The appropriate authority shall, if possible, take action to eliminate or to prevent the establishment of garbage disposal dumps or any other source which may attract wildlife to the aerodrome, or its vicinity, unless an appropriate wildlife assessment indicates that they are unlikely to create conditions conducive to a wildlife hazard problem.

Where the elimination of existing sites is not possible, the appropriate authority shall take the necessary steps to ensure that any risk to aircraft posed by these sites is assessed and reduced to as low as reasonably practicable.

9.4.5

Intentionally left blank.

GM1 9.4 Wildlife strike hazard reduction

WILDLIFE RISK ASSESSMENT

(a) The aerodrome operator should:

(1) conduct a risk assessment using strike data for each species, as well as information on the presence of species, the number of individuals, and their biology, and update this regularly;

(2) take into account the number of strikes for each species and the severity of damage;

arising from those strikes; and

(3) target actions on those species which are present with the highest frequency and create;

the greatest damage.

(b) Wildlife risk assessments should be made by qualified personnel.

GM2 9.4 Wildlife strike hazard reduction

WILDLIFE RISK MANAGEMENT PROGRAMME

The wildlife risk management programme may cover an area of approximately 13 km (7 NM) from the aerodrome reference point, and should include, at least, the following elements:

(a) assignment of personnel:

(1) a person who is accountable for developing and implementing the wildlife risk programme;

(2) a person who oversees the daily wildlife control activities, and analyses the collected data and carries out risk assessments in order to develop and implement the wildlife risk management programme; and

(3) trained and qualified staff who detect and record the birds/wildlife, and assess the bird/wildlife hazard, and expel hazardous birds/wildlife;

(b) a process to report, collect, and record data of struck and living birds/wildlife;

(c) a process to analyse the data and to assess the bird/wildlife hazard to develop mitigation, proactive, and reactive measures. This should include a risk assessment methodology;

(d) a process of habitat and land management both on, and in its surroundings, whenever possible, in order to reduce the attractiveness of the area to birds/wildlife;

(e) a process to remove hazardous birds/wildlife;

(f) a process for liaison with non-aerodrome agencies and local landowners, etc. to ensure the aerodrome is aware of developments that may contribute to creating additional bird hazards within the surrounding of the aerodrome's infrastructure, vegetation, land use and activities (for example crop harvesting, seed planting, ploughing, establishment of land or water features, hunting, etc. that might attract birds/wildlife).

GM3 9.4 Wildlife strike hazard reduction

TRAINING FOR WILDLIFE CONTROL

(a) The aerodrome wildlife control personnel should receive formal training prior to their initial engagement as wildlife controllers.

(b) Training for aerodrome wildlife control should be documented and records of it should be retained to satisfy periodic reviews, audits, and competence checks;

(c) Training of aerodrome wildlife control personnel should be conducted by qualified aerodrome wildlife control personnel, or specialists with proven experience in this field.

(d) Wildlife control initial training should, at least, address the following general areas:

(1) an understanding of the nature and extent of the aviation wildlife management problem, and local hazard identification;

(2) an understanding of the national and local regulations, standards, and guidance material related to aerodrome wildlife management programs (use of best-practice models);

(3) appreciation of the local wildlife ecology and biology, including (where applicable) the importance of good airfield grass management policies, and the benefits they can deliver to wildlife control;

(4) the importance of accurate wildlife identification and observations, including the use of field guides;

(5) local and national laws and regulations relating to rare and endangered species, and species of special concern, and the aerodrome operators policies relating to them;

(6) wildlife strike remains collection, and identification policies and procedures;

(7) long-term (passive) control measures, including on and off aerodrome habitat management, including identification of wildlife attractions, vegetation policies, air navigation aids protection, and drainage system, and water body management practicalities;

(8) short-term (active) tactical measures, using well established effective wildlife removal, dispersal, and control techniques;

(9) documentation of wildlife activities and control measures, and reporting procedures (the aerodrome wildlife management plan);

(10) firearms and field safety, including the use of personal protective equipment; and

(11) wildlife strike risk assessment and risk management principles, and how these programs integrate with the aerodrome's safety management system.

(e) Wildlife control staff should be fully aware of the conditions and terms of the operations of the aerodrome environment. Where this is not relevant, the wildlife control personnel should receive appropriate training, including:

(1) aerodrome airside driver training, including aerodrome familiarisation, air traffic control communications, signs and marking, navigational aids, aerodrome operations, and safety and other matters the aerodrome operator deems appropriate; and

(2) aircraft familiarisation, including aircraft identification, aircraft engine design, and impact of wildlife strikes on aircraft systems.

(f) It should be ensured that wildlife control staff maintains competence in the role. This could be achieved either by regular refresher training or another system of monitoring, acceptable to the authority. The maintenance of competence should include the areas in (d) and (e) above, and also include:

(1) reviewing firearms safety;

(2) changes in the local environment;

(3) changes in risk management policy;

(4) recent wildlife events at the aerodrome;

(5) improvements in active and passive measures; and

(6) any other matters the aerodrome operator deems appropriate.

GM4 9.4 Wildlife strike hazard reduction

RECORDING AND REPORTING OF WILDLIFE STRIKES AND OBSERVED WILDLIFE

(a) It is necessary to maintain a record of all wildlife activity or 'bird/wildlife log'. The log should include, at least, the following information:

(1) numbers, species, and location of birds/wildlife seen; and

(2) actions taken to disperse birds/wildlife, and the results of these actions.

(b) The log should be completed at regular intervals by the wildlife control staff.

(c) The log should be analysed to identify which species represent a hazard, at which times of day or year, or under which weather conditions, etc.

(d) The aerodrome operator should have a system in place to collect bird/wildlife strike reports in close cooperation with data owners, like aircraft operators, air navigation service providers, aircraft engine maintenance departments, etc. (See AMC1 1.4.13 paragraph (b) and AMC2 1.4.6(b) .

These reports are recorded by the Authority for analysis and forwarded to ICAO.

9.5 Apron management service

9.5.1 Apron management safety related activities

The aerodrome operator shall ensure that means and procedures are established and implemented on the apron in order to:

a) regulate movement with the objective of preventing collisions between aircraft, and between aircraft and obstacles;

b) regulate entry of aircraft into, and coordinate exit of aircraft from, the apron with the aerodrome control tower; and

c) ensure safe and expeditious movement of vehicles and appropriate regulation of other activities;

(d) and appropriate management of the following activities:

(i) aircraft stand allocation;

(ii) provision of marshalling services;

(iii) aircraft parking procedure and departure from the stand;

(iv) aircraft refuelling (see 9.6.3);

(v) jet blast precautions and engine tests;

(vi) start up clearances and taxi instructions.

The aerodrome operator, in order to implement point (a) may allocate responsibilities to other organisations. If the aerodrome operator allocates such responsibilities, it shall include the allocation in the aerodrome manual.

AMC1 9.5.1(d)(v) Apron management safety related activities

Jet blast precautions

(a) The aerodrome operator should make apron users aware of the hazards arising from jet blast and propeller slipstream.

(b) The aerodrome operator should require the apron users to secure vehicles and equipment properly and designate parking areas where the effect of jet blast or propeller slipstream is minimised.

(c) When designing or making changes to apron layouts, the aerodrome operator should take into consideration the effect of jet blast or propeller slipstream.

(d) The aerodrome operator should identify jet blast-sensitive places and shall either publish a request for minimum thrust to pilots, or take appropriate mitigating measures to minimize the jet blast effect.

AMC2 9.5.1(d)(v) Apron management safety related activities

Engine test

(a) The aerodrome operator should establish and implement an engine test procedure.

(b) The procedure shall include the following:

(1) the person that has the authority to approve engine tests;

(2) the areas where engine tests are conducted;

(3) the safety measures that need to be taken.

9.5.2 Apron management safety related activities (cont.)

The aerodrome operator shall ensure that the aircraft entry to and exit from the apron is coordinated with the air traffic services provider, where aircraft movement on the apron is not managed by the air traffic service provider.

Note.— Procedures on apron safety are specified in the PANS-Aerodromes (Doc 9981). Guidance on an apron management service is given in the Airport Services Manual (Doc 9137), Part 8, and in the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476).

9.5.3 Apron management safety related activities (cont.)

(a) The aerodrome operator shall ensure that the aircraft entry to and exit from the apron is coordinated with the air traffic services provider, where aircraft movement on the apron is not managed by the air traffic service provider. The coordination shall include:

(1) designated handover points between apron management service and air traffic service for arriving and departing aircraft;

(2) designated air-ground communication facilities to be used at the apron;

(3) holding areas for arriving aircraft when aircraft stands are not available.

(b) The aerodrome operator shall provide to the organisation responsible for aeronautical information in Aruba for publication in the Aeronautical Information Publication (AIP):

(1) the designated handover points referred to in point (a)(1);

(2) the designated air-ground communication facilities referred to in point (a)(2).

9.5.4 Apron management safety related activities (cont.)

Where low visibility procedures are in effect, persons and vehicles operating on an apron shall be restricted to the essential minimum by the aerodrome operator.

Note.— Guidance on related special procedures is given in the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476).

9.5.5 Apron management safety related activities (cont.)

An emergency vehicle responding to an emergency shall be given priority over all other surface movement traffic.

9.5.6 Apron management safety related activities (cont.)

A vehicle operating on an apron shall:

a) give way to an emergency vehicle; an aircraft taxiing, about to taxi, or being pushed or towed; and

b) give way to other vehicles in accordance with local regulations.

9.5.7 Apron management safety related activities (cont.)

An aircraft stand shall be visually monitored to ensure that the recommended clearance distances are provided to an aircraft using the stand.

Note.— Procedures on the training of operational personnel, and on apron safety and operations, are specified in the PANS-Aerodromes (Doc 9981), Part II, Chapters 1 and 7.

9.5.8 Apron boundaries

(a) The aerodrome operator, in cooperation with the air traffic service provider, shall define and provide the apron boundaries to the organisation responsible for aeronautical information in Aruba for publication in the Aeronautical Information Publication (AIP).

(b) When defining the apron boundaries, at least the following shall be taken into consideration:

(1) aerodrome layout;

(2) runway and taxiway configuration and method of operation;

(3) traffic density;

(4) weather conditions;

(5) operational procedures

9.5.9 Management of aircraft movements on the apron

The aerodrome operator shall ensure that:

(a) aircraft are provided with instructions on the route to be followed on the apron;

(b) adequate visual aids are provided in order to ensure that flight crews are able to identify the assigned route;

(c) the intended route is free of any obstacle that may risk collision with the moving aircraft.

9.5.10 Apron Management Services Personnel requirement

The aerodrome operator shall be responsible that for the provision of AMS, the organization:

(a) nominate a person responsible for the management and supervision of operational services related to apron management;

(b) have sufficient and qualified personnel for the planned tasks and activities to be performed in accordance with the applicable requirements;

(c) assign a sufficient number of personnel supervisors to defined duties and responsibilities, taking into account the structure of the organisation and the number of personnel employed;

(d) ensure that personnel involved in the provision of apron management service are adequately trained in accordance with the training programme. The training programme shall include:

(1) the initial training which comprises the following phases:

(i) transitional training phase, designed primarily to impart knowledge and understanding of site-specific operational procedures and task-specific aspects;

(ii) on-the-job training phase, which is the final phase of initial training during which previously acquired job-related routines and skills are integrated in practice under the supervision of a qualified training instructor in a live traffic situation;

After the on-the-job training phase, the Authority shall conduct a practical exam where personnel shall demonstrate skill and knowledge required for the provision of apron management services.

(2) recurrent training shall be conducted at intervals not exceeding 12 calendar months and contains a review of the initial training content

(3) refresher training shall be conducted when a person is absent from duties for a period of more than 12 months and shall include the entire initial training content.

(e) ensure that personnel involved in the provision of apron management service have a valid language proficiency in English. The language proficiency shall indicate the language(s), the level(s) of proficiency and the expiry date(s).

(1) The language proficiency level shall be determined in accordance with the rating scale set out in Annex I of the Chicago Convention.

(2) Language proficiency shall be demonstrated by a certificate attesting the result of the assessment.

(3) The demonstration of language proficiency shall be done through a method of assessment approved by the Department of Civil Aviation Aruba.

(4) The aerodrome operator shall make available language training to maintain the required level of language proficiency of its personnel.

(f) ensure the implementation of a proficiency check programme in order to ensure:

(1) their continued competence;

(2) that they are aware of the rules and procedures relevant to their functions and tasks. The aerodrome operator shall ensure that persons undergo proficiency checks at intervals not exceeding 12 months since the completion of their initial training.

AMC1 9.5.10(d) Apron Management Services Personnel requirement

INITIAL TRAINING

The initial training should include at least the following modules:

MODULE 1. General overview of apron management

(a) Air traffic procedures relevant to aerodrome operations;

(b) Air traffic flow management (ATFM) basic knowledge;

(c) Introduction to apron management services (AMS);

(d) Description of tasks and responsibilities;

(e) Aircraft characteristics, aircraft types, and air operator identification;

(f) Basics of meteorology;

(g) Operational agreements and procedures for the cooperation between apron management services (AMS) providers and other entities;

(h) Traffic priorities at the apron: aircraft, equipment, vehicles;

(i) Basic knowledge of air navigation services (ANS);

(j) Aeronautical information publication (AIP).

MODULE 2. Aeronautical law

(a) Introduction to aeronautical law;

(b) International aviation bodies;

(c) National aviation bodies;

(d) Overview of the relevant national and international legislation.

MODULE 3. Apron management services (AMS) equipment

(a) IT systems;

(b) Communication systems;

(c) Surveillance systems, such as closed-circuit television (CCTV), surface movement radar (SMR), etc.;

(d) Airfield lighting systems relevant to the provision of AMS;

(e) Visual/advanced visual docking guidance systems;

(f) Backup systems.

MODULE 4. Communication procedures and phraseology

(a) Radiotelephony communication phraseology;

(b) Communication procedures during emergencies;

(c) Radio communication with aircraft;

(d) Other communications on the apron.

MODULE 5. Procedures for arriving aircraft

(a) Coordination with ATS and handover of aircraft between ATS and AMS;

(b) Aircraft taxiing;

(c) Holding areas;

(d) Recording of on-block time;

(e) Aerodrome collaborative decision making (A-CDM) procedures.

MODULE 6. Procedures for departing aircraft

(a) Start-up clearances;

(b) Push-back, towing;

(c) Aircraft taxiing;

(d) Coordination with ATS and handover of aircraft between ATS and AMS;

(e) Recording of off-block time;

(f) Aerodrome collaborative decision making (A-CDM) procedures.

MODULE 7. Procedures for emergencies and incidents

(a) Awareness of the aerodrome emergency plan;

(b) Alerting of emergency services;

(c) Aircraft emergencies;

(d) Aircraft incidents at the apron;

(e) Other emergencies and incidents at the apron.

MODULE 8. Safety awareness

(a) Human factors;

(b) Basics of safety management;

(c) Internal and/or aerodrome safety management system (SMS).

MODULE 9. Stand allocation

(a) Factors that affect stand allocation to aircraft;

(b) Stand allocation procedures.

MODULE 10. Ground-servicing of aircraft

(a) Turn-around process overview;

(b) Special ground-servicing procedures.

MODULE 11. Coordination between apron management services (AMS) and air traffic services (ATS) providers

(a) Written agreement between AMS and ATS providers;

(b) Operational procedures for the cooperation between AMS and ATS;

(c) Communication with ATS;

(d) Areas of responsibility of the AMS and the ATS providers.

MODULE 12. All-weather operations

(a) Visibility conditions;

(b) Adverse weather procedures;

MODULE 13. Specific training for aerodrome

(a) Local operational agreements;

(b) Aerodrome layout;

(c) Local aerodrome procedures, included in the aerodrome manual, as regards:

(1) low visibility,

(2) adverse weather,

(3) aerodrome emergency plan,

(4) coordination with the ATS unit,

(5) coordination with the aerodrome operator,

(6) handover points,

(7) contingency procedures in case of systems' failure.

9.5.11 Formal arrangement between the organization responsible for the provision of AMS and the air traffic service provider

(a) The aerodrome operator or the organisation responsible for the provision of AMS shall have a formal arrangement with the air traffic service provider of the aerodrome where it intends to provide apron management service.

(b) The arrangement shall be concluded prior to the start of the provision of the service.

(c) The formal arrangement shall include as a minimum the following:

(1) duration of the arrangement;

(2) scope of services to be provided, including coordination of start-up clearances, taxi and push-back of aircraft;

(3) handover points between apron management service and air traffic service provider;

(4) methods of exchanging operational information between the air traffic service provider and the organisation responsible for the provision of AMS;

(5) coordination of start-up clearances, taxi and push-back of aircraft

9.6 Ground servicing of aircraft

9.6.1 Ground servicing of aircraft

Fire extinguishing equipment suitable for at least initial intervention in the event of fuel fire and personnel trained in its use shall be readily available during the ground servicing of an aircraft, and there shall be a means of quickly summoning the rescue and firefighting service in the event of a fire or major fuel spill.

9.6.2 Ground servicing of aircraft

When aircraft refuelling operations take place while passengers are embarking, on board or disembarking, ground equipment shall be positioned so as to allow:

a) the use of a sufficient number of exits for expeditious evacuation; and

b) a ready escape route from each of the exits to be used in an emergency.

9.6.3 Aircraft refuelling

(a) The aerodrome operator shall establish a procedure for aircraft refuelling.

(b) The procedure shall require, additional to 9.6.1 and 9.6.2, the following:

(1) the prohibition of open flames and the use of electrical or similar tools likely to produce sparks or arcs within the refuelling zone;

(2) the prohibition to start ground power units during refuelling;

(3) the existence of an unobstructed path from the aircraft to allow the quick removal of fuel bowsers and persons in case of emergency;

(4) the correct bonding of aircraft and fuel supply sources and the correct application of earthing procedures;

(5) the immediate notification of the fuelling supervisor in case of fuel spillage and detailed instructions on how to handle fuel spillages;

(6) the positioning of ground support equipment in such a way that emergency exits are free of any obstruction to allow the expeditious evacuation of the passengers, if passengers are embarking or disembarking or remain in the aircraft during refuelling;

(7) the discontinuation of refuelling operations if electrical thunderstorms are at or in the vicinity of the aerodrome.

9.7 Aerodrome vehicle operations

Note 1.— Procedures on the establishment of an airside driver permit scheme and vehicle/equipment safety requirements, including detailed personnel training, are specified in the PANS-Aerodromes (Doc 9981), Part II, Chapter 9.

Note 2.— Guidance on aerodrome vehicle operations is contained in Attachment A, Section 18, and on traffic rules and regulations for vehicles in the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476).

Note 3.— It is intended that roads located on the movement area be restricted to the exclusive use of aerodrome personnel and other authorized persons, and that access to the public buildings by an unauthorized person will not require use of such roads.

9.7.1 Aerodrome vehicle operations

The driver of a vehicle shall be operated:

a) on a manoeuvring area only as authorized by the aerodrome control tower; and

b) on an apron only as authorized by the appropriate designated unit.

9.7.2 Aerodrome vehicle operations (cont.)

The driver of a vehicle on the movement area shall comply with all mandatory instructions conveyed by markings and signs unless otherwise authorized by:

a) the aerodrome control tower when on the manoeuvring area; or

b) the appropriate designated unit when on the apron.

9.7.3 Aerodrome vehicle operations (cont.)

The driver of a vehicle on the movement area shall comply with all mandatory instructions conveyed by lights.

9.7.4 Aerodrome vehicle operations (cont.)

The driver of a vehicle on the movement area shall be appropriately trained for the tasks to be performed and shall comply with the instructions issued by:

a) the aerodrome control tower, when on the manoeuvring area; and

b) the appropriate designated unit, when on the apron.

9.7.5 Aerodrome vehicle operations (cont.)

The driver of a radio-equipped vehicle shall establish satisfactory two-way radio communication with the aerodrome control tower before entering the manoeuvring area and with the appropriate designated authority before entering the apron. The driver shall maintain a continuous listening watch on the assigned frequency when on the movement area.

9.8 Surface movement guidance and control systems (SMGCS)

9.8.1 Surface movement guidance and control systems — Application

The aerodrome operator shall ensure that a surface movement guidance and control system (SMGCS) is provided at the aerodrome.

Note.— Guidance on surface movement guidance and control systems is contained in the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476).

9.8.2 Surface movement guidance and control systems — Characteristics

The design of an SMGCS shall take into account:

a) the density of air traffic;

b) the visibility conditions under which operations are intended;

c) the need for pilot orientation;

d) the complexity of the aerodrome layout; and

e) movements of vehicles.

9.8.3 Surface movement guidance and control systems — Characteristics (cont.)

The visual aid components of an SMGCS, i.e. markings, lights and signs, shall be designed to conform with the relevant specifications in 5.2, 5.3 and 5.4, respectively.

9.8.4 Surface movement guidance and control systems — Characteristics (cont.)

An SMGCS shall be designed to assist in the prevention of inadvertent incursions of aircraft and vehicles onto an active runway.

9.8.5 Surface movement guidance and control systems — Characteristics (cont.)

The system shall be designed to assist in the prevention of collisions between aircraft, and between aircraft and vehicles or objects, on any part of the movement area.

Note.— Guidance on control of stop bars through induction loops and on a visual taxiing guidance and control system is contained in the Aerodrome Design Manual (Doc 9157), Part 4.

9.8.6 Surface movement guidance and control systems — Characteristics (cont.)

Where an SMGCS is provided by selective switching of stop bars and taxiway centre line lights, the following requirements shall be met:

a) taxiway routes which are indicated by illuminated taxiway centre line lights shall be capable of being terminated by an illuminated stop bar;

b) the control circuits shall be so arranged that when a stop bar located ahead of an aircraft is illuminated, the appropriate section of taxiway centre line lights beyond it is suppressed; and

c) the taxiway centre line lights are activated ahead of an aircraft when the stop bar is suppressed.

Note 1.— See Sections 5.3.17 and 5.3.20 for specifications on taxiway centre line lights and stop bars, respectively.

Note 2.— Guidance on installation of stop bars and taxiway centre line lights in SMGCSs is given in the Aerodrome Design Manual (Doc 9157), Part 4.

9.8.7 Surface movement guidance and control systems — Characteristics (cont.)

Surface movement radar for the manoeuvring area shall be provided at an aerodrome intended for use in runway visual range conditions less than a value of 350 m.

9.8.8 Surface movement guidance and control systems — Characteristics (cont.)

Surface movement radar for the manoeuvring area shall be provided at an aerodrome other than that in 9.8.7 when traffic density and operating conditions are such that regularity of traffic flow cannot be maintained by alternative procedures and facilities.

Note.— Guidance on the use of surface movement radar is given in the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476) and in the Air Traffic Services Planning Manual (Doc 9426).

9.9 Siting of equipment and installations on operational areas

Note 1.— Requirements for obstacle limitation surfaces are specified in 4.2.

Note 2.— The design of light fixtures and their supporting structures, light units of visual approach slope indicators, signs, and markers, is specified in 5.3.1, 5.3.5, 5.4.1 and 5.5.1, respectively. Guidance on the frangible design of visual and non-visual aids for navigation is given in the Aerodrome Design Manual (Doc 9157), Part 6.

9.9.1 Siting of equipment and installations on operational areas

Unless its function requires it to be there for air navigation or for aircraft safety purposes, no equipment or installation shall be:

a) on a runway strip, a runway end safety area, a taxiway strip or within the distances specified in Table 3-1, column 11, if it would endanger an aircraft; or

b) on a clearway if it would endanger an aircraft in the air.

9.9.2 Siting of equipment and installations on operational areas (cont.)

Any equipment or installation required for air navigation or for aircraft safety purposes which must be located:

a) on that portion of a runway strip within:

   1) 75 m of the runway centre line where the code number is 3 or 4; or

   2) 45 m of the runway centre line where the code number is 1 or 2; or

b) on a runway end safety area, a taxiway strip or within the distances specified in Table 3-1; or

c) on a clearway and which would endanger an aircraft in the air;

shall be frangible and mounted as low as possible.

9.9.3 Siting of equipment and installations on operational areas (cont.)

Any equipment or installation required for air navigation or for aircraft safety purposes which must be located on the non-graded portion of a runway strip shall be regarded as an obstacle and shall be frangible and mounted as low as possible.

Note.— Guidance on the siting of navigation aids is contained in the Aerodrome Design Manual (Doc 9157), Part 6.

9.9.4 Siting of equipment and installations on operational areas (cont.)

Unless its function requires it to be there for air navigation or for aircraft safety purposes, no equipment or installation shall be located within 240 m from the end of the strip and within:

a) 60 m of the extended centre line where the code number is 3 or 4; or

b) 45 m of the extended centre line where the code number is 1 or 2;

of a precision approach runway category I, II or III.

9.9.5 Siting of equipment and installations on operational areas (cont.)

Any equipment or installation required for air navigation or for aircraft safety purposes which must be located on or near a strip of a precision approach runway category I, II or III and which:

a) is situated within 240 m from the end of the strip and within:

   1) 60 m of the extended runway centre line where the code number is 3 or 4; or

   2) 45 m of the extended runway centre line where the code number is 1 or 2; or

b) penetrates the inner approach surface, the inner transitional surface or the balked landing surface;

shall be frangible and mounted as low as possible.

9.9.6 Siting of equipment and installations on operational areas (cont.)

Any equipment or installation required for air navigation or for aircraft safety purposes which is an obstacle of operational significance in accordance with 4.2.4, 4.2.11, 4.2.20 or 4.2.27 shall be frangible and mounted as low as possible.

9.10 Fencing

9.10.1 Fencing — Application

A fence or other suitable barrier shall be provided on an aerodrome to prevent the entrance to the movement area of animals large enough to be a hazard to aircraft.

9.10.2 Fencing — Application (cont.)

A fence or other suitable barrier shall be provided on an aerodrome to deter the inadvertent or premeditated access of an unauthorized person onto a non-public area of the aerodrome.

Note 1.— This is intended to include the barring of sewers, ducts, tunnels, etc., where necessary to prevent access.

Note 2.— Special measures may be required to prevent the access of an unauthorized person to runways or taxiways which overpass public roads.

9.10.3 Fencing — Application (cont.)

Suitable means of protection shall be provided to deter the inadvertent or premeditated access of unauthorized persons into ground installations and facilities essential for the safety of civil aviation located off the aerodrome.

9.10.4 Fencing — Location

The fence or barrier shall be located so as to separate the movement area and other facilities or zones on the aerodrome vital to the safe operation of aircraft from areas open to public access.

9.10.5 Fencing — Location (cont.)

When greater security is thought necessary, a cleared area shall be provided on both sides of the fence or barrier to facilitate the work of patrols and to make trespassing more difficult. Consideration shall be given to the provision of a perimeter road inside the aerodrome fencing for the use of both maintenance personnel and security patrols.

9.11 Security lighting

9.11 Security Lighting

The fence or barrier at the aerodrome shall be illuminated at a minimum essential level.

Consideration shall be given to locating lights so that the ground area on both sides of the fence or barrier, particularly at access points, is illuminated.

9.12 Autonomous runway incursion warning system

9.12.0 Autonomous runway incursion warning system

The inclusion of detailed specifications for an autonomous runway incursion warning system (ARIWS) in this section is not intended to imply that an ARIWS has to be provided at an aerodrome.

Note 1.— The implementation of an ARIWS is a complex issue deserving careful consideration by aerodrome operators, air traffic services and States, and in coordination with the aircraft operators.

Note 2.— Attachment A, Section 20, provides a description of an ARIWS and information on its use.

9.12.1 Autonomous runway incursion warning system — Characteristics

Where an ARIWS is installed at an aerodrome:

a) it shall provide autonomous detection of a potential incursion or of the occupancy of an active runway and a direct warning to a flight crew or vehicle operator;

b) it shall function and be controlled independently of any other visual system on the aerodrome;

c) its visual aid components, i.e. lights, shall be designed to conform with the relevant specifications in 5.3; and

d) failure of part or all of it shall not interfere with normal aerodrome operations. To this end, provision shall be made

to allow the ATC unit to partially or entirely shut down the system.

Note 1.— An ARIWS may be installed in conjunction with enhanced taxiway centre line markings, stop bars or runway guard lights.

Note 2.— It is intended that the system(s) be operational under all weather conditions, including low visibility.

Note 3.— An ARIWS may share common sensory components of an SMGCS or A-SMGCS, however, it operates independently of either system.

9.12.2 Autonomous runway incursion warning system — Characteristics (cont.)

Where an ARIWS is installed at an aerodrome, information on its characteristics and status shall be provided to the organisation responsible for aeronautical information in Aruba for promulgation in the AIP with the description of the aerodrome surface movement guidance and control system and markings as specified in Annex 15.

Note.— Detailed specifications concerning the AIP are contained in PANS-AIM (Doc 10066).

CHAPTER 10. AERODROME MAINTENANCE

10.1 General

10.1.1 Maintenance — General

The aerodrome operator shall establish and implement a maintenance programme, including preventive maintenance where appropriate, shall be established at an Aerodrome to maintain facilities in a condition which does not impair the safety, regularity or efficiency of air navigation.

The aerodrome operator shall ensure that appropriate and adequate means are provided for the effective implementation of the maintenance programme.

Note 1.— Preventive maintenance is programmed maintenance work done in order to prevent a failure or degradation of facilities.

Note 2.— “Facilities” are intended to include such items as pavements, visual aids, fencing, drainage systems, electrical systems and buildings.

10.1.2 Maintenance — General (cont.)

The design and application of the maintenance programme shall observe human factors principles.

Note 1.— Guidance material on human factors principles can be found in the Human Factors Training Manual (Doc 9683) and in the Airport Services Manual (Doc 9137), Part 8.

Note 2.— General principles and procedures on the training of aerodrome personnel, including training programmes and competence checks, are specified in the PANS-Aerodromes (Doc 9981).

AMC1 10.1.1 Maintenance — General

MAINTENANCE PROGRAMME

(a) The aerodrome operator should ensure that the maintenance programme:

(1) specifies the aerodrome facilities, systems, installations and equipment subject to maintenance;

(2) contains the necessary information for its timely and correct implementation including but not limited to:

(i) the type of inspections/checks to be carried out (e.g. visual inspection, cleaning of equipment, equipment stability/alignment, calibration, etc.) for each facility, system, installation and equipment, taking also into account factors such as their location and meteorological phenomena;

(ii) the frequency of inspections/checks for each facility, system, installation and equipment;

(iii) the tools and equipment required for each type of inspection/check; and

(iv) the periodic replacement of parts that may be required in accordance with the maintenance instructions of the manufacturer of the respective facility, system, installation and equipment, as appropriate.

(b) The aerodrome operator should ensure that arrangements are in place for timely corrective maintenance actions. Such arrangements should cover the cases of maintenance needs that are:

(1) identified either during preventive maintenance activities; or

(2) raised at any other time (e.g. due to equipment malfunction or failure).

GM1 10.1.1 Maintenance — General

MAINTENANCE PROGRAMME

The maintenance programme also includes maintenance of communication and alerting systems, fences and access control devices, perimeter roads and lighting, passenger boarding bridges, etc.

10.2 Pavements

10.2.1 Maintenance of pavements, other ground surfaces and drainage

The surfaces of all movement areas including pavements (runways, taxiways and aprons) and adjacent areas shall be inspected and their conditions monitored regularly as part of an aerodrome preventive and corrective maintenance programme with the objective of avoiding and eliminating any foreign object debris (FOD) that might cause damage to aircraft or impair the operation of aircraft systems.

Note 1.— See 2.9.3 for inspections of movement areas.

Note 2.— Procedures on carrying out daily inspections of the movement area and control of FOD are given in the PANS-Aerodromes (Doc 9981), the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476) and the Advanced Surface Movement Guidance and Control Systems (A-SMGCS) Manual (Doc 9830).

Note 3.— Additional guidance on sweeping/cleaning of surfaces is contained in the Airport Services Manual (Doc 9137), Part 9.

Note 4.— Guidance on precautions to be taken in regard to the surface of shoulders is given in Attachment A, Section 8, and the Aerodrome Design Manual (Doc 9157), Part 2.

Note 5.— Where the pavement is used by large aircraft or aircraft with tire pressures in the upper categories referred to in 2.6.6 c), particular attention should be given to the integrity of light fittings in the pavement and pavement joints.

10.2.2 Maintenance of pavements, other ground surfaces and drainage (cont.)

The surface of a runway shall be maintained in a condition such as to prevent formation of harmful irregularities.

Note.— See Attachment A, Section 5 for more information.

10.2.3 Maintenance of pavements, other ground surfaces and drainage (cont.)

(a) The aerodrome operator shall maintain a paved runway in a condition so as to provide surface friction characteristics at or above the minimum friction standards established in table 1.

Table 1

	65 km/h		95 km/h	
	Minimum	Maintenance planning	Minimum	Maintenance planning
Mu-meter Trailer	0.42	0.52	0.26	0.38
Skiddometer Trailer	0.50	0.60	0.34	0.47
Surface Friction Tester Vehicle	0.50	0.60	0.34	0.47
Runway Friction Tester Vehicle	0.50	0.60	0.41	0.54
TATRA Friction Tester Vehicle	0.48	0.57	0.42	0.52
RUNAR Trailer	0.45	0.52	0.32	0.42
GRIPTESTER Trailer	0.43	0.53	0.24	0.36

(b) Other friction measuring devices can be used, provided they have been correlated with, at least, one test equipment mentioned in the table above.

(c) Measurements at or below the maintenance planning level trigger a complete survey of the texture, contaminant and drainage state of the affected runway third.

(d) A complete survey shall ensure that the runway surface is able to create enough grip by the aeroplane tyre to ensure adequate aeroplane stopping and crosswind capability for the desired operation on a wet runway. This is achieved by ensuring that:

(1) exposed texture can indent the tyre rubber; and

(2) water drains from the runway pavement.

(e) In order to achieve the objectives of point (d), an inspection of the surface friction characteristics shall, as a minimum, ensure:

(1) the presence of exposed microtexture by touching the aggregates, if the polished or rubber coated extends to 100 m in the zone used by aeroplanes;

(2) the presence of macrotexture;

(3) that grooves, if present, are open and within set limits according to their design;

(4) that porous friction course, if present, drains according to its design; and

(5) that slopes are above minimum design specifications.

GM 10.2.3 Pavements, other ground surfaces and drainage

MONITORING OF PHYSICAL PARAMETERS

The following table describes how the physical parameters of the runway surface are monitored.

Physical parameter	How to monitor
Microtexture	Presence of microtexture is ensured by touching the pavement surface. If it feels smooth, there is a lack of microtexture, most commonly due to rubber deposits which normally should be visually detectable or by polishing. In either case, the amount of free exposed microtexture should be assessed.
Macrotexture	Can be measured using volumetric or profile measurement method and expressed by ESDU classification. ESDU 15002 groups runways into five classifications labelled A through E with A being the smoothest and E the most heavily textured. The classification can be used to compare the runway texture relevant to the recommended texture depth which is 1.0 mm.
Drainage	Slopes are within the certification specifications. If the slope falls below the minimum values, then the runway becomes more susceptible to standing water during heavy rainfalls.
Ponding	Visually, during and after rain storm events as the runway dries up.
Rutting	Visually, during and after rain storm events. The degree of rutting can be measured using a straight edge.
Sand and vegetation	Visually during and after rain storm events. Normally, ordinary maintenance activities should prevent sand to accumulate and vegetation to form alongside the runway to such a degree that it becomes a hazard.

10.2.4 Maintenance of pavements, other ground surfaces and drainage (cont.)

Runway surface friction characteristics for maintenance purposes shall be periodically measured and reported to the authority by the aerodrome operator with a continuous friction measuring device using self-wetting features and documented. The frequency of these measurements shall be sufficient to determine the trend of the surface friction characteristics of the runway.

Note 1.— Guidance on evaluating the runway surface friction characteristics is provided in Assessment, Measurement and Reporting of Runway Surface Conditions (Cir 355).

Note 2.— The objective of 10.2.3 to 10.2.8 is to ensure that the surface friction characteristics for the entire runway remain at or above a minimum friction level.

AMC1 10.2.4 Maintenance of pavements, other ground surfaces and drainage

PERIODIC ASSESSMENTS OF RUNWAY SURFACE FRICTION CHARACTERISTICS

The aerodrome operator when establishing a plan of periodic assessments of runway surface friction characteristics, should take into consideration the number of jet aircraft movements per runway end, the weight of the aircraft, the type and age of the surface of the runway as well as climatic conditions.

AMC2 10.2.4 Maintenance of pavements, other ground surfaces and drainage

TREND MONITORING OF RUNWAY SURFACE FRICTION CHARACTERISTICS

The aerodrome operator should monitor the trend of degradation of runway surface friction characteristics that is caused by:

(a) rubber deposits;

(b) surface polishing; and

(c) poor drainage.

AMC3 10.2.4 Maintenance of pavements, other ground surfaces and drainage

FUNCTIONAL FRICTION EVALUATIONS WITH CONTINUOUS FRICTION MEASURING DEVICES

The aerodrome operator when conducting functional friction evaluations with continuous friction measuring device, should:

(a) for friction evaluations on runways at 65 km/h, begin recording the data 150 m from the threshold end to allow for adequate acceleration distance and terminate approximately 150 m from the opposite end of the runway to allow for adequate distance to safely decelerate the vehicle;

(b) for friction evaluations on runways at 95 km/h, begin recording the data 300 m from the threshold end to allow for adequate acceleration distance and terminate approximately 300 m from the opposite end of the runway to allow for adequate distance to safely decelerate the vehicle; and

(c) conduct the surveys at a distance from the runway centre line that is representative of the wheel span of the aeroplanes operating on the runway.

The aerodrome layout or other circumstances may dictate other distances in order to ensure the personal safety of the operator of the friction measuring device.

GM1 10.2.4 Maintenance of pavements, other ground surfaces and drainage

TREND MONITORING PROGRAMME

(a) The objective of the trend monitoring programme is to ensure that the surface friction characteristics for the entire runway remain at or above the minimum standards, to avoid the runway becoming slippery wet.

(b) Degradation is typically caused by rubber deposits, surface polishing or poor drainage. These can be mitigated as follows:

(1) Accumulation trend of rubber can be managed through a rubber removal programme.

(2) Polishing trend of the surface can be managed by monitoring loss of sharpness and retexturing/resurfacing programme.

(3) Drainage trend can be managed by monitoring changes in geometry and blocking of drainage channels and reshaping programme.

(c) In the construction of new runways or the resurfacing of existing runways, the construction of surfaces with adequate slopes and aggregate of angular fragments from crushed gravel or stone so as to provide a sharp texture will help to ensure surface friction characteristics providing good braking action in wet conditions. The surface friction characteristics of a new constructed or resurfaced runway surface establish the normal starting point for trend monitoring; however, trend monitoring can also start at any given time through the lifespan of a pavement.

(d) The determination that a runway or portion thereof is slippery wet stems from various methods used by themselves or in combination. Additionally, substandard runways or portion thereof can be identified through repeated reports by aeroplane operators based upon flight crew experience or through analysis of aeroplane stopping performance. When such reports are received, it is an indication that the surface friction characteristics are likely to be severely degraded and immediate remedial action is necessary.

GM2 10.2.4 Maintenance of pavements, other ground surfaces and drainage

FRICTION EVALUATIONS WITH CONTINUOUS FRICTION MEASURING DEVICES

(a) The lateral location on the runway for performing friction measurements is based on the type and/or mix of aircraft operating on the runway:

(1) For runways serving only narrow-body aircraft, friction measurements are conducted 3 m to 5 m from the runway centre line.

(2) For runways serving narrow-body and wide-body aircraft, friction measurements are conducted 3 m and 6 m from the runway centre line to determine the worst-case condition. If the worst-case condition is found to be consistently to one track, future measurements may be limited to this track. Care needs to be exercised, however, to account for any future and/or seasonal changes in aircraft mix.

(b) The measurements are performed using a self-wetting continuous friction measuring device on a dry runway surface.

(c) Interpretation of comparative self-wetting friction measurements

(1) The texture of the tyre pavement contact patch area in direct contact with aircraft tyre penetrates the rubber of the aircraft tyre and creates horizontal forces in the aircraft tyre and creates grip. Grip is a micro-movement of the rubber over the texture indenting the rubber. This micro-movement is called slippage. On a free-rolling aircraft tyre, there is no relative movement between the aircraft tyre and the pavement regardless of the rolling speed. The amount of exposed texture, and the quality thereof, both micro and macrotexture, defines the ability of the pavement surface to create wet grip performance of the aircraft tyre.

(2) If the aircraft wheel is braked and the horizontal forces applied on the aircraft tyre are higher than those produced by the grip, the aircraft tyre starts to skid.

(3) The friction coefficient that can be calculated is a dynamic friction coefficient. The dynamic friction coefficient is lower than the static friction coefficient (maximum tyre grip that can be achieved). Related to stopping performance of the aircraft, the operation has become friction-limited when a tyre starts skidding.

(4) The basic assumption for the using a self-wetting continuous friction measuring device with a forced skid is to mirror a braked skidding aircraft tyre on a wet pavement surface. This is an oversimplification since the aircraft tyres are controlled by an anti-skid system and the friction measuring devices operate at a fixed slip.

(5) It is noted that friction measuring device values are not used to determine and report surface conditions. Joint industry and multi-national government tests have not established a reliable correlation between runway friction values and the relationship to aeroplane braking performance. However, the measured values can be used in a comparative way to support other survey information collected.

(6) The measured friction coefficient is a dynamic friction coefficient where the surfaces are forced to be in relative motion regardless of the measuring speed. The degree of relative motion is friction measuring device-specific.

(7) A complete survey is, as a minimum, performed at speeds of 65 km/h and 95 km/h.

(8) The measured value is an indication of the overall texture, contaminant and drainage capability of the pavement surface in the tyre pavement contact patch area of a skidding tyre. No single capability can be extracted but certain qualities can be deduced from comparative measurements using the same friction measurement device on the same surface.

(9) The measured values are to be compared with measured values from previous surveys in order to monitor the trend of the texture, contaminant and drainage characteristics of the runway pavement.

(i) Texture

(A) At low speed, the microtexture of the aggregates in the tyre pavement contact patch area penetrates the residual water film between the pavement and the rubber. These are qualities associated with 65 km/h. Lower comparative values at low speed indicate reduced exposed microtexture and are indicative of microtexture cover-up (rubber) and polishing of aggregates.

(B) At higher speed,the microtexture may not penetrate the residual water film. As speed increases, the residual water film may become thicker and reduce the amount of microtexture that penetrates the water film. If no microtexture penetrates the water film, there is no effect of the microtexture on the performance of the aircraft tyre. The tyre then goes into an aquaplaning mode with no stopping and directional control capability. These are qualities associated with 95 km/h, and lower comparative values are indicative of the combined rubber build-up and reduced drainage capability.

(C) Macrotexture creates escape channels for bulk water and reduces the susceptibility of the pavement surface to build up water films under the aircraft tyre. Lower comparative values at high speed indicate reduced macrotexture.

(ii) Contaminant

(A) The most common contaminant to consider is the build-up of rubber. Build– up of rubber reduces the amount of exposed microtexture and the fill-up of the macrotexture, and thereby reduces the drainage capability of the pavement in the tyre pavement contact patch area. Affected areas can readily be identified by the eye.

(B) If the aerodrome operator suspects that the runway has a microtexture problem, this can be identified by the touch; pavement surface does feel 'sandpapery'. This applies to both rubber build-up, where the aggregates get covered, and the polishing of aggregates.

(C) For interpretation of comparative measurements on rubber built-up areas, see (i) Texture above.

(10) Drainage

(i) The aircraft tyres' contribution to drainage is the drainage through the longitudinal grooves. The pavements' contribution is the drainage through their macrotexture. This drainage can be in all directions, and in the case of porous friction course drainage downwards, through the porous friction course layer itself. If the pavement is transverse grooved, the drainage in the transverse direction of travel is enhanced. Lower comparative values at high speed indicate reduced drainage capability under the aircraft tyre and reduced macrotexture.

(ii) It should be noted that the effects of drainage defects, such as ponding and rutting, will not be detected by comparative measurements by self-wetting continuous friction measuring devices. As the self-wetting continuous friction measurements are performed on a dry runway, there will be no ponding, nor any water stream in any rutting if the runway has such defects.

10.2.5 Maintenance of pavements, other ground surfaces and drainage (cont.)

When runway surface friction measurements are made for maintenance purposes using a self-wetting continuous friction measuring device, the performance of the device shall meet the standard agreed with the Authority.

10.2.6 Maintenance of pavements, other ground surfaces and drainage (cont.)

The aerodrome operator shall ensure that the personnel designated for measuring runway surface friction required in 10.2.5, are competent and trained to fulfil their duties.

10.2.7 Maintenance of pavements, other ground surfaces and drainage (cont.)

(a) Corrective maintenance action shall be taken by the aerodrome operator to prevent the runway surface friction characteristics for either the entire runway or a portion thereof from falling below a minimum friction level specified by the Authority.

(b) In the case that the friction characteristics are below the minimum friction level, the operator shall inform the authority regarding the measures to bring the runway back in the condition as stated in 10.2.3.

10.2.8 Maintenance of pavements, other ground surfaces and drainage (cont.)

The runway surface shall be visually assessed by the aerodrome operator, as necessary, under natural or simulated rain conditions for ponding or poor drainage.

AMC1 10.2.8 Maintenance of pavements, other ground surfaces and drainage

(a) The evaluation should be conducted for the full width and length of the pavement and should focus on:

    (1) slopes;

    (2) texture; and

    (3) drainage.

(b) The area symmetrical from the centre line representative of the wheel span of the aeroplanes operating on the runway should be inspected with special focus on:

(1) rubber deposits;

(2) polishing of aggregates; and

(3) amount of exposed texture.

10.2.9 Maintenance of pavements, other ground surfaces and drainage (cont.)

When a taxiway is used by turbine-engined aeroplanes, the surface of the taxiway shoulders shall be maintained so as to be free of any loose stones or other objects that could be ingested by the aeroplane engines.

Note.— Guidance on this subject is given in the Aerodrome Design Manual (Doc 9157), Part 2.

10.3 Removal of contaminants

10.3.1 Removal of contaminants

The aerodrome operator shall ensure, that standing water, mud, dust, sand, oil, rubber deposits and other contaminants be removed from the surface of runways in use as rapidly and completely as possible to minimize accumulation.

10.3.2

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10.3.3

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10.3.6 Removal of contaminants (cont.)

Chemicals which may have harmful effects on aircraft or pavements, or chemicals which may have toxic effects on the aerodrome environment, shall not be used.

10.4 Runway pavement overlays

10.4.0 Aerodrome works safety

The aerodrome operator shall establish and implement procedures to ensure that:

(1) aircraft safety is not affected by aerodrome works; and

(2) aerodrome works safety is not affected by aerodrome operational activities.

AMC1 10.4.0 Aerodrome works safety

GENERAL

(a) The procedures should be appropriate to the volume and nature of operations at the aerodrome.

(b) Construction or maintenance work on the movement area, or work affecting aerodrome operations should be planned, established, implemented, or approved by the aerodrome operator.

(c) The scope of work, physical extent, and time period should be notified to the relevant parties concerned. If such work will render limitations to the use of a particular runway, additional measures should be implemented to ensure safety. In case the works necessitate the temporary change of the declared distances of the runway, a recalculation of the declared distances should be performed, in accordance with an established procedure, and the relevant information should be provided to the Authority, the air traffic services and organisation responsible for aeronautical information in Aruba, before the implementation of the new declared distances. The aerodrome operator should also request the broadcast of relevant information via the local ATIS.

(d) Roles and responsibilities for operations and tasks associated with the reduction of runway length available and the work in progress (WIP) are clearly understood and complied with.

(e) The aerodrome operator should put in place appropriate measures to monitor the safety of the aerodrome and aircraft operations during aerodrome works such that timely corrective action is taken when necessary to assure continued safe operations.

(f) The aerodrome operator should ensure the works site is returned to operational use in a safe and timely manner by ensuring:

(1) the works site is cleared of personnel, vehicles, and plant in a safe and timely manner;

(2) The works-affected area is inspected for operational serviceability in accordance with the hand-back procedures; and

(3) relevant authorities or organisations are notified of the restoration of aerodrome serviceability in accordance with procedures, using suitable means of communication.

10.4.1 Runway pavement overlays

The aerodrome operator shall ensure that when a runway is to be returned temporarily to an operational status before resurfacing is complete, the longitudinal slope of the temporary ramp, measured with reference to the existing runway surface or previous overlay course, should be:

a) 0.5 to 1.0 per cent for overlays up to and including 5 cm in thickness; and

b) not more than 0.5 per cent for overlays more than 5 cm in thickness.

10.4.2 Runway pavement overlays (cont.)

The aerodrome operator shall ensure that overlaying shall proceed from one end of the runway toward the other end so that based on runway utilization most aircraft operations will experience a down ramp.

10.4.3 Runway pavement overlays (cont.)

The aerodrome operator shall ensure that the entire width of the runway shall be overlaid during each work session.

10.4.4 Runway pavement overlays (cont.)

The aerodrome operator shall ensure that before a runway being overlaid is returned to a temporary operational status, a runway centre line marking conforming to the specifications in Section 5.2.3 be provided. Additionally, the location of any temporary threshold shall be identified by a 3.6 m wide transverse stripe.

10.4.5 Runway pavement overlays (cont.)

The aerodrome operator shall ensure that the overlay be constructed and maintained above the minimum friction level specified in 10.2.3.

10.5 Visual aids

10.5.1 Maintenance of visual aids

A light shall be deemed to be unserviceable when the main beam average intensity is less than 50 per cent of the value specified in the appropriate figure in Appendix 2. For light units where the designed main beam average intensity is above the value shown in Appendix 2, the 50 per cent value shall be related to that design value.

10.5.2 Maintenance of visual aids (cont.)

A preventive and corrective maintenance programme shall be established and implemented by the aerodrome operator to ensure serviceability of the individual lights and aerodromes lighting and marking system reliability.

Note.— Guidance on preventive maintenance of visual aids is given in the Airport Services Manual (Doc 9137), Part 9.

10.5.3 Maintenance of visual aids (cont.)

The system of preventive maintenance implemented for a precision approach runway category II or III shall include at least the following checks:

a) visual inspection and in-field measurement of the intensity, beam spread and orientation of lights included in the approach and runway lighting systems;

b) control and measurement of the electrical characteristics of each circuitry included in the approach and runway lighting systems; and

c) control of the correct functioning of light intensity settings used by air traffic control.

10.5.4 Maintenance of visual aids (cont.)

In-field measurement of intensity, beam spread and orientation of lights included in approach and runway lighting systems for a precision approach runway category II or III shall be undertaken by measuring all lights, as far as practicable, to ensure conformance with the applicable specification of Appendix 2.

10.5.5 Maintenance of visual aids (cont.)

Measurement of intensity, beam spread and orientation of lights included in approach and runway lighting systems for a precision approach runway category II or III shall be undertaken using a mobile measuring unit of sufficient accuracy to analyse the characteristics of the individual lights.

10.5.6 Maintenance of visual aids (cont.)

The frequency of measurement of lights for a precision approach runway category II or III shall be based on traffic density, the local pollution level, the reliability of the installed lighting equipment and the continuous assessment of the results of the in-field measurements but, in any event, shall not be less than twice a year for in-pavement lights and not less than once a year for other lights.

10.5.7 Maintenance of visual aids (cont.)

The system of preventive maintenance employed for a precision approach runway category II or III shall have as its objective that, during any period of category II or III operations, all approach and runway lights are serviceable and that, in any event, at least:

a) 95 per cent of the lights are serviceable in each of the following particular significant elements:

   1) precision approach category II and III lighting system, the inner 450 m;

   2) runway centre line lights;

   3) runway threshold lights; and

   4) runway edge lights;

b) 90 per cent of the lights are serviceable in the touchdown zone lights;

c) 85 per cent of the lights are serviceable in the approach lighting system beyond 450 m; and

d) 75 per cent of the lights are serviceable in the runway end lights.

In order to provide continuity of guidance, the allowable percentage of unserviceable lights shall not be permitted in such a way as to alter the basic pattern of the lighting system. Additionally, an unserviceable light shall not be permitted adjacent to another unserviceable light, except in a barrette or a crossbar where two adjacent unserviceable lights may be permitted.

Note.— With respect to barrettes, crossbars and runway edge lights, lights are considered to be adjacent if located consecutively and:

— *laterally: in the same barrette or crossbar; or*

— *longitudinally: in the same row of edge lights or barrettes.*

10.5.8 Maintenance of visual aids (cont.)

The system of preventive maintenance employed for a stop bar provided at a runway-holding position used in conjunction with a runway intended for operations in runway visual range conditions less than a value of 350 m shall have the following objectives:

a) no more than two lights will remain unserviceable; and

b) two adjacent lights will not remain unserviceable unless the light spacing is significantly less than that specified.

10.5.9 Maintenance of visual aids (cont.)

The system of preventive maintenance employed for a taxiway intended for use in runway visual range conditions less than a value of 350 m shall have as its objective that no two adjacent taxiway centre line lights be unserviceable.

10.5.10Maintenance of visual aids (cont.)

The system of preventive maintenance employed for a precision approach runway category I shall have as its objective that, during any period of category I operations, all approach and runway lights are serviceable and that, in any event, at least 85 per cent of the lights are serviceable in each of the following:

a) precision approach category I lighting system;

b) runway threshold lights;

c) runway edge lights; and

d) runway end lights.

In order to provide continuity of guidance an unserviceable light shall not be permitted adjacent to another unserviceable light unless the light spacing is significantly less than that specified.

Note.— In barrettes and crossbars, guidance is not lost by having two adjacent unserviceable lights.

10.5.11Maintenance of visual aids (cont.)

The system of preventive maintenance employed for a runway meant for take-off in runway visual range conditions less than a value of 550 m shall have as its objective that, during any period of operations, all runway lights are serviceable and that in any event:

a) at least 95 per cent of the lights are serviceable in the runway centre line lights (where provided) and in the runway edge lights; and

b) least 75 per cent of the lights are serviceable in the runway end lights.

In order to provide continuity of guidance, an unserviceable light shall not be permitted adjacent to another unserviceable light.

10.5.12Maintenance of visual aids (cont.)

The system of preventive maintenance employed for a runway meant for take-off in runway visual range conditions of a value of 550 m or greater shall have as its objective that, during any period of operations, all runway lights are serviceable and that, in any event, at least 85 per cent of the lights are serviceable in the runway edge lights and runway end lights. In order to provide continuity of guidance, an unserviceable light shall not be permitted adjacent to another unserviceable light.

10.5.13Maintenance of visual aids (cont.)

During low visibility procedures the appropriate authority shall restrict construction or maintenance activities in the proximity of aerodrome electrical systems.

APPENDIX 1. COLOURS FOR AERONAUTICAL GROUND LIGHTS, MARKINGS, SIGNS AND PANELS

1. General

Introductory Note.— The following specifications define the chromaticity limits of colours to be used for aeronautical ground lights, markings, signs and panels. The specifications are in accord with the 1983 specifications of the International Commission on Illumination (CIE), except for the colour orange in Figure A1-2.

It is not possible to establish specifications for colours such that there is no possibility of confusion. For reasonably certain recognition, it is important that the eye illumination be well above the threshold of perception, that the colour not be greatly modified by selective atmospheric attenuations and that the observer's colour vision be adequate. There is also a risk of confusion of colour at an extremely high level of eye illumination such as may be obtained from a high-intensity source at very close range. Experience indicates that satisfactory recognition can be achieved if due attention is given to these factors.

*The chromaticities are expressed in terms of the standard observer and coordinate system adopted by the International Commission on Illumination (CIE) at its Eighth Session at Cambridge, England, in 1931.**

The chromaticities for solid state lighting (e.g. LED) are based upon the boundaries given in the standard S 004/E-2001 of the International Commission on Illumination (CIE), except for the blue boundary of white.

2. Colours for aeronautical ground lights

2.1 Chromaticities for lights having filament-type light sources

2.1.1 The chromaticities of aeronautical ground lights with filament-type light sources shall be within the following boundaries:

* See CIE Publication No. 15, Colorimetry (1971).

CIE Equations (see Figure A1-1a):	
a) Red	
Purple boundary	y = 0.980 – x
Yellow boundary	y = 0.335, except for visual approach slope indicator systems
Yellow boundary	y = 0.320, for visual approach slope indicator systems
Note.— See 5.3.5.15 and 5.3.5.31.	
b) Yellow	
Red boundary	y = 0.382
White boundary	y = 0.790 – 0.667x
Green boundary	y = x – 0.120
c) Green	
Yellow boundary	x = 0.360 – 0.080y
White boundary	x = 0.650y
Blue boundary	y = 0.390 – 0.171x
d) Blue	
Green boundary	y = 0.805x + 0.065
White boundary	y = 0.400 – x
Purple boundary	x = 0.600y + 0.133
e) White	
Yellow boundary	x = 0.500
Blue boundary	x = 0.285
Green boundary	y = 0.440 and y = 0.150 + 0.640x
Purple boundary	y = 0.050 + 0.750x and y = 0.382
f) Variable white	
Yellow boundary	x = 0.255 + 0.750y and y = 0.790 – 0.667x
Blue boundary	x = 0.285
Green boundary	y = 0.440 and y = 0.150 + 0.640x
Purple boundary	y = 0.050 + 0.750x and y = 0.382

Note.— Guidance on chromaticity changes resulting from the effect of temperature on filtering elements is given in the Aerodrome Design Manual (Doc 9157), Part 4.

2.1.2 Where dimming is not required, or where observers with defective colour vision must be able to determine the colour of the light, green signals should be within the following boundaries:

Yellow boundary	y = 0.726 – 0.726x
White boundary	x = 0.650y
Blue boundary	y = 0.390 – 0.171x

Note.— Where the colour signal is to be seen from long range, it has been the practice to use colours within the boundaries of 2.1.2.

2.1.3 Where increased certainty of recognition from white is more important than maximum visual range, green signals should be within the following boundaries:

Yellow boundary	$y = 0.726 - 0.726x$
White boundary	$x = 0.625y - 0.041$
Blue boundary	$y = 0.390 - 0.171x$

2.2 Discrimination between lights having filament-type sources

2.2.1 If there is a requirement to discriminate yellow and white from each other, they should be displayed in close proximity of time or space as, for example, by being flashed successively from the same beacon.

2.2.2 If there is a requirement to discriminate yellow from green and/or white, as for example on exit taxiway centre line lights, the y coordinates of the yellow light should not exceed a value of 0.40.

Note.— The limits of white have been based on the assumption that they will be used in situations in which the characteristics (colour temperature) of the light source will be substantially constant.

2.2.3 The colour variable white is intended to be used only for lights that are to be varied in intensity, e.g. to avoid dazzling. If this colour is to be discriminated from yellow, the lights should be so designed and operated that:

a) the x coordinate of the yellow is at least 0.050 greater than the x coordinate of the white; and

b) the disposition of the lights will be such that the yellow lights are displayed simultaneously and in close proximity to the white lights.

2.3 Chromaticities for lights having a solid state light source

2.3.1 The chromaticities of aeronautical ground lights with solid state light sources, e.g. LEDs, shall be within the following boundaries:

CIE Equations (see Figure A1-1b):		
a) Red		
	Purple boundary	y = 0.980 – x
	Yellow boundary	y = 0.335, except for visual approach slope indicator systems
	Yellow boundary	y = 0.320, for visual approach slope indicator systems
Note.— See 5.3.5.15 and 5.3.5.31.		
b) Yellow		
	Red boundary	y = 0.387
	White boundary	y = 0.980 – x
	Green boundary	y = 0.727x + 0.054
c) Green (also refer to 2.3.2 and 2.3.3)		
	Yellow boundary	x = 0.310
	White boundary	x = 0.625y – 0.041
	Blue boundary	y = 0.400
d) Blue		
	Green boundary	y = 1.141x – 0.037
	White boundary	y = 0.400 – y
	Purple boundary	x = 0.134 + 0.590y
e) White		
	Yellow boundary	x = 0.440
	Blue boundary	x = 0.320
	Green boundary	y = 0.150 + 0.643x
	Purple boundary	y = 0.050 + 0.757x
f) Variable white		
	The boundaries of variable white for solid state light sources are those of e) White above.	

2.3.2 Where observers with defective colour vision must be able to determine the colour of the light, green signals should be within the following boundaries:

Yellow boundary	y = 0.726 – 0.726x
White boundary	x = 0.625y – 0.041
Blue boundary	y = 0.400

2.3.3 In order to avoid a large variation of shades of green, if colours within the boundaries below are selected, colours within the boundaries of 2.3.2 should not be used.

Yellow boundary	x = 0.310
White boundary	x = 0.625y – 0.041
Blue boundary	y = 0.726 – 0.726x

2.4 Colour measurement for filament-type and solid state-type light sources

2.4.1 The colour of aeronautical ground lights shall be verified as being within the boundaries specified in Figure A1-1a or A1-1b, as appropriate, by measurement at five points within the area limited by the innermost isocandela curve (isocandela diagrams in Appendix 2 refer), with operation at rated current or voltage. In the case of elliptical or circular isocandela curves, the colour measurements shall be taken at the centre and at the horizontal and vertical limits. In the case of rectangular isocandela curves, the colour measurements shall be taken at the centre and the limits of the diagonals (corners).

In addition, the colour of the light shall be checked at the outermost isocandela curve to ensure that there is no colour shift that might cause signal confusion to the pilot.

Note 1.— For the outermost isocandela curve, a measurement of colour coordinates should be made and recorded for review and judgement of acceptability by the State.

Note 2.— Certain light units may have application so that they may be viewed and used by pilots from directions beyond that of the outermost isocandela curve (e.g. stop bar lights at significantly wide runway-holding positions). In such instances, the Authority will assess the actual application and if necessary require a check of colour shift at angular ranges beyond the outermost curve.

2.4.2 In the case of visual approach slope indicator systems and other light units having a colour transition sector, the colour shall be measured at points in accordance with 2.4.1, except that the colour areas shall be treated separately and no point shall be within 0.5 degrees of the transition sector.

3. Colours for markings, signs and panels

Note 1.— The specifications of surface colours given below apply only to freshly coloured surfaces. Colours used for markings, signs and panels usually change with time and therefore require renewal.

Note 2.— Guidance on surface colours is contained in the CIE document entitled Recommendations for Surface Colours for Visual Signalling — Publication No. 39-2 (TC-106) 1983.

Note 3.— The specifications recommended in 3.4 for transilluminated panels are interim in nature and are based on the CIE specifications for transilluminated signs. It is intended that these specifications will be reviewed and updated as and when CIE develops specifications for transilluminated panels.

3.1 The chromaticities and luminance factors of ordinary colours, colours of retroreflective materials and colours of transilluminated (internally illuminated) signs and panels shall be determined under the following standard conditions:

a) angle of illumination: 45°;

b) direction of view: perpendicular to surface; and

c) illuminant: CIE standard illuminant D65.

3.2 The chromaticity and luminance factors of ordinary colours for markings and externally illuminated signs and panels should be within the following boundaries when determined under standard conditions.

CIE Equations (see Figure A1-2):		
a)	Red	
	Purple boundary	y = 0.345 – 0.051x
	White boundary	y = 0.910 – x
	Orange boundary	y = 0.314 + 0.047x
	Luminance factor	*ß = 0.07 (mnm)*
b)	Orange	
	Red boundary	y = 0.285 + 0.100x
	White boundary	y = 0.940 – x
	Yellow boundary	y = 0.250 + 0.220x
	Luminance factor	*ß = 0.20 (mnm)*
c)	Yellow	
	Orange boundary	y = 0.108 + 0.707x
	White boundary	y = 0.910 – x
	Green boundary	y = 1.35x – 0.093
	Luminance factor	*ß = 0.45 (mnm)*
d)	White	
	Purple boundary	y = 0.010 + x
	Blue boundary	y = 0.610 – x
	Green boundary	y = 0.030 + x
	Yellow boundary	y = 0.710 – x
	Luminance factor	*ß = 0.75 (mnm)*
e)	Black	
	Purple boundary	y = x – 0.030
	Blue boundary	y = 0.570 – x
	Green boundary	y = 0.050 + x
	Yellow boundary	y = 0.740 – x
	Luminance factor	ß = 0.03 (max)
f)	Yellowish green	
	Green boundary	y = 1.317x + 0.4
	White boundary	y = 0.910 – x
	Yellow boundary	y = 0.867x + 0.4

g)	Green	
	Yellow boundary	x = 0.313
	White boundary	y = 0.243 + 0.670x
	Blue boundary	y = 0.493 – 0.524x
	Luminance factor	*β = 0.10 (mnm)*

Note.— The small separation between surface red and surface orange is not sufficient to ensure the distinction of these colours when seen separately.

3.3 The chromaticity and luminance factors of colours of retroreflective materials for markings, signs and panels should be within the following boundaries when determined under standard conditions.

CIE Equations (see Figure A1-3):		
a)	Red	
	Purple boundary	y = 0.345 – 0.051x
	White boundary	y = 0.910 – x
	Orange boundary	y = 0.314 + 0.047x
	Luminance factor	*ß = 0.03 (mnm)*
b)	Orange	
	Red boundary	y = 0.265 + 0.205x
	White boundary	y = 0.910 – x
	Yellow boundary	y = 0.207 + 0.390x
	Luminance factor	*ß = 0.14 (mnm)*
c)	Yellow	
	Orange boundary	y = 0.160 + 0.540x
	White boundary	y = 0.910 – x
	Green boundary	y = 1.35x – 0.093
	Luminance factor	*ß = 0.16 (mnm)*
d)	White	
	Purple boundary	y = x
	Blue boundary	y = 0.610 – x
	Green boundary	y = 0.040 + x
	Yellow boundary	y = 0.710 – x
	Luminance factor	*ß = 0.27 (mnm)*
e)	Blue	
	Green boundary	y = 0.118 + 0.675x
	White boundary	y = 0.370 – x
	Purple boundary	y = 1.65x – 0.187
	Luminance factor	*ß = 0.01 (mnm)*
f)	Green	
	Yellow boundary	y = 0.711 – 1.22x
	White boundary	y = 0.243 + 0.670x
	Blue boundary	= 0.405 – 0.243x
	Luminance factor	*β = 0.03 (mnm)*

3.4 The chromaticity and luminance factors of colours for luminescent or transilluminated (internally illuminated) signs and panels should be within the following boundaries when determined under standard conditions.

CIE Equations (see Figure A1-4):	
a) Red	
Purple boundary	y = 0.345 – 0.051x
White boundary	y = 0.910 – x
Orange boundary	y = 0.314 + 0.047x
Luminance factor (day condition)	*ß = 0.07 (mnm)*
Relative luminance to white (night condition)	*5% (mnm)* *20% (max)*
b) Yellow	
Orange boundary	y = 0.108 + 0.707x
White boundary	y = 0.910 – x
Green boundary	y = 1.35x – 0.093
Luminance factor (day condition)	*ß = 0.45 (mnm)*
Relative luminance to white (night condition)	*30% (mnm)* *80% (max)*
c) White	
Purple boundary	y = 0.010 + x
Blue boundary	y = 0.610 – x
Green boundary	y = 0.030 + x
Yellow boundary	y = 0.710 – x
Luminance factor (day condition)	*ß = 0.75 (mnm)*
Relative luminance to white (night condition)	*100%*
d) Black	
Purple boundary	y = x – 0.030
Blue boundary	y = 0.570 – x
Green boundary	y = 0.050 + x
Yellow boundary	y = 0.740 – x
Luminance factor (day condition)	*0% (mnm)*
Relative luminance to white (night condition)	*2% (max)*
e) Green	
Yellow boundary	x = 0.313
White boundary	y = 0.243 + 0.670x

Blue boundary	y = 0.493 – 0.524x
Luminance factor	*β = 0.10 minimum (day conditions)*
Relative luminance to white (night condition)	*5% (minimum)* *30% (maximum)*

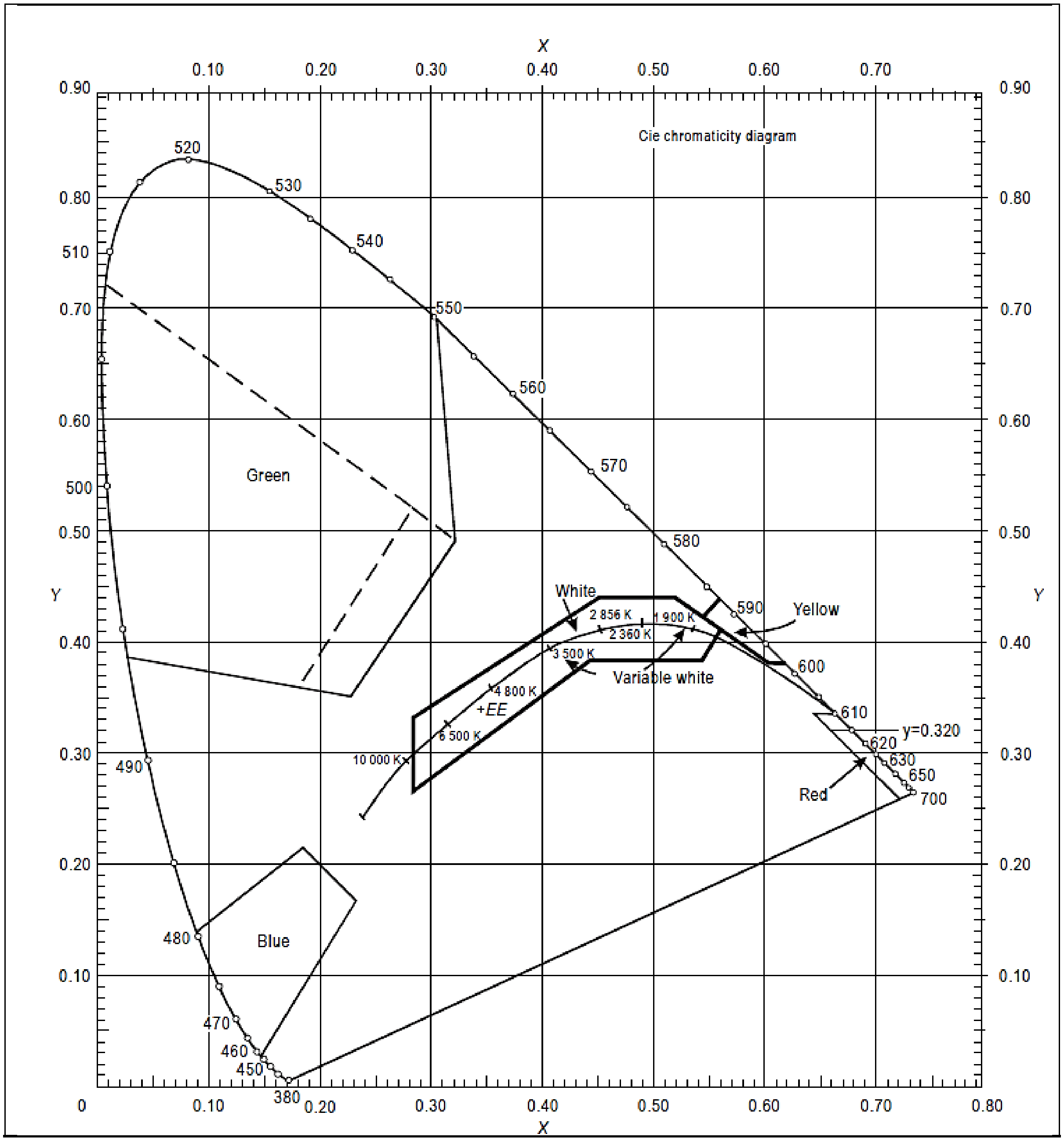


Figure A1-1a. Colours for aeronautical ground lights (filament-type lamps)

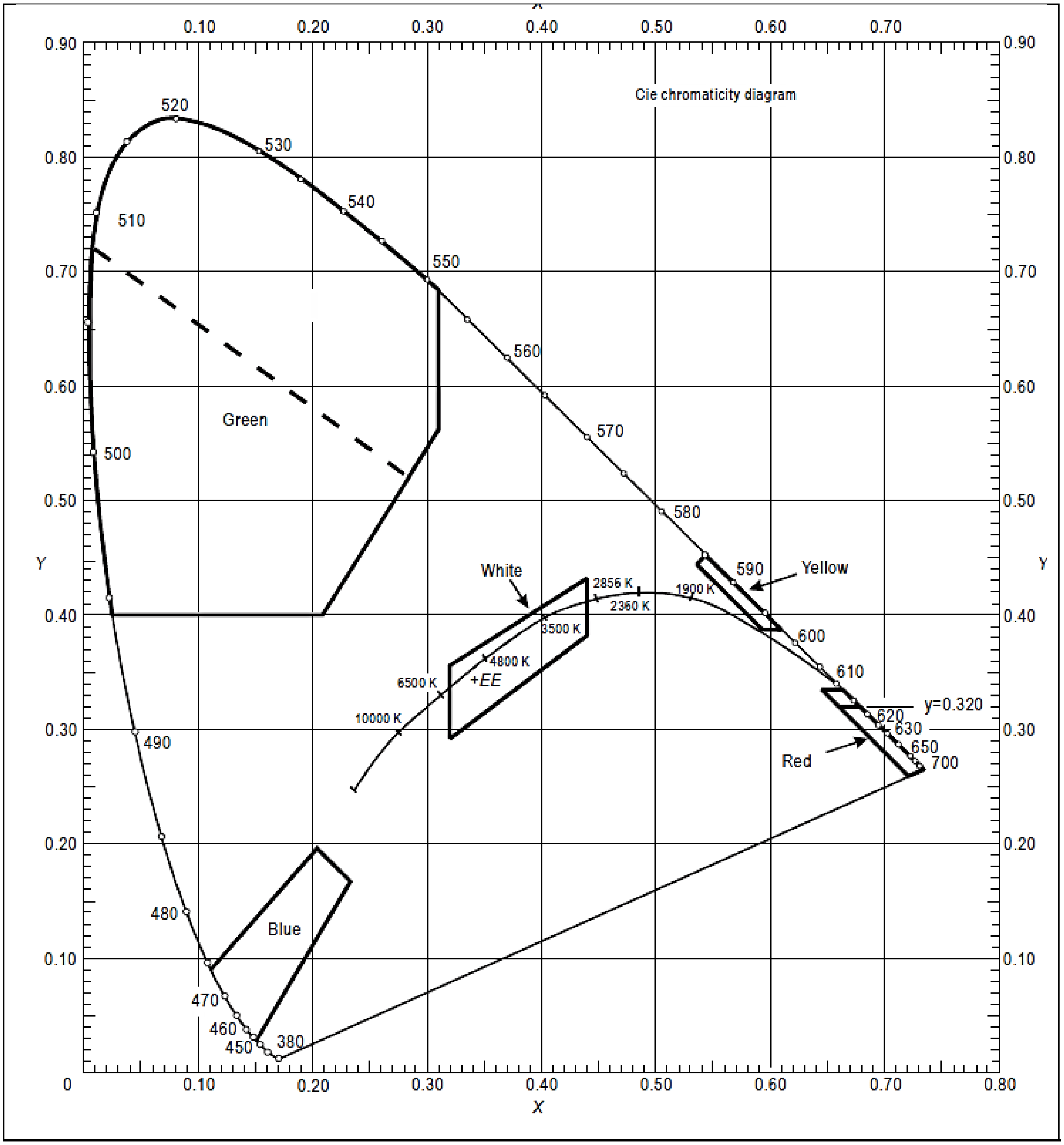


Figure A1-1b. Colours for aeronautical ground lights (solid state lighting)

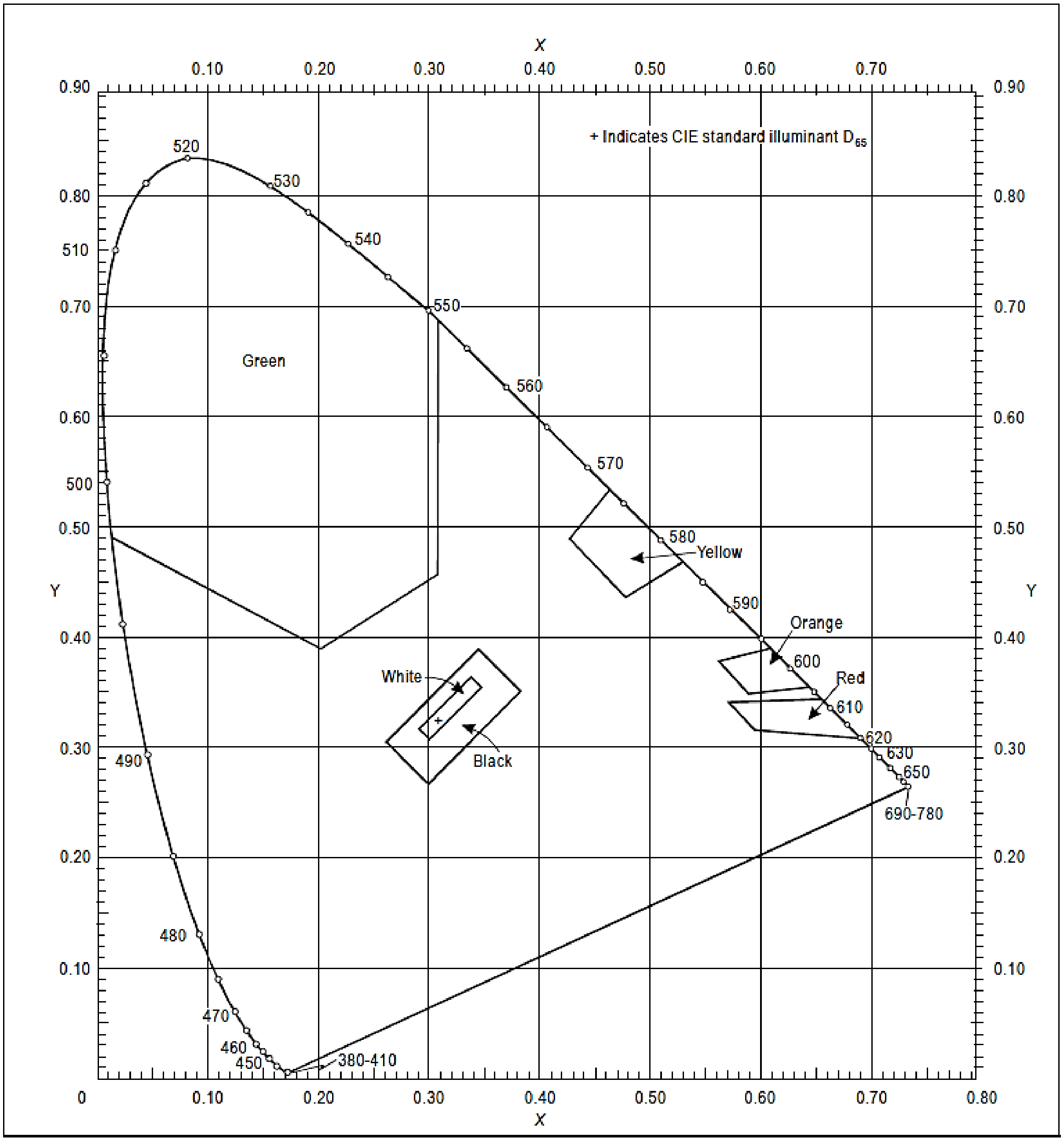


Figure A1-2. Ordinary colours for markings and externally illuminated signs and panels

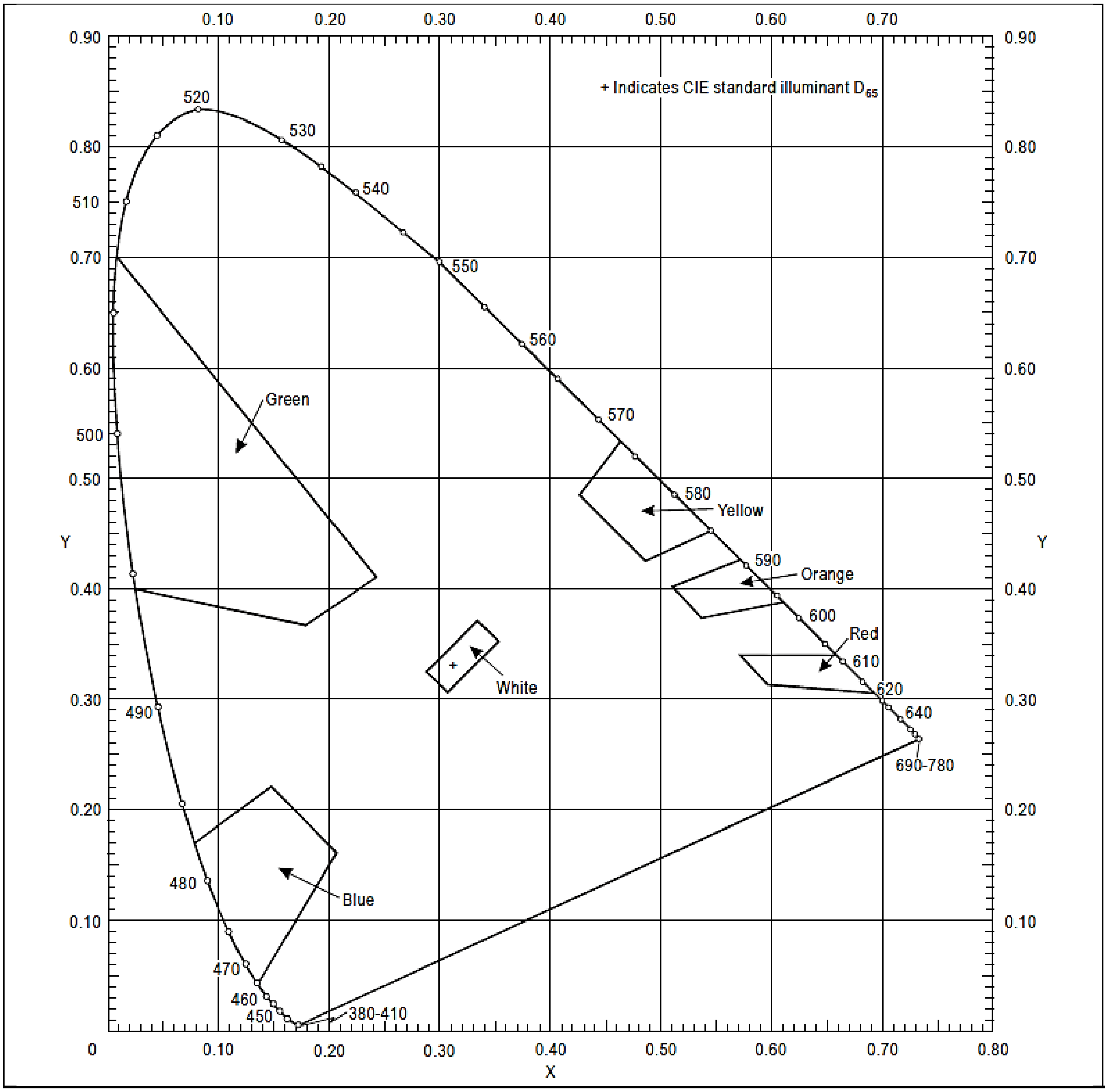


Figure A1-3. Colours of retroreflective materials for markings, signs and panels

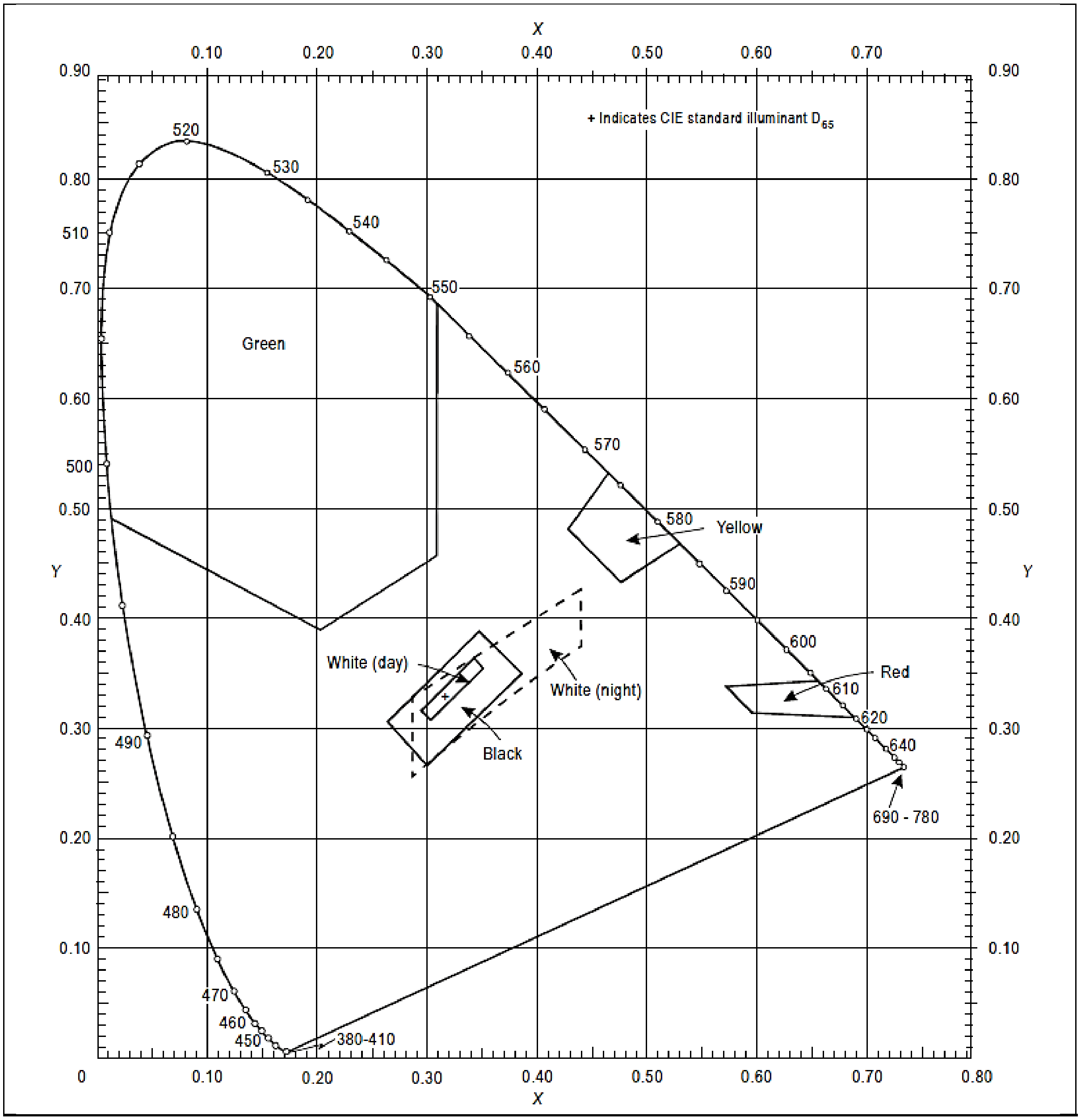
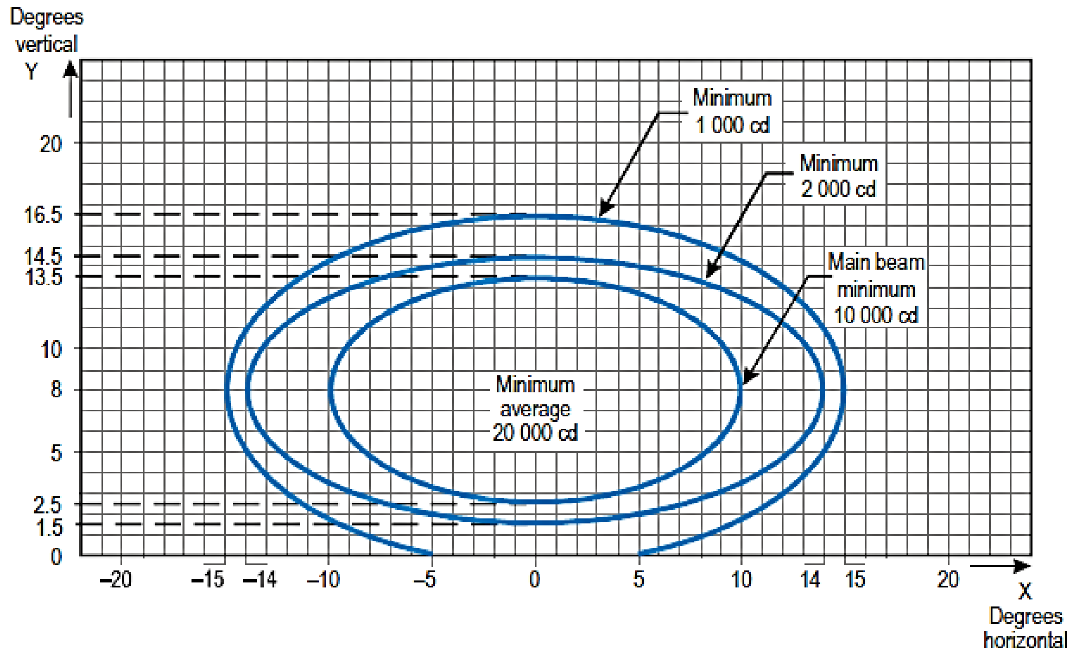


Figure A1-4. Colours of luminescent or transilluminated (internally illuminated) signs and panels

APPENDIX 2. AERONAUTICAL GROUND LIGHT CHARACTERISTICS



Notes:

1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	10	14	15
b	5.5	6.5	8.5

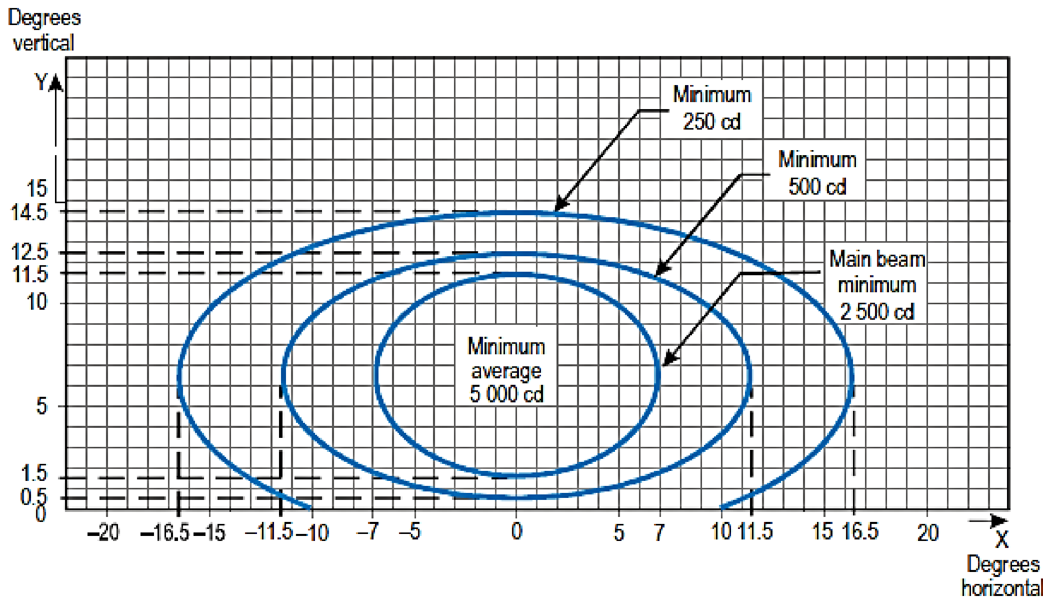
2. Vertical setting angles of the lights shall be such that the following vertical coverage of the main beam will be met:

distance from threshold	vertical main beam coverage
threshold to 315 m	0° — 11°
316 m to 475 m	0.5° — 11.5°
476 m to 640 m	1.5° — 12.5°
641 m and beyond	2.5° — 13.5° (as illustrated above)

3. Lights in crossbars beyond 22.5 m from the centre line shall be toed-in 2 degrees. All other lights shall be aligned parallel to the centre line of the runway.

4. See collective notes for Figures A2-1 to A2-11 and A2-26.

Figure A2-1. Isocandela diagram for approach centre line light and crossbars (white light)



Notes:

1. Curves calculated on formula $$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$$

a	7.0	11.5	16.5
b	5.0	6.0	8.0

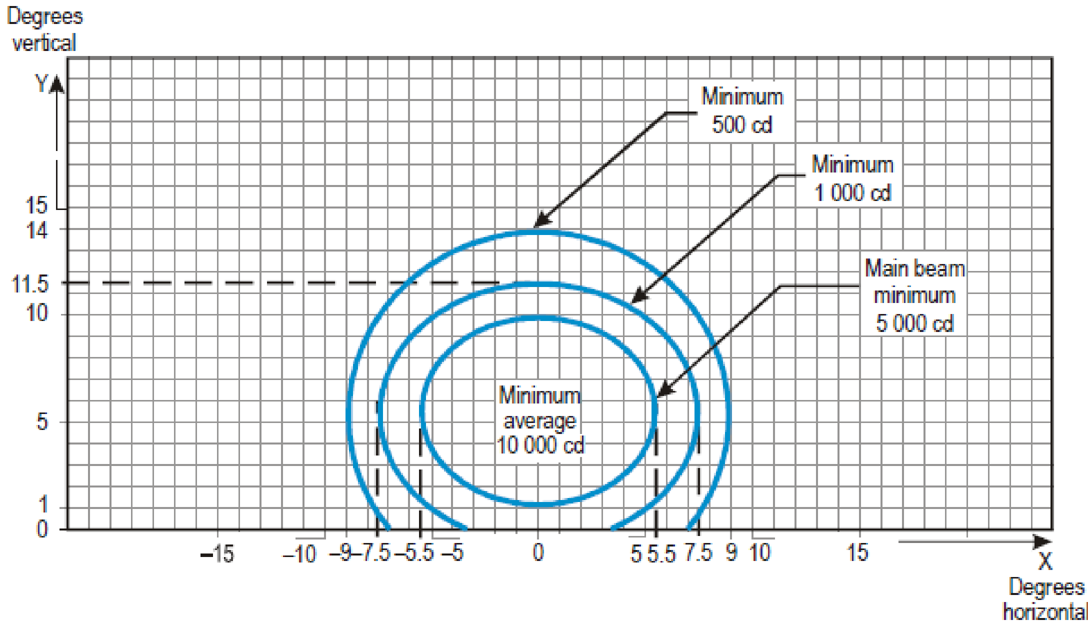
2. Toe-in 2 degrees

3. Vertical setting angles of the lights shall be such that the following vertical coverage of the main beam will be met:

distance from threshold	vertical main beam coverage
threshold to 115 m	0.5° — 10.5°
116 m to 215 m	1° — 11°
216 m and beyond	1.5° — 11.5° (as illustrated above)

4. See collective notes for Figures A2-1 to A2-11 and A2-26.

Figure A2-2. Isocandela diagram for approach side row light (red light)



Notes:

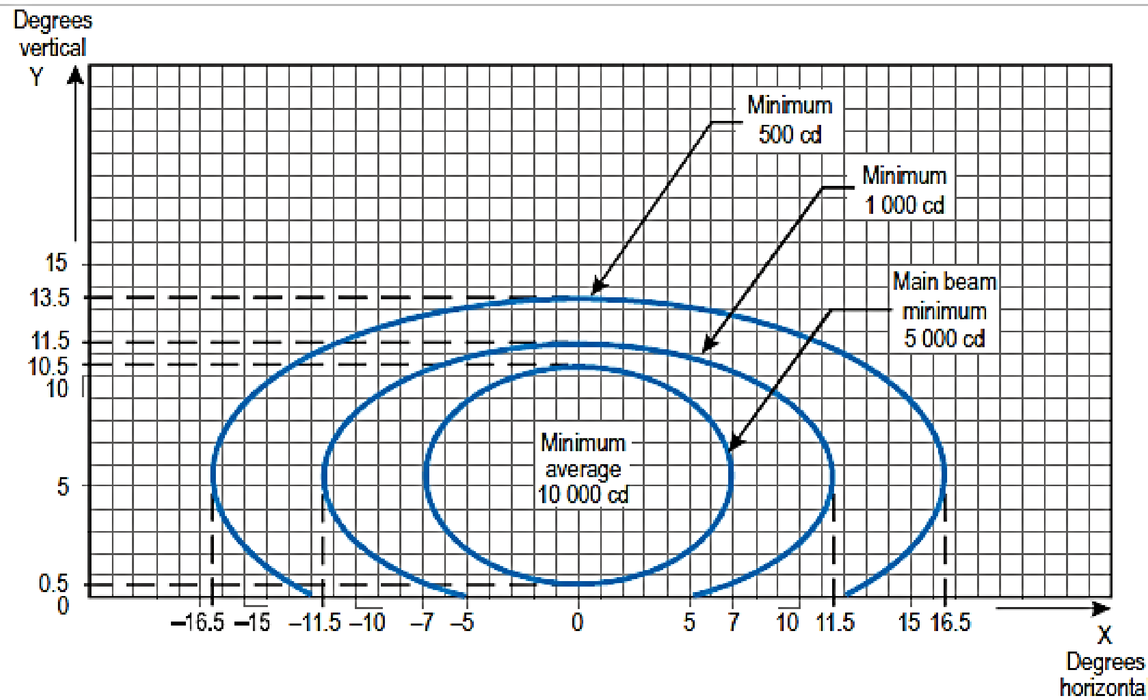
1. Curves calculated on formula $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$

a	5.5	7.5	9.0
b	4.5	6.0	8.5

2. Toe-in 3.5 degrees

3. See collective notes for Figures A2-1 to A2-11 and A2-26.

Figure A2-3. Isocandela diagram for threshold light (green light)



Notes:

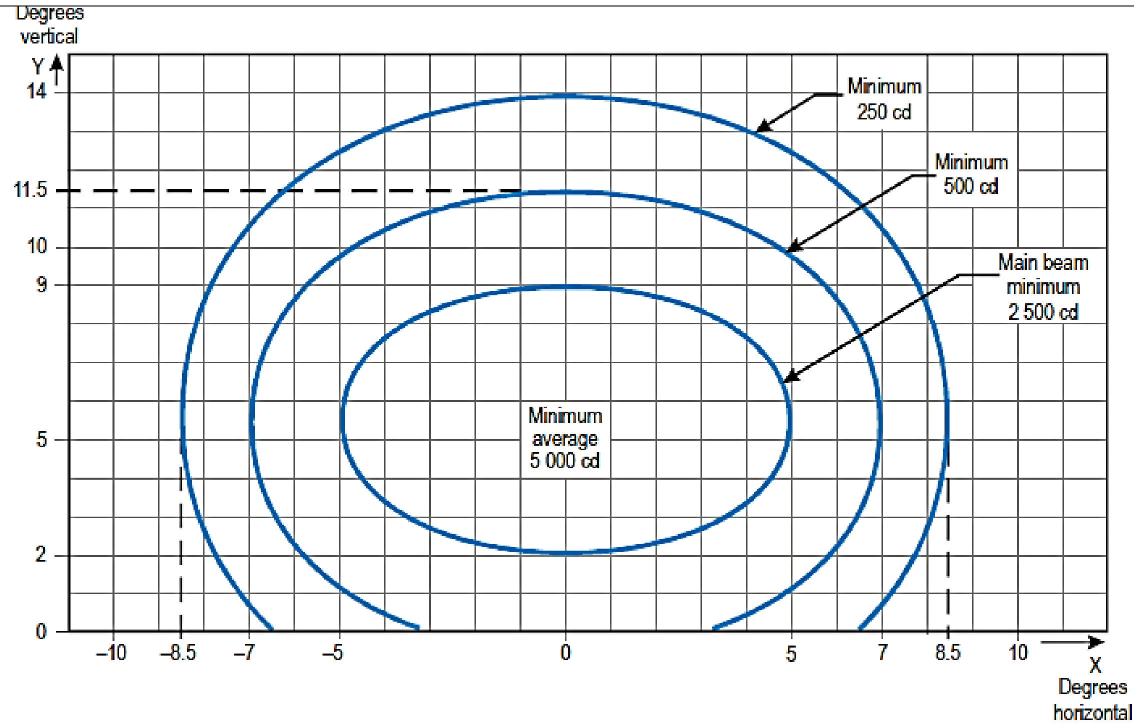
1. Curves calculated on formula $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$

a	7.0	11.5	16.5
b	5.0	6.0	8.0

2. Toe-in 2 degrees

3. See collective notes for Figures A2-1 to A2-11 and A2-26.

Figure A2-4. Isocandela diagram for threshold wing bar light (green light)



Notes:

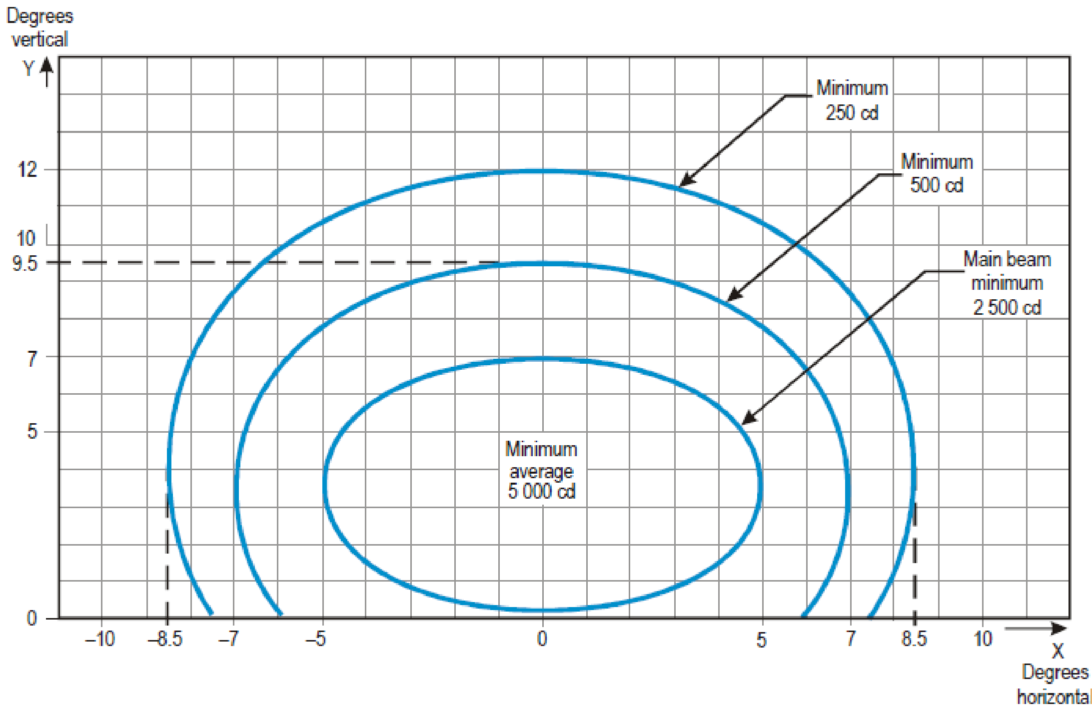
1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	5.0	7.0	8.5
b	3.5	6.0	8.5

2. Toe-in 4 degrees

3. See collective notes for Figures A2-1 to A2-11 and A2-26.

Figure A2-5. Isocandela diagram for touchdown zone light (white light)



Notes:

1. Curves calculated on formula $$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$$

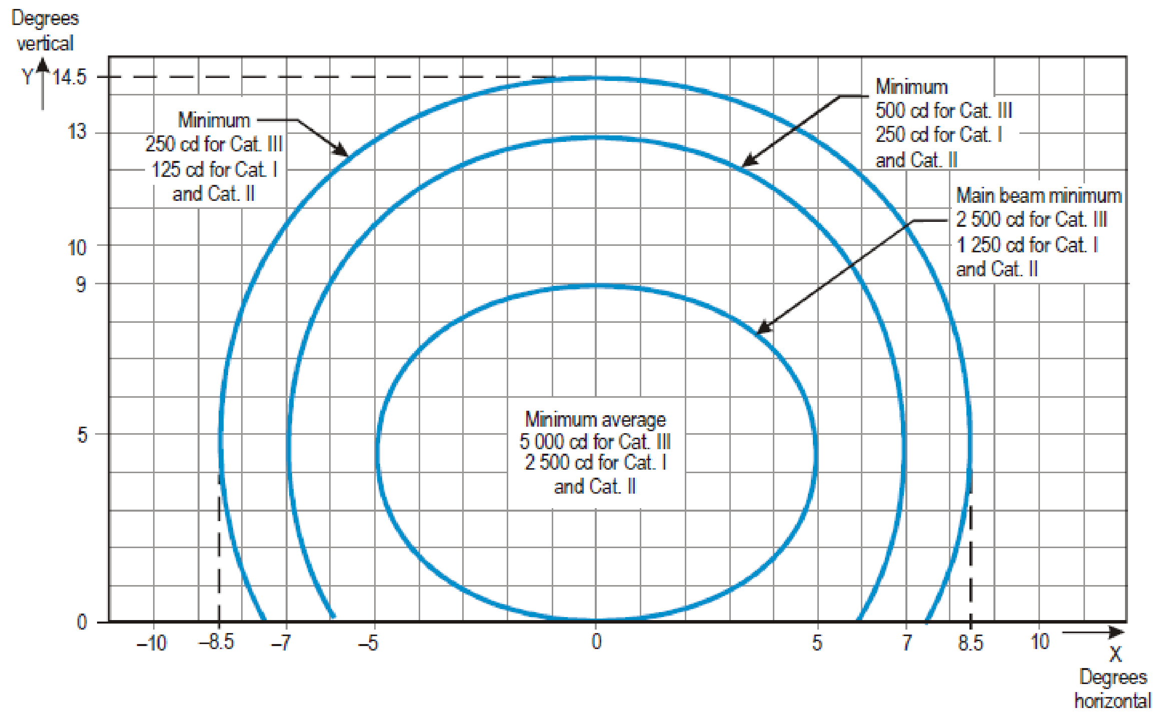
a	5.0	7.0	8.5
b	3.5	6.0	8.5

2. For red light, multiply values by 0.15.

3. For yellow light, multiply values by 0.40.

4. See collective notes for Figures A2-1 to A2-11 and A2-26.

Figure A2-6. Isocandela diagram for runway centre line light with 30 m longitudinal spacing (white light) and rapid exit taxiway indicator light (yellow light)



Notes:

1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

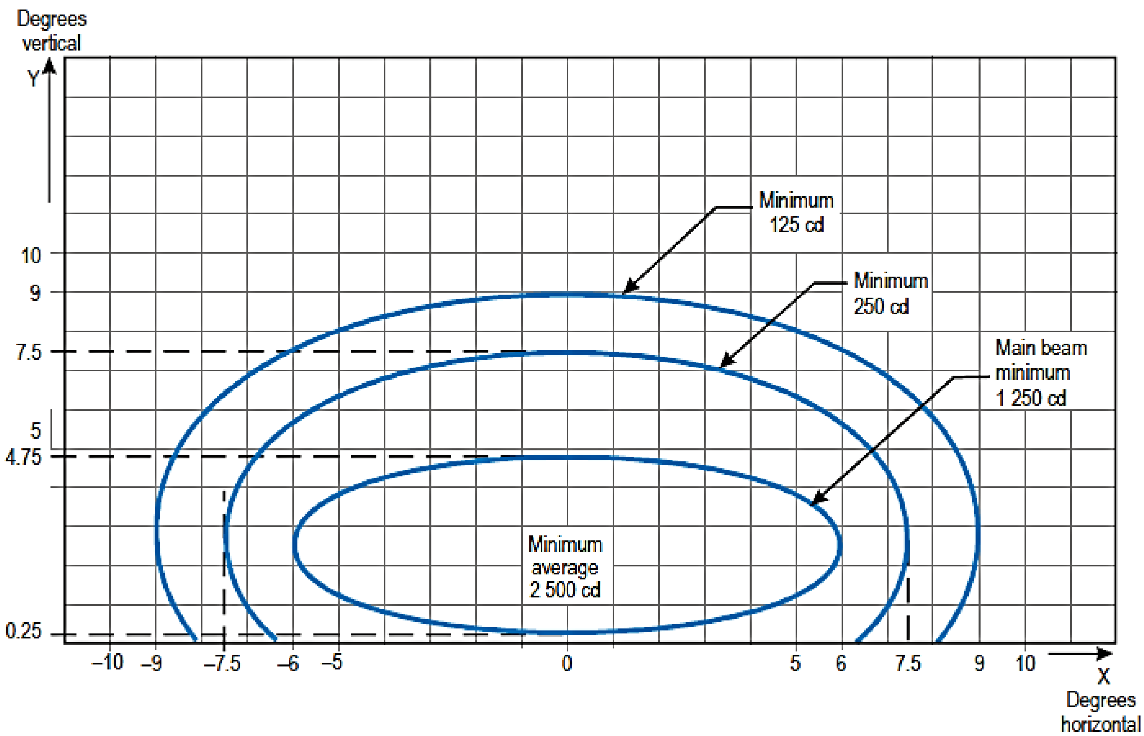
a	5.0	7.0	8.5
b	4.5	8.5	10

2. For red light, multiply values by 0.15.

3. For yellow light, multiply values by 0.40.

4. See collective notes for Figures A2-1 to A2-11 and A2-26.

Figure A2-7. Isocandela diagram for runway centre line light with 15 m longitudinal spacing (white light) and rapid exit taxiway indicator light (yellow light)



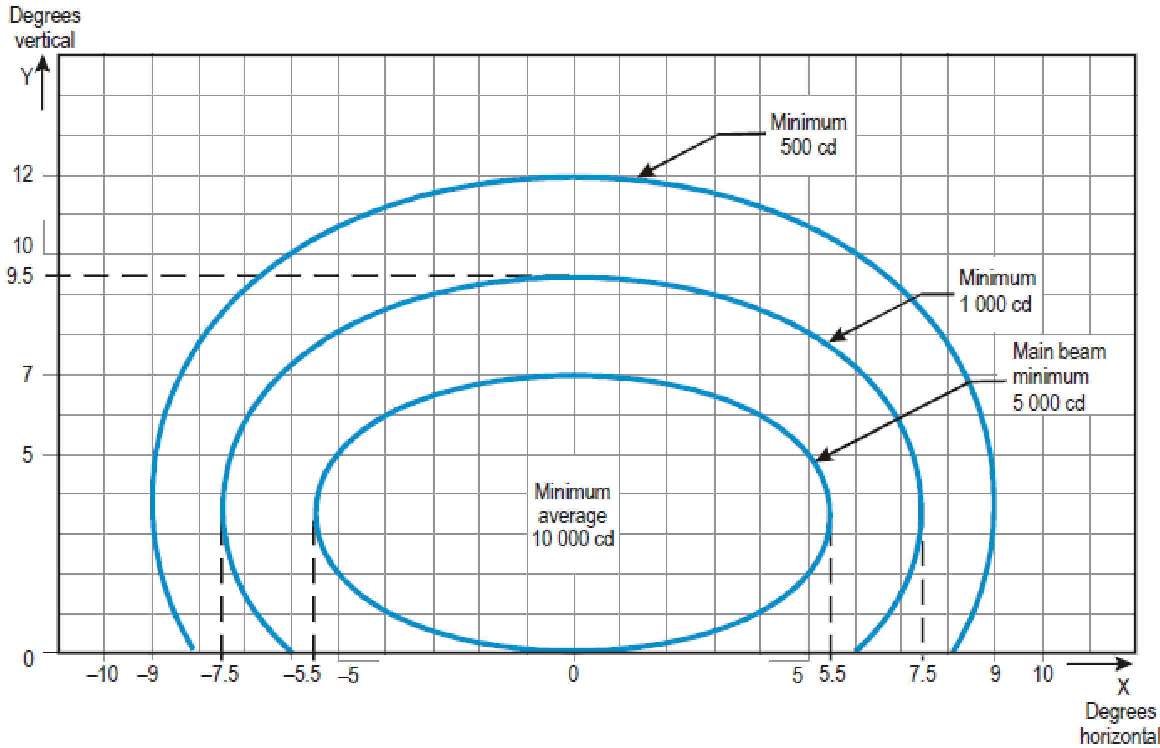
Notes:

1. Curves calculated on formula $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$

a	6.0	7.5	9.0
b	2.25	5.0	6.5

2. See collective notes for Figures A2-1 to A2-11 and A2-26.

Figure A2-8. Isocandela diagram for runway end light (red light)



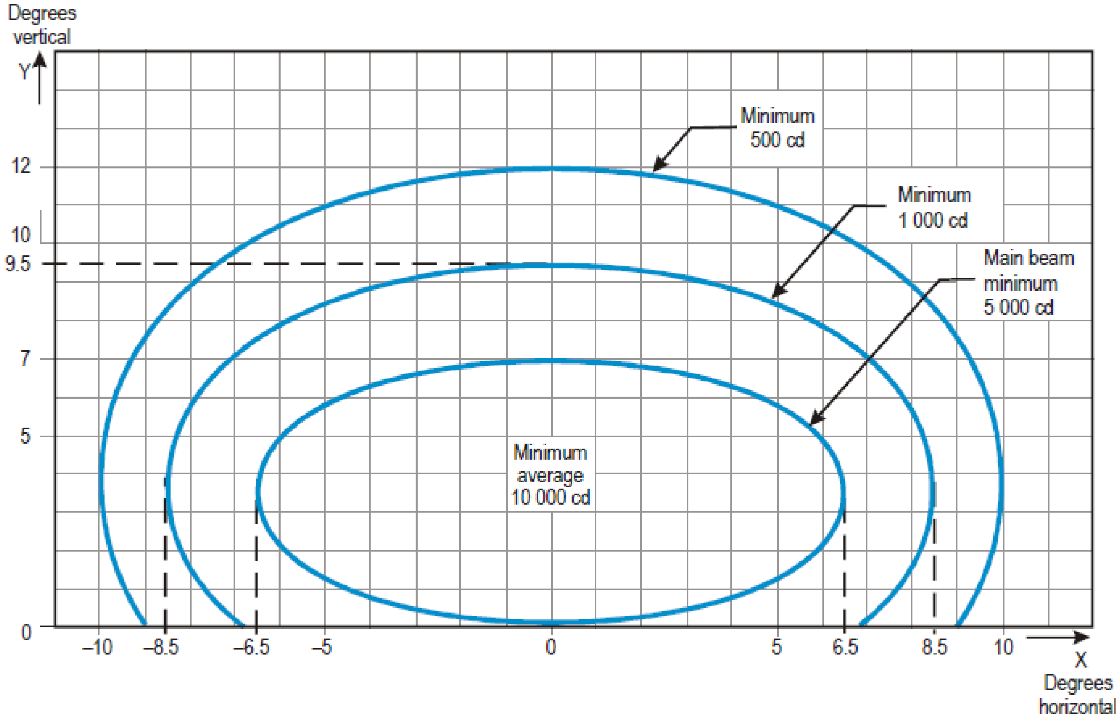
Notes:

1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	5.5	7.5	9.0
b	3.5	6.0	8.5

2. Toe-in 3.5 degrees
3. For red light, multiply values by 0.15.
4. For yellow light, multiply values by 0.40.
5. See collective notes for Figures A2-1 to A2-11 and A2-26.

Figure A2-9. Isocandela diagram for runway edge light where width of runway is 45 m (white light)



Notes:

1. Curves calculated on formula $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$

a	6.5	8.5	10.0
b	3.5	6.0	8.5

2. Toe-in 4.5 degrees
3. For red light, multiply values by 0.15.
4. For yellow light, multiply values by 0.40.
5. See collective notes for Figures A2-1 to A2-11 and A2-26.

Figure A2-10. Isocandela diagram for runway edge light where width of runway is 60 m (white light)

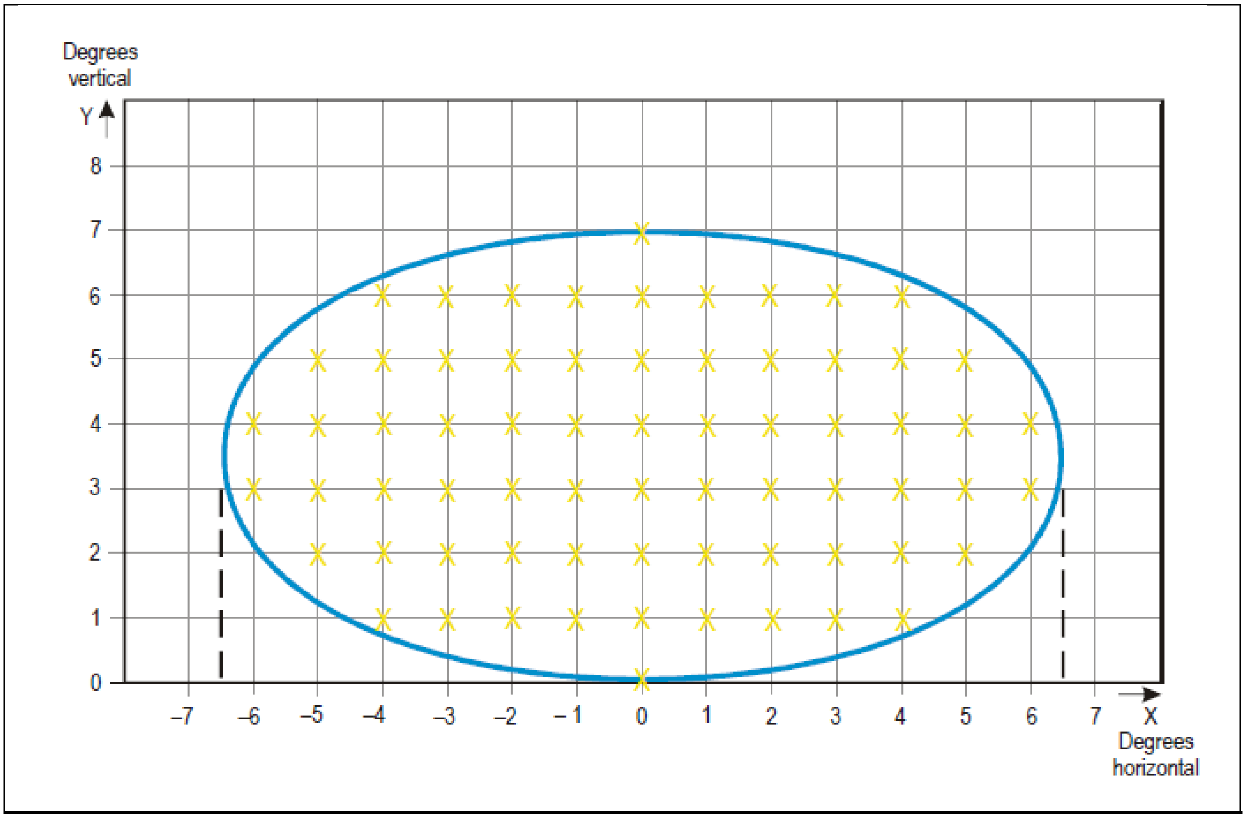


Figure A2-11. Grid points to be used for the calculation of average intensity of approach and runway lights

__Collective notes to Figures A2-1 to A2-11 and A2-26__

1. The ellipses in each figure are symmetrical about the common vertical and horizontal axes.

2. Figures A2-1 to A2-10, as well as Figure A2-26, show the minimum allowable light intensities. The average intensity of the main beam is calculated by establishing grid points as shown in Figure A2-11 and using the intensity value measures at all grid points located within and on the perimeter of the ellipse representing the main beam. The average value is the arithmetic average of light intensities measured at all considered grid points.

3. No deviations are acceptable in the main beam pattern when the lighting fixture is properly aimed.

4. Average intensity ratio. The ratio between the average intensity within the ellipse defining the main beam of a typical new light and the average light intensity of the main beam of a new runway edge light shall be as follows:

Figure A2-1	Approach centre line and crossbars	1.5 to 2.0 (white light)
Figure A2-2	Approach side row	0.5 to 1.0 (red light)
Figure A2-3	Threshold	1.0 to 1.5 (green light)
Figure A2-4	Threshold wing bar	1.0 to 1.5 (green light)
Figure A2-5	Touchdown zone	0.5 to 1.0 (white light)
Figure A2-6	Runway centre line (longitudinal spacing 30 m)	0.5 to 1.0 (white light)
Figure A2-7	Runway centre line (longitudinal spacing 15 m)	0.5 to 1.0 for CAT III (white light) 0.25 to 0.5 for CAT I, II (white light)
Figure A2-8	Runway end	0.25 to 0.5 (red light)
Figure A2-9	Runway edge (45 m runway width)	1.0 (white light)
Figure A2-10	Runway edge (60 m runway width)	1.0 (white light)

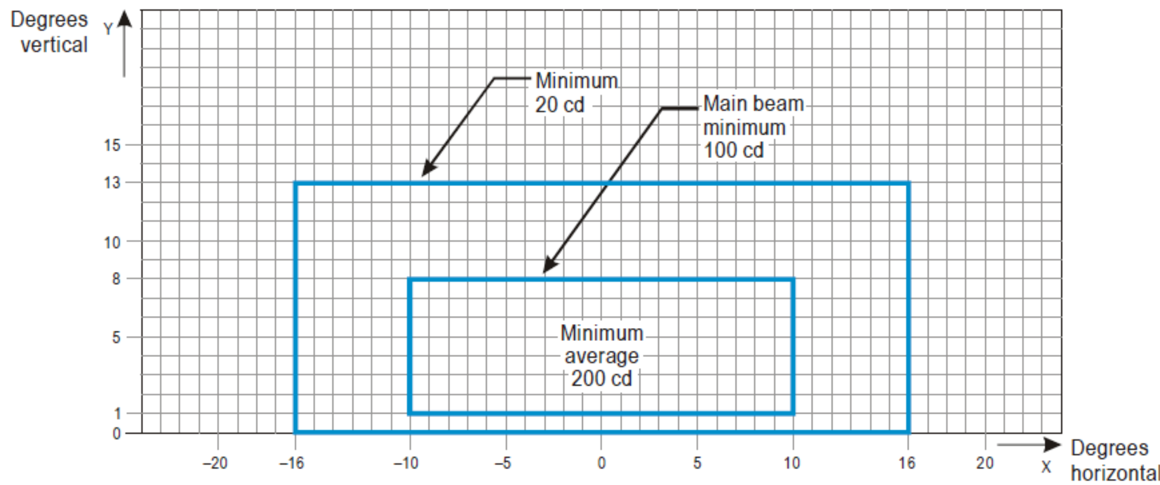
5. The beam coverages in the figures provide the necessary guidance for approaches down to an RVR of the order of 150 m and take-offs down to an RVR of the order of 100 m.

6. Horizontal angles are measured with respect to the vertical plane through the runway centre line. For lights other than centre line lights, the direction towards the runway centre line is considered positive. Vertical angles are measured with respect to the horizontal plane.

7. Where, for approach centre line lights and crossbars and for approach side row lights, inset lights are used in lieu of elevated lights, e.g. on a runway with a displaced threshold, the intensity requirements can be met by installing two or three fittings (lower intensity) at each position.

8. The importance of adequate maintenance cannot be overemphasized. The average intensity should never fall to a value less than 50 per cent of the value shown in the figures, and it should be the aim of airport authorities to maintain a level of light output close to the specified minimum average intensity.

9. The light unit shall be installed so that the main beam is aligned within one-half degree of the specified requirement.



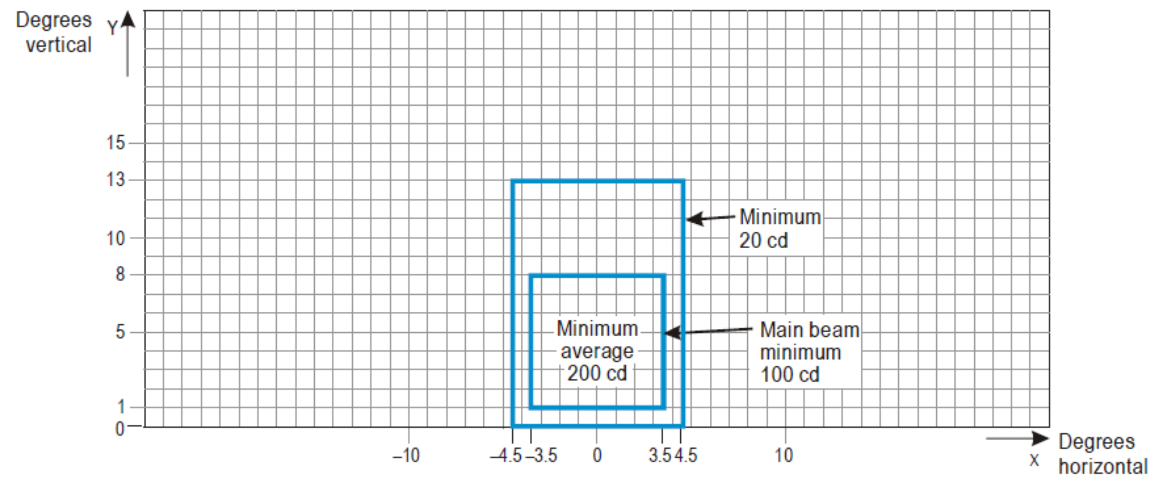
Notes:

1. These beam coverages allow for displacement of the cockpit from the centre line up to distances of the order of 12 m and are intended for use before and after curves.

2. See collective notes for Figures A2-12 to A2-21.

3. Increased intensities for enhanced rapid exit taxiway centre line lights as recommended in 5.3.16.9 are four times the respective intensities in the figure (i.e. 800 cd for minimum average main beam).

Figure A2-12. Isocandela diagram for taxiway centre line (15 m spacing), RELs, no-entry bar and stop bar lights in straight sections intended for use in runway visual range conditions of less than a value of 350 m where large offsets can occur and for low-intensity runway guard lights, Configuration B

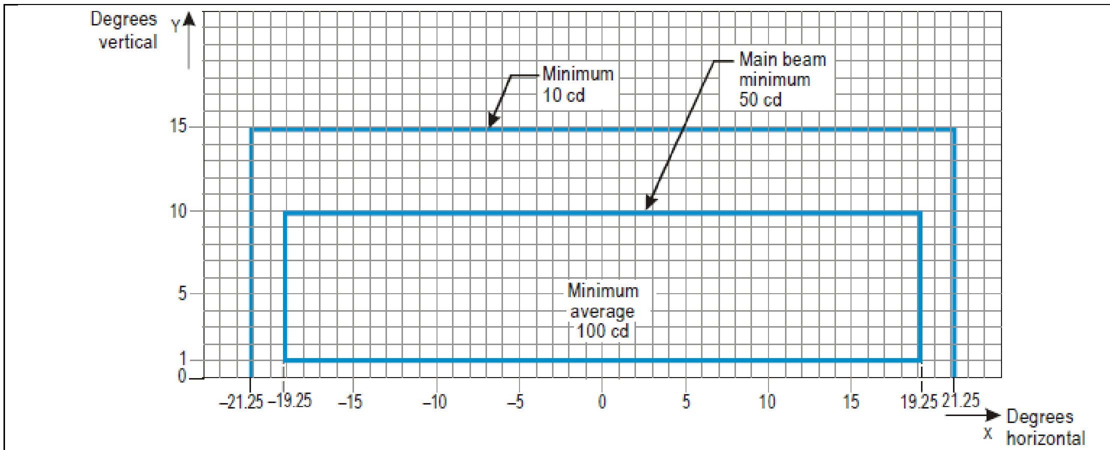


Notes:

1. These beam coverages are generally satisfactory and cater for a normal displacement of the cockpit from the centre line of approximately 3 m.

2. See collective notes for Figures A2-12 to A2-21.

Figure A2-13. Isocandela diagram for taxiway centre line (15 m spacing), no-entry bar and stop bar lights in straight sections intended for use in runway visual range conditions of less than a value of 350 m



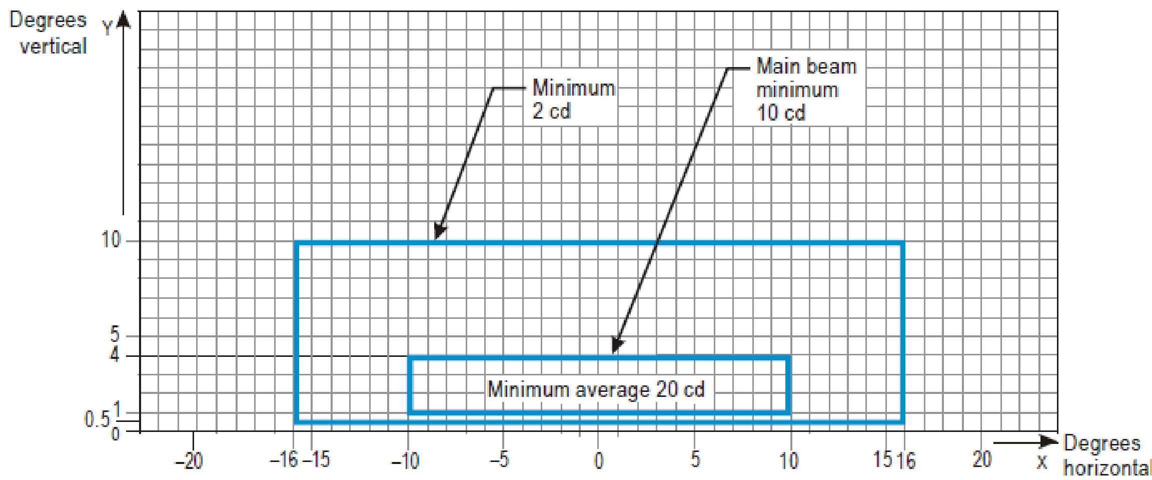
Notes:

1. Lights on curves to be toed-in 15.75 degrees with respect to the tangent of the curve. This does not apply to runway entrance lights (RELs)

2. Increased intensities for RELs shall be twice the specified intensities, i.e., minimum 20 cd, main beam minimum 100 cd and minimum average 200 cd.

3. See collective notes for Figures A2-12 to A2-21.

Figure A2-14. Isocandela diagram for taxiway centre line (7.5 m spacing), RELs, no-entry bar and stop bar lights in curved sections intended for use in runway visual range conditions of less than a value of 350 m



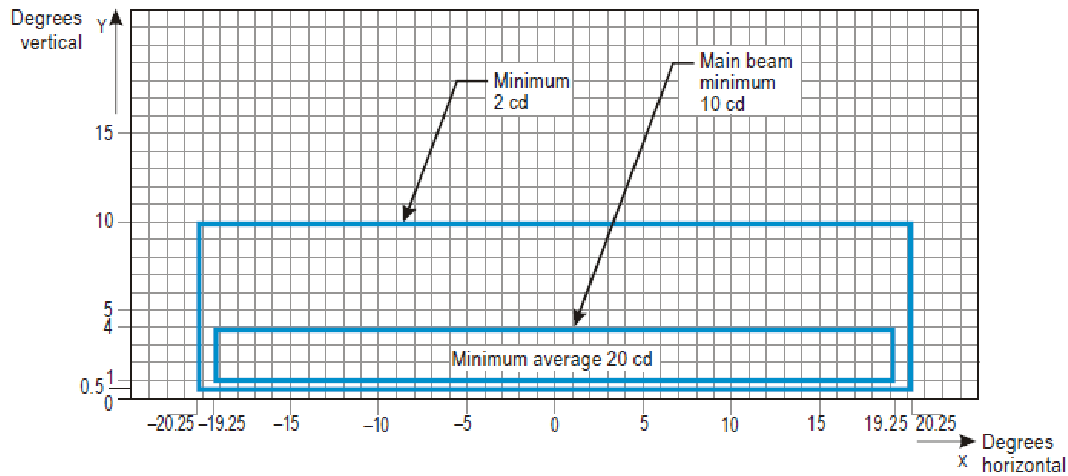
Notes:

1. At locations where high background luminance is usual and where deterioration of light output resulting from dust, snow and local contamination is a significant factor, the cd-values should be multiplied by 2.5.

2. Where omnidirectional lights are used they shall comply with the vertical beam requirements in this figure.

3. See collective notes for Figures A2-12 to A2-21.

Figure A2-15. Isocandela diagram for taxiway centre line (30 m, 60 m spacing), no-entry bar and stop bar lights in straight sections intended for use in runway visual range conditions of 350 m or greater



Notes:

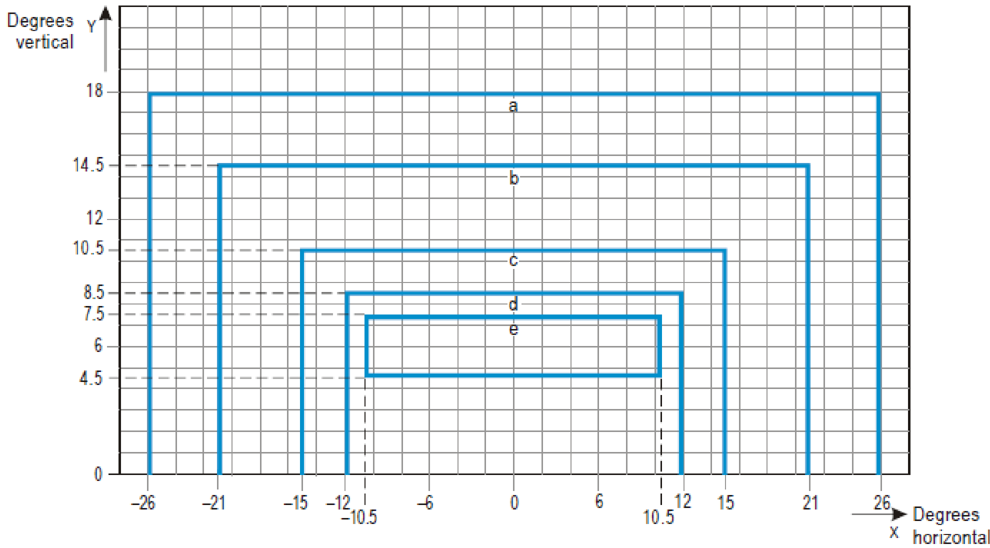
1. Lights on curves to be toed-in 15.75 degrees with respect to the tangent of the curve.

2. At locations where high background luminance is usual and where deterioration of light output resulting from dust, snow and local contamination is a significant factor, the cd-values should be multiplied by 2.5.

3. These beam coverages allow for displacement of the cockpit from the centre line up to distances of the order of 12 m as could occur at the end of curves.

4. See collective notes for Figures A2-12 to A2-21.

Figure A2-16. Isocandela diagram for taxiway centre line (7.5 m, 15 m, 30 m spacing), no-entry bar and stop bar lights in curved sections intended for use in runway visual range conditions of 350 m or greater



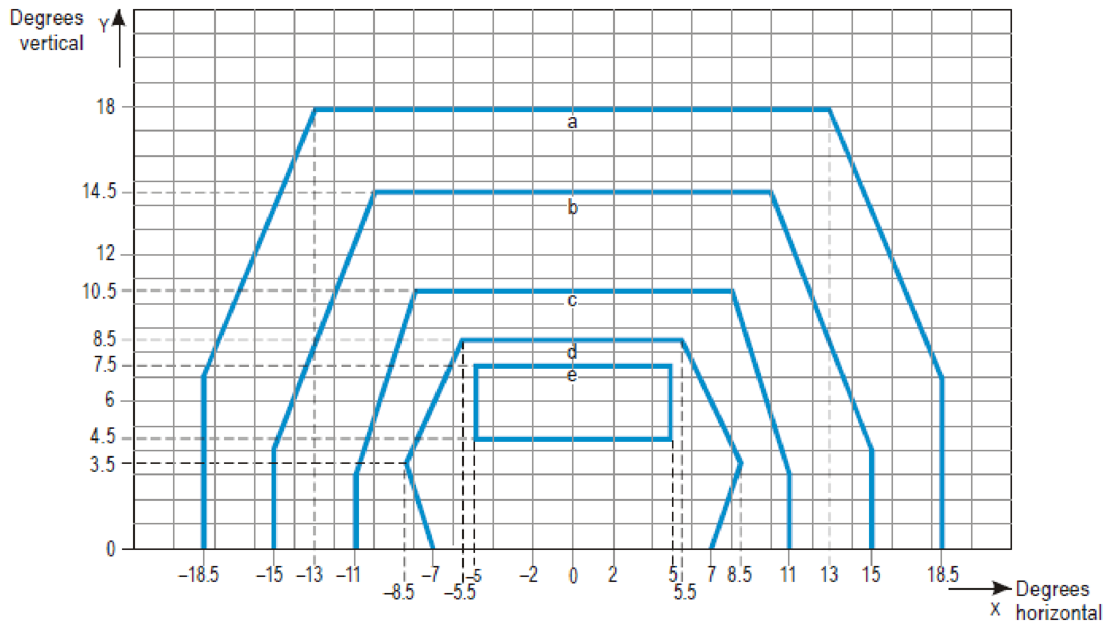
Curve	a	b	c	d	e
Intensity (cd)	8	20	100	450	1 800

Notes:

1. These beam coverages allow for displacement of the cockpit from the centre line up to distances of the order of 12 m and are intended for use before and after curves.

2. See collective notes for Figures A2-12 to A2-21.

Figure A2-17. Isocandela diagram for high-intensity taxiway centre line (15 m spacing), no-entry bar and stop bar lights in straight sections intended for use in an advanced surface movement guidance and control system where higher light intensities are required and where large offsets can occur



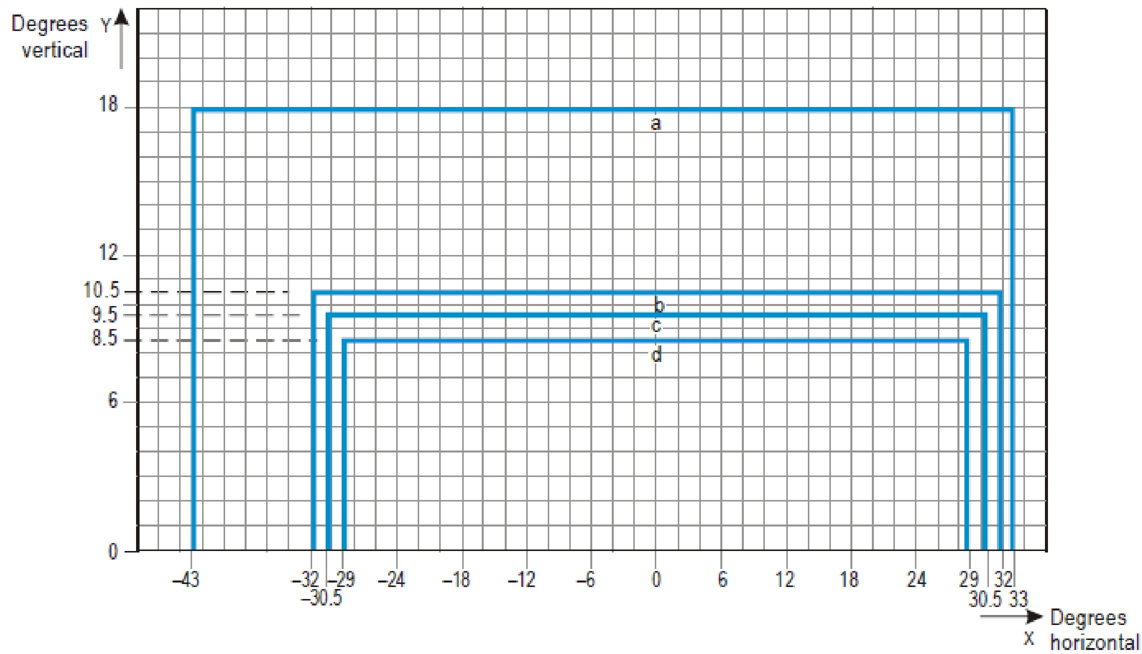
Curve	a	b	c	d	e
Intensity (cd)	8	20	100	450	1 800

Notes:

1. These beam coverages are generally satisfactory and cater for a normal displacement of the cockpit corresponding to the outer main gear wheel on the taxiway edge.

2. See collective notes for Figures A2-12 to A2-21.

Figure A2-18. Isocandela diagram for high-intensity taxiway centre line (15 m spacing), no-entry bar and stop bar lights in straight sections intended for use in an advanced surface movement guidance and control system where higher light intensities are required

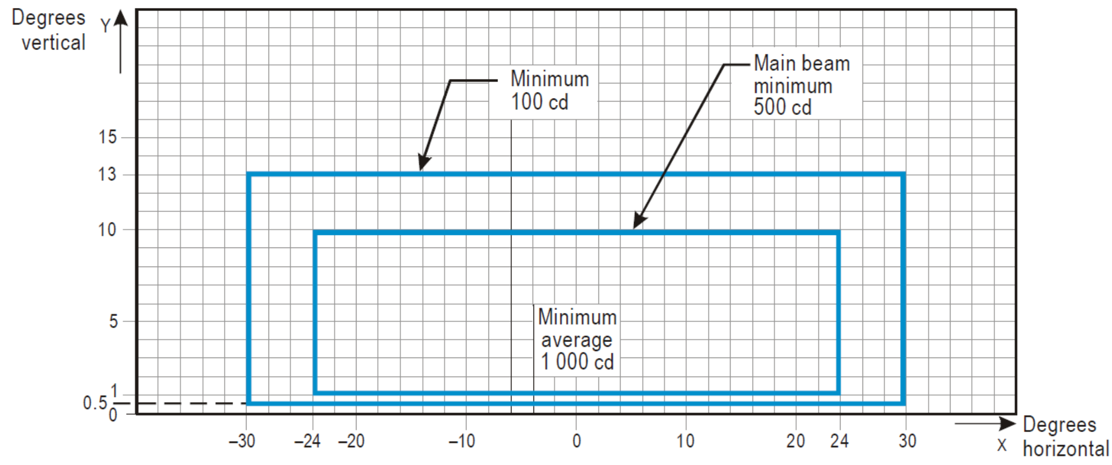


Curve	a	b	c	d
Intensity (cd)	8	100	200	400

Notes:

1. Lights on curves to be toed-in 17 degrees with respect to the tangent of the curve.
2. See collective notes for Figures A2-12 to A2-21.

Figure A2-19. Isocandela diagram for high-intensity taxiway centre line (7.5 m spacing), no-entry bar and stop bar lights in curved sections intended for use in an advanced surface movement guidance and control system where higher light intensities are required



Notes:

1. Although the lights flash in normal operation, the light intensity is specified as if the lights were fixed for incandescent lamps.

2. See collective notes for Figures A2-12 to A2-21.

Figure A2-20. Isocandela diagram for high-intensity runway guard lights, Configuration B

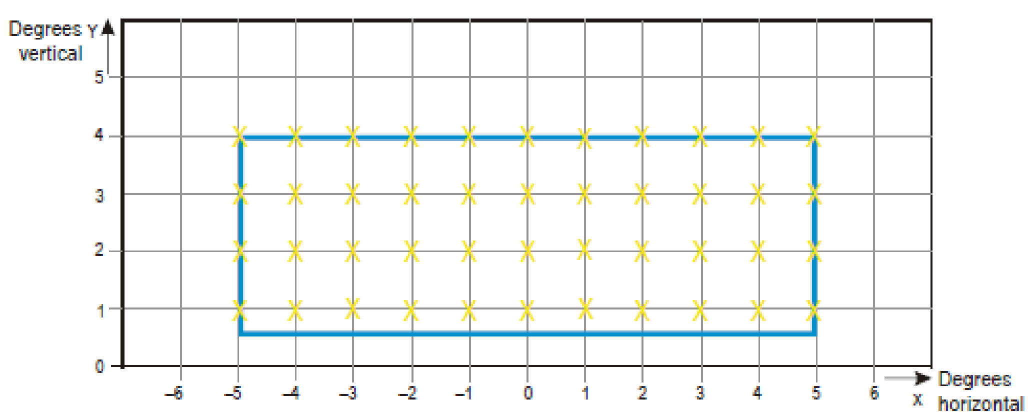


Figure A2-21. Grid points to be used for calculation of average intensity of taxiway centre line and stop bar lights

Collective notes to Figures A2-12 to A2-21

1. The intensities specified in Figures A2-12 to A2-20 are in green and yellow light for taxiway centre line lights, yellow light for runway guard lights and red light for stop bar lights.

2. Figures A2-12 to A2-20 show the minimum allowable light intensities. The average intensity of the main beam is calculated by establishing grid points as shown in Figure A2-21 and using the intensity values measured at all grid points located within and on the perimeter of the rectangle representing the main beam. The average value is the arithmetic average of the light intensities measured at all considered grid points.

3. No deviations are acceptable in the main beam or in the innermost beam, as applicable, when the lighting fixture is properly aimed.

4. Horizontal angles are measured with respect to the vertical plane through the taxiway centre line except on curves where they are measured with respect to the tangent to the curve.

5. Vertical angles are measured from the longitudinal slope of the taxiway surface.

6. The importance of adequate maintenance cannot be overemphasized. The intensity, either average where applicable or as specified on the corresponding isocandela curves, should never fall to a value less than 50 per cent of the value shown in the figures, and it should be the aim of airport authorities to maintain a level of light output close to the specified minimum average intensity.

7. The light unit shall be installed so that the main beam or the innermost beam, as applicable, is aligned within one-half degree of the specified requirement.

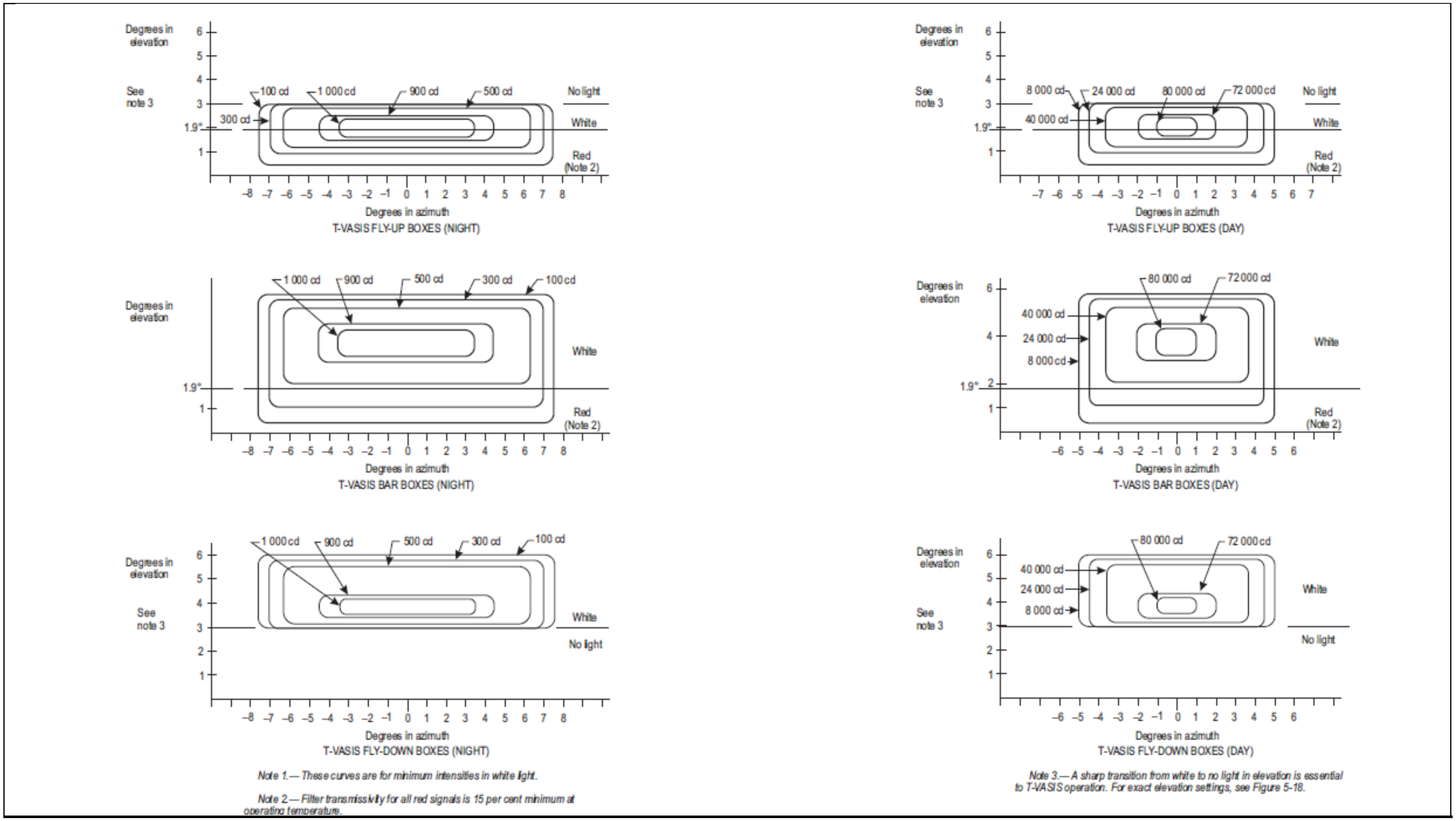
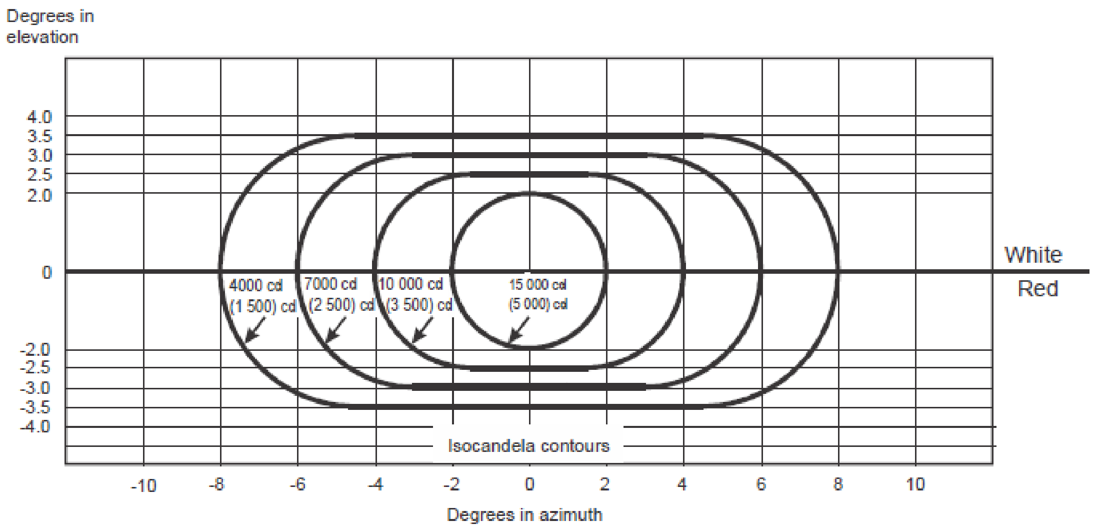


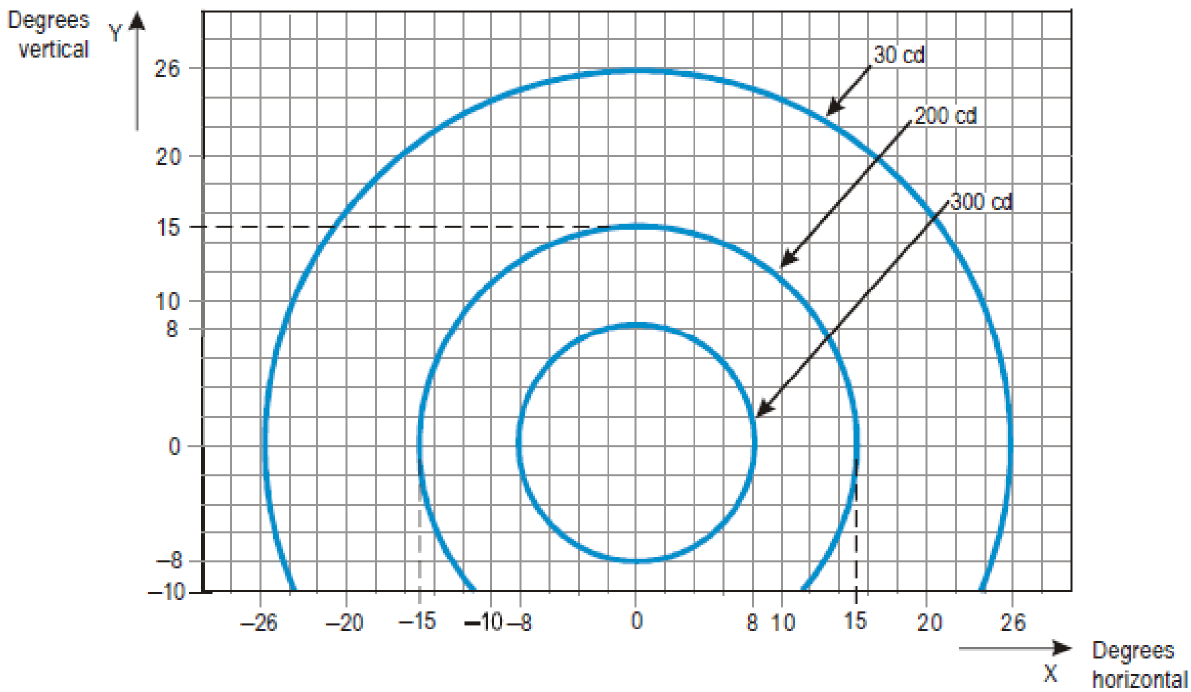
Figure A2-22. Light intensity distribution of T-VASIS and AT-VASIS



Notes:

1. These curves are for minimum intensities in red light.
2. The intensity value in the white sector of the beam is no less than 2 and may be as high as 6.5 times the corresponding intensity in the red sector.
3. The intensity values shown in brackets are for APAPI.

Figure A2-23. Light intensity distribution of PAPI and APAPI

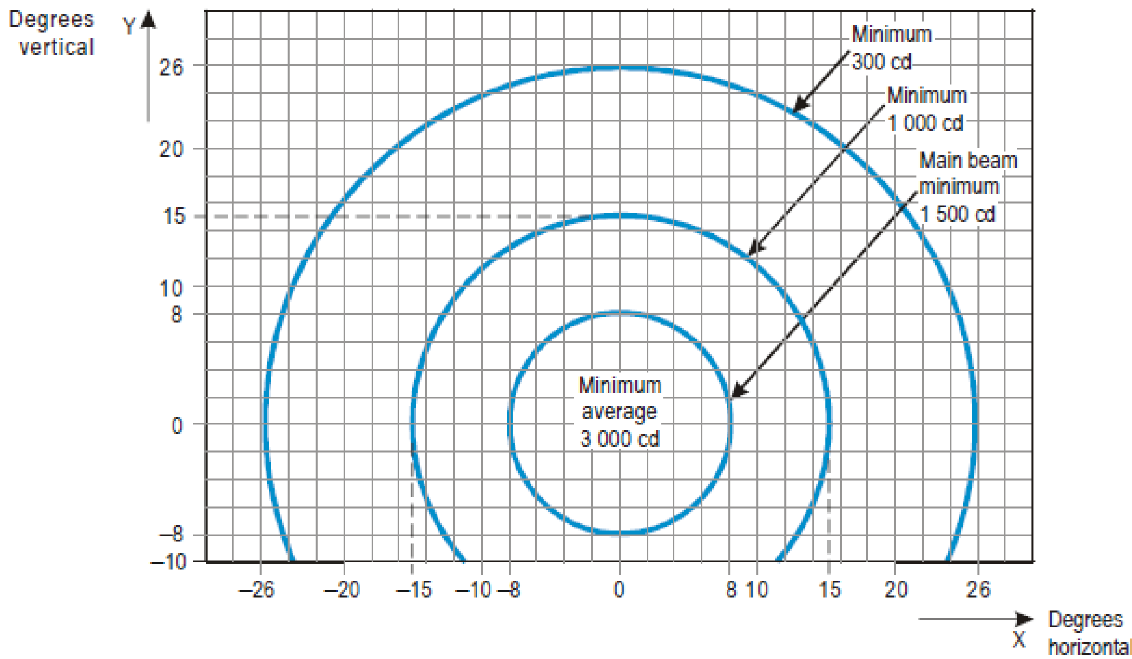


Notes:

1. Although the lights flash in normal operation, the light intensity is specified as if the lights were fixed for incandescent lamps.

2. The intensities specified are in yellow light.

Figure A2-24. Isocandela diagram for each light in low-intensity runway guard lights, Configuration A

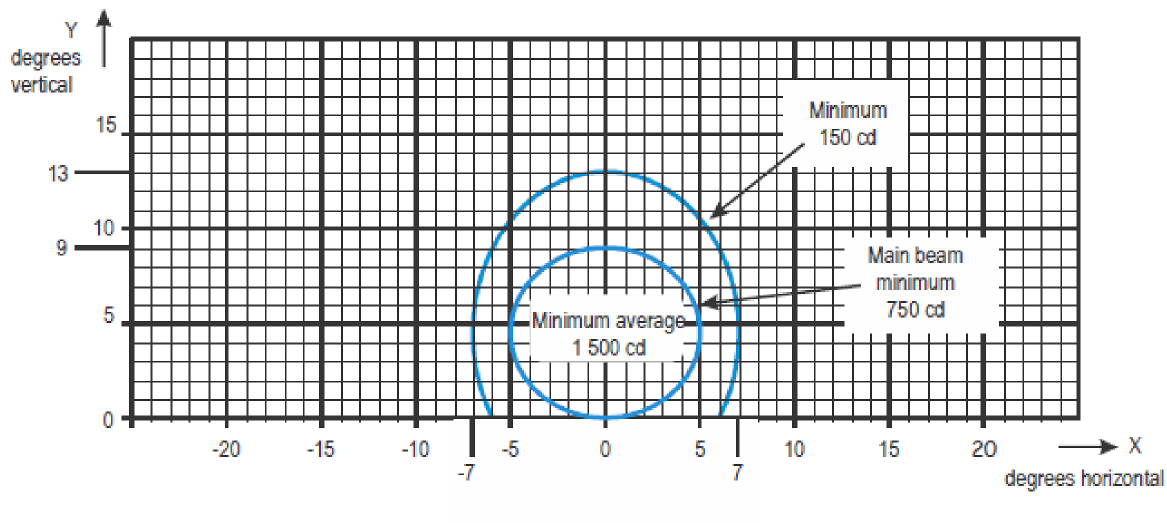


Notes:

1. Although the lights flash in normal operation, the light intensity is specified as if the lights were fixed for incandescent lamps.

2. The intensities specified are in yellow light.

Figure A2-25. Isocandela diagram for each light in high-intensity runway guard lights, Configuration A



Notes:

1. Curves calculated on formula $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$

a	5.0	7.0
b	4.5	8.5

2. See collective notes for Figures A2-1 to A2-11 and A2-26.

Figure A2-26. Isocandela diagram for take-off and hold lights (THL) (red light)

APPENDIX 3. MANDATORY INSTRUCTION MARKINGS AND INFORMATION MARKINGS

Note 1.— See Chapter 5, Sections 5.2.16 and 5.2.17, for specifications on the application, location and characteristics of mandatory instruction markings and information markings.

Note 2.— This appendix details the form and proportions of the letters, numbers and symbols of mandatory instruction markings and information markings on a grid.

Note 3.— The mandatory instruction markings and information markings on pavements are formed as if shadowed (i.e., stretched) from the characters of an equivalent elevated sign by a factor of 2.5 as shown in Figure A3-1. The shadowing, however, only affects the vertical dimension. Therefore, the spacing of characters for pavement marking is obtained by first determining the equivalent elevated sign character height and then proportioning from the spacing values given in Table A4-1.

*For example, in the case of the runway designator "10" which is to have a height of 4 000 mm (Hps), the equivalent elevated sign character height is 4 000/2.5=1 600 mm (Hes). Table A4-1(b) indicates numeral to numeral code 1 and from Table A4-1(c) this code has a dimension of 96 mm, for a character height of 400 mm. The pavement marking spacing for "10" is then (1 600/400)*96=384 mm.*

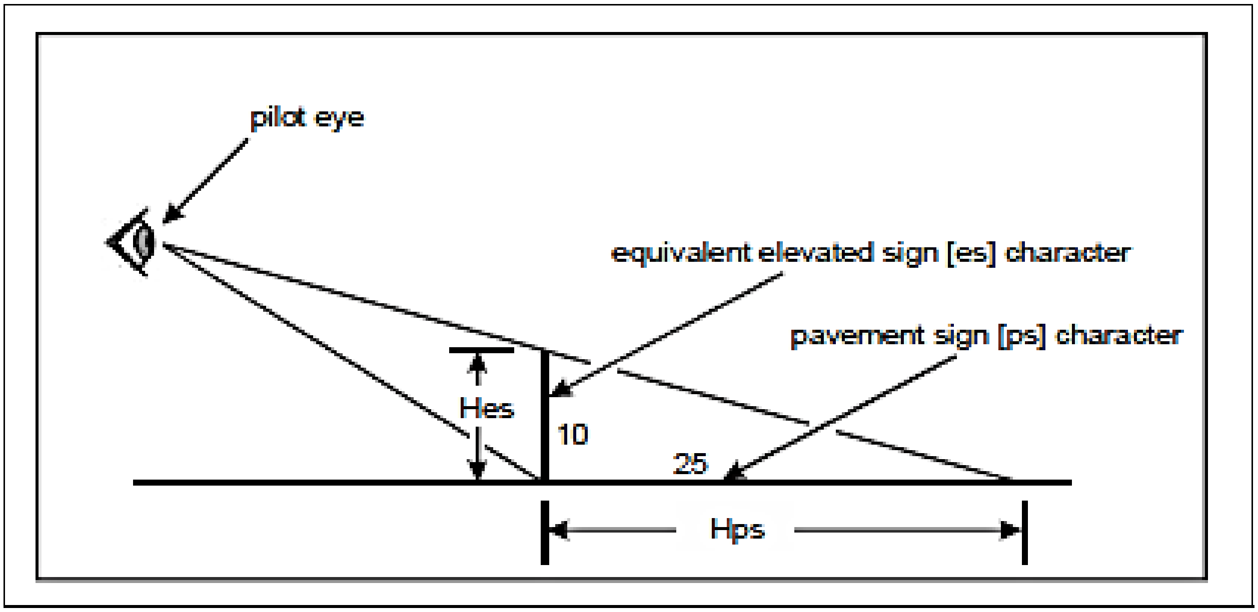
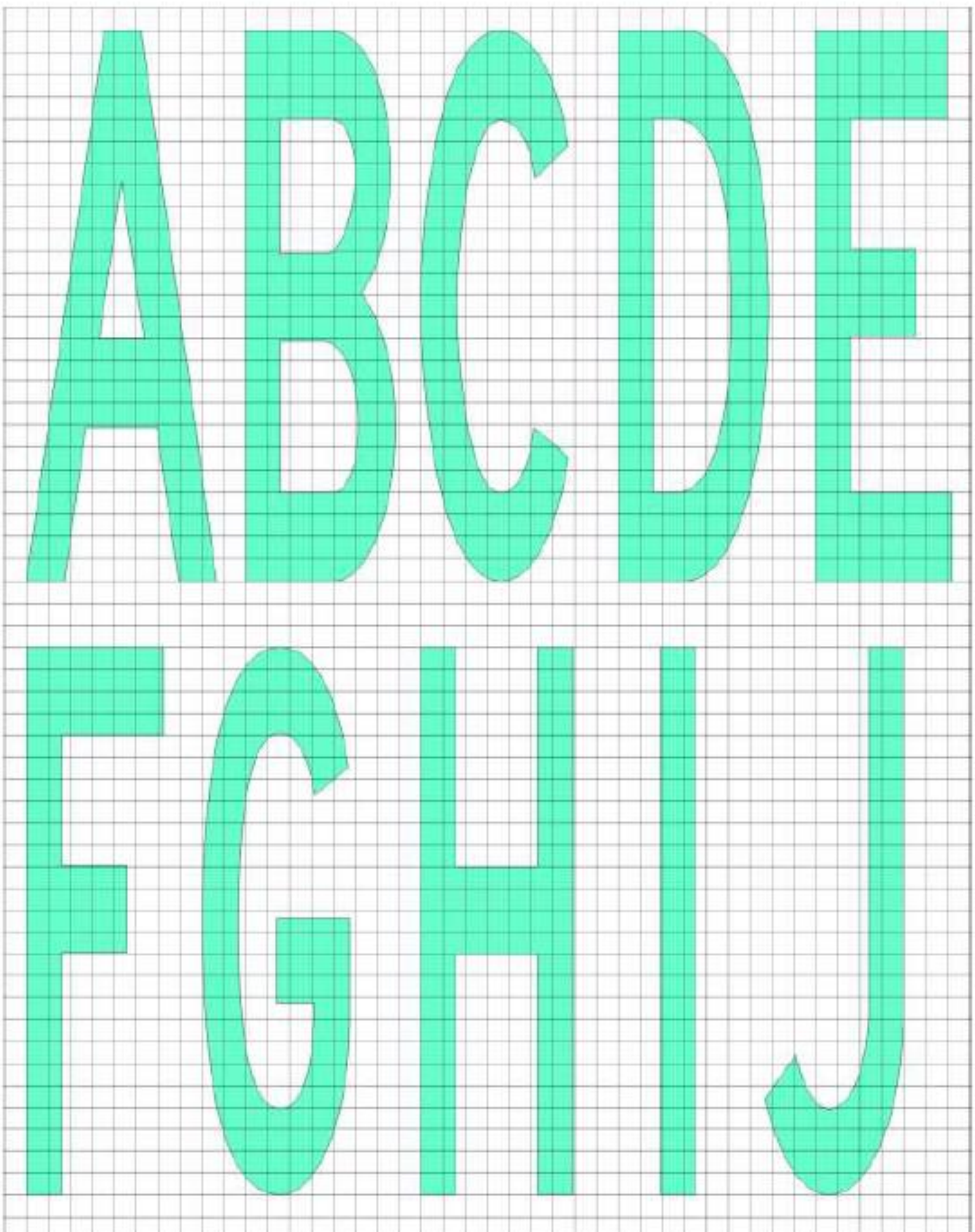
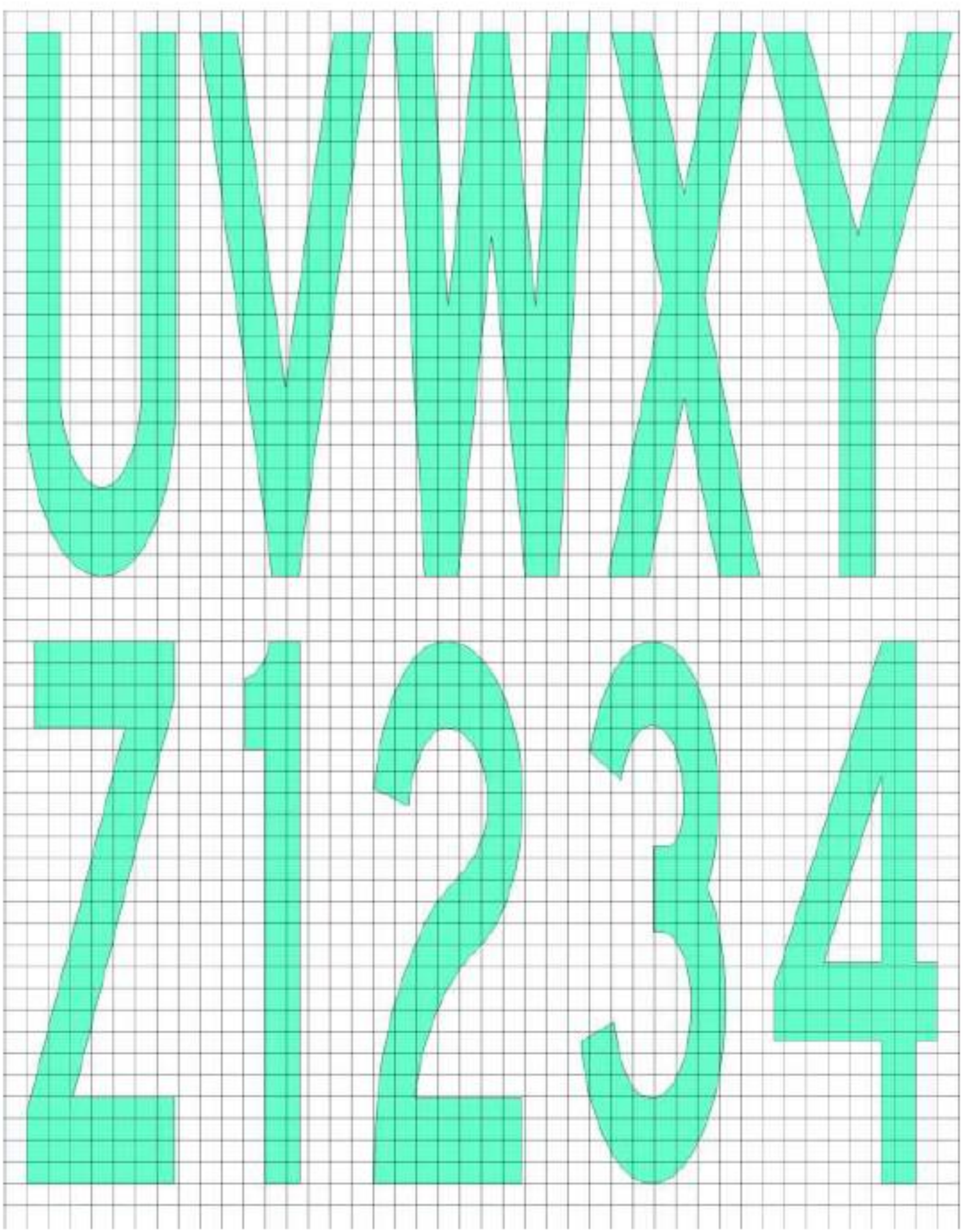


Figure A3-1


ABCDE
FGHIJ


KLMNO
PQRST


UVWXY
Z1234

APPENDIX 4. REQUIREMENTS CONCERNING DESIGN OF TAXIING GUIDANCE SIGNS

Note.— See Chapter 5, Section 5.4, for specifications on the application, location and characteristics of signs.

1. Inscription heights shall conform to the following tabulation.

Runway code number	Minimum character height		
	Mandatory instruction sign	Information sign	
		Runway exit and runway vacated signs	Other signs
1 or 2	300 mm	300 mm	200 mm
3 or 4	400 mm	400 mm	300 mm

Note.— Where a taxiway location sign is installed in conjunction with a runway designation sign (see 5.4.3.22), the character size shall be that specified for mandatory instruction signs.

2. Arrow dimensions shall be as follows:

Legend height	*Stroke*
200 mm	32 mm
300 mm	48 mm
400 mm	64 mm

3. Stroke width for single letter shall be as follows:

Legend height	*Stroke*
200 mm	32 mm
300 mm	48 mm
400 mm	64 mm

4. Sign luminance shall be as follows:

a) Where operations are conducted in runway visual range conditions less than a value of 800 m, average sign luminance shall be at least:

Red	30 cd/m^2
Yellow	150 cd/m^2
White	300 cd/m^2

b) Where operations are conducted in accordance with 5.4.1.7 b) and c) and 5.4.1.8, average sign luminance shall be at least:

Red	10 cd/m^2
Yellow	50 cd/m^2
White	100 cd/m^2

Note.— In runway visual range conditions less than a value of 400 m, there will be some degradation in the performance of signs.

5. The luminance ratio between red and white elements of a mandatory sign shall be between 1:5 and 1:10.

6. The average luminance of the sign is calculated by establishing grid points as shown in Figure A4-1 and using the luminance values measured at all grid points located within the rectangle representing the sign.

7. The average value is the arithmetic average of the luminance values measured at all considered grid points.

Note.— Guidance on measuring the average luminance of a sign is contained in the Aerodrome Design Manual (Doc 9157), Part 4.

8. The ratio between luminance values of adjacent grid points shall not exceed 1.5:1. For areas on the sign face where the grid spacing is 7.5 cm, the ratio between luminance values of adjacent grid points shall not exceed 1.25:1. The ratio between the maximum and minimum luminance value over the whole sign face shall not exceed 5:1.

9. The forms of characters, i.e. letters, numbers, arrows and symbols, shall conform to those shown in Figure A4-2. The width of characters and the space between individual characters shall be determined as indicated in Table A4-1.

10. The face height of signs shall be as follows:

Legend height	*Face height (min)*
200 mm	300 mm
300 mm	450 mm
400 mm	600 mm

11. The face width of signs shall be determined using Figure A4-4 except that, where a mandatory instruction sign is provided on one side of a taxiway only, the face width shall not be less than:

a) 1.94 m where the code number is 3 or 4; and

b) 1.46 m where the code number is 1 or 2.

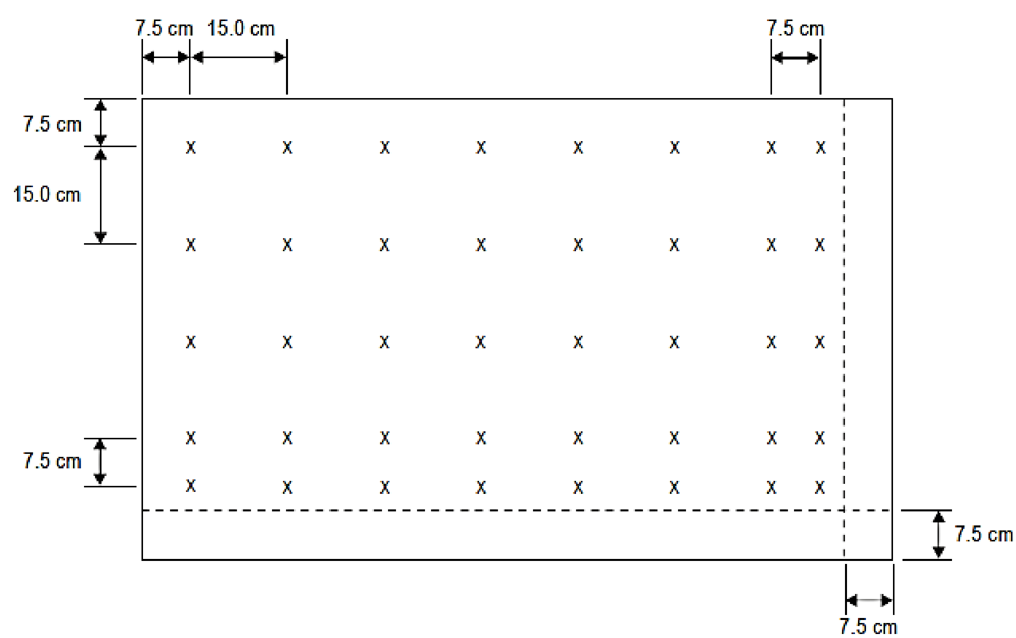
Note.— Additional guidance on determining the face width of a sign is contained in the Aerodrome Design Manual (Doc 9157), Part 4.

12. Borders

a) The black vertical delineator between adjacent direction signs should have a width of approximately 0.7 of the stroke width.

b) The yellow border on a stand-alone location sign should be approximately 0.5 stroke width.

13. The colours of signs shall be in accordance with the appropriate specifications in Appendix 1.



Note 1.— The average luminance of a sign is calculated by establishing grid points on a sign face showing typical inscriptions and a background of the appropriate colour (red for mandatory instruction signs and yellow for direction and destination signs) as follows:

a) *Starting at the top left corner of the sign face, establish a reference grid point at 7.5 cm from the left edge and the top of the sign face.*

b) *Create a grid of 15 cm spacing horizontally and vertically from the reference grid point. Grid points within 7.5 cm of the edge of the sign face shall be excluded.*

c) *Where the last point in a row/column of grid points is located between 22.5 cm and 15 cm from the edge of the sign face (but not inclusive), an additional point shall be added 7.5 cm from this point.*

d) *Where a grid point falls on the boundary of a character and the background, the grid point shall be slightly shifted to be completely outside the character.*

Note 2.— Additional grid points may be required to ensure that each character includes at least five evenly spaced grid points.

Note 3.— Where one unit includes two types of signs, a separate grid shall be established for each type.

Figure A4-1. Grid points for calculating average luminance of a sign

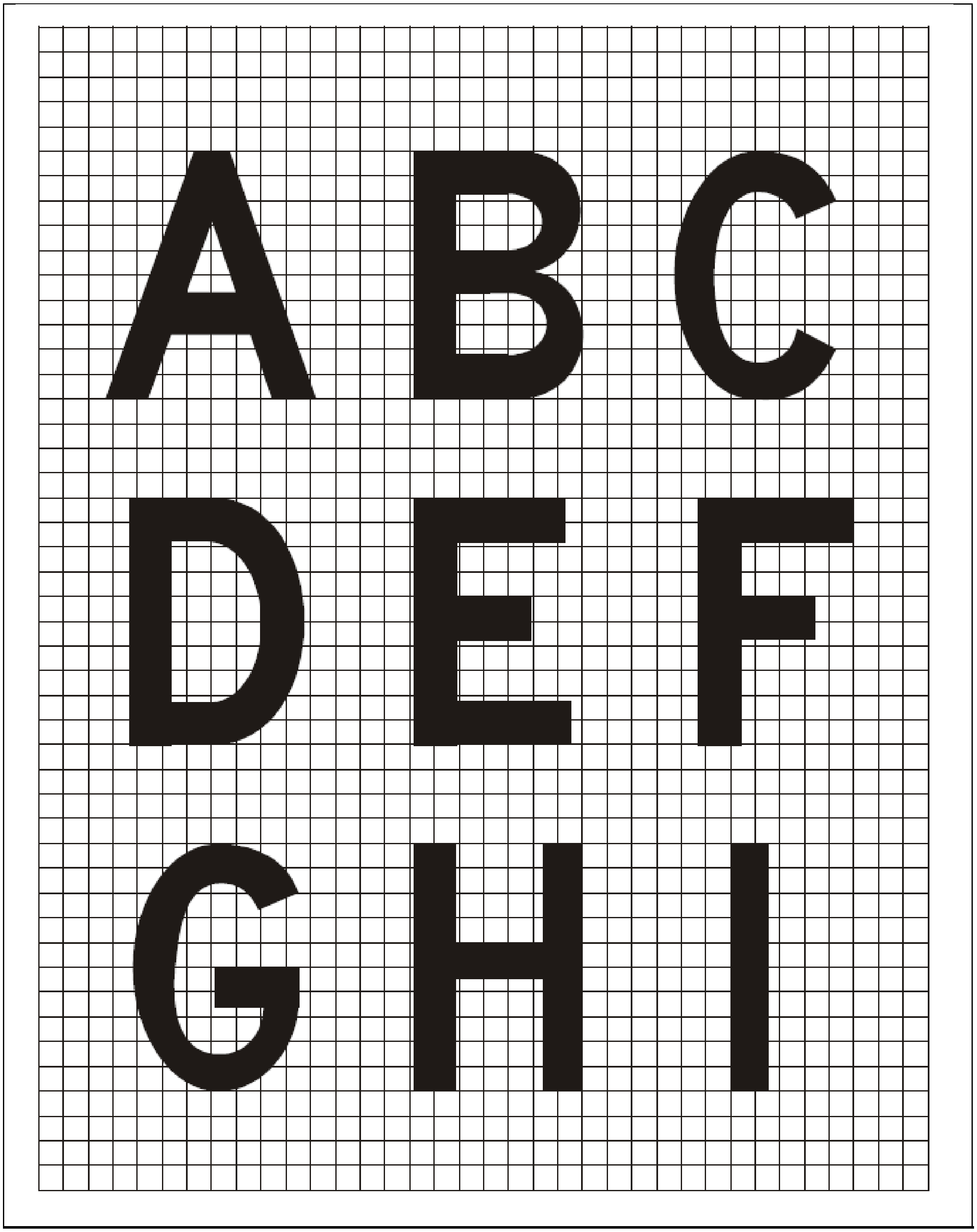


Figure A4-2. Forms of characters

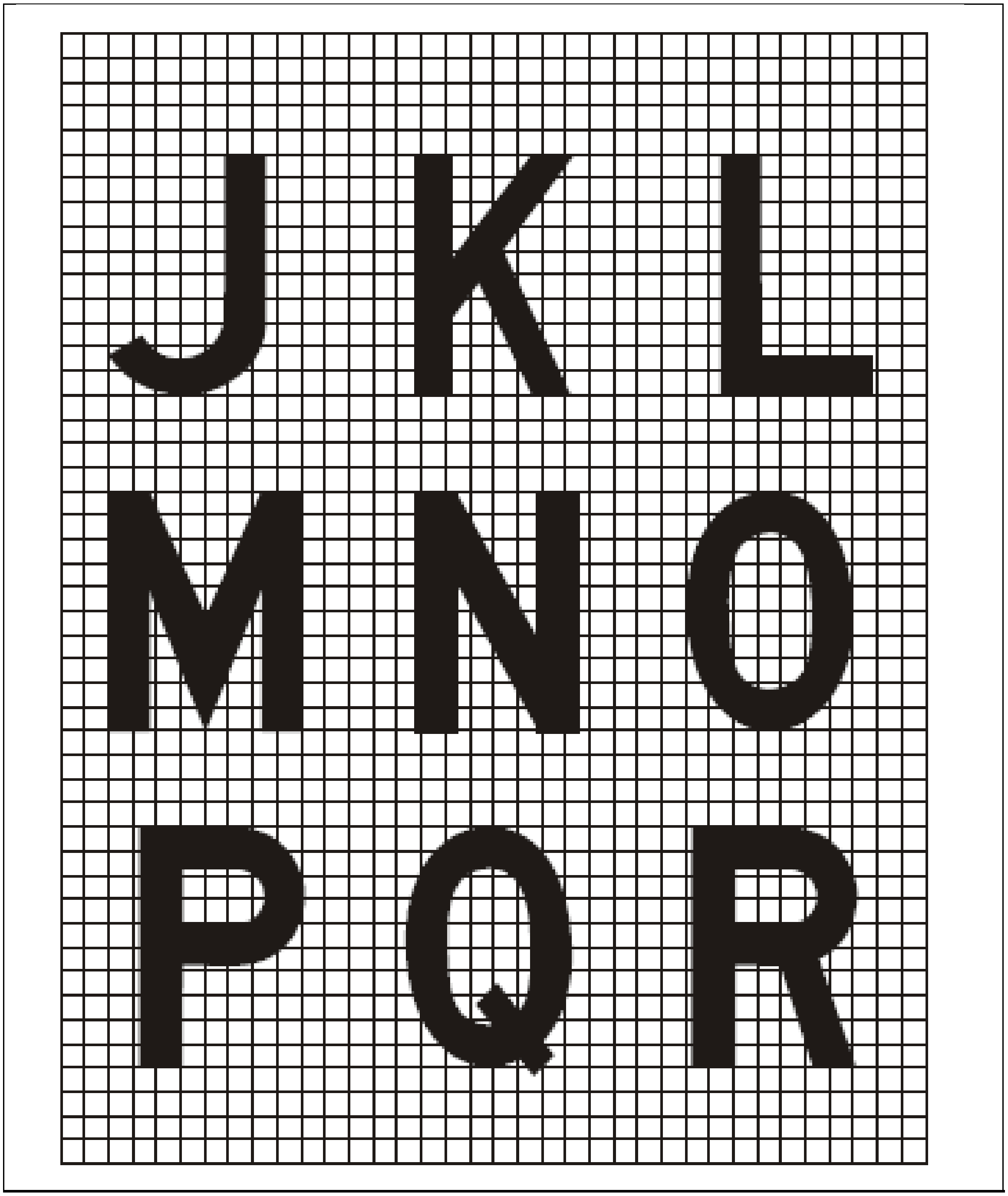


Figure A4-2. (cont.)

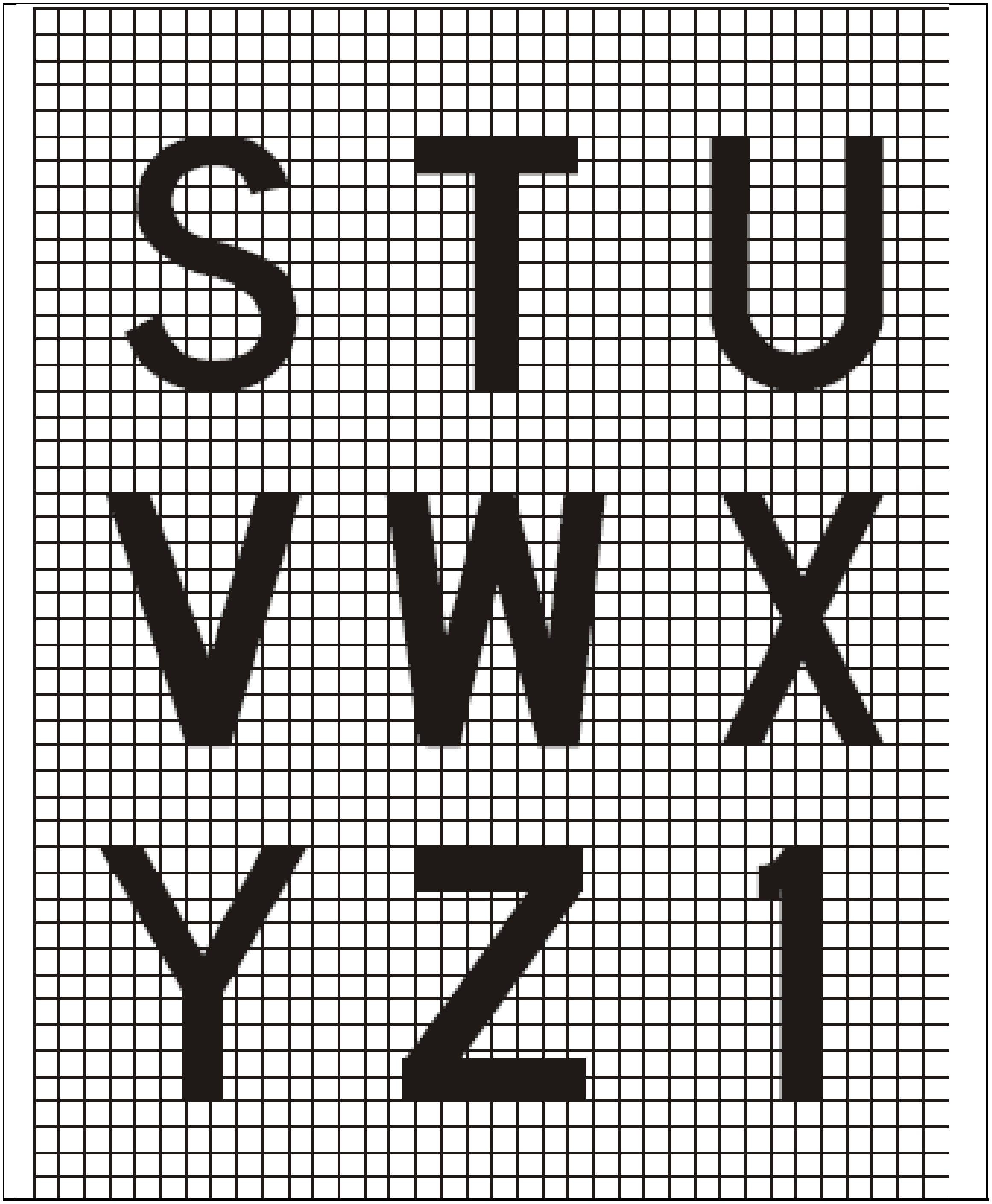


Figure A4-2. (cont.)

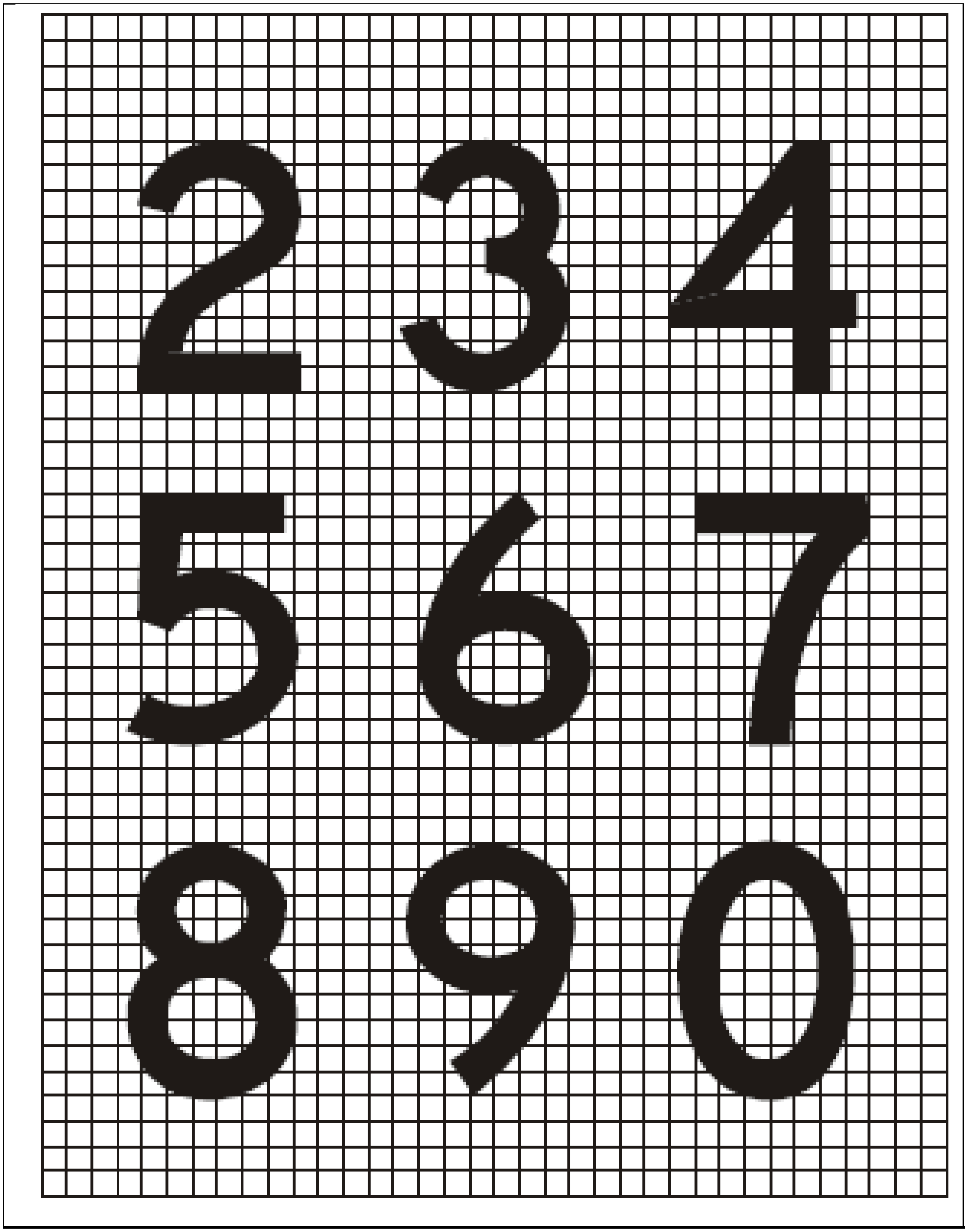


Figure A4-2. (cont.)

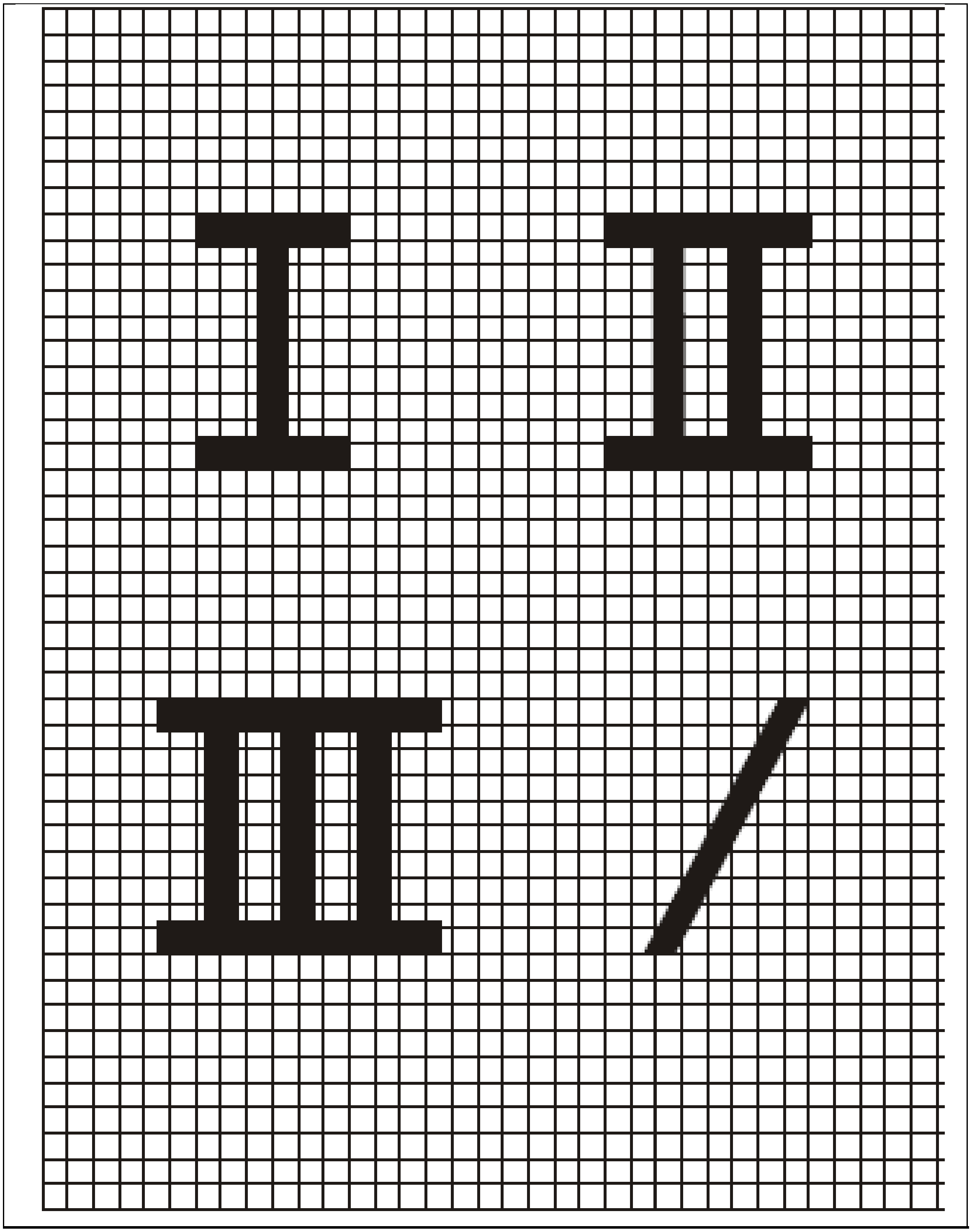
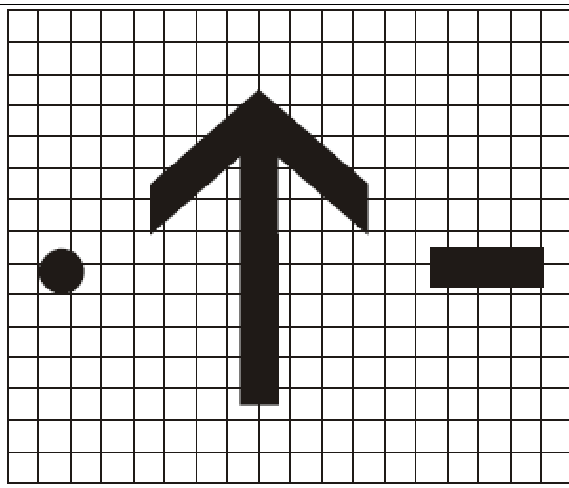


Figure A4-2. (cont.)

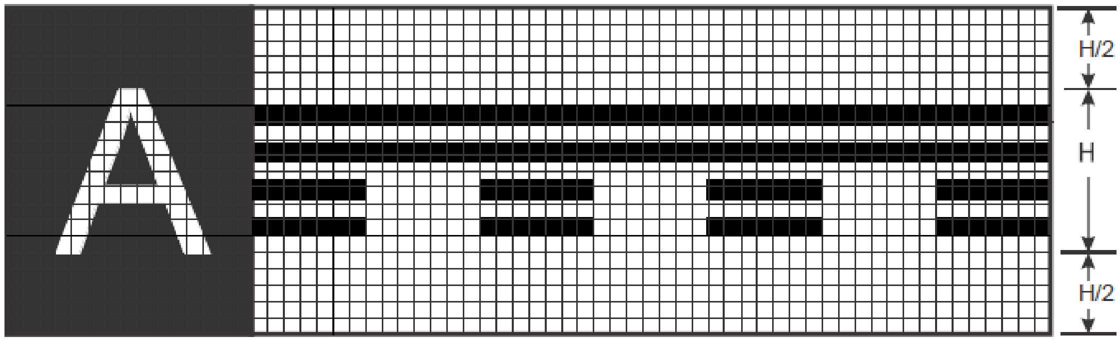


Arrow, dot and dash

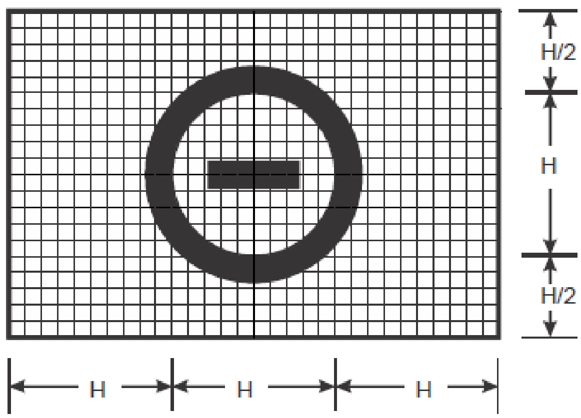
Note 1.—The arrow stroke width, diameter of the dot, and both width and length of the dash shall be proportioned to the character stroke widths.

Note 2.— The dimensions of the arrow shall remain constant for a particular sign size, regardless of orientation.

Figure A4-2. (cont.)

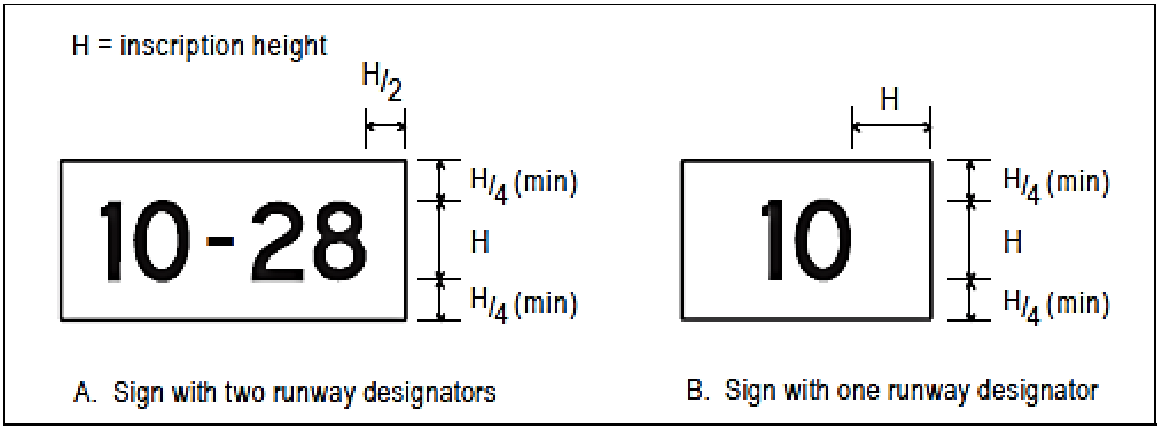


Runway vacated sign (with typical location sign)



NO ENTRY sign

Figure A4-3. Runway vacated and NO ENTRY signs



Explanatory Note to Figure A4-4: "H" stands for the inscription height.

Figure A4-4. Sign dimensions

Table A4-1. Letter and numeral widths and space between letters or numerals

a) Letter to letter code number

Preceding Letter	Following Letter: B, D, E, F, H, I, K, L, M, N, P, R, U	C, G, O, Q, S, X, Z	A, J, T, V, W, Y
	Code number		
A	2	2	4
B	1	2	2
C	2	2	3
D	1	2	2
E	2	2	3
F	2	2	3
G	1	2	2
H	1	1	2
I	1	1	2
J	1	1	2
K	2	2	3
L	2	2	4
M	1	1	2
N	1	1	2
O	1	2	2
P	1	2	2
Q	1	2	2
R	1	2	2
S	1	2	2
T	2	2	4
U	1	1	2
V	2	2	4
W	2	2	4
X	2	2	3
Y	2	2	4
Z	2	2	3

b) Numeral to numeral code number

Preceding Numeral	Following number: 1, 5	2, 3, 6, 8, 9, 0	4, 7
	Code number		
1	1	1	2
2	1	2	2
3	1	2	2
4	2	2	4
5	1	2	2
6	1	2	2
7	2	2	4
8	1	2	2
9	1	2	2
0	1	2	2

c) Space between characters

Code No.	Character height (mm): 200	300	400
	Space (mm)		
1	48	71	96
2	38	57	76
3	25	38	50
4	13	19	26

d) Width of letter

Letter	Letter height (mm): 200	300	400
	Width (mm)		
A	170	255	340
B	137	205	274
C	137	205	274
D	137	205	274
E	124	186	248
F	124	186	248
G	137	205	274
H	137	205	274
I	32	48	64
J	127	190	254
K	140	210	280
L	124	186	248
M	157	236	314
N	137	205	274
O	143	214	286
P	137	205	274
Q	143	214	286
R	137	205	274
S	137	205	274
T	124	186	248
U	137	205	274
V	152	229	304
W	178	267	356
X	137	205	274
Y	171	257	342
Z	137	205	274

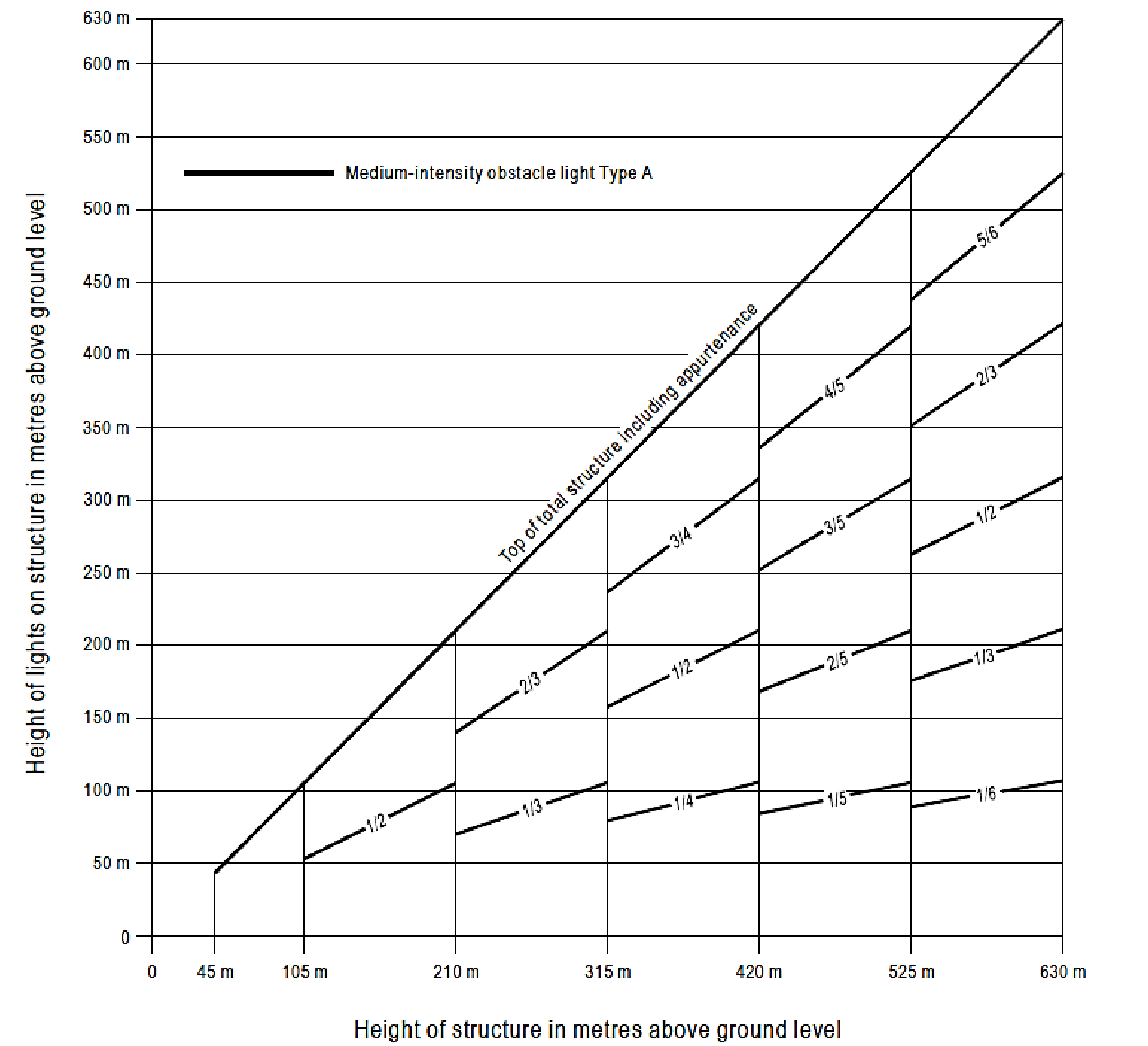
e) Width of numeral

Numeral	Numeral height (mm): 200	300	400
	Width (mm)		
1	50	74	98
2	137	205	274
3	137	205	274
4	149	224	298
5	137	205	274
6	137	205	274
7	137	205	274
8	137	205	274
9	137	205	274
0	143	214	286

INSTRUCTIONS

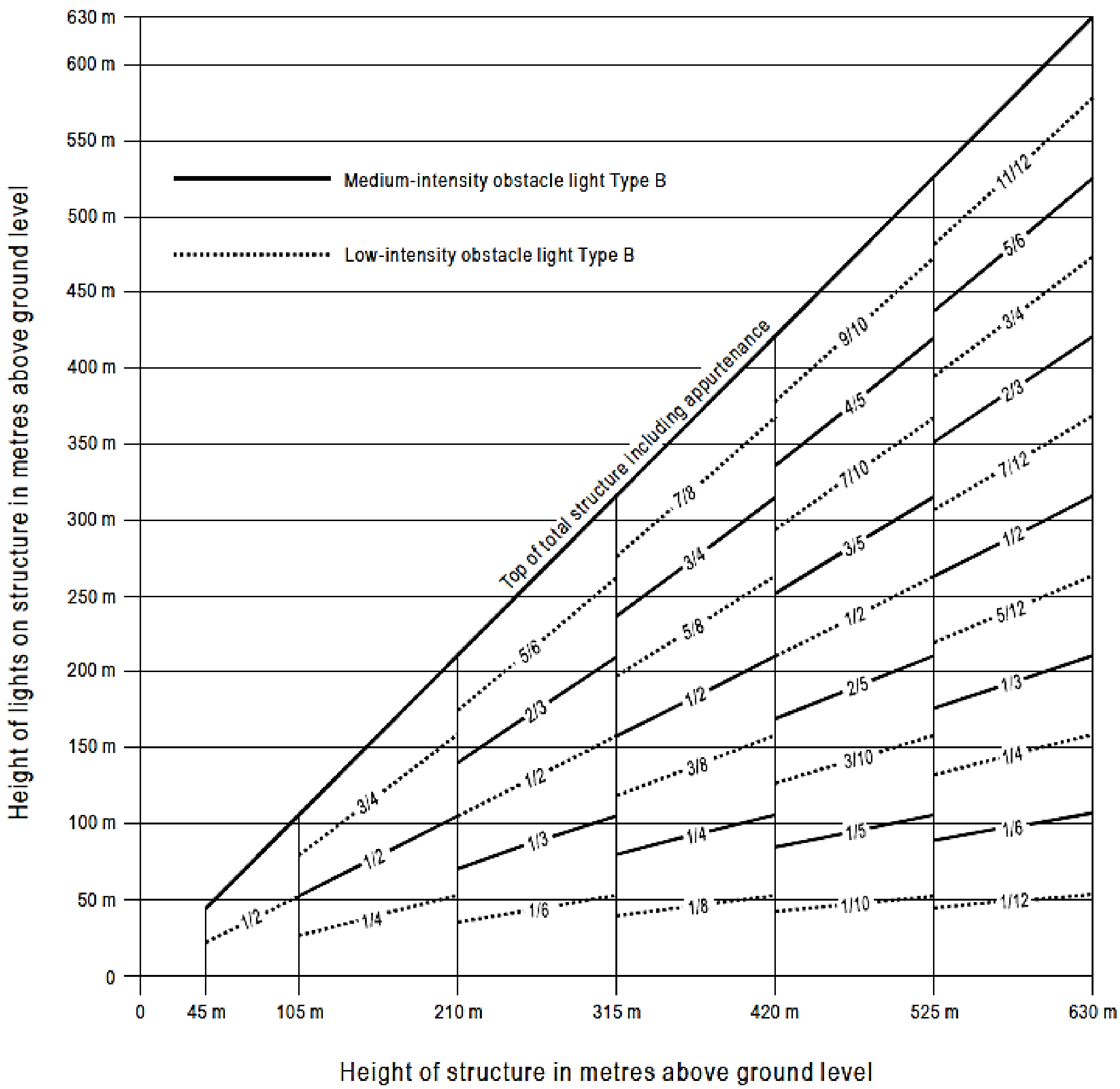
1. To determine the proper SPACE between letters or numerals, obtain the code number from table a) or b) and enter table c) for that code number to the desired letter or numeral height.
2. The space between words or groups of characters forming an abbreviation or symbol should be equal to 0.5 to 0.75 of the height of the characters used except that where an arrow is located with a single character such as ‘A →‘, the space may be reduced to not less than one quarter of the height of the character in order to provide a good visual balance.
3. Where the numeral follows a letter or vice versa use Code 1.
4. Where a hyphen, dot, or diagonal stroke follows a character or vice versa use Code 1.
5. For the intersection take-off sign, the height of the lower case “m” is 0.75 of the height of the preceding “0” (zero) and spaced from the preceding “0” at code 1 for the character height of the numerals.

APPENDIX 5. LOCATION OF LIGHTS ON OBSTACLES



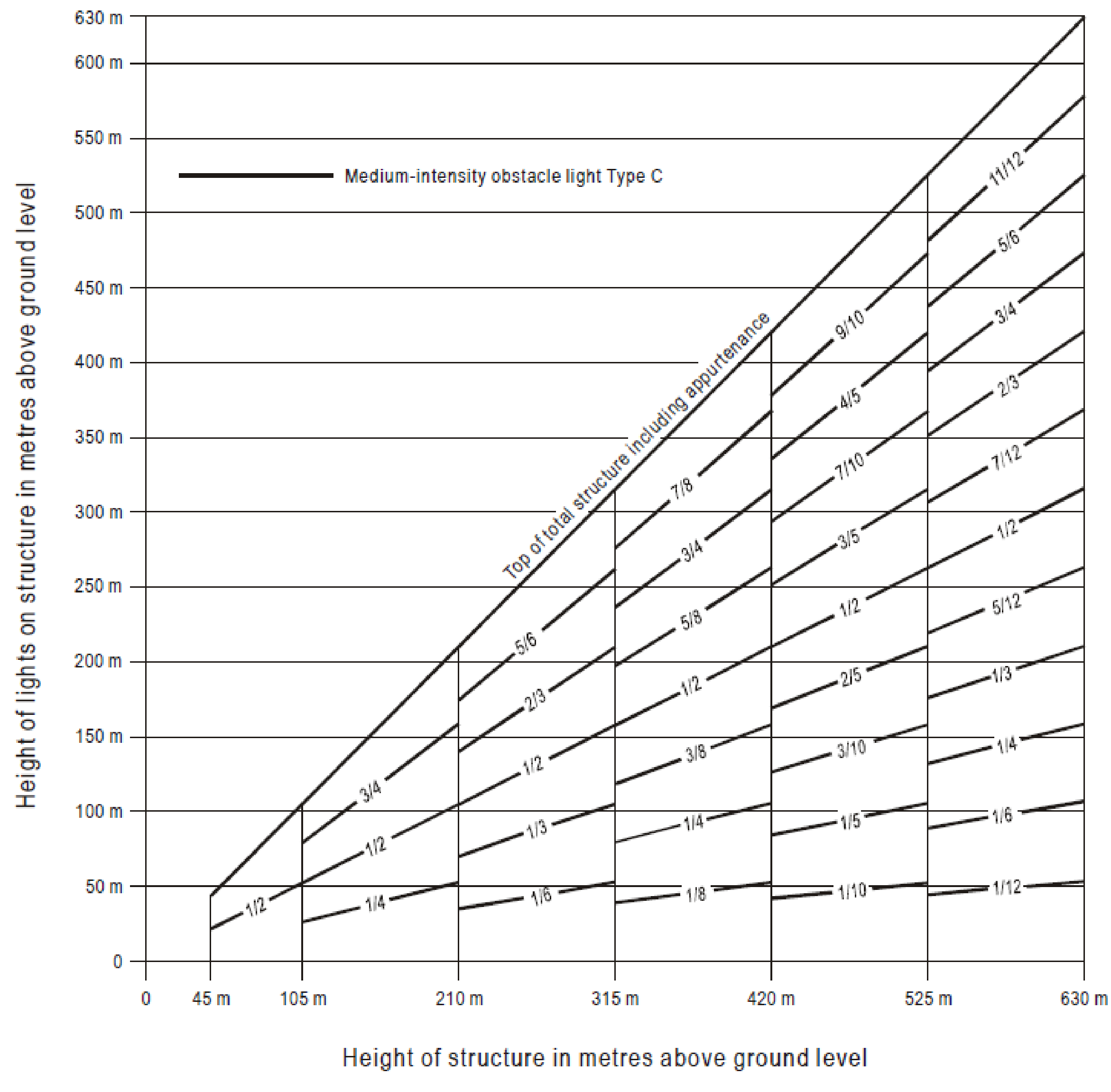
Note.— High-intensity obstacle lighting is recommended on structures with a height of more than 150 m above ground el. If medium-intensity lighting is used, marking will also be required.

Figure A5-1. Medium-intensity flashing-white obstacle lighting system, Type A



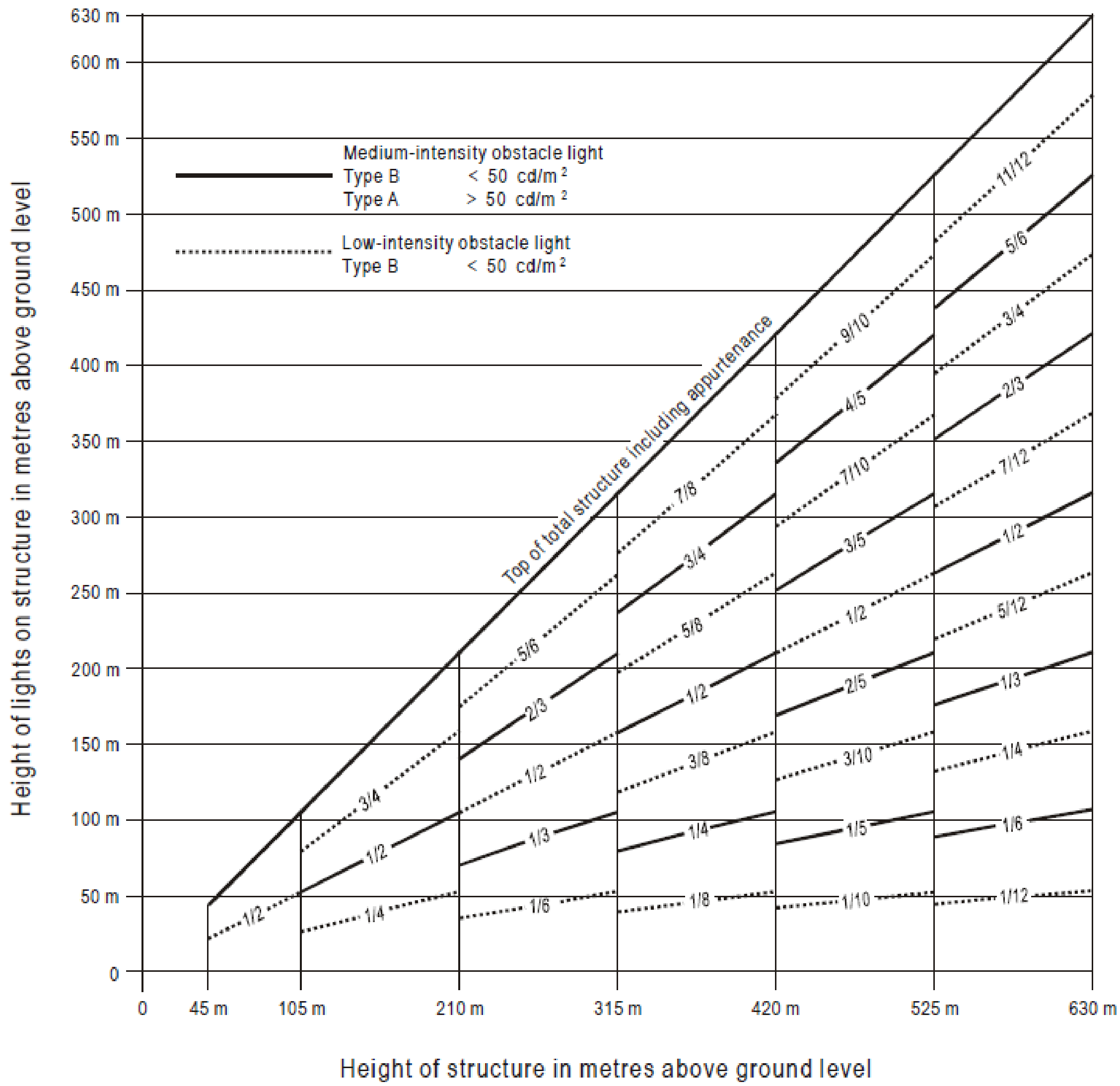
Note.— For night-time use only.

Figure A5-2. Medium-intensity flashing-red obstacle lighting system, Type B



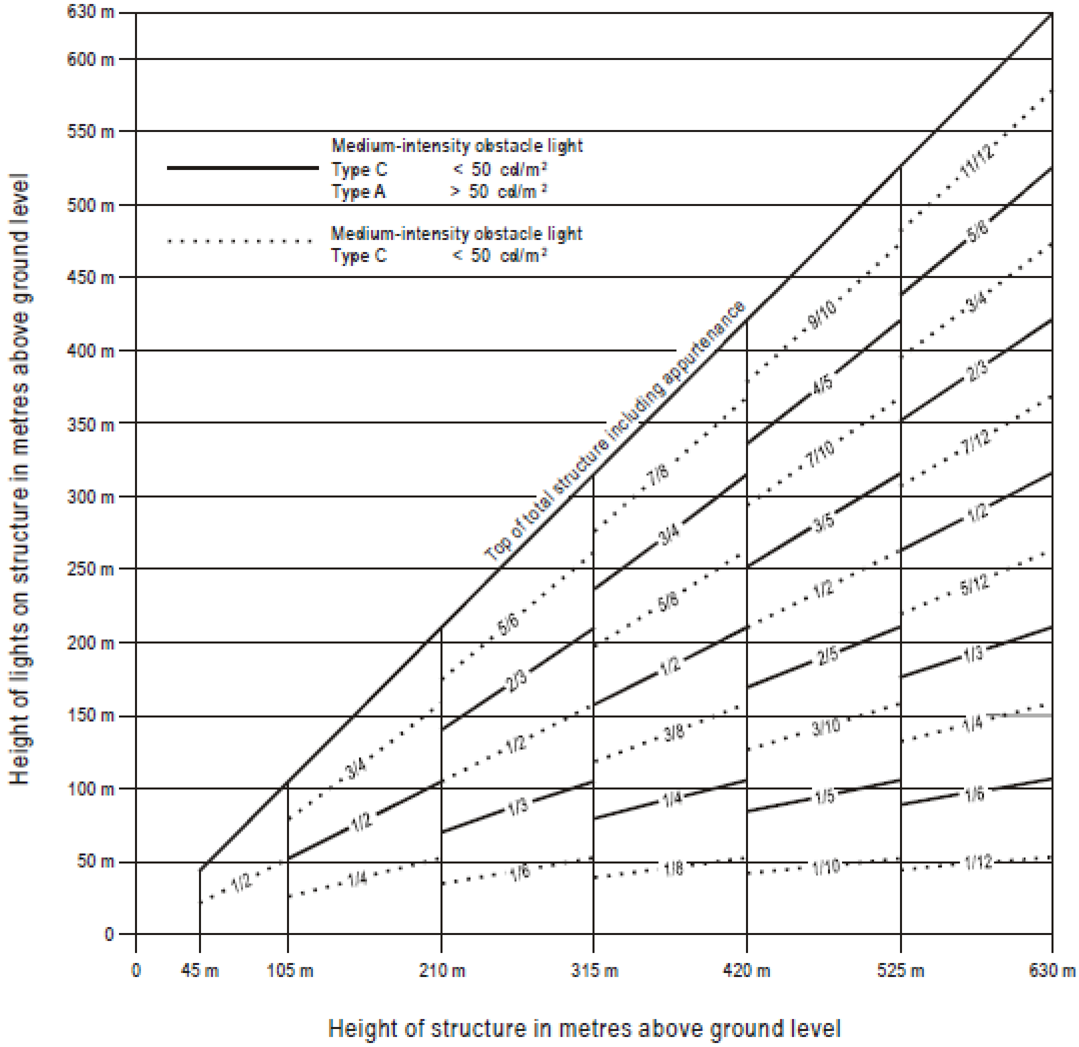
Note.— For night-time use only.

Figure A5-3. Medium-intensity fixed-red obstacle lighting system, Type C



Note.— High-intensity obstacle lighting is recommended on structures with a height of more than 150 m above ground vel. If medium-intensity lighting is used, marking will also be required.

Figure A5-4. Medium-intensity dual obstacle lighting system, Type A/Type B



Note.— High-intensity obstacle lighting is recommended on structures with a height of more than 150 m above ground level. If medium-intensity lighting is used, marking will also be required.

Figure A5-5. Medium-intensity dual obstacle lighting system, Type A/Type C

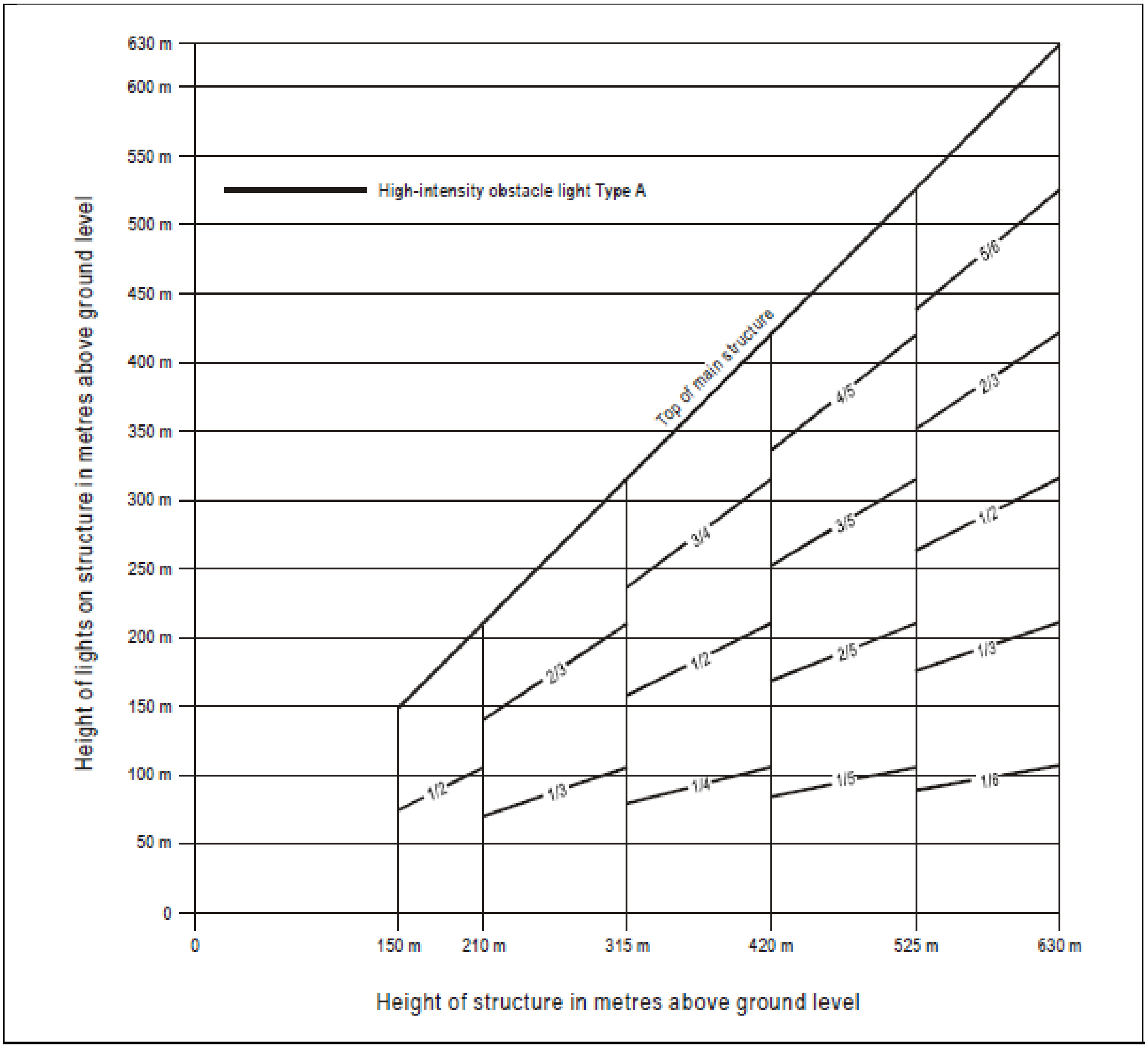


Figure A5-6. High-intensity flashing-white obstacle lighting system, Type A

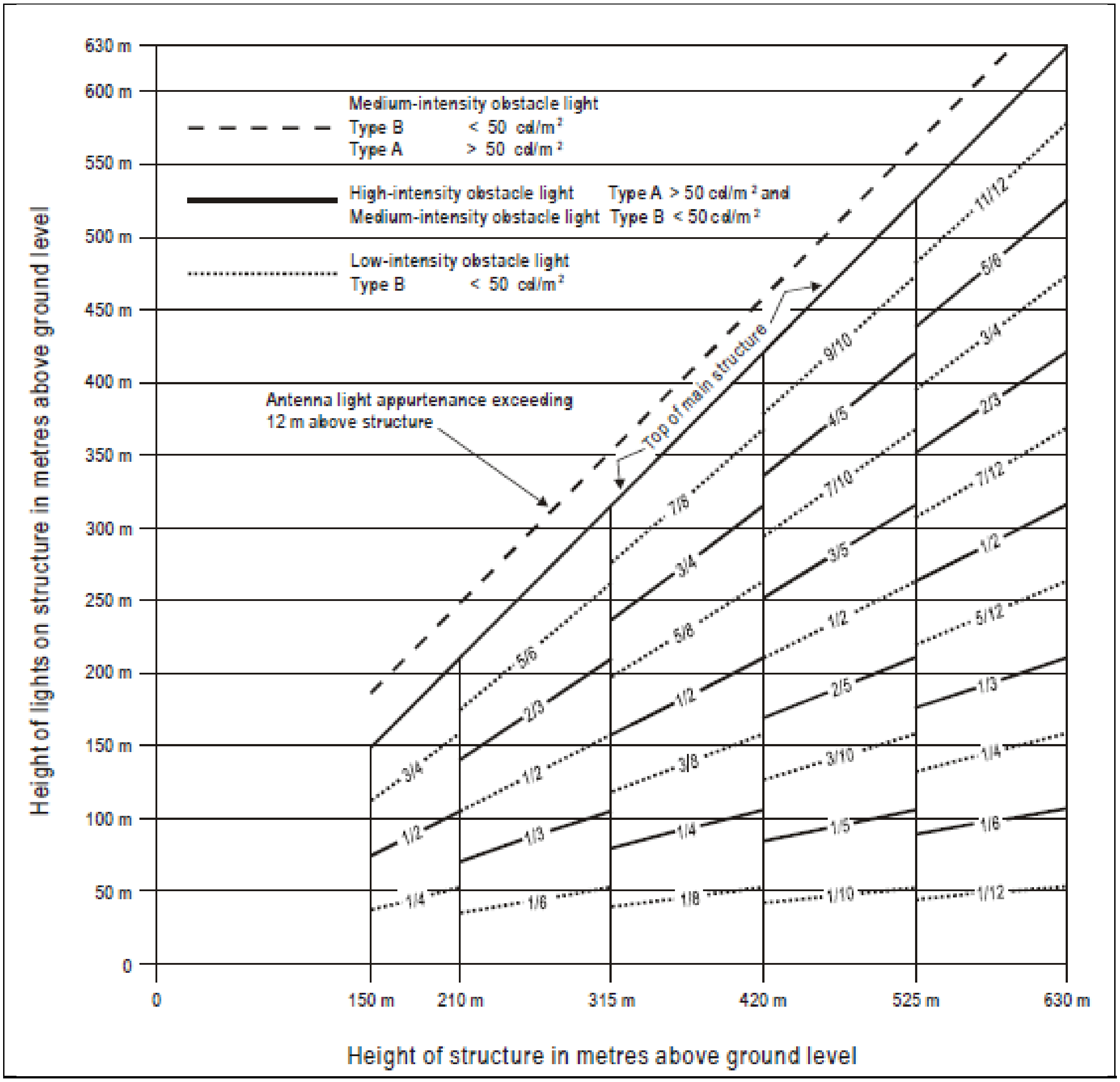


Figure A5-7. High-/medium-intensity dual obstacle lighting system, Type A/Type B

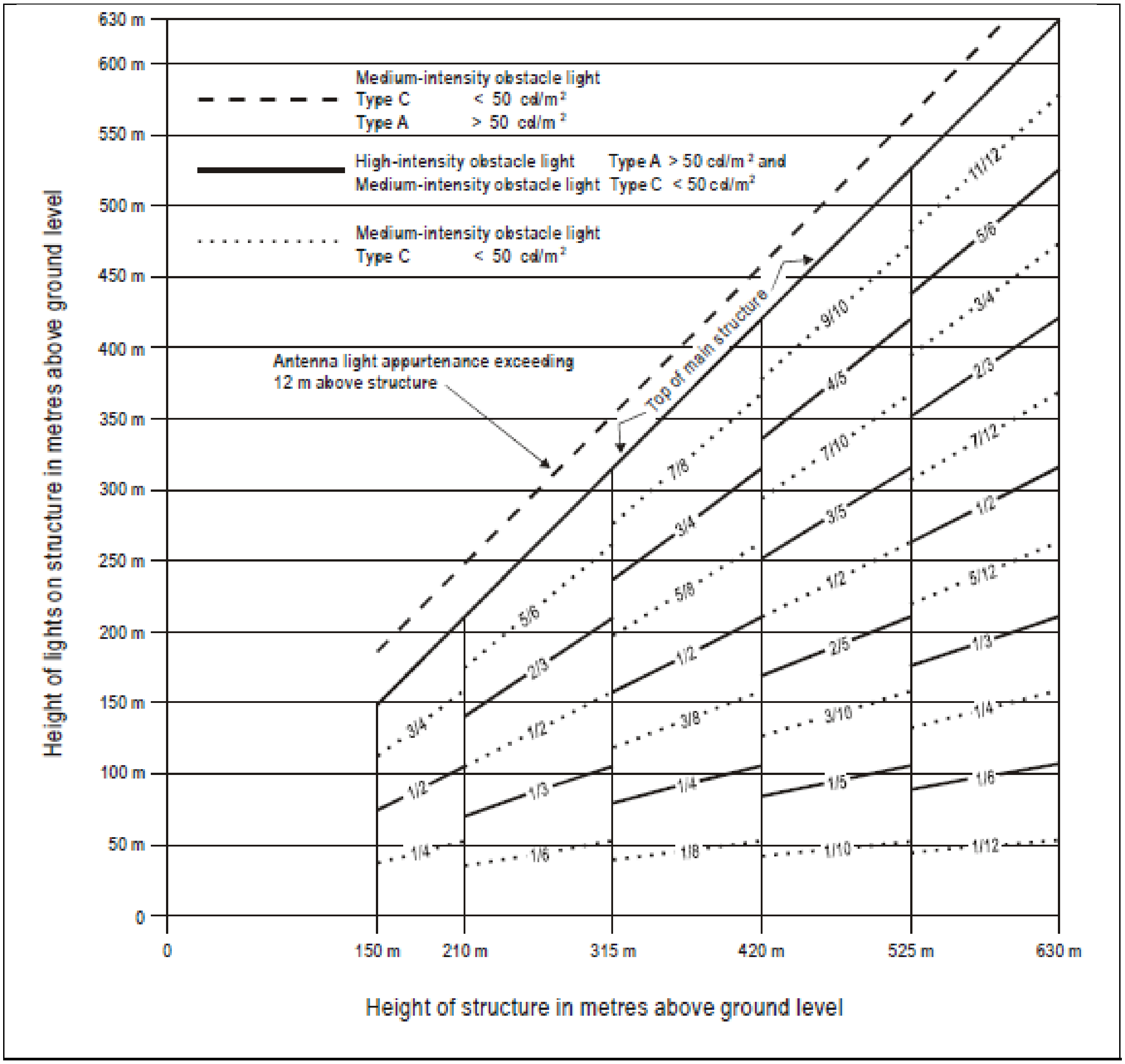


Figure A5-8. High-/medium-intensity dual obstacle lighting system, Type A/Type C

ATTACHMENT A. GUIDANCE MATERIAL SUPPLEMENTARY TO ANNEX 14, VOLUME I.

1. Number, siting and orientation of runways

Siting and orientation of runways

1.1 Many factors should be taken into account in the determination of the siting and orientation of runways. Without attempting to provide an exhaustive list of these factors nor an analysis of their effects, it appears useful to indicate those which most frequently require study. These factors may be classified under four headings:

1.1.1 Type of operation. Attention should be paid in particular to whether the aerodrome is to be used in all meteorological conditions or only in visual meteorological conditions, and whether it is intended for use by day and night, or only by day.

1.1.2 Climatological conditions. A study of the wind distribution should be made to determine the usability factor. In this regard, the following comments should be taken into account:

a) Wind statistics used for the calculation of the usability factor are normally available in ranges of speed and direction, and the accuracy of the results obtained depends, to a large extent, on the assumed distribution of observations within these ranges. In the absence of any sure information as to the true distribution, it is usual to assume a uniform distribution since, in relation to the most favourable runway orientations, this generally results in a slightly conservative usability factor.

b) The maximum mean crosswind components given in Chapter 3, 3.1.3, refer to normal circumstances. There are some factors which may require that a reduction of those maximum values be taken into account at a particular aerodrome. These include:

1) the wide variations which may exist, in handling characteristics and maximum permissible crosswind components, among diverse types of aeroplanes (including future types) within each of the three groups given in 3.1.3;

2) prevalence and nature of gusts;

3) prevalence and nature of turbulence;

4) the availability of a secondary runway;

5) the width of runways;

6) the runway surface conditions — water, snow and ice on the runway materially reduce the allowable crosswind component; and

7) the strength of the wind associated with the limiting crosswind component.

A study should also be made of the occurrence of poor visibility and/or low cloud base. Account should be taken of their frequency as well as the accompanying wind direction and speed.

1.1.3 Topography of the aerodrome site, its approaches, and surroundings, particularly:

a) compliance with the obstacle limitation surfaces;

b) current and future land use. The orientation and layout should be selected so as to protect as far as possible the particularly sensitive areas such as residential, school and hospital zones from the discomfort caused by aircraft noise. Detailed information on this topic is provided in the Airport Planning Manual (Doc 9184), Part 2, and in Guidance on the Balanced Approach to Aircraft Noise Management (Doc 9829);

c) current and future runway lengths to be provided;

d) construction costs; and

e) possibility of installing suitable non-visual and visual aids for approach-to-land.

1.1.4 Air traffic in the vicinity of the aerodrome, particularly:

a) proximity of other aerodromes or ATS routes;

b) traffic density; and

c) air traffic control and missed approach procedures.

Number of runways in each direction

1.2 The number of runways to be provided in each direction depends on the number of aircraft movements to be catered to.

2. Clearways and stopways

2.1 The decision to provide a stopway and/or a clearway as an alternative to an increased length of runway will depend on the physical characteristics of the area beyond the runway end, and on the operating performance requirements of the prospective aeroplanes. The runway, stopway and clearway lengths to be provided are determined by the aeroplane take-off performance, but a check should also be made of the landing distance required by the aeroplanes using the runway to ensure that adequate runway length is provided for landing. The length of a clearway, however, cannot exceed half the length of take-off run available.

2.2 The aeroplane performance operating limitations require a length which is enough to ensure that the aeroplane can, after starting a take-off, either be brought safely to a stop or complete the take-off safely. For the purpose of discussion it is supposed that the runway, stopway and clearway lengths provided at the aerodrome are only just adequate for the aeroplane requiring the longest take-off and accelerate-stop distances, taking into account its take-off mass, runway characteristics and ambient atmospheric conditions. Under these circumstances there is, for each take-off, a speed, called the decision speed; below this speed, the take-off must be abandoned if an engine fails, while above it the take-off must be completed. A very long take-off run and take-off distance would be required to complete a take-off when an engine fails before the decision speed is reached, because of the insufficient speed and the reduced power available. There would be no difficulty in stopping in the remaining accelerate-stop distance available provided action is taken immediately. In these circumstances the correct course of action would be to abandon the take-off.

2.3 On the other hand, if an engine fails after the decision speed is reached, the aeroplane will have sufficient speed and power available to complete the take-off safely in the remaining take-off distance available. However, because of the high speed, there would be difficulty in stopping the aeroplane in the remaining accelerate-stop distance available.

2.4 The decision speed is not a fixed speed for any aeroplane, but can be selected by the pilot within limits to suit the accelerate-stop and take-off distance available, aeroplane take-off mass, runway characteristics and ambient atmospheric conditions at the aerodrome. Normally, a higher decision speed is selected as the accelerate-stop distance available increases.

2.5 A variety of combinations of accelerate-stop distances required and take-off distances required can be obtained to accommodate a particular aeroplane, taking into account the aeroplane take-off mass, runway characteristics, and ambient atmospheric conditions. Each combination requires its particular length of take-off run.

2.6 The most familiar case is where the decision speed is such that the take-off distance required is equal to the accelerate-stop distance required; this value is known as the balanced field length. Where stopway and clearway are not provided, these distances are both equal to the runway length. However, if landing distance is for the moment ignored, runway is not essential for the whole of the balanced field length, as the take-off run required is, of course, less than the balanced field length. The balanced field length can, therefore, be provided by a runway supplemented by an equal length of clearway and stopway, instead of wholly as a runway. If the runway is used for take-off in both directions, an equal length of clearway and stopway has to be provided at each runway end. The saving in runway length is, therefore, bought at the cost of a greater overall length.

2.7 In case economic considerations preclude the provision of stopway and, as a result, only runway and clearway are to be provided, the runway length (neglecting landing requirements) should be equal to the accelerate-stop distance required or the take-off run required, whichever is the greater. The take-off distance available will be the length of the runway plus the length of clearway.

2.8 The minimum runway length and the maximum stopway or clearway length to be provided may be determined as follows, from the data in the aeroplane flight manual for the aeroplane considered to be critical from the viewpoint of runway length requirements:

a) if a stopway is economically possible, the lengths to be provided are those for the balanced field length. The runway length is the take-off run required or the landing distance required, whichever is the greater. If the accelerate-stop distance required is greater than the runway length so determined, the excess may be provided as stopway, usually at each end of the runway. In addition, a clearway of the same length as the stopway must also be provided;

b) if a stopway is not to be provided, the runway length is the landing distance required, or if it is greater, the accelerate-stop distance required, which corresponds to the lowest practical value of the decision speed. The excess of the take-off distance required over the runway length may be provided as clearway, usually at each end of the runway.

2.9 In addition to the above consideration, the concept of clearways in certain circumstances can be applied to a situation where the take-off distance required for all engines operating exceeds that required for the engine failure case.

2.10 The economy of a stopway can be entirely lost if, after each usage, it must be regraded and compacted. Therefore, it should be designed to withstand at least a certain number of loadings of the aeroplane which the stopway is intended to serve without inducing structural damage to the aeroplane.

3. Calculation of declared distances

3.1 The declared distances to be calculated for each runway direction comprise: the take-off run available (TORA), take-off distance available (TODA), accelerate-stop distance available (ASDA), and landing distance available (LDA).

3.2 Where a runway is not provided with a stopway or clearway and the threshold is located at the extremity of the runway, the four declared distances should normally be equal to the length of the runway, as shown in Figure A-1 (A).

3.3 Where a runway is provided with a clearway (CWY), then the TODA will include the length of clearway, as shown in Figure A-1 (B).

3.4 Where a runway is provided with a stopway (SWY), then the ASDA will include the length of stopway, as shown in Figure A-1 (C).

3.5 Where a runway has a displaced threshold, then the LDA will be reduced by the distance the threshold is displaced, as shown in Figure A-1 (D). A displaced threshold affects only the LDA for approaches made to that threshold; all declared distances for operations in the reciprocal direction are unaffected.

3.6 Figures A-1 (B) through A-1 (D) illustrate a runway provided with a clearway or a stopway or having a displaced threshold. Where more than one of these features exist, then more than one of the declared distances will be modified — but the modification will follow the same principle illustrated. An example showing a situation where all these features exist is shown in Figure A-1 (E).

3.7 A suggested format for providing information on declared distances is given in Figure A-1 (F). If a runway direction cannot be used for take-off or landing, or both, because it is operationally forbidden, then this should be declared and the words “not usable” or the abbreviation “NU” entered.

4. Slopes on a runway

4.1 Distance between slope changes

The following example illustrates how the distance between slope changes is to be determined (see Figure A-2):

D for a runway where the code number is 3 should be at least:

15 000 (|x – y| + |y – z|) m
|x – y| being the absolute numerical value of x – y
|y – z| being the absolute numerical value of y – z

Assuming x = +0.01
y = –0.005
z = +0.005
then |x – y| = 0.015
then |y – z| = 0.01

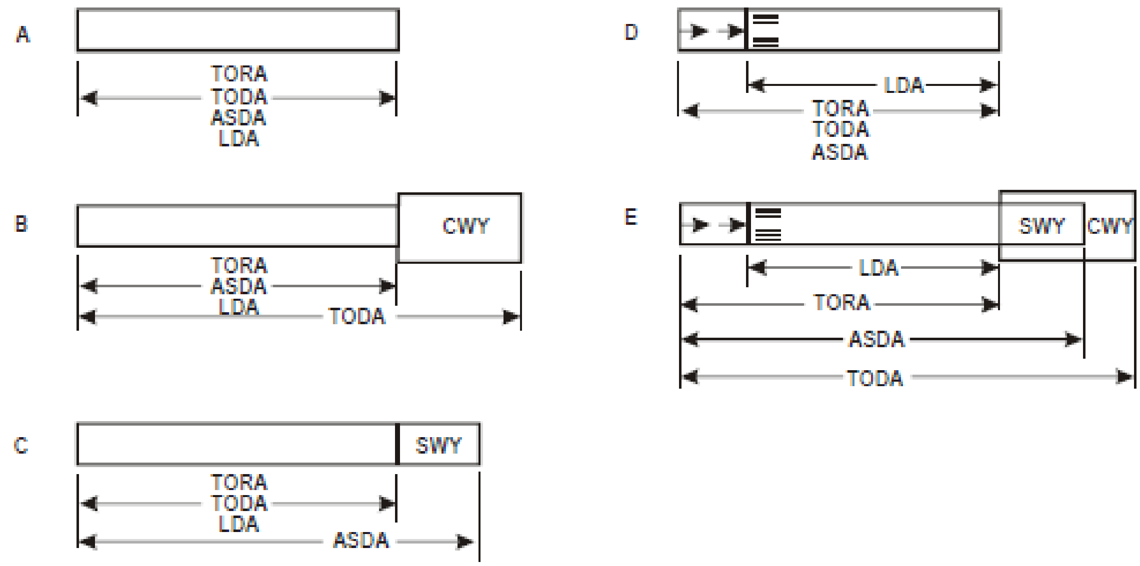
To comply with the specifications, D should be not less than:

15 000 (0.015 + 0.01) m,

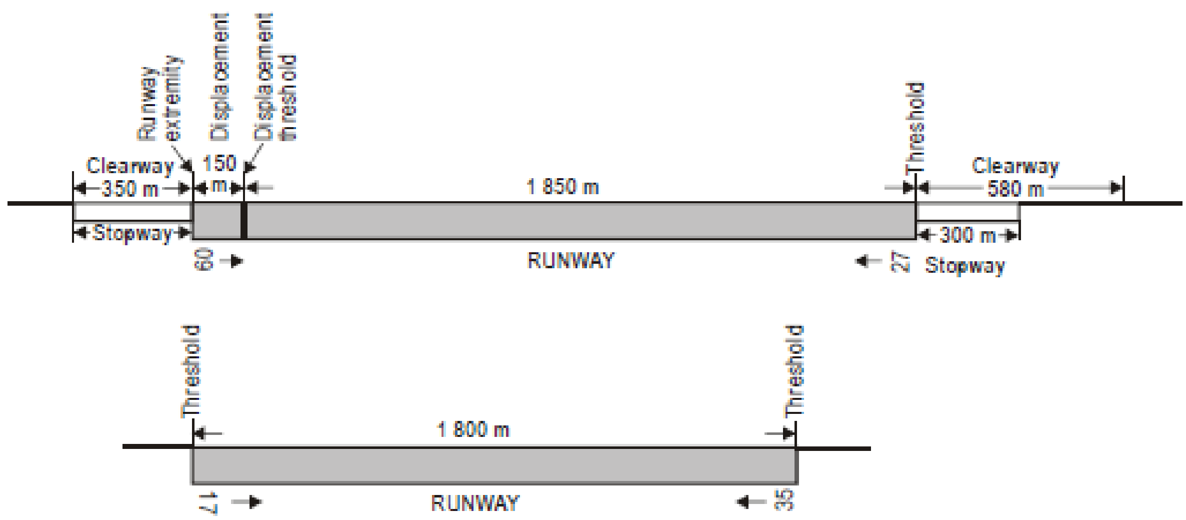
that is, 15 000 × 0.025 = 375 m

4.2 Consideration of longitudinal and transverse slopes

When a runway is planned that will combine the extreme values for the slopes and changes in slope permitted under Chapter 3, 3.1.13 to 3.1.19, a study should be made to ensure that the resulting surface profile will not hamper the operation of aeroplanes.



Note.— All declared distances are illustrated for operations from left to right.



F

RUNWAY	TORA	ASDA	TODA	LDA
	m	m	m	m
09	2 000	2 300	2 580	1 850
27	2 000	2 350	2 350	2 000
17	NU	NU	NU	1 800
35	1 800	1 800	1 800	NU

Figure A-1. Illustration of declared distances

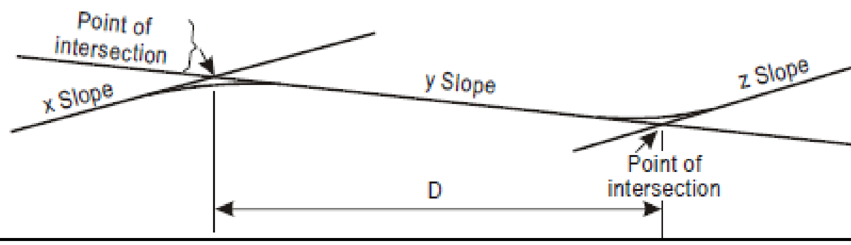


Figure A-2. Profile on centre line of runway

4.3 Radio altimeter operating area

In order to accommodate aeroplanes making auto-coupled approaches and automatic landings irrespective of weather conditions) it is desirable that slope changes be avoided or kept to a minimum, on a rectangular area at least 300 m long before the threshold of a precision approach runway. The area should be symmetrical about the extended centre line, 120 m wide. When special circumstances so warrant, the width may be reduced to no less than 60 m if an aeronautical study indicates that such reduction would not affect the safety of operations of aircraft. This is desirable because these aeroplanes are equipped with a radio altimeter for final height and flare guidance, and when the aeroplane is above the terrain immediately prior to the threshold, the radio altimeter will begin to provide information to the automatic pilot for auto-flare. Where slope changes cannot be avoided, the rate of change between two consecutive slopes should not exceed 2 per cent per 30 m.

5. Runway surface evenness

5.1 In adopting tolerances for runway surface irregularities, the following standard of construction is achievable for short distances of 3 m and conforms to good engineering practice:

> Except across the crown of a camber or across drainage channels, the finished surface of the wearing course is to be of such regularity that, when tested with a 3 m straight-edge placed anywhere in any direction on the surface, there is no deviation greater than 3 mm between the bottom of the straight-edge and the surface of the pavement anywhere along the straight-edge.

5.2 Caution should also be exercised when inserting runway lights or drainage grilles in runway surfaces to ensure that adequate smoothness of the surface is maintained.

5.3 The operation of aircraft and differential settlement of surface foundations will eventually lead to increases in surface irregularities. Small deviations in the above tolerances will not seriously hamper aircraft operations. In general, isolated irregularities of the order of 2.5 cm to 3 cm over a 45 m distance are acceptable, as shown in Figure A-3. Although maximum acceptable deviations vary with the type and speed of an aircraft, the limits of acceptable surface irregularities can be estimated to a reasonable extent. The following table describes acceptable, tolerable and excessive limits:

a) if the surface irregularities exceed the heights defined by the acceptable limit curve but are less than the heights defined by the tolerable limit curve, at the specified minimum acceptable length, herein noted by the tolerable region, then maintenance action should be planned. The runway may remain in service. This region is the start of possible passenger and pilot discomfort;

b) if the surface irregularities exceed the heights defined by the tolerable limit curve, but are less than the heights defined by the excessive limit curve, at the specified minimum acceptable length, herein noted by the excessive region, then maintenance corrective action is mandatory to restore the condition to the acceptable region. The runway may remain in service but be repaired within a reasonable period. This region could lead to the risk of possible aircraft structural damage due to a single event or fatigue failure over time; and

c) if the surface irregularities exceed the heights defined by the excessive limit curve, at the specified minimum acceptable length, herein noted by the unacceptable region, then the area of the runway where the roughness has been identified warrants closure. Repairs must be made to restore the condition to within the acceptable limit region and the aircraft operators may be advised accordingly. This region runs the extreme risk of a structural failure and must be addressed immediately.

	Length of irregularity (m)								
Surface irregularity	3	6	9	12	15	20	30	45	60
Acceptable surface irregularity height (cm)	2.9	3.8	4.5	5	5.4	5.9	6.5	8.5	10
Tolerable surface irregularity height (cm)	3.9	5.5	6.8	7.8	8.6	9.6	11	13.6	16
Excessive surface irregularity height (cm)	5.8	7.6	9.1	10	10.8	11.9	13.9	17	20

Note that "surface irregularity" is defined herein to mean isolated surface elevation deviations that do not lie along a uniform slope through any given section of a runway. For the purposes of this concern, a "section of a runway" is defined herein to mean a segment of a runway throughout which a continuing general uphill, downhill or flat slope is prevalent. The length of this section is generally between 30 and 60 metres, and can be greater, depending on the longitudinal profile and the condition of the pavement.

The maximum tolerable step type bump, such as that which could exist between adjacent slabs, is simply the bump height corresponding to zero bump length at the upper end of the tolerable region of the roughness criteria of Figure A-3. The bump height at this location is 1.75 cm.

5.4 Figure A-3 illustrates a comparison of the surface roughness criteria with those developed by the United States Federal Aviation Administration. Further guidance regarding temporary slopes for overlay works on operational runways can be found in the Aerodrome Design Manual, Part 3 — Pavements (Doc 9157).

5.5 Deformation of the runway with time may also increase the possibility of the formation of water pools. Pools as shallow as approximately 3 mm in depth, particularly if they are located where they are likely to be encountered at high speed by landing aeroplanes, can induce aquaplaning, which can then be sustained on a wet runway by a much shallower depth of water. Improved guidance regarding the significant length and depth of pools relative to aquaplaning is the subject of further research. It is, of course, especially necessary to prevent pools from forming whenever there is a possibility that they might become frozen.

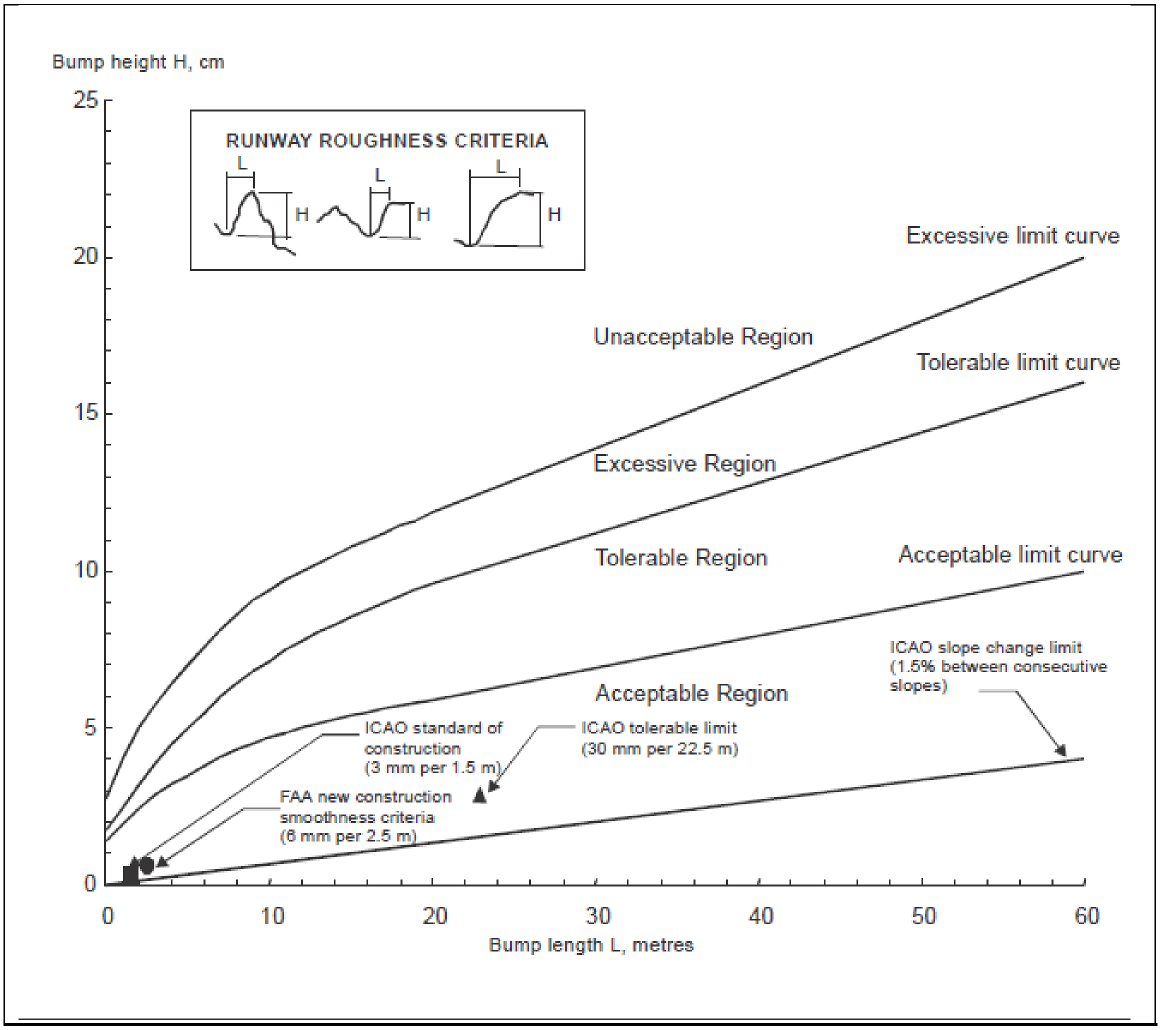


Figure A-3. Comparison of roughness criteria

Note.— These criteria address single event roughness, not long wavelength harmonic effects nor the effect of repetitive surface undulations.

6. Runway condition report for reporting runway surface condition

6.1 On a global level, movement areas are exposed to a multitude of climatic conditions and consequently a significant difference in the condition to be reported.

6.2 The concept of the RCR is premised on:

a) an agreed set of criteria used in a consistent manner for runway surface condition assessment, aeroplane (performance) certification and operational performance calculation;

b) a unique runway condition code (RWYCC) linking the agreed set of criteria with the aircraft landing and takeoff performance table, and related to the braking action experienced and eventually reported by flight crews;

c) reporting of contaminant type and depth that is relevant to take-off performance;

d) a standardized common terminology and phraseology for the description of runway surface conditions that can be used by aerodrome operator inspection personnel, air traffic controllers, aircraft operators and flight crew; and

e) globally-harmonized procedures for the establishment of the RWYCC with a built-in flexibility to allow for local variations to match the specific weather, infrastructure and other particular conditions.

6.3 These harmonized procedures are reflected in a runway condition assessment matrix (RCAM) which correlates the RWYCC, the agreed set of criteria and the aircraft braking action which the flight crew should expect for each value of the RWYCC.

6.4 Procedures which relate to the use of the RCAM are provided in the PANS-Aerodromes (Doc 9981).

6.5 It is recognized that information provided by the aerodrome's personnel assessing and reporting runway surface condition is crucial to the effectiveness of the runway condition report. A misreported runway condition alone should not lead to an accident or incident. Operational margins should cover for a reasonable error in the assessment, including unreported changes in the runway condition. But a misreported runway condition can mean that the margins are no longer available to cover for other operational variance (such as unexpected tailwind, high and fast approach above threshold or long flare).

6.6 This is further amplified by the need for providing the assessed information in the proper format for dissemination, which requires insight into the limitations set by the syntax for dissemination. This in turn restricts the wording of plain text remarks that can be provided.

6.7 It is important to follow standard procedures when providing assessed information on the runway surface conditions to ensure that safety is not compromised when aeroplanes use wet or contaminated runways. Personnel should be trained in the relevant fields of competence and their competence verified in a manner required by the State to ensure confidence in their assessments.

6.8 Training

(A) The training syllabus shall include initial, recurrent, refresher and continuation training in the following areas:

1) aerodrome familiarization, including aerodrome markings, signs and lighting;

2) aerodrome procedures as described in the aerodrome manual;

3) aerodrome emergency plan;

4) Notice to Airmen (NOTAM) initiation procedures;

5) aerodrome driving rules;

6) air traffic control procedures on the movement area;

7) radiotelephone operating procedures;

8) phraseology used in aerodrome control, including the ICAO spelling alphabet;

9) aerodrome inspection procedures and techniques;

10) procedures for reporting inspection results and observations;

11) low-visibility procedures.

(B) Personnel conducting runway surface condition assessment, shall in addition to the training specified in (A) be trained in at least the following areas:

1) procedures for completion of/initiation procedures for RCR;

2) type of runway contaminants and reporting;

3) assessment and reporting of runway surface friction characteristics;

4) use of runway friction measurement device;

5) calibration and maintenance of runway friction measurement device;

6) awareness of uncertainties related to l) and m); and

7. Drainage characteristics of the movement area and adjacent areas

7.1 General

7.1.1 Rapid drainage of surface water is a primary safety consideration in the design, construction and maintenance of the movement area and adjacent areas. The objective is to minimize water depth on the surface by draining water off the runway in the shortest path possible and particularly out of the area of the wheel path. There are two distinct drainage processes taking place:

a) natural drainage of the surface water from the top of the pavement surface until it reaches the final recipient such as rivers or other water bodies; and

b) dynamic drainage of the surface water trapped under a moving tire until it reaches outside the tire-to-ground contact area.

7.1.2 Both processes can be controlled through:

a) design;

b) construction; and

c) maintenance.

of the pavements in order to prevent accumulation of water on the pavement surface.

7.2 Design of pavement

7.2.1 Surface drainage is a basic requirement and serves to minimize water depth on the surface. The objective is to drain water off the runway in the shortest path. Adequate surface drainage is provided primarily by an appropriately sloped surface (in both the longitudinal and transverse directions). The resulting combined longitudinal and transverse slope is the path for the drainage run-off. This path can be shortened by adding transverse grooves.

7.2.2 Dynamic drainage is achieved through built-in texture in the pavement surface. The rolling tire builds up water pressure and squeezes the water out the escape channels provided by the texture. The dynamic drainage of the tire-to-ground contact area may be improved by adding transverse grooves provided that they are subject to rigorous maintenance.

7.3 Construction of pavement

7.3.1 Through construction, the drainage characteristics of the surface are built into the pavement. These surface characteristics are:

a) slopes;

b) texture:

1) microtexture;

2) macrotexture;

7.3.2 Slopes for the various parts of the movement area and adjacent parts are described in Chapter 3 and figures are given as per cent. Further guidance is given in the Aerodrome Design Manual (Doc 9157), Part 1, Chapter 5.

7.3.3 Texture in the literature is described as microtexture or macrotexture. These terms are understood differently in various parts of the aviation industry.

7.3.4 Microtexture is the texture of the individual stones and is hardly detectable by the eye. Microtexture is considered a primary component in skid resistance at slow speeds. On a wet surface at higher speeds a water film may prevent direct contact between the surface asperities and the tire due to insufficient drainage from the tire-to-ground contact area.

7.3.5 Microtexture is a built-in quality of the pavement surface. By specifying crushed material that will withstand polishing microtexture, drainage of thin waterfilms are ensured for a longer period of time. Resistance against polishing is expressed in terms of the Polished Stone Values (PSV) which is in principle a value obtained from a friction measurement in accordance with international standards. These standards define the PSV minima that will enable a material with a good microtexture to be selected.

7.3.6 A major problem with microtexture is that it can change within short time periods without being easily detected. A typical example of this is the accumulation of rubber deposits in the touchdown area which will largely mask microtexture without necessarily reducing macrotexture.

7.3.7 Macrotexture is the texture among the individual stones. This scale of texture may be judged approximately by the eye. Macrotexture is primarily created by the size of aggregate used or by surface treatment of the pavement and is the major factor influencing drainage capacity at high speeds. Materials shall be selected so as to achieve good macrotexture.

7.3.8 The primary purpose of grooving a runway surface is to enhance surface drainage. Natural drainage can be slowed down by surface texture, but grooving can speed up the drainage by providing a shorter drainage path and increasing the drainage rate.

7.3.9 For measurement of macrotexture, simple methods such as the “sand and grease patch” methods described in the Airport Services Manual (Doc 9137), Part 2 were developed.

These methods were used for the early research on which current airworthiness requirements are based, which refer to a classification categorizing macrotexture from A to E. This classification was developed, using sand or grease patch measuring techniques, and issued in 1971 by the Engineering Sciences Data Unit (ESDU).

Runway classification based on texture information from ESDU 71026:	
Classification	Texture depths (mm)
A	0.10 – 0.14
B	0.15 - 0.24
C	0.25 – 0.50
D	0.51 – 1.00
E	1.01 – 2.54

7.3.10 Using this classification, the threshold value between microtexture and macrotexture is 0.1 mm mean texture depth (MTD). Related to this scale, the normal wet runway aircraft performance is based upon texture giving drainage and friction qualities midway between classification B and C (0.25 mm). Improved drainage through better texture might qualify for a better aircraft performance class. However, such credit must be in accordance with aeroplane manufacturers' documentation and agreed by the State. Presently credit is given to grooved or porous friction course runways following design, construction and maintenance criteria acceptable to the State. The harmonized certification standards of some States refer to texture giving drainage and friction qualities midway between classification D and E (1.0 mm).

7.3.11 For construction, design and maintenance, States use various international standards. Currently ISO 13473-1: Characterization of pavement texture by use of surface profiles — Part 1: Determination of Mean Profile Depth links the volumetric measuring technique with non-contact profile measuring techniques giving comparable texture values. These standards describe the threshold value between microtexture and macrotexture as 0.5 mm. The volumetric method has a validity range from 0.25 to 5 mm MTD. The profilometry method has a validity range from 0 to 5 mm mean profile depth (MPD). The values of MPD and MTD differ due to the finite size of the glass spheres used in the volumetric technique and because the MPD is derived from a two-dimensional profile rather than a three-dimensional surface. Therefore, a transformation equation must be established for the measuring equipment used to relate MPD to MTD.

7.3.12 The ESDU scale groups runway surfaces based on macrotexture from A through E, where E represents the surface with best dynamic drainage capacity. The ESDU scale thus reflects the dynamic drainage characteristics of the pavement. Grooving any of these surfaces enhances the dynamic drainage capacity. The resulting drainage capacity of the surface is thus a function of the texture (A through E) and grooving. The contribution from grooving is a function of the size of the grooves and the spacing between the grooves. Aerodromes exposed to heavy or torrential rainfall must ensure that the pavement and adjacent areas have drainage capability to withstand these rainfalls or put limitations on the use of the pavements under such extreme situations. These airports should seek to have the maximum allowable slopes and the use of aggregates providing good drainage characteristics. They should also consider grooved pavements in the E classification to ensure that safety is not impaired.

7.4 Maintenance of drainage characteristics of pavement

7.4.1 Macrotexture does not change within a short timespan but accumulation of rubber can fill up the texture and as such reduce the drainage capacity, which can result in impaired safety. Furthermore the runway structure may change over time and give unevenness which results in ponding after rainfall. Guidance on rubber removal and unevenness can be found in the Airport Services Manual (Doc 9137), Part 2. Guidance on methods for improving surface texture can be found in the Aerodrome Design Manual (Doc 9157), Part 3.

7.4.2 When groovings are used, the condition of the grooves should be regularly inspected to ensure that no deterioration has occurred and that the grooves are in good condition. Guidance on maintenance of pavements is available in the Airport Services Manual (Doc 9137), Part 2 — Pavement Surface Conditions and Part 9 — Airport Maintenance Practices and the Aerodrome Design Manual (Doc 9157), Part 2.

7.4.3 The pavement may be shot blasted in order to enhance the pavement macrotexture.

8. Strips

8.1 Shoulders

8.1.1 The shoulder of a runway or stopway should be prepared or constructed so as to minimize any hazard to an aeroplane running off the runway or stopway. Some guidance is given in the following paragraphs on certain special problems which may arise, and on the further question of measures to avoid the ingestion of loose stones or other objects by turbine engines.

8.1.2 In some cases, the bearing strength of the natural ground in the strip may be sufficient, without special preparation, to meet the requirements for shoulders. Where special preparation is necessary, the method used will depend on local soil conditions and the mass of the aeroplanes the runway is intended to serve. Soil tests will help in determining the best method of improvement (e.g. drainage, stabilization, surfacing, light paving).

8.1.3 Attention should also be paid when designing shoulders to prevent the ingestion of stones or other objects by turbine engines. Similar considerations apply here to those which are discussed for the margins of taxiways in the Aerodrome Design Manual (Doc 9157), Part 2, both as to the special measures which may be necessary and as to the distance over which such special measures, if required, should be taken.

8.1.4 Where shoulders have been treated specially, either to provide the required bearing strength or to prevent the presence of stones or debris, difficulties may arise because of a lack of visual contrast between the runway surface and that of the adjacent strip. This difficulty can be overcome either by providing a good visual contrast in the surfacing of the runway or strip, or by providing a runway side stripe marking.

8.2 Objects on strips

Within the general area of the strip adjacent to the runway, measures should be taken to prevent an aeroplane's wheel, when sinking into the ground, from striking a hard vertical face. Special problems may arise for runway light fittings or other objects mounted in the strip or at the intersection with a taxiway or another runway. In the case of construction, such as runways or taxiways, where the surface must also be flush with the strip surface, a vertical face can be eliminated by chamfering from the top of the construction to not less than 30 cm below the strip surface level. Other objects, the functions of which do not require them to be at surface level, should be buried to a depth of not less than 30 cm.

8.3 Grading of a strip for precision approach runways

Chapter 3, 3.4.8, required that the portion of a strip of an instrument runway within at least 75 m from the centre line should be graded where the code number is 3 or 4. For a precision approach runway, it may be desirable to adopt a greater width where the code number is 3 or 4. Figure A-4 shows the shape and dimensions of a wider strip that may be considered for such a runway. This strip has been designed using information on aircraft running off runways. The portion to be graded extends to a distance of 105 m from the centre line, except that the distance is gradually reduced to 75 m from the centre line at both ends of the strip, for a length of 150 m from the runway end.

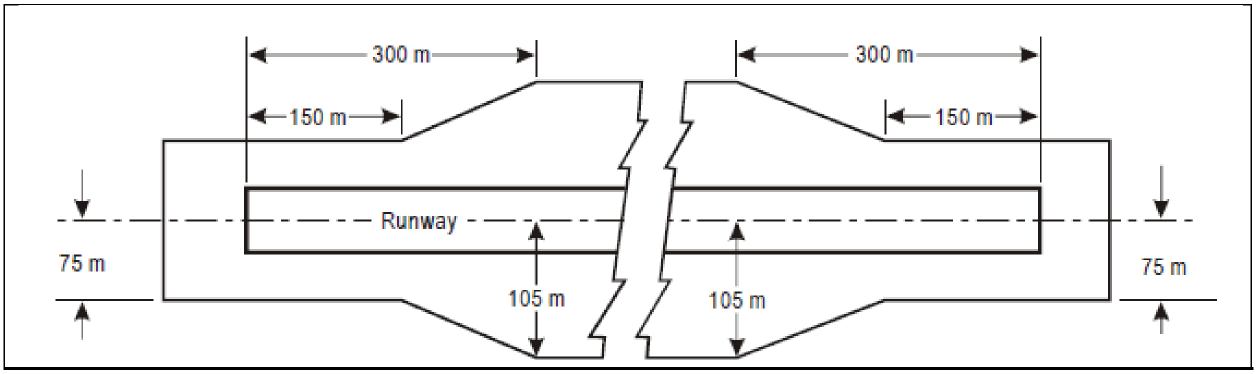


Figure A-4. Graded portion of a strip including a precision approach runway where the code number is 3 or 4

9. Runway end safety areas

9.1 Where a runway end safety area is provided in accordance with Chapter 3, consideration should be given to providing an area long enough to contain overruns and undershoots resulting from a reasonably probable combination of adverse operational factors. On a precision approach runway, the ILS localizer is normally the first upstanding obstacle, and the runway end safety area should extend up to this facility. In other circumstances, the first upstanding obstacle may be a road, a railroad or other constructed or natural feature. The provision of a runway end safety area should take such obstacles into consideration.

9.2 Where provision of a runway end safety area would be particularly prohibitive to implement, consideration would have to be given to reducing some of the declared distances of the runway for the provision of a runway end safety area and installation of an arresting system.

9.3 Research programmes, as well as evaluation of actual aircraft overruns into arresting systems, have demonstrated that the performance of some arresting systems can be predictable and effective in arresting aircraft overruns.

9.4 Demonstrated performance of an arresting system can be achieved by a validated design method, which can predict the performance of the system. The design and performance should be based on the type of aircraft anticipated to use the associated runway that imposes the greatest demand upon the arresting system.

9.5 The design of an arresting system must consider multiple aircraft parameters, including but not limited to, allowable aircraft gear loads, gear configuration, tire contact pressure, aircraft centre of gravity and aircraft speed. Accommodating undershoots must also be addressed. Additionally, the design must allow the safe operation of fully loaded rescue and firefighting vehicles, including their ingress and egress.

9.6 The information relating to the provision of a runway end safety area and the presence of an arresting system should be published in the AIP.

9.7 Additional information is contained in the Aerodrome Design Manual (Doc 9157), Part 1.

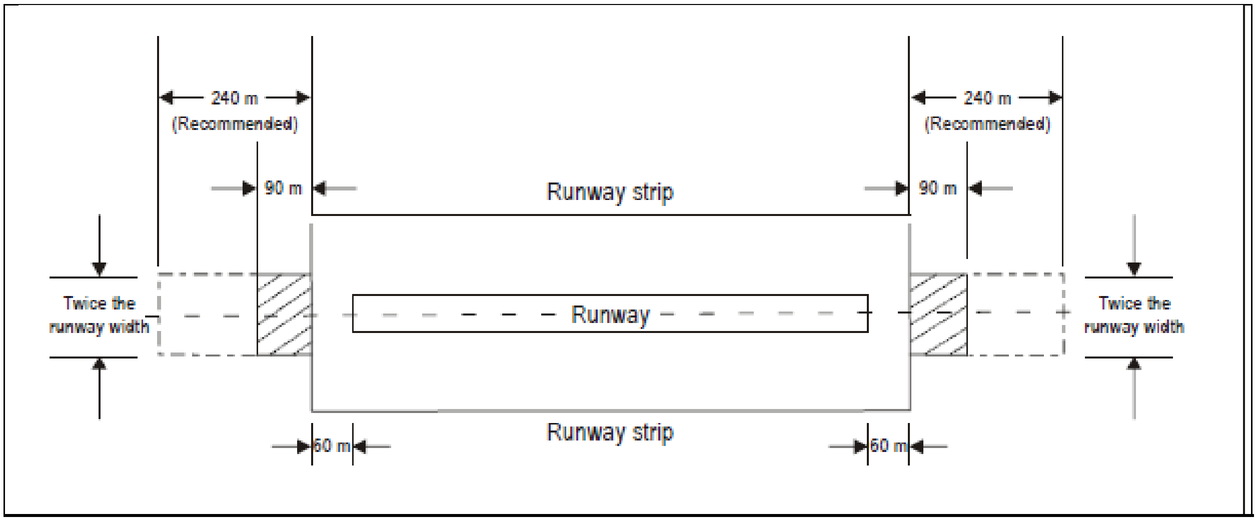


Figure A-5. Runway end safety area for a runway where the code number is 3 or 4

10. Location of threshold

10.1 General

10.1.1 The threshold is normally located at the extremity of a runway, if there are no obstacles penetrating above the approach surface. In some cases, however, due to local conditions it may be desirable to displace the threshold permanently (see below). When studying the location of a threshold, consideration should also be given to the height of the ILS reference datum and/or MLS approach reference datum and the determination of the obstacle clearance limits. (Specifications concerning the height of the ILS reference datum and MLS approach reference datum are given in Annex 10, Volume I.)

10.1.2 In determining that no obstacles penetrate above the approach surface, account should be taken of mobile objects (vehicles on roads, trains, etc.) at least within that portion of the approach area within 1 200 m longitudinally from the threshold and of an overall width of not less than 150 m.

10.2 Displaced threshold

10.2.1 If an object extends above the approach surface and the object cannot be removed, consideration should be given to displacing the threshold permanently.

10.2.2 To meet the obstacle limitation objectives of Chapter 4, the threshold should ideally be displaced down the runway for the distance necessary to provide that the approach surface is cleared of obstacles.

10.2.3 However, displacement of the threshold from the runway extremity will inevitably cause reduction of the landing distance available, and this may be of greater operational significance than penetration of the approach surface by marked and lighted obstacles. A decision to displace the threshold, and the extent of such displacement, should therefore have regard to an optimum balance between the considerations of clear approach surfaces and adequate landing distance. In deciding this question, account will need to be taken of the types of aeroplanes which the runway is intended to serve, the limiting visibility and cloud base conditions under which the runway will be used, the position of the obstacles in relation to the threshold and extended centre line and, in the case of a precision approach runway, the significance of the obstacles to the determination of the obstacle clearance limit.

10.2.4 Notwithstanding the consideration of landing distance available, the selected position for the threshold should not be such that the obstacle free surface to the threshold is steeper than 3.3 per cent where the code number is 4 or steeper than 5 per cent where the code number is 3.

10.2.5 In the event of a threshold being located according to the criteria for obstacle free surfaces in the preceding paragraph, the obstacle marking requirements of Chapter 6 should continue to be met in relation to the displaced threshold.

10.2.6 Depending on the length of the displacement, the RVR at the threshold could differ from that at the beginning of the runway for take-offs. The use of red runway edge lights with photometric intensities lower than the nominal value of 10 000 cd for white lights increases that phenomenon. The impact of a displaced threshold on take-off minima should be assessed by the appropriate authority.

10.2.7 Provisions in AUA-AGA, regarding marking and lighting of displaced thresholds and some operational recommendations can be found in 5.2.4.9, 5.2.4.10, 5.3.5.5, 5.3.8.1, 5.3.9.7, 5.3.10.3, 5.3.10.7 and 5.3.12.6.

11. Approach lighting systems

11.1 Types and characteristics

11.1.1 The specifications in this volume provide for the basic characteristics for simple and precision approach lighting systems. For certain aspects of these systems, some latitude is permitted, for example, in the spacing between centre line lights and crossbars. The approach lighting patterns that have been generally adopted are shown in Figures A-7 and A-8. A diagram of the inner 300 m of the precision approach category II and III lighting system is shown in Figure 5-14.

11.1.2 The approach lighting configuration is to be provided irrespective of the location of the threshold, i.e. whether the threshold is at the extremity of the runway or displaced from the runway extremity. In both cases, the approach lighting system should extend up to the threshold. However, in the case of a displaced threshold, inset lights are used from the runway extremity up to the threshold to obtain the specified configuration. These inset lights are designed to satisfy the structural requirements specified in Chapter 5, 5.3.1.9, and the photometric requirements specified in Appendix 2, Figure A2-1 or A2-2.

11.1.3 Flight path envelopes to be used in designing the lighting are shown in Figure A-6.

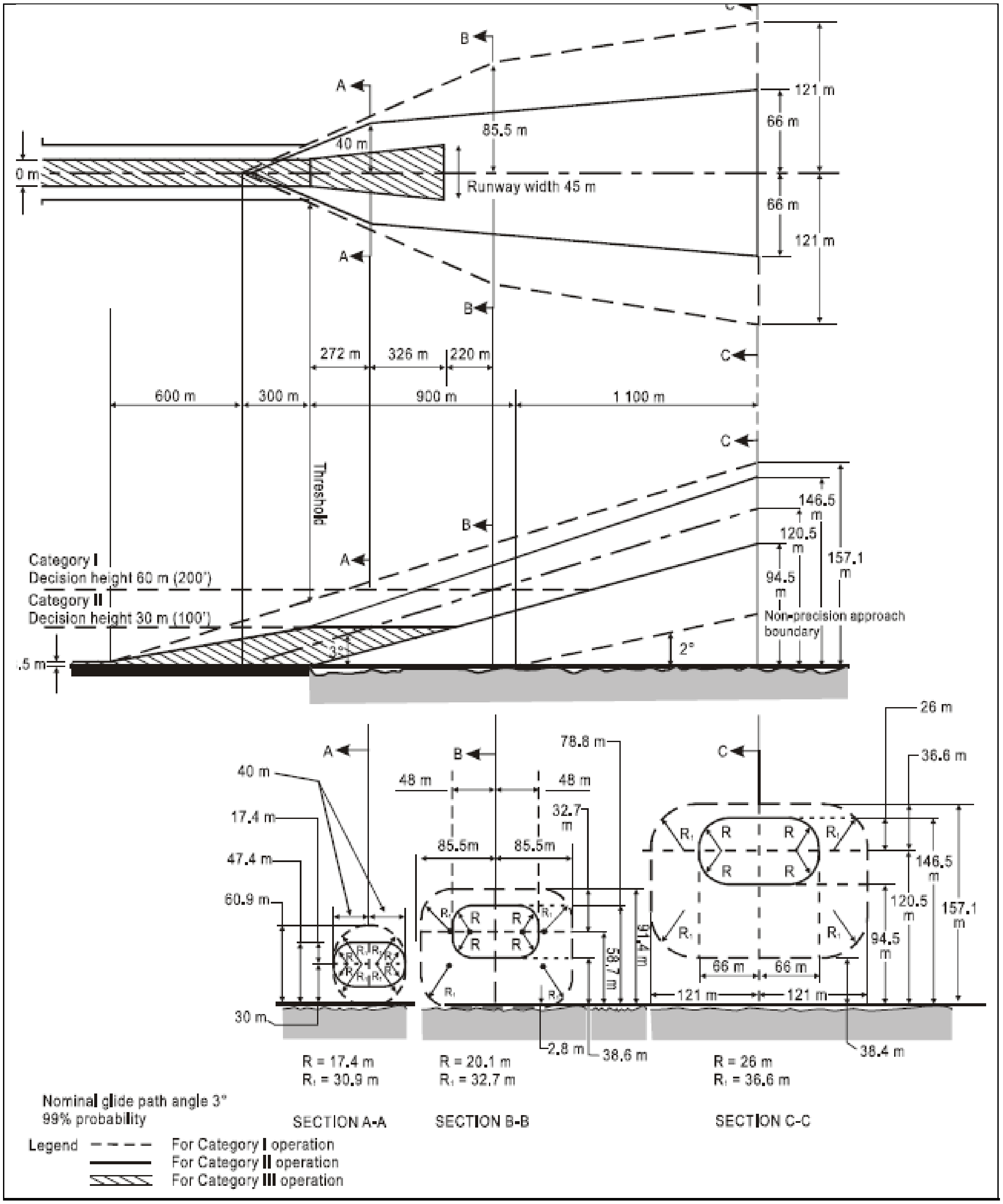


Figure A-6. Flight path envelopes to be used for lighting design for category I, II and III operations

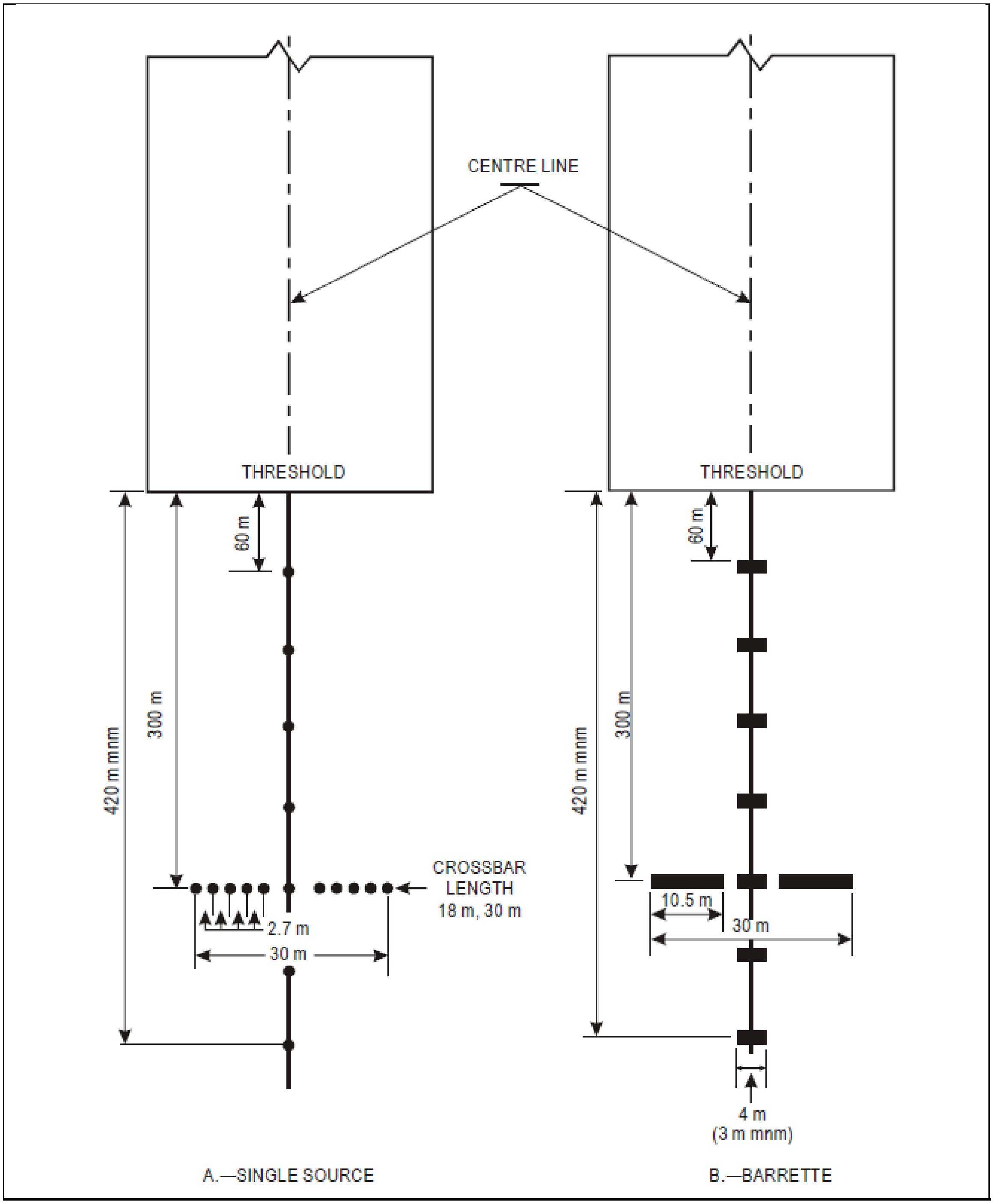


Figure A-7. Simple approach lighting systems

<u>11.2 Installation tolerances</u>

Horizontal

11.2.1 The dimensional tolerances are shown in Figure A-8.

11.2.2 The centre line of an approach lighting system should be as coincident as possible with the extended centre line of the runway with a maximum tolerance of ±15’.

11.2.3 The longitudinal spacing of the centre line lights should be such that one light (or group of lights) is located in the centre of each crossbar, and the intervening centre line lights are spaced as evenly as practicable between two crossbars or a crossbar and a threshold.

11.2.4 The crossbars and barrettes should be at right angles to the centre line of the approach lighting system with a tolerance of ±30’, if the pattern in Figure A-8 (A) is adopted or ± 2°, if Figure A-8 (B) is adopted.

11.2.5 When a crossbar has to be displaced from its standard position, any adjacent crossbar should, where possible, be displaced by appropriate amounts in order to reduce the differences in the crossbar spacing.

11.2.6 When a crossbar in the system shown in Figure A-8 (A) is displaced from its standard position, its overall length should be adjusted so that it remains one-twentieth of the actual distance of the crossbar from the point of origin. It is not necessary, however, to adjust the standard 2.7 m spacing between the crossbar lights, but the crossbars should be kept symmetrical about the centre line of the approach lighting.

Vertical

11.2.7 The ideal arrangement is to mount all the approach lights in the horizontal plane passing through the threshold (see Figure A-9), and this should be the general aim as far as local conditions permit. However, buildings, trees, etc., should not obscure the lights from the view of a pilot who is assumed to be 1° below the electronic glide path in the vicinity of the outer marker.

11.2.8 Within a stopway or clearway, and within 150 m of the end of a runway, the lights should be mounted as near to the ground as local conditions permit in order to minimize risk of damage to aeroplanes in the event of an overrun or undershoot. Beyond the stopway and clearway, it is not so necessary for the lights to be mounted close to the ground, and therefore undulations in the ground contours can be compensated for by mounting the lights on poles of appropriate height.

11.2.9 It is desirable that the lights be mounted so that, as far as possible, no object within a distance of 60 m on each side of the centre line protrudes through the plane of the approach lighting system. Where a tall object exists within 60 m of the centre line and within 1 350 m from the threshold for a precision approach lighting system, or 900 m for a simple approach lighting system, it may be advisable to install the lights so that the plane of the outer half of the pattern clears the top of the object.

11.2.10 In order to avoid giving a misleading impression of the plane of the ground, the lights should not be mounted below a gradient of 1 in 66 downwards from the threshold to a point 300 m out, and below a gradient of 1 in 40 beyond the 300 m point. For a precision approach category II and III lighting system, more stringent criteria may be necessary, e.g. negative slopes not permitted within 450 m of the threshold.

11.2.11 Centre line. The gradients of the centre line in any section (including a stopway or clearway) should be as small as practicable, and the changes in gradients should be as few and small as can be arranged and should not exceed 1 in 60. Experience has shown that as one proceeds outwards from the runway, rising gradients in any section of up to 1 in 66, and falling gradients of down to 1 in 40, are acceptable.

11.2.12 Crossbars. The crossbar lights should be so arranged as to lie on a straight line passing through the associated centre line lights, and wherever possible this line should be horizontal. It is permissible, however, to mount the lights on a transverse gradient not more than 1 in 80, if this enables crossbar lights within a stopway or clearway to be mounted nearer to the ground on sites where there is a cross-fall.

11.3 Clearance of obstacles

11.3.1 An area, hereinafter referred to as the light plane, has been established for obstacle clearance purposes, and all lights of the system are in this plane. This plane is rectangular in shape and symmetrically located about the approach lighting system's centre line. It starts at the threshold and extends 60 m beyond the approach end of the system, and is 120 m wide.

11.3.2 No objects are permitted to exist within the boundaries of the light plane which are higher than the light plane except as designated herein. All roads and highways are considered as obstacles extending 4.8 m above the crown of the road, except aerodrome service roads where all vehicular traffic is under control of the aerodrome authorities and coordinated with the aerodrome traffic control tower. Railroads, regardless of the amount of traffic, are considered as obstacles extending 5.4 m above the top of the rails.

11.3.3 It is recognized that some components of electronic landing aids systems, such as reflectors, antennas, monitors, etc., must be installed above the light plane. Every effort should be made to relocate such components outside the boundaries of the light plane. In the case of reflectors and monitors, this can be done in many instances.

11.3.4 Where an ILS localizer is installed within the light plane boundaries, it is recognized that the localizer, or screen if used, must extend above the light plane. In such cases the height of these structures should be held to a minimum and they should be located as far from the threshold as possible. In general the rule regarding permissible heights is 15 cm for each 30 m the structure is located from the threshold. As an example, if the localizer is located 300 m from the threshold, the screen will be permitted to extend above the plane of the approach lighting system by 10 × 15 = 150 cm maximum, but preferably should be kept as low as possible consistent with proper operation of the ILS.

11.3.5 In locating an MLS azimuth antenna the guidance contained in Annex 10, Volume I, Attachment G, should be followed. This material, which also provides guidance on collocating an MLS azimuth antenna with an ILS localizer antenna, suggests that the MLS azimuth antenna may be sited within the light plane boundaries where it is not possible or practical to locate it beyond the outer end of the approach lighting for the opposite direction of approach. If the MLS azimuth antenna is located on the extended centre line of the runway, it should be as far as possible from the closest light position to the MLS azimuth antenna in the direction of the runway end. Furthermore, the MLS azimuth antenna phase centre should be at least 0.3 m above the light centre of the light position closest to the MLS azimuth antenna in the direction of the runway end. (This could be relaxed to 0.15 m if the site is otherwise free of significant multipath problems.) Compliance with this requirement, which is intended to ensure that the MLS signal quality is not affected by the approach lighting system, could result in the partial obstruction of the lighting system by the MLS azimuth antenna. To ensure that the resulting obstruction does not degrade visual guidance beyond an acceptable level, the MLS azimuth antenna should not be located closer to the runway end than 300 m and the preferred location is 25 m beyond the 300 m crossbar (this would place the antenna 5 m behind the light position 330 m from the runway end). Where an MLS azimuth antenna is so located, a central part of the 300 m crossbar of the approach lighting system would alone be partially obstructed. Nevertheless, it is important to ensure that the unobstructed lights of the crossbar remain serviceable all the time.

11.3.6 Objects existing within the boundaries of the light plane, requiring the light plane to be raised in order to meet the criteria contained herein, should be removed, lowered or relocated where this can be accomplished more economically than raising the light plane.

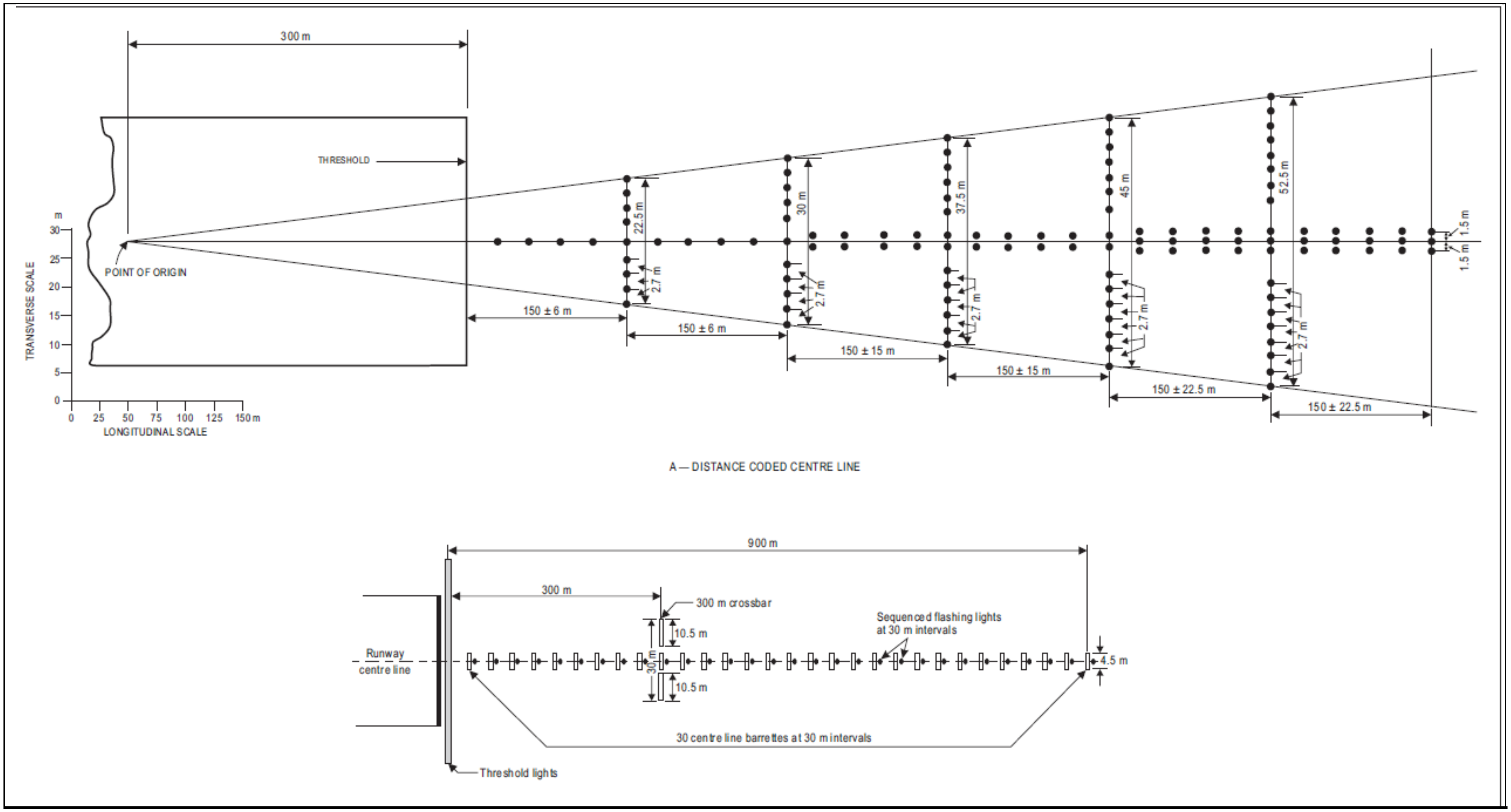


Figure A-8. Precision approach category I lighting systems ATT A-21 3/11/22

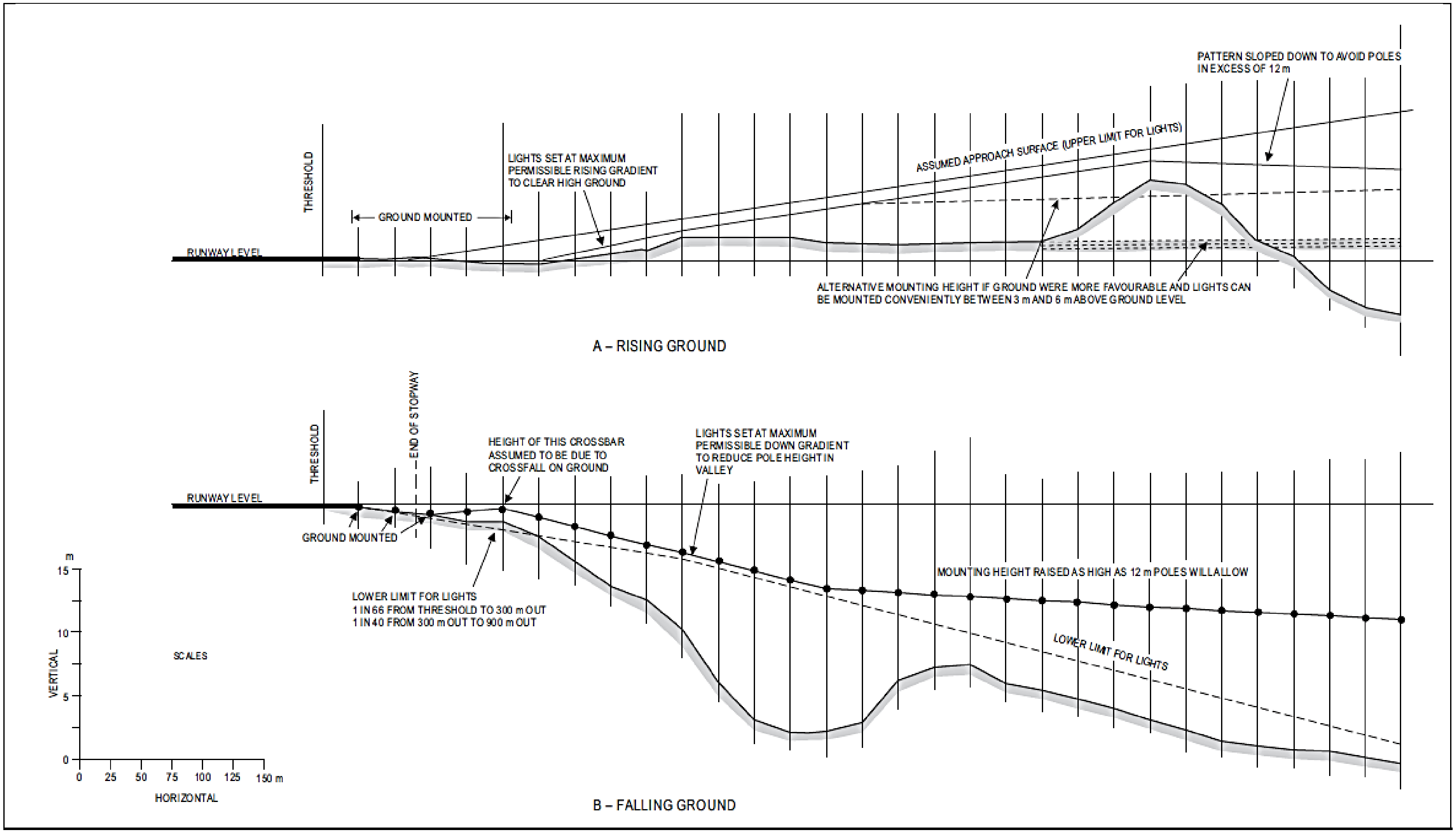


Figure A-9. Vertical installation tolerance

11.3.7 In some instances objects may exist which cannot be removed, lowered or relocated economically. These objects may be located so close to the threshold that they cannot be cleared by the 2 per cent slope. Where such conditions exist and no alternative is possible, the 2 per cent slope may be exceeded or a “stair step” resorted to in order to keep the approach lights above the objects. Such “step” or increased gradients should be resorted to only when it is impracticable to follow standard slope criteria, and they should be held to the absolute minimum. Under this criterion no negative slope is permitted in the outermost portion of the system.

11.4 Consideration of the effects of reduced lengths

11.4.1 The need for an adequate approach lighting system to support precision approaches where the pilot is required to acquire visual references prior to landing cannot be stressed too strongly. The safety and regularity of such operations is dependent on this visual acquisition. The height above runway threshold at which the pilot decides there are sufficient visual cues to continue the precision approach and land will vary, depending on the type of approach being conducted and other factors such as meteorological conditions, ground and airborne equipment, etc. The required length of approach lighting system which will support all the variations of such approaches is 900 m, and this shall always be provided whenever possible.

11.4.2 However, there are some runway locations where it is impossible to provide the 900 m length of approach lighting system to support precision approaches.

11.4.3 In such cases, every effort should be made to provide as much approach lighting system as possible. The appropriate authority may impose restrictions on operations to runways equipped with reduced lengths of lighting. There are many factors which determine at what height the pilot must have decided to continue the approach to land or execute a missed approach. It must be understood that the pilot does not make an instantaneous judgement upon reaching a specified height. The actual decision to continue the approach and landing sequence is an accumulative process which is only concluded at the specified height. Unless lights are available prior to reaching the decision point, the visual assessment process is impaired and the likelihood of missed approaches will increase substantially. There are many operational considerations which must be taken into account by the appropriate authorities in deciding if any restrictions are necessary to any precision approach and these are detailed in Annex 6.

12. Priority of installation of visual approach slope indicator systems

12.1 It has been found impracticable to develop guidance material that will permit a completely objective analysis to be made of which runway on an aerodrome should receive first priority for the installation of a visual approach slope indicator system. However, factors that must be considered when making such a decision are:

a) frequency of use;

b) seriousness of the hazard;

c) presence of other visual and non-visual aids;

d) type of aeroplanes using the runway; and

e) frequency and type of adverse weather conditions under which the runway will be used.

12.2 With respect to the seriousness of the hazard, the order given in the application specifications for a visual approach slope indicator system, 5.3.5.1 b) to e) of Chapter 5, may be used as a general guide. These may be summarized as:

a) inadequate visual guidance because of:

1) approaches over water or featureless terrain, or absence of sufficient extraneous light in the approach area by night;

2) deceptive surrounding terrain;

b) serious hazard in approach;

c) serious hazard if aeroplanes undershoot or overrun; and

d) unusual turbulence.

12.3 The presence of other visual or non-visual aids is a very important factor. Runways equipped with ILS or MLS would generally receive the lowest priority for a visual approach slope indicator system installation. It must be remembered, though, that visual approach slope indicator systems are visual approach aids in their own right and can supplement electronic aids. When serious hazards exist and/or a substantial number of aeroplanes not equipped for ILS or MLS use a runway, priority might be given to installing a visual approach slope indicator on this runway.

12.4 Priority should be given to runways used by turbojet aeroplanes.

13. Lighting of unserviceable areas

Where a temporarily unserviceable area exists, it may be marked with fixed-red lights. These lights should mark the most potentially dangerous extremities of the area. A minimum of four such lights should be used, except where the area is triangular in shape where a minimum of three lights may be employed. The number of lights should be increased when the area is large or of unusual configuration. At least one light should be installed for each 7.5 m of peripheral distance of the area. If the lights are directional, they should be orientated so that as far as possible their beams are aligned in the direction from which aircraft or vehicles will approach. Where aircraft or vehicles will normally approach from several directions, consideration should be given to adding extra lights or using omnidirectional lights to show the area from these directions. Unserviceable area lights should be frangible. Their height should be sufficiently low to preserve clearance for propellers and for engine pods of jet aircraft.

14. Rapid exit taxiway indicator lights

14.1 Rapid exit taxiway indicator lights (RETILs) comprise a set of yellow unidirectional lights installed in the runway adjacent to the centre line. The lights are positioned in a 3-2-1 sequence at 100 m intervals prior to the point of tangency of the rapid exit taxiway centre line. They are intended to give an indication to pilots of the location of the next available rapid exit taxiway.

14.2 In low visibility conditions, RETILs provide useful situational awareness cues while allowing the pilot to concentrate on keeping the aircraft on the runway centre line.

14.3 Following a landing, runway occupancy time has a significant effect on achievable runway capacity. RETILs allow pilots to maintain a good roll-out speed until it is necessary to decelerate to an appropriate speed for the turn into a rapid exit turn-off. A roll-out speed of 60 knots until the first RETIL (three-light barrette) is reached is seen as the optimum.

15. Intensity control of approach and runway lights

15.1 The conspicuity of a light depends on the impression received of contrast between the light and its background. If a light is to be useful to a pilot by day when on approach, it must have an intensity of at least 2 000 or 3 000 cd, and in the case of approach lights an intensity of the order of 20 000 cd is desirable. In conditions of very bright daylight fog it may not be possible to provide lights of sufficient intensity to be effective. On the other hand, in clear weather on a dark night, an intensity of the order of 100 cd for approach lights and 50 cd for the runway edge lights may be found suitable. Even then, owing to the closer range at which they are viewed, pilots have sometimes complained that the runway edge lights seemed unduly bright.

15.2 In fog the amount of light scattered is high. At night this scattered light increases the brightness of the fog over the approach area and runway to the extent that little increase in the visual range of the lights can be obtained by increasing their intensity beyond 2 000 or 3 000 cd. In an endeavour to increase the range at which lights would first be sighted at night, their intensity must not be raised to an extent that a pilot might find excessively dazzling at diminished range.

15.3 From the foregoing will be evident the importance of adjusting the intensity of the lights of an aerodrome lighting system according to the prevailing conditions, so as to obtain the best results without excessive dazzle that would disconcert the pilot. The appropriate intensity setting on any particular occasion will depend both on the conditions of background brightness and the visibility. Detailed guidance material on selecting intensity setting for different conditions is given in the Aerodrome Design Manual (Doc 9157), Part 4.

16. Signal area

A signal area need be provided only when it is intended to use visual ground signals to communicate with aircraft in flight. Such signals may be needed when the aerodrome does not have an aerodrome control tower or an aerodrome flight information service unit, or when the aerodrome is used by aeroplanes not equipped with radio. Visual ground signals may also be useful in the case of failure of two-way radio communication with aircraft. It should be recognized, however, that the type of information which may be conveyed by visual ground signals should normally be available in AIPs or NOTAM. The potential need for visual ground signals should therefore be evaluated before deciding to provide a signal area.

17. Rescue and firefighting services

17.1 Administration

17.1.1 The rescue and firefighting service at an aerodrome should be under the administrative control of the aerodrome management, which should also be responsible for ensuring that the service provided is organized, equipped, staffed, trained and operated in such a manner as to fulfil its proper functions.

17.1.2 In drawing up the detailed plan for the conduct of search and rescue operations in accordance with 4.2.1 of Annex 12 — Search and Rescue, the aerodrome management should coordinate its plans with the relevant rescue coordination centres to ensure that the respective limits of their responsibilities for an aircraft accident within the vicinity of an aerodrome are clearly delineated.

17.1.3 Coordination between the rescue and firefighting service at an aerodrome and public protective agencies, such as local fire brigade, police force, coast guard and hospitals, should be achieved by prior agreement for assistance in dealing with an aircraft accident.

17.1.4 A grid map of the aerodrome and its immediate vicinity should be provided for the use of the aerodrome services concerned. Information concerning topography, access roads and location of water supplies should be indicated. This map should be conspicuously posted in the control tower and fire station, and available on the rescue and firefighting vehicles and such other supporting vehicles required to respond to an aircraft accident or incident. Copies should also be distributed to public protective agencies as desirable.

17.1.5 Coordinated instructions should be drawn up detailing the responsibilities of all concerned and the action to be taken in dealing with emergencies. The appropriate authority should ensure that such instructions are promulgated and observed.

17.2 Training

The training curriculum should include initial and recurrent instruction in at least the following areas:

a) airport familiarization;

b) aircraft familiarization;

c) rescue and firefighting personnel safety;

d) emergency communications systems on the aerodrome, including aircraft fire-related alarms;

e) use of the fire hoses, nozzles, turrets and other appliances required for compliance with Chapter 9, 9.2;

f) application of the types of extinguishing agents required for compliance with Chapter 9, 9.2;

g) emergency aircraft evacuation assistance;

h) firefighting operations;

i) adaptation and use of structural rescue and firefighting equipment for aircraft rescue and firefighting;

j) dangerous goods;

k) familiarization with firefighters' duties under the aerodrome emergency plan; and

l) protective clothing and respiratory protection.

17.3 Level of protection to be provided

17.3.1 In accordance with Chapter 9, 9.2, aerodromes should be categorized for rescue and firefighting purposes and the level of protection provided should be appropriate to the aerodrome category.

17.3.2 However, Chapter 9, 9.2.3, permits a lower level of protection to be provided for a limited period where the number of movements of the aeroplanes in the highest category normally using the aerodrome is less than 700 in the busiest consecutive three months. It is important to note that the concession included in 9.2.3 is applicable only where there is a wide range of difference between the dimensions of the aeroplanes included in reaching 700 movements.

17.4 Rescue equipment for difficult environments

17.4.1 Suitable rescue equipment and services should be available at an aerodrome where the area to be covered by the service includes water, swampy areas or other difficult environment that cannot be fully served by conventional wheeled vehicles. This is particularly important where a significant portion of approach/departure operations takes place over these areas.

17.4.2 The rescue equipment should be carried on boats or other vehicles such as helicopters and amphibious or air cushion vehicles, capable of operating in the area concerned. The vehicles should be so located that they can be brought into action quickly to respond to the areas covered by the service.

17.4.3 At an aerodrome bordering the water, the boats or other vehicles should preferably be located on the aerodrome, and convenient launching or docking sites provided. If these vehicles are located off the aerodrome, they should preferably be under the control of the aerodrome rescue and firefighting service or, if this is not practicable, under the control of another competent public or private organization working in close coordination with the aerodrome rescue and firefighting service (such as police, military services, harbour patrol or coast guard).

17.4.4 Boats or other vehicles should have as high a speed as practicable so as to reach an accident site in minimum time. To reduce the possibility of injury during rescue operations, water jet-driven boats are preferred to water propellerdriven boats unless the propellers of the latter boats are ducted. Should the water areas to be covered by the service be frozen for a significant period of the year, the equipment should be selected accordingly. Vehicles used in this service should be equipped with life rafts and life preservers related to the requirements of the larger aircraft normally using the aerodrome, with two-way radio communication, and with floodlights for night operations. If aircraft operations during periods of low visibility are expected, it may be necessary to provide guidance for the responding emergency vehicles.

17.4.5 The personnel designated to operate the equipment should be adequately trained and drilled for rescue services in the appropriate environment.

17.5 Facilities

17.5.1 The provision of special telephone, two-way radio communication and general alarm systems for the rescue and firefighting service is desirable to ensure the dependable transmission of essential emergency and routine information.

Consistent with the individual requirements of each aerodrome, these facilities serve the following purposes:

a) direct communication between the activating authority and the aerodrome fire station in order to ensure the prompt alerting and dispatch of rescue and firefighting vehicles and personnel in the event of an aircraft accident or incident;

b) direct communication between the rescue and firefighting service and the flight crew of an aircraft in emergency;

c) emergency signals to ensure the immediate summoning of designated personnel not on standby duty;

d) as necessary, summoning essential related services on or off the aerodrome; and

e) maintaining communication by means of two-way radio with the rescue and firefighting vehicles in attendance at an aircraft accident or incident.

17.5.2 The availability of ambulance and medical facilities for the removal and after-care of casualties arising from an aircraft accident should receive the careful consideration of the appropriate authority and should form part of the overall emergency plan established to deal with such emergencies.

18. Operators of vehicles

18.1 The authorities responsible for the operation of vehicles on the movement area should ensure that the operators are properly qualified. This may include, as appropriate to the driver's function, knowledge of:

a) the geography of the aerodrome;

b) aerodrome signs, markings and lights;

c) radiotelephone operating procedures;

d) terms and phrases used in aerodrome control including the ICAO spelling alphabet;

e) rules of air traffic services as they relate to ground operations;

f) airport rules and procedures; and

g) specialist functions as required, for example, in rescue and firefighting.

18.2 The operator should be able to demonstrate competency, as appropriate, in:

a) the operation or use of vehicle transmit/receive equipment;

b) understanding and complying with air traffic control and local procedures;

c) vehicle navigation on the aerodrome; and

d) special skills required for the particular function.

In addition, as required for any specialist function, the operator should be the holder of a State driver's licence, a State radio operator's licence or other licences.

18.3 The above should be applied as is appropriate to the function to be performed by the operator, and it is not necessary that all operators be trained to the same level, for example, operators whose functions are restricted to the apron.

18.4 If special procedures apply for operations in low visibility conditions, it is desirable to verify an operator's knowledge of the procedures through periodic checks.

19. The aircraft classification number-pavement classification number (ACN-PCN) method of reporting pavement strength

Applicable until 27 November 2024

19.1 Overload operations

19.1.1 Overloading of pavements can result either from loads too large, or from a substantially increased application rate, or both. Loads larger than the defined (design or evaluation) load shorten the design life, whilst smaller loads extend it. With the exception of massive overloading, pavements in their structural behaviour are not subject to a particular limiting load above which they suddenly or catastrophically fail. Behaviour is such that a pavement can sustain a definable load for an expected number of repetitions during its design life. As a result, occasional minor overloading is acceptable, when expedient, with only limited loss in pavement life expectancy and relatively small acceleration of pavement deterioration. For those operations in which magnitude of overload and/or the frequency of use do not justify a detailed analysis, the following criteria are suggested:

a) for flexible pavements, occasional movements by aircraft with ACN not exceeding 10 per cent above the reported PCN should not adversely affect the pavement;

b) for rigid or composite pavements, in which a rigid pavement layer provides a primary element of the structure, occasional movements by aircraft with ACN not exceeding 5 per cent above the reported PCN should not adversely affect the pavement;

c) if the pavement structure is unknown, the 5 per cent limitation should apply; and

d) the annual number of overload movements should not exceed approximately 5 per cent of the total annual aircraft movements.

19.1.2 Such overload movements should not normally be permitted on pavements exhibiting signs of distress or failure. Furthermore, overloading should be avoided during any periods of thaw following frost penetration, or when the strength of the pavement or its subgrade could be weakened by water. Where overload operations are conducted, the appropriate authority should review the relevant pavement condition regularly, and should also review the criteria for overload operations periodically since excessive repetition of overloads can cause severe shortening of pavement life or require major rehabilitation of pavement.

19.2 ACNs for several aircraft types

For convenience, several aircraft types currently in use have been evaluated on rigid and flexible pavements founded on the four subgrade strength categories in Chapter 2, 2.6.6 b), and the results tabulated in the Aerodrome Design Manual (Doc 9157), Part 3.

19. The aircraft classification rating-pavement classification rating (ACR-PCR) method of reporting pavement strength

Applicable as of 28 November 2024

19.1 Overload operations

19.1.1 Overloading of pavements can result either from loads too large, or from a substantially increased application rate, or both. Loads larger than the defined (design or evaluation) load shorten the design life, whilst smaller loads extend it. With the exception of massive overloading, pavements in their structural behaviour are not subject to a particular limiting load above which they suddenly or catastrophically fail. Behaviour is such that a pavement can sustain a definable load for an expected number of repetitions during its design life. As a result, occasional minor overloading is acceptable, when expedient, with only limited loss in pavement life expectancy and relatively small acceleration of pavement deterioration. For those operations in which magnitude of overload and/or the frequency of use do not justify a detailed analysis, the following criteria are suggested:

a) for flexible and rigid pavements, occasional movements by aircraft with ACR not exceeding 10 per cent above the reported PCR should not adversely affect the pavement; and

b) the annual number of overload movements should not exceed approximately 5 per cent of the total annual movements excluding light aircraft.

19.1.2 Such overload movements should not normally be permitted on pavements exhibiting signs of distress or failure. Furthermore, overloading should be avoided during any periods of thaw following frost penetration, or when the strength of the pavement or its subgrade could be weakened by water. Where overload operations are conducted, the appropriate authority should review the relevant pavement condition regularly, and should also review the criteria for overload operations periodically since excessive repetition of overloads can cause severe shortening of pavement life or require major rehabilitation of pavement.

19.2 ACRs for several aircraft types

For convenience, a dedicated software is available on the ICAO website, for computing any aircraft ACRs at any mass on rigid and flexible pavements for the four standard subgrade strength categories detailed in Chapter 2, 2.6.6 b).

20. Autonomous runway incursion warning system (ARIWS)

Note 1.— These autonomous systems are generally quite complex in design and operation and, as such, deserve careful consideration by all levels of the industry, from the regulating authority to the end user. This guidance is offered to provide a more clear description of the system(s) and offer some suggested actions required in order to properly implement these system(s) at an aerodrome in any State.

Note 2.— The Manual on the Prevention of Runway Incursion (Doc 9870) presents different approaches for the prevention of runway incursion.

20.1 General description

20.1.1 The operation of an ARIWS is based upon a surveillance system which monitors the actual situation on a runway and automatically returns this information to warning lights at the runway (take-off) thresholds and entrances. When an aircraft is departing from a runway (rolling) or arriving at a runway (short final), red warning lights at the entrances will illuminate, indicating that it is unsafe to enter or cross the runway. When an aircraft is aligned on the runway for take-off and another aircraft or vehicle enters or crosses the runway, red warning lights will illuminate at the threshold area, indicating that it is unsafe to start the take-off roll.

20.1.2 In general, an ARIWS consists of an independent surveillance system (primary radar, multilateration, specialized cameras, dedicated radar, etc.) and a warning system in the form of extra airfield lighting systems connected through a processor which generates alerts independent from ATC directly to the flight crews and vehicle operators.

20.1.3 An ARIWS does not require circuit interleaving, secondary power supply or operational connection to other visual aid systems.

20.1.4 In practice, not every entrance or threshold needs to be equipped with warning lights. Each aerodrome will have to assess its needs individually depending on the characteristics of the aerodrome. There are several systems developed offering the same or similar functionality.

20.2 Flight crew actions

20.2.1 It is of critical importance that flight crews understand the warning being transmitted by the ARIWS system. Warnings are provided in near real-time, directly to the flight crew because there is no time for “relay” types of communications. In other words, a conflict warning generated to ATS which must then interpret the warning, evaluate the situation and communicate to the aircraft in question, would result in several seconds being taken up where each second is critical in the ability to stop the aircraft safely and prevent a potential collision. Pilots are presented with a globally consistent signal which means "STOP IMMEDIATELY" and must be taught to react accordingly. Likewise, pilots receiving an ATS clearance to take-off or cross a runway, and seeing the red light array, must STOP and advise ATS that they aborted/stopped because of the red lights. Again, the criticality of the timeline involved is so tight that there is no room for misinterpretation of the signal. It is of utmost importance that the visual signal be consistent around the world.

20.2.2 It must also be stressed that the extinguishing of the red lights does not, in itself, indicate a clearance to proceed. That clearance is still required from air traffic control. The absence of red warning lights only means that potential conflicts have not been detected.

20.2.3 In the event that a system becomes unserviceable, one of two things will occur. If the system fails in the extinguished condition, then no procedural changes need to be accomplished. The only thing that will happen is the loss of the automatic, independent warning system. Both ATS operations and flight crew procedures (in response to ATS clearances) will remain unchanged.

20.2.4 Procedures should be developed to address the circumstance where the system fails in the illuminated condition. It will be up to the ATS and/or aerodrome operator to establish those procedures depending on their own circumstances. It must be remembered that flight crews are instructed to "STOP" at all red lights. If the affected portion of the system, or the entire system, is shut off the situation is reverted to the extinguished scenario described in 20.2.3.

20.3 Aerodromes

20.3.1 An ARIWS does not have to be provided at all aerodromes. An aerodrome considering the installation of such a system may wish to assess its needs individually, depending on traffic levels, aerodrome geometry, ground taxi patterns, etc.

Local user groups such as the Local Runway Safety Team (LRST) can be of assistance in this process. Also, not every runway or taxiway needs to be equipped with the lighting array(s), and not every installation requires a comprehensive ground surveillance system to feed information to the conflict detection computer.

20.3.2 Although there may be local specific requirements, some basic system requirements are applicable to all ARIWS:

a) the control system and energy power supply of the system must be independent from any other system in use at the aerodrome, especially the other parts of the lighting system;

b) the system must operate independently from ATS communications;

c) the system must provide a globally accepted visual signal that is consistent and instantly understood by crews; and

d) local procedures should be developed in the case of malfunction or failure of a portion of, or the entire system.

20.4 Air traffic services

20.4.1 The ARIWS is designed to be complementary to normal ATS functions, providing warnings to flight crews and vehicle operators when some conflict has been unintentionally created or missed during normal aerodrome operations. The ARIWS will provide a direct warning when, for example, ground control or tower (local) control has provided a clearance to hold short of a runway but the flight crew or vehicle operator has “missed” the hold short portion of their clearance and tower has issued a take-off or landing clearance to that same runway, and the non-read back by the flight crew or vehicle operator was missed by air traffic control.

20.4.2 In the case where a clearance has been issued and a crew reports a non-compliance due to “red lights”, or aborting because of “red lights”, then it is imperative that the controller assess the situation and provide additional instructions as necessary. It may well be that the system has generated a false warning or that the potential incursion no longer exists; however, it may also be a valid warning. In any case, additional instructions and/or a new clearance need to be provided. In a case where the system has failed, then procedures will need to be put into place as described in 20.2.3 and 20.2.4 . In no case should the illumination of the ARIWS be dismissed without confirmation that, in fact, there is no conflict. It is worth noting that there have been numerous incidents avoided at aerodromes with such systems installed. It is also worth noting that there have been false warnings as well, usually as a result of the calibration of the warning software, but in any case, the potential conflict existence or non-existence must be confirmed.

20.4.3 While many installations may have a visual or audio warning available to ATS personnel, it is in no way intended that ATS personnel be required to actively monitor the system. Such warnings may assist ATS personnel in quickly assessing the conflict in the event of a warning and help them to provide appropriate further instructions, but the ARIWS should not play an active part in the normal functioning of any ATS facility.

20.4.4 Each aerodrome where the system is installed will develop procedures depending upon its unique situation. Again, it must be stressed that under no circumstances should pilots or operators be instructed to "cross the red lights". As indicated previously, the use of local runway safety teams can greatly assist in this development process.

20.5 Promulgation of information

20.5.1 Information on the characteristics and status of an ARIWS at an aerodrome are promulgated in the AIP section AD 2.9 in PANS-AIM (Doc 10066), and its status updated as necessary through NOTAM or ATIS in compliance with 2.9.1 of this Annex.

20.5.2 Aircraft operators are to ensure that flight crews' documentation include procedures regarding ARIWS and appropriate guidance information, in compliance with Annex 6, Part I.

20.5.3 Aerodromes may provide additional sources of guidance on operations and procedures for their personnel, aircraft operators, ATS and third-party personnel who may have to deal with an ARIWS.

21. Taxiway design guidance for minimizing the potential for runway incursions

21.1 Good aerodrome design practices can reduce the potential for runway incursions while maintaining operating efficiency and capacity. The following taxiway design guidance may be considered to be part of a runway incursion prevention programme as a means to ensure that runway incursion aspects are addressed during the design phase for new runways and taxiways. Within this focused guidance, the prime considerations are to limit the number of aircraft or vehicles entering or crossing a runway, provide pilots with enhanced unobstructed views of the entire runway, and correct taxiways identified as hot spots as much as possible.

21.2 The centre line of an entrance taxiway should be perpendicular to the runway centre line, where possible. This design principle provides pilots with an unobstructed view of the entire runway, in both directions, to confirm that the runway and approach are clear of conflicting traffic before proceeding towards the runway. Where the taxiway angle is such that a clear unobstructed view, in both directions, is not possible, consideration should be given to providing a perpendicular portion of the taxiway immediately adjacent to the runway to allow for a full visual scan by the pilots prior to entering or crossing a runway.

21.3 For taxiways intersecting with runways, avoid designing taxiways wider than recommended in this Annex. This design principle offers improved recognition of the location of the runway holding position and the accompanying sign, marking and lighting visual cues.

21.4 Existing taxiways wider than recommended in this Annex, can be rectified by painting taxi side stripe markings to the recommended width. As far as practicable, it is preferable to redesign such locations properly rather than to repaint such locations.

21.5 Multi-taxiway entrances to a runway should be parallel to each other and should be distinctly separated by an unpaved area. This design principle allows each runway holding location an earthen area for the proper placement of accompanying sign, marking and lighting visual cues at each runway holding position. Moreover, the design principle eliminates the needless costs of building unusable pavement and as well as the costs for painting taxiway edge markings to indicate such unusable pavement. In general, excess paved areas at runway holding positions reduce the effectiveness of sign, marking and lighting visual cues.

21.6 Build taxiways that cross a runway as a single straight taxiway. Avoid dividing the taxiway into two after crossing the runway. This design principle avoids constructing "Y-shaped" taxiways known to present risk of runway incursions.

21.7 If possible, avoid building taxiways that enter at the mid-runway location. This design principle helps to reduce the collision risks at the most hazardous locations (high energy location) because normally departing aircraft have too much energy to stop, but not enough speed to take-off, before colliding with another errant aircraft or vehicle.

21.8 Provide clear separation of pavement between a rapid exit taxiway and other non-rapid taxiways entering or crossing a runway. This design principle avoids two taxiways from overlapping each other to create an excessive paved area that would confuse pilots entering a runway.

21.9 Avoid the placement of different pavement materials (asphalt and cement concrete) at or near the vicinity of the runway holding position, as far as practicable. This design principle avoids creating visual confusion as to the actual location of the runway holding position.

21.10 Many aerodromes have more than one runway, notably paired parallel runways (two runways on one side of the terminal), which creates a difficult problem in that either on arrival or departure an aircraft is required to cross a runway.

Under such a configuration, the safety objective here is to avoid or at least keep to a minimum the number of runway crossings. This safety objective may be achieved by constructing a "perimeter taxiway". A perimeter taxiway is a taxi route that goes around the end of a runway, enabling arrival aircraft (when landings are on outer runway of a pair) to get to the terminal, or departure aircraft (when departures are on outer runway of a pair) to get to the runway, without either crossing a runway or conflicting with a departing or approaching aircraft.

21.11 A perimeter taxiway would be designed according to the following criteria:

a) Sufficient space is required between the landing threshold and the taxiway centre line where it crosses under the approach path to enable the critical taxiing aircraft to pass under the approach without penetrating any approach surface.

b) The jet blast impact of aircraft taking off should be considered in consultation with aircraft manufacturers; the extent of take-off thrust should be evaluated when determining the location of a perimeter taxiway.

c The requirement for a runway end safety area, as well as possible interference with landing systems and other navigation aids should also be taken into account. For example, in the case of an ILS, the perimeter taxiway should be located behind the localiser antenna, not between the localiser antenna and the runway, due to the potential for severe ILS disturbance, noting that this is harder to achieve as the distance between the localizer and the runway increases.

d) Human factors issues should also be taken into account. Appropriate measures should be put in place to assist pilots to distinguish between aircraft that are crossing the runway and those that are safely on a perimeter taxiway.

22. Aerodrome mapping data

22.1 Introduction

Chapter 2, 2.1.2 and 2.1.3, relate to the provision of aerodrome mapping data. The aerodrome mapping data features are collected and made available to the organisation responsible for aeronautical information in Aruba for aerodromes designated with consideration of the intended applications. These applications are closely tied to an identified need and operational use where the application of the data would provide a safety benefit or could be used as mitigation of a safety concern.

22.2 Applications

22.2.1 Aerodrome mapping data include aerodrome geographic information that supports applications which improve the user's situational awareness or supplement surface navigation, thereby increasing safety margins and operational efficiency. With appropriate data element accuracy, these data sets support collaborative decision-making, common situational awareness and aerodrome guidance applications. The data sets are intended to be used in the following air navigation applications:

a) on-board positioning and route awareness including moving maps with own aircraft position, surface guidance and navigation;

b) traffic awareness including surveillance and runway incursion detection and alerting (such as, respectively, in A-SMGCS levels 1 and 2);

c) ground positioning and route awareness including situational displays with aircraft and vehicles position and taxi route, surface guidance and navigation (such as A-SMGCS levels 3 and 4);

d) facilitation of aerodrome-related aeronautical information, including NOTAMs;

e) resource and aerodrome facility management; and

f) aeronautical chart production.

22.2.2 The data may also be used in other applications such as training/flight simulators and on-board or ground enhanced vision systems (EVS), synthetic vision systems (SVS) and combined vision systems (CVS).

22.3 Determination of aerodromes to be considered for collection of aerodrome mapping data features

In order to determine which aerodromes may make use of applications requiring the collection of aerodrome mapping data features, the following aerodrome characteristics may be considered:

– safety risks at the aerodrome;

– visibility conditions;

– aerodrome layout; and

– traffic density.

Note.— Further guidance on aerodrome mapping data can be found in the Airport Services Manual, Part 8 — Airport Operational Service (Doc 9137).

ATTACHMENT B. OBSTACLE LIMITATION SURFACES

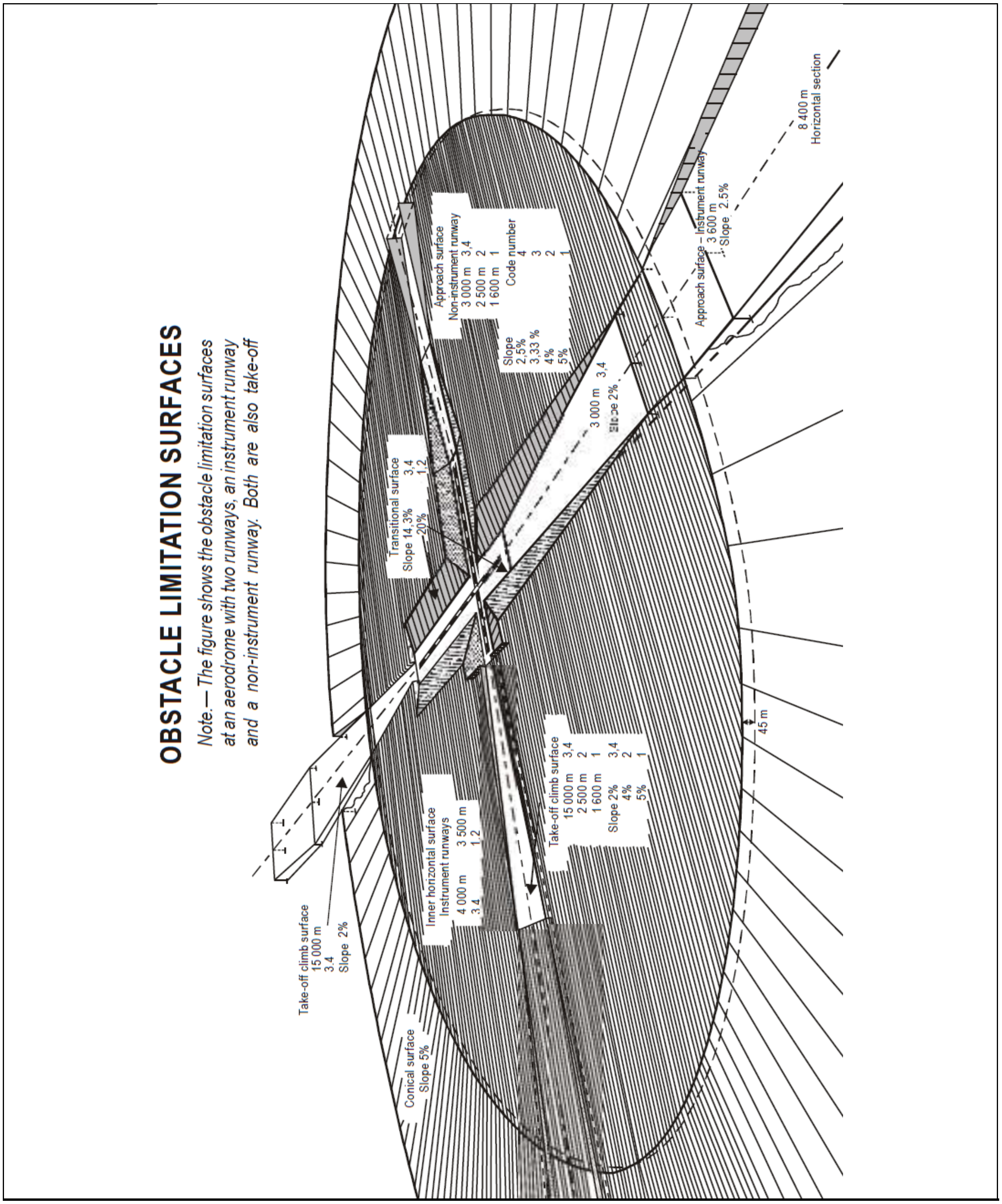


Figure B-1