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SUPLEMENTO

SUMÁRIO

AGÊNCIA DA AVIAÇÃO CIVIL

Conselho de Administração

DELIBERAÇÃO Nº 10/2009

Ao abrigo do disposto no artigo 173º do Código Aeronáutico (Decreto Legislativo 1/2001 de 20 Agosto) e da alínea *a*) do nº 2 do artigo 12 dos estatutos da Agencia de Aviação Civil aprovado pelo Decreto-Lei nº 24/2008, de 12 de Julho, o Conselho de Administração da AAC aprovou a 21 de Agosto de 2009 o Manual de Normas de Aeródromos em versão Inglesa, contendo regulamentos complementares à Parte 14 – Certificação e Operação de Aeródromos, que detalham especificações relativas à concepção, construção e operação de aeródromos.

Este novo regulamento visa, essencialmente, substituir o sistema de referência às normas do Anexo 14 da ICAO adoptado pela anterior edição de Março de 2005 do CV CAR 14, pela especificação directa e detalhada das normas desse mesmo Anexo na regulamentação nacional.

A versão portuguesa do Manual de Normas de Aeródromos será publicada logo que possível.

Conselho de Administração da Agência da Aviação Civil, na Praia, aos 21 de Agosto de 2009. – O Presidente, *Carlos Brazão Monteiro.*

MANUAL OF STANDARDS

PART 14 – AERODROMES (MOS 14)

1st Edition

July 2009

FOREWORD

Application

The specifications contained in this manual are applicable to land airports which are certified pursuant to the Aerodrome Regulations CV CAR Part 14 as amended.

Status of manual components

This manual serves as the authoritative document for airport specifications, including physical characteristics, obstacle limitations surfaces, lighting, markers, marking and signs. It uses the ICAO phraseology of "standard" or "recommended practice" to identify specifications which are considered to have a direct impact on the safety of flight from those which effect only operational efficiency. These terms are defined as:

Standard: A standard includes any specification for physical characteristics, configuration, material, performance, personnel or procedure, the uniform application of which is recognized as necessary for the safety or regularity of air navigation and to which operators will conform. Standards identified by the use of the verb "shall" are mandatory for certification unless a deviation has been approved.

Recommended Practice: Any specification for physical characteristics, configuration, material, performance, personnel or procedure, the uniform application of which is recognized as desirable in the interest of safety, regularity or efficiency of air navigation, and to which operators will endeavour to conform. Specifications designated as recommended practices are identified by the verb "should".

Appendices, annexes, tables or figures, which are used to amplify or illustrate standards or recommended practices, are considered to form part of the main document and therefore have the same status as the primary text.

Notes and attachments comprise material supplementary to the Standards and Recommended Practices or are included as a guide to their application.

Some standards and recommended practices in this document may incorporate, by reference, other specifications, standards and recommended practices in other publications. In such cases, the text of these references becomes part of the MOS 14, Standards and Recommended Practices.

Editorial practices

The following practices have been adhered to in order to indicate at a glance the status of each statement; Standards have been printed in light face gothic the status being indicated by the prefix Standard; Recommended Practices have been printed in light face gothic, the status being indicated by the prefix Recommendation. Notes have been printed in light face italics, the status being indicated by the prefix Note.

The following editorial practice has been followed in the writing of specification for Standards, the operative verb "shall" is used, and for Recommended Practices the operative verb "should" is used.

In some cases it has been recognized during the design of a specification that uniform application may not be possible. This has been recognized within the specification by the use of "if practicable", "where physically practicable" or other similar wording. In such cases, the final authority as to the application of the specification concerned rests with the Certifying Authority.

Manual procurement

This manual is published initially in the English language. A Portuguese language edition will be issued as soon as possible.

Aerodrome Standards and Recommended Practices – MOS 14

Copies of the English edition are available for download from the AAC website at www.aac.cv. Hard copies are available from:

Agencia de Aviação Civil

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ABBREVIATIONS AND SYMBOLS
(used in Aerodrome Standards and Recommended Practices)

Abbreviations

AAE	Above aerodrome elevation
AAS	Airport Advisory Service
ACN	Aircraft classification number
AIS	Aeronautical Information Services
ALR	Aircraft loading rating
APAPI	Abbreviated precision approach path indicator
aprx	Approximately
ARP	Aerodrome reference point
ASDA	Accelerate stop distance available
ATF	Aerodrome traffic frequency
ATS	Air traffic services
C	Degrees Celsius
CAT I	Category I
CAT II	Category II
CAT III	Category III
cd	Candela
cm	Centimetre
DME	Distance measuring equipment
E	East
EWH	Eye to wheel height
FOD	Foreign object damage
ft	Foot
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GS	Glide slope

HAA	Height above aerodrome
HIAL	High intensity approach lighting
ICAO	International Civil Aviation Organization
IFR	Instrument flight rules
ILS	Instrument landing system
IMC	Instrument meteorological conditions
JBI	James Brake Index (??)
K	Degree Kelvin
kg	Kilogram
km/h	Kilometre per hour
km	Kilometre
kt	Knot
L	Litre
LDA	Landing distance available
m	Metre
M	Magnetic
MALSR	Medium intensity approach lighting system with run way alignment indicator lights
max	Maximum
MF	Mandatory frequency
min	Minimum
MLS	Microwave landing system
mm	Millimetre
MN	Meganewton
MPa	Megapascal
MSL	Above mean sea level
N	North
NM	Nautical mile
NOTAM	Notices to airmen
NU	Not usable
OCA/H	Obstacle clearance altitude/height
ODALS	Omni-directional lighting system
OFZ	Obstacle free zone
OLS	Obstacle limitation surface
PAPI	Precision approach path indicator
PCN	Pavement classification number
PLR	Pavement load rating
RCR	Runway condition report
RESA	Runway end safety area
RILS	Runway identification lights
RSC	Runway surface condition
RVR	Runway visual range
S	South
secs	Seconds
SIRO	Simultaneous intersecting runway operations
T	True
TDZ	Touchdown zone
TDZE	Touchdown zone elevation
TDZL	Touchdown zone lighting
TODA	Take-off distance available
TORA	Take-off run available
VFR	Visual flight rules
VMC	Visual meteorological conditions
VOR	Very high frequency omnidirectional range
W	West

Symbols

°	Degrees
>	Greater than
<	Less than
-	Minus
´	Minute of arc
µ	Friction coefficient
%	Percentage
±	Plus or minus
+	Plus
´´	Seconds of arc

CHAPTER 1. GENERAL

14.1.100 GENERAL

14.1.103 Background and scope

Aerodrome safety is a vital link in aviation safety. It is achieved by providing appropriate aerodrome services, facilities and equipment and maintaining them and the aerodrome environment to a level safe for aircraft operations. By complying with the prescribed standards and procedures, and by taking a pro-active safety management approach in the operation of their aerodromes, aerodrome operators can demonstrate that they have discharged their safety obligations to the travelling public.

This Manual contains Aerodrome Standards and guidance materials pertaining to the planning, construction, operation and maintenance of aerodrome, services, facilities and equipment to be complied with by aerodrome operators.

The scope of this manual is confined to the safety, regularity and efficiency aspects of aerodrome facilities, equipment and operations.

It does not cover such aspects as those related to aeronautical meteorology, the administration of aerodrome finances and the servicing of passengers and cargo. It also excludes air traffic services and aeronautical information services, although their coordination with the aerodrome operator, which forms an integral part of an aerodrome's operations, has been incorporated.

14.1.106 Regulatory responsibilities

The regulatory roles and responsibilities with regard to aerodromes include:

a) ensuring that aerodromes in Cabo Verde offer a safe operating environment in accordance with the Convention on International Civil Aviation;

b) reviewing ICAO State letters on the subject of aerodromes, preparing response thereto and taking action thereon;

c) notifying ICAO of differences between national aerodrome regulations and practices vis-à-vis the SARPs contained in ICAO Annex 14.

d) carrying out aerodrome certification in accordance with the Civil Aviation regulations;

e) developing and reviewing national safety standards;

f) monitoring and ensuring adherence to aerodrome standards and recommended practices through regular safety audits and providing measures for enforcing compliance;

g) conducting regular reviews of aerodrome regulations and practices, and developing and issuing aerodrome safety

directives, instructions, circulars and/or publications containing guidance material relating to aerodrome standards and recommended practices to promote the improvement of aerodrome safety;

h) reviewing aerodrome-related accident and incident investigation reports and performing investigations, where necessary, to determine if there is any violation of safety regulations and requirements by aerodrome operators;

i) notification of Aeronautical Information regarding the certified status and particulars of aerodromes through promulgation in the Aeronautical Information Publications; and

j) maintaining a technical library containing files for each certified aerodrome; records of the organisation; documents issued by the ICAO relating to the design, operations and maintenance of aerodrome facilities and equipment; national aerodrome standards, guidance material and where necessary, other relevant reference materials.

Notwithstanding the fact that the Authority sets and maintains aerodrome standards, certifies aerodrome operators and conducts aerodrome safety oversight audit, the responsibility for the safety of aerodrome operations rests with the aerodrome operators. A certified aerodrome operator with a Safety Management System in place is required to maintain its own safety audit and inspection program with the Authority taking an interest in what the internal safety audit program is achieving and how the aerodrome operator organisation is performing from a safety perspective.

The Authority will monitor the safety performance through conducting regular safety audits, reviewing the findings, identifying preventive and corrective actions needed, examining safety occurrences at the aerodromes and evaluating concerns expressed by the public or other industry participants.

14.1.109 Relevant legislation and documents

The relevant legislation and document hierarchy relating to the certification and safe operation of aerodromes consists of:

a) the Aeronautical Code as may be amended from time to time;

b) the relevant provisions of the civil aviation regulations and in particular CV CAR Part 14 – Aerodrome Certification, Operation and Use.

c) this Manual of Aerodrome Standards (with references to relevant sections of ICAO Annex 14 and related guidance material); and

d) Any applicable Directives, Instructions, Circulars and/or Publications, as and when published, by the Authority.

14.1.112 Publication of differences in AIP

Differences between the Standards prescribed in this Manual and those contained in ICAO Annex 14, if any, shall be promulgated in the Aeronautical Information Publications (AIP) and ICAO notified.

Aerodrome operators shall publish any differences between the provisions at their aerodromes and the Standards prescribed in this Manual through the Aerodrome (AD) section of the AIP. Such differences shall be subject to approval by the Authority.

14.1.115 Related reference documents

This Manual should be read in conjunction with other guidance documents published by the Authority and ICAO.

14.1.118 Definitions

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

Aerodrome. A defined area on land (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 elevation. The elevation of the highest point of the landing area.

Aerodrome reference point. The designated point on an aerodrome normally located at or near the geometric centre of the runway complex that establishes the focus of the radius or radii of the outer surface.

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.

Aerodrome reference temperature. The monthly mean of the maximum daily temperature for the hottest month of the year (the hottest month being that which has the highest monthly mean temperature).

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.

Aeroplane 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 aeroplane flight manual prescribed by the certificating authority or equivalent data from the aeroplane manufacturer. Field length means balanced field length for aeroplanes, if applicable, or take-off distance in other cases.

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

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

Aerodrome zoning regulations. A regulation respecting a given aerodrome pursuant to article 44 of the Aeronautical Code made by Authority.

Airside. The movement area of an aerodrome, adjacent terrain and buildings or portions thereof, access to which is controlled.

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.

Authority. The civil aviation authority responsible for the oversight of civil aviation in Cabo Verde (The Agencia de Aviação Civil (AAC)).

Average Luminous Intensity. A theoretical intensity calculated so that the luminous intensity produced by a light unit, within the specified beam dimensions, nowhere falls to less than 50 per cent or rises to more than 150 per cent of the average value.

Balanced Field Length. A field length where the distance to accelerate and stop is equal to the take-off distance of an aeroplane experiencing an engine failure at the critical engine failure recognition speed (V1).

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.

Bearing strength. The structural ability of a surface to support loads imposed by aircraft.

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

Candela. The luminous intensity as defined in the International System of Units (SI).

Capacitor discharge light. A lamp in which high-intensity flashes of extremely short duration are produced by the discharge of electricity at high voltage through a gas enclosed in a tube.

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

Circling 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.

Circling procedure. Visual manoeuvring required after completing an instrument approach procedure.

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

Critical aeroplane. The aeroplane or aeroplanes identified from among the aeroplanes the aerodrome is intended to serve as having the most demanding operational requirements with respect to the determination of movement area dimensions, pavement bearing strength and other physical characteristics in the design of aerodromes.

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.

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 aeroplane taking off.

b) Take-off distance available (TODA). The length of the take-off run available plus the

c) length of the clearway, if provided.

d) Accelerate-stop distance available (ASDA). The length of the take-off run available plus the length of the stopway, if provided.

e) Landing distance available (LDA). The length of runway which is declared available and suitable for the ground run of an aeroplane 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.

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

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

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

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

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.

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 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.*

Geometric centre. The geographical coordinates of the centre of the runway complex that locates the aerodrome for charting purposes. It is determined by the mean of the latitudes of the furthest north runway threshold and furthest south runway threshold and the mean of the longitudes of the furthest east runway threshold and furthest west runway threshold.

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

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

Human Factors Principle. 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.

Instrument Approach Procedure. A series of predetermined manoeuvres by reference to flight instruments for the orderly transfer of an aircraft from the beginning of the initial approach to a landing, or to a point from which a landing may be made.

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

a) Non-precision approach runway. An instrument runway served by visual aids and a non-visual aid providing at least directional guidance adequate for a straight-in approach.

b) Precision approach runway, category I. An instrument runway served by ILS and/or MLS and visual aids intended for operations with a decision height not lower than 60m (200 ft) and either a visibility not less than 800m or a runway visual range not less than 550m.

c) Precision approach runway, category II. An instrument runway served by ILS and/or MLS and visual aids intended for operations with a decision height lower than 60m (200 ft) but not lower than 30m (100 ft) and a runway visual range not less than 350m.

d) Precision approach runway, category III. An instrument runway served by ILS and/or MLS to and along the surface of the runway and:

1) - intended for operations with a decision height lower than 30m (100ft), or no decision height and a runway visual range not less than 200m.

2) - intended for operations with a decision height lower than 15m (50 ft), or no decision height and a runway visual range less than 200m but not less than 50m.

3) - intended for operations with no decision height and no runway visual range limitations.

Note.— *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.*

Integrity (aeronautical data). A degree of assurance that an aeronautical data and its value has not been lost nor altered since the data origination or authorized amendment.

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.

Laser-beam critical flight zone (LCFZ). Airspace in the proximity of an aerodrome but beyond the LFFZ where the irradiance is restricted to a level unlikely to cause glare effects.

Laser-beam free flight zone (LFFZ). Airspace in the immediate proximity to the aerodrome where the irradiance is restricted to a level unlikely to cause any visual disruption.

Laser-beam sensitive flight zone (LSFZ). Airspace outside, and not necessarily contiguous with, the LFFZ and LCFZ where the irradiance is restricted to a level unlikely to cause flash-blindness or after-image effects.

Light failure. A light shall be considered to have failed when for any reason the average intensity determined using the specified angles of beam elevation, toe-in and spread falls below 50 per cent of the specified average intensity.

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

Manoeuvring 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 manoeuvring area and the apron(s).

Non-instrument runway. A runway intended for the operation of aircraft using visual approach procedures.

Normal flight zone (NFZ). Airspace not defined as LFFZ, LCFZ or LSFZ but which must be protected from laser radiation capable of causing biological damage to the eye.

Obstacle. All fixed (whether temporary or permanent) and mobile objects, or parts thereof, that are located on an area intended for the surface movement of aircraft or that extend above a defined surface intended to protect aircraft in flight.

Obstacle free zone (OFZ). The airspace above the inner approach surface, inner transitional 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.

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

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 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 aeroplane 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.

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

Secondary runway. The runway(s) designed to serve less critical aeroplanes and not necessarily sufficient for all aeroplanes which the primary runway is intended to serve and is provided to take account of the effect of particular winds of high velocity.

Shielding. A situation which permits the practice whereby an obstacle may be unmarked in spite of other adjacent dominant marked obstacles of equal height; it follows that an aircraft whose path of flight would avoid the dominant obstacle would as a result fly over the shielded obstacle without risk of collision.

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 predetermined 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 taxi lane. 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.

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.

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 aeroplanes first contact the runway.

Transverse slope. The slope of a runway or a strip measured perpendicular to the runway centre line.

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.— *Cross-wind component means the surface wind component at right angles to the runway centre line.*

14.1.200 APPLICABILITY

14.1.203 The interpretation of some of the specifications in this manual expressly requires the exercising of discretion, the taking of a decision or the performance of a function by the appropriate authority. In other specifications, the expression appropriate authority does not actually appear although its inclusion is implied. In both cases, the responsibility for whatever determination or action is necessary shall rest with the Authority.

14.1.206 The specifications, unless otherwise indicated in a particular context, shall apply to all aerodrome certified in accordance with CV CAR Part 14 Aerodrome Certification, Operation and Use and to the extent determined by the Authority to other aerodromes required to be certified in accordance with CV CAR Part 14. The specifications of MOS 14, Chapter 3 shall apply only to land aerodromes.

14.1.209 Wherever a colour is referred to in this Document, the specifications for that colour given in Appendix A shall apply.

14.1.300 COMMON REFERENCE SYSTEMS

14.1.303 Horizontal reference system - World Geodetic System — 1984 (WGS-84) shall be used 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.

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

14.1.306 Vertical reference system - Mean sea level (MSL) datum, which gives the relationship of gravity-related height (elevation) to a surface known as the geoid, shall be used as the vertical reference system.

Note 1.— *The geoid globally most closely approximates 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.*

Note 2.— *Gravity-related heights (elevations) are also referred to as orthometric heights while distances of points above the ellipsoid are referred to as ellipsoidal heights.*

14.1.309 Temporal reference system - The Gregorian calendar and Coordinated Universal Time (UTC) shall be used as the temporal reference system.

14.1.400 AIRPORT DESIGN

14.1.403 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.

Note.— *Guidance on all aspects of the planning of aerodromes including security considerations is contained in the Airport Planning Manual, (Doc 9184) Part 1.*

14.1.406 Recommendation. The design of aerodromes should take into account, where appropriate, 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.*

14.1.500 REFERENCE CODE

Note.— *The intent of the reference code is to provide a simple method for interrelating the numerous specifications concerning the characteristics of aerodromes so as to provide a series of aerodrome facilities that are suitable for the aeroplanes that are intended to operate at the aerodrome. The code is not intended to be used for determining runway length or pavement strength requirements. The code is composed of two elements which are related to the aeroplane performance characteristics and dimensions. Element 1 is a number based on the aeroplane reference field length and element 2 is a letter based on the aeroplane wing span and outer main gear wheel span. A particular specification is related to the more appropriate of the two elements of the code or to an appropriate combination of the two code elements. The code letter or number within an element selected for design proposes is related to the critical aeroplane characteristics for which the facility is provided. When applying MOS 14, the aeroplanes which the aerodrome is intended to serve are first identified and then the two elements of the code.*

14.1.503 An aerodrome reference code (code number and letter) which is selected for aerodrome planning purposes shall be determined in accordance with the characteristics of the aeroplane for which an aerodrome facility is intended.

14.1.506 The aerodrome reference code numbers and letters shall have the meanings assigned to them in Table 1-1.

14.1.509 The code number for element 1 shall be determined from Table 1-1, column 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.

Note.— *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.*

Table 1-1. Aerodrome reference code (see 14.1.506 to 14.1.512)

Code element I		Code element 2		
Code Number	Aeroplane reference field length	Code Letter	Wing span	Outer main gear wheel span a
	(1)		(2)	(3)
1	Less than 800 m	A	Up to but not including 15 m	up to but not including 4.5 m
2	800 m up to but not including 1200 m	B	15 m up to but not including 24 m	4.5 m up to but not including 6 m
3	1200 m up to but not including 1800 m	C	24 m up to but not including 36 m	6 m up to but not including 9 m
4	1800 m and over	D	36 m up to but not including 52 m	9 m up to but not including 14 m
		E	52 m up to but not including 65 m	9 m up to but not including 14 m
		F	65 m up to but not including 80 m	14 m up to but not including 16 m

a. Distance between the outside edges of the main gear wheels.

14.1.512 The code letter for element 2 shall be determined from Table 1-1, column 3, by selecting the code letter which corresponds to the greatest wing span, or the greatest outer main gear wing span, whichever gives the more demanding code letter of the aeroplanes for which the facility is intended.

Note.— *Guidance to assist the appropriate authority in determining the aerodrome reference code is given in the ICAO Aerodrome Design Manual, Part 1 and 2.*

CHAPTER 2. AERODROME DATA

Note.— *This chapter contains specifications relating to the provision of data about aerodromes to be determined and recorded in the Aerodrome Operation Manual and where specified, reported to the regional Aeronautical Information Service.*

14.2.100 AERONAUTICAL DATA

14.2.103 Determination and reporting of aerodrome related aeronautical data shall be in accordance with the accuracy and integrity requirements set forth in Table 1 to 5 contained in Appendix E while taking into account the established quality system procedures. Accuracy requirements for aeronautical data are based upon a 95 per cent confidence level and in that respect, three types of positional data shall be identified:

a) surveyed points (e.g. runway threshold),

b) calculated points (mathematical calculations from known surveyed points of points in space, fixed) and

c) declared points (e.g. flight information region boundary points).

14.2.106 The integrity of aeronautical data shall be maintained throughout the data process from survey/origin to the next intended user. Aeronautical data integrity requirements shall be based upon the potential risk resulting from the corruption of data and upon the use to which the data item is put. Consequently, the following classification and data integrity level shall apply:

a) critical data, integrity level 1×10^{-8}: 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;

b) essential data, integrity level 1×10^{-5}: 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;

c) routine data, integrity level 1×10^{-3}: there is a very 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.

14.2.109 Protection of electronic aeronautical data while stored or in transit shall be totally monitored by the cyclic redundancy check (CRC). To achieve protection of the integrity level of critical and essential aeronautical data as classified in paragraph 14.2.106 above, a 32 or 24 bit CRC algorithm shall apply respectively.

14.2.112 Recommendation.— To achieve protection of the integrity level of routine aeronautical data as classified in paragraph 14.2.106 above, a 16 bit CRC algorithm should apply.

Note *– Guidance material on the aeronautical data integrity quality requirements (accuracy, resolution, integrity, protection and traceability) is contained in the ICAO World Geodetic System – 1984 (WGS-84) Manual (Doc 9274).*

14.2.115 Geographical coordinates including latitude and longitude shall be determined and reported to the Aeronautical Information Services in terms of the World Geodetic System – 1984 (WGS-84) geodetic reference datum, identifying those geographical coordinates which have been transformed into WGS-84 coordinates by mathematical means and whose accuracy of original field work does not meet the requirements in APPENDIX E; Table 1.

14.2.118 The order of accuracy of the field work shall be such that the resulting operational navigational data for the phases of flight will be within the maximum deviations, with respect to an appropriate reference frame, as indicated in the tables contained in APPENDIX E.

14.2.121 In addition to the elevation (referenced to mean sea level) of the specific surveyed ground positions at aerodromes, geoid undulation (referenced to the WGS-84 ellipsoid) for those positions as indicated in APPENDIX E shall be determined and reported to the Aeronautical Information Services.

14.2.200 AERODROME REFERENCE POINT

14.2.203 An aerodrome reference point shall be established for an aerodrome.

14.2.206 The aerodrome reference point shall be located near the initial or planned geometric centre of the aerodrome and shall normally remain where first established.

14.2.209 The position of the aerodrome reference point shall be measured and reported to the Aeronautical Information Services in degrees, minutes and seconds.

14.2.300 AERODROME AND RUNWAY ELEVATIONS

14.2.303 The aerodrome elevation and geoid undulation at the aerodrome elevation position shall be measured to the accuracy of one-half metre and reported to the Aeronautical Information Services.

14.2.306 For an aerodrome used by international civil aviation for non-precision approaches, 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 shall be measured to the accuracy of one-half metre and reported to the Aeronautical Information Services.

14.2.309 For precision approach runways, the elevation and geoid undulation of the threshold, the elevation of the runway end and the highest elevation of the touchdown zone shall be measured to the accuracy of one quarter metre and reported to the Aeronautical Information Services.

Note *– Geoid undulation must be measured in accordance with the appropriate system of coordinates.*

14.2.400 AERODROME REFERENCE TEMPERATURE

14.2.403 An aerodrome reference temperature shall be determined for an aerodrome in degrees Celsius.

14.2.406 Recommendation.— The aerodrome reference temperature should 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 should be averaged over a period of at least eight years.

14.2.500 AERODROME DIMENSIONS AND RELATED INFORMATION

14.2.503 The following data shall be measured or described, as appropriate, for each facility provided on an aerodrome:

a) runway - true bearing, to one-hundredth of a degree, designation number, length, width, displaced threshold location to the nearest metre, slope, surface type, and type of runway and, for a precision approach runway category I, the existence of an obstacle free zone when provided;

b) strip, runway end safety area and stopway - length, width to the nearest metre, and surface type.

c) taxiway - designation, width, surface type;

d) apron - surface type, aircraft stands;

e) the boundaries of the air traffic control service;

f) clearway – length to the nearest metre, 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 of localizer and glide path elements comprising an instrument landing system (ILS) or azimuth and elevation antenna of microwave landing system (MLS) in relation to the associated runway extremities.

14.2.506 The geographical coordinates of each threshold shall be measured and reported to the AIS in degrees, minutes, seconds and hundredths of seconds.

14.2.509 The geographical coordinates of appropriate taxiway centre line points shall be measured and reported to the AIS in degrees, minutes, seconds and hundredths of seconds.

14.2.512 The geographical coordinates of each aircraft stand shall be measured and reported to the AIS in degrees, minutes, seconds and hundredths of seconds.

14.2.515 The geographical coordinates of significant obstacles in the approach and take-off areas, in the circling area and in the vicinity of an aerodrome shall be measured and reported to the AIS in degrees, minutes, seconds and tenths of seconds. In addition, the top elevation rounded up to the nearest metre, type, marking and lighting (if any) of the significant obstacles shall be reported to the AIS.

14.2.600 STRENGHT OF PAVEMENTS

14.2.603 The bearing strength of a pavement shall be determined.

14.2.606 The bearing strength of a pavement intended for aircraft of apron (ramp) mass greater than 5700 kg shall be made available using the aircraft classification number - pavement classification number (ACN-PCN) method by reporting all of the following information:

a) the 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.

14.2.609 The pavement classification number (PCN) reported shall indicate that an 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.*

14.2.612 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, Part 3.*

14.2.615 For the purposes of determining the ACN, the behaviour of a pavement shall be classified as equivalent to a rigid or flexible construction.

14.2.618 Information on pavement type for ACN-PCN determination, subgrade strength category, maximum allowable tire pressure category and evaluation method shall be reported using the codes specified in Table 2-1.

14.2.621 Recommendation.— Procedures should be established to regulate the use of a pavement by an aircraft with an ACN higher than the PCN reported for that pavement in accordance with 14.2.606 and 14.2.609.

14.2.624 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.

Note*: Example: 4 000 kg/0.50 MPa.*

Table 2-1. Pavement Classification Number (PCN) Reporting codes

Pavement type for ACN-PCN determination:	**Codes**
Rigid pavement	R
Flexible pavement	F
Note.— *If the actual construction is composite or non standard, include a note to that effect (see example 2 below).*	
Subgrade strength category:	
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 above13 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
Maximum allowable tire pressure category:	
High: no pressure limit	W
Medium: pressure limited to 1.50 MPa	X
Low: pressure limited to 1.00 MPa	Y
Very low: pressure limited to 0.50 MPa	Z
Evaluation method:	
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

Note.— *The following examples illustrate how pavement strength data are reported under the ACN-PCN method.*

Example 1. — If the bearing strength of a rigid pavement, resting on a medium strength subgrade, has been assessed by technical evaluation to be PCN 80 and there is no tire pressure limitation, then the reported information would be:

PCN 80/ R / B / W / T

Example 2.— If the bearing strength of a composite pavement, behaving like a flexible pavement and resting on a high strength subgrade, has been assessed by using aircraft experience to be PCN 50 and the maximum tire pressure allowable is 1.00 MPa, then the reported information would be:

PCN 50/ F/A/Y/U *Note.— Composite construction.*

Example 3.— If the bearing strength of a flexible pavement, resting on a medium strength subgrade, has been assessed by technical evaluation to be PCN 40 and the maximum allowable tire pressure is 0.80 MPa, then the reported information would be:

PCN 40 / F / B / 0.80 MPa / T

Example 4.— If a pavement is subject to a B747-400 all-up mass limitation of 390 000 kg, then the reported information would include the following note.

Note.— *The reported PCN is subject to a B747-400 all-up mass limitation of 390 000 kg.*

14.2.700 PRE-FLIGHT ALTIMETER CHECK LOCATION

14.2.703 One or more pre-flight altimeter check locations shall be established for an aerodrome.

14.2.706 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.*

14.2.709 The elevation of a pre-flight altimeter check location shall be given as the average elevation, rounded to the nearest metre, 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 of the average elevation for that location.

14.2.800 DECLARED DISTANCES

14.2.803 The following distances shall be calculated to the nearest metre for each runway intended for use for 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).

14.2.806 Recommendation.— Where a runway is not provided with a stopway or clearway and the threshold is located at the extremity of the runway, the declared distances should be equal to the length of the runway.

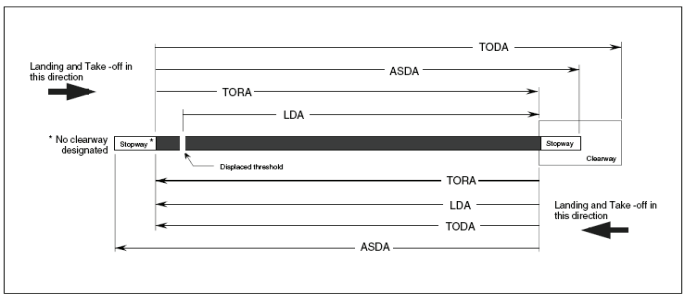
14.2.809 Where a runway is provided with a clearway, then the Take-off Distance Available shall include the length of the clearway as shown in Figure 2-1.

14.2.812 Where a runway is provided with a stopway, then the Accelerate-stop Distance Available shall include the length of the stopway as shown in Figure 2-1.

14.2.815 Where a runway has a displaced threshold, the Landing Distance Available shall be reduced by the distance between the displace threshold and the extremity of the runway as shown in Figure 2-1.

***Note**.— A displaced threshold effects only the LDA for approaches made to that runway. The declared distances for the reciprocal runway remain unaffected.*

Figure 2-1. Illustration of Declared Distances



14.2.900 CONDITION OF THE MOVEMENT AREA AND RELATED FACILITIES

14.2.903 Information on the condition of the movement area and the operational status of related facilities shall be provided to the appropriate aeronautical information service units, 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 and changes in conditions reported without delay.

14.2.906 The condition of the movement area and the operational status of related facilities shall be monitored and reports on matters of operational significance or affecting aircraft performance given, 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) standing - 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.

14.2.909 To facilitate compliance with 14.2.903 and 14.2.906 inspections of the movement area shall be carried out each day at least once where the code number is I or 2 and at least twice where the code number is 3 or 4.

***Note** – Guidance on carrying out daily inspections of the movement area is given in the ICAO Airport Services Manual, Part 8 and in the Manual of Surface Movement Guidance and Control Systems (SMGCS).*

14.2.912 Whenever water is present on a runway, a description of the runway surface conditions on the centre half of the width of the runway, including the possible assessment of water depth, where applicable, shall be made available using the following terms:

a) DAMP – the surface shows a change of colour due to moisture.

b) WET – the surface is soaked but there is no stagnant water.

c) WATER PATCHES – significant patches of standing water are visible.

d) FLOODED – extensive standing water is visible.

14.2.915 Information that a runway or portion thereof may be slippery when wet shall be made available.

14.2.918 A runway or portion thereof shall be determined as being slippery when wet when the measurements specified in 14.10.209 show that the runway surface friction characteristics as measured by a continuous friction measuring device are below the specified minimum friction level specified in Table A-1, Attachment A.

***Note**.— Guidance on determining and expressing the minimum friction level is provided in Attachment A, Section 5 .*

14.2.921 The minimum friction level specified in this Manual for different types of friction measuring devices shall be taken for reporting slippery runway conditions.

14.2.924 Recommendation.— when it is suspected that a runway may become slippery under unusual conditions, then additional measurements should be made when such conditions occur, and information on the runway surface friction characteristics made available when these additional measurements show that the runway or a portion thereof has become slippery.

14.2.1000 DISABLED AIRCRAFT REMOVAL

***Note**.— See 14.9.300 for information on disabled aircraft removal services.*

14.2.1003 The telephone/telex number(s) 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, to aircraft operators.

14.2.1006 Information concerning the capability to remove an aircraft disabled on or adjacent to the movement area shall be made available.

***Note**.— 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.*

14.2.1100 RESCUE AND FIRE FIGHTING

***Note**.— See 14.9.200 for information on rescue and fire fighting services.*

14.2.1103 Information concerning the level of protection provided at an aerodrome for aircraft rescue and fire fighting purposes shall be made available.

14.2.1106 The level of protection normally available at an aerodrome shall be expressed in terms of the category of the rescue and fire fighting services in accordance with Table 2-2 and in accordance with the types and amounts of extinguishing agents normally available at the aerodrome.

14.2.1109 Significant changes in the level of protection normally available at an aerodrome for rescue and fire fighting shall be notified to the appropriate air traffic services units and aeronautical information units 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.

Table 2-2. Aerodrome category for rescue and fire fighting

Aerodrome category	Aeroplane over all length	Maximum fuselage width
(1)	(2)	(3)
1	0 up to but not including 9 m	2 m
2	9 m up to but not including 12 m	2 m
3	12m 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
Note.— *To categorize the aeroplanes using the aerodrome, first evaluate their over-all length and, second, their fuselage width. If, after selecting the category appropriate to an aeroplanes over-all length, That aeroplane's fuselage width is greater than the maximum width in column 3 for that category, then the category for that aeroplane is actually on category higher.*		

Note.— *A significant change in the level of protection is considered to be a change in the category of the rescue and fire fighting service from the category normally available at the aerodrome, resulting from a change in availability of extinguishing agents, equipment to deliver the agents or personnel to operate the equipment, etc.*

14.2.1112 A significant change shall be expressed in terms of the new category of the rescue and fire fighting service available at the aerodrome.

14.2.1200 VISUAL APPROACH SLOPE INDICATOR SYSTEMS

14.2.1203 The following information concerning a visual approach slope indicator system installation shall be made available:

a) Associated runway designation number;

b) Type of system according to 14.5.3201. For 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 PAPI and an APAPI this shall be angle (B + C) ÷ 2 and (A + B) ÷ 2, respectively as in Figure 5-15; and

e) Minimum eye height(s) over the threshold of the on-slope signal(s). 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′.

14.2.1300 COORDINATION BETWEEN AERONAUTICAL INFORMATION SERVICES AND AERODROME OPERATORS

14.2.1303 To ensure that aeronautical information services units 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 aeronautical information services and aerodrome operators responsible for aerodrome services to report to the responsible aeronautical information services unit, with a minimum of delay:

a) Information on aerodrome conditions;

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.

14.2.1306 Before introducing changes to the air navigation system, due account shall be taken by the services responsible for such changes of the time needed by the aeronautical information service for the preparation, production and issue of relevant material for promulgation. To ensure timely provision of the information to the aeronautical information service, close coordination between those services concerned is therefore required.

14.2.1309 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 and Appendix D. The predetermined, internationally agreed AIRAC effective dates in addition to 14 days postage time shall be observed by the responsible aerodrome services when submitting the raw information/data to aeronautical information services.

14.2.1312 The aerodrome services responsible for the provision of raw aeronautical information/data to the aeronautical information services shall do that while taking into account accuracy and integrity requirements for aeronautical data as specified in Appendix E to this Manual.

Note.— *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.— *The schedule of the predetermined internationally agreed AIRAC common effective dates at intervals of 28 days, including 6 November 1997 and guidance for the AIRAC use are contained in the Aeronautical Information Services Manual (Doc 8126, Chapter 2).*

CHAPTER 3. PHYSICAL CHARACTERISTICS

14.3.100 RUNWAYS

Number and Orientation of Runways

Note.— *Many factors affect the determination, of the orientation, sitting 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.

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.

14.3.103 Recommendation.— The number and orientation of runways at an aerodrome should 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.

14.3.106 Recommendation.— The sitting and orientation of runways at aerodromes should, 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 Part 1 and in Guidance on the Balanced Approach to Aircraft Noise Management (Doc 9829)*

Choice of maximum permissible cross–wind components

14.3.109 Recommendation.— In the application of 14.3.103 it should be assumed that landing or take–off of aeroplanes is, in normal circumstances, precluded when the cross–wind component exceeds:

a) 37 km/h (20 kts) in the case of aeroplanes whose reference field length is 1500 m or over, except that when poor runway braking action owing to an insufficient longitudinal coefficient of friction is experienced with some frequency, a cross–wind component not exceeding 24 km/h (13 kt) should be assumed;

b) 24 km/h (13 kts) in the case of aeroplanes whose reference field length is 1 200 m or up to but not including 1 500 m; and

c) 19 km/h (10 kts) 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.*

Data to be used

14.3.112 Recommendation.— The selection of data to be used for the calculation of the usability factor should 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 should 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.*

Location of Threshold

14.3.115 A threshold shall normally be located at the extremity of a runway unless operational considerations justify the choice of another location.

14.3.118 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 should be available between the unserviceable area and the displaced threshold. Additional distance should also be provided to meet the requirements of the runway end safety area as appropriate.

Actual Length of Runways

Primary runway

14.3.121 Recommendation.— Except as provided in 14.3.127, the actual runway length to be provided for a primary runway should be adequate to meet the operational requirements of the aeroplanes for which the runway is intended and should 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.— *This specification does not necessarily mean providing for operations by the critical aeroplane at its maximum mass.*

Note.— *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.— *Local conditions that may need to be considered include elevation, temperature, runway slope, humidity and the runway surface characteristics.*

Note.— *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 ICAO Aerodrome Design Manual, Part 1.*

Secondary runway

14.3.124 Recommendation.— The length of a secondary runway should 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.

Runways with stopways or clearways

14.3.127 Recommendation.— Where a runway is associated with a stopway or clearway, an actual runway length less than that resulting from application of 14.3.121 or 14.3.124, as appropriate, may be considered satisfactory, but in such a case any combination of runway, stopway and clearway provided should 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.*

Width of Runways

14.3.130 The width of a runway shall be not less than the appropriate dimension specified in the following tabulation:

Code number	Code letter					
	A	B	C	D	E	F
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	60 m	60 m

a:— The width of a precision approach runway should be not less than 30 m where the code number is 1 or 2.

Note.— *The combinations of code numbers and letters for which widths are specified have been developed for typical aeroplane characteristics.*

Note.— *Factors affecting runway width are given in the Aerodrome Design Manual, Part 1.*

Minimum Distance Between Parallel Runways

14.3.133 Where parallel non-instrument runways are intended for simultaneous use, the minimum distance between their centre lines shall be:

a) 210 m where the higher code number is 3 or 4;

b) 150 m where the higher code number is 2; and

c) 120 m where the higher code number 1.

14.3.136 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:

a) 1 035 m for independent parallel approaches;

b) 915 m for dependent parallel approaches;

c) 760 m for independent parallel departures;

d) 760 m for segregated parallel operations;

except that:

a) for segregated parallel operations the specified separation 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) should 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 Doc 4444 may be applied when it is determined that such combinations would not adversely affect the safety of aircraft operations.

Slopes on runways

Longitudinal slopes

14.3.139 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:

a) 1 per cent where the code number is 3 or 4; and

b) 2 per cent where the code number is 1 or 2.

14.3.142 Along no portion of a runway shall the longitudinal slope exceed:

a) 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 should not exceed 0.8 per cent;

b) 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 should not exceed 0.8 per cent; and

c) 2 per cent where the code number is 1 or 2.

Longitudinal slope changes

14.3.145 Recommendation.— Where slope changes cannot be avoided, a slope change between two consecutive slopes should not exceed:

a) 1.5 per cent where the code number is 3 or 4; and

b) 2 per cent where the code number is 1 or 2.

Note.— *Guidance on slope changes before a runway is given in Attachment A, Section 3.*

14.3.148 Recommendation.— The transition from one slope to another should be accomplished by a curved surface with a rate of change not exceeding:

a) 0.1 per cent per 30 m (minimum radius of curvature of 30 000 m) where the code number is 4;

b) 0.2 per cent per 30 m (minimum radius of curvature of 15 000 m) where the code number is 3; and

c) 0.4 per cent per 30 m (minimum radius of curvature of 7 500 m) where the code number is 1 or 2.

Sight Distance

14.3.151 Recommendation.— Where slope changes cannot be avoided, they should be such that there will be an unobstructed line of sight from:

a) 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;

b) 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

c) 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.— *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 ICAO Aerodrome Design Manual, Part 1.*

Distance between slope changes

14.3.154 Recommendation.— Undulations or appreciable changes in slopes located close together along a runway should be avoided. The distance between the points of intersection of two successive curves should not be less than:

a) the sum of the absolute numerical values of the corresponding slope changes multiplied by the appropriate value as follows:

1) 30 000 m where the code number is 4;

2) 15 000 m where the code number is 3; and

3) 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 3.*

Transverse Slopes

14.3.157 Recommendation.— 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 should ideally be:

a) 1.5 per cent where the code letter is C, D, E or F; and

b) 2 per cent where the code letter is A or B;

but in any event should 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 runway surface, the transverse slope on each side of the centre line should be symmetrical.

Note.— *On wet runways with cross–wind conditions the problem of aquaplaning from poor drainage is apt to be accentuated.*

14.3.160 Recommendation.— The transverse slope should be substantially the same throughout the length of a runway except at an intersection with another runway or a taxiway where an even transition should be provided taking account of the need for adequate drainage.

Note.— *Guidance on transverse slope is given in the ICAO Aerodrome Design Manual, Part 3.*

Strength of runways

14.3.163 A runway shall be capable of withstanding the traffic of aeroplanes the runway is intended to serve.

Surface of runways

14.3.166 The surface of a runway shall be constructed without irregularities that would result in loss in friction characteristics or otherwise adversely affect the take–off or landing of an aeroplane.

Note.— *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.*

Note.— *Guidance on design tolerances and other information is given in Attachment A, Section 3. Additional guidance is included in the ICAO Aerodrome Design Manual, Part 3.*

14.3.169 The surface of a paved runway shall be so constructed as to provide good friction characteristics when the runway is wet.

14.3.172 Recommendation.— Measurements of the friction characteristics of a new or resurfaced runway should be made with a continuous friction measuring device using self–wetting features in order to assure that the design objectives with respect to its friction characteristics have been achieved.

Note.— *Guidance on friction characteristics of new runway surfaces is given in the ICAO Airport Services Manual, Part 2.*

14.3.175 Recommendation.— The average surface texture depth of a new surface should be not less than 1.0 mm.

Note.— *This normally requires some form of special surface treatment.*

Note.— *Guidance on methods used to measure surface texture is given in the ICAO Airport Services Manual, Part 2.*

14.3.178 Recommendation.— When the surface is grooved or scored, the grooves or scorings should be either perpendicular to the runway centre line or parallel to non–perpendicular transverse joints, where applicable.

Note.— *Guidance on methods for improving the runway surface texture is given in the ICAO Aerodrome Design Manual, Part 3.*

14.3.200 RUNWAY SHOULDERS

General

Note.— *Guidance on characteristics and treatment of runway shoulders is given in Attachment A, Section 6, and in the ICAO Aerodrome Design Manual, Part 2.*

14.3.203 Runway shoulders shall be provided for a runway where the code letter is D or E and the runway width is less than 60 m.

14.3.206 Runway shoulders shall be provided for a runway where the code letter is F.

Width of runway shoulders

14.3.209 The runway shoulders shall extend symmetrically on each side of the runway so that the over–all width of the runway and its shoulders is not less than:

a) 60 m where the code letter is D or E; and

b) 75 m where the code letter is F.

Slopes on runway shoulders

14.3.212 The surface of the shoulder that abuts the runway shall be flush with the surface of the runway and its transverse slope should not exceed 2.5 per cent.

Strength of runway shoulders

14.3.215 A runway shoulder 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.

14.3.300 RUNWAY TURN PADS

14.3.303 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 180 degree turn of aeroplanes.

14.3.306 Recommendation.— 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 should be provided to facilitate a 180-degree turn of aeroplanes.

14.3.309 Recommendation.— 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.

14.3.312 The intersection angle of the runway turn pad with the runway shall not exceed 30 degrees.

14.3.315 The nose wheel steering angle to be used in the design of the runway turn pad shall not exceed 45 degrees.

14.3.318 The design of a runway turn pad shall be such that, where the cockpit of the aeroplane for which the turn pad is intended remains over the turn pad marking, the clearance distance between any wheels of the aeroplane landing gears and the edge of the turn pad shall not be less than that given by the following tabulation:

Code letter	Clearance
A	1.5 m
B	2.25 m
C	3 m if the turn pad is intended to be used by aeroplane with a wheel base less than 18 m;
	4.5 m if the turn pad is intended to be used by aeroplanes with a wheelbase equal to or greater than 18 m;
D	4.5 m
E	4.5 m
F	4.5 m

***Note**: - wheel base means the distance from the nose gear to the geometric centre of the main gear.*

14.3.321 Recommendation.— Where severe weather conditions and resultant lowering of surface friction characteristics prevail, a larger wheel-to-edge clearance of 6 m should be provided where the code letter is E or F.

Slopes on runway turn pads

14.3.324 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.

Strength of runway turn pads

14.3.327 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.*

Surface of runway turn pads

14.3.330 The surface of a runway turn pad shall not have surface irregularities that may cause damage to an aeroplane using the turn pad.

14.3.333 The surface of a runway turn pad shall be so constructed as to provide good friction characteristics for aeroplanes using the facility when the surface is wet.

Shoulders for runway turn pads

14.3.336 Recommendation.— The runway turn pads should 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.

***Note**.— 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.*

14.3.339 Recommendation.— The strength of runway turn pad shoulders should 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.

14.3.400 RUNWAY STRIPS

General

14.3.403 A runway and any associated stopways shall be included in a strip.

Length of runway strips

14.3.406 A strip shall extend before the threshold and beyond the end of the runway or stopway for a distance of at least:

a) 60 m where the code number is 2, 3 or 4;

b) 60 m where the code number is 1 and the runway is an instrument one; and

c) 30 m where the code number is 1 and the runway is a non–instrument one.

Width of runway strips

14.3.409 A strip including a precision approach runway shall extend laterally to a distance of at least:

a) 150 m where the code number is 3 or 4; and

b) 75 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.

14.3.412 Recommendation.— A strip including a non–precision approach runway should extend laterally to a distance of at least:

a) 150 m where the code number is 3 or 4;

b) 75 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.

14.3.415 .—A strip including a non–instrument runway should 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:

a) 75 m where the code number is 3 or 4;

b) 40 m where the code number is 2; and

c) 30 m where the code number is 1.

Objects on runway strips

***Note**.— See 14.9.900 for information regarding siting and construction of equipment and installations on runway strips.*

14.3.418 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.

14.3.421 No object shall be permitted:

a) For a fixed object, other than visual aids required for air navigation purposes and satisfying the relevant frangibility requirement in Chapter 5, on a runway strip:

1) within 77.5 m of the runway centre line of a precision approach runway category I, II or III where the code number is 4 and the code letter is F; or

2) within 60 m of the runway centre line of a precision approach runway category I, II or III where the code number is 3 or 4; or

3) within 45 m of the runway centre line of a precision approach runway category I where the code number is 1 or 2.

b) For a mobile object, on this part of the runway strip during the use of the runway for landing or take–off except that equipment and radio equipped personnel associated with in-flight inspections of navigation and landing aids are permitted on a runway strip within graded areas while flight inspections are being carried out.

Grading of runway strips

14.3.424 That portion of a strip of an instrument runway within a distance of at least:

a) 75 m where the code number is 3 or 4;

b) 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.

14.3.427 That portion of a strip of a non–instrument runway within a distance of at least:

a) 75 m where the code number is 3 or 4;

b) 40 m where the code number is 2; and

c) 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.

14.3.430 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.

14.3.433 Recommendation.— That portion of a strip to at least 30 m before a threshold shall be prepared against blast erosion in order to protect a landing aeroplane from the danger of an exposed edge.

Slopes on runway strips

Longitudinal slopes

14.3.436 Recommendation.— A longitudinal slope along that portion of a strip to be graded should not exceed:

a) 1.5 per cent where the code number is 4;

b) 1.75 per cent where the code number is 3; and

c) 2 per cent where the code number is 1 or 2.

Longitudinal slope changes

14.3.439 Recommendation.— Slope changes on that portion of a strip to be graded should be as gradual as practicable and abrupt changes or sudden reversals of slopes avoided.

Transverse slopes

14.3.442 Recommendation.— Transverse slopes on that portion of a strip to be graded should be adequate to prevent the accumulation of water on the surface but should not exceed:

a) 2.5 per cent where the code number is 3 or 4; and

b) 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 should be negative as measured in the direction away from the runway and may be as great as 5 per cent.

14.3.445 Recommendation.— The transverse slopes of any portion of a strip beyond that to be graded should not exceed an upward slope of 5 per cent as measured in the direction away from the runway.

Strength of runway strips

14.3.448 Recommendation.— That portion of a strip of an instrument runway within a distance of at least:

a) 75 m where the code number is 3 or 4; and

b) 40 m where the code number is 1 or 2;

from the centre line of the runway and its extended centre line should 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, Part 1.*

14.3.451 Recommendation.— That portion of a strip containing a non-instrument runway within a distance of at least:

a) 75 m where the code number is 3 or 4;

b) 40 m where the code number is 2; and

c) 30 m where the code number is 1;

from the centre line of the runway and its extended centre line should 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.

Drainage ditches

14.3.454 Drainage ditches, shall not be located within the graded portion of the strip. Where drainage ditches are located at the edge of the graded area, they shall be contoured in order to reduce structural damage in the event an aeroplane overruns the ditch:

a) Earth displaced by contouring of ditch sides, particularly on the side nearest the runway, should not significantly alter the transverse slopes;

b) Open ditches should have a side slope of 4 units of horizontal measure to 1 unit of vertical measure;

c) Open ditches should be graded and sodded for erosion control and ease of maintenance.

14.3.500 RUNWAY END SAFETY AREAS

14.3.503 A runway end safety area shall be provided at each end of a runway strip where:

a) the code number is 3 or 4;

b) the code number is 1 or 2 and the runway is a instrument one.

Dimensions of runway end safety areas

14.3.506 A runway end safety area shall extend from the end of a runway strip to a distance of at least 90 m.

14.3.509 Recommendation.— A runway end safety area should, as far as practicable, extend from the end of a runway strip to a distance of at least:

a) 240 m where the code number is 3 or 4; and

b) 120 m where the code number is 1 or 2.

14.3.512 The width of a runway end safety area should be at least twice that of the associated runway.

14.3.515 Recommendation.— The width of a runway end safety area should, wherever practicable, be equal to that of the graded portion of the associated runway strip.

Objects on runway end safety areas

Note.— *See 14.9.900 for information regarding siting and construction of equipment and installations on runway end safety areas.*

14.3.518 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.

Clearing and grading of runway end safety areas

14.3.521 Recommendation.— A runway end safety area should 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.

Note.— *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, 14.3.533*

Slopes on runway end safety areas

General

14.3.524 Recommendation.— The slopes of a runway end safety area should be such that no part of the runway end safety area penetrates the approach or take–off climb surface.

Longitudinal slopes

14.3.527 Recommendation.— The longitudinal slopes of a runway end safety area should not exceed a downward slope of 5 per cent. Longitudinal slope changes should be as gradual as practicable and abrupt changes or sudden reversals of slopes avoided.

Transverse slopes

14.3.530 Recommendation.— The transverse slopes of a runway end safety area should not exceed an upward or downward slope of 5 per cent. Transitions between differing slopes should be as gradual as practicable.

Strength of runway end safety areas

14.3.533 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 and facilitate the movement of rescue and fire fighting vehicles as required in 14.9.242 to 14.9.248.

14.3.600 CLEARWAYS

Note.— *The inclusion of detailed specifications for clearways in this section is not intended to imply that a clearway has to be provided.*

Location of clearways

14.3.603 Recommendation.— The origin of a clearway should be at the end of the take–off run available.

length of clearways

14.3.606 The length of a clearway shall not exceed half the length of the take –off run available.

width of clearways

14.3.609 A clearway shall extend laterally to a distance of at least 75 m on each side of the extended centre line of the runway.

Slopes on clearways

14.3.612 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.

Note.— *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.*

14.3.615 Recommendation.— Abrupt upward changes in slope should 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 should generally conform with those of the runway with which the clearway is associated.

objects on clearways

Note.— *See 14.9.900 for information regarding siting and construction of equipment and installations on clearways.*

14.3.618 An object situated on a clearway which may endanger aeroplanes in the air shall be regarded as an obstacle and should be removed.

14.3.700 STOPWAYS

Note.— *The inclusion of detailed specifications for stopways in this section is not intended to imply that a stopway has to be provided.*

width of stopways

14.3.703 A stopway shall have the same width as the runway with which it is associated.

slopes on stopways

14.3.706 Slopes and changes in slope on a stopway, and the transition from a runway to a stopway, shall comply with the specifications of 14.3.136 to 14.3.154 for the runway with which the stopway is associated except that:

a) the limitation in 14.3.139 (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 30 m (minimum radius of curvature of 10 000 m) for a runway where the code number is 3 or 4.

Strength of stopways

14.3.709 A stopway shall be prepared or constructed so as to be capable, in the event of an abandoned take–off, of supporting the aircraft which the stopway is intended to serve without inducing structural damage to the aircraft.

Note.— *Attachment A, Section 2 presents guidance relative to the support capability of a stopway.*

Surface of stopways

14.3.712 The surface of a paved stopway shall be so constructed as to provide a good coefficient of friction when the stopway is wet.

14.3.715 The friction characteristics of an unpaved stopway shall not be substantially less than that of the runway with which the stopway is associated.

14.3.800 RADIO ALTIMETER OPERATING AREA

14.3.803 Recommendation.— A radio altimeter operating area should be established in the pre-threshold area of a precision approach runway.

Length of the area

14.3.806 Recommendation.— A radio altimeter operating area should extend before the threshold for a distance of at least 300 m.

Width of the area

14.3.809 Recommendation.— A radio altimeter operating area should 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.

Longitudinal slope changes

14.3.812 Recommendation.— On a radio altimeter operating area, slope changes should be avoided or kept to a minimum. Where slope changes cannot be avoided, the slope changes should be as gradual as practicable and abrupt changes or sudden reversals of slopes avoided. The rate of change between two consecutive slopes should not exceed 2 per cent per 30 m.

Note.— *Guidance on radio altimeter operating area is given in Attachment A, Section 3.3 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 III, Chapter 21.*

14.3.900 TAXIWAYS

Note.— *Unless otherwise indicated the requirements in this section are applicable to all types of taxiways.*

General

14.3.903 Recommendation - Taxiways should be provided to permit the safe and expeditious surface movement of aircraft.

Note.— *Guidance on layout of taxiways is given in the ICAO Aerodrome Design Manual, Part 2.*

14.3.906 Recommendation.— Sufficient entrance and exit taxiways for a runway should 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.

14.3.909 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 should be not less than that given by the following tabulation:

Code letter	Clearance
A	1.5 m
B	2.25 m
C	3 m if the taxiway is intended to be used by aeroplanes with a wheel base less than 18 m; 4.5 m if the taxiway is intended to be used by aeroplanes with a wheel base equal to or greater than 18 m.
D	4.5 m
E	4.5 m
F	4.5 m

Note.— *Wheel base means the distance from the nose gear to the geometric centre of the main gear.*

Note.— *Where the code letter is F and the traffic density is high, a wheel-to-edge clearance greater than 4.5 m may be provided to permit higher taxing speeds.*

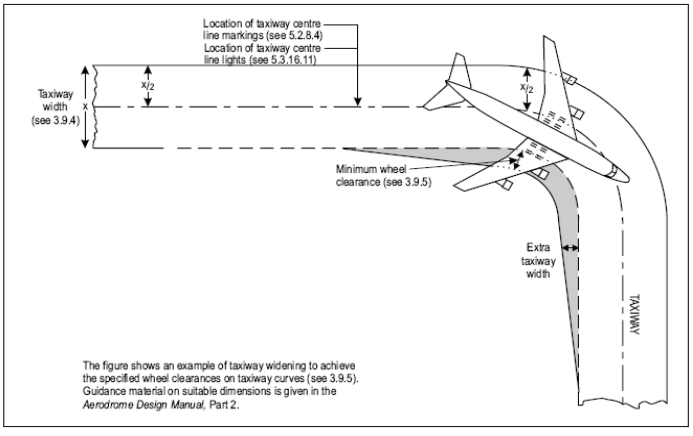
14.3.912 Reserved

Width of taxiways

14.3.915 A straight portion of a taxiway shall have a width of not less than that given by the following tabulation:

Code letter	Taxiway width
A	7.5 m
B	10.5 m
C	15 m if the taxiway is intended to be used by aeroplanes with a wheel base less than 18 m; 18 m if the taxiway is intended to be used by aeroplanes with a wheel base equal to or greater than 18 m.
D	18 m if the taxiway is intended to be used by aeroplanes with an outer main gear wheel span of less than 9 m; 23 m if the taxiway is intended to be used by aeroplanes with an outer main gear wheel span equal to or greater than 9 m.
E	23 m
F	25 m

Figure 3-1. Taxiway Curve



Taxiway curves

14.3.918 Recommendation.— Changes in direction of taxiways should be as few and small as possible. The radii of the curves should be compatible with the manoeuvring capability and normal taxiing speeds of the aeroplanes for which the taxiway is intended. The design of the curve should 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 should not be less than those specified in 14.3.909.

Note.— *An example of widening taxiways to achieve the wheel clearance specified is illustrated in Figure 3–1. Guidance on the values of suitable dimensions is given in the ICAO Aerodrome Design Manual, Part 2.*

Note.— *The location of taxiway centre line markings and lights is specified in 14.5.2138 and 14.5.3486.*

Note.— *Compound curves may reduce or eliminate the need for extra taxiway width.*

Junctions and intersections

14.3.921 Recommendation.— To facilitate the movement of aeroplanes, fillets should be provided at junctions and intersections of taxiways with runways, aprons and other taxiways. The design of the fillets should ensure that the minimum wheel clearances specified in 14.3.915 are maintained when aeroplanes are manoeuvring through the junctions or intersections.

Note.— *Guidance on the design of fillets is given in the ICAO Aerodrome Design Manual, Part 2.*

Taxiway minimum separation distances

14.3.924 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.

Code letter	Distance between taxiway centreline 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 object (metres)
	Instrument runways				Non-instrument runways						
	Code number				Code number						
	1	2	3	4	1	2	3	4			
(1)	(2)				(3)				(4)	(5)	(6)
A	82.5	82.5	-	-	37.5	47.5	-	-	23.75	16.25	12
B	87	87	-	-	42	52	-	-	33.5	21.5	16.5
C	-	-	168	-	-	-	93	-	44	26	24.5
D	-	-	176	176	-	-	101	101	66.5	40.5	36
E	-	-	-	182.5	-	-	-	107.5	80	47.5	42.5
F	-	-	-	190	-	-	-	115	97.5	57.5	50.5

Note.— *Guidance on factors which may be considered in the aeronautical study is given in the Aerodrome Design Manual, part 2.*

Note.— *ILS installation may also influence the location of taxiways due to interferences to ILS signals by a taxiing or stopped aircraft. Information on critical and sensitive areas surrounding ILS installations is contained in Annex 10, Volume I, Attachments C and G (respectively).*

Note.— *The separation distances of Table 3- 1, column 4 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 ICAO Aerodrome Design Manual, Part 2.*

Note.— *The separation distance between the centre line of an aircraft stand taxilane and an object shown in table 3-1, column 12, may need to be increased when jet exhaust wake velocity may cause hazardous for ground servicing.*

Slopes on taxiways

Longitudinal slopes

14.3.927 Recommendation.— The longitudinal slope of a taxiway should not exceed:

a) 1.5 per cent where the code letter is C, D, E or F; and

b) 3 per cent where the code letter is A or B.

Longitudinal slope changes

14.3.930 Recommendation.— Where slope changes on a taxiway cannot be avoided, the transition from one slope to another slope should be accomplished by a curved surface with a rate of change not exceeding:

a) 1 per cent per 30 m (minimum radius of curvature of 3000 m) where the code letter is C, D, E or F; and

b) 1 per cent per 25 m (minimum radius of curvature of 2500 m) where the code letter is A or B.

Sight distance

14.3.933 Recommendation.— Where a change in slope on a taxiway cannot be avoided, the change should be such that, from any point:

a) 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;

b) 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

c) 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.

Transverse slopes

14.3.936 Recommendation.— The transverse slopes of a taxiway should be sufficient to prevent the accumulation of water on the surface of the taxiway but should not exceed:

a) 1.5 per cent where the code letter is C, D, E or F; and

b) 2 per cent where the code letter is A or B.

Note.— *See 14.3.1312 regarding transverse slopes on an aircraft stand taxilane.*

Strength of taxiways

14.3.939 Recommendation.— The strength of a taxiway should be at least equal to that of the runway it serves, due consideration being given to the fact that a taxiway will be 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.

Note.— *Guidance on the relation of the strength of taxiways to the strength of runways is given in the ICAO Aerodrome Design Manual, Part 3.*

Surface of taxiways

14.3.942 The surface of a taxiway shall not have irregularities that may cause damage to aeroplane structures.

14.3.945 The surface of a paved taxiway should be so constructed as to provide good friction characteristics when the taxiway is wet.

14.3.1000 TAXIWAY SHOULDERS

General

Note.— *Guidance on characteristics of taxiway shoulders and on shoulder treatment is given in the ICAO Aerodrome Design Manual, Part 2.*

14.3.1003 Recommendation.— Straight portions of a taxiway where the code letter is C, D, E or F should be provided with shoulders which extend symmetrically on each side of the taxiway so that the over–all width of the taxiway and its shoulders on straight portions is not less than:

a) 60 m where the code letter is F;

b) 44 m where the code letter is E;

c) 38 m where the code letter is D; and

d) 25 m where the code letter is C.

On taxiway curves and on junctions or intersections where increased pavement is provided, the shoulder width should be not less than that on the adjacent straight portions of the taxiway.

14.3.1006 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.

14.3.1100 TAXIWAY STRIPS

Note.— *Guidance on characteristics of taxiway strips is given in the ICAO Aerodrome Design Manual, Part 2.*

General

14.3.1103 A taxiway, other than an aircraft stand taxilane, shall be included in a strip.

Width of taxiway strips

14.3.1106 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 5.

Objects on taxiway strips

Note.— *See 14.9.900 for information regarding siting and construction of equipment and installations on taxiway strips.*

14.3.1109 The taxiway strip should provide an area clear of objects which may endanger taxiing aeroplanes.

Note.— *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.*

Grading of taxiway strips

14.3.1112 Recommendation.— The centre portion of a taxiway strip should provide a graded area to a distance from the centre line of the taxiway of at least:

a) 11 m where the code letter is A;

b) 12.5 m where the code letter is B or C;

c) 19 m where the code letter is D; and

d) 22 m where the code letter is E.

e) 30 m where the code letter is F.

Slopes on taxiway strips

14.3.1115 Recommendation.— The surface of the strip should be flush at the edge of the taxiway or shoulder, if provided, and the graded portion should not have an upward transverse slope exceeding:

a) 2.5 per cent for strips of taxiways where the code letter is C, D, E or F; and

b) 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 downwards transverse slope should not exceed 5 per cent measured with reference to the horizontal.

14.3.1118 Recommendation.— The transverse slopes on any portion of a taxiway strip beyond that to be graded should not exceed an upward slope of 5 per cent as measured in the direction away from the taxiway.

14.3.1200 RUNWAY HOLDING POSITIONS, INTERMEDIATE HOLDING POSITION AND ROAD–HOLDING POSITIONS

Application

14.3.1203 A runway holding position or positions shall be established:

a) on the taxiway, at an intersection of a taxiway with a runway;

b) at an intersection of a runway with another runway when the former runway is part of a standard taxi–route; and

14.3.1206 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.

14.3.1209 Recommendation.— An intermediate holding position should be established on a taxiway at any point other than a runway-holding position where it is desirable to define a specific holding limit.

14.3.1212 A road–holding position shall be established at an intersection of a road with a runway.

Location

14.3.1215 The distance between runway-holding position established at a taxiway/runway intersection or road-holding position and the centre line of a runway shall be not less than the appropriate dimension specified in 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.

14.3.1218 Recommendation.— At elevations greater than 700 m the distance of 90 m specified in Table 3-2 for a precision approach runway code number 4 should be increased as follows:

a) up to an elevation of 2 000 m; 1 m for every 100 m in excess of 700 m;

b) elevation in excess of 2 000 m and up to 4 000 m; 13 m plus 1.5 m for every 100 m in excess of 2 000 m; and

c) elevation in excess of 4 000 m and up to 5 000 m; 43 m plus 2 m for every 100 m in excess of 4 000 m.

14.3.1221 Recommendation.— If a 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 of 90 m or 107.5 m, as appropriate, specified in Table 3-2 of this chapter should be further increased 5 m for every metre the bay or position is higher than the threshold.

14.3.1224 The location of a runway-holding position established in accordance with paragraph 14.3.1206 of this Manual shall be such that a holding aircraft or vehicle will not infringe the obstacle free zone, approach surface, take-off climb surface or ILS critical/ sensitive area or interfere with the operation of radio navigation aids.

Table 3-2 Minimum distance from the runway centre line to a runway holding position, or road-holding position

Type of Runway	CODE NUMBER 1	2	3	4
Non-instrument approach	30 m	40 m	75 m	75 m
Non precision approach	40 m	40 m	75 m	75 m
Precision approach Cat I	60 m (1)	60 m (1)	90 m (1)	90 m (1)
Precision approach Cat II and III	-----	-----	90 m (1)	90 m (1)
Take-off Runway	30 m	40 m	75 m	75 m

Note 1.—*This distance shall not be closer than the ILS/MLS critical/sensitive area.*

Note 2.— *The distance of 90m where the code number is 3 or 4, is based on an aeroplane with a tail height of 20m, a distance from the nose to the highest part of the tail of 52.7m and a nose height of 10m holding at an angle of 45 degrees or more with respect to the runway centre line, being clear of the obstacle free zone and not accountable for the calculation of obstacle clearance for instrument approach procedures.*

Note 3.— *The distance of 60m where the code number 2 is based on an aeroplane with a tail height of 8m, a distance from the nose to the highest part of the tail of 24.6 and a nose height of 5.2m holding at an angle of 45 degrees or more with respect to the runway centre line, being clear of the obstacle free zone.*

14.3.1227 The distance between a road–holding position and the centre line of a runway shall be not less than the appropriate dimension specified in Table 3–2, and in the case of a precision approach runway, such that a holding vehicle will not interfere with the operation of radio navigation aids.

14.3.1230 Recommendation.— Where vehicles hold at other than a runway threshold on a frequent or recurring basis for the purpose of crossing runways, the distance between the road holding position and the centre line of a runway should not be less than the appropriate dimensions specified in Table 3-3.

Table 3-3. Minimum distance from the runway centre line to a frequently used runway holding position or road-holding position not located at the runway threshold

Type of Runway	Code Number 1	2	3	4
Non-instrument approach	75 m	75 m	115 m	115 m
Non precision approach	75 m	75 m	115 m	115 m
Precision approach Cat I	90 m (1)	90 m (1)	115 m (1)	115 m (1)
Precision approach Cat II and III	-----	-----	115 m	115 m (1)
Take-off Runway A	30 m	40 m	105 m (1)	105 m
B	75 m	75 m	115 m	115 m

A—For take-off runways only, runway holding positions or road-holding positions established beyond the runway departure end up to and including the mid-point of the runway.

B—For take-off runways only, runway holding positions or road holding positions established beyond the departure runway mid-point to the end of the runway.

Note 1.— This distance shall not be closer than the ILS/MLS critical/sensitive area.

14.3.1300 APRONS

General

14.3.1303 Aprons shall be provided 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.

Size of aprons

14.3.1306 Recommendation.— The total apron area should be adequate to permit expeditious handling of the aerodrome traffic at its maximum anticipated density.

Strength of aprons

14.3.1309 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.

Slopes on aprons

14.3.1312 Recommendation.— Slopes on an apron, including those on an aircraft stand taxilane, should be sufficient to prevent accumulation of water on the surface of the apron but should be kept as level as drainage requirements permit.

14.3.1315 Recommendation.— On an aircraft stand the maximum slope should not exceed 1 per cent.

14.3.1318 Recommendation.— Aprons should not slope toward any building. If such a slope is unavoidable, special measures should be taken to reduce the fire hazard posed by spilled flammable liquids.

Clearance distances on apron and aircraft stands

14.3.1321 Recommendation.— An aircraft stand should provide the following minimum clearances between an aircraft using 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

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:

a) between the terminal, including any fixed passenger bridge, and the nose of an aircraft; and

b) 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.*

14.3.1400 ISOLATED AIRCRAFT PARKING POSITION

Application

14.3.1403 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.

Location

14.3.1406 The isolated aircraft parking position shall be located at least 100 m from other parking positions, buildings, or public use areas.

14.3.1409 Recommendation.— The isolated aircraft parking position should be located at the maximum distance practicable from other parking positions, buildings, or public areas, etc. Care should 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.

CHAPTER 4. OBSTACLE RESTRICTION AND REMOVAL

Note.— *The objectives of the specifications in this chapter are;*

a) to define the airspace around aerodromes to be maintained free from obstacles in order to minimize the dangers presented by obstacles to an aircraft, either during an entirely visual approach or during the visual segment of an instrument approach; and

b) to prevent the aerodrome from becoming unusable by the growth of obstacles around the aerodrome.

These objectives are achieved by establishing a series of obstacle limitation surfaces that define the limits to which objects may project into the airspace.

14.4.100 OBSTACLE LIMITATION SURFACES

The following civil airport imaginary surfaces are established with relation to the airport and to each runway. The size of each such imaginary surface is based on the category of each runway according to the type of approach available or planned for that runway. The slope and dimensions of the approach surface applied to each end of a runway are determined by the most precise approach existing or planned for that runway end. (see Figure 4-1)

Note *1.— Obstacle limitation surfaces normally extend beyond the boundary of the aerodrome Such surfaces are protected by the enactment of the specific aerodrome zoning regulations issued in accordance with article 44 of the Aeronautical Code and Decree Law 18/2009 of June 22nd. Such regulations prohibit the erection of any new structure which would violate any of the defined surfaces.*

Note *2.— Objects which project into 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. Criteria for evaluating obstacles are contained in Procedures for Air Navigation Service – Aircraft Operations (PANS-OPS) (Doc 8168)*

Note *3.— The establishment of, and requirements for, an obstacle protection surface for visual approach slope indicator systems are specified in 14.5.3264 to 14.5.3276.*

Outer horizontal surface

Characteristics

14.4.103 The limits of an outer surface shall comprise a common plane established at a constant elevation of 150 m above the assigned elevation of the aerodrome reference point and extending from the upper edge of the conical surface over a specified distance measured from the designated aerodrome reference point and extending horizontally 360° about the aerodrome.

Conical surface

14.4.106 Conical surface. A surface extending upwards and outwards at a slope of 20 to 1 from the periphery of the inner horizontal surface, the perimeter of which is constructed by swinging arcs of calculated radii measured from points located at the interception of the each runway centreline with the inner edge of each corresponding approach surface and connecting the adjacent arcs by lines tangent to those arcs.

Characteristics

14.4.109 Standard. — 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, at the interception with the outer horizontal surface.

14.4.112 The slope of the conical surface shall be measured in a vertical plane perpendicular to the periphery of the inner horizontal surface.

Inner horizontal surface

Characteristics

14.4.115 Inner horizontal surface. A surface located in a horizontal plane established at a constant elevation of 45 m above the assigned elevation of the aerodrome reference point, the perimeter of which is constructed by swinging arcs of specified radii measured from points located at the interception of the each runway center line with the inner edge of each corresponding approach surface and connecting the adjacent arcs by lines tangent to those arcs.

Note:— *Guidance on determining the elevation datum is contained in the ICAO Airport Services Manual, Part 6.*

Approach surface

14.4.118 Approach surface. An inclined plane or combination of planes preceding the threshold.

Characteristics

14.4.121 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 extended centre line of the runway; and

c) an outer edge parallel to the inner edge.

14.4.124 The elevation of the inner edge shall be equal to the elevation of the mid-point of the threshold.

14.4.127 The slope(s) of the approach surface shall be measured in the vertical plane containing the centre line of the runway and shall be of a constant gradient.

Inner approach surface

14.4.130 Inner approach surface. A rectangular portion of the approach surface immediately preceding the threshold.

Characteristics

14.4.133 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.

Transitional surface

14.4.136 Transitional surface. 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.

Characteristics

14.4.139 The limits of the 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.

14.4.142 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.

Note *– 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.*

14.4.145 The slope of a transitional surface shall be measured in a vertical plane at right angles to the centre line of the runway.

Inner transitional surface

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 be penetrated except for frangible objects. The transitional surface described in paragraph 14.4.136 of this Manual is intended to remain as the controlling obstacle limitation surface for buildings, etc.*

14.4.148 Inner transitional surface - A surface similar to the transitional surface but closer to the runway.

Characteristics

14.4.151 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.

14.4.154 — 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.

Note *– As a result of b), the inner 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 inner transitional surface with the inner horizontal surface will also be a curved or a straight line depending on the runway profile.*

14.4.157 The slope of inner transitional surface shall be measured in a vertical plane at right angles to the centre line of the runway.

Balked landing surface

14.4.160 Balked landing surface. An inclined plane located at a specified distance after the threshold, extending between the inner transitional surfaces.

Characteristics

14.4.163 The limits of the balked landing surface shall comprise:

a) an inner edge horizontal and perpendicular to the centre line of the runway and location 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.

14.4.166 The elevation of the inner edge shall be equal to the elevation of the runway centre line at the location of the inner edge.

14.4.169 The slope of the balked landing surface shall be measured in the vertical plane containing the centre line of the runway.

Take-off climb surface

14.4.172 Take-off climb surface. An inclined plane or other specified surface beyond the end of a runway or clearway.

Characteristics

14.4.175 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

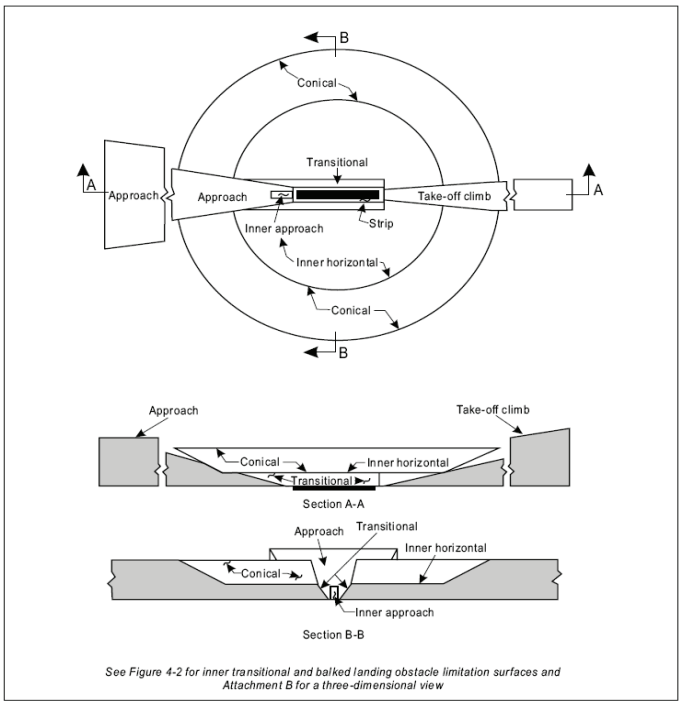
c) an outer edge horizontal and perpendicular to the specified takeoff track.

14.4.178 The elevation of the inner edge shall be equal to the highest point on the 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.

14.4.181 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.

14.4.184 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 normal to its centre line, and the slope of the centre line shall be the same as that for a straight take-off flight path.

Figure 4-1. Obstacle Limitation Surfaces



See Figure 4-2 for inner transitional and balked landing obstacle limitation surfaces and Attachment B for a three-dimensional view

14.4.200 OBSTACLE LIMITATION REQUIREMENTS

Note.— *The requirements for obstacle limitation surfaces are specified on the basis of the intended use of a runway, i.e. type of approach and take–off or landing, and are intended to be applied when such use is made of the runway. In case 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.*

Non-instrument runways

14.4.203 The following obstacle limitation surfaces shall be established for all non–instrument runways:

– conical surface;

– inner horizontal surface;

– approach surface; and

– transitional surfaces.

14.4.206 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 of this manual.

14.4.209 New objects or extensions of existing objects shall not be permitted above an approach or transitional surface except when, in the opinion of the certifying 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 ICAO Airport Services Manual, Part 6.*

14.4.212 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 certifying 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 aircraft.

14.4.215 Recommendation.— Existing objects above any of the surfaces required by 14.4.203 should 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.

Note.— *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.*

14.4.218 Recommendation.— In considering proposed construction, account should be taken of the possible future development of an instrument runway and consequent requirement for more stringent obstacle limitation surfaces.

Non–precision approach runways

14.4.221 The following obstacle limitation surfaces shall be established for all non–precision approach runway:

– conical surface;

– inner horizontal surface;

– approach surface; and

– transitional surfaces.

14.4.224 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 14.4.227).

Table 4-1. Dimensions and Slopes of Obstacle Limitation Surfaces
Approach Runways

Surface and Dimensions [a] (in meters and percentages)	RUNWAY TYPE / CODE NUMBER									
	Non-instrument				Instrument					
					Non-precision approach			Precision approach category		
								I		II or III
	Code number				Code number			Code number		Code number
	1	2	3	4	1 & 2	3	4	1 & 2	3 & 4	3 & 4
OUTER HORIZONTAL Height (m) Radius (m)						150 15 000	150 15 000		150 15 000	150 15 000
CONICAL Slope (%) Height (m)	5 35	5 55	5 75	5 100	5 60	5 75	5 100	5 60	5 100	5 100
INNER HORIZONTAL Height (m) Radius (m)	45 2 000	45 2 500	45 4 000	45 3 500	45 4 000	45 4 000	45 3 500	45 4 000	45 4 000	45 4 000
INNER APPROACH Width (m) Distance from threshold (m) Length (m) Slope (%)	— — — —	— — — —	— — — —	— — — —	— — — —	— — — —	— — — —	90 60 900 2.5	120 [e] 60 900 2	120[e] 60 900 2

APPROACH										
Length of inner edge (m)	60	80	150	150	150	300	300	150	300	300
Distance from threshold (m)	30	60	60	60	60	60	60	60	60	60
Divergence (each side) (%)	10	10	10	15	15	15	15	15	15	15
First section										
Length (m)	1 600	2 500	3 000	3 000	2 500	3 000	3 000	3 000	3 000	3 000
Slope (%)	5	4	3.33	2.5	3.33	2	2	2.5	2	2
Second section										
Length (m)	—	—	—	—	—	3 600 [b]	3 600 [b]	12 000	3 600 [b]	3 600
Slope (%)	—	—	—	—	—	2.5	2.5	3	2.5	2.5
Horizontal section										
Length (m)	—	—	—	—	—	8 400 [b]	8 400 [b]	—	8 400 m[b]	8 400 [b]
Total length (m)	—	—	—	—	—	15 000	15 000	15 000	15 000 m	15 000
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 (m)	—	—	—	—	—	—	—	90	120 [e]	120 [e]
Distance from threshold (m)	—	—	—	—	—	—	—	[c]	1 800 [d]	1 800 [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 paragraph 14.4.227 or 14.4.251 of this Manual).

c. Distance to the end of strip.

d. Or end of runway whichever is less.

e. Where the code letter is F (Column (3) of Table 3-1 of this Manual), the width is increased to 155 m.

14.4.227 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.

14.4.230 New objects or extensions of existing objects shall not be permitted above approach surface within 3 000 m of the inner edge or above a transitional surface except when, in the opinion of the certifying 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 ICAO Airport Services Manual, Part 6.*

14.4.233 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 certifying 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 aircraft.

14.4.236 Recommendation.— Existing objects above any of the surfaces required by 14.4.221 should as far as practicable be removed except when, in the opinion of the certifying 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 aircraft.

Note.— *Because of transverse or longitudinal slopes on a strip, in certain cases the inner edge or portions of the inner edge of 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.*

Precision approach runways

Note.— *See 14.9.900 for information regarding siting and construction of equipment and installations on operational areas.*

14.4.239 The following obstacle limitation surfaces shall be established for a precision approach runway category I:

– outer horizontal surface

– conical surface;

– inner horizontal surface;

– approach surface; and

– transitional surfaces.

14.4.242 The following obstacle limitation surfaces shall be established for a precision approach runway category I, when so directed by the Authority:

– inner approach surface;

– inner transitional surfaces; and

– balked landing surface.

14.4.245 The following obstacle limitation surfaces shall be established for a precision approach runway category II or III.

– outer horizontal surface;

– conical surface;

– inner horizontal surface;

– approach surface and inner approach surface;

– transitional surfaces;

– inner transitional surfaces; and

– balked landing surface.

14.4.248 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 14.4.251).

14.4.251 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.

14.4.254 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.

14.4.257 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 certifying 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 ICAO Airport Services Manual, Part 6.*

14.4.260 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 certifying 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 aircraft.

14.4.263 Recommendation.— Existing objects above an approach surface, a transitional surface, the conical surface and the inner horizontal surface should as far as practicable be removed except when, in the opinion of the certifying 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 aircraft.

Note.— *Because of transverse or longitudinal slopes on a strip or clearway, 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 or clearway. 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 aircraft.*

Runway meant for take-off

14.4.266 The following obstacle limitation surface shall be established for a runway meant for take-off:

– take-off climb surface.

14.4.269 The dimension of the surface shall be not less than the dimensions specified in Table 4-2 of this Manual, except that a lesser length may be adopted or the take-off climb surface where such lesser length would be consistent with procedural measures adopted to govern the outward flight of aeroplanes.

14.4.272 The operational characteristics of aeroplanes for which the runway is intended should be examined to see if it is desirable to reduce the slope specified in Table 4-2 of this Manual when critical operating conditions are to be catered to. If the specified slope is reduced, corresponding adjustment in the length of take-off climb surface should be made so as to provide protection to a height of 300 m.

Table 4-2 – Dimensions and slopes of obstacle limitation surfaces

Surface and dimensions[a]	Code number		
	1	2	3 or 4
TAKE-OFF CLIMB			
Length of inner edge (m)	60	80	180
Minimum Distance from runway end (m) [b]	30	60	60
Divergence (each side) (%)	10	10	12.5
Final width (m)	380	580	1 200 1 800 [c]
Overhaul Length (m)	1 600	2 500	15 000
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 intended track includes changes of heading greater than 15° for operations conducted in IMC, VMC by night.

14.4.275 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.

Note – *Circumstances in which the shielding principle may reasonably be applied are described in the ICAO Airport Services Manual, Part 6.*

14.4.278 Recommendation.— If no object reaches the 2 per cent (1:50) take-off climb surface, new objects should be limited to preserve the existing obstacle free surface or a surface down to a slope of 1.6 per cent (1:62.5).

14.4.281 Recommendation.— Existing objects that extend above a take-off climb surface should 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 of aeroplane operations.

Note – *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 it is intended that terrain or objects, which are above the take-off, climb surface beyond the end of the strip of clearway, but below the level of the strip or clearway, be removed unless it is considered that my endanger aeroplanes. Similar considerations apply at the junction of a clearway and strip where differences in transverse slopes exist.*

14.4.300 OBJECTS OUTSIDE THE OBSTACLE LIMITIATION SURFACES

General

14.4.303 No object shall be erected to penetrate the obstacle limitation surfaces, as specified in Table 4-1, or as specifically determined by the Authority in the applicable aerodrome zoning regulations, without the permission of the Authority.

14.4.306 Recommendation.— In areas beyond the limits of the obstacle limitation surfaces, at least those objects that extend to a height of 150 m or more above ground elevation should be regarded as obstacles, unless a special aeronautical study indicate that they do not constitute a hazard to operations.

Note *– The study may have regard to the nature of operations concerned and may distinguish between day and night operations.*

14.4.400 OTHER OBJECTS

General

14.4.403 Recommendation.— 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.

14.4.406 Recommendation.— Anything which in the opinion of the certifying authority after aeronautical study, endanger aircraft on the movement area or in the air within the limits of the inner horizontal and conical surfaces should be regarded as an obstacle and should be removed in so far as practicable.

Note*.— In certain circumstances, objects that do not project above any of the surfaces enumerated in 14.4.100 may constitute a hazard to aircraft as, for example, where there are one or more isolated objects in the vicinity of aerodrome.*

14.4.500 AERODROME OBSTACLE CHART

Type A Charts

14.4.503 The Type A chart is an ICAO chart which identifies information on all significant obstacles within the take-off area of an aerodrome up to 10 km from the end of the runway.

14.4.506 A Type A chart shall be prepared for each runway that is used in international operations.

14.4.509 The obstacle data to be collected and the manner of presentation of the Type A chart shall be in accordance with the standards and procedures set out in ICAO Annex 4.

Note*: A Type A chart meeting the accuracy requirements of Annex 4 is adequate.*

14.4.512 Where no significant obstacle exists within the take-off flight path area, as specified by Annex 4, a Type A chart is not required but a statement shall be included in the Aerodrome Manual.

14.4.515 At aerodromes with no international operations, used by aircraft above 5,700 kg engaged in air transport operations, the decision to prepare Type A charts, or discrete obstacle information instead of a Type A chart, is a matter for the aerodrome operator to be made in conjunction with the relevant airline.

14.4.518 Where a Type A chart has been prepared, or updated, a copy of the chart shall be given to the Authority.

14.4.521 Where a Type A chart has been prepared and issued the take-off flight area shall be monitored and any changes to the Type A chart information shall immediately be communicated to all users of the Type A chart.

Aerodrome Obstacle Charts

Notes*: 1: Changes to the Type A chart information but not to OLS takeoff climb surface does not require NOTAM action.*

Note *2: Where the change to Type A chart information is also the subject of NOTAM action, additional separate advice to Type A chart holders is not necessary.*

14.4.524 A distribution list of current Type A chart holders shall be maintained.

14.4.527 A Type A chart shall be updated when the number of changes to the chart, notified through NOTAM or separate advice, reaches a level, which the Authority considers excessive.

Type B Charts

14.4.530 A Type B chart is an ICAO obstacle chart that provides obstacle data around the aerodrome.

14.4.533 Recommendation. A Type B chart, prepared in accordance with the standards and procedures set out in Annex 4, should be provided.

Note*: This may be required by operators of aircraft above 5,700 kg to identify obstacles around an aerodrome.*

14.4.536 The decision to prepare a Type B chart shall be made in consultation with the Auhtority.

14.4.539 Where required, the obstacle data to be collected and the manner of presentation of the Type B chart shall be in accordance with the standards and procedures set out in ICAO Annex 4.

Type C Charts

14.4.542 A Type C chart is an ICAO obstacle chart that provides data on all significant obstacles up to 45 km from the aerodrome. International aircraft operators may require this chart.

14.4.545 For aerodromes regularly used by aircraft engaged in international aviation, the decision to prepare a Type C chart must be made in consultation with the international aircraft operators and the Authority.

14.4.548 Where prepared, the Type C charts may be produced using one of the following methods:

a) a complete Type C chart in accordance with the standards and procedures set out in ICAO Annex 4; or

b) based on an actual survey meeting the order of accuracy requirements of Annex 4, produce a list containing all significant obstacles above a nominal obstacle height; or

c) based on topographical maps, where available, meeting the order of accuracy requirements of Annex 14, produce a list containing all significant obstacles above a nominal obstacle height.

CHAPTER 5. VISUAL AIDS FOR NAVIGATION

14.5.100 INDICATORS AND SIGNALLING DEVICES

Wind direction indicators

Application

14.5.103 An aerodrome shall be equipped with at least one wind direction indicator.

Location

14.5.106 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.

14.5.109 Recommendation.— Aerodromes with runways greater than 1200 m should have a wind direction indicator located at each end of the runway at a point approximately 60 m outwards from the runway edge and approximately 150 m inwards from the approach end.

Note*.— Where runways intersect near the threshold or where parallel runways are separated by 180 m or less between centre lines, one wind direction indicator may be suitably located to serve both runways.*

14.5.112 Recommendation.— Aerodromes with runways 1200 m or less in length should have a wind direction indicator centrally located on the aerodrome except that at aerodromes with only one runway the wind direction indicator should be centrally located along the runway and approximately 60 m from the edge.

Note*.— If a location near the apron would be of greater value to the pilot in selecting the runway for takeoff at locations where airport advisory service is not provided such a site may be selected in lieu of the centre of the aerodrome or runway complex. In such cases, the possible effects of buildings causing false wind indications need to be considered.*

Characteristics

14.5.115 The height of wind direction indicators shall not exceed a height of 7.5 m when located in the runway strip.

14.5.118 The wind direction indicator shall be in the form of a truncated cone made of fabric and should 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 should 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 should 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, should be used. Where a

combination of two colours is required to give adequate conspicuity against changing backgrounds, they should preferably be orange and white, red and white, or black and white, and should be arranged in five alternate bands, the first and last bands being the darker colour.

14.5.121 Recommendation.— The location of at least one wind direction indicator should be marked by a circular band 15 m in diameter and 1.2 m wide. The band should be centred about the wind direction indicator support and should be in a colour chosen to give adequate conspicuity, preferably white.

14.5.124 Provision shall be made for illuminating at least one wind indicator at an aerodrome intended for use at night.

Signalling lamp

Application

14.5.127 A signalling lamp shall be provided at a controlled aerodrome in the aerodrome control tower.

Characteristics

14.5.130 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 should be made of the restricted boundary of green as specified in Appendix A, 2.1.2.

14.5.133 Recommendation.— The beam spread should 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 should be not less than 6 000 cd.

14.5.200 MARKINGS

General

Interruption of runway markings

14.5.203 At an intersection of two (or more) runways the marking 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.

14.5.206 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.

14.5.209 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 14.5.2141 regarding the manner of connecting runway and taxiway centre line markings.*

Colour

14.5.212 Runway markings shall be white.

14.5.215 Taxiway markings, runway turn pad markings and aircraft stand markings shall be yellow.

14.5.218 Apron safety lines shall be of a conspicuous colour which shall contrast with that used for aircraft stand markings.

Note.— It is preferable that the risk of uneven friction characteristics on markings be reduced in so far as practical by the use of a suitable kind of paint.

Note.— *Where it is necessary to increase the visibility of a parking area boundary line, a red line equal in width may be painted on the apron side of the white line, thus reinforcing that the parking of vehicles and/or equipment beyond the line, is prohibited.*

14.5.221 Recommendation.— At aerodromes where operations take place at night, pavement markings should be made with reflective materials designed to enhance the visibilities of the markings.

Unpaved taxiways

14.5.224 Recommendation.— An unpaved taxiway should be provided, so far as practicable, with the markings prescribed for paved taxiways.

Runway designation markings

Application

14.5.227 A runway designation marking shall be provided at the threshold of a paved runway.

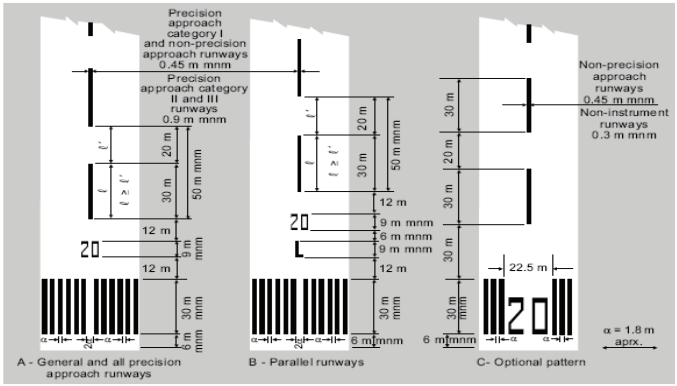
14.5.230 Recommendation.— A runway designation marking should be provided, so far as practicable, at the threshold of an unpaved runway.

Location

14.5.233 A runway designation marking shall be located at a threshold as shown in Figure 5–1 as appropriate.

Note.— *If the runway threshold is displaced from the extremity of the runway, a location sign showing the designation of the runway may be provided for aeroplanes taking off.*

Figure 5-1. Runway designation, centre line and threshold markings



Characteristics

14.5.236 A runway designation marking shall consist of a two–digit number and on parallel runways shall be supplemented with a letter. 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.

14.5.239 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:

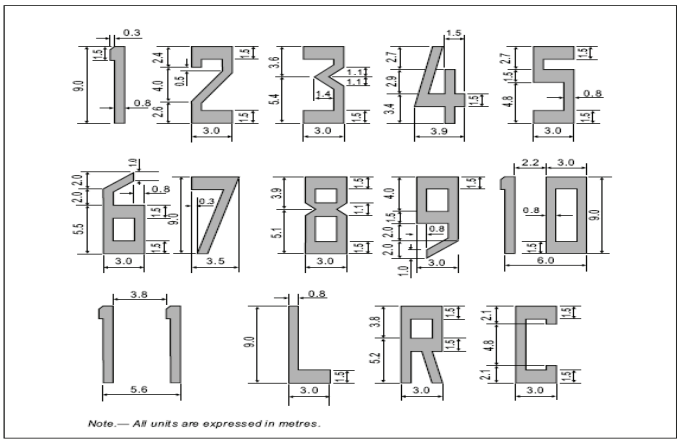
– for two parallel runways: "L" "R";

– for three parallel runways: "L" "C" "R";

– for four parallel runways: "L" "R" "L" "R"

14.5.242 The numbers and letters shall be in the form and proportion shown in Figure 5–2. The dimensions shall be not less than those shown in Figure 5–2, 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. Form and proportion of numbers and letters for runway designation markings



Runway centre line marking

Application

14.5.245 A runway centre line marking shall be provided on a paved runway.

Location

14.5.248 A runway centre line marking shall be located along the centre line of the runway between the runway designation markings as shown in Figure 5–1, except when interrupted in compliance with 14.5.203.

Characteristics

14.5.251 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 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.

14.5.254 The width of the stripes shall be not less than:

- 0.9 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 no-precision approach runways where the code number is 1 or 2, and on non-instrument runways.

Threshold marking

Application

14.5.257 A threshold marking shall be provided at the threshold of a paved runway where the width is 23 m or greater.

14.5.260 Recommendation.— A threshold marking should be provided at the threshold of a paved runway where the width is less than 23 m.

14.5.263 Recommendation.— A threshold marking should be provided, so far as practicable, at the thresholds of an unpaved runway.

Location

14.5.266 The stripes of the threshold marking shall commence 6 m from the threshold.

Characteristics

14.5.269 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 5–1 (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

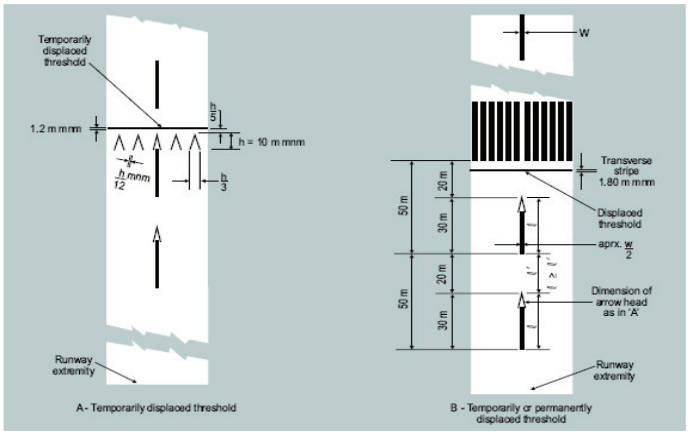
except that on non-precision approach and non-instrument runways 45m or greater in width, they may be as shown in Figure 5-1 (C).

14.5.272 The stripes shall extend laterally to within 3 m of the edge the 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.

Transverse stripe

14.5.275 Where a threshold is displaced from the extremity of a runway or where the extremity of a runway is not square with the centre line, a transverse stripe as shown in Figure 5–3 (B) shall be added to the threshold marking.

Figure 5-3. Displaced Runway Threshold Markings



Note.— *Where the threshold is displaced for only a short period of time, it has been found satisfactory to use flags and/or cones of a conspicuous colour to mark the threshold location when painting is not practicable.*

14.5.278 A transverse stripe shall be not less than 1.80 m wide.

Arrows

14.5.281 Where a runway threshold is permanently displaced arrows conforming to Figure 5–3 (B) shall be provided on the portion of the runway before the displaced threshold.

14.5.284 When a runway threshold is temporarily displaced from the normal position, it shall be marked as shown in Figure 5–3 (A) or (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, markers in the form and colour of a of a displaced threshold marking may be used, 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 14.7.103 shall be provided.*

Aiming point marking

Note.— *Aiming point markings were previously described as fixed distance markings.*

Application

14.5.287 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.

14.5.290 Recommendation.— An aiming point marking should be provided at each approach end of:

- a paved non-instrument runway where the code number is 3 or 4,
- a paved instrument runway where the code number is 1, when additional conspicuity of the aiming point is desirable.

Location

14.5.293 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.

Table 5-1. Location and Dimensions of the Aiming Point Marking

Location and Dimensions	Landing distance available			
	Less than 800 m	800 m up to but not including 1 200 m	1 200 m up to but not including 2 400 m	2 400 m and above
Distance from threshold to beginning of marking	150 m	250 m	300 m	400 m
Length of stripe [a]	30 - 45 m	30 - 45 m	45 - 60 m	45 - 60 m
Width of stripe	4 m	6 m	6 - 10 m[b]	6 - 10 m[b]
Lateral spacing between inner sides of stripes	6 m	9 m	18 - 22.5 m	18 - 22.5 m

a. The greater dimensions of the specified ranges are intended to be used where increased conspicuity is required
b. The lateral spacing may be varied within these limits to minimize the contamination of the marking by rubber deposits.

Characteristics

14.5.296 An aiming point marking shall consist of two conspicuous stripes. The dimensions of the stripes and the lateral spacing between their inner sides should be in accordance with the provisions of the appropriate column of Table 5–1. Where the touchdown zone marking is provided , the lateral spacing between the markings shall be the same as that of the touchdown zone marking.

Touchdown zone marking

Application

14.5.299 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.

14.5.2102 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.

Location and characteristics

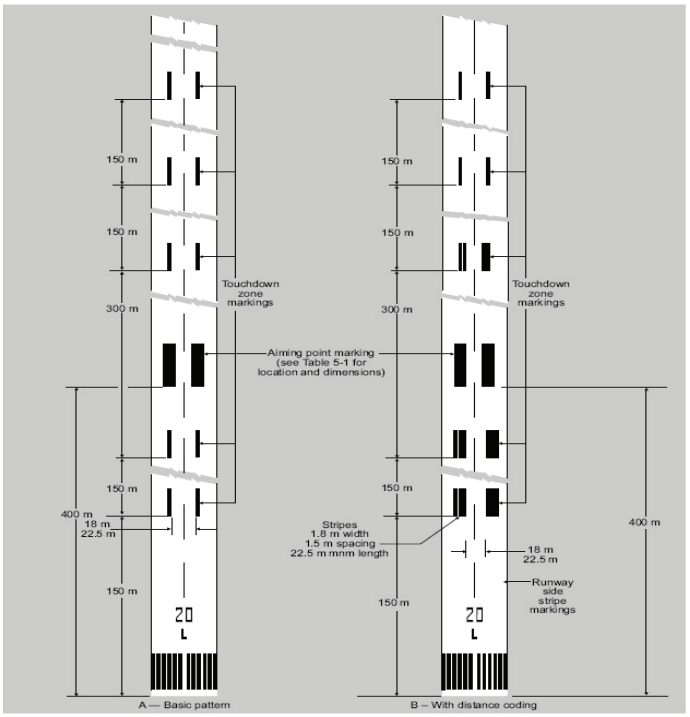
14.5.2105 A touchdown zone marking shall consist of pairs of rectangular markings symmetrically disposed about the runway centre line with the number of such pairs related to the landing distance available and, where the marking is to be displayed at both the approach directions of a runway, the distance 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

14.5.2108 A touchdown zone marking shall conform to the pattern shown in Figure 5–4. The markings shall not be less than 22.5 m long and 3 m wide. Each stripe of each marking shall be not less than 22.5 m long and 1.8 m wide with spacing of 1.5 m between adjacent stripes. 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 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. The pairs of markings shall be provided at longitudinal spacing 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.

14.5.2111 Recommendation.— Where operationally necessary, an additional pair of touchdown zone marking stripes should be provided on a code 2 runway, 150 m beyond the beginning of the aiming point marking.

Figure 5-4. Aiming point and touchdown zone markings



Runway side stripe marking

Application

14.5.2114 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.

14.5.2117 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.

Location

14.5.2120 A runway side stripe marking shall consist of two stripe, one placed along each edge of the runway with the outer edge of each strip approximately on the edge of the runway, except that, where the runways is greater than 60 m in width, the strip is shall be located 30 m from the runway centre line.

14.5.212326 Recommendation.— Where the runway turn pad is provided , the runway side strip marking should be continued between the runway and the runway turn pad.

Characteristics

14.5.2126 A runway side stripe shall have an over–all width of at least 0.9 m on runways 30 m or more in width and at least 0.45 m on narrower runways.

Taxiway centre line marking

Application

14.5.2129 A taxiway centre line marking shall be provided on a paved taxiway and apron where the code number is 3 or 4 in such a way as to provide guidance from the runway centre line to a point on the apron where aircraft stand markings.

14.5.2132 Recommendation.— Taxiway centre line markings should be provided on a paved taxiway and apron where the code number is 1 or 2 in such a way as to provide guidance from the runway centre line to the point on the apron where aircraft stand markings.

14.5.2135 Taxiway centre line marking shall be provided on a paved runway when the runway is part of a standard taxi route, and where the taxiway centre line is not coincident with the runway centre line.

Location

14.5.2138 On a straight section of 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 14.3.918 and Figure 3–1.*

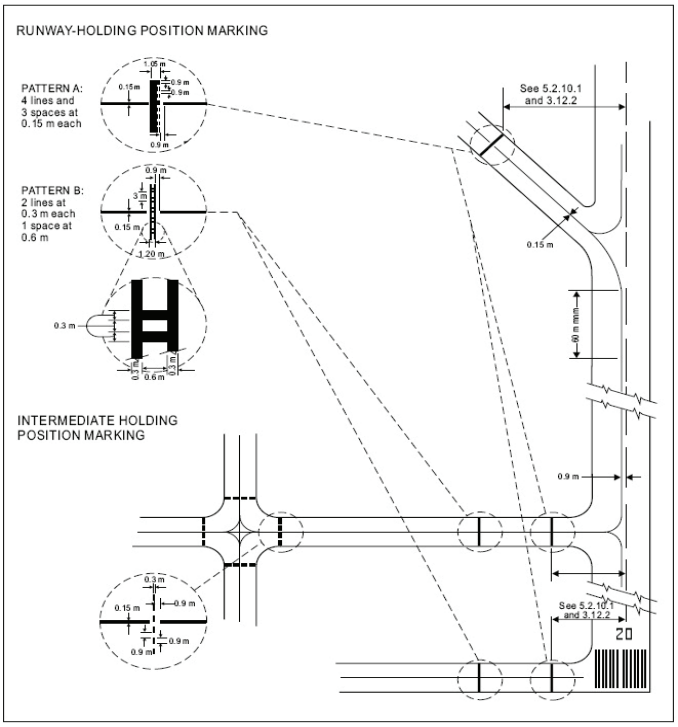
14.5.2141 Recommendation.— At an intersection of a taxiway with a runway where the taxiway serves as an exit from the runway, the taxiway centre line marking should be curved into the runway centre line marking as shown in Figure 5–5. The taxiway centre line marking should be extended parallel to the 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.

14.5.2144 Recommendation.— Where a taxiway centre line marking is provided on a runway in accordance with 14.5.2135, the marking should be located on the centre of the designated taxiway.

Characteristics

14.5.2147 A taxiway centre line marking shall be at least 15 cm in width and continuous in length except where it intersects a runway–holding position marking or an intermediate holding position marking as shown in Figure 5-5.

Figure 5-5. Taxiway Markings



Runway turn pad marking

Application

14.5.2150 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.

Location

14.5.2153 Recommendation.— The runway turn pad marking should be curved from the runway centre line into the turn pad. The radius of the curve should 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 should not be greater than 30 degrees.

14.5.2156 Recommendation.— The runway turn pad marking should 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.

14.5.2159 Recommendation.— A runway turn pad marking should 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 should be parallel to the outer edge of the runway turn pad.

14.5.2162 Recommendation.— The design of the curve allowing the aeroplane to negotiate a 180-degree turn should be based on a nose wheel steering angle not exceeding 45 degrees.

14.5.2165 Recommendation.— The design of the turn pad marking should 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 should be not less than those specified in 14.3.318.

Characteristics

14.5.2168 A runway turn pad marking shall be at least 15 cm in width and continuous in length.

Runway-holding positions marking

Application

14.5.2171 A runway–holding position marking shall be displayed along a runway-holding position.

Location

14.5.2174 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 5–5, pattern A.

14.5.2177 Where a single runway–holding position is provided at an intersection of a taxiway and a precision approach runway category I, II or III, the runway–holding position marking shall be as shown in Figure 5–5, pattern A. Where two or three runway–holding positions are provided at such an intersection, the runway–holding position marking closest to the runway shall be as shown in Figure 5–5, pattern A and the markings furthest from the runway shall be as shown in Figure 5–5, pattern B.

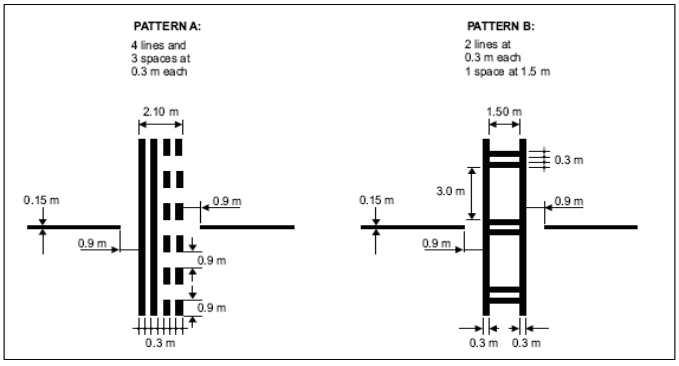
14.5.2180 The runway-holding position marking displayed at a runway-holding position established in accordance with 14.3.1206 shall be as shown in Figure 5-5, pattern A.

14.5.2183 Recommendation.— Where increased conspicuity of the runway-holding position is required, the runway-holding position marking should be as shown in Figure 5-6, pattern A or pattern B, as appropriate.

14.5.2186 Recommendation.— 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 should 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 should be not less than 1.8 m high and should be placed not more than 0.9 m beyond the holding position marking.

14.5.2189 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 5–6, pattern A.

Figure 5-6. Runway-holding position markings



Intermediate holding position marking

Application and location

14.5.2192 Recommendation.— An intermediate holding position marking should be displayed along an intermediate holding position.

14.5.2195 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.

Characteristics

14.5.2198 An intermediate holding position marking shall consist of a single broken line as shown in Figure 5-5.

VOR Aerodrome check-point marking

Application

14.5.2201 When a VOR aerodrome check-point is established, it shall be indicated by a VOR aerodrome check-point marking and sign.

Note.— *Guidance on the selection of sites for VOR aerodrome check-points is given in Annex 10, Volume I, Attachment E.*

Location

14.5.2204 A VOR aerodrome check-point marking shall be centred on the spot at which an aircraft is to be parked to receive the correct VOR signal.

Characteristics

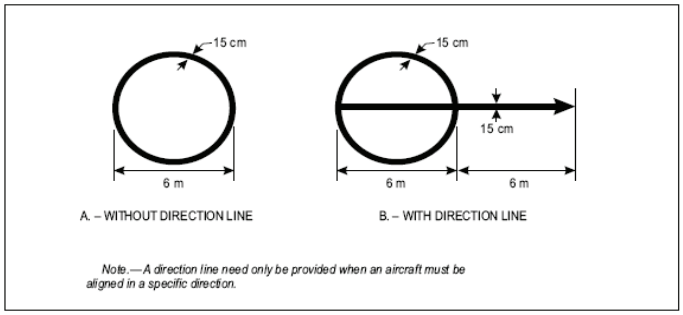
14.5.2207 A VOR aerodrome check-point marking shall consist of a circle 6 m in diameter and have a line width of 15 cm (see Figure 5-7 (A)).

14.5.2210 Recommendation.— When it is preferable for an aircraft to be aligned in a specific direction, a line should be provided that passes through the centre of the circle on the desired azimuth. The line should extend 6 m outside the circle in the desired direction of heading and terminate in an arrowhead. The width of the line should be 15 cm (see Figure 5-7 (B)).

14.5.2213 Recommendation.— A VOR aerodrome checkpoint marking should preferably be white in colour but should differ from the colour used for the taxiway markings.

Note.— *To provide contrast, markings may be bordered with black.*

Figure 5-7. VOR aerodrome check-point marking



Aircraft stand markings

Application

14.5.2216 Recommendation.— Aircraft stand markings should be provided for designated parking positions on a paved apron.

Location

14.5.2219 Recommendation.— Aircraft stand markings should be located so as to provide the clearances specified in 14.3.1321 when the nose wheel follows the stand marking.

Characteristics

14.5.2222 Recommendation.— Aircraft stand markings should 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.

14.5.2225 Recommendation.— An aircraft stand identification marking (letter and/or number) should be included in the lead–in line a short distance after the beginning of the lead–in line. The height of the identification should be adequate to be readable from the cockpit of aircraft using the stand.

14.5.2228 Recommendation.— 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 should 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 should be added to the stand identification.

Note. *— Example: 2A – B747, 2B – F28*

14.5.2231 Recommendation.— Lead–in, turning and lead–out lines should 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 should be continuous for the most demanding aircraft and broken for other aircraft.

14.5.2234 Recommendation.— The curved portions of lead–in, turning and lead–out lines should have radii appropriate to the most demanding aircraft type for which the markings are intended.

14.5.2237 Recommendation.— Where it is intended that an aircraft proceed in one direction only, arrows pointing in the direction to be followed should be added as part of the lead–in and lead–out lines.

14.5.2240 Recommendation.— A turn bar should 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 should 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.

14.5.2243 Recommendation.— If more than one turn bar and/or stop line is required, they should be coded.

14.5.2246 Recommendation.— An alignment bar should 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 should have a width of not less than 15 cm.

14.5.2249 Recommendation.— A stop line should be located at right angles to the alignment bar, abeam the left pilot position at the intended point of stop. It should 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.*

Apron safety lines

Application

14.5.2252 Apron safety lines shall be provided on a paved apron as required by the parking configurations and ground facilities.

Location

14.5.2255 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.

Characteristics

14.5.2258 Recommendation.— Apron safety lines should include such elements as wing tip clearance lines and service road boundary lines as required by the parking configurations and ground facilities.

14.5.2261 Recommendation.— An apron safety line should be continuous in length and at least 10 cm in width.

14.5.2264 An apron safety line shall not be coloured red where an aircraft will cross the line (eg. vehicle corridors).

Apron passenger path lines

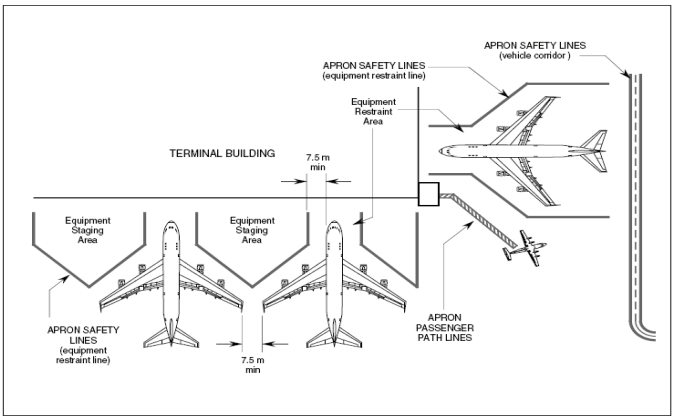
Application

14.5.2267 Recommendation.— Where passengers are required to walk on an apron between the aircraft stand and the passenger terminal, apron passenger path line markings should be provided.

Location

14.5.2270 Recommendation.— The apron passenger path line markings should be located such that they provide continuous guidance from the edge of the apron to the entry door position of the aircraft for which the aircraft stand is normally intended to serve.

Figure 5-8. Examples of apron safety lines and passenger path lines



Characteristics

14.5.2273 Recommendation.— Apron passenger path line markings should not cross aircraft stand markings, aircraft stand taxilane markings, or taxiway markings.

14.5.2276 Recommendation.— Apron passenger path line markings should consist of two parallel lines with diagonal hatching between them giving a zebra stripe appearance.

Note.— *It has been found acceptable to paint parallel lines spaced approximately 2 m apart with hatching at 450 angle to the parallel lines. The hatching is spaced at 1 m intervals. The individual lines are 150 mm wide.*

Road-holding position marking

Application

14.5.2279 A road–holding position marking shall be provided at all road entrances to a runway.

Location

14.5.2282 The road–holding position marking shall be located across the road at the holding position.

Characteristics

14.5.2285 The road–holding position marking shall be in accordance with the local traffic regulations.

Mandatory instruction marking

Application

14.5.2288 Where it is impracticable to install a mandatory instruction sign in accordance with the 14.5.436, a mandatory instruction marking shall be provided on the surface of the pavement. the information should be conveyed through an information marking.

14.5.2291 Recommendation.— Where operationally required, such as on taxiways exceeding 60 m in width, a mandatory instruction sign should be supplemented by a mandatory instruction marking.

Location

14.5.2294 The mandatory instruction marking shall be located on the left-hand side of the taxiway centre line marking and on the holding side of the runway-holding position marking as show in Figure 5-9. 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.

14.5.2297 Recommendation.— Except where operationally required, a mandatory instruction marking should not be located on a runway.

Characteristics

14.5.2300 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.

14.5.2303 A NO ENTRY marking shall consist of an inscription in white reading NO ENTRY on a red background.

14.5.2306 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.

14.5.2309 Recommendation.— The character height should be 4 m. The inscriptions should be in the form and proportions shown in Appendix C.

14.5.2312 Recommendation.— The background should be rectangular and extend a minimum of 0.5 m laterally and vertically beyond the extremities of the inscription.

Information marking

Application

14.5.2315 Where an information sign would normally be installed and is impractical to install, as determined by Authority, an information marking shall be displayed on the surface of the pavement.

14.5.2318 Recommendation.— Where operationally required an information sign should be supplemented by an information marking.

14.5.2321 Recommendation.— An information (location/ direction) marking should 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.

14.5.2324 Recommendation.— An information (location) marking should be displayed on the pavement surface at regular intervals along taxiways of great length.

Location

14.5.2327 Recommendation.— The information marking should 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.

Characteristics

14.5.2330 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.

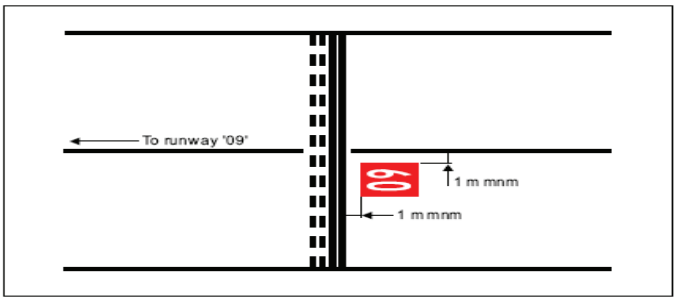
14.5.2333 Where there is insufficient contrast between the marking background and the pavement surface, the marking shall include:

a) a black border where the inscriptions are in black; and

b) a yellow border where the inscriptions are in yellow.

14.5.2336 Recommendation.— The character height should be 4 m. The inscriptions should be in the form and proportions shown in Appendix C.

Figure 5-9. Mandatory instruction marking



14.5.300 LIGHTS

General

Lights which may endanger the safety of aircraft

14.5.303 A non–aeronautical ground light near an aerodrome which might endanger the safety of aircraft shall be extinguished, screened or otherwise modified so as to eliminate the source of danger.

Laser emissions may endanger the safety of aircraft

14.5.306 Recommendation.— To protect the safety of aircraft against the hazardous effects of laser emitters, the following protected zones should be established around aerodromes:

– a laser-beam free flight zone (LFFZ),

– a laser-beam critical flights zone (LCFZ), and

– a laser-beam sensitive flight zone.

Note.— *Figures 5-10 and 5-11 may be used to determine the exposure levels and distances that adequately protects flights operations.*

Note.– *The restrictions in the use of laser beams in the three protected flight zones, LFFZ, LCFZ and LSFZ, refer to visible laser beams only. Laser emitters operated by the authorities in a manner compatible with flight safety are excluded. In all navigable air space, the irradiance level of any laser beam, visible or invisible, is expected to be less than or equal to the maximum permissible exposure (MPE).*

Note.– *The protected flight zones are established in order to mitigate the risks of operating laser emitters in the vicinity of aerodromes.*

Note.– *Further guidance on how to protect flight operations from the hazardous effects of laser emitters is contained in the ICAO Manual on Laser Emitters and Flights Safety (ICAO Doc 5815).*

Note.– *See also ICAO Annex 11 – Air Traffic Services, Chapter 2.*

Figure 5-10. Protected flight zones

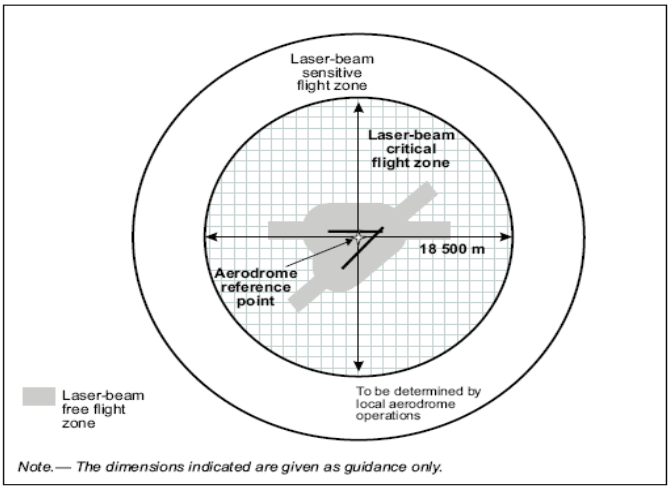
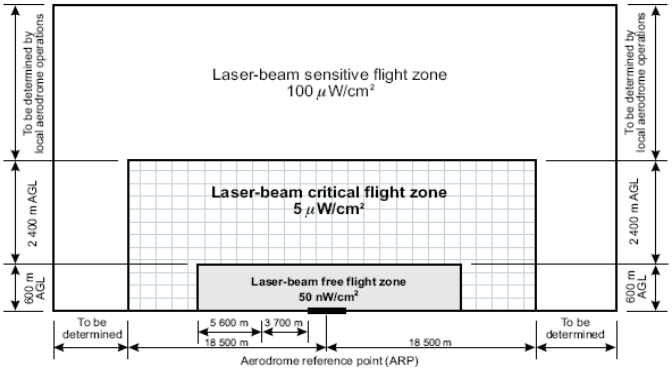


Figure 5-11. Protected flight zones with indication of maximum irradiance levels for visible laser beams



Lights which may cause confusion

14.5.309 Recommendation.— A non-aeronautical ground light which, by reason of its intensity, configuration or colour, might prevent, or cause confusion in, the clear interpretation of aeronautical ground lights should be extinguished, screened or otherwise modified so as to eliminate such a possibility. In particular, attention should be directed to a non–aeronautical ground light visible from the air within the areas described hereunder:

a) Instrument runway — code number 4:

within the areas before the threshold and beyond the end of the runway extending at least 4 500 m in length from the threshold and runway end and 750 m either side of the extended runway centre line in width.

b) Instrument runway — code number 2 or 3:

as in a), except that the length should be at least 3 000 m.

c) Instrument runway — code number 1;

and non-instrument runway:

within the approach area.

Aeronautical ground lights which may cause confusion to mariners

Note.— *In the case of aeronautical ground lights near navigable waters, consideration needs to be given to ensuring that the lights do not cause confusion to mariners.*

Light fixtures and supporting structures

Note.— *See 14.9.900 for information regarding siting and construction of equipment and installations on operational areas, and the ICAO Aerodrome Design Manual, Part 4 for guidance on frangibility of light fixtures and supporting structures.*

Elevated approach lights

14.5.312 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 weight of 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 surrounding objects shall be frangible.

14.5.315 An elevated approach light fixture shall not penetrate an obstacle limitation surface.

14.5.318 When an approach light fixture or supporting structure is not in itself sufficiently conspicuous, it shall be suitably marked.

Elevated lights

14.5.321 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.

Surface lights

14.5.324 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.

14.5.327 Recommendation.— The temperature produced by conduction or radiation at the interface between an installed inset light and an aircraft tire should not exceed 160ºC during a 10 minute period of exposure.

Note.— *Guidance on measuring the temperature of inset lights is given in the ICAO Aerodrome Design Manual, Part 4.*

Light intensity and control

Note.— *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.*

14.5.330 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.

Note.— *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.*

14.5.333 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 and wing bar lights;
- runway end lights;
- runway centre line lights;
- runway touchdown zone lights; and
- taxiway centre line lights.

14.5.336 On the perimeter of and within the ellipse defining the main beam in Appendix B, Figures B-1 to B-10, the maximum light intensity value shall not be greater than three times the minimum light intensity value measured in accordance with Appendix B, collective notes for Figures B-1 to B-11, Note 2.

14.5.339 On the perimeter of and within the rectangle defining the main beam in Appendix B, Figures B-12 to B-17, the maximum light intensity value shall not be greater than three times the minimum light intensity value measured in accordance with Appendix B, collective notes for Figures B-12 to B-18, Note 2.

Emergency lighting

Application

14.5.342 Recommendation.— At an aerodrome provided with runway lighting and without a secondary power supply, sufficient emergency lights should 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.*

Location

14.5.345 Recommendation.— When installed on a runway the emergency lights should, as a minimum, conform to the configuration required for a non–instrument runway.

Characteristics

14.5.348 Recommendation.— The colour of the emergency lights should 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.

Aerodrome beacon

Application

14.5.351 An aerodrome beacon shall be provided at each aerodrome intended for use at night, except when, in special circumstances, the beacon is considered by the Authority as unnecessary upon determination that it is not required by one or more of the following conditions:

a) the aerodrome is located on or near a frequently used night VFR route.

b) the aerodrome is frequently used by aircraft navigating visually during periods of reduced visibility.

c) it is difficult to locate the aerodrome from the air due to surrounding lights or terrain.

14.5.354 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 relations to its surroundings and the installations of other visual and non-visual aids useful in location the aerodrome.

Location

14.5.357 The aerodrome beacon shall be located on or adjacent to the aerodrome in an area of low ambient background lighting.

14.5.360 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.

Note.— *Care is required to ensure that any electrical disturbance generated from the switching technique of the beacon light does not cause any radio interference.*

Characteristics

14.5.363 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.

14.5.366 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 1º. The effective intensity of the flash in white shall not be less than 2000 cd.

Note.— *Aerodrome beacon may be of two types, the rotating beacon or flashing capacitor discharge light.*

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.*

Approach lighting system

Application

Non–instrument runway

14.5.369 Recommendation.— Where a physically practicable, a simple approach lighting system as specified in 14.5.381 to 14.5.3102 should be provided to serve a non-instrument runway where circling guidance is necessary or 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 Light System can also provide visual guidance by day.*

Non precision approach runway

14.5.372 Where a physically practicable a simple approach lighting system as specified in 14.5.381 to 14.5.3102 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 may be advisable to give consideration to the installation of a precision approach category I lighting system.*

Precision approach runway category I

14.5.375 Where physically practicable, a precision approach category I lighting system as specified in 14.5.3105 to 14.5.3138 shall be provided to serve a precision approach runway category I.

Precision approach runway category II and III

14.5.378 Precision approach runway category II and III lighting systems as specified in 14.5.3141 to 14.5.3192 shall be provided to serve a precision approach runway category II or III.

Simple approach lighting system

Location

14.5.381 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 de threshold with a row of lights forming a cross bar 18 m or 30 m in landing at distance 300 m from the threshold.

14.5.384 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.— *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 fire fighting vehicles.*

Note.— *See Attachment A, Section 8 for guidance on installation tolerances.*

14.5.387 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.

14.5.390 Recommendation.— If it is not physically possible to provide a centre line extending for a distance of 420 m from the threshold, it should be extended to 300 m so as to include the crossbar. If this is not possible, the centre line lights should be extended as far as practicable, and each centre line light should 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.

14.5.393 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.

Characteristics

14.5.396 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 system is readily distinguishable from other aeronautical ground lights, and from extraneous lighting if present. Each centre line light shall consist of either: a single source or a barrette at least 3 m in length.

Note.— *When the barrette 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.— *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.— *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.*

14.5.399 Recommendation.— Where provided for a non-instrument runway, the lights should show at all angles in azimuth necessary to a pilot on base leg and final approach. The intensity of the lights should be adequate for all conditions of visibility and ambient light for which the system has been provided.

14.5.3102 Recommendation.— Where provided for a non-precision approach runway, the lights should 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 should 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 should remain usable.

Precision approach category I lighting system

Location

14.5.3105 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 8.*

14.5.3108 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.— *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 fire fighting vehicles.*

Note.— *See Attachment A, Section 8 for guidance on installation tolerances.*

14.5.3111 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.

14.5.3114 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.

Characteristics

14.5.3117 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.

14.5.3120 Where the serviceability level of the approach lights specified as a maintenance objective in 14.10.430 can be demonstrated, each centre line light position may consist of either a single light source or a barrette.

14.5.3123 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.

14.5.3126 Recommendation.— If the centre line consists of barrettes as described in 14.5.3117 b) or 14.5.3120 b), each barrette should be supplemented by a capacitor discharge light, except where such lighting is considered unnecessary taking into account the characteristics of the system and the nature of the meteorological conditions.

14.5.3129 Each capacitor discharge light as described in 14.5.3126 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.

14.5.3132 If the centre line consists of lights as described in 14.5.3117 a) or 14.5.3120 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 lone. These gaps shall be kept to a minimum to meet local requirements and each shall not exceed 6 m.

14.5.3135 Where the additional crossbars described in 14.5.3132 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.

14.5.3138 The lights shall be in accordance with the specifications of Appendix B, Figure B-1.

Precision approach category II and III lighting system

Location

14.5.3141 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 5-12. Where the serviceability level of the approach lights specified as maintenance objectives in 14.10.421 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 5-13.

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 8.*

14.5.3144 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.

14.5.3147 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 14.10.421 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.

14.5.3150 The crossbar provided at 150 m from the threshold shall fill in the gaps between the centre line and side row lights.

14.5.3153 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.

14.5.3156 If the centre line beyond a distance of 300 m from the threshold consists of lights as described in 14.5.3168 b) or 14.5.3171 b), additional crossbars of lights shall be provided at 450 m, 600 m and 750 m from the threshold.

14.5.3159 Where the additional crossbars described in 14.5.3156 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.

14.5.3162 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.

Characteristics

14.5.3165 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 14.10.421 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 14.5.3171 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 14.5.3171 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.

14.5.3168 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.

14.5.3171 Where the serviceability level of the approach lights specified as maintenance objectives in 14.10.421 can be demonstrated, beyond 300 m from the threshold each centre line light position may consist of either a barrette or a single light source;

all of which shall show variable white.

14.5.3174 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.

14.5.3177 Recommendation.— If the centre line beyond 300 m from the threshold consists of barrettes as described in 14.5.3168 a) or 14.5.3171 a), each barrette beyond 300 m should be supplemented by a capacitor discharge light, except where such lighting is considered unnecessary taking into account the characteristics of the system and the nature of the meteorological conditions.

14.5.3180 Each capacitor discharge light 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.

14.5.3183 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.

14.5.3186 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.

14.5.3189 The intensity of the red lights shall be compatible with the intensity of the white lights.

14.5.3192 The lights shall be in accordance with the specifications of Appendix B, Figures B-1 and B-2.

Note.— *The flight path envelopes used in the design of these lights are given in Attachment A, Figure A-3.*

Figure 5-12. Inner 300 m approach and runway lighting for precision approach runways categories II and III

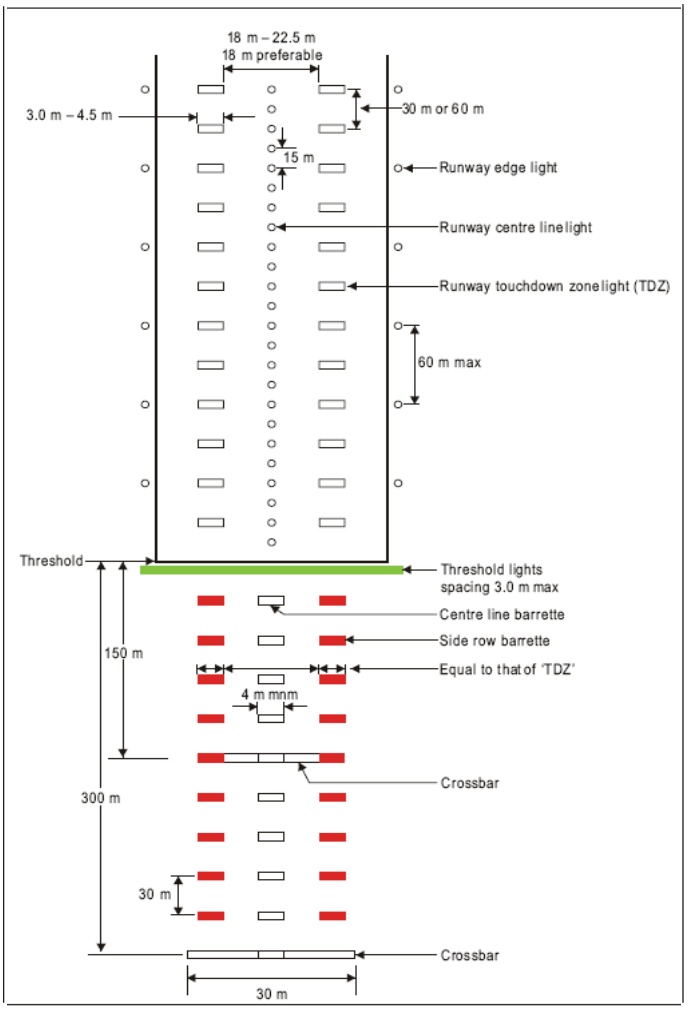
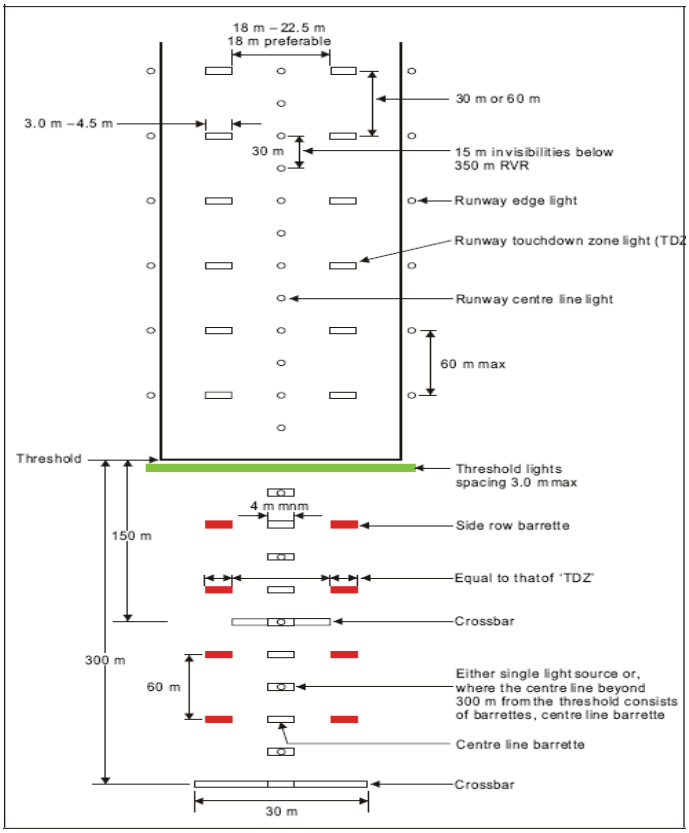


Figure 5-13. Inner 300 m approach and runway lighting for precision approach runways categories II and III



Visual approach slope indicator systems

Application

14.5.3195 A visual approach slope indicator system shall be provided to serve the approach to a runway where one or more of the following conditions exits:

a) the runway is used by turbojet or other aircraft with similar approach guidance requirements;

b) the pilot of any type of aircraft 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 aircraft 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 aircraft under shooting or overrunning the runway; and

e) terrain or prevalent meteorological conditions are such that the aircraft may be subjected to unusual turbulence during approach.

14.5.3198 Recommendation.— A visual approach slope indicator system should be provided to serve the approach to a runway where the runway threshold is temporarily displaced from the normal position and the runway is served by turbojet aeroplanes.

14.5.3201 The standard visual approach slope indicator systems shall consist of PAPI and APAPI systems conforming to the specifications contained in 14.5.3210 to 14.5.3261 inclusive.

14.5.3204 PAPI or APAPI shall be provided when one or more of the conditions specified in 14.5.3195 exist in accordance with the following:

a) PAPI shall be installed where the code number is 3 or 4.

b) PAPI or APAPI shall be installed where the code number is 1 or 2.

14.5.3207 Recommendation.— Where a runway threshold is temporarily displaced from the normal position and one or more of the conditions specified in 14.5.3195 exist, a PAPI should be provided except that where the code number is 1 or 2 an APAPI may be provided.

Note.— *APAPI systems require regular inspection or monitoring to detect a misalignment which could lead to a dangerous approach path.*

PAPI and APAPI

Description

PAPI

14.5.3210 The PAPI system shall consist of a wing bar of 4 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.*

14.5.3213 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 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 units as red.

APAPI

14.5.3216 The APAPI system shall consist of a wing bar of 2 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.*

14.5.3219 The wing bar of an APAPI shall be constructed and arranged in such a manner that a pilot marking 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;

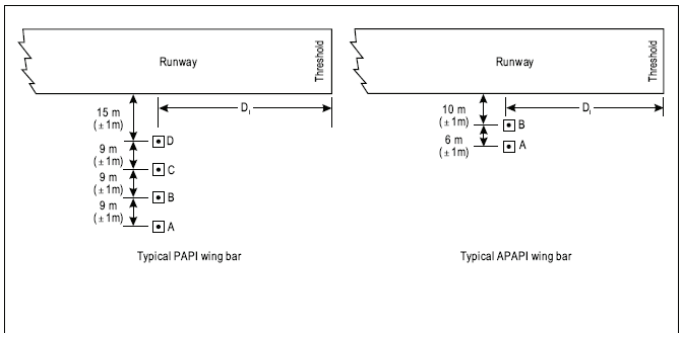
b) when above the approach slope, see both the units as white; and

c) when below the approach slope, see both the units as red.

Siting

14.5.3222 The light units shall be located as in the basic configuration illustrated in Figure 5–14 for PAPI and APAPI, 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 aircraft to be substantially in a horizontal line. The light units shall be mounted as low as possible and shall be sufficiently light and frangible not to constitute a hazard to aircraft.

Figure 5-14. Siting of PAPI and APAPI



Installations 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 5-15, 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.— *Guidance on the harmonization of PAPI, ILS and/or MLS signals is contained in the Aerodrome Design Manual, 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 that 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.

Characteristics of the light units

14.5.3225 The system shall be suitable for both day and night operations.

14.5.3228 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 minutes of arc.

14.5.3231 At full intensity the red light shall have a Y coordinate not exceeding 0.320.

14.5.3234 The light intensity distribution of the light units shall be as shown in Appendix B, Figure B-3.

14.5.3237 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.

14.5.3240 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 1º30´ and at least 4º30´ above the horizontal.

14.5.3243 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 not affect the contrast between the red and white signals and the elevation of the transition sector.

Approach slope and elevation setting of light units

14.5.3246 The approach slope as defined in Figure 5-15 shall be appropriate for use by the aeroplanes using the approach.

14.5.3249 When the runway is equipped with an ILS, 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 as appropriate.

Note.— *Guidance on the harmonization of PAPI and ILS signals is contained in the ICAO Aerodrome Design Manual, Part 4.*

14.5.3252 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 aircraft observing a signal of one white and three reds will clear all objects in the approach area by a safe margin.

14.5.3255 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 aircraft observing the lowest on slope signal, i.e. one white and one red, will clear all objects in the approach area by a safe margin.

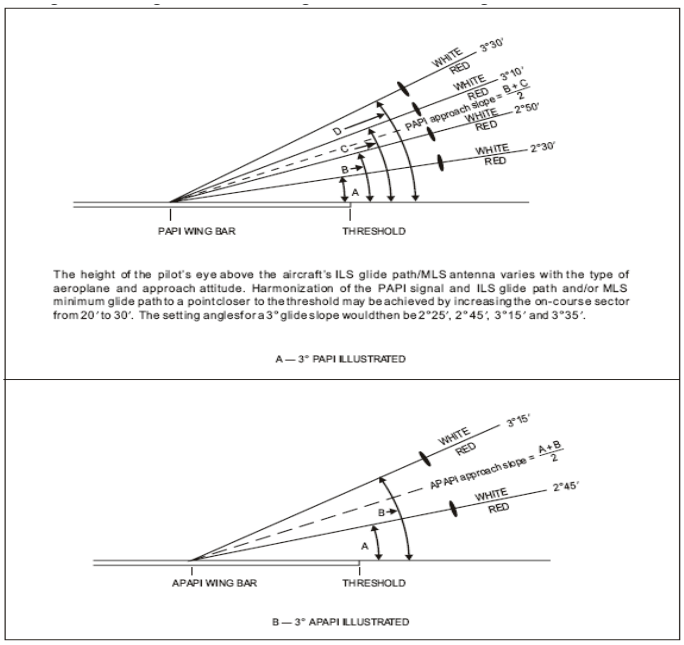
14.5.3258 The azimuth spread of the light beam shall be suitably restricted where an object located outside the obstacle protection surface of the PAPI or APAPI system, but within the lateral limits of its light beam, is found to extend above the plane of the obstacle protection surface and an aeronautical 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 14.5.3264 to 14.5.3276 concerning the related obstacle protection surface.*

14.5.3261 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.

Figure 5-15. Light beams and angle of elevation setting of PAPI and APAPI



Obstacle protection surface

14.5.3264 An obstacle protection surface shall be established when it is intended to provide a visual approach slope indicator system.

14.5.3267 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 5–16.

Table 5-2. Wheel clearance over threshold for PAPI and APAPI

Eye-to-wheel height of aeroplane in the approach configuration [a]	Desired wheel clearance (metres) [b,c]	Minimum wheel clearance (metres) [d]
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-turbo-jet aeroplanes.

Table 5-3. Dimensions and slopes of the Obstacle Protection Surfaces

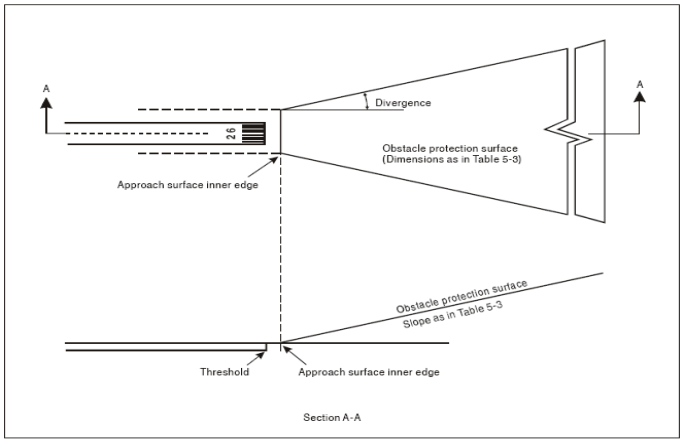
Surface Dimensions	RUNWAY TYPE / CODE NUMBER							
	Non-instrument				Instrument			
	Code number				Code number			
	1	2	3	4	1	2	3	4
Length of inner edge (m)	60	80	150	150	150	150	300	300
Distance from threshold (m)	30	60	60	60	60	60	60	60
Divergence (each side) (%)	10	10	10	10	15	15	15	15
Total length (m)	7500	7500	15 000	15 000	7500	7500	15000	15000
Slope								
PAPI[a]	–	A–0.57°	A–0.57°	A–0.57°	A–0.57°	A–0.57°	A–0.57°	A–0.57°
APAPI[a]	A–0.9°	A–0.9°	—	—	A–0.9°	A–0.9°	—	—

a. Angles as indicated in Figure 5-15.

14.5.3270 New objects or extensions of existing objects shall not be permitted above an obstacle protection surface except when, in the opinion of the certifying authority, the new object or extension would be shielded by an existing immovable object.

14.5.3273 Existing objects above an obstacle protection surface shall be removed except when, in the opinion of the 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.

Figure 5-16. Obstacle protection surface for visual approach slope indicator systems



14.5.3276 Where an aeronautical study indicates that an existing object extending above an obstacle protection surface could adversely affect the safety of operations of aircraft one or more of the following measures shall be taken:

a) suitably raise the approach slope of the system;

b) reduce the azimuth spread of the system so that the object is outside the confines of the beam;

c) displace the axis of the system and its associated obstacle protection surface by no more than 5º;

d) suitably displace the threshold; and

e) where d) is found to be impracticable, suitably displace the system upwind of the threshold to provide an increase in threshold crossing height equal to the height of the object penetration.

Circling guidance lights

Application

14.5.3279 Recommendation.— Circling guidance lights should 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.

Location

14.5.3282 Recommendation.— The location and number of circling guidance lights should 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.

14.5.3285 Recommendation.— Circling guidance lights should 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, Part 4.*

Characteristics

14.5.3288 Recommendation.— Circling guidance lights should 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 should be white, and the steady lights either white or gaseous discharge lights.

14.5.3291 Recommendation.— The lights should 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.

Runway lead-in lighting systems

Application

14.5.3294 Recommendation.— A runway lead–in lighting system should 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.

Location

14.5.3297 Recommendation.— A runway lead–in lighting system should 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 should not exceed approximately 1600 m.

Note.— *Runway lead–in lighting systems may be curved, straight or a combination thereof.*

14.5.3300 Recommendation.— A runway lead–in lighting system should extend from a point as determined by the Authority, up to a point where the approach lighting system, if provided, or the runway or the runway lighting system is in view.

Characteristics

14.5.3303 Recommendation.— Each group of lights of a runway lead–in lighting system should 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.

14.5.3306 Recommendation.— The flashing lights should be white, and the steady burning lights gaseous discharge lights.

14.5.3309 Recommendation.— Where practicable, the flashing lights in each group should flash in sequence towards the runway.

Runway threshold identification lights

Application

14.5.3312 Runway threshold identification lights shall be provided:

a) at the threshold of a non–precision approach runway when additional threshold conspicuity is necessary or where it is not practical 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.

Location

14.5.3315 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.

Characteristics

14.5.3318 Runway threshold identification lights shall be flashing white lights with a flash frequency between 60 and 120 per minute.

14.5.3321 The lights shall be visible only in the direction of approach to the runway .

Runway edge lights

Application

14.5.3324 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.

14.5.3327 Recommendation.— Runway edge lights should be provided on a runway intended for take-off with an operating minimum below an RVR of the order of 800 m by day.

Location

14.5.3330 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.

14.5.3333 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.

14.5.3336 Recommendation.— Where the width of the area which could be declared as runway exceeds 60 m, the distance between the rows of lights should 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.

14.5.3339 The lights shall be uniformly spaced in rows at intervals of not more than 60 m for a 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.

Characteristics

14.5.3342 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.

14.5.3345 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.

Note.— *Asymmetric or symmetric lenses may be installed if there is no requirement for circling guidance.*

14.5.3348 In all angles of azimuth required in 14.5.3345, runway edge lights shall show at angles up to 15º 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.

14.5.3351 Runway edge lights on a precision approach runway shall be in accordance with the specifications of Appendix B, Figure B-9 or B-10.

14.5.3354 Runway edge light mountings shall be frangible.

Runway threshold and wing bar lights

Application of runway threshold lights

14.5.3357 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.

Location of runway threshold lights

14.5.3360 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.

14.5.3363 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.

14.5.3366 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.

14.5.3369 Recommendation.— The lights prescribed in 14.5.3366 a) and b) should be either:

a) equally spaced between the rows of runway edge lights, or

b) symmetrically disposed about the runway centre line in two group, with lights uniformly spaced in each group and with a gap between the group 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.

Application of wing bar lights

14.5.3372 Wing bar lights shall be provided on a precision approach runway when additional conspicuity is considered desirable.

14.5.3375 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.

Location of wing bar lights

14.5.3378 To indicate the location of a displaced threshold, 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 5 lights extending at least 10 m outward from, and at right angles to, the line of runway edge lights, with the innermost light of each wing bar in the line of runway edge lights.

14.5.3381 Recommendation.— Where practicable, a wing bar indicating the location of a displaced threshold should be aligned with a runway edge light.

Characteristics of runway threshold and wing bar lights

14.5.3384 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.

14.5.3387 Runway threshold lights on a precision approach runway shall be in accordance with the specifications of Appendix B, Figure B-3.

14.5.3390 Threshold and wing bar lights on a precision approach runway shall be in accordance with the specification of Appendix B, Figure. B-4.

Runway end lights

Application

14.5.3393 Runway end lights shall be provided for a runway equipped with runway edge lights.

Location

14.5.3396 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.

14.5.3399 Recommendation.— Runway end lighting should consist of at least six lights. The lights should 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, should not exceed 6 m.

Characteristics

14.5.3402 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.

14.5.3405 Runway end lights on a precision approach runway shall be in accordance with the specifications of Appendix B, Figure B-8.

14.5.3408 Runway end light mountings shall be frangible.

Runway centre line lights

Application

14.5.3411 Runway centre line lights shall be provided on a precision approach runway category II or III.

14.5.3414 Recommendation.— Runway centre line lights should 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.

14.5.3417 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.

14.5.3420 Recommendation.— Runway centre line lights should be provided on a runway intended to be used for take–off 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.

Location

14.5.3423 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 a longitudinal spacing approximately 15 m. Where the serviceability level of the runway centre line lights specified as maintenance objectives in 14.10.421 or 14.10.433, as appropriate, can be demonstrate and the runway is intended for use in runway visual range conditions of 350 m or greater, the longitudinal spacing maybe approximately 30 m.

Note.— *Existing centre line lighting where lights are spaced at 7.5 m need not be replaced.*

14.5.3426 Recommendation.— Centre line guidance for take-off from the beginning of a runway to a displaced threshold should 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 length and spaced at uniform intervals of 30 m, as shown in Figure 5-18, 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 should 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 should 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.

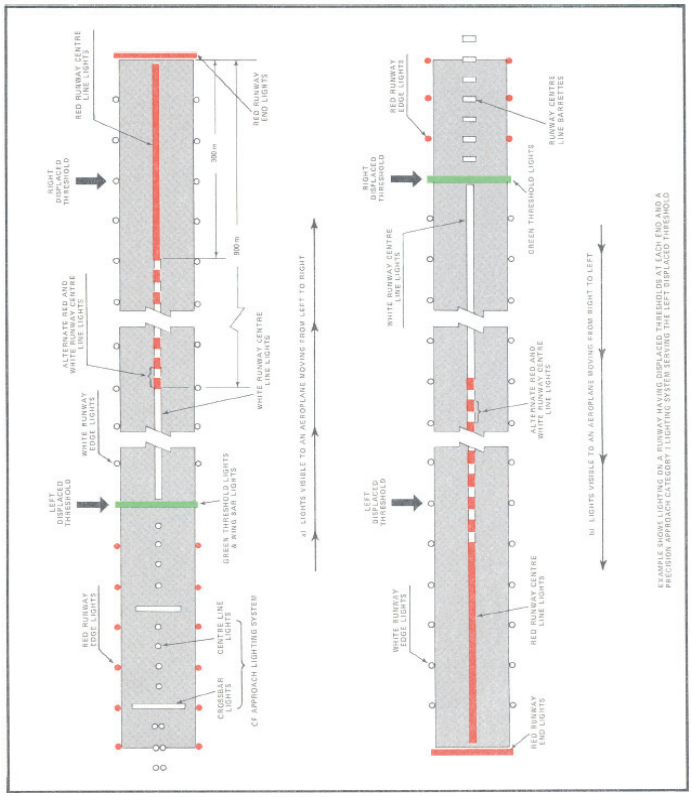
Characteristics

14.5.3429 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 mid point 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.*

14.5.3432 Runway centre line lights shall be in accordance with the specifications of Appendix B, Figure B-6 or B-7.

Figure 5-18. Example of approach and runway lighting for runway with displaced thresholds



Runway touchdown zone lights

Application

14.5.3435 Touchdown zone lights shall be provided in the touchdown zone of a precision approach runway category II or III.

Location

14.5.3438 Touchdown zone lights shall extend from the threshold for a longitudinal distance of 900 m, except that, on runways less than 1800 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.

Characteristics

14.5.3441 A barrette shall be composed of at least three lights with a spacing between the lights of not more than 1.5 m.

14.5.3444 Recommendation.— A barrette should be not less than 3 m nor more than 4.5 m in length.

14.5.3447 Touchdown zone lights shall be fixed unidirectional lights showing variable white.

14.5.3450 Touchdown zone lights shall be in accordance with the specifications of Appendix B, Figure B-5.

Stopway lights

Application

14.5.3453 Stopway lights shall be provided for a stopway intended for use at night.

Location

14.5.3456 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.

Characteristics

14.5.3459 Stopway lights shall be fixed unidirectional lights showing red in the direction of the runway.

Taxiway centre line lights

Application

14.5.3462 Taxiway centre line lights shall be provided on an exit taxiway, taxiway and apron intended for use in runway visual range conditions less than a value of the 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 there is a low volume of traffic and taxiway edge lights and centre line marking provide adequate guidance.

Note.—*See 14.5.3210 concerning the provision of aircraft stand manoeuvring guidance lights.*

14.5.3465 Recommendation.— Taxiway centre line lights should 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 there is a low volume of traffic and taxiway edge lights and centre line marking provide adequate guidance.

Note 1.— Where there may be a need to delineate the edges of a taxiway, e.g. on a rapid exit taxiway or narrow taxiway, this may be done with taxiway edge lights or markers.

14.5.3468 Recommendation.— Taxiway centre line lights should be provided on an exit taxiway and apron in all visibility condition 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.

14.5.3471 Taxiway centre line lights shall be provide 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 there is a low volume of traffic and taxiway edge lights and centre line marking provide adequate guidance.

Note.— *See 14.8.209 for provisions concerning the interlocking of runway and taxiway lighting systems.*

14.5.3474 Recommendation.— Taxiway centre line lights should be provided on an exit taxiway and apron in all visibility condition on a runway forming part of a standard taxi route where specified as components of an advanced surface movement guidance and control system.

Characteristics

14.5.3477 With the exception of an exit taxiway, taxiway centre line lights on a taxiway and on a runway forming part of a recognized taxi–route, shall be fixed lights showing green with beam dimensions such that the light is visible only from aircraft on or in the vicinity of the taxiway.

14.5.3480 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. (See Figure 5–17). The light nearest to the perimeter shall always show yellow. Where aircraft may follow the same centre line in both directions, all the centre line lights shall show green to aircraft approaching the runway.

Note.— *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.— *For yellow filter characteristics see Appendix A, 2.2.*

Note.— *The size of the ILS/MLS critical/sensitive area depends on the characteristics of the associated ILS or MLS. Guidance is provide in a Annex 10, volume I, Attachments C and G.*

14.5.3483 Taxiway centre line lights shall be in accordance with the specifications of:

a) Appendix B, Figure B-12 or B-13 for taxiways intended for use in runway visual range conditions of less than a value of 350 m); and

b) Appendix B, Figure B-14 or B-15 for other taxiways.

Location

14.5.3486 Recommendation.— Taxiway centre line lights should 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.

Taxiway centre line lights on taxiways

Location

14.5.3489 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) 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.

b) larger intervals not exceeding 60 m may be used where, because of the prevailing meteorological conditions, adequate guidance is provided by such spacing; and

c) intervals less than 30 m should be provided on short straight sections.

14.5.3492 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.

14.5.3495 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 should extend for 60 m before and after the curve.

14.5.3498 Recommendation.— On a taxiway intended for use in RVR conditions of 350 m or greater, the lights on a curve should not exceed a spacing of:

Curve radius	Light spacing
up to 400 m	7.5 m
401 m to 899 m	15 m
900 m or greater	30 m

This spacing should extend for 60 m before and after the curve.

Note.— *See 14.3.918 and Figure 3–1.*

Taxiway centre line lights on rapid exit taxiways

Location

14.5.3501 Taxiway centre line lights on a rapid exit taxiway shall 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 aircraft can be expected to reach normal taxiing speed. The lights on that portion parallel to the runway centre line should always be at least 60 cm from any row of runway centre line lights.

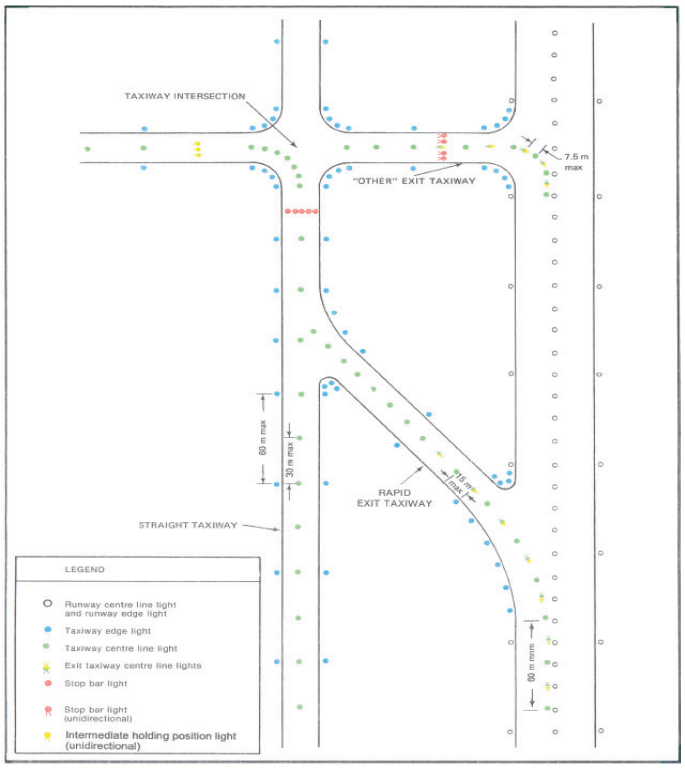
14.5.3504 The lights should be spaced at longitudinal intervals of not more than 15 m, except that, where runway centre line lights are not provided, a greater interval not exceeding 30 m may be used.

Taxiway centre line lights on other exit taxiways

Location

14.5.3507 Recommendation.— Taxiway centre line lights on exit taxiways other than rapid exit taxiways should 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 should be at least 60 cm from any row of runway centre line lights.

Figure 5-19. Taxiway Lighting



14.5.3510 Recommendation.— The lights should be spaced at longitudinal intervals of not more than 7.5 m.

Taxiway centre line lights on runways

14.5.3513 Recommendation.— Taxiway centre line lights on a runway forming part of a standard taxi–route and intended for taxiing in RVR conditions of less than a value of 350 m should be spaced at longitudinal intervals not exceeding 15 m.

Taxiway edge lights

Application

14.5.3516 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.

14.5.3519 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 lights.

Location

14.5.3522 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 should be spaced at intervals less than 60 m so that a clear indication of the curve is provided.

14.5.3525 Recommendation.— Taxiway edge lights on apron, should be spaced at uniform longitudinal intervals of not more than 60 m.

14.5.3528 Recommendation.— Taxiway edge lights on a runway turn pad should be spaced at uniform longitudinal intervals of not more than 30 m.

14.5.3531 The lights should be located as near as practicable to the edges of the taxiway, runway turn pad, holding bay, apron or runway etc. or outside the edges at a distance of not more than 3 m.

Characteristics

14.5.3534 Taxiway edge lights shall be fixed lights showing blue. The lights shall show up to at least 30º 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.

14.5.3537 Taxiway edge light mountings shall be frangible

Runway turn pad lights

Application

14.5.3540 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.

14.5.3543 Recommendation.— Runway turn pad lights should be provided on a runway turn pad intended for use at night.

Location

14.5.3546 Recommendation.— Runway turn pad lights should 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.

14.5.3549 Recommendation.— Runway turn pad lights on a straight section of the runway turn pad marking should be spaced at longitudinal intervals of not more than 15 m.

14.5.3552 Recommendation.— Runway turn pad lights on a curved section of the runway turn pad marking should not exceed a spacing of 7.5 m.

Characteristics

14.5.3555 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.

14.5.3558 Runway turn pad lights shall be in accordance with the specifications of Appendix B, Figure B-12, B-13 or B-14, as appropriate.

Stop bars

Application

Note.— *The provision of stop bars requires their control by air traffic services.*

Note.— *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.*

14.5.3561 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 350m, except where:

a) appropriate aids and procedures are available to assist in preventing inadvertent incursions of aircraft and vehicles onto the runway; or

b) operational procedures exist to limit, in runway visual range condition 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.

14.5.3564 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 of values between 350 m and 550 m except where:

a) appropriate aids and procedures are available to assist in preventing inadvertent incursions of aircraft and vehicles 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.

14.5.3567 Recommendation.— A stop bar should be provided at an intermediate holding position when it is desired to supplement markings with lights and to provide traffic control by visual means.

14.5.3570 Recommendation.— Where the normal stop bar lights might be obscured (from a pilot's view), 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, then a pair of elevated lights should be added to each end of the stop bar.

Location

14.5.3573 Stop bars shall be located across the taxiway at the point where it is desired that traffic stop. Where the additional lights specified in 14.5.3570 are provided, these lights shall be located not less than 3 m from the taxiway edge.

Characteristics

14.5.3576 Stop bars shall consist of lights spaced at intervals of 3 m across the taxiway showing red in the intended direction(s) of approach to the intersection or runway–holding position.

14.5.3579 Stop bars installed at a runway–holding position shall be unidirectional and shall show red in the direction of approach to the runway.

14.5.3582 Where the additional lights specified in 14.5.3570 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.

14.5.3585 Selectively switchable stop bars other than at a taxi-holding position shall be installed in conjunction with at least three taxiway centre line lights (extending for at least 90 m from the stop bar) in the direction that it is intended for an aircraft to proceed from the stop bar.

Note.— *See 14.5.3489 for provisions concerning the spacing of taxiway centre line lights.*

14.5.3588 The intensity in red light and beam spreads of stop bar lights should be in accordance with the specifications in Appendix B, Figure B-12 through B-15, as appropriate.

14.5.3591 Recommendation.— 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 should be in accordance with the specifications of Appendix B, Figure B-16 or B-17.

Note.— *High-intensity stop bars should only be used in case of an absolute necessity and following a specific study.*

14.5.3594 Recommendation.— Where a wide beam fixture is required, the intensity in red light and beam spreads of stop bar lights should be in accordance with the specifications of Appendix B, Figure B-17.

14.5.3597 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 shall be 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**.— A stop bar is switched on to indicate that traffic stop and switched off to indicate that traffic proceed.*

***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.*

***Note**.— See 8.8 for provisions for selective switching of stop bars and taxiway centre line lights.*

Intermediate holding position lights

Application

14.5.3600 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.

Location

14.5.3603 Intermediate holding position lights shall be located along the intermediate holding position marking at a distance of 0.3 m prior to the marking.

Characteristics

14.5.3606 Intermediate holding position lights shall consist of three fixed unidirectional lights showing yellow in the direction of approach to the Intermediate holding position lights 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.

Apron floodlighting

Application

14.5.3609 Recommendation.— Apron floodlighting should be provided on an apron, and on a designated isolated aircraft parking position, intended to be used at night.

***Note**.— The designation of an isolated aircraft parking position is specified in 14.3.1400.*

***Note**.— Guidance on apron floodlighting is given in the ICAO Aerodrome Design Manual, Part 4.*

Location

14.5.3612 Recommendation.— Apron floodlights should 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 should be such that an aircraft stand receives light from two or more directions to minimize shadows.

Characteristics

14.5.3615 The spectral distribution of apron floodlights shall be such that the colours used for aircraft marking connected with routine servicing, and/or surface and obstacle marking, can be correctly identified.

14.5.3618 Recommendation.— The average illuminance should 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.

Road-holding position light

Application

14.5.3621 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.

14.5.3624 Recommendation.— A road-holding position light should 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.

Location

14.5.3627 A road–holding position light shall be located adjacent to the holding position marking 1.5 m (+ or – 0.5 m) from the right hand edge of the road.

Note.— See 14.9.900 for the mass and height limitations and frangibility requirements of navigational aids located on runway strips.

Characteristics

14.5.3630 The road–holding position light shall comprise:

a) a controllable red (stop)/green (go) traffic light; or

b) a flashing red light.

14.5.3633 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.

14.5.3636 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 14.5.3633 and 14.5.3636.*

14.5.3639 The flash frequency of flashing red light shall be between 30 and 60 per minute with the lamp illuminated approximately 50 per cent of the time.

14.5.400 SIGNS

General

***Note**.— Signs that convey instructions or information to a pilot are an essential component of the visual aids system at aerodromes. A sign provides a visual message by virtue of its situation, shape, colour, or pattern and by the use of symbols and alphanumeric characters. A sign therefore needs to be conspicuous, legible, comprehensible and credible.*

Application

14.5.403 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 section 14.9.803.

***Note**.— Where an information sign would normally be installed and it is physically impossible to install a sign an information marking may be displayed on the surface of the pavement.*

Characteristics

14.5.406 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 5-4.

Table 5-4 Location distances for taxiing guidance signs including runway exit signs

Sign height (mm)				Perpendicular distance from defined taxiway edge to near side of sign	Perpendicular distance from defined runway edge to near side of sign
Code number	Legend	Face (min.)	Installed (max.)		
1 or 2	200	400	700	5-11 m	3-10 m
1 or 2	300	600	900	5-11 m	3-10 m
3 or 4	300	600	900	11-21 m	8-15 m
3 or 4	400	800	1 100	11-21 m	8-15 m

14.5.409 Signs shall be rectangular, as show in Figures 5-17 and 5-18 with the longer side horizontal.

14.5.412 The only signs on the movement area utilizing red shall be mandatory instruction signs.

14.5.415 The inscriptions on a sign shall be in accordance with Appendix D.

14.5.418 Where signs of differing minimum character heights are located together to form an array, the signs shall be of uniform dimensions, conforming to the larger of the character heights (eg. location sign collocated with a runway designation sign).

14.5.421 Signs shall be illuminated, when intended for use:

a) in conditions of visibility 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.

14.5.424 Signs shall be retro-reflective and/or illuminated in accordance with provisions in Appendix D when intended for use at night in association with non-instrument runways where the code number is 1 or 2.

14.5.427 Recommendation.— Signs provided in accordance with 14.5.421 should also be retro-reflective.

14.5.430 A sign illuminated in accordance with 14.5.421 and 14.5.424 shall be visible over a distance of at least 250 m and legible at a distance of 180 m on a clear night.

14.5.433 The characters on a sign lighted using imbedded fibreoptic elements shall be illuminated such that:

a) the characters on mandatory instruction signs shall show red;

b) the characters on information signs shall show white except that the characters on a location sign shall show yellow;

c) the sign shall be legible when viewed from angles up to 80º from the optical axis; and

d) a single lamp failure shall not result in the character or any portion of the character being extinguished.

Figure 5-20. Mandatory instruction signs

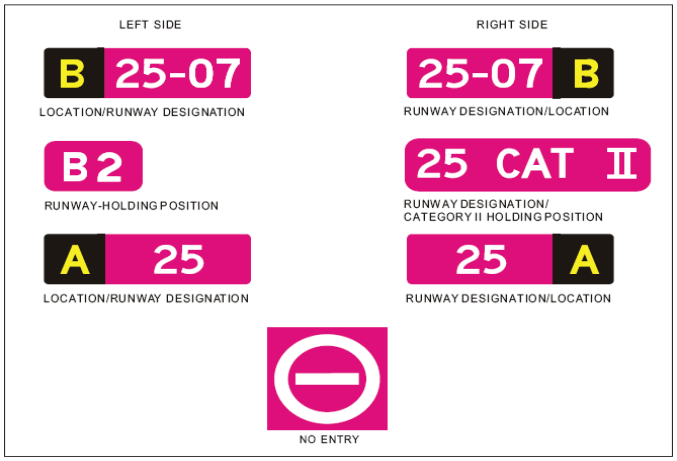
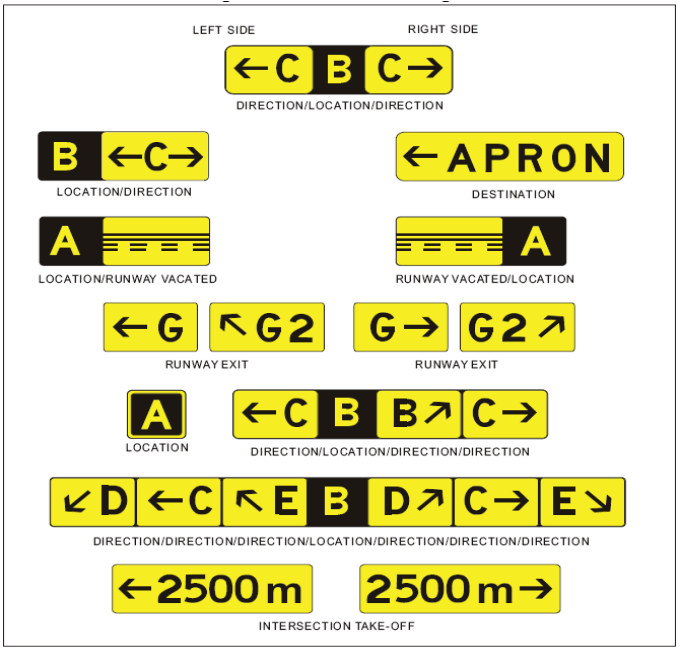


Figure 5-21. Information signs



Mandatory instruction signs

Note.— *See Figure 5-20 for pictorial representation of mandatory instruction signs and Figure 5-22 for examples of locating signs at taxiway/runway intersections.*

Application

14.5.436 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.

14.5.439 Mandatory instruction signs shall include:

a) runway designation signs;

b) Category I, Category II, Category III or Category II/III holding position signs;

c) road-holding position signs; and

d) no entry signs.

14.5.442 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.

14.5.445 A pattern "B" runway-holding position marking shall be supplemented with a Category I, II, or III holding position sign.

14.5.448 A pattern "A" runway-holding position marking at a runway-holding position established in accordance with 14.3.1206 shall be supplemented with a runway-holding position sign.

14.5.451 A runway designation sign at a taxiway/runway intersection shall be supplemented with a location sign in the outboard (furthest from the taxiway) position.

14.5.454 A no entry sign shall be provided when entry into an area is prohibited.

Location

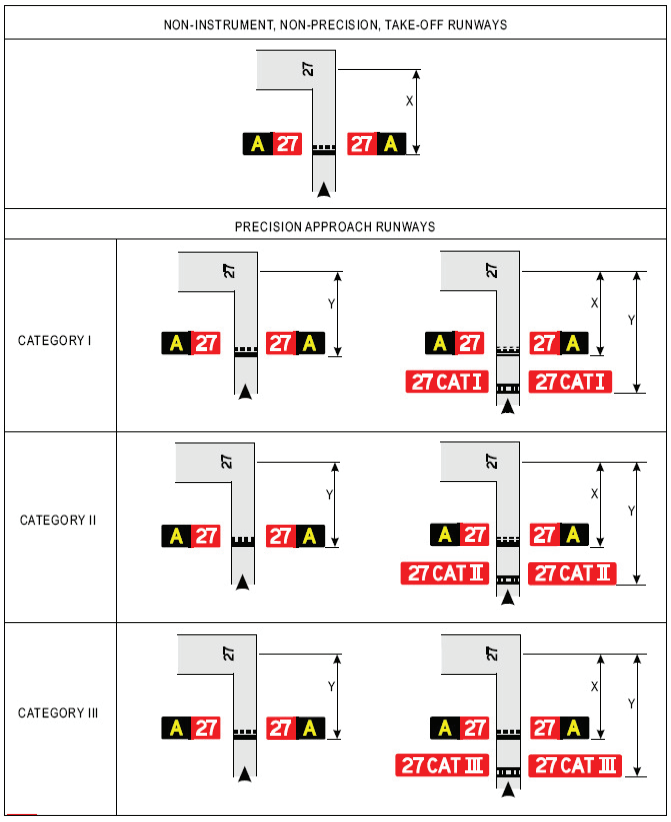
14.5.457 A runway designation sign at a taxiway/runway intersection or a runway/runway intersection shall be located on each side of the runway-holding position marking facing the direction of approach to the runway.

14.5.460 A Category II, Category III or Category II/III holding position sign shall be located on each side of the holding position marking facing the direction of approach to the critical area.

14.5.463 A no entry sign shall be located at the beginning of the area to which entrance is prohibited at least on the left hand side of the taxiway as viewed by the pilot. Where practicable, a no entry sign shall be located on each side of the taxiway.

14.5.466 A runway-holding position sign shall be located on each side of the runway-holding position established in accordance with 14.3.1206, facing the approach to the obstacle limitation surface or ILS/MLS critical/sensitive area, as appropriate.

Figure 5-22. Examples of signs positions at taxiway/runway intersections



Characteristics

14.5.469 A mandatory instruction sign shall consist of an inscription in white on a red background.

14.5.472 The inscription on a runway designation sign shall consist of the runway designation 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.

14.5.475 The inscription on a Category I, II or III holding position sign shall consist of the runway designator of the runway for which the holding position is established followed by the CAT I, CAT II, CAT III or CAT II/III designation as appropriate.

14.5.478 The inscription on a no entry sign shall be in accordance with Figure 5-20.

14.5.481 The inscription on a runway-holding position sign at a runway-holding position established in accordance with 14.3.1206 shall consist of the taxiway designation and a number

14.5.484 Where appropriate, the inscriptions/symbols depicted in Table 5-5 shall be used.

Table 5-5. Information to be displayed on Mandatory Instruction Signs

SYMBOL/INSCRIPTION	EXAMPLE	USE
Runway designation of a runway extremity		To indicate a taxi–holding position at a runway extremity
Runway designation of both extremities of a runway		To indicate a runway-holding designation of position located at other both extremities taxiway/runway intersections or of a runway runway/runway intersections
ILS/MLS Category I hold position		To indicate a Category I runway–holding position at the threshold of a runway.
ILS/MLS Category II hold position		To indicate a Category II runway–holding position at the threshold of runway 25.
ILS/MLS Category III hold position		To indicate a Category III runway–holding position at the threshold of runway 25
ILS/MLS Category II and III hold Position		To indicate a joint Category II/III runway–holding position at the threshold of runway 25
No Entry		To indicate that entry to an area is prohibited

Information signs

Note.— *See Figure 5-21 for pictorial representations of information signs.*

Application

14.5.487 An information sign shall be provided where there is an operational need to identify by a sign, a specific location, or routing information.

14.5.490 Information signs shall include direction signs, location signs, destination signs, and runway exit signs.

14.5.493 A runway exit sign shall be provided where there is an operational need to identify a runway exit.

14.5.496 Recommendation.— Where necessary, a destination sign should be provided to indicate the direction of a specific destination on the aerodrome, such as cargo area, general aviation, etc.

14.5.499 A combined location and direction sign shall be provided when it is intended to indicate routing information prior to a taxiway intersection.

14.5.4102 A direction sign shall be provided when there is an operational need to identify the designation and direction of taxiways at an intersection.

14.5.4105 Recommendation.— A location sign should be provided at an intermediate holding position.

14.5.4108 A location sign shall be provided in conjunction with a runway designation sign except at a runway/runway intersection.

14.5.4111 A location sign shall be provided in conjunction with a direction sign or a runway designation sign, except that it may be omitted where an aeronautical study indicates that it is not needed.

14.5.4114 Recommendation.— Where necessary, a location sign should be provided to identify taxiways exiting an apron or to identify taxiways beyond an intersection.

14.5.4117 Recommendation.— Where a taxiway ends at an intersection such as a "T" and it is necessary to identify this, a direction sign and/or other appropriate visual aid should be used.

Location

14.5.4120 Except as specified in 14.5.4132 and 14.5.4147, information signs shall, wherever practicable, be located on the left hand side of the taxiway in accordance with Table 5-4.

14.5.4123 At a taxiway intersection, information signs shall be located prior to the intersection and in line with the taxiway intersection marking. Where there is no taxiway intersection 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 taxiway location sign installed beyond a taxiway intersection may be located on either side of the taxiway.*

14.5.4126 A runway exit sign shall be located on the same side of the runway (left or right) as the exit and positioned in accordance with Table 5-4.

14.5.4129 A runway exit sign shall be located prior to the runway exit point in line with a position at least 60 m prior to the point of tangency where the code number is 3 or 4, and at least 30 m where the code number is 1 or 2.

14.5.4132 A taxiway location sign installed in conjunction with a runway designation sign shall be positioned outboard of the runway designation sign.

14.5.4135 Recommendation.— A destination sign should not normally be collocated with a location or direction sign.

14.5.4138 An information sign other than a location sign shall not be collocated with a mandatory instruction sign.

14.5.4141 Recommendation.— A direction sign or other appropriate visual aid used to identify a "T" intersection should be located on the opposite side of the intersection facing the taxiway.

Characteristics

14.5.4144 An information sign shall consist of an inscription in black on a yellow background except that a location sign shall consist of an inscription in yellow on a black background.

14.5.4147 The inscription on a runway exit sign shall consist of the designator of the exit taxiway and an arrow indicating the direction to follow.

14.5.4150 The inscription on a destination sign shall comprise an alpha, alpha numeric or numeric message identifying the destination plus an arrow indicating the direction to proceed.

14.5.4153 The inscriptions on a direction sign shall comprise an alpha or alphanumeric message identifying the taxiway(s) plus an arrow or arrows appropriately oriented.

14.5.4156 The inscription on a location sign shall comprise the designation of the location, taxiway, or other pavement the aircraft is on or is entering and shall not contain arrows.

14.5.4159 Recommendation.— Where it is necessary to identify each of a series of intermediate holding positions on the same taxiway, the location sign should consist of the taxiway designation and a number.

14.5.4162 Where a location sign and direction signs are used in combination to provide routing guidance:

a) all direction signs related to left turns shall be located to the left of the location sign and all direction signs related to right turns shall be located to the right 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 more than 25º beyond the intersection; and

d) adjacent direction signs shall be delineated by a vertical black line as shown in Figure 5-21.

14.5.4165 A taxiway shall be identified by a designator comprising a letter, letters or a combination of letters followed by a number.

14.5.4168 Recommendation.— When designating taxiways, the use of the letters I , O and X and the use of such words as inner and outer for the designation of taxiways should be avoided whenever possible to avoid confusion with the numerals 1 (one), 0 (zero) and closed markings.

14.5.4171 Where required, apron areas shall be identified with signs having Roman numerals.

14.5.4174 Recommendation.— Apron exits from taxiways should be identified with the taxiway to which they are connected and use an alpha/alpha system (i.e. AA, AB, etc.) The first letter represents the associated taxiway, the second the apron exit and should be lettered sequentially.

Note.— *Taxiways leading to privately owned aprons and/or hangars need not be identified unless a requirement exists for public use.*

14.5.4177 The use of numbers alone on the manoeuvring area shall be reserved for the designation of runways

VOR aerodrome check-point sign

Application

14.5.4180 When a VOR aerodrome check-point is established, it shall be indicated by a VOR aerodrome check-point marking and sign.

Location

14.5.4183 A VOR aerodrome check-point sign shall be located as near as possible to the check-point and so that the inscriptions are visible from the cockpit of an aircraft properly positioned on the VOR aerodrome check-point marking.

Characteristics

14.5.4186 A VOR aerodrome check-point sign shall consist of an inscription in black on a yellow background.

14.5.4189 Recommendation.— The inscriptions on a VOR check-point sign should be in accordance with one of the alternatives shown in Figure 5-23 in which:

VOR - is an abbreviation identifying this as a VOR check-point;

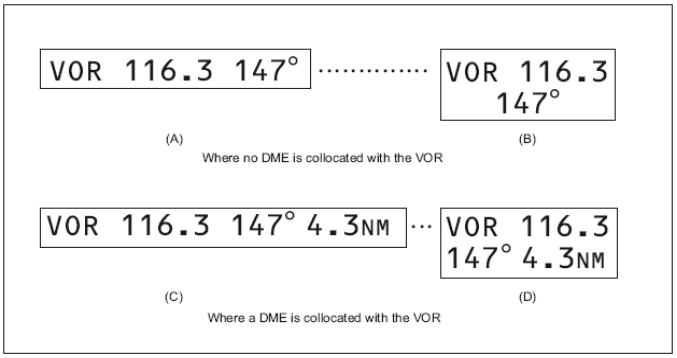
116.3 - is an example of the radio frequency of the VOR concerned;

147° - is an example of the VOR bearing, to the nearest degree, which should be indicated at the VOR check-point; and

4.3 NM - is an example of the distance in nautical miles to a DME collocated with the VOR concerned.

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 check-point can only be used operationally when periodic checks show it to be consistently within ± 2 degrees of the stated bearing.*

Figure 5-23. VOR aerodrome check-point sign



Aerodrome identification sign

Application

14.5.4192 Recommendation.— An aerodrome identification sign should be provided at an aerodrome where there is insufficient alternative means of visual identification.

Location

14.5.4195 Recommendation.— The aerodrome identification sign should be placed on the aerodrome so as to be legible in so far as is practicable, at all angles above the horizontal.

Characteristics

14.5.4198 The aerodrome identification sign shall consist of the name of the aerodrome.

14.5.4201 Recommendation.— The colour selected for the sign should give adequate conspicuity when viewed against its background.

14.5.4204 Recommendation.— The characters should have a height of not less than 3 m.

Aircraft stand identification signs

Application

14.5.4207 Recommendation.— An aircraft stand identification marking should be supplemented with an aircraft stand identification sign where feasible.

Location

14.5.4210 Recommendation.— An aircraft stand identification sign should be located so as to be clearly visible from the cockpit of an aircraft prior to entering the aircraft stand.

Characteristics

14.5.4213 An aircraft stand identification sign shall consist of an inscription in black on a yellow background.

Road-holding position sign

Application

14.5.4216 A road-holding position sign shall be provided at all road entrances to a runway.

Location

14.5.4219 The road-holding position sign shall be located 1.5 m from the right-hand edge of the road at the holding position.

Characteristics

14.5.4222 A road-holding position sign shall consist of an inscription in white on a red background.

14.5.4225 The inscriptions on a road-holding position sign shall be in the national language(s) and shall include the following:

a) a requirement to stop. This shall be in conformity with the local traffic convention;

b) a requirement to obtain ATC clearance to cross the runway; and

c) location designator.

14.5.4228 A road-holding position sign intended for night use shall be retro-reflective or illuminated.

14.5.500 MARKERS

General

14.5.503 Markers shall be lightweight and frangible mounted. 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.— *Anchors or chains, to prevent markers which have broken from their mounting from blowing away, are sometimes used.*

Note.— *Guidance on frangibility of markers is given in the Aerodrome Design Manual, Part 4.*

Unpaved runway edge markers

Application

14.5.506 Recommendation.— Markers should 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.

Location

14.5.509 Recommendation.— Where runway lights are provided, the markers should be incorporated in the light fixtures. Where there are no lights, markers of flat rectangular or conical shape should be placed so as to delimit the runway clearly.

Characteristics

14.5.512 Recommendation.— The flat rectangular markers should have a minimum size of 1 m by 3 m and should be placed with their long dimension parallel to the runway centre line. The conical markers should have a height not exceeding 50 cm.

Stopway edge markers

Application

14.5.515 Recommendation.— Stopway edge markers should be provided when the extent of a stopway is not clearly indicated by its appearance compared with that of the surrounding ground.

Characteristics

14.5.518 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.*

Taxiway edge markers

Application

14.5.521 Recommendation.— Taxiway edge markers should 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.

Location

14.5.524 Recommendation.— Taxiway edge markers should be installed a least at the same locations as would the taxiway edge lights had they been used.

Characteristics

14.5.527 A taxiway edge marker shall be retro-reflective blue.

14.5.530 Recommendation.— The marked surface as viewed by the pilot should be a rectangle and should have a minimum viewing are of 150 cm^2.

14.5.533 Taxiway edge markers shall be light weight and frangible. Their height shall be sufficiently low to preserve clearance for propellers and for the engine pods of jet aircraft.

Taxiway centre line markers

Application

14.5.536 Recommendation.— Taxiway centre line markers should 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.

14.5.539 Recommendation.— Taxiway centre line markers should be provided on a taxiway where the code number is 3 or 4 and taxiway centre lights are not provided if there is a need to improve the guidance provided by the taxiway centre line marking.

Location

14.5.542 Recommendation.— Taxiway centre line markers should be installed at least at the same location as would taxiway centre line lights had they been used.

Note.— *See 14.5.3489 for the spacing of taxiway centre line lights.*

14.5.545 Recommendation.— Taxiway centre line markers should 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.

Characteristics

14.5.548 A taxiway centre line marker shall be retro-reflective green.

14.5.551 Recommendation.— The marked surface as viewed by the pilot should be a rectangle and have a minimum viewing area of 20 cm^2.

14.5.554 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.

Unpaved taxiway edge markers

Application

14.5.557 Recommendation.— Where the extent of an unpaved taxiway is not clearly indicated by its appearance compared with that of the surrounding ground, markers should be provided.

Location

14.5.560 Recommendation.— Where taxiway lights are provided, the markers should be incorporated in the light fixtures. Where there are no lights, markers of conical shape should be placed so as to delimit the taxiway clearly.

CHAPTER 6. VISUAL AIDS FOR DENOTING OBSTACLES

14.6.100 OBJECTS TO BE MARKED AND/OR LIGHTED

Note.— *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.— *The requirements of this chapter are intended to be applied to objects located within the perimeter of the aerodrome and immediate vicinity.*

Objects on movement areas

14.6.103 Vehicles and other mobile objects, excluding aircraft, on the manoeuvring area of an aerodrome are obstacles and shall be marked and, if the vehicle and aerodrome are used at night or in conditions of low visibility, lighted.

14.6.106 Recommendation.— Vehicles and other mobile objects, excluding aircraft, used on an apron should be marked and, if the vehicle and aerodrome are used at night or in conditions of low visibility, lighted.

14.6.109 Elevated aeronautical ground lights within the movement area shall be marked so as to be conspicuous by day.

Objects on runway strips

14.6.112 A fixed object located on a runway strip shall be marked and if the aerodrome is used at night, lighted, excluding visual aids that are by their nature visually conspicuous

Other objects

14.6.115 Recommendation.— 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 should 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 height of the obstacle above the level of the surrounding ground does not exceed 150 m and it is lighted by medium intensity obstacle light, Type A by day;

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.

14.6.118 Recommendation.— A fixed object, other than an obstacle, adjacent to a take-off/ climb surface should 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 height of the obstacle above the level of the surrounding ground does not exceed 150 m and it is lighted by medium intensity obstacle light, Type A, by day; or

b) the object is lighted by high–intensity obstacle lights by day.

14.6.121 A fixed obstacle that extends above an approach or transitional surface within 3 000 m of the inner edge of the approach surface shall be marked and if the aerodrome 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.

14.6.124 A fixed object that extends above an obstacle protection surface shall be marked and, if the runway is used at night, lighted.

14.6.127 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.

14.6.130 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.

14.6.133 All obstacles within the distance specified in Table 3-1, column 5 or 6, 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.

14.6.136 Recommendation.— Obstacles in accordance with 14.4.306 should be marked and lighted, except that the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day.

14.6.139 Recommendation.— Overhead wires, cables, etc., crossing a river, valley or highway should 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, except that the marking of the supporting towers may be omitted when they are lighted by high-intensity obstacle lights by day.

14.6.142 Recommendation.— 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, should be provided on their supporting towers.

14.6.200 MARKING OF OBJECTS

Fixed objects

General

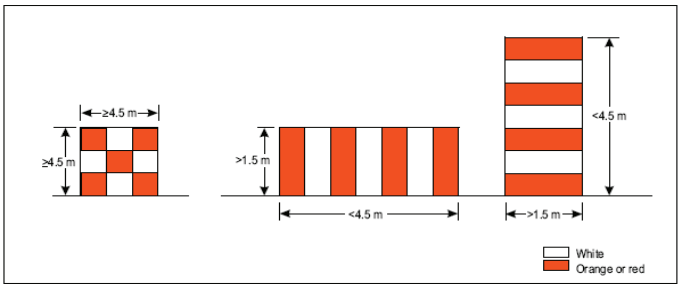
14.6.203 All fixed objects to be marked shall, whenever possible, be coloured but if this is not possible, markers or flags shall be displayed on or above them, except that objects that are sufficiently conspicuous by their shape, size, or colour need not otherwise be marked.

14.6.206 All mobile objects to be marked shall be coloured or display flags.

Use of colours

14.6.209 Recommendation.— An object should 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 should 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 should contrast each with the other and with the background against which they will be seen. Orange and white or alternatively red and white should be used, except where such colours merge with the background. (See Figure 6-1.)

Figure 6-1. Basic marking patterns



14.6.212 Recommendation.— An object should 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 should 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 should contrast with the background against which they will be seen.

Orange and white should be used, except where such colours are not conspicuous when viewed against the background. The bands on the extremities of the object should be of the darker colour. (See Figures 6-1 and 6-2.)

Note.— *Table 6-1 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.*

14.6.215 Recommendation.— An object should 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 should 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.*

14.6.218 Recommendation.— When mobile objects are marked by colour, a single conspicuous colour, preferably red or yellowish green for emergency vehicles and yellow for service vehicles should be used.

Table 6-1. 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 " " "

Use of markers

14.6.221 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 the 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.

14.6.224 Recommendation.— A marker displayed on an overhead wire, cable, etc., should be spherical and have a diameter of not less than 60 cm.

14.6.227 Recommendation.— The spacing between two consecutive markers or between a marker and a supporting tower should be appropriate to the diameter of the marker, but in no case should 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 should be located not lower than the level of the highest wire at the point marked.

14.6.230 Recommendation.— A marker should be of one colour. When installed, white and red, or white and orange markers should be displayed alternately. The colour selected should contrast with the background against which it will be seen.

Use of flags

14.6.233 Flags used to mark fixed objects shall be displayed around, on top of, or around the highest edge of, an 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.

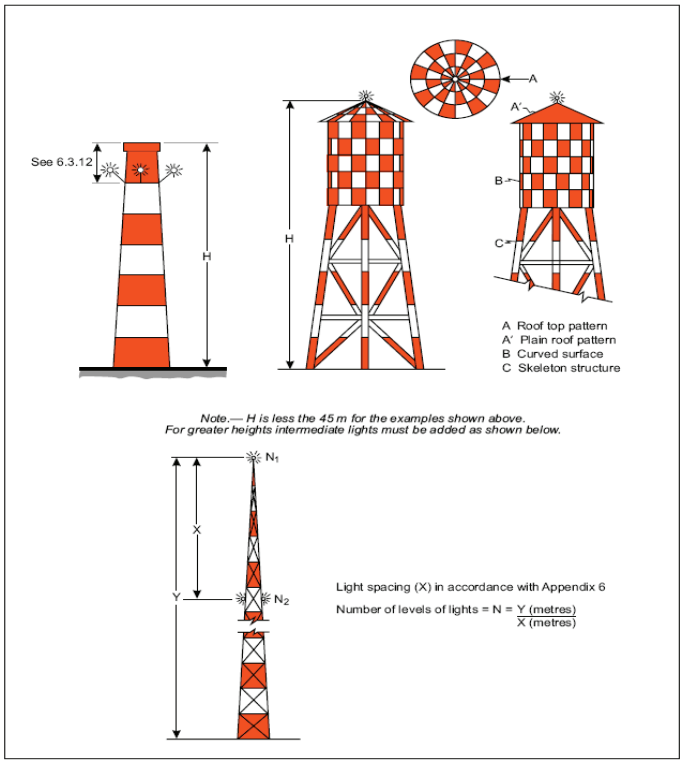
14.6.236 Flags used to mark fixed objects shall not be less than 0.6 m square and flags used to mark mobile objects, not less than 0.9 m square.

14.6.239 Recommendation.— Flags used to mark fixed objects should 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 should be used.

14.6.242 Flags used to mark mobile objects 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.

Figure 6-2. Examples of marking and lighting of tall structures



14.6.300 LIGHTING OF OBJECTS

Use of obstacle lights

14.6.303 The presence of objects which must be lighted, as specified in 14.6.100, shall be indicated by low-, medium- or high-intensity obstacle lights, or a combination of such lights.

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, Part 4.*

14.6.306 Recommendation.— Low-intensity obstacle lights, Type A or B, should be used where the object is a less extensive one and its height above the surrounding ground is less than 45 m.

14.6.309 Recommendation.— 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 should be used.

14.6.312 Low-intensity obstacle lights, Type C, shall be displayed on vehicles and other mobile objects excluding aircraft.

14.6.315 Low-intensity obstacle lights, Type D, shall be displayed on follow-me vehicles.

14.6.318 Recommendation.— Low-intensity obstacle lights, Type B, should be used either alone or in combination with medium-intensity obstacle lights, Type B, in accordance with 14.6.321.

14.6.321 Recommendation.— Medium-intensity obstacle lights, Type A, B or C, should be used where the object is an extensive one or its height above the level of the surrounding ground is greater than 45 m. Medium-intensity obstacle lights, Types A and C, should be used alone, whereas medium intensity obstacle lights, Type B, should be used either alone or in combination with low-intensity obstacle lights, Type B.

Note.— *A group of trees or buildings is regarded as an extensive object.*

14.6.324 Recommendation.— High-intensity obstacle lights, Type A, should 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.

14.6.327 Recommendation.— High-intensity obstacle lights, Type B, should 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.

14.6.330 Recommendation.— Where, in the opinion of authority, the use of high-intensity obstacle lights, Type A or B, 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 should be provided. This system should be composed of high-intensity obstacle lights, Type A or B, 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.

Location of obstacle lights

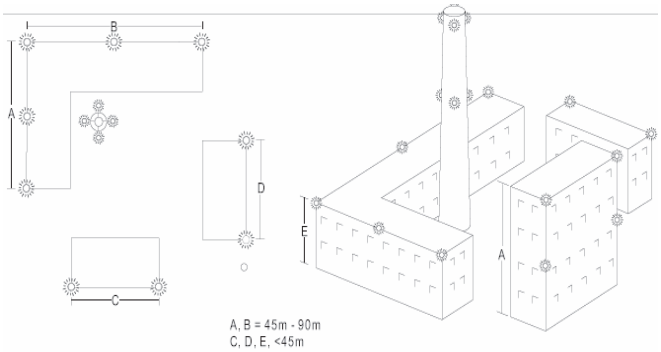
Note.— *Recommendations on how a combination of low-, medium-, and/or high-intensity lights on obstacles should be displayed are given in Appendix 6.*

14.6.333 One or more low-, medium- or high-intensity obstacle lights shall be located as close as practicable to the top of the object. 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.

14.6.336 Recommendation.— In the case of chimney or other structure of like function, the top lights should be placed sufficiently below the top so as to minimize contamination by smoke etc. (see Figures 6-2 and 6-3).

14.6.339 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.

Figure 6-2. Examples of marking and lighting of tall structures



14.6.342 In the case of an extensive object or of a group of closely spaced objects, top lights shall be displayed at least on the points or edges of the objects highest in relation to the obstacle limitation surface, 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. Where low-intensity lights are used, they shall be spaced at longitudinal intervals not exceeding 45 m. Where medium-intensity lights are used, they shall be spaced at longitudinal intervals not exceeding 900 m.

14.6.345 Recommendation.— When the obstacle limitation surface concerned is sloping and the highest point above the obstacle limitation surface is not the highest point of the object, additional obstacle lights should be placed on the highest point of the object.

14.6.348 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 (see 14.6.321).

14.6.351 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.

14.6.354 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.

14.6.357 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 14.6.333 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.

14.6.360 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.*

14.6.363 Recommendation.— The installation setting angles for high-intensity obstacle lights, Types A and B, should be in accordance with Table 6-2.

14.6.366 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 object 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.

Table 6-2. Installation setting angles for high-intensity obstacle lights

Height of light unit above terrain	Angle of the peak of the beam above the horizontal
greater than 151 m AGL	0°
122 m to 151 m AGL	1°
92 m to 122 m AGL	2°
less than 92 m AGL	3°

Low-intensity obstacle light — Characteristics

14.6.369 Low-intensity obstacle lights on fixed objects, Types A and B, shall be fixed-red lights.

14.6.372 Low-intensity obstacle lights, Types A and B, shall be in accordance with the specifications in Table 6-3.

14.6.375 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.

14.6.378 Low-intensity obstacle lights, Type D, displayed on follow-me vehicles shall be flashing-yellow.

14.6.381 Low-intensity obstacle lights, Types C and D, shall be in accordance with the specifications in Table 6-3.

14.6.384 Low-intensity obstacle lights on objects with limited mobility such as aerobridges shall be fixed-red. The intensity of the lights shall be sufficient to ensure conspicuity considering the intensity of the adjacent lights and the general levels of

14.6.387 Low-intensity obstacle lights on objects with limited mobility shall as a minimum be in accordance with the specifications for low-intensity obstacle lights, Type A, in Table 6-3.

Medium-intensity obstacle light — Characteristics

14.6.390 Medium-intensity obstacle lights, Type A, shall be flashing-white lights, Type B shall be flashing-red lights and Type C shall be fixed-red lights.

14.6.393 Medium-intensity obstacle lights, Types A, B and C, shall be in accordance with the specifications in Table 6-3.

14.6.396 Medium-intensity obstacle lights, Types A and B, located on an object shall flash simultaneously.

High-intensity obstacle light — Characteristics

14.6.399 High-intensity obstacle lights, Types A and B, shall be flashing-white lights.

14.6.3102 High-intensity obstacle lights, Types A and B, shall be in accordance with the specifications in Table 6-3.

14.6.3105 High-intensity obstacle lights, Type A, located on an object shall flash simultaneously.

14.6.3108 Recommendation.— High-intensity obstacle lights, Type B, indicating the presence of a tower supporting overhead wires, cables, etc., should flash sequentially; first the middle light, second the top light and last, the bottom light. The intervals between flashes of the lights should 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

Table 6-3. Characteristics of obstacle lights

1	2	3	4	5	6	7	8	9	10	11	12
Light Type	Colour	Signal Type/(flash rate)	Peak intensity (cd) at given Background Luminance			Vertical Bean Spread (c)	Intensity (cd) at given Elevation Angles when the light unit is levelled (d)				
			Above 500 cd/m²	50-500 cd/m²	Below 50 cd/m²		-10º (e)	-1º (f)	± 0º (f)	+ 6º	+10º
Low-intensity, Type A (fixed obstacle)	Red	Fixed	N/A	10 mnm	10 mnm	10º	–	–	–	10 mnm (g)	10 mnm (g)
Low-intensity, Type B (fixed obstacle)	Red	Fixed	N/A	32 mnm	32 mnm	10º	–	–	–	32 mnm (g)	32 mnm (g)
Low-intensity, Type C (fixed obstacle)	Yellow/Blue (a)	Flashing (60-90 fpm)	N/A	40 mnm (b) 400 max	40 mnm (b) 400 max	12º (h)	–	–	–	–	
Low-intensity, Type D Follow-me vehicle	Yellow	Flashing (60-90 fpm)	N/A	200 mnm (b) 400 max	200 mnm (b) 400 max	12º (h)	–	–	–	–	
Medium-intensity, Type A	White	Flashing (20-60 fpm)	20 000(b) ± 25%	20 000(b) ± 25%	2 000(b) ± 25%	3º mnm	3% max	50%mnm 75%max	100%mnm	–	
Medium-intensity, Type B	Red	Flashing (20-60 fpm)	N/A	N/A	2 000(b) ± 25%	3º mnm	–	50%mnm 75%max	100%mnm	–	
Medium-intensity, Type C	Red	Fixed	N/A	N/A	2 000(b) ± 25%	3º mnm	–	50%mnm 75%max	100%mnm	–	
High-intensity, Type A	White	Flashing (40-60 fpm)	200 000(b) ± 25%	20 000(b) ± 25%	2 000(b) ± 25%	3º -7º	3% max	50%mnm 75%max	100%mnm	–	
High-intensity, Type B	White	Flashing (40-60 fpm)	100 000(b) ± 25%	20 000(b) ± 25%	2 000(b) ± 25%	3º -7º	3% max	50%mnm 75%max	100%mnm	–	

Note.— *This table does not include recommended horizontal beam spreads. 6.3.22 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) See 14.6.375

b) Effective intensity, as determined in accordance with the Aerodrome Design Manual, Part 4.

c) Beam spread is defined as the angle between two directions in a plane for which the intensity is equal to 50% of the lower tolerance value of the intensity shown in columns 4, 5 and 6. The beam pattern is not necessarily symmetrical about the elevation angle at which the peak intensity occurs.

d) Elevation (vertical) angles are referenced to the horizontal.

e) Intensity at any specified horizontal radial as a percentage of the actual peak intensity at the same radial when operated at each of the intensities shown in columns 4, 5 and 6.

f) Intensity at any specified horizontal radial as a percentage of the lower tolerance value of the intensity shown in columns 4, 5 and 6.

g) In addition to specified values, lights shall have sufficient intensity to ensure conspicuity at elevation angles between ± 0° and 50°.

h) Peak intensity should be located at approximately 2.5° vertical.

i) Peak intensity should be located at approximately 17° vertical.

CHAPTER 7. VISUAL AIDS FOR DENOTING RESTRICTED USE AREAS

14.7.100 CLOSED RUNWAYS AND TAXIWAYS, OR PARTS THEREOF

Closed markings

Application

14.7.103 A closed marking shall be displayed on a runway or taxiway, or portion thereof, which is permanently closed to the use of all aircraft.

14.7.106 Recommendation.— A closed marking should 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.

Location

14.7.109 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.

Characteristics

14.7.112 The closed marking shall be of the form and proportions as detailed in Figure 7–1, Illustration A, when displayed on a runway, 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.— *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.*

14.7.115 When a runway or taxiway or portion thereof is permanently closed, all normal runway and taxiway markings shall be obliterated.

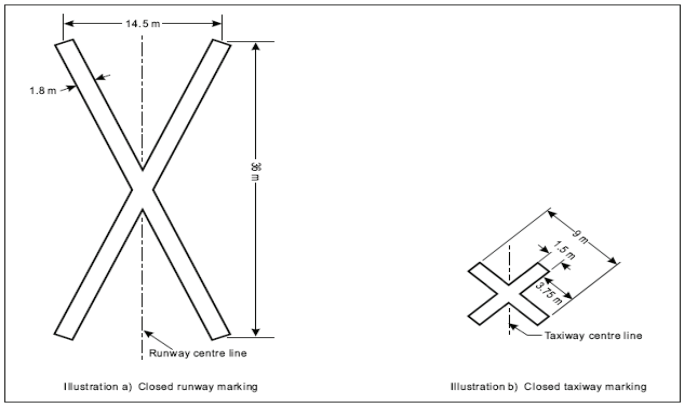
Lighting

General

14.7.118 Lighting on a closed runway or taxiway or portion thereof shall not be operated, except as required for maintenance purposes.

14.7.121 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.

Figure 7-1. Closed runway and Taxiway Markings



14.7.200 NON LOAD–BEARING SURFACES

Application

14.7.203 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.

Location

14.7.206 Recommendation.— A taxi side stripe marking should 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.

Characteristics

14.7.209 Recommendation.— A taxi side stripe marking should 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, Part 4.*

14.7.300 PRE– THRESHOLD AREAS

Application

14.7.303 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.

Note.— *Chevron markings are not to be applied to closed portions of runways.*

Location

14.7.306 A chevron marking shall point in the direction of the runway and originate at the threshold as shown in Figure 7–2.

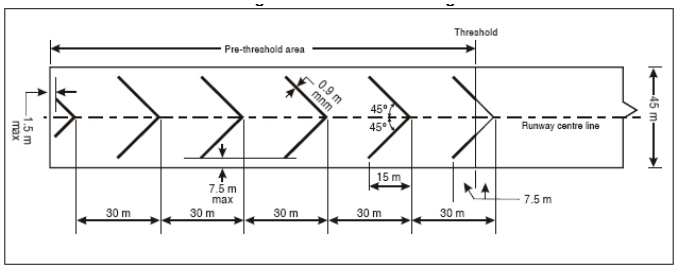
14.7.309 The maximum interval between individual chevrons shall be 30 m and the minimum interval shall be 15 m.

Characteristics

14.7.312 A chevron marking shall be yellow.

14.7.315 Recommendation.— A chevron marking should have an over–all width of at least 0.9 m.

Figure 7-2. Chevron Marking



14.7.400 UNSERVICEABLE AREAS

Application

14.7.403 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.— *Unserviceability markers 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.*

Location

14.7.406 Unserviceability markers and lights shall be placed at intervals sufficiently close so as to delineate the unserviceable area.

Characteristics of unserviceability markers

14.7.409 Unserviceability markers shall consist of conspicuous upstanding devices such as flags, cones, or marker boards.

Characteristics of unserviceability lights

14.7.412 An unserviceability light shall consist of a red fixed light. The red fixed 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.

Characteristics of unserviceability cones

14.7.415 Recommendation.— An unserviceability cone should be at least 0.5 m in height and red or international orange in combination with white.

Characteristics of unserviceability flags

14.7.418 Recommendation.— An unserviceability flag should be at least 0.5 m square and red or international orange in combination with white.

Characteristics of unserviceability marker boards

14.7.421 Recommendation.— An unserviceability marker board should be at least 0.5 m in height and 0.9 m in length, with alternate red and white or international orange and white vertical stripes.

CHAPTER 8. ELECTRICAL SYSTEMS

14.8.100 ELETRICAL 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.

Application

14.8.103 Adequate primary power supply shall be available at aerodromes for the safe functioning of air navigation facilities.

14.8.106 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.

14.8.109 Recommendation.— A secondary power supply should be provided, capable of supplying the power requirements of at least the aerodrome facilities listed below:

a) the signalling lamp and the minimum lighting necessary to enable air traffic services personnel to carry out their duties;

b) all obstacle lights which, in the opinion of the authority, are essential to ensure the safe operation of aircraft;

c) approach, runway and taxiway lighting as specified in 14.8.124 to 14.8.130;

d) meteorological equipment;

e) essential security lighting, if provided in accordance with 14.5.3615 ;

f) essential equipment and facilities for the aerodrome responding emergency agencies; and

g) illumination of apron areas over which passengers may walk.

Characteristics

14.8.112 Recommendation.— Electric power supply connections to those facilities for which secondary power is required should be so arranged that the facilities are automatically connected to the secondary power supply on failure of the normal source of power.

14.8.115 Recommendation.— The time interval between failure of the primary source of power and the complete restoration of the services required by 14.8.109 should be as short as practicable and should not exceed two minutes, except for visual aids associated with non-precision, precision approach or take-off runways the requirements of Table 8-1 for maximum switch-over times should apply.

14.8.118 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.

Note.— *In certain cases, less than thirty seconds has been found to be attainable.*

14.8.121 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 secondary power supply is given in the ICAO Aerodrome Design Manual, Part 5.*

VISUAL AIDS

Application

14.8.124 Recommendation.— At an aerodrome where the primary runway is a non-instrument runway, a secondary power supply capable of meeting the requirements of paragraph 14.8.115 should 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 14.5.342 is provided and capable of being deployed in 15 minutes.

Note.— *Guidance on means of achieving the specified secondary power supply switch-over time, etc., is given in the ICAO Aerodrome Design Manual, Part 5.*

14.8.127 Recommendation.— 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 should be provided except that a secondary power supply for visual aids need not be provided for more than one non-precision approach runway.

14.8.130 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.

14.8.133 For a runway intended to be used for take-off with an operating minimum below an RVR of the 800 m, a secondary power supply capable of meeting the relevant requirements of Table 8-1 shall be provided.

Table 8-1. Secondary power supply requirements (see 14.8.115)

Runway	Lighting aids requiring power	Maximum switch-over time
(1)	(2)	(3)
Non-instrument	Visual approach slope indicators [a] Runway edge [b] Runway threshold [b] Runway end [b] Obstacle [a]	See 14.8.115 and 14.8.121
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] PAPI [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
Take-off runway intended for use 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, section 5.3.2 regarding the use of emergency lighting.
c.— 1 second where no runway centre line lights are provided.
d.— 1 second where approach are over hazardous or precipitous terrain.

14.8.136 Where secondary power is provided, the following aerodrome visual aids shall be provided with a secondary power source:

a) Precision approach category I lighting systems;

b) Precision approach category II and III lighting systems;

c) Runway and taxiway centre line lights;

d) Touchdown zone lights;

e) Runway edge lights; and

f) apron lighting – those luminaries that provide illumination to the apron areas over which passengers will walk from the aircraft to the terminal except that it is not required when deplaning is by means of passenger loading bridges or passenger transport vehicles.

14.8.200 SYSTEM DESIGN

14.8.203 For a precision approach runway and a take-off runway intended for use in runway visual range conditions less than a value of 550 m, the electrical system for the power supply, lighting and control of the lighting systems included in Table 8-1 shall be so designed that the failure of one circuit will not leave the pilot without visual guidance or will not result in a misleading or inadequate pattern.

14.8.206 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.

14.8.209 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.

14.8.300 MONITORING

Visual aids

Note.— *Guidance on this subject is given in the ICAO Aerodrome Design Manual.*

General

14.8.303 Recommendation.— A system of monitoring visual aids should be employed to ensure lighting system reliability.

14.8.306 APAPI installations shall be inspected on a daily basis to detect an out of level condition or, alternately, shall be fitted with an automatic shut-off switch which will extinguish both units in the event of a misalignment on one or both units.

Note.— *This is to preclude a misalignment on one or both APAPI units caused by a nature (eg. frost heaves) or by physical interference which could result in a dangerously low "on slope" indication.*

Automatic monitoring

14.8.309 Where lighting systems are used for aircraft control purposes, such systems shall be monitored automatically so as to provide an immediate indication of any fault which may affect the control functions. This information shall be automatically relayed to the air traffic service unit.

14.8.312 Recommendation.— Where a change in the operational status of lights has occurred, an indication should 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.

14.8.315 Recommendation.— For a precision approach runway and runways intended to be used for take-off with an operating minimum below an RVR of the order of 550 m, the lighting systems detailed in Table 8-1 should be monitored so as to provide an immediate indication when the serviceability level of any element falls below the minimum serviceability level specified in paragraphs 14.10.421 to 14.10.433 as appropriate. This information should be immediately relayed to the maintenance centre.

14.8.318 Recommendation.— For a precision approach runway and runways intended to be used for take-off with an operating minimum below an RVR of the order of 550 m, the lighting systems detailed in Table 8-1 should be monitored automatically to provide an immediate indication when the serviceability level of any element falls below the minimum specified serviceability level, below which operations should not continue. This information should be automatically relayed to the air traffic services unit.

Note.— *Guidance on air traffic control interface and visual aids monitoring is included in the ICAO Aerodrome Design Manual, Part 5.*

CHAPTER 9. AERODROME OPERATIONAL SERVICES, EQUIPMENT AND INSTALLATIONS

14.9.100 AERODROME EMERGENCY PLANNING

Note *1.— 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 with respect to 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 in establishing aerodrome emergency planning is given in

a) the Airport Emergency Planning Manual;

b) the ICAO Airport Services Manual Part 7.

Application

14.9.103 An aerodrome emergency response plan shall be established at an aerodrome, commensurate with the aircraft operations and other activities conducted at the aerodrome.

14.9.106 The aerodrome emergency response plan shall provide for the coordination of the actions to be taken in an emergency occurring at an aerodrome or in its vicinity.

Note.— *Examples of emergencies are: aircraft emergencies, sabotage including bomb threats, unlawfully seized aircraft, medical emergencies, dangerous goods occurrences, building fires and natural disasters. Aircraft emergencies may include aircraft crashes on or off aerodrome (in water at some sites).*

14.9.109 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.— *Examples of agencies are:*

a) on the aerodrome: air traffic services unit, rescue and fire fighting services, aerodrome administration, medical and ambulance services, aircraft operators, security services, and police;

b) off the aerodrome: fire departments, police, medical and ambulance services, hospitals, military, and harbour patrol or coast guard.

Emergency response plan document

14.9.112 The plan shall provide for cooperation and coordination with the rescue coordination centre, as necessary.

14.9.115 The aerodrome emergency plan document shall include at least the following:

a) types of emergencies planned for;

b) agencies involved in the plan (both on and off the aerodrome) along with their telephone numbers and notification procedures;

c) responsibility and role of each agency, the emergency operations centre and the command post, for each type of emergency;

d) a clearly specified commander and chain of authority for each emergency specified and covering all phases of the emergency;

e) information on names and telephone numbers of offices or people to be contacted in the case of a particular emergency;

f) a list of pertinent on-aerodrome services available with telephone numbers and contact procedures;

g) copies of Memoranda of Understanding (MOUs) or agreements with other agencies for mutual aid and the provision of emergency services; and

h) a grid map of the aerodrome and its immediate vicinity.

14.9.118 The plan shall observe Human Factors principles to ensure optimum response by all existing agencies participating in emergency operations.

14.9.121 Recommendation.— At aerodromes receiving regularly scheduled passenger service, aircraft crash charts should be provided to the emergency response vehicle(s) normally providing first emergency response.

Emergency operations centre and command post

Application

14.9.124 Recommendation.— A fixed emergency operations centre and a mobile command post should be available for use during an emergency.

Characteristics

14.9.127 Recommendation.— The emergency operations centre should be a part of the aerodrome facilities and should be responsible for the overall coordination and general direction of the response to an emergency.

14.9.130 Recommendation.— The command post should be a facility capable of being moved rapidly to the site of an emergency, when required, and should undertake the local coordination of those agencies responding to the emergency.

14.9.133 Recommendation.— The aerodrome operator should assign a person to assume control of the emergency operations centre and, when appropriate, another person the command post.

Communication system

14.9.136 Recommendation.— Adequate communication systems linking the command post and the emergency operations centre with each other and with the participating agencies should be provided in accordance with the plan and consistent with the particular requirements of the aerodrome.

Aerodrome emergency exercise

14.9.139 The aerodrome emergency response 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 resources.*

14.9.142 The aerodrome emergency response plan shall be

tested by conducting a full-scale aerodrome emergency exercise at the interval specified in CV CAR 14.C.130; and

partial emergency exercises as required in CV CAR 14.C.130 to ensure that any deficiencies found during the full-scale aerodrome emergency exercise have been corrected and reviewed thereafter, or after an actual emergency, so as to correct any deficiency found during such exercises or actual emergency.

Note.— *The purpose of a full-scale exercise is to ensure the adequacy of the plan to cope with different types of emergencies. The purpose of a partial exercise is to ensure the adequacy of the response to individual participating agencies and components of the plan, such as the communications system.*

Emergencies in difficult environments

14.9.145 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.

14.9.148 Recommendation.— At those aerodromes located close to water and/or swampy areas, or difficult terrain, the aerodrome emergency plan should include the establishment, testing and assessment at regular intervals of a pre-determined response for the specialist rescue services.

14.9.200 RESCUE AND FIRE FIGHTING

General

Note.— *The principal objective of a rescue and fire fighting service is to save lives. For this reason, the provision of means of dealing with an aircraft accident or incident occurring at, or in the immediate vicinity of, an aerodrome assumes primary importance because it is within this area that there are the greatest opportunities of saving lives. This must assume at all times the possibility of, and need for, extinguishing a fire which may occur either immediately following an aircraft accident or incident, or at any time during rescue operations.*

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 fire fighting purposes can be put into use.

Requirements to combat building and fuel farm fires, or to deal with foaming of runways, are not taken into account.

Application

14.9.203 Rescue and fire fighting equipment and services shall be provided at an aerodrome.

Note.— *Public or private organizations, suitably located and equipped, may be designated to provide the rescue and fire fighting service. It is intended that the fire station housing these organizations be normally located on the aerodrome, although an off-aerodrome location is not precluded provided the response time can be met.*

14.9.206 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 fire fighting equipment appropriate to the hazard and risk shall be available.

Note.— *Special fire fighting 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.— *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.— *Additional guidance is available in Chapter 13 of the Airport Services Manual, Part 1.*

Level of protection to be provided

Note.— *See CV CAR 14.F.120 for standards relating to the required level of protection for rescue and fire fighting considering aeroplanes categories.*

Note.— *Guidance on categorizing aerodromes for rescue and fire fighting purposes and on providing rescue and fire fighting equipment and services is given in the Airport Services Manual, Part 1.*

Extinguishing agents

Note.— *Descriptions of the agents may be found in the Airport Services Manual, Part 1.*

14.9.209 Recommendation.— The principal extinguishing agent should be:

a) a foam meeting the minimum performance level A; or

b) a foam meeting the minimum performance level B; or

c) a combination of these agents;

except that the principal extinguishing agent for aerodromes in categories 1 to 3 should preferably meet the minimum performance level B.

Note.— *Information on the required physical properties and fire extinguishing performance criteria needed for a foam to achieve an acceptable performance level A or B rating is given in the Airport Services Manual, Part 1.*

Note.— *When selecting dry chemical powders for use with foam, care must be exercised to ensure compatibility.*

Note.— *Alternate complementary agents having equivalent fire fighting capability may be utilized. Additional information on extinguishing agents is given in the Airport Services Manual, Part 1.*

14.9.212 The amounts of water for foam production and the complementary agents to be provided on the rescue and fire fighting vehicles shall be in accordance with the aerodrome category, except that these amounts may be modified as follows:

a) for aerodrome categories 1 and 2 up to 100 per cent of the water may be replaced by complementary agent; or

b) for aerodrome categories 3 to 10 when a foam meeting performance level A is used, up to 30 per cent of the water may be replaced by complementary agent.

For the purpose of agent substitution, the following equivalents shall be used:

1kg = 1.0 L water for production of foam complementary agent meeting performance level A

1kg = 0.66 L water for production of foam complementary agent meeting performance level B

Note.— *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, and 5.5 L/min/m2 for a foam meeting performance level B.*

Note.— *When any other complementary agent is used, the substitution ratios need to be checked.*

14.9.215 Recommendation.— Supplementary water supplies, for the expeditious replenishment of rescue and fire fighting vehicles at the scene of an aircraft accident, should be provided.

14.9.218 Recommendation.— When both a foam meeting performance level A and a foam meeting performance level B are to be used, the total amount of water to be provided for foam production should first be based on the quantity which would be required if only a foam meeting performance level A were used, and then reduced by 3 L for each 2 L of water provided for the foam meeting performance level B.

14.9.221 Recommendation.— The complementary agents should comply with the appropriate specifications of the International Organization for Standardization (ISO).*

14.9.224 Recommendation.— The discharge rate of complementary agents should be selected for optimum effectiveness of the agent.

14.9.227 Recommendation.— A reserve supply of foam concentrate and complementary agent, equivalent to 200 per cent of the quantities of these agents to be provided in the rescue and fire fighting vehicles, should be maintained on the aerodrome for vehicle replenishment purposes. Where a major delay in the replenishment of this supply is anticipated, the amount of reserve supply should be increased.

Rescue equipment

Note.— *Guidance on the rescue equipment to be provided at an aerodrome is given in the Airport Services Manual, Part 1.*

Response time

14.9.230 The operational objective of the rescue and fire fighting 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.

14.9.233 Recommendation.— The operational objective of the rescue and fire fighting service should be to achieve a response time not exceeding two minutes to any point of each operational runway, in optimum visibility and surface conditions.

14.9.236 Recommendation.— The operational objective of the rescue and fire fighting service should 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.— *Response time is considered to be the time between the initial call to the rescue and fire fighting 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.*

Note.— *To meet the operational objective as nearly as possible in less than optimum conditions of visibility, it may be necessary to provide suitable guidance and/or procedures for rescue and fire fighting vehicles.*

Note.— *Optimum visibility and surface conditions are defined as daytime, good visibility, no precipitation with normal response route free of surface contamination.*

14.9.239 Recommendation.— A system of preventive maintenance of rescue and fire fighting vehicles should be employed to ensure effectiveness of the equipment and compliance with the specified response time throughout the life of the vehicle.

Emergency access roads

14.9.242 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 should 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 should be taken into account.

Note.— *Aerodrome service roads may serve as emergency access roads when they are suitably located and constructed.*

14.9.245 Recommendation.— Emergency access roads should 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 should be surfaced to prevent surface erosion and the transfer of debris to the runway. Sufficient vertical clearance should be provided from overhead obstructions for the largest vehicles.

14.9.248 Recommendation.— When the surface of the road is indistinguishable from the surrounding area, edge markers should be placed at intervals of about 10 m.

Fire stations

14.9.251 All rescue and fire fighting vehicles should normally be housed in a fire station. Satellite fire stations should be provided whenever the response time cannot be achieved from a single fire station.

14.9.254 Recommendation.— The fire station should be located so that the access for rescue and fire fighting vehicles into the runway area is direct and clear, requiring a minimum number of turns.

Communication and alerting systems

14.9.257 Recommendation.— A discrete communication system should be provided linking a fire station with the control tower, any other fire station on the aerodrome and the rescue and fire fighting vehicles.

14.9.260 Recommendation.— An alerting system for rescue and fire fighting personnel, capable of being operated from that station, should be provided at a fire station, any other fire station on the aerodrome and the aerodrome control tower.

14.9.300 DISABLED AIRCRAFT REMOVAL

Note.— *Guidance on removal of a disabled aircraft, including recovery equipment, is given in the ICAO Airport Services Manual, Part 5 and Part 8, chapter 14.*

Application

14.9.303 A plan for the removal of an aircraft disabled on, or adjacent to, the movement area shall be established for an aerodrome certified for international operations, and a coordinator designated to implement the plan, when necessary.

Note.— *In determining the requirement for, and extent of a Disabled Aircraft Removal Plan factors to be considered include but are not limited to:*

a) frequency of air traffic at the aerodrome;

b) size and weight of aircraft using the aerodrome; and

c) the physical characteristics of the aerodrome.

Characteristics

14.9.306 Recommendation.— The disabled aircraft removal plan should be developed by the aerodrome operator in consultation with aircraft owners and operators.

14.9.309 — 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;

b) arrangements for the rapid receipt of aircraft recovery equipment kits available from other aerodromes;

c) a list of nominated agents acting on behalf of each aircraft operator at the aerodrome;

d) a statement of the aircraft operator arrangements for the use of pooled specialist equipment; and

e) a list of local contractors (with contacts and telephone numbers) with suitable removal equipment for hire.

14.9.312 Recommendation.— All major users of the aerodrome should be informed of the preparations and capabilities contained within the disabled aircraft removal plan. The designated coordinator should be made known to all aircraft owners and operators.

Removal of disabled aircraft from operational areas

Note.— *See introductory note at the beginning of this section*

14.9.315 Where a disabled aircraft is on a part of an aerodrome that interferes with the movement of other aircraft, the disabled aircraft shall be moved as quickly as is consistent with the safety of life and property.

Note.— *A claim for damages could follow an attempt to move a crashed or disabled aircraft if it was proven the act of moving worsened the damage. It is important therefore, to allow only the aircraft owner, operator, or his appointed representative to control the aircraft removal operation.*

14.9.400 BIRD HAZARD REDUCTION

General

14.9.403 The bird strike hazard on, or in the vicinity of, an aerodrome shall be assessed through:

a) the establishment of a national procedure for recording and reporting bird strikes to aircraft; and

b) the collection of information from aircraft operators, airport personnel, etc. on the presence of birds on or around the aerodrome.

14.9.406 Bird strike reports shall be collected and forwarded to ICAO for inclusion in the ICAO Bird Strike Information System (IBIS) database.

Note.— *The IBIS is designed to collect and disseminate information on bird strikes to aircraft. Information on the system is included in the Manual on the ICAO Bird Strike Information System (IBIS).*

14.9.409 When a bird strike hazard is identified at an aerodrome, the aerodrome operator shall take action to decrease the number of birds constituting a potential hazard to aircraft operations by adopting measures for discouraging their presence on, or in the vicinity of, an aerodrome.

Note.— Guidance on effective measures for establishing whether or not birds, on or near an aerodrome, constitute a potential hazard to aircraft operations, and on methods for discouraging their presence, is given in Airport Services Manual, Part 3.

14.9.412 The aerodrome operator shall take action to eliminate or to prevent the establishment of garbage disposal dumps or any such other source attracting bird activity on, or in the vicinity of, an aerodrome unless an aeronautical study indicates that they are unlikely to create conditions conducive to a bird hazard problem.

14.9.500 APRON MANAGEMENT SERVICE

General

14.9.503 Recommendation.— When warranted by the volume of traffic and operating conditions, an appropriate apron management service should be provided on an apron by an ATS unit, by another aerodrome operating authority, or by a cooperative combination of these, 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.

14.9.506 When the aerodrome control tower does not participate in the apron management service, Recommendation.— Procedures should be established to facilitate the orderly transition of aircraft between the apron management unit and the aerodrome control tower.

Note.— *Guidance on an apron management service is given in the Airport Services Manual, Part 8 and Manual of Surface Movement* ***Guidance and Control Systems (SMGCS).***

14.9.509 An apron management service shall be provided with radiotelephony communications facilities.

14.9.512 Where low visibility procedures are in effect, persons and vehicles operating on an apron shall be restricted to the essential minimum.

Note.— *Guidance on related special procedures is given in the ICAO Manual of Surface Movement Guidance and Control Systems (SMGCS).*

14.9.515 An emergency vehicle responding to an emergency shall be given priority over all other surface movement traffic.

14.9.518 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.

14.9.521 An aircraft stand shall be visually monitored to ensure that the recommended clearances distances are provided to an aircraft using the stand.

14.9.600 GROUND SERVICING OF AIRCRAFT

General

14.9.603 Fire extinguishing equipment suitable for at least initial intervention in the event of a 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 emergency response service in the event of a fire or major fuel pill.

14.9.606 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.

14.9.700 AERODROME VEHICLE OPERATIONS

Note.— *Guidance on aerodrome vehicle operations is contained in Attachment A, Section 12 and on traffic rules and regulations for vehicles in the Manual of Surface Movement Guidance and Control Systems (SMGCS).*

Note.— *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.*

14.9.703 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 authority.

14.9.706 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 authority when on the apron.

14.9.709 The driver of a vehicle on the movement area shall comply with all mandatory instructions conveyed by lights.

14.9.712 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 authority, when on the apron.

14.9.715 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.

14.9.800 SURFACE MOVEMENT GUIDANCE AND CONTROL SYSTEMS

Application

14.9.803 A surface movement guidance and control system shall be provided at an aerodrome.

Note.— Guidance on surface movement guidance and control systems is contained in the Manual of Surface Movement Guidance and Control Systems (SMGCS).

Characteristics

14.9.806 Recommendation.— The design of a surface movement guidance and control system should 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.

14.9.809 Recommendation.— The visual aid components of a surface movement guidance and control system, i.e. markings, lights and signs should be designed to conform with the relevant specifications in 14.5.200, 14.5.300 and 14.5.400, respectively.

14.9.812 Recommendation.— A surface movement guidance and control system should be designed to assist in the prevention of inadvertent incursions of aircraft and vehicles onto an active runway.

14.9.815 Recommendation.— The system should 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, Part 4.*

14.9.818 Where a surface movement guidance and control system 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.— *Guidance on installation of stop bars and taxiway centre line lights in surface movement guidance and control systems is given in the Aerodrome Design Manual, Part 4.*

14.9.821 Recommendation.— Surface movement radar for the manoeuvring area should be provided at an aerodrome intended for use in runway visual range conditions less than a value of 350 m.

14.9.824 Recommendation.— Surface movement radar for the manoeuvring area should be provided at an aerodrome other than that in 14.9.821 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) and in the Air Traffic Services Planning Manual (Doc 9426).*

14.9.900 SITING OF EQUIPMENT AND INSTALATIONS ON OPERATIONAL AREAS

Note.— *Requirements for obstacle limitation surfaces are specified in 14.4.200.*

Note.— *The design of light fixtures and their supporting structures, light units of visual approach slope indicators, signs, and markers. Guidance on the frangible design of visual and non-visual aids for navigation is given in the Aerodrome Design Manual, Part 6 (in preparation).*

14.9.903 Unless its function requires it to be there for air navigation 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 5, if it would endanger an aircraft; or

b) on a clearway if it would endanger an aircraft in the air.

14.9.906 Any equipment or installation required for air navigation 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.

14.9.909 Existing non-visual aids need not meet the requirement of 14.9.906 until 1 January 2010.

14.9.912 Recommendation.— Any equipment or installation required for air navigation purposes which must be located on the non-graded portion of a runway strip should be regarded as an obstacle and should be frangible and mounted as low as possible.

Note.— *Guidance on the siting of navigation aids is contained in the Aerodrome Design Manual, Part 6 (in preparation).*

14.9.915 Unless its function requires it to be there for air navigation 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.

14.9.918 Any equipment or installation required for air navigation 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 on that portion of the strip within 77.5 m of the runway centre line where the code number is 4 and the code letter is F; or

b) 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

c) penetrates the inner approach surface, the inner transitional surface or the balked landing surface;

shall be frangible and mounted as low as possible.

14.9.921 Existing non-visual aids need not meet the requirement of 14.9.918 b) until 1 January 2010.

Note.— *See 14.5.312 for the protection date for existing elevated approach lights.*

14.9.924 Recommendation.— Any equipment or installation required for air navigation purposes which is an obstacle of operational significance in accordance with 14.4.212, 14.4.233, 14.4.261 or 14.4.282 should be frangible and mounted as low as possible.

14.9.1000 FENCING

Application

14.9.1003 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.

14.9.1006 A fence or other suitable barrier shall be provided on an aerodrome to deter the inadvertent or premeditated access of an unauthorized person to a non-public area of the aerodrome.

Note.— *This is intended to include the barring of sewers, ducts, tunnels, etc., where necessary to prevent access.*

Note.— *Special measures may be required to prevent the access of an unauthorized person to runways or taxiway which overpass public roads.*

14.9.1009 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.

Location

14.9.1012 The fence or barrier should 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.

14.9.1015 Recommendation.— When greater security is thought necessary, a cleared area should be provided on both sides of the fence or barrier to facilitate the work of patrols and to make trespassing more difficult. Consideration should be given to the provision of a perimeter road inside the aerodrome fencing for the use of both maintenance personnel and security patrols.

Security lighting

14.9.1018 Recommendation.— At an aerodrome where it is deemed desirable for security reasons, a fence or other barrier provided for the protection of the aerodrome and its facilities should be illuminated at a minimum essential level. Consideration should be given to locating lights so that the ground area on both sides of the fence or barrier, particularly at access points, is illuminated.

CHAPTER 10. AERODROME MAINTENANCE

14.10.100 GENERAL

14.10.103 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.

Note.— *Preventive maintenance is programmed maintenance work done in order to prevent a failure or degradation of facilities.*

Note.— *"Facilities" are intended to include, but are not limited to, such items as pavements, prepared surfaces, visual aids, fencing, drainage systems and buildings.*

14.10.106 Recommendation.— The design and application of the maintenance programme should observe Human Factors principles.

Note.— *Guidance material on Human Factors principles can be found in the Human Factors Training Manual.*

14.10.200 PAVEMENTS

14.10.203 The surface of pavements (runways, taxiways, aprons, etc.) shall be kept clear of any loose stones or other objects that might cause damage to aircraft structures or engines, or impair the operation of aircraft systems.

Note.— *Guidance on precautions to be taken in regard to the surface of shoulders is given in Attachment A, Section 6, and the Aerodrome Design Manual, Part 2.*

14.10.206 The surface of a runway shall be maintained in a condition such as to preclude formation of harmful irregularities.

Note.— *See Attachment A, Section 4.*

14.10.209 For a runway serving turbojet aeroplanes, measurements of the friction characteristics of a runway surface shall be made periodically with a continuous friction measuring device using self-wetting features.

14.10.212 Corrective maintenance action shall be taken when:

a) the average coefficient of friction for the entire runway is below 0.50; or

b) any areas of a runway surface that are 100 metres or greater in length have an average coefficient of friction less than 0.30.

14.10.215 Corrective maintenance action shall be programmed when:

a) the average coefficient of friction for the entire runway is below 0.60; or

b) any areas of a runway surface that are 100 metres or greater in length have an average coefficient of friction less than 0.50.

14.10.218 Recommendation.— When there is reason to believe that the drainage characteristics of a runway or portions thereof are poor due to slopes or depressions then the runway friction characteristics should be assessed under natural or simulated conditions that are representative of local rain and corrective maintenance action should be taken as necessary.

14.10.221 Recommendation.— When a taxiway is used by turbine-engined aeroplanes the surface of the taxiway shoulders should 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 the subject is given in the ICAO Aerodrome Design Manual, Part 2.*

14.10.224 The surface of a runway shall be maintained in a condition so as to provide good friction characteristics and low rolling resistance. standing water and other contaminants should be removed as rapidly and completely as possible to minimize accumulation.

14.10.227 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.

14.10.300 RUNWAY PAVEMENT OVERLAYS

Note.— *The following specifications are intended for runway pavement overlay projects when the runway is to be returned to an operational status before overlay of the entire runway is complete thus normally necessitating a temporary ramp between the new and old runway surfaces. Guidance on overlaying pavements and assessing their operational status is given in the ICAO Aerodrome Design Manual, Part 3.*

14.10.303 The longitudinal slope of the temporary ramp shall not exceed 1.0 per cent measured with reference to the existing runway surface or previous overlay course, shall 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.

14.10.306 Recommendation.— Overlaying should 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.

14.10.309 Recommendation.— The entire width of the runway should be overlaid during each work session.

14.10.312 Before a runway being overlaid is returned to a temporary operational status, a runway centre line marking conforming to the specifications in Section 14.5.245 shall be provided. Additionally, the location of any temporary threshold shall be identified by a 3.6 m wide transverse stripe.

14.10.400 VISUAL AIDS

Note.— *These specifications are intended to define the maintenance performance level objectives. They are not intended to define whether the failure of a lighting system.*

Application

14.10.403 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.

14.10.406 A system of preventive maintenance of visual aids shall be employed to ensure lighting and marking system reliability.

Note.— *Guidance on preventive maintenance of visual aids is given in the ICAO Airport Services Manual, Part 9.*

14.10.409 Recommendation.— The system of preventive maintenance employed for a precision approach runway category II or III should 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.

14.10.412 Recommendation.— 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 should be undertaken by measuring all lights, as far as practicable, to ensure conformance with the applicable specification of Appendix 2.

14.10.415 Recommendation.— 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 should be undertaken using a mobile measuring unit of sufficient accuracy to analyze the characteristics of the individual lights.

14.10.418 Recommendation.— The frequency of measurement of lights for a precision approach runway category II or III should 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 should not be less than twice a year for in-pavement lights and not less than once a year for other lights.

14.10.421 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:

– precision approach category II and III lighting system, the inner 450 m;

– runway centre line lights;

– runway threshold lights; and

– 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 should 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.

14.10.424 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.

14.10.427 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.

14.10.430 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.

14.10.433 The system of preventive maintenance employed for a runway intended for take-off in runway visual range conditions less than a value of 550 m shall have as its objective that all 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:

– runway centre line lights;

– runway threshold lights; and

– runway edge lights; and

b) 75 per cent of the lights are serviceable in the runway end lights.

In order to provide continuity of guidance, an unserviceable lights shall not be permitted in such a way as to alter the basic pattern of the lighting system. Additionally, an unserviceable light should not be permitted adjacent to another unserviceable light.

Note.— *With respect to runway edge lights, lights are considered to be adjacent if located sequentially in the same row of edge lights.*

14.10.436 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.

14.10.439 Recommendation.— During low visibility procedures construction or maintenance activities in the proximity of aerodrome electrical systems should be restricted.

APPENDIX A. AERONAUTICAL GROUND LIGHT, MARKINGS, SIGNS AND PANELS COLOURS

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).

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.**

2 Colours for aeronautical ground lights

2.1 Chromaticities

2.1.1 The chromaticities of aeronautical ground lights shall be within the following boundaries:

CIE Equations (see Figure A1-1):

a) Red

Purple boundary	y = 0.980 – x
Yellow boundary	y = 0.335

b) Yellow

Red boundary	y = 0.382
White boundary	y = 0.790 – 0.667x
Green boundary	y = x – 0.120

c) Green

ellow 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 x = 1.185 – 1.500 y
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, Part 4.*

2.1.2 Recommendation.— 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

2.1.3 Recommendation.— Where increased certainty of recognition 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

2.2.1 Recommendation.— 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 Recommendation.— 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 Recommendation.— 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.

2.2.4 The colour of aeronautical ground lights shall be verified as being within the boundaries specified in Figure A1-1 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.— *For the outermost isocandela curve, a measurement of colour coordinates should be made and recorded for review and judgement of acceptability by the Authority.*

Note.— *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 should assess the actual application and if necessary require a check of colour shift at angular ranges beyond the outermost curve.*

2.2.5 In the case of visual approach slope indicators and other light units having a colour transition sector, the colour shall be measured at points in accordance with 2.2.4, 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.— *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.— *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.— *The specifications recommended in 3.4 below 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 retro-reflective 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 Recommendation.— 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

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 Recommendation.— The chromaticity and luminance factors of colours of retro-reflective materials for markings, signs and panels should be within the following boundaries when determined under standard conditions.

CIE Equations

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	y = 0.405 – 0.243x
Luminance factor	ß = 0.03 (mnm)

3.4 Recommendation.— The chromaticity and luminance factors of colours for 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%

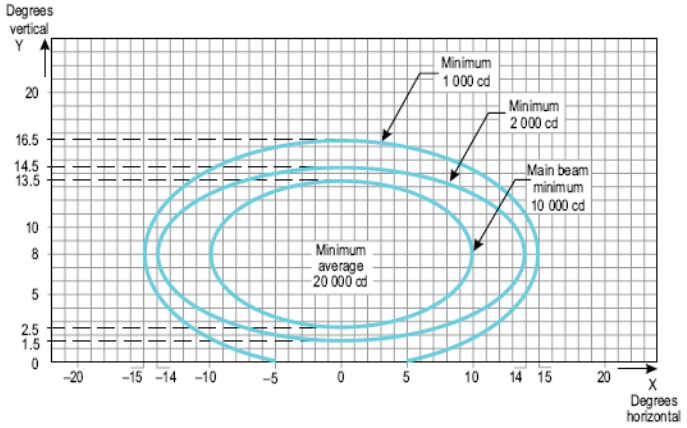
d) Black

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)	ß = 0.03 (max)
Relative luminance to white (night condition)	0% (mnm) 2% (max)

APPENDIX B. AERONAUTICAL GROUND LIGHT CHARACTERISTICS

B.1 APPROACH AND RUNWAY LIGHTS

Figure B-1. Isocandela diagram for approach centre line lights 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. Vertical setting angles of the lights shall be such that the following vertical coverage of the main beam will be met:

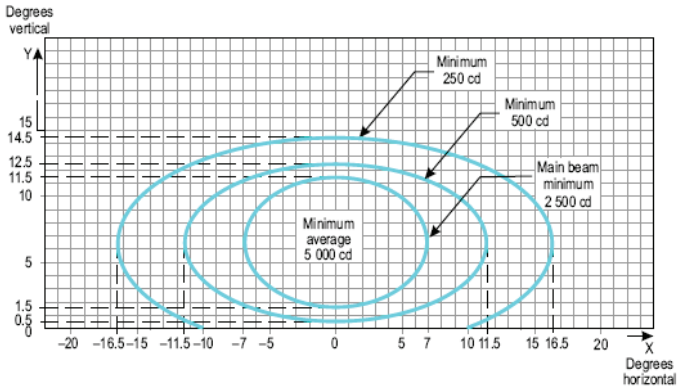
Distance from threshold	Vertical main beam coverage
threshold to 315 m	0.0°— 11°
316 m to 475 m	0.5°— 11.5°
476 m to 640 m	1.5°— 12.5°
641 m and beyond	2.5°— 13.5° (as illustrated above)

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 B-1 to-B-11.

B.1.2 APPROACH SIDE ROW LIGHTS

Figure B-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	7.0	11.5	16.5
B	5.0	6.0	8.0

2. Toe-in 2 degrees

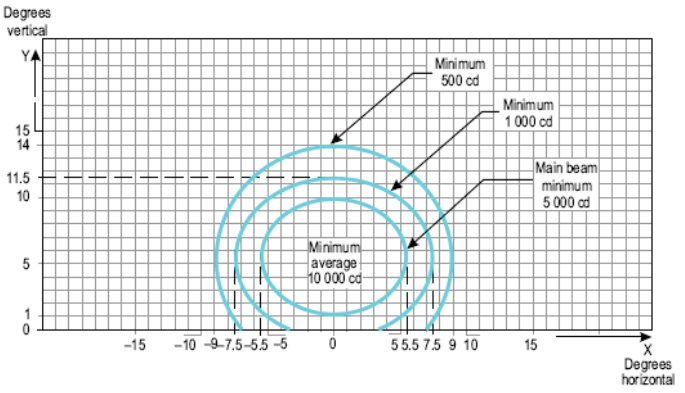
3. Vertical setting angles of the lights shall be such that the following vertical coverage of the main beam will be met:

Distance from threshold	Vertical main beam coverage
threshold to 115 m	0.5°— 10.5°
116 m to 215 m 0	1°— 11°
216 m and beyond	1.5°— 11.5° (as illustrated above)

4. See collective notes for Figures B-1 to B-11.

B.1.3 THRESHOLD LIGHTS

Figure B-3. Isocandela diagram for threshold light (green light)



Notes:

1. Curves calculated on formula

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

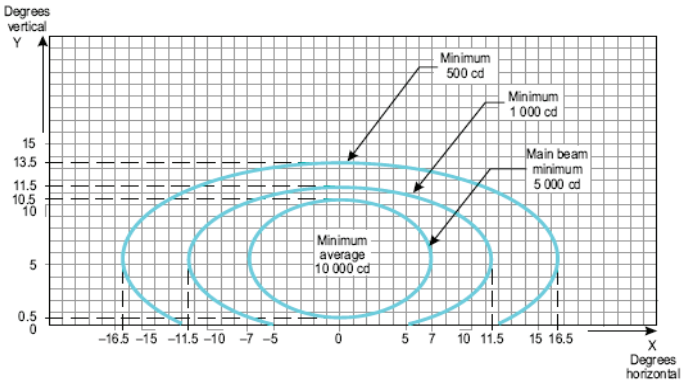
a	5.5	7.5	9.0
B	4.5	6.0	8.5

2. Toe-in 3.5 degrees

3. See collective notes for Figures B-1 to B-11.

B.1.4 WING BAR LIGHTS

Figure B-4. Isocandela diagram for wing bar light (green light)



Notes:

1. Curves calculated on formula

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

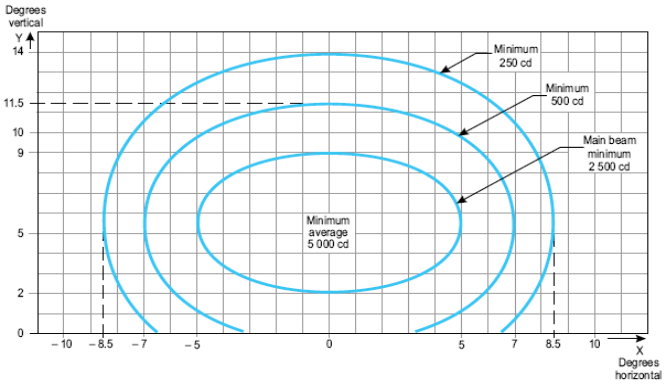
a	7.0	11.5	16.5
B	5.0	6.0	8.0

2. Toe-in 3 degrees

3. See collective notes for Figures B-1 to B-11.

B.1.5 TOUCHDOWN ZONE LIGHTS

Figure B-5. Isocandela diagram for touchdown zone light (white light)



Notes:

1. Curves calculated on formula

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

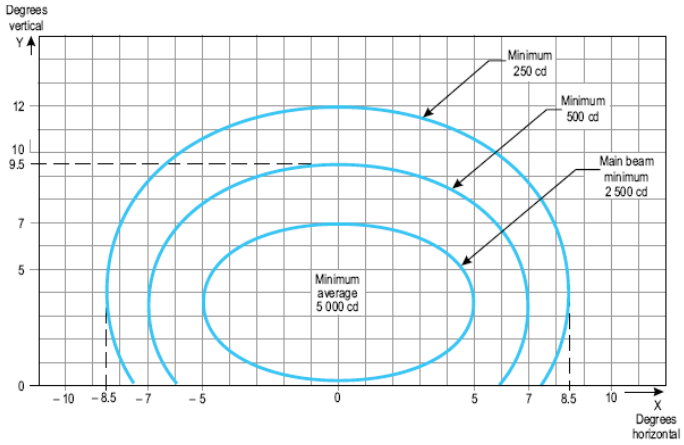
a	5.0	7.0	8.5
B	3.5	6.0	8.5

2. Toe-in 4 degrees

3. See collective notes for Figures B-1 to B-11.

B.1.6 RUNWAY CENTRE LINE LIGHTS (30 m spacing)

Figure B-6. Isocandela diagram for runway centre line light with 30 m longitudinal spacing (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

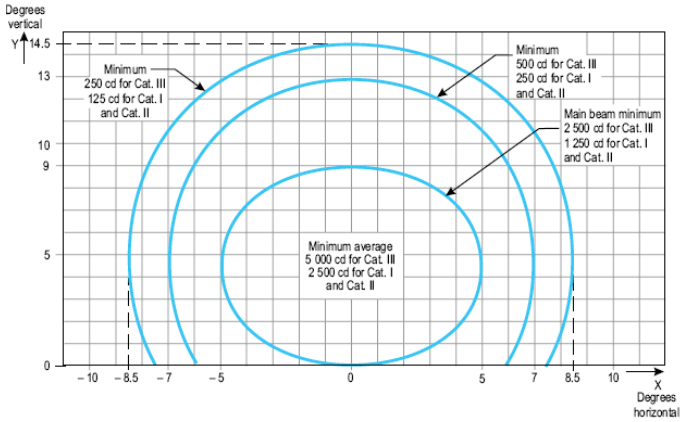
2. For red light, multiply values by 0.15.

3. For yellow light, multiply values by 0.40.

4. See collective notes for Figures B-1 to B-11.

B.1.7 RUNWAY CENTRE LINE LIGHTS (15 m spacing)

Figure B-7. Isocandela diagram for runway centre line light with 15 m longitudinal spacing (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	4.5	8.5	10

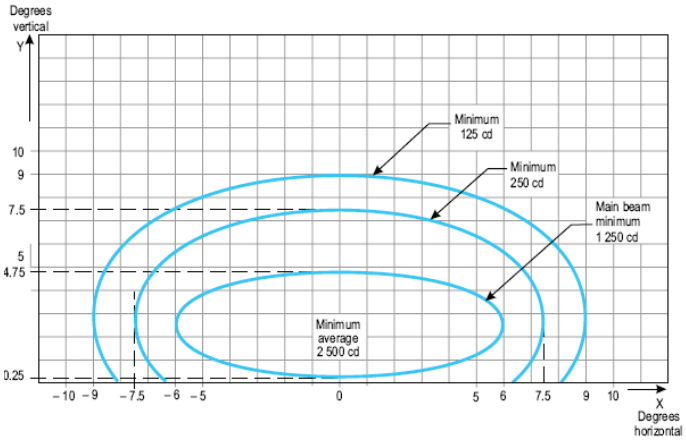
2. For red light, multiply values by 0.15.

3. For yellow light, multiply values by 0.40.

4. See collective notes for Figures B-1 to B-11.

B.1.8 RUNWAY END LIGHTS

Figure B-8. Isocandela diagram for runway end light (red light)



Notes:

1. Curves calculated on formula

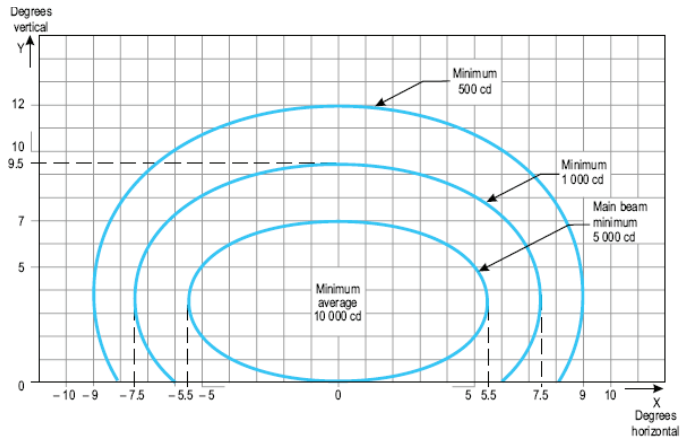
$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

a	6.0	7.5	9.0
b	2.25	5.0	6.5

2. See collective notes for Figures B-1 to B-11.

B.1.9 RUNWAY EDGE LIGHTS (45 m runway width)

Figure B-9. Isocandela diagram for runway edge light where the width of the runway is 45 m (white 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

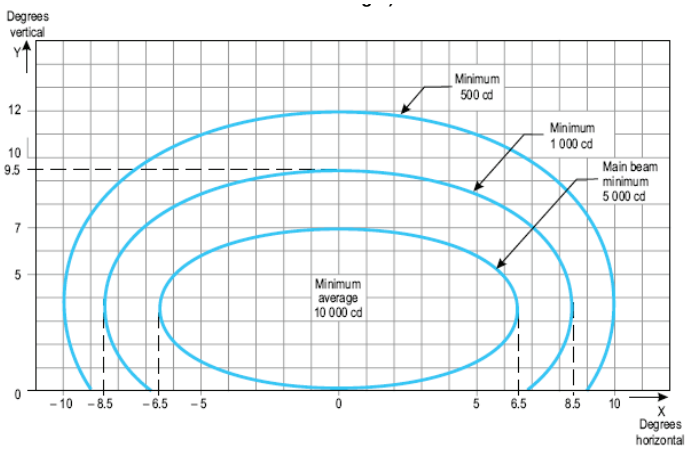
2. Toe-in 3.5 degrees.

3. For yellow light, multiply values by 0.40.

4. See collective notes for Figures B-1 to B-11.

B.1.10 RUNWAY EDGE LIGHTS (60 m runway width)

Figure B-10. Isocandela diagram for runway edge light where width of runway is 60 m (white light)



Notes:

1. Curves calculated on formula

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

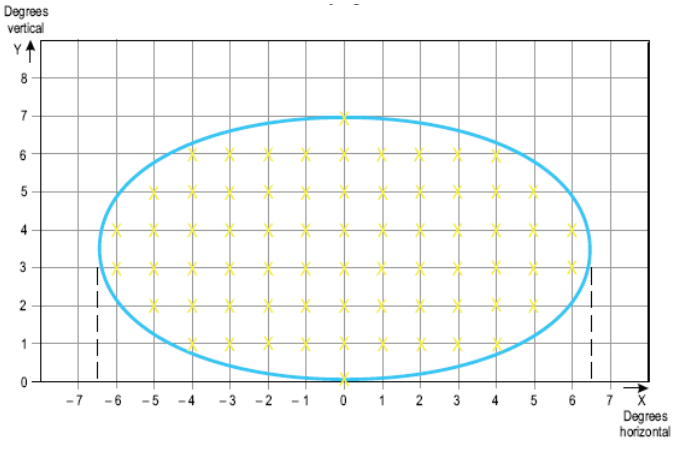
a	6.5	8.5	10.0
b	3.5	6.0	8.5

2. Toe-in 4.5 degrees.

3. For yellow light, multiply values by 0.40.

4. See collective notes for Figures B-1 to B-11.

Figure B-11 . Grid points to be used for the calculation of average intensity of approach and runway lights



B.1.12 COLLECTIVE REQUIREMENTS FOR APPROACH AND RUNWAY LIGHTS

B.1.12.1 The ellipses in each figure are symmetrical about the common vertical and horizontal axes.

B.1.12.2 The average intensity of the main beam of an approach or runway light (sections B.1.1 to B.1.10) shall be calculated by establishing grid points as shown in Figure B-11 and using the intensity values measured at all grid points located within and on the perimeter of the ellipse representing the main beam. The average value shall be the arithmetic average of light intensities measured at all considered grid points.

B.1.12.3 No deviations are acceptable in the main beam pattern when the lighting fixture is properly aimed.

B.1.12.4 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 B-1	Approach centre line and crossbars	1.5 to 2.0 (white light)
Figure B-2	Approach side row	0.5 to 1.0 (red light)
Figure B-3	Threshold	1.0 to 1.5 (green light)
Figure B-4	Wing bar	1.0 to 1.5 (green light)
Figure B-5	Touchdown zone	0.5 to 1.0 (white light)
Figure B-6	Runway centre line (30 m spacing)	0.5 to 1.0 (white light)
Figure B-7	Runway centre line (15 m spacing)	0.5 to 1.0 for CAT III (white light)
		0.25 to 0.5 for CAT I, II (white light)
Figure B-8	Runway end	0.25 to 0.5 (red light)
Figure B-9	Runway edge (45 m runway width)	1.0 (white light)
Figure B-10	Runway edge (60 m runway width)	1.0 (white light)

B.1.12.5 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.

B.1.12.6 Horizontal angles shall be 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 shall be considered positive. Vertical angles shall be measured with respect to the horizontal plane.

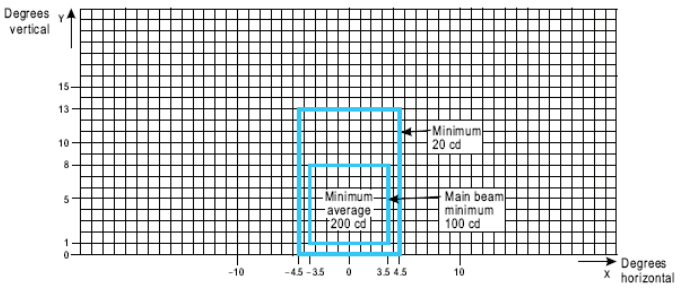
B.1.12.7 Where, for approach centre line lights and crossbars and for approach side row lights, inset lights are used in lieu of elevated lights, e.g. on a runway with a displaced threshold, the intensity requirements can be met by installing two or three fittings (lower intensity) at each position.

B.1.12.8 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.

B.2 TAXIWAY LIGHTS

B.2.1 TAXIWAY CENTRE LINE LIGHTS (15 m spacing) and STOP BAR LIGHTS IN STRAIGHT SECTIONS INTENDED FOR USE IN RVR CONDITIONS LESS THAN A VALUE OF 350 M

Figure B-12. Isocandela diagram for taxiway centre line (15 m spacing) and stop bar lights in straight sections intended for use in runway visual range conditions of less than a value of 350m



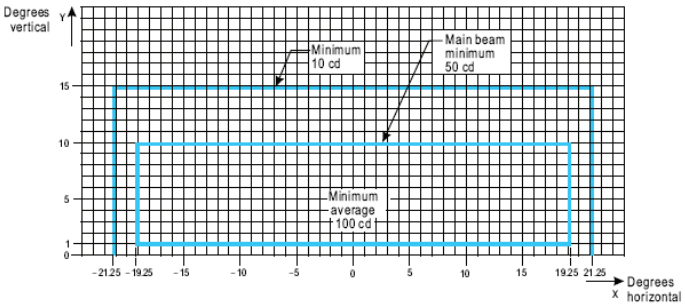
Notes:

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 B-12 to B-19.

B.2.2 TAXIWAY CENTRE LINE LIGHTS (7.5 m spacing) and STOP BAR LIGHTS IN CURVED SECTIONS INTENDED FOR USE IN RVR CONDITIONS LESS THAN A VALUE OF 350 M

Figure B-13. Isocandela diagram for taxiway centre line (7.5 m spacing) and stop bar lights in curved sections intended for use in runway visual range conditions of less than a value of the order of 350 m



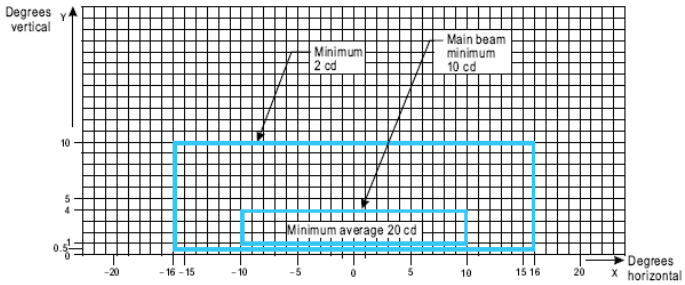
Notes:

1. Lights on curves to be toed-in 15.75 degrees with respect to the tangent of the curve.

2. See collective notes for Figures B-12 to B-19.

B.2.3 TAXIWAY CENTRE LINE LIGHTS (30 m, 60 m spacing) and STOP BAR LIGHTS IN STRAIGHT SECTIONS INTENDED FOR USE IN RVR CONDITIONS OF 350 M or GREATER

Figure B-14 . Isocandela diagram for taxiway centre line (30 m and 60 m spacing) and stop bar lights in straight sections intended for use in runway visual range conditions of the order of 350 m or greater



Notes:

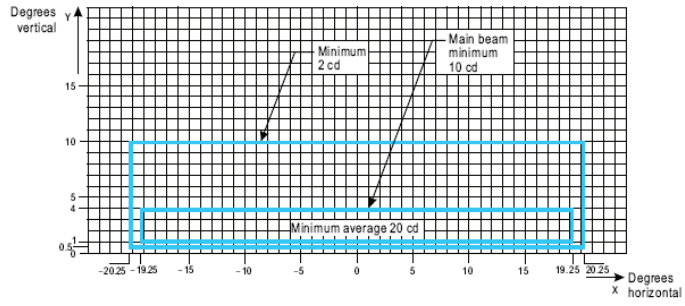
1. At locations where high background luminance is usual and where deterioration of light output resulting from dust and local contamination is a significant factor, the cd-values should be multiplied by 2.5.

2. Where omnidirectional lights are used they shall comply with the vertical beam requirements in this figure.

3. See collective notes for Figures B-12 to B-19.

B.2.4 TAXIWAY CENTRE LINE LIGHTS (7.5 m, 15 m, 30 m spacing) and STOP BAR LIGHTS IN CURVED SECTIONS INTENDED FOR USE IN RVR CONDITIONS OF 350 M OR GREATER

Figure B-15. Isocandela diagram for taxiway centre line (7.5 m, 15 m, 30 m spacing) and stop bar lights in curved sections intended for use in runway visual range conditions of the order of 350 m or greater



Notes:

1. Lights on curve to be toed-in 15.75 degrees with respect to the tangent of the curve.

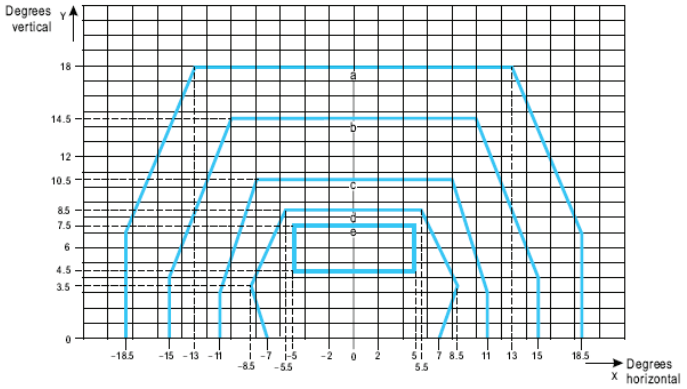
2. At locations where high background luminance is usual and where deterioration of light output resulting from dust and local contamination is a significant factor, the cd-values should be multiplied by 2.5.

2. These bean 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.

3. See collective notes for Figures B-12 to B-19.

B.2.5 HIGH-INTENSITY TAXIWAY CENTRE LINE LIGHTS (15 m spacing) 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

Figure A2-16. Isocandela diagram for high-intensity taxiway centre line (15 m spacing) 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	e
Intensity (cd)	8	20	100	450	1 800

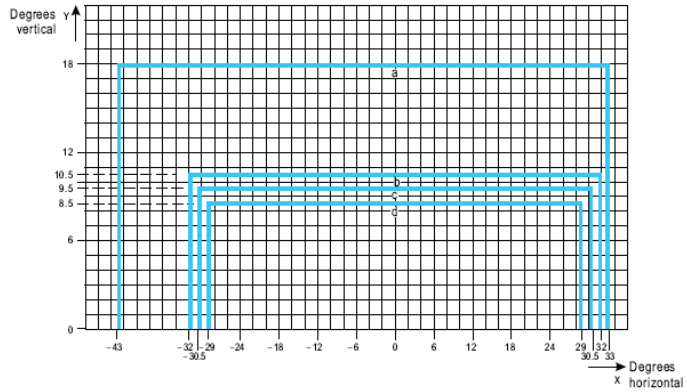
Notes:

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 B-12 to B-19.

B.2.6 HIGH-INTENSITY TAXIWAY CENTRE LINE LIGHTS (7.5 m spacing) and STOP BAR LIGHTS IN CURVE SECTIONS INTENDED FOR USE IN AN ADVANCED SURFACE MOVEMENT GUIDANCE AND CONTROL SYSTEM WHERE HIGHER LIGHT INTENSITIES ARE REQUIRED

Figure A2-17. Isocandela diagram for high-intensity taxiway centre line (7.5 m spacing) 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



Curve	a	B	c	d	e
Intensity (cd)	8	100	200	450	400

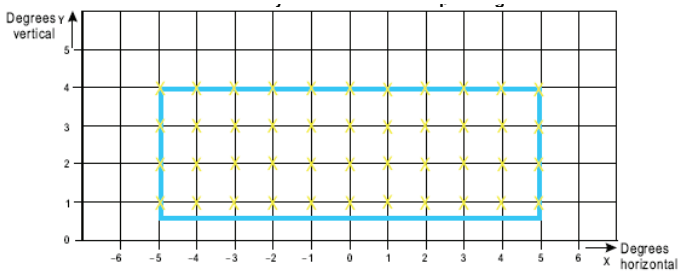
Notes:

1. Lights on curves to be toed-in 17 degrees with respect to the tangent of the curve.

2. See collective notes for Figures B-12 to B-19.

B.2.7 COLLECTIVE REQUIREMENTS FOR TAXIWAY LIGHTS

Figure B-18 . Grid points to be used for the calculation of average intensity of taxiway centre line and stop bar lights



1.The intensities specified in Figures B-12 to B-17 are in green and yellow light for taxiway centre line lights and red light for stop bar lights.

2. Figures B-12 to B-17 show the minimum allowable light intensities. The average intensity of the main beam is calculated by establishing grid points as shown in Figure B-18 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.

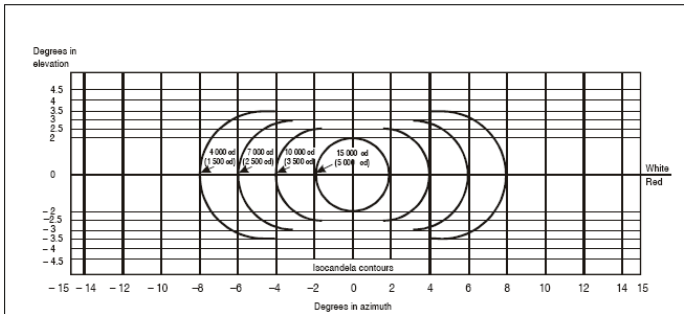
6. The importance of adequate maintenance cannot be over-emphasized. The intensity, either average where applicable or as specified on the corresponding isocandela curves, should never fall to a value less than 50 per cent of the value shown in the figures, and it should be the aim of airport authorities 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.

B.3 VISUAL APPROACH SLOPE INDICATOR SYSTEMS

B.3.1 PAPI and APAPI

Figure B-19 . Light intensity and distribution of PAPI and APAPI



B.3.1.1 The light intensity distribution of a PAPI or APAPI light unit shall be as illustrated in Figure B-19.

Note.— The curves shown in Figure B-19 are for minimum intensities in red light .

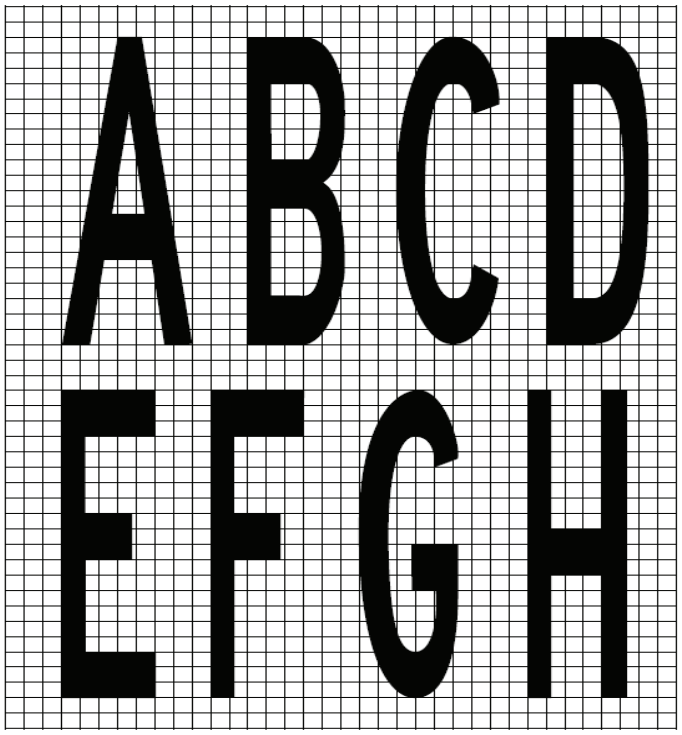
B.3.1.2 The light intensity value of the white sector of the beam as illustrated in Figure B-19 shall not be less than 2 times the corresponding intensity in the red sector.

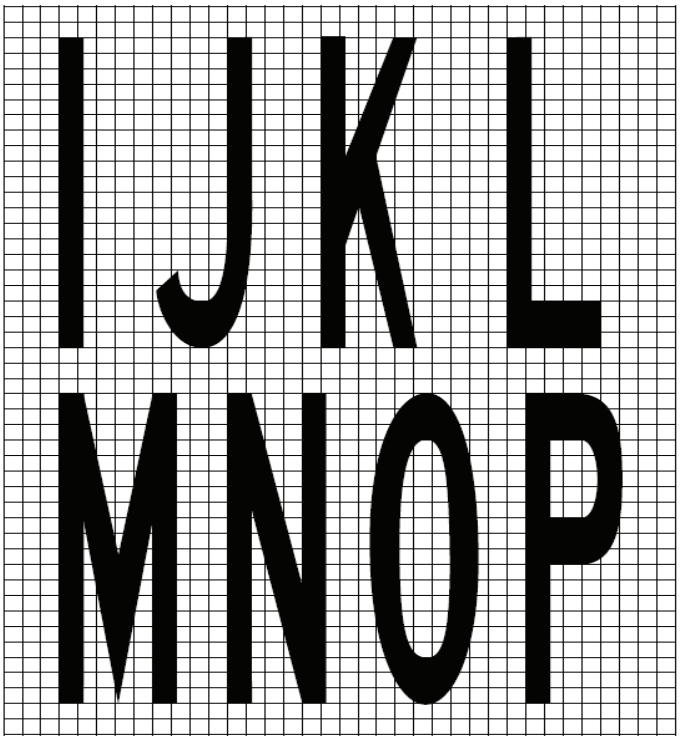
Note.— The intensity value in the white sector of the beam may be as high as 6.5 times the corresponding intensity in the red sector.

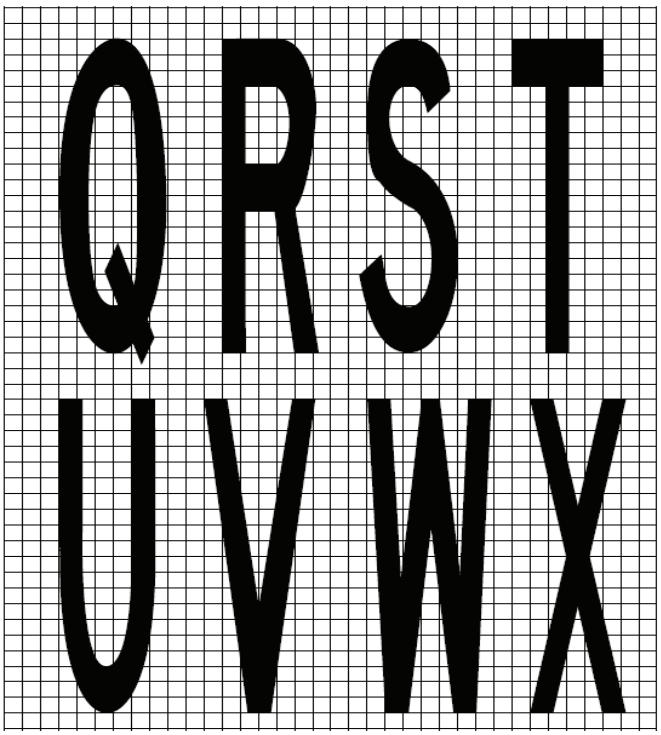
B.3.1.3 At full intensity, the red light shall have a V coordinate not exceeding 0.320.

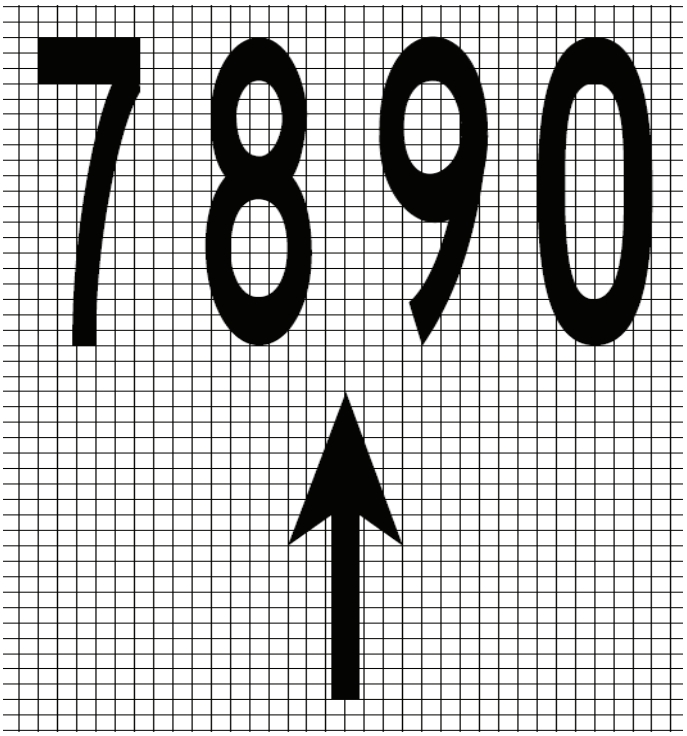
APPENDIX C. MANDATORY INSTRUCTION MARKINGS AND INFORMATION MARKINGS

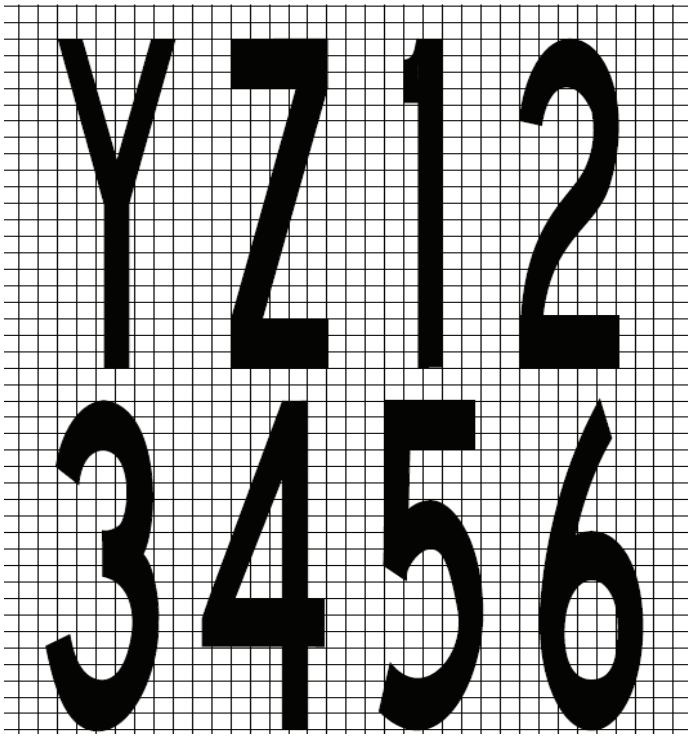
Note.— This appendix details the form and proportions of the letters, numbers and symbols of mandatory instruction markings and information markings on a 20 cm grid.











APPENDIX D. AIRSIDE GUIDANCE SIGN DESIGN SPECIFICATIONS

Note.— *See Chapter 5, Section 14.5.400 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 vacate sign	Other sign
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 14.5.4135), 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/m2
Yellow	150 cd/m2
White	300 cd/m2

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/m2
Yellow	50 cd/m2
White	100 cd/m2

Note.— *In runway visual range conditions less than a value of 400m, 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 D-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, 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 D-2.

The width of characters and the space between individual characters shall be determined as indicated in Table D-1.

10. The face height of signs shall be as follows:

Legend height	Face height (min)
200 mm	400 mm
300 mm	600 mm
400 mm	800 mm

11. The face width of signs shall be determined using Figure D-3 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, Part 4.*

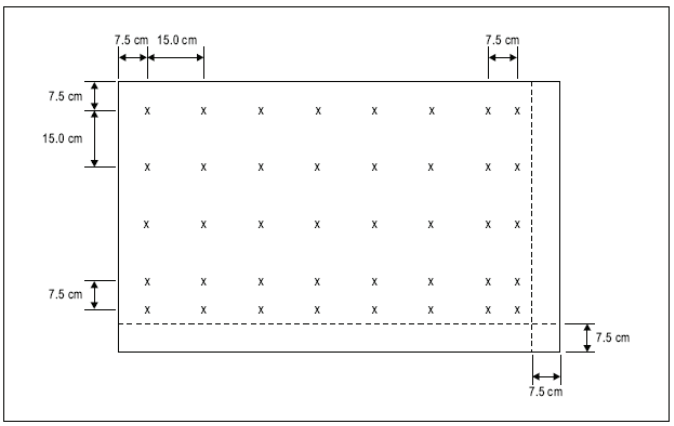
12. Borders

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 A.

Figure D-1. Grid points for calculating average luminance of a sign



Note.— *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.— *Additional grid points may be required to ensure that each character includes at least five evenly spaced grid points.*

Note.— *Where one unit includes two types of signs, a separate grid shall be established for each type.*

Figure D-2. Form and proportion of sign characters (sheet1)

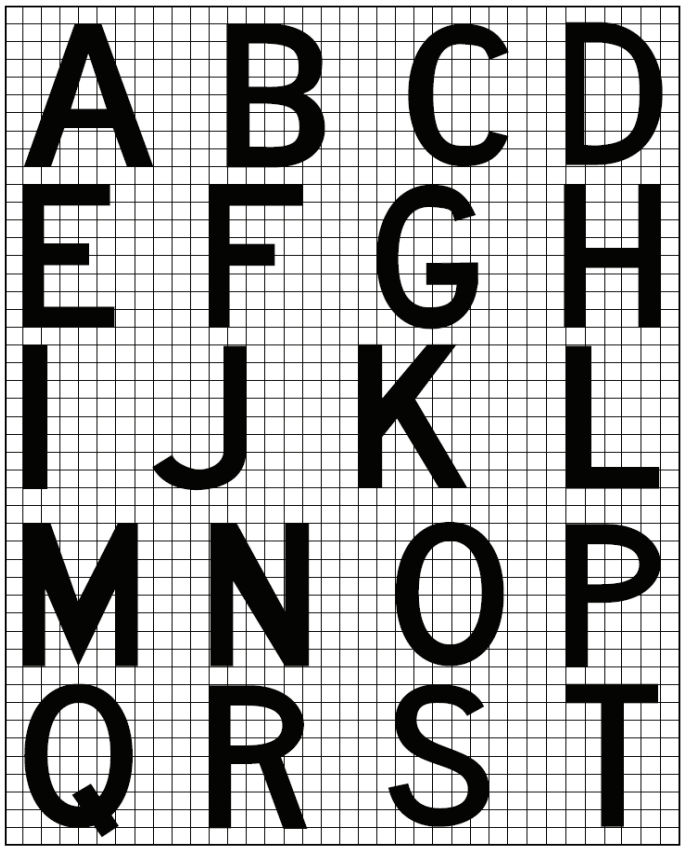


Figure D-2. Form and proportion of sign characters (sheet 2)

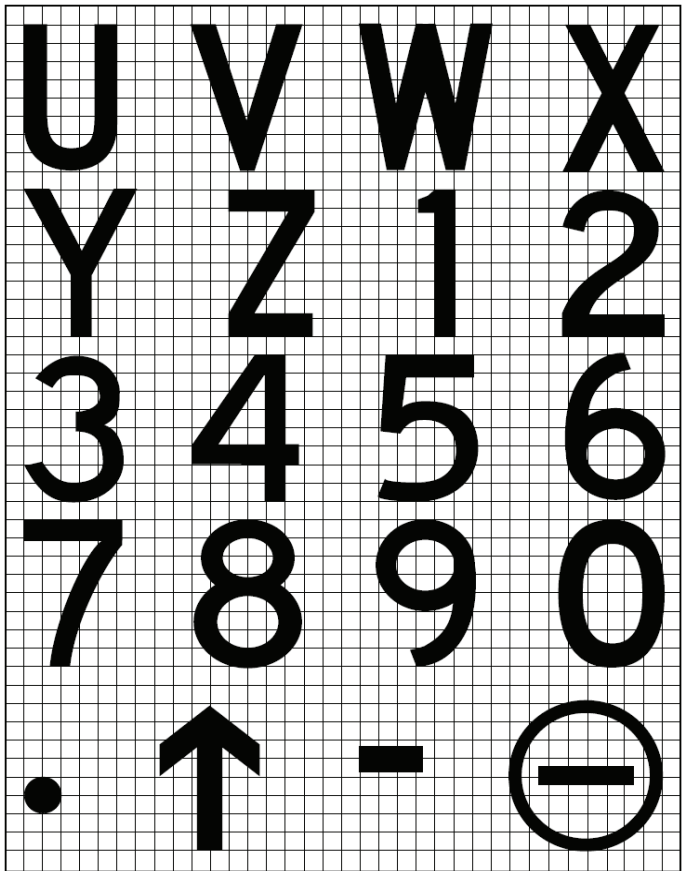


Table D-1. Dimensions of sign letters

LETTER	WIDTH OF LETTER (millimetres)		
	Character Height (millimetres)		
	200	300	400
(1)	(2)	(3)	(4)
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
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

Table D-2. Sign character and word spacing

PRECEDING LETTER or NUMERAL	REFERENCE NUMBER for LETTER/NUMERAL to LETTER/NUMERAL SPACING		
	Following letter or Numeral		
	B, D, E, F, H, I, K, L, M, N, P, R, U, 1, 5	C, G, O, Q, S, X, Z, 2, ,3, 6, 8, 9, 0	A, J, T, V, W,Y, 4, 7
(1)	(2)	(3)	(4)
A	2	2	4
B	1	2	2
C	2	2	3
D	1	2	2
E	2	2	3
F	2	3	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	3
X	2	2	3
Y	2	2	4
Z	2	2	3
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

SPACE LETTER

Reference number (from above)	Letter/Numeral Height (mm) 200	300	400
1	48	71	96
2	38	57	76
3	25	38	50
4	13	19	26

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.

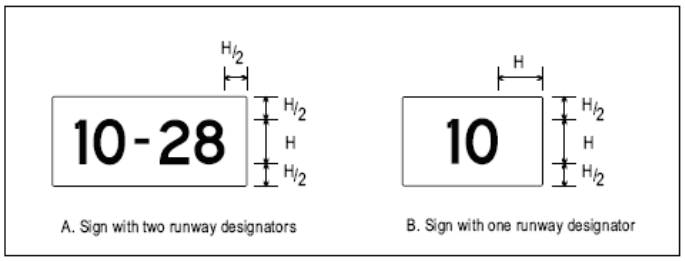
2. The space between words or groups of characters forming an abbreviation or symbol should be equal to 0.5 to 0.75 of the height of the characters used except that where an arrow is located with a single

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.

Figure A4-3. Sign dimensions



APPENDIX E. AERONAUTICAL DATA QUALITY REQUIREMENTS

Table E-1. Latitude and longitude

Latitude and longitude	Accuracy Data type	Integrity Classification
Aerodrome reference point	30 m surveyed/ calculated	1×10^{-3} routine
Navaids located at the aerodrome	3 m surveyed	1×10^{-5} essential
Obstacles in Area 3	0.5 m surveyed	1×10^{-5} essential
Obstacles in Area 2 (the part within the aerodrome boundary)	5 m surveyed	1×10^{-5} essential
Runway thresholds	1 m surveyed	1×10^{-8} critical
Runway end (flight path alignment point)	1 m surveyed	1×10^{-8} critical
Runway centre line points	1 m surveyed	1×10^{-8} critical
Runway holding position	0.5 m surveyed	1×10^{-8} critical
Taxiway centre line/parking guidance line points	0.5 m surveyed	1×10^{-5} essential
Taxiway intersection marking line	0.5 m surveyed	1×10^{-5} essential
Exit guidance line	0.5 m surveyed	1×10^{-5} essential
Apron boundaries (polygon)	1 m surveyed	1×10^{-3} routine
Aircraft stand points/INS checkpoints	0.5 m surveyed	1×10^{-3} routine

Note.— *See Annex 15, Appendix 8, for graphical illustrations of obstacle data collection surfaces and criteria used to identify obstacles in the defined areas.*

Note.— *Implementation of Annex 15 provision 10.6.1.2 concerning the availability, as of 18 November 2010, of obstacle data according to Area 2 and Area 3 specifications would be facilitated by appropriate advanced planning for the collection and processing of such data.*

Table E-2. Elevation/altitude/height

Elevation/altitude/height	Accuracy Data type	Integrity Classification
Aerodrome elevation	0.5 m surveyed	1×10^{-5} essential
WGS-84 geoid undulation at aerodrome elevation position	0.5 m surveyed	1×10^{-5} essential
Runway threshold, non-precision approaches	0.5 m surveyed	1×10^{-5} essential
WGS-84 geoid undulation at runway threshold, non-precision approaches	0.5 m surveyed	1×10^{-5} essential
Runway thresholds, precision approaches	0.25 m surveyed	1×10^{-8} critical
WGS-84 geoid undulation at runway threshold, precision approaches	0.25 m surveyed	1×10^{-8} critical
Runway centre line points	0.25 m surveyed	1×10^{-8} critical
Taxiway centre line/parking guidance line points	1 m surveyed	1×10^{-5} essential
Obstacles in Area 2 (the part within the aerodrome boundary)	3 m surveyed	1×10^{-5} essential
Obstacles in Area 3	0.5 m surveyed	1×10^{-5} essential
Distance measuring equipment/ precision (DME/P)	3 m surveyed	1×10^{-5} essential

Note.— *See Annex 15, Appendix 8, for graphical illustrations of obstacle data collection surfaces and criteria used to identify obstacles in the defined areas.*

Note.— *Implementation of Annex 15 provision 10.6.1.2 concerning the availability, as of 18 November 2010, of obstacle data according to Area 2 and Area 3 specifications would be facilitated by appropriate advanced planning for the collection and processing of such data.*

Table E-3. Declination and magnetic variation

Declination/variation	Accuracy Data type	Integrity Classification
Aerodrome magnetic variation	1 degree surveyed	1×10^{-5} essential
ILS localizer antenna magnetic variation	1 degree surveyed	1×10^{-5} essential
MLS azimuth antenna magnetic variation	1 degree surveyed	1×10^{-5} essential

Table E-4. Bearing

Bearing	Accuracy Data type	Integrity Classification
ILS localizer alignment	1/100 degree surveyed	1×10^{-5} essential
MLS azimuth alignment	1/100 degree surveyed	1×10^{-5} essential
Runway bearing (True)	1/100 degree surveyed	1×10^{-5} routine

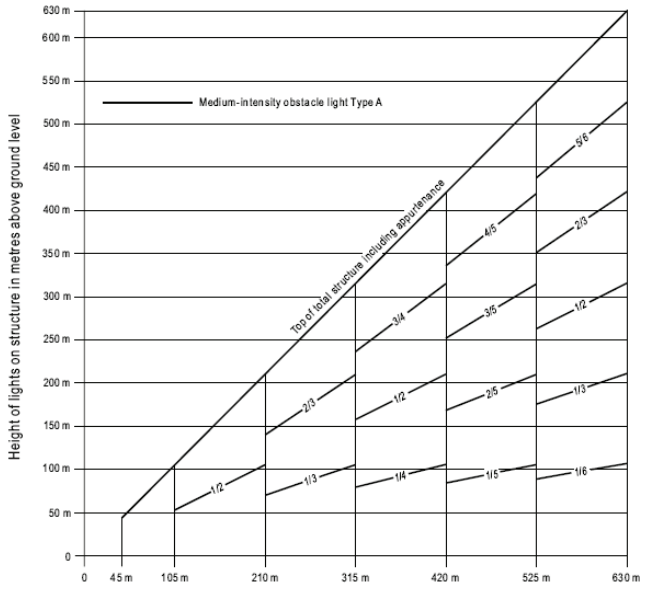
Table E-5. Length/Distance/Dimension

Latitude and longitude	Accuracy Data type	Integrity Classification
Runway length	1 m surveyed	1×10^{-8} critical
Runway width	1 m surveyed	1×10^{-5} essential
Displaced threshold distance	1 m surveyed	1×10^{-3} routine
Stopway length and width	1 m surveyed	1×10^{-8} critical
Clearway length and width	1 m surveyed	1×10^{-5} essential
Landing distance available	1 m surveyed	1×10^{-8} critical
Take-off run available	1 m surveyed	1×10^{-8} critical
Take-off distance available	1 m surveyed	1×10^{-8} critical
Accelerate-stop distance available	1 m surveyed	1×10^{-8} critical
Runway shoulder width	1 m surveyed	1×10^{-5} essential
Taxiway width	1 m surveyed	1×10^{-5} essential
Taxiway shoulder width	1 m surveyed	1×10^{-5} essential
ILS localizer antenna-runway end, distance	3 m surveyed	1×10^{-3} routine

ILS glide slope antenna-threshold, distance along centre line	3 m surveyed	1×10^{-3} routine
ILS marker-threshold distance	3 m surveyed	1×10^{-5} essential
ILS DME antenna-threshold, distance along centre line	3 m surveyed	1×10^{-5} essential
MLS azimuth antenna-runway end, distance	3 m surveyed	1×10^{-3} routine
MLS glide slope antenna-threshold, distance along centre line	3 m surveyed	1×10^{-3} routine
MLS DME/P antenn-threshold, distance along centre line	3 m surveyed	1×10^{-5} essential

APPENDIX F. LOCATION OF LIGHTS ON OBSTACLES

Figure F-1. Medium-intensity flashing-white obstacle lighting system, Type A

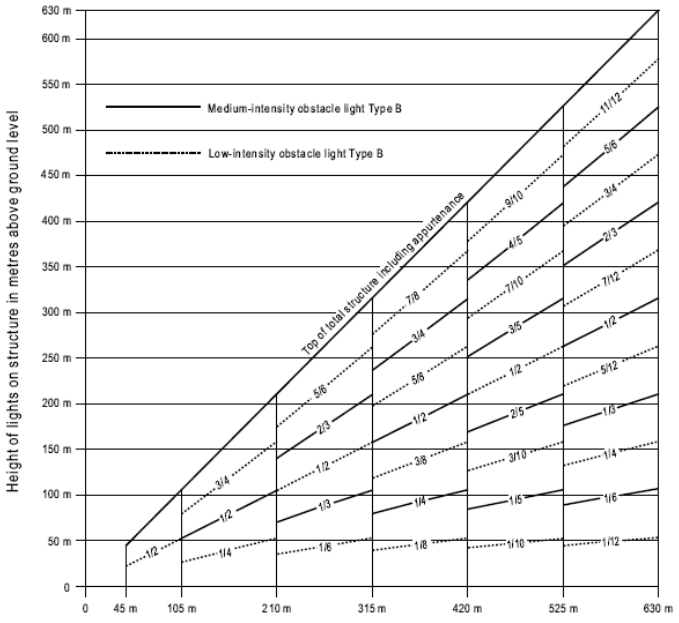


Height of structure in metres above ground level

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.

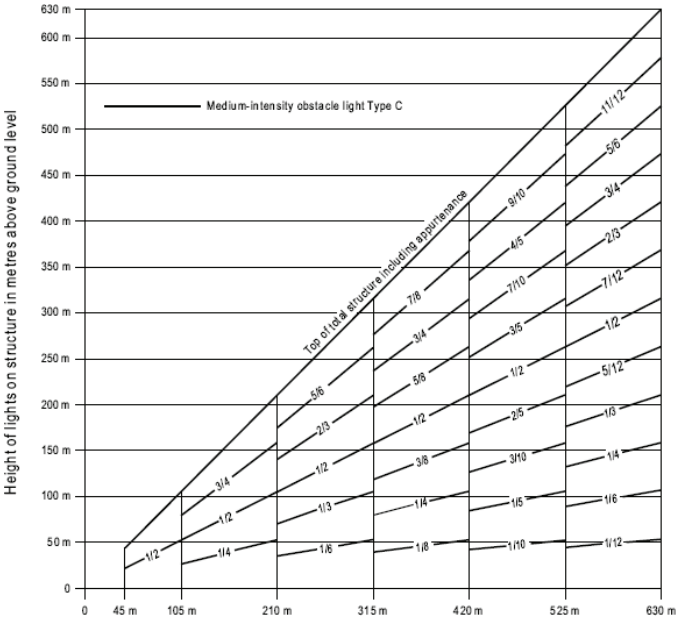
Figure F-2. Medium-intensity flashing-red obstacle lighting system, Type B



Height of structure in metres above ground level

Note.— *For night-time use only.*

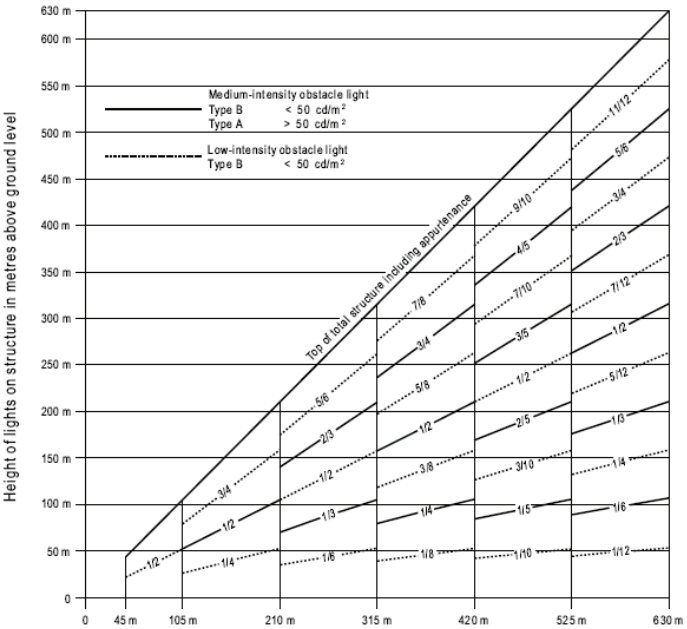
Figure F-3. Medium-intensity fixed-red obstacle lighting system, Type C



Height of structure in metres above ground level

Note.— *For night-time use only.*

Figure F-4. Medium-intensity dual obstacle lighting system, Type A/Type B

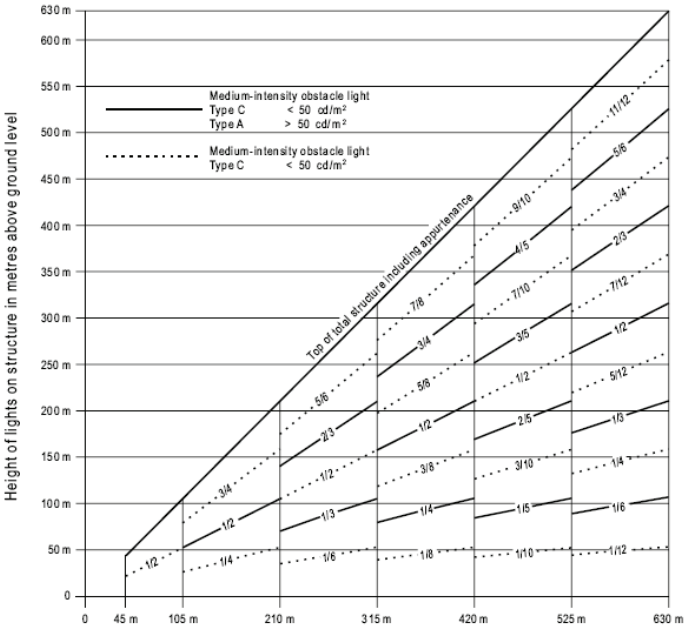


Height of structure in metres above ground level

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 F-5. Medium-intensity dual obstacle lighting system, Type A/Type C

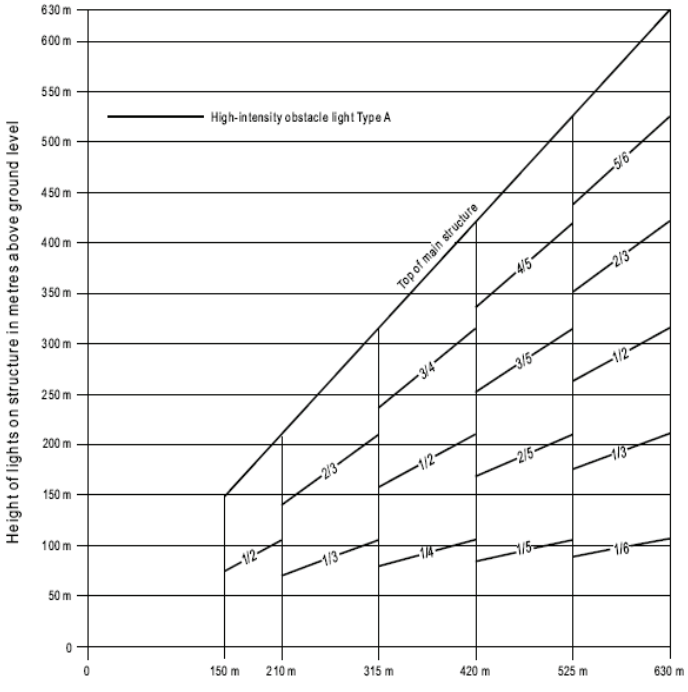


Height of structure in metres above ground level

Note.— *High-intensity obstacle lighting is recommended on structures with a height of more than 150 m above ground level.*

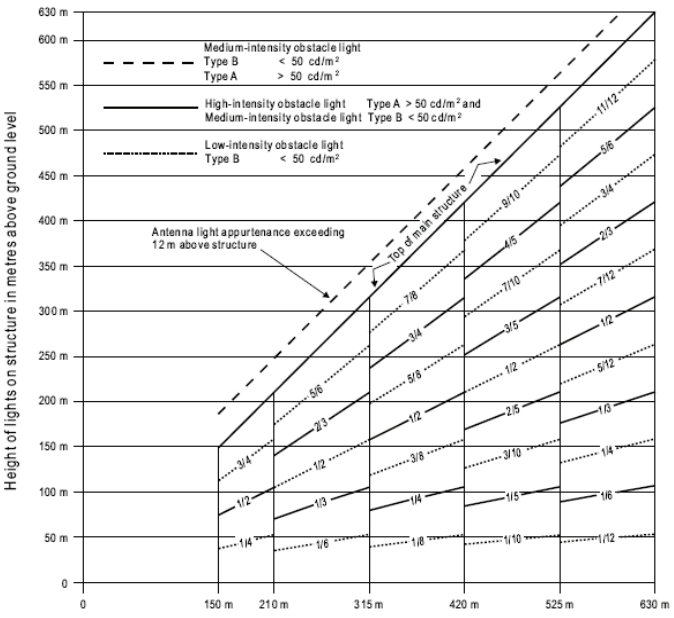
If medium-intensity lighting is used, marking will also be required.

Figure F-6. High-intensity flashing-white obstacle lighting system, Type A



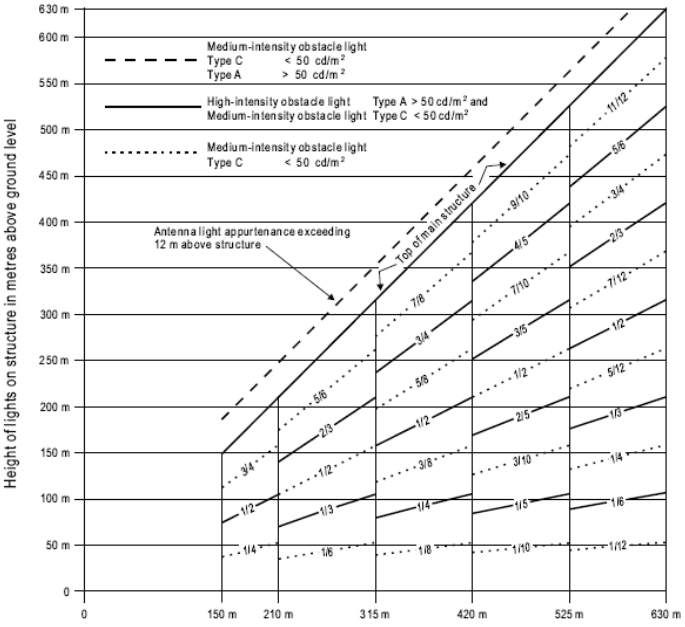
Height of structure in metres above ground level

Figure F-7. High-/medium-intensity dual obstacle lighting system, Type A/Type B



Height of structure in metres above ground level

Figure F-8. High-/medium-intensity dual obstacle lighting system, Type A/Type C



Height of structure in metres above ground level

ATTACHMENT A. GUIDANCE MATERIAL SUPPLEMENTARY TO MOS 14

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

extend, 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 figure for the usability factor.

b) The maximum mean cross-wind components given in Chapter 3, 3.1.2 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 cross-wind components, among diverse types of aeroplanes (including future types) within each of the three groups given 3.1.1.2;

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 cross-wind component; and

7) the strength of the wind associated with the limiting cross-wind 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;

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 and 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 takeoff, 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 takeoff 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 takeoff 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 stop-way has to be provided at each runway end. The saving in runway length is, therefore, bought at the cost of a greater over-all 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 require, 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 a!so 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. SLOPES ON A RUNWAY

3.1 Distance between slope changes

The following example illustrates how the distance between slope changes is to be determined (see Figure 1):

Distance D for a runway where the code number is 3 should be at least:

$$15000 (|x - y| + |y - z|) \text{ m}$$

where: $|x - y|$ is the absolute numerical value of $x - y$

$|y - z|$ is the absolute numerical value of $y - z$

Example: Assuming; $x = +0.01$

$y = - 0.005$

$z = + 0.005$

then; $|x - y| = 0.015$

$|y - z| = 0.01$

To comply with the specifications, D should be not less than:

$$15\,000 (0.015 + 0.01) \text{ m}$$

that is: $15\,000 \times 0.025 = 375$ m

D = 375 m

3.2 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, 14.3.139 to 14.3.160, a study should be made to ensure that the resulting surface profile will not hamper the operation of aeroplanes.

3.3 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 an area symmetrical about the extended runway centre-line approximately 60 m wide and 300 m long before the threshold of a precision approach runway. 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 ratio 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.

4. RUNWAY SURFACE EVENNESS

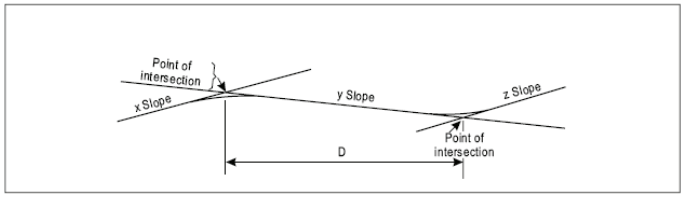
4.1 In adopting tolerances for runway surface irregularities, the following standard of construction is achievable for short distances of 3 m and conforms to good engineering practice:

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 straightedge 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.

4.2 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.

4.3 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 tolerable. Exact information of the maximum acceptable deviation cannot be given, as it varies with the type and speed of an aircraft.

Figure A-1. Slope changes on a runway - profile on centre line of runway



5. DETERMINATION OF FRICTION CHARACTERISTIC OF WET PAVED RUNWAYS

5.1 The friction of a wet paved runway should be measured to:

a) verify the friction characteristics of new or resurfaced paved runways when wet (Chapter 3, 14.3.172);

b) assess periodically the slipperiness of paved runways when wet (Chapter 10, 14.10.209);

c) determine the effect on friction when drainage characteristics are poor (Chapter 10, 14.10.218); and

d) determine the friction of paved runways that become slippery under unusual conditions (Chapter 2, 14.2.924).

5.2 Runways should be evaluated when first constructed or after resurfacing to determine the wet runway surface friction characteristics. Although it is recognized that friction reduces with use, this value will represent the friction of the relatively long central portion of the runway that is uncontaminated by rubber deposits from aircraft operations and is therefore of operational value. Evaluation tests should be made on clean surfaces. If it is not possible to clean a surface before testing, then for purposes of preparing an initial report a test could be made on a portion of clean surface in the central part of the runway.

5.3 Friction tests of existing surface conditions should be taken periodically in order to identify runways with low friction when wet. A State should define what minimum friction level it considers acceptable before a runway is classified as slippery when wet and publish this value in the aeronautical information publication (AIP). When the friction of a runway is found to be below this reported value, then such information should be promulgated by NOTAM.

The aerodrome should also establish a maintenance planning level, below which, appropriate corrective maintenance action should be initiated to improve the friction. However, when the friction characteristics for either the entire runway or a portion thereof are below the minimum friction level, corrective maintenance action must be taken without delay. Friction measurements should be taken at intervals that will ensure identification of runways in need of maintenance or special surface treatment before the condition becomes serious. The time interval between measurements will depend on factors such as: aircraft type and frequency of usage, climatic conditions, pavement type, and pavement service and maintenance requirements.

5.4 For uniformity and to permit comparison with other runways, friction tests of existing, new or resurfaced runways should be made with a continuous friction measuring device provided with a smooth tread tire. The device should have a capability of using self-wetting features to enable measurements of the friction characteristics of the surface to be made at a water depth of at least 1 mm.

5.5 When it is suspected that the friction characteristics of a runway may be reduced because of poor drainage, owing to inadequate slopes or depressions, then an additional test should be made, but this time under natural conditions representative of a local rain. This test differs from the previous one in that water depths in the poorly cleared areas are normally greater in a local rain condition. The test results are thus more apt to identify problem areas having low friction values that could induce aquaplaning than the previous test. If circumstances do not permit tests to be conducted during natural conditions representative of a rain, then this condition may be simulated.

5.6 Even when the friction has been found to be above the level set by the State to define a slippery runway, it may be known that under unusual conditions, such as after a long dry period, the runway may have become slippery. When such a condition is known to exist, then a friction measurement should be made as soon as it is suspected that the runway may have become slippery.

5.7 When the results of any of the measurements identified in 5.3 through 5.6 indicate that only a particular portion of a runway surface is slippery, then action to promulgate this information and, if appropriate, take corrective action is equally important.

5.8 When conducting friction tests on wet runways, it is important to note that, in which there is very limited variation of the friction coefficient with speed, a wet runway produces a drop in friction with an increase in speed. However, as the speed increases, the rate at which the friction is reduced becomes less. Among the factors affecting the friction coefficient between the tire and the runway surface, texture is particularly important. If the runway has a good macro-texture allowing the water to escape beneath the tire, then the friction value will be less affected by speed.

Conversely, a low macro-texture surface will produce a larger drop in friction with increase in speed. Accordingly, when testing runways to determine their friction characteristics and whether maintenance action is necessary to improve it, a speed high enough to reveal these friction/speed variations should be used.

5.9 The friction levels as follows:

a) a maintenance friction level below which corrective maintenance action should be initiated; and

b) a minimum friction level below which information that a runway may be slippery when wet should be made available.

Furthermore, the Authority should establish criteria for the friction characteristics of new or resurfaced runway surfaces.

Table A-1 provides guidance on establishing the design objective for new runway surfaces and maintenance planning and minimum friction levels for runway surfaces in use.

5.10 The friction values given above are absolute values and are intended to be applied without any tolerance. The two friction measuring tires mounted on the Mu-meter were smooth tread and had a special rubber formulation, i.e. Type A. The tires were tested at a 15 degree included angle of alignment along the longitudinal axis of the trailer. The single friction measuring tires mounted on the Skiddo meter, Surface Friction Tester, Runway Friction Tester and TATRA were smooth tread and used the same rubber formulation, i.e. Type B. The GRIPTESTER was tested with a single smooth tread tire having the same rubber formulation as Type B but the size was smaller, i.e. Type C. The specifications of these tires (i.e. Types A, B and C) are contained in the Airport Services Manual, Part 2. Friction measuring devices using rubber formulation, tire tread/groove patterns, water depth, tire pressures, or test speeds different from those used in the programme described above, cannot be directly equated with the friction values given in the table. The values in columns (5), (6) and (7) are averaged values representative of the runway or significant portion thereof. It is considered desirable to test the friction characteristics of a paved runway at more than one speed.

5.11 Other friction measuring devices can be used, provided they have been correlated with at least one test equipment mentioned above. The Airport Services Manual, Part 2 provides guidance on the methodology for determining the friction values corresponding to the design objective, maintenance planning level and minimum friction level for a friction tester not identified in the above table.

Table A-1.

Test equipment	Test tire		Test speed (km/h)	Test water dept (mm)	Design objective for new surface	Maintenance planning level	Minimum friction level
	Type	Pressure (kPa)					
Mu-meter Trailer	A	70	65	1.0	0.72	0.52	0.42
	A	70	95	1.0	0.66	0.38	0.26
Skiddometer	B	210	65	1.0	0.82	0.60	0.50
Trailer	B	210	95	1.0	0.74	0.47	0.34
Surface Friction	B	210	65	1.0	0.82	0.60	0.50
Tester Vehicle	B	210	95	1.0	0.74	0.47	0.34
Runway Friction	B	210	65	1.0	0.82	0.60	0.50
Tester Vehicle	B	210	95	1.0	0.74	0.54	0.41
TATRA Friction	B	210	65	1.0	0.76	0.57	0.48
Tester Vehicle	B	210	95	1.0	0.67	0.52	0.42
GRIPTESTER	C	140	65	1.0	0.74	0.53	0.43
Trailer	C	140	95	1.0	0.64	0.36	0.24

6. STRIPS

6.1 Shoulders

6.1.1 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 measure to avoid the ingestion of loose stones or other objects by turbine engines.

6.1.2 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).

6.1.3 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 ICAO Aerodrome Design Manual, 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.

6.1.4 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.

6.2 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.

6.3 Temporary hazards on runway strips

It is the responsibility of the aerodrome operator to ensure that the existence of all temporary obstructions or hazards within strips be made known as appropriate to pilots, either directly by Air Traffic Control or by NOTAM.

The following paragraphs give guidance on the operational implications and dealing with temporary hazards on runways strips.

6.3.1 Three zones alongside runways can be identified as follows:

ZONE I. – This zone lies within 23 m of the runway edge where the runway code number is 2, 3, or 4; and, 21 m of the runway edge where the runway code number is 1.

ZONE II. – This zone extends from the outer edge of Zone I to the edge of the graded strip. Refer to Chapter 3 for dimension of graded areas.

ZONE III. – This zone applies only to non precision approach runways used in conditions of poor visibility or low cloud base. It extends outwards from the edge of the graded strip to the edge of the strip required for missed approaches, i.e. 150 m from the runway centre line.

6.3.2 Procedures for Zone 1. No work should be permitted on a precision approach runway when the runway is in use. For a non-instrument or non-precision approach runway, work may take place in this zone on only one side of the runway at a time. The area of the obstacle should not exceed 9 m^2, but narrow trenches may exceptionally be allowed up to 28 m^2. Any obstacle permitted should be limited in height to provide propeller or pod clearance for the type of aircraft using the aerodrome, and in no case should the height exceed 1 m above the ground.

Any piles of earth or debris which could damage aircraft or engines must be removed. Trenches and other excavations should be backfilled and compacted as soon as possible.

No plant or vehicles should operate in this zone when the runway is in use.

An aircraft immobilized in this zone would automatically require the closure of the runway.

6.3.3 Procedures for Zone 2. No work should be permitted on a precision approach runway when the runway is in use. For a non-instrument or non-precision approach runway, the restrictions to be applied depend on the type of operation taking place and the weather conditions.

With a dry runway and not more than 15 Kt crosswind component for runways of code number 4, and 10 Kt cross-wind component for runways of code number 2 or 3, the following work may be permitted:

a) Visual flight conditions:

i) Unrestricted areas of construction, with the length of excavation or excavated material parallel to the runway being kept to a minimum. The overall height of excavated material should be limited to 2 m above the ground.

ii) All construction equipment should be mobile and kept within normal height limits.

ii) The runway may continue in use when an aircraft is immobilized in this zone.

b) Instrument flight conditions:

i) Unrestricted areas of construction, with the length of excavation or excavated material parallel to the runway being kept to a minimum. The overall height of excavated material should be limited to 2 m above the ground.

ii) All construction equipment should be mobile and kept within normal height limits.

iii) When an aircraft becomes immobilized in this zone, the runway should be closed.

6.3.4 Procedures for Zone 3. There are no restrictions on the work in this area. However, care must be taken to ensure that the work and the vehicles associated with the work do not interfere with the operation of radio navigational aids.

Note.— *Contractor's permanent and semi permanent plant and mobile equipment withdrawn form the strips should not infringe the transitional surfaces described in chapter 4.*

6.3.5 Runway Ends. In the case of work adjacent to the runway ends, the maximum possible use should be made of alternate runways or the displacement of the threshold so that the obstacle does not fall within the effective strip length or penetrate the associated approach surfaces. However, where landing distance may be critical, it may be safer to permit such an infringement near the runway end rather than displace the threshold.

6.3.6 Recommendation.— Procedures during Navigation Aid Flight Inspection. Notwithstanding the foregoing instruction contained in 6.3.2 and 6.3.3, a theodolite and radio equipped flight inspection technician may be permitted in either Zone I or Zone II during precision approach navigation aid flight inspection while a runway is in use. NOTAM and voice advisory be issued during flight inspections.

6.3.7 Pre-Construction Meeting. It is an excellent practice for the contractor, airport operator and traffic control authority (where traffic control exists) to meet well in advance of the start of construction. This meeting can then consider such matters as discussed above, and agree on:

a) means of control of construction vehicles so as to minimize interference with aircraft operations;

b) scheduling of construction activities to conform as much as possible to periods of minimum aircraft activity; and

c) disposal of excavated material, storage of construction material and equipment, and conditions of work site at the end of the period of work.

6.3.8 Procedures for Revising Declared Distances. In the event that an unacceptable obstacle exists within the strip areas or associated clearway, the continued availability of the runway may be authorized at a restricted length, if the reduced distances available would be operationally usable by the type of traffic expected. The declared distances have a statutory application in aircraft operations and it is important that amendments are made when circumstances give a rise to their restrictions. See example in Figure 2-1, Chapter 2.

The changes to the declared distances for a runway restricted in length by the presence of an obstacle are to be made as follows:

a) Commencement of takeoff runs from the obstructed end. TORA may commence at the beginning of the usable runway.

b) Termination of declared distances towards the obstructed end.

TORA - terminates at the end of the usable runway.

ASDA - terminates at the end of the runway or stopway if provided.

TODA - terminates at the obstruction or at

TORA plus 300 m, whichever comes first.

LDA - terminates at the end of the usable runway.

6.3.9 Instrument Approach Procedures. The presence of temporary obstructions and/or changes to the runway threshold may require an amendment to the instrument approach procedure. Details should be provided to the Certifying Authority.

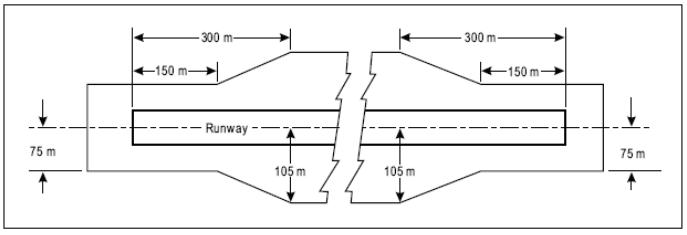
6.3.10 Taxiway Obstructions. In considering the acceptability of an obstruction near a taxiway the aerodrome operator will be guided by the type of aircraft using the airport and the availability of an alternative ground routing avoiding the affected length of taxiway. A clearance distance of whichever is the greater of 20% of wing span or 7.5 m (25 ft.) should be preserved between the obstruction and the wing tip of an aircraft on the taxiway centre line, when the aircraft is permitted to use that taxiway. If in doubt a marshaller should be positioned at the point and the pilot warned by radio when approaching the affected area.

6.3.11 Marking of Obstructions. The marking by day and night of obstructed areas should be in accordance with the marking requirements of unserviceable areas of a runway, taxiway or other areas prescribed in Chapter 7. It will be appropriate by night, and possible by day also, to mark the perimeter of the obstruction itself if it is close to a taxiway, the continued use of which has been authorized. However, it will serve little purpose to a pilot landing or taking off, to mark either by day or night, an obstruction in a position which does not affect the continued use of the runway. Indeed, extraneous red lights may be misleading from the air and the pilot is only interested in seeing a pattern which clearly indicates the part of the runway which can be used.

6.3.12 Tall Obstruction (e.g. Cranes, etc.). The responsibility for lighting and marking of obstructions rests with the aerodrome operator regardless of the owner of the obstruction. A certificate may be withheld or withdrawn if the requirements for lighting and/or marking are not met. Every attempt should be made to remove or lower the obstruction during the hours of darkness or during periods of idleness, i.e. weekends, etc.

If this is not practicable, the obstruction should be marked at the top by one or more obstruction (red) lights. Day marking normally will not be required where the obstruction is painted in bright colours.

Figure A-2. Graded portion of a strip including a precision approach runwaywhere the code number is 3 or 4



7. RUNWAY END SAFETY AREAS

7.1 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 under shoots 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 and on a non-precision approach or non-instrument runway, the first upstanding obstacle may be a road, a railroad or other constructed or natural feature. In such circumstances, the runway end safety area should extend as far as the obstacle.

7.2 Where provision of a runway end safety area may involve encroachment in areas where it would be particularly prohibitive to implement, and the Authority considers a runway end safety area essential, consideration may have to be given to reducing some of the declared distances.

8. APPROACH LIGTHING SYSTEMS

8.1 Types and characteristics

8.1.1 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-5 and A-6. A diagram of the inner 300 m of the precision approach category II and III lighting system is shown in Figure 5-15.

8.1.2 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.

8.1.3 Flight path envelopes to be used in designing the lighting are shown in Figure A-3.

8.2 Installation tolerances Horizontal

8.2.1 The dimensional tolerances are shown in Figure A-4.

8.2.2 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´.

8.2.3 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.

8.2.4 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-4 (A) is adopted or ± 2°, if Figure A-4 (B) is adopted.

8.2.5 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.

8.2.6 When a crossbar in the system shown in Figure A-4 (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

8.2.7 The ideal arrangement is to mount all the approach lights in the horizontal plane passing through the threshold, 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.

8.2.8 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.

8.2.9 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.

8.2.10 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.

8.2.11 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.

8.2.12 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.

8.3 Clearance of obstacles

8.3.1 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.

8.3.2 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.

8 .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.

8.3.4 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 $10 \times 15 = 150$ cm maximum, but preferably should be kept as low as possible consistent with proper operation of the ILS.

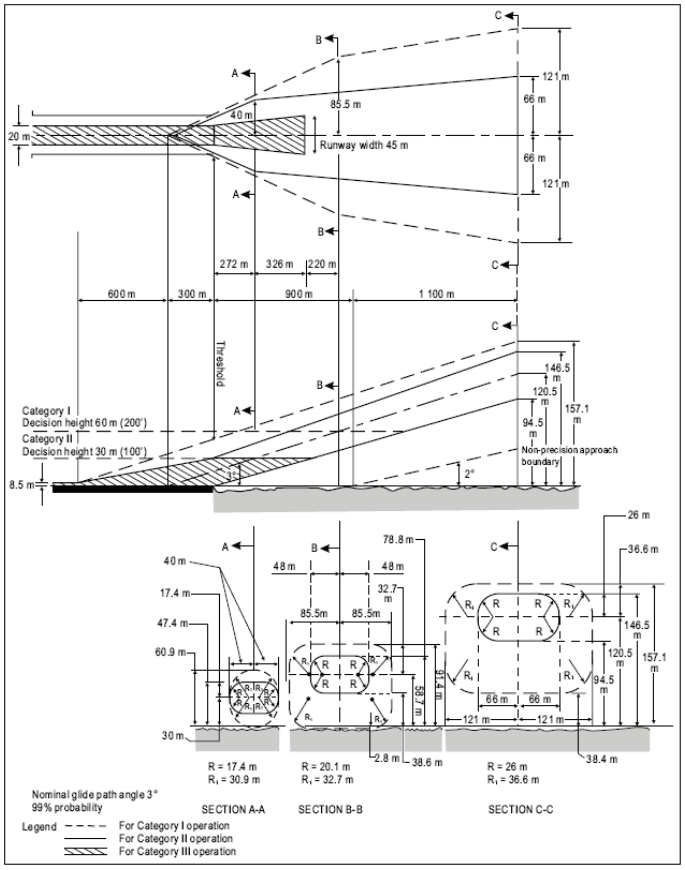
8.3.5 In locating an MLS azimuth antenna the guidance contained in Annex 10, Volume I, Attachment G should be followed. This material, which also provides guidance on collocating an MLS azimuth antenna with an ILS localizer antenna, suggests that the MLS azimuth antenna may be sited within the light 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.

8.3.6 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.

8.3.7 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.

Figure A-3. Flight path envelopes to be used for lighting design for category I, II and III operations



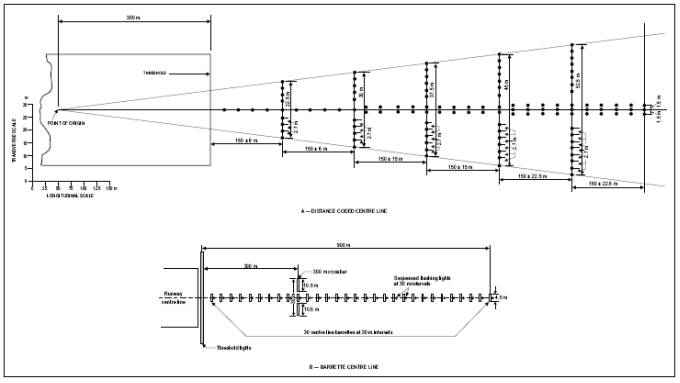
8.4 Consideration of the effects of reduced lengths

8.4.1 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.

8.4.2 However, there are some runway locations where it is impossible to provide the 900 m length of approach lighting system to support precision approaches.

8.4.3 In such cases, every effort should be made to provide as much approach lighting system as possible. The 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.

Figure A-4. Precision approach category I lighting systems



9. PRIORITY OF INSTALLATION OF VISUAL APPROACH SLOPE INDICATOR SYSTEMS

9.1 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.

9.2 With respect to the seriousness of the hazard, the order given in the application specifications for a visual approach slope indicator system, 14.5.3195 *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.

9.3 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.

9.4 Priority should be given to runways used by turbojet aeroplanes.

10. 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.

11. INTENSITY OF APPROACH AND RUNWAY LIGHTS

11.1 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.

11.2 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.

11.3 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, Part 4.

12. OPERATORS OF VEHICLES

12.1 The aerodrome operator shall ensure the operators of vehicles on the movement area 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 fire fighting.

12.2 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.

12.3 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.

12.4 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.

13. THE ACN-PCN METHOD OF REPORTING PAVEMENT STRENGTH

13.1 Overload operations

13.1.1 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 over-loading 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 CAN 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.

13.1.2 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 aerodrome operator 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.

13.2 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, 14.2.621 table 2-1 and the results tabulated in the Aerodrome Design Manual, Part 3.

Conselho de Administração da Agência da Aviação Civil, na Praia, aos 15 de Julho de 2009. – O Presidente, *Carlos Brazão Monteiro*.

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