Brunei Department of Civil Aviation

Negara Brunei Darussalam

www.mtic.gov.bn/dca

Brunei Aviation Requirements

BAR 14 Volume I - Aerodromes

Table of Contents

Amendment Records

The amendments listed below have been incorporated into this BAR 14 Volume I

Amendment no.	Version no.	Subject	Source	Section affected	Entered by (Date)	Approved by (Date)	Effective Date
-	01	Original version	ICAO Annex 14 Vol.I 7th Edition	All	UKCAAi (2017)	(2017)	(1 Feb 2017)
1	02	Table of Contents; Amendment Records; Control of This Document; General Definition; Applicability; Purpose; ICAO Annex 14 Compliance; a consequential amendment, as a result of the restructuring of Annex 15 and the introduction of PANS-AIM (Doc 10066); relating to change of references; safeguarding; data quality requirements and performance-based data error detection requirements;	ICAO Annex 14 Vol.I 8th Edition (Arising from Amendment 14 to ICAO Annex 14; include provisions applicable after Nov 2018)	DC.1.1; DC.1.2; 1.1; 1.2; 1.3; 1.4.1; 1.4.2; 1.6.3 Table 1; 1.7.1 l); 1.7.1 r); 1.9; 1.10; 1.11; 1.12; 1.13; 1.14; 1.15; 2.1.1; 2.1.2; 2.1.4; 2.3.3; 2.3.5; 2.3.8; 2.3.8 b); 2.3.8 c); 3.1.10; 3.2.1; 3.2.2; 3.2.4; 3.2.5; 3.2.6; 3.3.6 Table; 3.4.3; 3.4.4; 3.9.3 Table; 3.9.4; 3.9.9 Table; 3.10; 3.10.1; 3.10.2; 3.11.4; Chapter 4 Table 8; 9.4.1; 9.12; 10.2.8; 10.3.4; 13.3; Appendix l (3); Appendix ll (3); Appendix Xll	Pg Rasman bin Pg Sulaiman 30 Jan 2019	13 March 2019 (Aviation Safety Circular 1/2019)	13 March 2019

Amendment no.	Version no.	Subject	Source	Section affected	Entered by (Date)	Approved by (Date)	Effective Date
2	2.1	Table of Content Page Numbers; Added 'Recommendation' for Recommended Practices; Chapter 1 General Standard and Recommended Practices; Exemption; Chapter 2 Aerodrome Certification; Chapter 3 Physical Characteristics; Chapter 5 Obstacle Restriction and Removal; Visual Aids for Navigation, Denoting Obstacles and Restricted Areas; Chapter 9 Aerodrome Operational Services, Equipment & Installation; Chapter 10 Aerodrome Maintenance; Chapter 11 Aviation Fuel; Chapter 13 Safeguarding; Birdstrike Report Form	ICAO Annex 14 Vol.I 8th Edition (July 2018) (Arising from Amendment 14 to ICAO Annex 14: include provisions applicable after Nov 2018; include further information of aerodrome certification process)	1.4.1, 1.4.2, 1.4.3;1.6.4; 1.6.5; 2.1; 2.1.1; 2.1.2 (a) (b) (c); 2.1.3; 2.1.3 (d); 2.1.4 (a) (b) (c); 2.1.12 (a) (b); 3.1.18; 3.1.19; 3.2.3; 3.4.15; 3.5.7; 3.6.6; 3.9.11; 3.9.18; 3.11.5; 4.2.6; 5.1.3.3; 5.2.1.4; 5.2.1.7; 5.2.4.10; 5.2.13.11; 5.2.13.12; 5.2.17; 5.3.1.2; 5.3.4.8; 5.3.4.9; 5.4.4.4; 9.1.16; 9.4.1; 9.4.2; 9.4.4; 9.6.1; 9.6.2; 9.7; 9.8.3; 9.9.6; 9.11; 9.12; 10.5.13; 13.1; 13.2; Appendix I; Appendix III (1) (2) & (5); Appendix IV;	Pg Rasman bin Pg Sulaiman 1 Dec 2019	Subject to the issued associated Aviation Safety Circular	Subject to the issued associated Aviation Safety Circular

Control of this Document

DC.1 Introduction

DC.1.1 Pursuant to Civil Aviation Order 2006 and the Civil Aviation Regulations 2006 and their subsequent amendments, the following requirements are hereby established for compliance by all persons concerned, the Director of Civil Aviation is empowered to adopt and amend Brunei Aviation Requirements. In accordance herewith, the following requirement is hereby established for compliance by all persons concerned. This requirement shall be known as BAR 14 Volume I - Aerodromes and any reference to this title shall mean referring to the requirements to be met for civil aviation in Brunei Darussalam.

DC.1.2 This document is based on ICAO Annex 14 Volume 1 – Aerodromes, ICAO Doc 9774, Manual on Certification of Aerodromes and other related and relevant document. A comprehensive cross reference is provided in Appendix XIII describing the BAR 14 material and their source document, as well as a list of differences between BAR 14 and ICAO provisions.

DC.2 Authority for this Requirement

DC.2.1 This BAR 14 Volume I - Aerodromes is issued on the authority of the Director of Civil Aviation.

DC.3 Applicability

DC.3.1 This BAR 14 Volume I - Aerodromes is applicable to the aviation industry of Brunei Darussalam.

DC.4 Scope

DC.4.1 BAR 14 Volume I Aerodromes contains the basic requirements to be met for civil aviation in Brunei Darussalam, and shows compliance with ICAO Annexes. The requirements are separated into the following civil aviation safety requirements with cross references where applicable.

BAR 1 – Personnel Licensing

BAR 2 – Rules of the Air

BAR 3 – Meteorological Service for International Air Navigation

BAR 4 – Aeronautical Charts

BAR 5 – Units of Measurement

BAR 6 – Operation of Aircraft

BAR 7 – Aircraft Registration and Cancellation

BAR 8 – Airworthiness of Aircraft and Continuous Airworthiness

BAR 9 – Facilitation

BAR 10 – Aeronautical Telecommunications

BAR 11 – Air Traffic Services

BAR 12 – Search and Rescue

BAR 13 – Aircraft Accident and Incident Investigation

BAR 14 – Volume I – Aerodromes

BAR 14 – Volume II - Heliports

BAR 15 – Aeronautical Information Services

BAR 16 – Environmental Protection

BAR 17 – Aviation Security

BAR 18 – The Safe Transport of Dangerous Goods by Air

BAR 19 – Safety Management

DC.5 Definitions

DC.5.1 Terms not defined within this document shall have the meaning given to them in the relevant legal instruments or international legal instruments in which they appear, especially as they appear in the Convention and its Annexes.

Reference Documents

(related to the specifications of BAR 14 Vol I)

ICAO Annex 14, Aerodromes - Volume I, Aerodrome design and operation;

ICAO Annex 14, Aerodromes – Volume II, Heliports;

ICAO Annexes (relevant parts) 2, 3, 4, 6, 10, 11, 14, 15, 16, 17 and 19;

ICAO Doc 4444, Procedures for Air Navigation Services - Air Traffic Management (PANS-ATM);

ICAO Doc 8071, Manual on Testing of Radio Navigation Aids;

ICAO Doc 8126, Aeronautical Information Services Manual;

ICAO Doc 8168, Procedures for Air Navigation Services - Aircraft Operations Volumes I and II (PANS-OPS);

ICAO Doc 8643, Aircraft Type Designators;

ICAO Doc 9137, Airport Services Manual, Parts 1 to 9;

ICAO Doc 9150, Stolport Manual;

ICAO Doc 9157, Aerodrome Design Manual, Part 1 to 6;

ICAO Doc 9184, Airport Planning Manual, Parts 1 to 3;

ICAO Doc 9261, Heliport Manual;

ICAO Doc 9332, Manual on the ICAO Bird Strike Information System (IBIS);

ICAO Doc 9365, Manual of All-Weather Operations;

ICAO Doc 9426, Air Traffic Services Planning Manual;

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

ICAO Doc 9640, Manual of Aircraft Ground De-icing/Anti-icing Operations;

ICAO Doc 9643, Manual on Simultaneous Operations on Parallel or near-Parallel Instrument Runways;

ICAO Doc 9674, World Geodetic System — 1984 (WGS-84) Manual;

ICAO Doc 9683, Human Factors Training Manual;

ICAO Doc 9734, Establishment and Management of a State's Safety Oversight System;

ICAO Doc 9760, Airworthiness Manual, Volumes I and II;

ICAO Doc 9774, Manual on Certification of Aerodromes;

ICAO Doc 9815, Manual on Laser Emitters and Flight Safety;

ICAO Doc 9829, Guidance on the Balanced Approach to Aircraft Noise Management;

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

ICAO Doc 9859, Safety Management Manual (SMM);

ICAO Doc 9870, Manual on the Prevention of Runway Incursions;

ICAO Doc 9981 Procedures for Air Navigation Services — Aerodromes (PANS-AERODROMES);

ICAO Doc 10066 Procedures for Air Navigation Services – Aeronautical Information Management (PANS-AIM);

ICAO Circular 305 AN/177 Operation of New Larger Aeroplanes at Existing Aerodromes, June 2004

ICAO Circular 329 AN/191 Assessment, Measurement and Reporting of Runway Surface Condition, 2012

European Action Plan for the Prevention of Runway Incursions (EAPPRI);

BAR 19 – Safety Management.

Chapter 1. General

1.1. Definitions

Acceptable Means of Compliance (AMC): Provisions adopted by the Brunei DCA to indicate the normal means of compliance to establish compliance with the BARs. An entity or a person not wishing to comply with an AMC must show compliance using an Alternative Means of Compliance procedure accepted by the Brunei DCA.

Accuracy: A degree of conformance between the estimated or measured value and the true value.

Note: For measured positional data, the accuracy is normally expressed in terms of a distance from a stated position within which there is a defined confidence of the true position falling.

Advanced Surface Movement Guidance and Control System (A-SMGCS): A system providing routing, guidance and surveillance for the control of aircraft and vehicles in order to maintain the declared surface movement rate under all weather conditions within the aerodrome visibility operational level (AVOL) while maintaining the required safety.

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

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

Aerodrome Certificate: A certificate issued by the Brunei DCA under BAR 14 Volume I - Aerodromes and any other applicable requirements, subsequent to the acceptance/approval of the Aerodrome Manual, for the operation of an aerodrome.

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

Aerodrome facilities and equipment: Facilities and equipment, inside or outside the boundaries of an aerodrome, that are constructed or installed and maintained for the arrival, departure and surface movement of aircraft.

Aerodrome Identification Sign: A sign placed on an aerodrome to aid in identifying the aerodrome from the air.

Aerodrome Manual: The manual that forms the aerodrome exposition and is part of the application for an Aerodrome Certificate pursuant to these BARs, including any amendments thereto accepted by the Brunei DCA.

Aerodrome Operator: In relation to a certified aerodrome, the Aerodrome Certificate holder.

Aerodrome Post Holder: Those positions identified in BAR 14 Volume I - Aerodromes who are subject to acceptance by the Brunei DCA.

Aerodrome Reference Point: The designated geographical location of an aerodrome.

Aerodrome Traffic Density:

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.

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.

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

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

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

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

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

Aeronautical Study: A study of an aeronautical problem to identify possible solutions and select a solution that is acceptable to the Brunei DCA without degrading safety.

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.

Note: ICAO Annex 14, Volume 1, Attachment A, Section 2 provides information on the concept of balanced field length and the ICAO Airworthiness Manual (Doc 9760) contains detailed guidance on matters related to take-off distance.

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

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

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

Alternative Means of Compliance: Alternative means of compliance are those that propose an alternative to an existing Acceptable Means of Compliance (AMC) or those that propose new means to establish compliance with the BAR for which no associated AMC have been adopted by the Brunei DCA.

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, including any apron taxiways and aircraft stand taxilanes.

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

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

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

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

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.

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

Competence: The ability to apply knowledge, understanding and skills in performing to the standards required in employment. This includes problems and meeting changing demands.

Competence in Application: The ability of individuals to demonstrate consistently that the performance outcomes defined for their role can be achieved to the standard expected in the workplace.

Competent in Acquisition: The ability of individuals to demonstrate that they can apply the learning acquired in the workplace to the standards defined in the performance criteria for their role.

Contaminated Runway: A runway is contaminated when more than 25 per cent of the runway surface area (whether in isolated areas or not) within the required length and width being used is covered by:

Water or slush more than 3 mm (0.125 in) deep;

Loose snow more than 20 mm (0.75 in) deep; or

Compacted snow or ice, including wet ice.

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

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

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

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

Datum: Any quantity or set of quantities that may serve as a reference or basis for the calculation of other quantities (ref. ISO 19104, Geographic information - Terminology).

Declared Distances:

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

Take-off Distance Available (TODA). The length of the Take-off Run Available plus the length of the clearway, if provided.

Accelerate-Stop Distance Available (ASDA). The length of the Take-off Run Available plus the length of the stopway, if provided.

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

Dependent Parallel Approaches: Simultaneous approaches to parallel or near- parallel Instrument Runways where radar separation minima between aircraft on adjacent extended runway centre lines are prescribed.

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.

Final approach and take-off area (FATO): A defined area over which the final phase of the approach manoeuvre to hover or landing is completed and from which the take-off manoeuvre is commenced. Where the FATO is to be used by helicopters operated in performance class 1, the defined area includes the rejected take-off area available.

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.

Note: Guidance on design for frangibility is contained in the ICAO Aerodrome Design Manual (Doc 9157) Part 6.

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

Geoid: The equipotential surface in the gravity field of the Earth which coincides with the undisturbed Mean Sea Level (MSL) extended continuously through the continents.

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

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

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

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

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

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

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

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

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

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

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

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

Independent Parallel Approaches: Simultaneous approaches to parallel or near- parallel Instrument Runways where radar separation minima between aircraft on adjacent extended runway centre lines are not prescribed.

Independent Parallel Departures: Simultaneous departures from parallel or near-parallel Instrument Runways.

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

Non-precision Approach Runway. An Instrument Runway served by visual aids and a non-visual aid providing at least directional guidance.

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 60 m (200 ft) and either a visibility not less than 800 m or a Runway Visual Range not less than 550 m.

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 60 m (200 ft) but not lower than 30 m (100 ft) and a Runway Visual Range not less than 300 m.

Precision Approach Runway, Category III. An Instrument Runway served by ILS and/or MLS to and along the surface of the runway and:

intended for operations with a decision height lower than 30 m (100 ft), or no decision height and a Runway Visual Range not less than 175 m.

intended for operations with a decision height lower than 15 m (50 ft), or no decision height and a Runway Visual Range less than 175 m but not less than 50 m.

intended for operations with no decision height and no Runway Visual Range limitations

Note 1. See ICAO Annex 10, Volume I for related ILS and/or MLS specifications.

Note 2. Visual aids need not necessarily be matched to the scale of non-visual aids provided. The criterion for the selection of visual aids is the conditions in which operations are intended to be conducted.

Note 3. The categorisation of a precision approach is dependent on a number of factors, including but not limited to aeronautical ground lighting, standby power supplies, ILS specifications, marking, and aerodrome procedures.

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

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

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

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

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

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

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

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.

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

Low Visibility Conditions (LVC): The meteorological conditions requiring approaches and landings in Category II and Category III, take offs in RVR less than 550 metres or for surface movements in meteorological conditions not permitting ATC to be carried out with visual reference.

Low Visibility Procedures (LVP): The measures required to support safe operations at an aerodrome in Low Visibility Conditions (LVC).

Manoeuvring Area: That part of an aerodrome to be used for the take-off, landing and taxiing of aircraft, excluding aprons and any other part of the aerodrome provided for the maintenance of aircraft.

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.

Maximum carrying capacity: In relation to an aircraft, means the maximum passenger-seating capacity, or the maximum payload, permitted under the aircraft's certificate of type approval.

Maximum passenger-seating capacity: In relation to an aircraft, means the maximum number of seats for passengers permitted under the aircraft's certificate of type approval.

Minister: The Minister of Communications and where applicable includes the Director of Civil Aviation, or the Head or officers of the Regulatory Division, or any authorised person to whom the Minister has delegated his powers.

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).

Near-parallel Runways: Non-intersecting runways whose extended centre lines have an angle of convergence/divergence of 15 degrees or less.

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,

or that stand outside those defined surfaces and that have been assessed as being a hazard to air navigation.

Obstacle Free Zone (OFZ): The airspace above the Inner Approach Surface, Inner Transitional Surfaces, and Balked Landing Surface and that portion of the strip bounded by these surfaces, which is not penetrated by any fixed obstacle other than a low-mass and frangibly mounted one required for air navigation purposes.

Obstacle limitation surfaces (OLS): A series of surfaces that define the volume of airspace at and around an aerodrome to be kept free of obstacles in order to permit the intended aeroplane operations to be conducted safely and to prevent the aerodrome from becoming unusable by the growth of obstacles around the aerodrome.

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

Orthometric Height: Height of a point related to the geoid, generally presented as an mean sea level (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.

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

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

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

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 turn on a runway.

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

Safety Management System (SMS): A system for the management of safety at aerodromes including the organizational structure, responsibilities, procedures, processes and provisions for the implementation of aerodrome safety policies by an aerodrome operator, which provides for the control of safety at, and the safe use of, the aerodrome.

Segregated Parallel Operations: Simultaneous operations on parallel or near- parallel Instrument Runways in which one runway is used exclusively for approaches and the other runway is used exclusively for departures.

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:

Fixed message sign. A sign presenting only one message.

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

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

Slush: Water-saturated snow which with a heel-and-toe slap-down motion against the ground will be displayed with a splatter, specific gravity: 0.5 up to 0.8.

Note. Combinations of ice, snow and/or standing water may, especially when rain, rain and snow, or snow is falling produce substances with specific gravities in excess of 0.8. These substances, due to their high water/ice content, will have a transparent rather than a cloudy appearance and, at the higher specific gravities, will be readily distinguishable from slush.

State Safety Programme (SSP): An integrated set of requirements and activities for the management of aviation safety by the State.

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.

Surface Movement Guidance and Control System (SMGCS): A system for the provision of guidance to and control of, all aircraft, ground vehicles and personnel on the Movement Area of an aerodrome for the prevention of collisions and to ensure that traffic flows smoothly and freely.

Note: Reference to SMGCS also includes A-SMGCS.

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:

Aircraft Stand Taxilane. A portion of an apron designated as a taxiway and intended to provide access to aircraft stands only.

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

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

Taxiway Intersection: A junction of two or more taxiways.

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

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 aeroplane first contact the runway.

Unmanned Aircraft Systems (UAS): An aircraft and its associated elements which are operated with no pilot on board.

Unserviceable area: A part of the movement area that is unfit and unavailable for use by aircraft.

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

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

Work area: A part of an aerodrome in which maintenance or construction works are in progress.

1.2. Applicability

1.2.1. BAR 14 Volume I - Aerodromes applies to all aerodromes that are certificated within Brunei Darussalam. Any aerodrome within Brunei Darussalam may apply for an Aerodrome Certificate under these requirements.

1.2.2. These requirements represent the minimum requirements to achieve an acceptable level of safety performance.

1.2.3. Where there is a difference or missing provision between BAR 14 Volume I - Aerodromes and ICAO SARPs, the aerodrome certificate holder shall comply with the more stringent provision.

1.3. Purpose

1.3.1. This BAR 14 Volume I – Aerodromes provides requirements that are primarily based upon the Standards and Recommended Practices (SARPs) of ICAO Annex 14 Volume I, as well as those of Annex 15 and PANS-AIM (Doc 10066) to the Convention on International Civil Aviation (Chicago Convention) and other related ICAO documents.

1.3.2. The issue of a certificate, licence or approval indicates only that the holder is considered competent to secure the safe operation of an aerodrome in accordance with the Aerodrome Manual. The possession of such a certificate or Aerodrome Manual does not relieve the aerodrome certificate holder from the

responsibility for compliance with BAR 14 Volume I - Aerodromes and any other legislation in force. Neither does it relieve the Aerodrome of its responsibility for oversight of any service provider contracted by the aerodrome to meet the requirements imposed upon service providers.

1.3.3. In addition, BAR 14 Volume I - Aerodromes includes material and specifications to support the safety oversight activities by the Brunei DCA and to provide guidance to aerodrome operators on the physical characteristics of an aerodrome, the operational requirements and the infrastructure that is required to be provided. Where appropriate, reference is made to other documents in support of BAR 14 Volume I - Aerodromes. This material can be used to establish minimum acceptable standards or Acceptable Means of Compliance (AMC) under the discretion of the Brunei DCA.

1.4. Standards and Recommended Practices

1.4.1. Standards and Recommended Practices in the context of this BAR 14 Volume I – Aerodromes are defined as follows:

Standard. 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 international air navigation and to which aerodrome operators shall conform in accordance with the provisions of the BAR 14 Volume I - Aerodromes. In the event of non-compliance with any standard, an application for exemption and justification (through appropriate risk assessment and/ or aeronautical studies) to the Brunei DCA is compulsory.

Recommended Practices. 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 international air navigation and to which aerodrome operators should endeavour to conform in accordance with the provisions of the BAR 14 Volume I – Aerodromes. In the event of non-compliance with any recommended practice, notification to the Brunei DCA is compulsory.

1.4.2 In this BAR 14 Volume I - Aerodromes, ***standards*** are identified by the words 'must' or 'shall'. Unless otherwise exempted pursuant to paragraph 1.6 below, they shall be complied with at all times.

1.4.3 In this BAR 14 Volume I – Aerodromes, ***recommended practices*** are identified by the words 'should' or 'may'. Aerodrome operators should endeavour to comply with recommended practices.

1.5. ICAO Annex 14 compliance

1.5.1. Except as provided in this paragraph, the operator of a certificated aerodrome shall comply with the requirements contained in BAR 14 Volume I - Aerodromes. Where there is a difference or missing provision between BAR 14 Volume I - Aerodromes and ICAO SARPs, the aerodrome certificate holder shall comply with the more stringent provision.

1.5.2. The RFFS level of protection to be available shall not be less than that needed for the highest category of aeroplane planned to use the aerodrome.

1.5.3. The additional requirements in paragraph 9.1 apply to emergency planning and emergency exercises.

1.5.4. An alternative means of compliance to that specified in paragraph 1.5.1 & 1.3.3 above may be proposed through the submission to the Brunei DCA of an aeronautical study. An aeronautical study is a study of an aeronautical problem to identify possible solutions and select a solution that is acceptable without degrading safety. An aeronautical study shall:

(a) assess the impact of a proposed deviation from the requirements;

(b) present alternative means of ensuring the safety of aircraft operations; and

(c) estimate the effectiveness of each alternative and to recommend procedures to compensate for the deviation.

Note: A more detailed description of an aeronautical study can be found in Appendix lll of this BAR 14 Volume l - Aerodromes.

1.5.5. Any agreement or contract between an aerodrome operator and any service provider or sub-contractor providing services to the certificate holder shall include the specific requirement for compliance with BAR 14 Volume I - Aerodromes as appropriate.

1.5.6 A cross reference between the requirements of BAR 14 Volume 1 and ICAO Annex 14 Volume I and other provisions is shown in Appendix XIII. Differences are also identified and ICAO shall be notified of these differences. Where a difference is deemed to be significant, it shall be published in the Brunei Aeronautical Information Publication (AIP) in accordance with the requirements of BAR 15, Annex 15 and PANS-AIM (Doc 10066).

1.6. Exemptions

1.6.1. The Brunei DCA may exempt, in writing, an aerodrome operator from complying with specific provisions of these requirements. However, before the Brunei DCA decides to exempt the aerodrome operator, the Brunei DCA must take into account all safety-related aspects.

1.6.2. An exemption is subject to the aerodrome operator complying with the conditions and procedures specified by the Brunei DCA in the aerodrome certificate as being necessary in the interest of safety.

1.6.3. When an aerodrome does not meet the requirement of a standard or practice specified in a requirement, the Brunei DCA may determine, after reviewing the submitted aeronautical study, only if and where permitted by the standards and practices, the alternative conditions and procedures that are necessary to ensure a level of safety equivalent to that established by the relevant standard or practice (see also paragraph 1.5.4).

1.6.4. Any accepted deviation from a standard or practice and conditions and procedures referred to shall be set out in an endorsement on the aerodrome certificate.

1.6.5. Exemptions granted to an aerodrome operator must also be recorded in the Aerodrome Manual. The Aerodrome Manual must contain details of exemption, reasons that the exemption was requested for, any resultant limitations, conditions or procedures imposed, and other related safety information.

1.7. Aerodrome reference code

1.7.1. An aerodrome reference code comprising a code number and a letter shall be identified for aerodrome planning purposes. The code numbers and letters shall have the meanings assigned to them in Tables 1 and 2 below. The code shall take into account the characteristics of the largest aeroplane regularly using the aerodrome facility.

1.7.2. Column 1, Table 1, corresponds to the longest of the declared distances ASDA or TODA instead of aeroplane reference field length. However, this shall not restrict the actual runway length provided.

1.7.3. Column 3, Table 2, corresponds to the greatest wing span of the aeroplanes for which the facility is intended.

Table 1. Aerodrome reference code, Code element 1 (Table1-1 ICAO Annex 14)

Code element 1	
Code number (1)	**The Greater of ASDA or TODA (2)**
1	Less than 800m
2	800m but less than 1200m
3	1200m but less than 1800m
4	1800m and over

Note. Further guidance on determining the runway length is given in the Aerodrome Design Manual, (Doc 9157), Part 1 - Runways

Table 2. Aerodrome reference code, Code element 2 (Table 1-1 ICAO Annex 14)

Code element 2	
Code letter (3)	**Wingspan (4)**
A	Less than 15m
B	15m but less than 24m
C	24m but less than 36m
D	36m but less than 52m
E	52m but less than 65m
F	65m but less than 80m

Note. This table are used to determine the aerodrome reference code. Further guidance on planning for aeroplanes with wingspans greater than 80 m is given in ICAO Doc 9157 Parts 1 and 2.

1.8. **Aerodrome dimensions and related information.**

1.8.1 General information, including the following shall be made available:

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

b) strip, runway end safety areas, stopways - length, width and surface type;

c) taxiway - designation, width and surface type;

d) apron - surface type and aircraft stands;

e) clearway - length and ground profile;

f) visual approach slope indicator and other systems – system type (PAPI/APAPI and T-VASIS/AT-VASIS); marking and lighting of runways, taxiways, and aprons; other visual guidance and control aids on taxiways, including runway holding positions, intermediate holding positions and stop bars, and location and type of visual docking guidance system; availability of standby power of lighting;

g) location and radio frequency of VOR aerodrome check-point;

h) location and designation of standard taxi-routes;

i) the geographical coordinates of each threshold.

j) the geographical coordinates of appropriate taxiway center line points;

k) the geographical coordinates of each aircraft stand;

l) the geographical coordinates, the top elevation, type, marking, and lighting (if any) of significant obstacles in the approach and take-off areas, in the circling area and in the vicinity of the aerodrome. This information may best be shown in the form of charts such as those required for the preparation of aeronautical information publications as specified in BAR 4 and BAR 15, Annex 4 and Annex 15 and PANS-AIM (Doc 10066);

m) pavement surface type and bearing strength using Aircraft Classification Number - Pavement Classification Number (ACN - PCN) method;

n) one or more pre-flight altimeter check locations shall be established on an apron and their elevation;

o) declared distances; take-off run available (TORA); take-off distance available (TODA); accelerate-stop distance available (ASDA); landing distance available (LDA);

Note.— Guidance on calculation of declared distances is given in the Annex 14 Volume I Attachment A, Section 3.

p) disabled aircraft removal plan: the telephone/telex/facsimile numbers; e-mail address of the aerodrome coordinator for the removal of an aircraft disabled on or adjacent to the movement area; information on the capability to remove a disabled aircraft - expressed in terms of the aircraft which the aerodrome is equipped to remove; and

q) rescue and fire fighting: level of protection provided should be expressed terms of the category of the rescue and fire fighting services which should be in accordance with the longest aeroplane normally using the aerodrome and the type and amounts of extinguishing agents normally available at the aerodrome.

r) Information on the condition of the movement area and the operational status of related facilities shall be provided to the appropriate aeronautical information services 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. Note.— The Nature, format and conditions of the information to be provided are specified in the PANS-AIM (Doc 10066) and the PANS-ATM (Doc 4444).

Note. – The accuracy of the information provided under paragraph 1.7.1 is critical to aircraft safety. Information requiring engineering survey and assessment should be gathered or verified by qualified technical persons.

1.9. Strength of pavements.

1.9.1 The bearing strength of a pavement shall be determined.

1.9.2 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.

1.9.3 The PCN reported shall indicate that an aircraft with an ACN equal to or less than the reported PCN can operate on the pavement subject to any limitation on the tire pressure, or an all-up mass for specified aircraft type(s).

1.9.4 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 ICAO Aerodrome Design Manual (Doc. 9157), Part 3.

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

1.9.6 Information on pavement type for ACN-PCN determination, subgrade strength category, maximum allowable tire pressure category and evaluation method shall be specified as detailed in ICAO Annex 14, Volume 1, paragraph 2.6.6.

1.9.7 **Recommendation -** Criteria 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 1.9.2 and 1.9.3.

1.9.8 The bearing strength of a pavement intended for aircraft of apron (ramp) mass equal to or less than 5700 kg shall be made available by reporting the following information:

a) maximum allowable aircraft mass; and

b) maximum allowable tire pressure.

1.10. **Aeronautical Data**

1.10.1 Determination and reporting of aerodrome-related aeronautical data shall be in accordance with the accuracy and integrity classification required to meet the needs of the end-users of aeronautical data. Specifications concerning the accuracy and integrity classification related to aerodrome-related aeronautical data are contained in PANS-AIM (Doc 10066), Appendix 1.

1.10.2 **Recommendation -** Aerodrome mapping data should be made available to the aeronautical information services for aerodromes deemed relevant by States where safety and/or performance-based operations suggest possible benefits.

Note 1.— Aerodrome mapping databases related provisions are contained in Annex 15, Chapter 5 and PANS-AIM (Doc 10066), Chapter 5.

Note 2.— Guidance material concerning the application of aerodrome mapping databases is provided in Attachment A, Section 23.

1.10.3 Where made available in accordance with 1.10.2, the selection of the aerodrome mapping data features to be collected shall be made with consideration of the intended applications.

1.10.4 Digital data error detection techniques shall be used during the transmission and/or storage of aeronautical data and digital data sets.

Note.— Detailed specifications concerning digital data error detection techniques are contained in PANS-AIM (Doc 10066).

1.11. **Common Reference Systems**

1.11.1 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).

1.11.2 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 gravityfield 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.

1.11.3 Temporal reference system

The Gregorian calendar and Coordinated Universal Time (UTC) shall be used as

the temporal reference system. When a different temporal reference system is used, this shall be indicated in GEN 2.1.2 of the Aeronautical Information Publication (AIP).

Note.— See PANS-AIM (Doc 10066), Appendix 2.

1.12. Airport design

1.12.1 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.

1.12.2 **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.

1.13. Aerodrome and runway elevations

1.13.1 The aerodrome elevation and geoid undulation at the aerodrome elevation position shall be measured to the accuracy of one-half metre or foot and reported to the aeronautical information services authority.

1.13.2 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 or foot and reported to the aeronautical information services authority.

1.13.3 For precision approach runway, 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 or foot and reported to the aeronautical information services authority.

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

1.14. Aerodrome reference temperature

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

1.14.2 **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 years.

1.15. Conditions of the movement area and related facilities

1.15.1 Information on the condition of the movement area and the operational status of related facilities shall be provided to the appropriate aeronautical information services 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.

Note.— The nature, format and conditions of the information to be provided are specified in the PANS-AIM (Doc 10066) and the PANS-ATM (Doc 4444).

1.15.2 The condition of the movement area and the operational status of related facilities shall be monitored, and reports on matters of operational significance affecting aircraft and aerodrome operations shall be provided in order to take appropriate action, particularly in respect of the following:
a) construction or maintenance work;
b) rough or broken surfaces on a runway, a taxiway or an apron;
c) Not in use;
d) water on a runway, a taxiway or an apron;
e) chemicals or other contaminants on a runway, taxiway or apron;
f) Not in use;
g) other temporary hazards, including parked aircraft;
h) failure or irregular operation of part or all of the aerodrome visual aids; and
i) failure of the normal or secondary power supply.

Note 1.— Other contaminants may include mud, dust, sand, volcanic ash, oil and rubber. Annex 6, Part I — International Commercial Air Transport — Aeroplanes, Attachment C provides guidance on the description of runway surface conditions. Additional guidance is included in the Airport Services Manual (Doc 9137), Part 2.

1.15.3 To facilitate compliance with 1.15.1 and 1.15.2, inspections of the movement area shall be carried out each day at least once where the code number is 1 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 Airport Services Manual (Doc 9137), Part 8 and in the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476).

1.15.4 **Recommendation -** Personnel assessing and reporting runway surface conditions required in 1.15.2 should be trained and competent to meet criteria set by the State.

Note.— Guidance on criteria is included in the Airport Services Manual (Doc 9137), Part 8, Chapter 7.

Water on a runway

1.15.5 **Recommendation -** Whenever water is present on a runway, a description of the runway surface conditions should be made available using the following terms:

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

WET — the surface is soaked but there is no standing water.
STANDING WATER — for aeroplane performance purposes, a runway where more than 25 per cent of the runway surface area (whether in isolated areas or not) within the required length and width being used is covered by water more than 3 mm deep.

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

Note.— The determination that a runway or portion thereof may be slippery when wet is not based solely on the friction measurement obtained using a continuous friction measuring device. Supplementary tools to undertake this assessment are described in the Airport Services Manual (Doc 9137), Part 2.

1.15.7 Notification shall be given to aerodrome users when the friction level of a paved runway or portion thereof is less than that specified by the State in accordance with 10.2.3. of this manual.

Note.— Guidance on conducting a runway surface friction characteristics evaluation programme that includesdetermining and expressing the minimum friction level is provided in the Annex 14 Vol.I, Attachment A, Section 7.

1.16. Coordination between aeronautical information services and aerodrome authorities

1.16.1 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 authorities responsible for aerodrome services to report to the responsible aeronautical information services unit, with a minimum of delay:

a) information on the status of certification of aerodromes and aerodrome conditions (ref. 1.4, 2.9, 2.10, 2.11 and 2.12 of ICAO Annex 14 Volume l and Chapter 2 of BAR 14 Volume l - Aerodromes);

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.

1.16.2 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 aeronautical information services for the preparation, production and issue of relevant material for promulgation. To ensure timely provision of the information to aeronautical information services, close coordination between those services concerned is therefore required.

1.16.3 Of a particular importance are changes to aeronautical information that affect charts and/or computer-based navigation systems which qualify to be notified by the Aeronautical Information Regulation and Control (AIRAC) system, as specified in Annex 15, Chapter 6. The predetermined, internationally agreed AIRAC effective dates shall be observed by the responsible aerodrome services when submitting the raw information/data to aeronautical information services.

Note.— Detailed specifications concerning the AIRAC system are contained in PANS-AIM (Doc 10066), Chapter 6.

1.16.4 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 necessary to meet the needs of the end-user of aeronautical data.

Note 1.— Specifications concerning the accuracy and integrity classification of aerodrome-related aeronautical data are contained in PANS-AIM (Doc 10066), Appendix 1.

Note 2.— Specifications for the issue of NOTAM and SNOWTAM are contained in Annex 15, Chapter 6 and PANS-AIM (Doc 10066), Appendices 3 and 4, respectively.

Note 3.— AIRAC information is distributed by the AIS at least 42 days in advance of the AIRAC effective dates with the objective of reaching recipients at least 28 days in advance of the effective date.

Note 4.— The schedule of the predetermined internationally agreed AIRAC common effective dates at intervals of 28 days and guidance for the AIRAC use are contained in the Aeronautical Information Services Manual (Doc 8126,Chapter 2).

Chapter 2. Aerodrome Certification

2.1. Aerodrome Certification Process

(a) This chapter describes the requirement for aerodromes to operate with an Aerodrome Certificate and the process of certification by the Brunei DCA.

(b) Information and guidance for aerodrome operators may be issued by Brunei DCA as a separate advisory publication or incorporated into the applicable BARs to support the aerodrome certification process.

2.1.1. Requirement for an aerodrome certificate:

The operator of an aerodrome within Brunei Darussalam intended for international operations or public use shall be in possession of an Aerodrome Certificate in accordance with the specifications contained in the Annex 14 as well as other relevant ICAO specifications through an appropriate regulatory framework.

2.1.2. Application for an aerodrome certificate:

(a) An application for an Aerodrome Certificate shall be submitted officially to the Brunei DCA not later than 6 months prior to intended operation, for approval at the following address:

Director of Civil Aviation
Department of Civil Aviation
Ministry of Transport and Infocommunications
Brunei International Airport
Bandar Seri Begawan BB 2513
Negara Brunei Darussalam

(b) The application form shall be the form ADR 019 - APPLICATION FOR AN AERODROME CERTIFICATE, found in this BAR 14 Volume I - Aerodromes, Appendix II or as prescribed on the Brunei DCA website.

(c) The Applicant shall submit but not limited to:

i. Completed application form ADR 019 **(Appendix II)**
ii. Aerodrome Manual
iii. Aerodrome Emergency Plan
iv. Safety Management System (SMS) Manual

(d) Brunei DCA may require other documentation to facilitate the assessment of application.

Note: Guidance Materials ADR 012 AERODROME CERTIFICATION MANUAL and ADR 017 AERODROME CERTIFICATION APPLICATION PROCEDURE, prescribed the aerodrome certification process in more details and can be found on the Brunei DCA website.

2.1.3. Assessment of Application

(a) The initial assessment of application shall be based on information provided by Applicant in the form ADR 019, and other documentation as required by Brunei DCA.

(b) The Aerodrome Manual is a fundamental requirement of the aerodrome certification process and shall take the form and contains information as detailed set out in paragraph 2.2 of this document.

(c) If the result of the initial assessment is negative, then there is no need to proceed any further and the Brunei DCA will inform the Applicant accordingly.

(d) The Applicant may appeal to the Brunei DCA's decisions and submit revised application.

(e) The initial assessment, however, does not take into consideration land-use and environmental protection issues that may require approval of other authorities. The Applicant shall provide information regarding these approvals as detailed in the application form ADR 019, where applicable.

2.1.4. **Certification Audit**

(a) Certification audit will only be conducted after the Brunei DCA has been satisfied with all the documentations submitted by the Applicant.

(b) The Applicant will be notified the date when certification audit is to be conducted.

(c) Brunei DCA will carry out a detailed examination of the aerodrome. The certification audit is undertaken for the purpose of verifying the information provided in the Aerodrome Manual; and to physically check and assess the facilities, equipment, services and operational organization and ensure that they comply with BAR 14 Volume I - Aerodromes and other relevant ICAO SARPs as determined by the Brunei DCA.

(d) Certification audit generally include the following steps:

(1) Notification
Notification by Authority on the audit date.

(2) Pre-Audit Briefing
On-site briefing regarding audit procedure, scope of audit, audit time schedule and Applicant's personnel to be made available during audit.

(3) Pre-Audit Review
Audit of documentation and other standard operating procedures, preventive and corrective maintenance plans, maintenance records, AIPs, Aeronautical Charts, NOTAMS and other relevant documentation relating to safe and efficient operations of the aerodrome.

(4) Physical Audit
Audit on facilities, equipment, services and operational organization to assess compliance with ICAO Annex 14 SARPS and relevant ASDs.

(5) Night Audit
Only for aerodromes where operations are conducted at night or where an approach lighting system is provided.

(6) Post Audit Briefing
Where audit findings on documentations, facilities, equipment, services and operational organization are informed to the Applicant.

(e) The Applicant shall allow the Brunei DCA access and inspect to any part of the aerodrome or any aerodrome facility, including equipment, records and documents, during the certification audit.

(f) The Applicant shall cooperate and facilitate with the Brunei DCA in conduct of the certification audit, and relevant Applicant's personnel shall be made available to the Brunei DCA to facilitate the audit.

2.1.5. **Audit Report**

(a) The Brunei DCA will issue an audit report to the Applicant within sixty (60) days upon the completion of a certification audit.

(b) The audit findings, if any, are registered in the form ADR 004 Aerodrome Audit Report.

(c) Findings and shortcomings are classified as follow –

(i) Level 1 Finding (major non-compliances) :

Level 1 findings are those which pose a hazard to aircraft operational safety or which contravenes a legal requirement or which lowers safety standards and immediate action by Applicant is required.

(ii) Level 2 Finding (minor non-compliances):

A Level 2 finding non-compliance with the applicable BARs or a finding against the aerodrome operator's procedures, which could possibly hazard the aircraft operational safety or which could lower safety standards. Immediate action by Applicant is encouraged or by the date agreed with the Brunei DCA.

(iii) Level 3 Finding (observations):

A level 3 finding is an observations or recommendation to improve safety standards and/or achieve a better practice by addressing: (1) opportunities for improvements or (2) deficiencies that may lead to potential findings. Immediate action by Applicant is encouraged or by the date agreed with the Brunei DCA.

2.1.6. **Remedial Action**

(a) All non-compliances registered in an audit report, and which are stated and issued to the Applicant in the Non-Compliance/Observation Report Form ADR 004 Audit Report, will require corrective action by the Applicant.

(b) Applicant shall state proposed corrective action plan in the Non–Compliance/ Observation Report Form ADR 004 Audit Report and to be submitted to the Brunei DCA within thirty (30) days of the date of the audit report issued by the Brunei DCA.

(c) The corrective action plan shall describe method(s) to be taken by the Applicant to address the non-compliance, the time duration required and the date which compliance will be achieved.

(d) The Brunei DCA, upon receipt and evaluation of Applicant's corrective action plan, may or may not approve the plan. Where the plan suggested is not satisfactory or the time duration to correct the findings is considered unacceptable, the Brunei DCA will notify the Applicant to revise his corrective action plan.

(e) A revised corrective action plan must be submitted to the Brunei DCA within fourteen (14) days of the notification by the Brunei DCA.

(f) Regardless of the above, Brunei DCA expects –

(i) Major non-compliances on aerodrome facilities, equipment and services shall be immediately corrected by the Applicant; and

(ii) Revision and amendment to correct deficiencies or discrepancies in the Aerodrome Manual and other operating procedures shall be submitted to the Brunei DCA within thirty (30) days of the date of the audit report issued by the Brunei DCA.

(g) The Brunei DCA may conduct a follow-up audit to certify the non-compliances have been satisfactorily corrected.

2.1.7. **Grant or refusal of an aerodrome certificate**

(a) Before granting an Aerodrome Certificate, the Brunei DCA must be satisfied that:

(1) The aerodrome facilities, services and equipment are in accordance with BAR 14 Volume I - Aerodromes and other relevant ICAO SARPs as determined by the Brunei DCA;

(2) The Aerodrome Manual prepared for the applicant's aerodrome and submitted with the application contains all the pertinent information on the aerodrome site, facilities, services, equipment, operating procedures and management including a safety management system;

(3) An acceptable safety management system is in place at the aerodrome and documented within the aerodrome manual;

Note – The intent of a safety management system is to have in place an organised and orderly approach in the management of aerodrome safety by the aerodrome operator. Annex 19 – Safety Management contains the safety management provisions applicable to certified aerodromes. Guidance on a harmonised safety management system is given in the ICAO Safety Management Manual (Doc 9859) and in the Manual on Certification of Aerodromes (Doc 9774). Procedures on the management of change, conduct of safety assessment, reporting and analysis of safety occurrences at aerodromes and continuous monitoring to enforce compliance with applicable specifications so that identified risks are mitigated can be found in the PANS-Aerodromes(Doc 9981)

(4) The applicant and their staff have the necessary competence to operate and maintain the aerodrome properly;

(5) The aerodrome operating procedures make satisfactory provision for the safety of aircraft; and

(6) Payment of the appropriate aerodrome certification fee has been received. (This is subject to the on-going 'Scheme of Charges')

(b) The Brunei DCA may refuse to grant an Aerodrome Certificate to an applicant. In such cases, the Brunei DCA must notify the applicant, in writing, of its reasons no later than 60 working days after making that decision.

(c) An application for a certificate of aerodrome may be refused if –

i. Application form ADR 019 not complete;

ii. Required documentation not submitted with the application;

iii. Corrective action plan are not submitted within the stipulated time;

iv. Corrective action on non-compliances not done or revision to documentation not submitted within stipulated time;

v. Corrective action plan(s) submitted are not satisfactory; or

vi. Follow-up audit reveals that non-compliances are not satisfactorily rectified.

(d) If the application is successful, an aerodrome certificate, incorporating conditions, as applicable, shall be granted to the Applicant.

(e) An Aerodrome Certificate remains in force until it is suspended, surrended varied or revoked by the Brunei DCA, or for a maximum of 2 years, and will be subject to any conditions considered appropriate by the Brunei DCA.

(f) An Aerodrome Certificate that has been suspended or revoked must be returned immediately to the Brunei DCA.

Note. A Sample Aerodrome Certificate is shown in ICAO Doc. 9774, Appendix 4.

2.1.8. **Promulgation in the AIP**

Upon satisfactory completion of the certification process, the Applicant shall provide all the information about the aerodrome to the Aeronautical Information Services for publication in the Aeronautical Information Publication.

2.1.9. **Aerodrome Certificate Surveillance Audit by Aerodrome Inspectorates**

An announced or unannounced surveillance audit and inspection shall be conducted by the aerodrome inspectorates personnel to ascertain whether the aerodrome certificate holder is or will continue to conduct operations in accordance with the term and condition of the aerodrome certificate, the national law, the BARs, national authority publications and to ensure that organisation's manuals and procedures are appropriately documented and followed.

2.1.10. **Transfer of Aerodrome Certificate**

(a) An Aerodrome Certificate shall not be transferable to any person without the prior concern in writing to Brunei DCA, and any purported transfer of an Aerodrome Certificate shall be void and of no effect.

(b) The holder of the Aerodrome Certificate must notifies the Brunei DCA in writing at least 6 months before ceasing to operate the aerodrome, that the current holder will cease to operate the aerodrome as of the date specified in the notice;

(c) The holder of the Aerodrome Certificate must notifies the Brunei DCA in writing, the name of the transferee;

(d) The transferee applies in writing to the Brunei DCA at least 6 months before the holder of the Aerodrome Certificate ceases to operate the aerodrome, for the Aerodrome Certificate to be transferred to the transferee; and

(e) The requirements set out in paragraph 2.1.7. are met.

(f) If the Brunei DCA does not consent to the transfer of an Aerodrome Certificate, it shall notify the transferee, in writing, of its reasons no later than 60 working days after making that decision and in any case, not less than 60 working days prior to the expiry of the Aerodrome Certificate.

2.1.11. **Endorsement of conditions on an Aerodrome Certificate.**

After successful completion of the processing of the application and the inspection of the aerodrome the Brunei DCA, when granting the Aerodrome Certificate, will endorse the conditions for the type of use of the aerodrome.

2.1.12. **Duration of the Aerodrome Certificate.**

(a) An aerodrome certificate shall remain in force until it is suspended or cancelled, or alternatively, an Aerodrome Certificate shall be valid for two years or until it is suspended or cancelled, whichever is earlier.

(b) The renewal or continuing validity of Aerodrome Certificates depend on the satisfactory outcome of regulatory surveillance/audits activities.

2.1.13. **Surrender of an Aerodrome Certificate.**

(a) An Aerodrome Certificate holder must give the Brunei DCA not less than 60 days' written notice of the date on which the certificate is to be surrendered in order that suitable promulgation action can be taken.

(b) The Brunei DCA will cancel the Aerodrome Certificate on the date specified in the notice.

2.1.14. **Amendment of an Aerodrome Certificate.**

The Brunei DCA may, provided that the appropriate rules have been met, amend an Aerodrome Certificate when:

(a) There is a change in the ownership or management of the aerodrome.

(b) There is a change in the use or operation of the aerodrome,

(c) There is a change in the boundaries of the aerodrome; or

(d) The holder of the Aerodrome Certificate requests an amendment.

2.2. Aerodrome Manual

2.2.1. Preparation of the Aerodrome Manual

(a) The operator of a certified aerodrome MUST have an Aerodrome Manual for the aerodrome.

(b) The Aerodrome Manual is a fundamental requirement of the certification process and shall take the form and contains information as detailed in guidance material ADR 013 Aerodrome Manual Checklist provided on DCA website.

(c) The Aerodrome Manual shall:

(1) be typewritten or printed, and signed by the aerodrome operator;

(2) be in a format that is easy to revise;

(3) have a system for recording the currency of pages and amendments thereto, including a page for logging revisions; and

(4) be organised in a manner that will facilitate the preparation, review and acceptance/approval process.

2.2.2. Location of the Aerodrome Manual

(a) The aerodrome operator must provide the Brunei DCA with a complete and current copy of the Aerodrome Manual.

(b) The aerodrome operator must keep at least one complete and current copy of the Aerodrome Manual at the aerodrome and one copy at the aerodrome operator's principal place of business if other than the aerodrome.

(c) The aerodrome operator must make the Aerodrome Manual available to all aerodrome operating staff and for inspection by Brunei DCA authorised person.

2.2.3. Information to be included in the Aerodrome Manual

(a) The operator of a certified aerodrome **MUST** include all pertinent information on the aerodrome site, facilities, services, equipment, operating procedures, organization and management including a safety management system.

(b) The information presented in the Aerodrome Manual shall demonstrate that the aerodrome conforms to the certification standards and practices as specified in BAR 14 Volume I - Aerodromes and other relevant ICAO SARPs as determined by the Brunei DCA and that there are no apparent shortcomings that would adversely affect the safety of aircraft operations. From the contents of the Aerodrome Manual, Brunei DCA will assess the suitability of the aerodrome for proposed aircraft operations and to judge an Applicant's fitness to hold a certificate. Aerodrome Manual may also refers to Heliport Manual.

(c) The content of the Aerodrome Manual shall be as follows:

(1) General information such as the purpose and scope of the Aerodrome Manual, the legal requirement for an Aerodrome Certificate and an Aerodrome Manual, the conditions for use of the aerodrome and the aeronautical information services available;

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

(3) Particulars of the aerodrome site;

(4) Particulars of the aerodrome required to be reported to the Aeronautical Information Service; and

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

Note 1.— The form and content information as detailed in guidance material ADR 013 Aerodrome Manual Checklist provided on DCA Website.

Note 2.— Detailed specifications concerning the information to be included in the Aerodrome Manual are contained in ICAO Doc 9774 Manual on Certification of Aerodromes, Appendix 1 and ICAO Doc 9981 PANS Aerodromes, Attachment C to Chapter 2.

2.2.4. Amendment of Aerodrome Manual

(a) The aerodrome manual is a living document, the operator of a certified aerodrome must amend the Aerodrome Manual, whenever necessary, in order to maintain the accuracy and currency of the information in the manual.

(b) To maintain the accuracy and currency of the Aerodrome Manual, the aerodrome operator shall preview the contents of Aerodrome Manual periodically at least once annually. The Brunei DCA may also issue a written directive to an aerodrome operator requiring the operator to alter or amend the manual in accordance with that directive.

(c) An aerodrome operator must notify the Brunei DCA, as soon as practicable, of any changes that the operator wishes to make, or has made, to the Aerodrome Manual.

2.2.5. Brunei DCA Approval of the Aerodrome Manual

The Brunei DCA shall approve the Aerodrome Manual and any amendments thereto, provided these meet the requirements of the preceding requirements in this BAR 14 and related ICAO Annex 14 and ICAO Doc, including any amendments to ICAO standards and recommended practices not yet incorporated into the requirements.

2.3. Obligations of the Aerodrome Operator

2.3.1. Compliance with standards and practices

The aerodrome operator shall comply with the standards and recommended practices specified in BAR 14 Volume I - Aerodromes and with any conditions endorsed in the aerodrome certificate pursuant to paragraphs 1.6.1 and 2.1.6.

2.3.2. Competence of operational and maintenance personnel

(a) The aerodrome operator shall employ an adequate number of competent personnel to perform all critical activities for aerodrome operation and maintenance.

(b) If the Brunei DCA or any other competent authority of the government requires competency certification for the personnel referred to in paragraph 2.3.2(a) the aerodrome operator shall employ only those persons possessing such certificates.

(c) The aerodrome operator shall implement a programme to maintain and upgrade as required the competency of the personnel referred to in paragraph 2.3.2(a).

2.3.3. Aerodrome operation and maintenance

(a) Subject to any directives that the Brunei DCA may issue, the aerodrome operator shall operate and maintain the aerodrome in accordance with the procedures set out in the Aerodrome Manual.

(b) To ensure the safety of aircraft, the Brunei DCA may give written directives to an aerodrome operator to alter the procedures set out in the Aerodrome Manual.

(c) The aerodrome operator shall ensure proper, efficient and competent maintenance of the aerodrome facilities.

(d) The aerodrome certificate holder shall coordinate with the ATS provider in order to be satisfied that appropriate air traffic services are available to ensure the safety of aircraft in the airspace associated with the aerodrome.

(e) The coordination between the aerodrome operator and the ATS provider shall cover other areas related to safety such as aeronautical information service, air traffic services, designated meteorological authorities, security, RFF, aerodrome safeguarding and any other relevant area.

Note. – Additional information for aerodrome safeguarding coordination with the ATS provider can be found in ICAO Doc 8168, Procedures for Air Navigation Services – Aircraft Operations Volume l and ll (PANS-OPS)

(f) An aerodrome operator shall include in, or referenced to, the Aerodrome Manual the terms of a letter of agreement or contract or memorandum of understanding covering all services provided by other parties which are required to be provided by an aerodrome operator.

2.3.4. Aerodrome operator's Safety Management System

(a) **The aerodrome operator shall establish and include details in the Aerodrome Manual and a Safety Management System** for the aerodrome describing the structure of the organisation and the duties, powers and responsibilities of the officials in the organisational structure, with a view to ensuring that operations are carried out in a demonstrably controlled way and are improved where necessary.

(b) The aerodrome operator shall oblige all users of the aerodrome, including, but not limited to, fixed-base operators, apron management operators, ground handling agencies and other organisations that perform activities independently at the aerodrome in relation to flight or aircraft handling, to comply with the requirements laid down by the aerodrome operator with regard to safety at the aerodrome. The aerodrome operator shall monitor such compliance.

(c) The aerodrome operator shall require, by contract or agreement, all users of the aerodrome, including, but not limited to, fixed-base operators, ground handling agencies and other organisations referred to in paragraph 2.3.4(b), to cooperate in the programme to promote safety at, and the safe use of, the aerodrome by immediately informing it of any accidents, incidents, defects, procedural errors and faults which have a bearing on safety.

2.3.5. Aerodrome operator's internal safety audit and safety reporting.

(a) The aerodrome operator shall arrange its own internal audit of the safety management system, including an inspection of the aerodrome facilities, procedures and equipment. The internal audit shall cover the aerodrome operator's own functions. The aerodrome operator shall also arrange its own internal audit and inspection programme for evaluating other users, including fixed-base operators, apron management operators, ground handling agencies and other organizations working at the aerodrome as referred to in parapraph 2.3.4(b).

(b) The audits referred to in paragraph 2.3.5(a) shall be carried out at intervals not exceeding 6 months or as agreed with the Brunei DCA.

(c) The aerodrome operator shall ensure that the internal audit reports, including the report on the aerodrome facilities, services and equipment, are prepared by competent safety experts.

(d) The aerodrome operator shall retain a copy of the report(s) referred to in 2.3.5(c) for a period of 10 years or more. The Brunei DCA may request a copy of the report(s) for its review and reference.

(e) The report(s) referred to in 2.3.5(c) shall be prepared and signed by the person(s) who carried out the internal audits and inspections and approved by the organisation for which the inspector worked.

2.3.6. Power to inspect

(a) The aerodrome certificate holder shall ensure that any person authorised by the Brunei DCA is allowed unrestricted access to an aerodrome or place where an aircraft has taken off or landed or which is involved in the operation or safety of the aerodrome.

(b) The aerodrome certificate holder shall ensure that any person authorised by the Brunei DCA shall have access to any documentation pertinent to the safety or certification of the aerodrome. The holder of a certificate shall be responsible for ensuring that, if requested to do so by an authorised person, documentation is produced within a period of 60 working days.

(c) Each aerodrome certificate holder or operator of an aerodrome shall comply with any request by the Brunei DCA for a practical demonstration or test to verify compliance with BAR 14 Volume I - Aerodromes.

2.3.7. Access to the aerodrome

(a) Personnel authorised by the Brunei DCA may inspect and carry out tests on the aerodrome facilities, services and equipment, inspect the aerodrome operator's documents and records and verify the aerodrome operator's safety management system before the aerodrome certificate is granted or renewed and, subsequently, at any other time, for the purpose of ensuring safety at the aerodrome.

(b) An aerodrome operator shall, at the request of the person referred to in paragraph 2.3.7(a), allow access to any part of the aerodrome or any aerodrome facility, including equipment, records, documents and operator personnel.

(c) The aerodrome operator shall cooperate in conducting the activities referred to in paragraph 2.3.7(a).

(d) The aerodrome operator shall provide a fence or other suitable barrier to prevent the entrance of unauthorised persons onto non-public areas or animals large enough to be a hazard to aircraft which the aerodrome is intended to serve onto the aerodrome movement area.

(e) The aerodrome operator shall provide suitable means to protect ground installations and facilities essential for the safety that are located off the aerodrome.

2.3.8. Notifying and reporting

(a) An aerodrome operator shall adhere to the requirement to notify and report to the Brunei DCA, air traffic control and pilots within the specified time limits required by these requirements.

(b) Notification of inaccuracies in aeronautical information service (AIS) publications. An aerodrome operator shall review all Aeronautical Information Publications (AIPs), AIP Supplements, AIP Amendments, Notices to Airmen (NOTAMs), Pre-flight Information Bulletins and Aeronautical Information Circulars issued by AIS on receipt thereof and immediately after such reviews shall notify AIS, copied to Brunei DCA, of any inaccurate information contained therein that pertains to the aerodrome.

Note.— Specifications concerning the accuracy and integrity classification of aerodrome-related aeronautical data are contained in PANS-AIM (Doc 10066), Appendix 1

(c) Of a particular importance are changes to aeronautical information that affect charts and/or computer-based navigation systems which qualify to be notified by the aeronautical information regulation and control (AIRAC) system, as specified in Annex 15, Chapter 6. The predetermined, internationally agreed AIRAC effective dates shall be observed by the responsible aerodrome services when submitting the raw information/data to aeronautical information services.

Note.— Detailed specifications concerning the AIRAC system are contained in PANS-AIM (Doc 10066), Chapter 6.

(d) Notification of changes to the aerodrome facilities, equipment and level of service planned in advance. An aerodrome operator shall notify AIS and the Brunei DCA in writing, at least 6 months before effecting any change to the aerodrome facility or equipment or the level of service at the aerodrome that has been planned in advance and which is likely to affect the accuracy of the information contained in any AIS publication referred to in paragraph 2.3.8(b).

(e) Issues requiring immediate notification. Subject to the requirements of paragraph 2.3.8(e), an aerodrome operator shall give AIS and shall arrange for air traffic control and those responsible for flight operations to receive immediate notice detailing any of the following circumstances of which the operator has knowledge:

(1) obstacles, obstructions and hazards:

(i) any projections by an object through an obstacle limitation surface or ICAO type A chart surface, relating to the aerodrome; and

(ii) the existence of any obstruction or hazardous condition affecting aviation safety at or near the aerodrome (for example runway contamination) ;

(2) level of service; reduction in the level of service at the aerodrome as set out in any of the AIS publications referred to in paragraph 2.3.8(b);

(3) movement area: closure of any part of the movement area of the aerodrome; and

(4) any other condition that could affect aviation safety at the aerodrome and against which precautions are warranted.

(f) Immediate notification to pilots. When it is not feasible for an aerodrome operator to arrange for the air traffic control and those responsible for flight operations to receive notice of a circumstance referred to in paragraph 2.3.8(d) in accordance with that regulation , the aerodrome operator must give immediate notice direct to the pilots who may be affected by that circumstance.

2.3.9. Special inspections

An aerodrome operator shall inspect an aerodrome, as circumstances require, to ensure aviation safety:

(a) as soon as practicable after any aircraft accident or incident (including UAS) within the meaning of these terms as defined in Annex 13 to the Convention on International Civil Aviation;

(b) during any period of construction or repair of the aerodrome facilities or equipment that is critical to the safety of aircraft operation; and

(c) at any other time when there are conditions at the aerodrome that could affect aviation safety.

2.3.10. Removal of obstructions from the aerodrome surface

An aerodrome operator shall remove from the aerodrome surface any vehicle or other obstruction, such as a hole on the surface of the movement area, that is likely to be hazardous and take immediate action upon becoming aware of such obstructions to ensure that a satisfactory level of safety is maintained, including immediate closure of all or part of the aerodrome if so warranted.

2.3.11. Warning notices

When low flying aircraft, at or near an aerodrome, or taxiing aircraft are likely to be hazardous to people or vehicular traffic, the aerodrome operator shall:

(a) post hazard warning notices on any public way that is adjacent to the manoeuvring area; or

(b) if such a public way is not controlled by the aerodrome operator, inform the authority responsible for posting the notices on the public way that there is a hazard.

Chapter 3. Physical characteristics

3.1. Runways

Number and orientation of runways

3.1.1. **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.

3.1.2. **Recommendation -** The sitting and orientation of runways at an aerodrome 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.

3.1.3. **Recommendation -** Choice of maximum permissible crosswind components. In the application of paragraph 3.1.1 it should be assumed that landing or take-off of aeroplanes is, in normal circumstances, precluded when the crosswind component exceeds:

(a) 37 km/h (20 kt) in the case of aeroplanes whose reference field length is 1 500 m or over, except that when poor runway braking action owing to an insufficient longitudinal coefficient of friction is experienced with some frequency, a crosswind component not exceeding 24 km/h (13 kt) should be assumed;

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

(c) 19 km/h (10 kt) in the case of aeroplanes whose reference field length is less than 1 200 m.

3.1.4. **Recommendation -** Data to be used. 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.

Location of threshold

3.1.5. **Recommendation -** A threshold should normally be located at the extremity of a runway unless operational considerations justify the choice of another location.

3.1.6. **Recommendation -** When it is necessary to displace a threshold, either permanently or temporarily, from its normal location, account should 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

3.1.7. **Recommendation -** Primary runway. Except as provided in paragraph 3.1.9, 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.

3.1.8. **Recommendation -** Secondary runway. 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.

3.1.9. **Recommendation -** Runways with stopways or clearways. Where a runway is associated with a stopway or clearway, an actual runway length less than that resulting from application of paragraph 3.1.7 or paragraph 3.1.8, 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.

3.1.10. **Recommendation -** The width of a runway should be not less than the appropriate dimension specified in the following tabulation:

Table 3. Runway width.

Outer Main Gear Wheel Span (OMGWS)				
Code Number	Up to but not including 4.5 m	4.5 m up to but not including 6 m	6 m up to but not including 9 m	9 m up to but not including 15 m
1[a]	*18 m*	*18 m*	*23 m*	–
2[a]	*23 m*	*23 m*	*30 m*	–
3	*30 m*	*30 m*	*30 m*	*45 m*
4	–	–	*45 m*	*45 m*

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

Minimum distance between parallel runways

3.1.11. **Recommendation -** Where parallel non-instrument runways are intended for simultaneous use, the minimum distance between their centre lines should 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 is 1.

3.1.12. **Recommendation -** 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 should 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:

for segregated parallel operations the specified minimum distance:

(1) may be decreased by 30 m for each 150 m that the arrival runway is staggered toward the arriving aircraft, to a minimum of 300 m; and

(2) should be increased by 30 m for each 150 m that the arrival runway is staggered away from the arriving aircraft;

for independent parallel approaches, combinations of minimum distances and associated conditions other than those specified in the PANS-ATM (Doc 4444) may be applied when it is determined that such combinations would not adversely affect the safety of aircraft operations.

Slopes on runways

3.1.13. Longitudinal slopes

Recommendation - The slope computed by dividing the difference between the maximum and minimum elevation along the runway centre line by the runway length should 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.

3.1.14. **Recommendation -** Along no portion of a runway should 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.

3.1.15. Longitudinal slope changes

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.

3.1.16. **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.

3.1.17. **Recommendation -** Sight distance. 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.

3.1.18. **Recommendation -** Distance between slope changes. 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.

3.1.19. Transverse slopes

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 surface the transverse slope on each side of the centre line should be symmetrical.

3.1.20. **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 shall be provided taking account of the need for adequate drainage.

3.1.21. **Recommendation -** A runway should be capable of withstanding the traffic of aeroplanes the runway is intended to serve.

Surface of runways

3.1.22. The surface of a runway shall be constructed without irregularities that would impair the runway surface friction characteristics or otherwise adversely affect the take-off or landing of an aeroplane.

3.1.23. A paved runway shall be so constructed or resurfaced as to provide surface friction characteristics at or above the minimum friction level set by the State.

3.1.24. **Recommendation -** The surface of a paved runway should be evaluated when constructed or resurfaced to determine that the surface friction characteristics achieve the design objectives.

3.1.25. **Recommendation -** Measurements of the surface friction characteristics of a new or resurfaced paved runway should be made with a continuous friction measuring device using self-wetting features.

3.1.26. **Recommendation -** The average surface texture depth of a new surface should be not less than 1.0 mm.

3.1.27. **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.

3.2. Runway shoulders

General

3.2.1. **Recommendation -** Runway shoulders should be provided for a runway where the code letter is D, E or F.

Width of runway shoulders

3.2.2. **Recommendation -** For aeroplanes with OMGWS from 9 m up to but not including 15 m, the runway shoulders should extend symmetrically on each side of the runway so that the overall width of the runway and its shoulders is not less than:

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

(b) 60 m where the code letter is F with two- or three-engined aeroplanes; and

(c) 75 m where the code letter is F with four (or more)-engined aeroplanes.

Slopes on runway shoulders

3.2.3. **Recommendation -** The surface of the shoulder that abuts the runway should be flush with the surface of the runway and its transverse slope should not exceed 2.5 per cent.

Strength of runway shoulders

3.2.4. **Recommendation -** The portion of a runway shoulder between the runway edge and a distance of 30 m from the runway centre line should 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.

Surface of runway shoulders

3.2.5 **Recommendation -** A runway shoulder should be prepared or constructed so as to resist erosion and the ingestion of the surface material by aeroplane engines.

3.2.6 **Recommendation -** Runway shoulders for code letter F aeroplanes should be paved to a minimum overall width of runway and shoulder of not less than 60 m.

Note.— Guidance on surface of runway shoulders is given in the Aerodrome Design Manual, (Doc 9157), Part 1.

3.3. Runway turn pads

General

3.3.1. Where the end of a runway is not served by a taxiway or a taxiway turnaround and where the code letter is D, E or F, a runway turn pad shall be provided to facilitate a 180-degree turn of aeroplanes. (See Figure 1.)

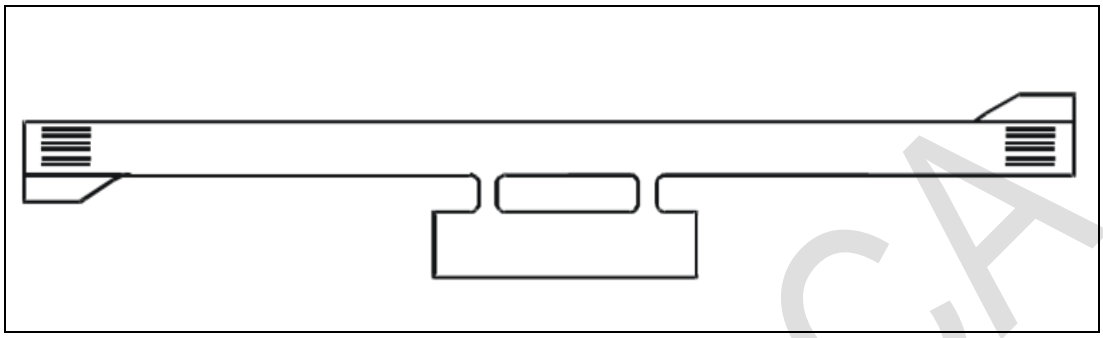


Figure 1. Runway turn pads (Figure 3-1 ICAO Annex 14)

3.3.2. **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.

3.3.3. **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.

3.3.4. **Recommendation -** The intersection angle of the runway turn pad with the runway should not exceed 30 degrees.

3.3.5. **Recommendation -** The nose wheel steering angle to be used in the design of the runway turn pad should not exceed 45 degrees.

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

Table 4. Runway turn pad clearance.

	OMGWS			
	Up to but not including 4.5 m	4.5 m up to but not including 6 m	6 m up to but not including 9 m	9 m up to but not including 15 m
Clearance	1.50 m	2.25 m	3 m[a] or 4 m[b]	4 m

a. If the turn pad is intended to be used by aeroplanes with a wheel base less than 18 m.
b. If the turn pad is intended to be used by aeroplanes with a wheel base equal to or greater than 18 m.

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

Slopes on runway turn pads

3.3.7. **Recommendation -** The longitudinal and transverse slopes on a runway turn pad should 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

3.3.8. **Recommendation -** The strength of a runway turn pad should 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.

Surface of runway turn pads

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

3.3.10. **Recommendation -** The surface of a runway turn pad should be so constructed or resurfaced as to provide surface friction characteristics at least equal to that of the adjoining runway.

Shoulders for runway turn pads

3.3.11. **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.

3.3.12. **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.

3.4. Runway strips

General

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

Length of runway strips

3.4.2. 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

3.4.3. A strip including a precision approach runway shall, wherever practicable, extend laterally to a distance of at least:

(a) 140 m where the code number is 3 or 4; and

(b) 70 m where the code number is 1 or 2;

on each side of the centre line of the runway and its extended centre line throughout the length of the strip.

3.4.4. **Recommendation -** A strip including a non-precision approach runway should extend laterally to a distance of at least:

(a) 140 m where the code number is 3 or 4; and

(b) 70 m where the code number is 1 or 2;

on each side of the centre line of the runway and its extended centre line throughout the length of the strip.

3.4.5. **Recommendation -** 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

3.4.6. **Recommendation -** An object situated on a runway strip which may endanger aeroplanes should be regarded as an obstacle and should, as far as practicable, be removed.

3.4.7. No fixed object, other than visual aids required for air navigation or those required for aircraft safety purposes and which must be sited on the runway strip, and satisfying the relevant frangibility requirement in Chapter 5, shall be permitted on a runway strip:

(a) 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

(b) 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

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

No mobile object shall be permitted on this part of the runway strip during the use of the runway for landing or take-off.

Grading of runway strips

3.4.8. **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 provide a graded area for aeroplanes which the runway is intended to serve in the event of an aeroplane running off the runway.

3.4.9. **Recommendation -** 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 should provide a graded area for aeroplanes which the runway is intended to serve in the event of an aeroplane running off the runway.

3.4.10. The surface of that portion of a strip that abuts a runway, shoulder or stopway shall be flush with the surface of the runway, shoulder or stopway.

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

3.4.12. **Recommendation -** Where the areas in 3.4.11 have paved surfaces, they should be able to withstand the occasional passage of the critical aeroplane for runway pavement design.

3.4.13. **Recommendation -** Longitudinal slopes. 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.

3.4.14. **Recommendation -** Longitudinal slope changes. 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.

3.4.15. **Recommendation -** Transverse slopes 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, shaller or stopway edge should be negative as measured in the direction away from the runway and may be as great as 5 per cent.

3.4.16. **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

3.4.17. **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.

3.4.18. **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.

3.5. Runway end safety areas

General

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

(a) the code number is 3 or 4; and

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

3.5.2. **Recommendation -** A runway end safety area should be provided at each end of a runway strip where the code number is 1 or 2 and the runway is a non-instrument one.

Dimensions of runway end safety areas

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

(a) the code number is 3 or 4; and

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

If an arresting system is installed, the above length may be reduced, based on the design specification of the system, subject to acceptance by the State.

3.5.4. **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; or a reduced length when an arresting system is installed;

(b) 120 m where the code number is 1 or 2 and the runway is an instrument one; or a reduced length when an arresting system is installed; and

(c) 30 m where the code number is 1 or 2 and the runway is a non-instrument one.

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

3.5.6. **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

3.5.7. **Recommendation -** An object situated on a runway end safety area which may endanger aeroplanes should be regarded as an obstacle and should, as far as practicable, be removed.

Clearing and grading of runway end safety areas

3.5.8. **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.

Slopes on runway end safety areas

3.5.9. **Recommendation -** General. 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.

3.5.10. **Recommendation -** Longitudinal slopes. 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.

3.5.11. **Recommendation -** Transverse slopes. 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

3.5.12. **Recommendation -** A runway end safety area should be so prepared or constructed as to reduce the risk of damage to an aeroplane undershooting or overrunning the runway, enhance aeroplane deceleration and facilitate the movement of rescue and fire fighting vehicles as required in 9.2.34 to 9.2.36.

3.6. Clearways

Location of clearways

3.6.1. **Recommendation -** The origin of a clearway should be at the end of the take-off run available.

Length of clearways

3.6.2. **Recommendation -** The length of a clearway should not exceed half the length of the take-off run available.

Width of clearways

3.6.3. **Recommendation -** A clearway should extend laterally to a distance of at least 75 m on each side of the extended centre line of the runway.

Slopes on clearways

3.6.4. **Recommendation -** The ground in a clearway should 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.

3.6.5. **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

3.6.6. **Recommendation -** An object situated on a clearway which may endanger aeroplanes in the air should be regarded as an obstacle and should be removed.

3.7. Stopways

Width of stopways

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

Slopes on stopways

3.7.2. **Recommendation -** Slopes and changes in slope on a stopway, and the transition from a runway to a stopway, should comply with the specifications of 3.1.13 to 3.1.19 for the runway with which the stopway is associated except that:

(a) the limitation in 3.1.14 of a 0.8 per cent slope for the first and last quarter of the length of a runway need not be applied to the stopway; and

(b) at the junction of the stopway and runway and along the stopway the maximum rate of slope change may be 0.3 per cent per 30 m (minimum radius of curvature of 10 000 m) for a runway where the code number is 3 or 4.

Strength of stopways

3.7.3. **Recommendation -** A stopway should be prepared or constructed so as to be capable, in the event of an abandoned take-off, of supporting the aeroplane which the stopway is intended to serve without inducing structural damage to the aeroplane.

Surface of stopways

3.7.4. The surface of a paved stopway shall be so constructed or resurfaced as to provide surface friction characteristics at or above those of the associated runway.

3.8. Radio altimeter operating area

General

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

Length of the area

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

Width of the area

3.8.3. **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

3.8.4. **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.

3.9. Taxiways

General

3.9.1. **Recommendation -** Where operationally required, taxiways should be provided to permit the safe and expeditious surface movement of aircraft.

3.9.2. **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.

3.9.3. The design of a taxiway shall be such that, when the cockpit of the aeroplane for which the taxiway is intended remains over the taxiway centre line markings, the clearance distance between the outer main wheel of the aeroplane and the edge of the taxiway shall be not less than that given by the following tabulation (Table 3):

Table 5. Taxiway clearance.

	OMGWS			
	Up to but not including 4.5 m	4.5 m up to but not including 6 m	6 m up to but not including 9 m	9 m up to but not including 15 m
Clearance	1.50 m	2.25 m	3 m[a,b] or 4 m[c]	4 m

a. On straight portions.
b. On curved portions if the taxiway is intended to be used by aeroplanes with a wheel base of less than 18 m.
c. On curved portions if the taxiway is intended to be used by aeroplanes with a wheel base equal to or greater than 18 m.

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

Width of taxiways

3.9.4. **Recommendation -** A straight portion of a taxiway should have a width of not less than that given by the following tabulation:

Table 6. Taxiway width

	OMGWS			
	Up to but not including 4.5 m	4.5 m up to but not including 6 m	6 m up to but not including 9 m	9 m up to but not including 15 m
Taxiway width	7.5 m	10.5 m	15 m	23 m

Note. Guidance on width of taxiways is given in the ICAO Aerodrome Design Manual (Doc 9157), Part 2.

Taxiway curves

3.9.5. **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 3.9.3.

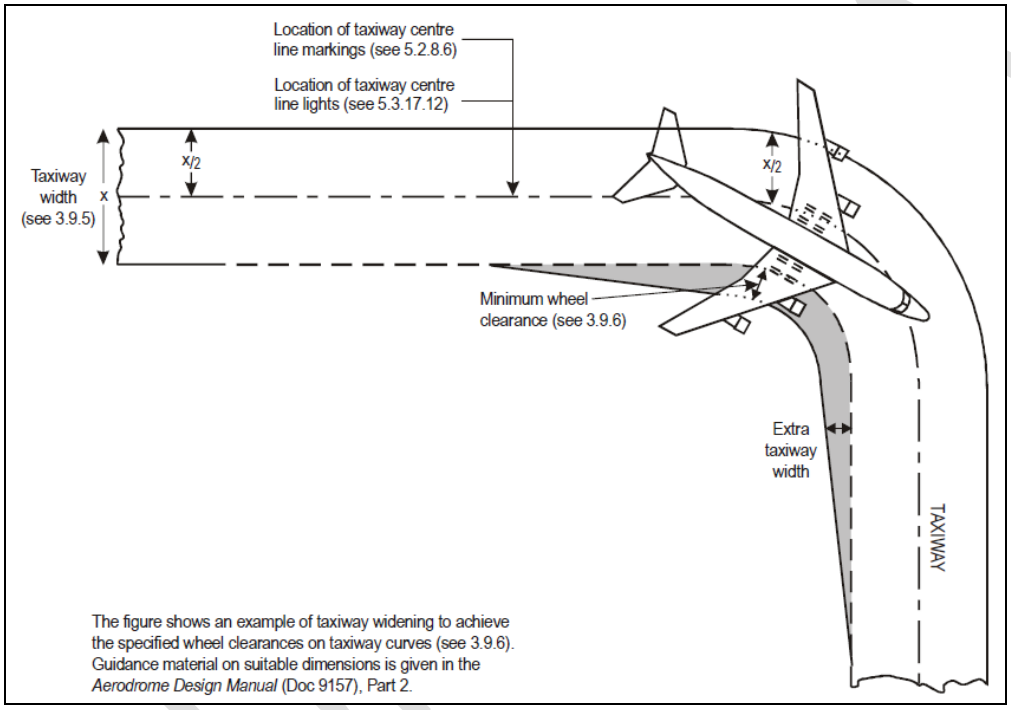


Figure 2. Taxiway curve (Figure 3-2 ICAO Annex 14)

Junctions and intersections

3.9.6. **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 3.9.3 are maintained when aeroplanes are manoeuvring through the junctions or intersections.

Taxiway minimum separation distances

3.9.7. **Recommendation -** 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 should not be less than the appropriate dimension specified in Table 7, 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.

Slopes on taxiways

3.9.8. **Recommendation -** Longitudinal slopes. 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.

3.9.9. **Recommendation -** Longitudinal slope changes. 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 3 000 m) where the code letter is C, D, E or F; and

(b) 1 per cent per 25 m (minimum radius of curvature of 2 500 m) where the code letter is A or B.

Table 7. Taxiway minimum separation distances (Table 3-1 ICAO Annex 14).

	Distance between taxiway centre line and runway centre line (metres)								Taxiway centre line to taxiway centre line (metres)	Taxiway other than aircraft stand taxilane, centre line to object (metres)	Aircraft stand taxilane centre line to aircraft stand taxilane centre line (metres)	Aircraft stand taxilane centre line to object (metres)
	Instrument runways Code number				Non instrument runways Code number							
Code letter	1	2	3	4	1	2	3	4				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
A	77.5	77.5	-	-	37.5	47.5	-	-	23	15.5	19.5	12
B	82	82	152	-	42	52	87	-	32	20	28.5	16.5
C	88	88	158	158	48	58	93	93	44	26	40.5	22.5
D	-	-	166	166	-	-	101	101	63	37	59.5	33.5
E	-	-	172.5	172.5	-	-	107.5	107.5	76	43.5	72.5	40
F	-	-	180	180	-	-	115	115	91	51	87.5	47.5

Note 1. The separation distances shown in columns (2) to (9) represent ordinary coordination of runways and taxiways. The basis for development of these distance is given in the ICAO Aerodrome Design Manual (Doc 9157), Part 2.

Note 2. The distances in columns (2) to (9) do not guarantee sufficient clearance behind a holding aeroplane to permit the passing of another aeroplane on a parallel taxiway. See the ICAO Aerodrome Design Manual (Doc 9157), Part 2.

3.9.10. **Recommendation -** Sight distance. 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.

3.9.11. **Recommendation -** Transverse slopes. 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.

Strength of taxiways

3.9.12. **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.

Surface of taxiways

3.9.13. **Recommendation -** The surface of a taxiway should not have irregularities that cause damage to aeroplane structures.

3.9.14. **Recommendation -** The surface of a paved taxiway should be so constructed or resurfaced as to provide suitable surface friction characteristics.

Rapid exit taxiways

3.9.15. **Recommendation -** A rapid exit taxiway should be designed with a radius of turn-off curve of at least:

(a) 550 m where the code number is 3 or 4; and

(b) 275 m where the code number is 1 or 2;

to enable exit speeds under wet conditions of:

(a) 93 km/h where the code number is 3 or 4; and

(b) 65 km/h where the code number is 1 or 2.

3.9.16. **Recommendation -** The radius of the fillet on the inside of the curve at a rapid exit taxiway should be sufficient to provide a widened taxiway throat in order to facilitate early recognition of the entrance and turn-off onto the taxiway.

3.9.17. **Recommendation -** A rapid exit taxiway should include a straight distance after the turn-off curve sufficient for an exiting aircraft to come to a full stop clear of any intersecting taxiway.

3.9.18. **Recommendation -** The intersection angle of a rapid exit taxiway with the runway should not be greater than 45° nor less than 25° and preferably should be 30°.

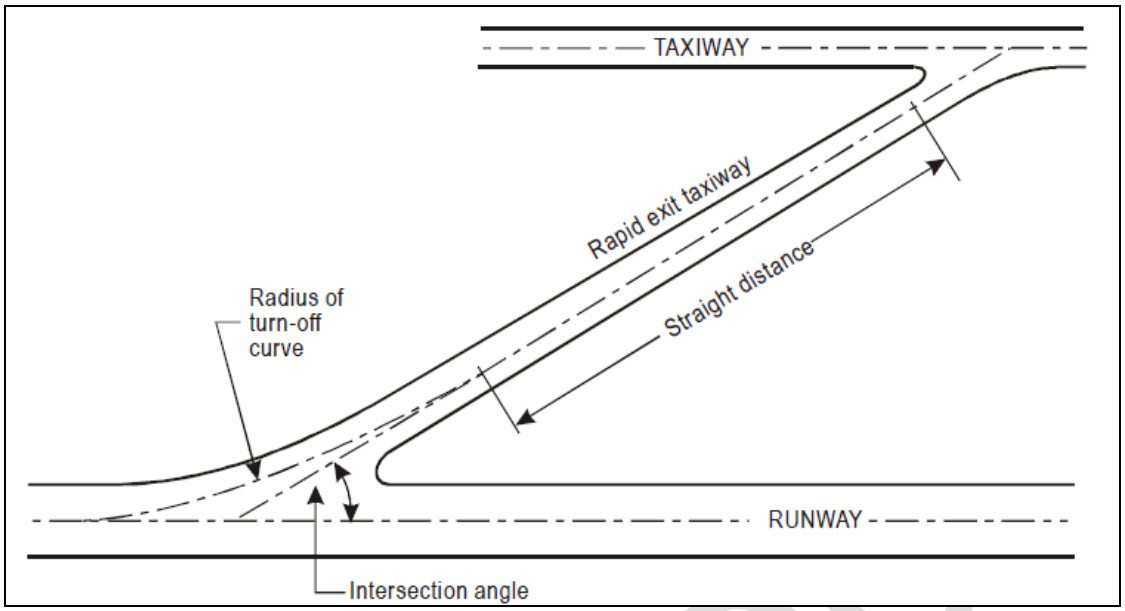


Figure 3. Rapid exit taxiway (Figure 3-3 ICAO Annex 14).

Taxiways on bridges

3.9.19. The width of that portion of a taxiway bridge capable of supporting aeroplanes, as measured perpendicularly to the taxiway centre line, shall not be less than the width of the graded area of the strip provided for that taxiway, unless a proven method of lateral restraint is provided which shall not be hazardous for aeroplanes for which the taxiway is intended.

3.9.20. **Recommendation -** Access should be provided to allow rescue and fire fighting vehicles to intervene in both directions within the specified response time to the largest aeroplane for which the taxiway bridge is intended.

3.9.21. **Recommendation -** A bridge should be constructed on a straight section of the taxiway with a straight section on both ends of the bridge to facilitate the alignment of aeroplanes approaching the bridge.

3.10. Taxiway shoulders

Note.— Guidance on characteristics of taxiway shoulders and on shoulder treatment is given in the Aerodrome Design Manual (Doc 9157), Part 2.

3.10.1. **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 overall width of the taxiway and its shoulders on straight portions is not less than:

(1) 44 m where the code letter is F;

(2) 38 m where the code letter is E;

(3) 34 m where the code letter is D; and

(4) 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.

3.10.2. **Recommendation -** When a taxiway is intended to be used by turbine-engined aeroplanes, the surface of the taxiway shoulder should be so prepared as to resist erosion and the ingestion of the surface material by aeroplane engines.

3.11. Taxiway strips

General

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

Width of taxiway strips

3.11.2. **Recommendation -** A taxiway strip should 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 7, column 11.

Objects on taxiway strips

3.11.3. **Recommendation -** The taxiway strip should provide an area clear of objects which may endanger taxiing aeroplanes.

Grading of taxiway strips

3.11.4. **Recommendation -** The centre portion of a taxiway strip should provide a graded area to a distance from the centre line of the taxiway of not less than that given by the following tabulation:

— 10.25 m where the OMGWS is up to but not including 4.5 m

— 11 m where the OMGWS is 4.5 m up to but not including 6 m

— 12.50 m where the OMGWS is 6 m up to but not including 9 m

— 18.50 m where the OMGWS is 9 m up to but not including 15 m, where the code letter is D

— 19 m where the OMGWS is 9 m up to but not including 15 m, where the code letter is E

— 22 m where the OMGWS is 9 m up to but not including 15 m, where the code letter is F

Note.— Guidance on width of the graded portion of a taxiway is given in the Aerodrome Design Manual (Doc 9157), Part 2.

Slopes on taxiway strips

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

(a) 2.5 per cent for strips 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 downward transverse slope should not exceed 5 per cent measured with reference to the horizontal.

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

3.12. Holding bays, runway-holding positions, intermediate holding positions and road-holding positions

General

3.12.1. **Recommendation -** Holding bay(s) should be provided when the traffic density is medium or heavy.

3.12.2. A runway-holding position or positions shall be established:

(a) on the taxiway, at the intersection of a taxiway and a runway; and

(b) at an intersection of a runway with another runway when the former runway is part of a standard taxi-route.

3.12.3. A runway-holding position shall be established on a taxiway if the location or alignment of the taxiway is such that a taxiing aircraft or vehicle can infringe an obstacle limitation surface or interfere with the operation of radio navigation aids.

3.12.4. **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.

3.12.5. A road-holding position shall be established at an intersection of a road with a runway.

Location

3.12.6. The distance between a holding bay, runway-holding position established at a taxiway/runway intersection or road-holding position and the centre line of a runway shall be in accordance with Table 8 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.

3.12.7. **Recommendation -** At elevations greater than 700 m (2 300 ft) the distance of 90 m specified in Table 8 for a precision approach runway code number 4 should be increased as follows:

(a) up to an elevation of 2 000 m (6 600 ft); 1 m for every 100 m (330 ft) in excess of 700 m (2 300 ft)

(b) elevation in excess of 2 000 m (6 600 ft) and up to 4 000 m (13 320 ft); 13 m plus 1.5 m for every 100 m (330 ft) in excess of 2 000 m (6 600 ft); and

(c) elevation in excess of 4 000 m (13 320 ft) and up to 5 000 m (16 650 ft); 43 m plus 2 m for every 100 m (330 ft) in excess of 4 000 m (13 320 ft).

3.12.8. **Recommendation -** If a holding bay, runway-holding position or road-holding position for a precision approach runway code number 4 is at a greater elevation compared to the threshold, the distance of 90 m or 107.5 m, as appropriate, specified in Table 8 should be further increased 5 m for every metre the bay or position is higher than the threshold.

3.12.9. The location of a runway-holding position established in accordance with 3.12.3 shall be such that a holding aircraft or vehicle will not infringe the obstacle

free zone, approach surface, take-off climb surface or ILS/MLS critical/ sensitive area or interfere with the operation of radio navigation aids.

Table 8. Minimum distance from the runway centre line to a holding bay, runway-holding position or road-holding position (Table 3-2 ICAO Annex 14).

Type of runway	Code number 1	2	3	4
Non-instrument	30 m	40 m	75 m	75 m
Non-precision approach	40 m	40 m	75 m	75 m
Precision approach category I	60 m[b]	60 m[b]	90 m[a,b]	90 m[a,b,c]
Precision approach categories II and III	—	—	90 m[a,b]	90 m[a,b,c]
Take-off runway	30 m	40 m	75 m	75 m

(a) If a holding bay, runway holding position or road-holding position is at a lower elevation compared to the threshold, the distance may be decreased 5 m for ever metre the bay or holding position is lower than the threshold, contingent upon not infringing the inner transitional surface.

(b) The distance may need to be increased to avoid interference with radio navigation aids, particularly the glide path and localizer facilities. Information on critical and sensitive area of ILS and MLS is contained in ICAO Annex 10, Volume 1, Attachments C and G, respectively.

Note 1. The distance of 90 m for code number 3 and 4 is based on an aircraft with a tail height of 20 m, a distance from the nose to the higher part of the tail of 52.7 m and a nose height of 10 m holding at an angle of 45° or more with respect to the runway centre line, being clear of the obstacle free zone and not accountable for the calculation of OCA/H.

Note 2. The distance of 60 m for code number 2 is based on an aircraft with a tail height of 8 m, a distance from the nose to the higher part of the tail of 24.6 m and a nose height of 5.2 m holding at an angle of 45°or more with respect to the runway centre line, being clear of the obstacle free zone.

(c) Where the code letter is F, this distance should be 107.5 m.

Note. The distance of 107.5 m for code number 4 is based on an aircraft with a tail height of 24 m, a distance from the nose to the higher part of the tail of 62.2 m and a nose height of 10 m holding at an angle of 45° or more with respect to the runway centre line, being clear of the obstacle free zone.

3.13. Aprons

General

3.13.1. **Recommendation -** Aprons should be provided where necessary to permit the on- and off-loading of passengers, cargo or mail as well as the servicing of aircraft without interfering with the aerodrome traffic.

Size of aprons

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

Strength of aprons

3.13.3. **Recommendation -** Each part of an apron should 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

3.13.4. **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 shall be kept as level as drainage requirements permit.

3.13.5. **Recommendation -** On an aircraft stand the maximum slope should not exceed 1 per cent.

Clearance distances on aircraft stands

3.13.6. **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:

Table 9. Clearance distance on aircraft stands.

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:

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

(2) over any portion of the stand provided with azimuth guidance by a visual docking guidance system.

3.14. Isolated aircraft parking position

3.14.1. An isolated aircraft parking position shall be designated or the aerodrome control tower shall be advised of an area or areas suitable for the parking of an aircraft which is known or believed to be the subject of unlawful interference, or which for other reasons needs isolation from normal aerodrome activities.

3.14.2. **Recommendation -** The isolated aircraft parking position should be located at the maximum distance practicable and in any case never less than 100 m from other parking positions, buildings or public areas, etc. Care 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.

3.15. De-icing/anti-icing facilities

General

3.15.1. **Recommendation -** Aeroplane de-icing/anti-icing facilities should be provided at an aerodrome where icing conditions are expected to occur.

Location

3.15.2. **Recommendation -** De-icing/anti-icing facilities should be provided either at aircraft stands or at specified remote areas along the taxiway leading to the runway meant for take-off, provided that adequate drainage arrangements for the collection and safe disposal of excess de-icing/anti-icing fluids are available to prevent ground water contamination. The effect of volume of traffic and departure flow rates should also be considered.

3.15.3. **Recommendation -** The remote de-icing/anti-icing facility should be located to be clear of the obstacle limitation surfaces specified in Chapter 4, not cause interference to the radio navigation aids and be clearly visible from the air traffic control tower for clearing the treated aeroplane.

3.15.4. **Recommendation -** The remote de-icing/anti-icing facility should be so located as to provide for an expeditious traffic flow, perhaps with a bypass configuration, and not require unusual taxiing manoeuvre into and out of the pads.

Size and number of de-icing/anti-icing pads

3.15.5. **Recommendation -** The size of a de-icing/anti-icing pad should be equal to the parking area required by the most demanding aeroplane in a given category with at least 3.8 m clear paved area all round the aeroplane for the movement of the de-icing/anti-icing vehicles.

3.15.6. **Recommendation -** The number of de-icing/anti-icing pads required should be determined based on the meteorological conditions, the type of aeroplanes to be treated, the method of application of de-icing/anti-icing fluid, the type and capacity of the dispensing equipment used, and the departure flow rates.

Slopes on de-icing/anti-icing pads

3.15.7. **Recommendation -** The de-icing/anti-icing pads should be provided with suitable slopes to ensure satisfactory drainage of the area and to permit collection of all excess de-icing/anti-icing fluid running off an aeroplane. The maximum longitudinal slope should be as little as practicable and the transverse slope shall not exceed 1 per cent.

Strength of de-icing/anti-icing pads

3.15.8. **Recommendation -** The de-icing/anti-icing pad should be capable of withstanding the traffic of the aircraft it is intended to serve, due consideration being given to the fact that the de-icing/anti-icing pad (like an 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.

Clearance distances on a de-icing/anti-icing pad

3.15.9. **Recommendation -** A de-icing/anti-icing pad should provide the minimum clearances specified in 3.13.6 for aircraft stands. If the pad layout is such as

to include bypass configuration, the minimum separation distances specified in Table 7, column 12, should be provided.

3.15.10. **Recommendation -** Where the de-icing/anti-icing facility is located adjoining a regular taxiway, the taxiway minimum separation distance specified in Table 7, column 11, should be provided. (See Figure 4.)

Environmental considerations

3.15.11. **Recommendation -** Where de-icing/anti-icing activities are carried out, the surface drainage should be planned to collect the run-off separately, preventing its mixing with the normal surface run-off so that it does not pollute the ground water.

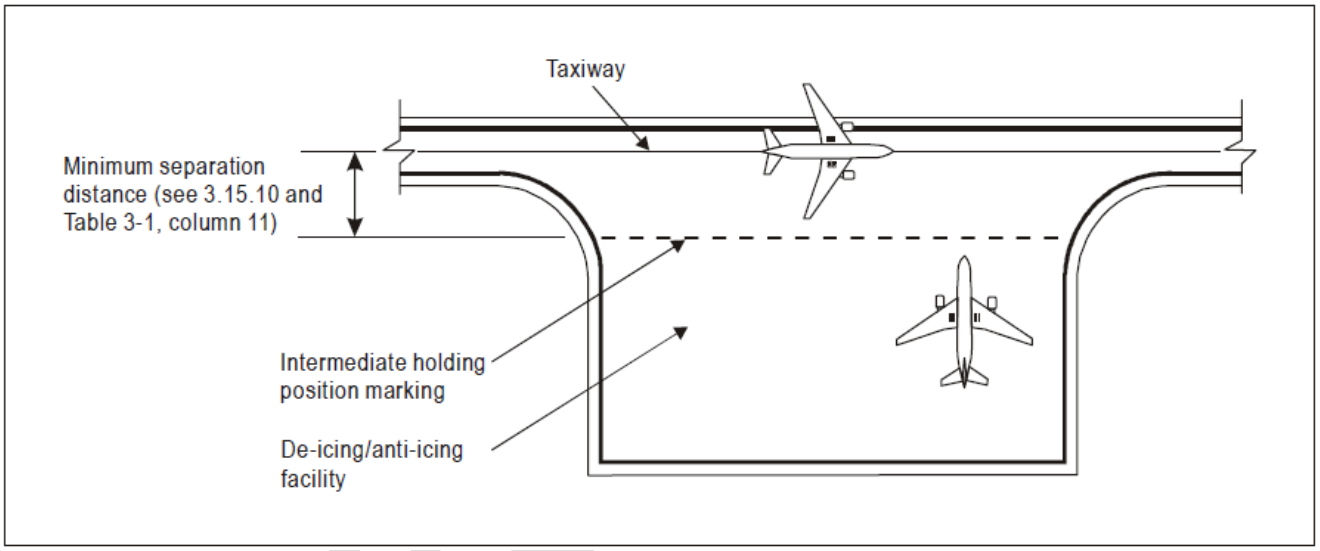


Figure 4. Minimum separation distance on a de-icing/anti-icing facility (Figure 3-4 ICAO Annex 14)

Note: Table 3-1 above refers to BAR 14, Volume I, Table 7.

Chapter 4. Obstacle Restriction and Removal

4.1. Obstacle limitation surfaces

Outer horizontal surface

Conical surface

4.1.1. Description.— Conical surface. A surface sloping upwards and outwards from the periphery of the inner horizontal surface.

4.1.2. Characteristics.— The limits of the conical surface shall comprise:

(a) a lower edge coincident with the periphery of the inner horizontal surface; and

(b) an upper edge located at a specified height above the inner horizontal surface.

4.1.3. 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

4.1.4. Description.— Inner horizontal surface. A surface located in a horizontal plane above an aerodrome and its environs.

4.1.5. Characteristics.— The radius or outer limits of the inner horizontal surface shall be measured from a reference point or points established for such purpose.

4.1.6. The height of the inner horizontal surface shall be measured above an elevation datum established for such purpose.

Approach surface

4.1.7. Description.— Approach surface. An inclined plane or combination of planes preceding the threshold.

4.1.8. Characteristics.— The limits of the approach surface shall comprise:

(a) an inner edge of specified length, horizontal and perpendicular to the extended centre line of the runway and located at a specified distance before the threshold;

(b) two sides originating at the ends of the inner edge and diverging uniformly at a specified rate from the extended centre line of the runway;

(c) an outer edge parallel to the inner edge; and

(d) the above surfaces shall be varied when lateral offset, offset or curved approaches are utilized, specifically, two sides originating at the ends of the inner edge and diverging uniformly at a specified rate from the extended centre line of the lateral offset, offset or curved ground track.

4.1.9. The elevation of the inner edge shall be equal to the elevation of the midpoint of the threshold.

4.1.10. The slope(s) of the approach surface shall be measured in the vertical plane containing the centre line of the runway and shall continue containing the centre line of any lateral offset or curved ground track.

Inner approach surface

4.1.11. Description.— Inner approach surface. A rectangular portion of the approach surface immediately preceding the threshold.

4.1.12. Characteristics.— The limits of the inner approach surface shall comprise:

(a) an inner edge coincident with the location of the inner edge of the approach surface but of its own specified length;

(b) two sides originating at the ends of the inner edge and extending parallel to the vertical plane containing the centre line of the runway; and

(c) an outer edge parallel to the inner edge.

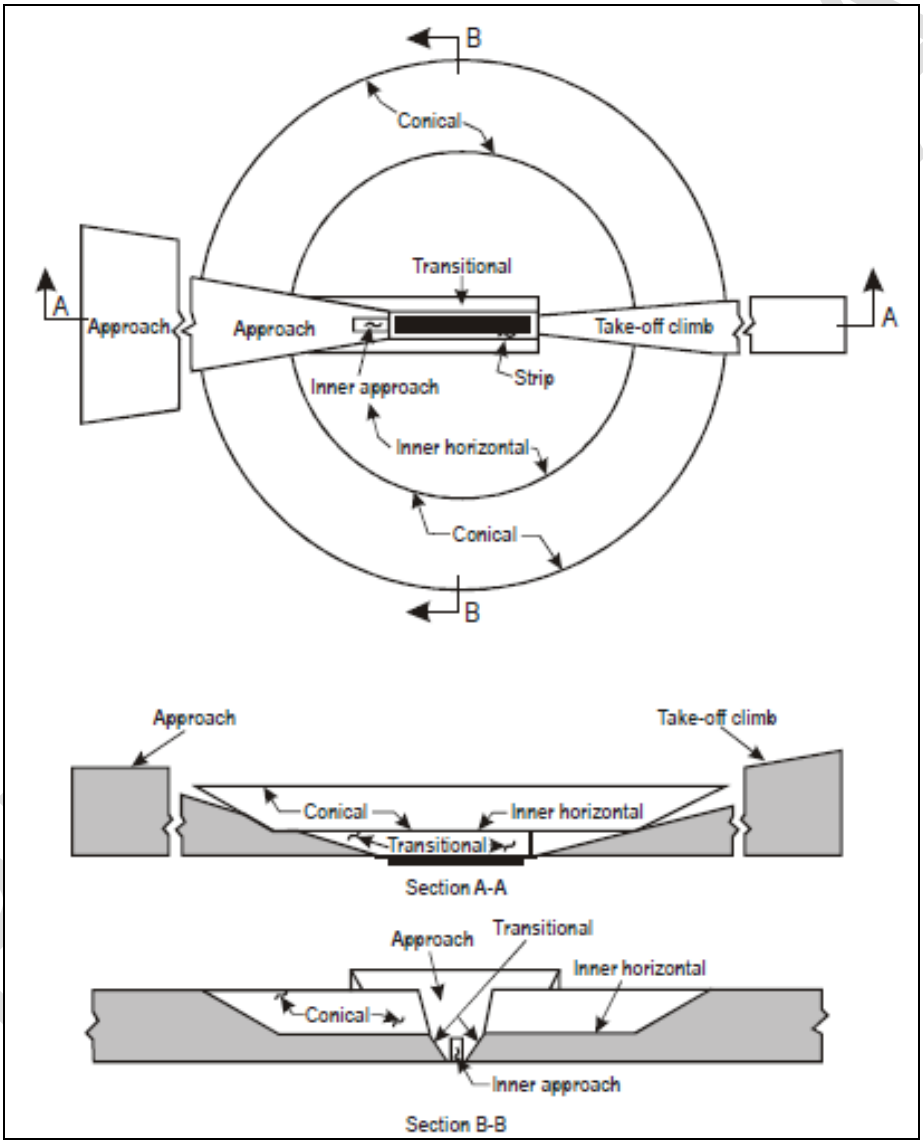


Figure 5. Obstacle limitation surfaces (Figure 4-2 ICAO Annex 14)

Note. See figure 6 for inner traditional and balked landing obstacle limitation surfaces.

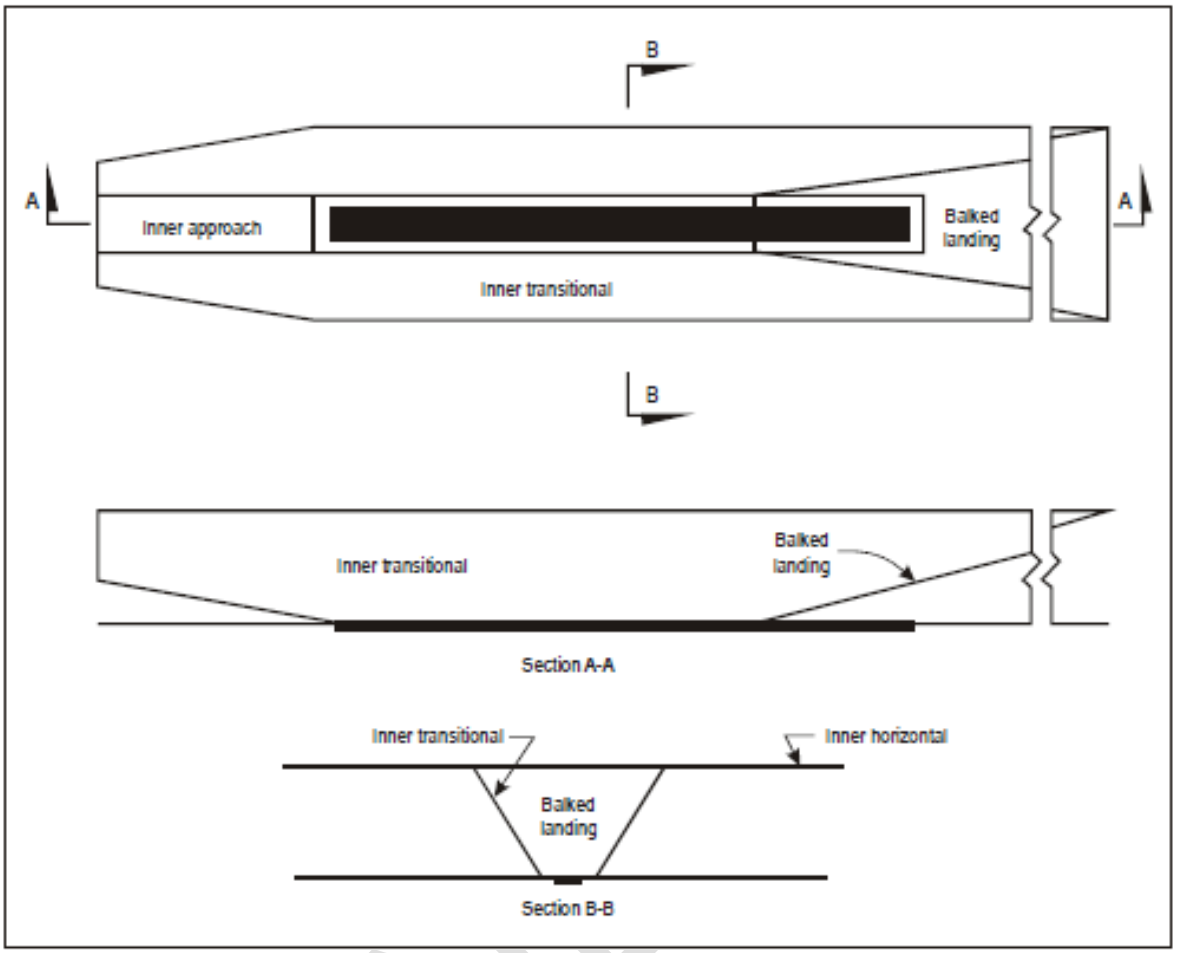


Figure 6. Inner approach, inner traditional and balked landing obstacle limitation surfaces (Figure 4-3 ICAO Annex 14)

Transitional surface

4.1.13. **Description.—** 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.

4.1.14. **Characteristics.—** The limits of a transitional surface shall comprise:

(a) a lower edge beginning at the intersection of the side of the approach surface with the inner horizontal surface and extending down the side of the approach surface to the inner edge of the approach surface and from there along the length of the strip parallel to the runway centre line; and

(b) an upper edge located in the plane of the inner horizontal surface.

4.1.15. 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.

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

Inner transitional surface

4.1.17. **Description.—** Inner transitional surface. A surface similar to the transitional surface but closer to the runway.

4.1.18. **Characteristics**.— The limits of an inner transitional surface shall comprise:

(a) a lower edge beginning at the end of the inner approach surface and extending down the side of the inner approach surface to the inner edge of that surface, from there along the strip parallel to the runway centre line to the inner edge of the balked landing surface and from there up the side of the balked landing surface to the point where the side intersects the inner horizontal surface; and

(b) an upper edge located in the plane of the inner horizontal surface.

4.1.19. The elevation of a point on the lower edge shall be:

(a) along the side of the inner approach surface and balked landing surface — equal to the elevation of the particular surface at that point; and

(b) along the strip — equal to the elevation of the nearest point on the centre line of the runway or its extension.

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

Balked landing surface

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

4.1.22. **Characteristics**.— The limits of the balked landing surface shall comprise:

(a) an inner edge horizontal and perpendicular to the centre line of the runway and located at a specified distance after the threshold;

(b) two sides originating at the ends of the inner edge and diverging uniformly at a specified rate from the vertical plane containing the centre line of the runway; and

(c) an outer edge parallel to the inner edge and located in the plane of the inner horizontal surface.

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

4.1.24. 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

4.1.25. **Description.—** Take-off climb surface. An inclined plane or other specified surface beyond the end of a runway or clearway.

4.1.26. **Characteristics**.— The limits of the take-off climb surface shall comprise:

(a) an inner edge horizontal and perpendicular to the centre line of the runway and located either at a specified distance beyond the end of the runway or at the end of the clearway when such is provided and its length exceeds the specified distance;

(b) two sides originating at the ends of the inner edge, diverging uniformly at a specified rate from the take-off track to a specified final width and

continuing thereafter at that width for the remainder of the length of the take-off climb surface; and

(c) an outer edge horizontal and perpendicular to the specified take-off track.

4.1.27. The elevation of the inner edge shall be equal to the highest point on the extended runway centre line between the end of the runway and the inner edge, except that when a clearway is provided the elevation shall be equal to the highest point on the ground on the centre line of the clearway.

4.1.28. In the case of a straight take-off flight path, the slope of the take-off climb surface shall be measured in the vertical plane containing the centre line of the runway.

4.1.29. In the case of a take-off flight path involving a turn, the take-off climb surface shall be a complex surface containing the horizontal normals to its centre line, and the slope of the centre line shall be the same as that for a straight take-off flight path.

4.2. Obstacle limitation requirements

Non-instrument runways

4.2.1. The following obstacle limitation surfaces shall be established for a non-instrument runway:

(a) conical surface;

(b) inner horizontal surface;

(c) transitional surfaces.

4.2.2. The heights and slopes of the surfaces shall not be greater than, and their other dimensions not less than, those specified in Table 10.

4.2.3. New objects or extensions of existing objects shall not be permitted above an approach or transitional surface except when, in the opinion of the appropriate authority, the new object or extension would be shielded by an existing immovable object.

4.2.4. **Recommendation -** New objects or extensions of existing objects should not be permitted above the conical surface or inner horizontal surface except when, in the opinion of the appropriate authority, the object would be shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

4.2.5. **Recommendation -** Existing objects above any of the surfaces required by 4.2.1 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.

4.2.6. **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

4.2.7. The following obstacle limitation surfaces shall be established for a non-precision approach runway:

(a) conical surface;

(b) inner horizontal surface;

(c) approach surface; and

(d) transitional surfaces.

4.2.8. The heights and slopes of the surfaces shall not be greater than, and their other dimensions not less than, those specified in Table 10, except in the case of the horizontal section of the approach surface (see 4.2.9).

4.2.9. 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.

Table 10. Dimensions and slopes of obstacle limitations surfaces – Approach runways (Table 4-1 ICAO Annex 14)

APPROACH RUNWAYS

	RUNWAY CLASSIFICATION									
	Non-instrument Code number				Non-precision approach Code number			Precision approach category I Code number		II or III Code number
Surface and dimensions[a]	1	2	3	4	1,2	3	4	1,2	3,4	3,4
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
CONICAL										
Slope	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Height	35 m	55 m	75 m	100 m	60 m	75 m	100 m	60 m	100 m	100 m
INNER HORIZONTAL										
Height	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m
Radius	2 000 m	2 500 m	4 000 m	4 000 m	3 500 m	4 000 m	4 000 m	3 500 m	4 000 m	4 000 m
INNER APPROACH										
Width	—	—	—	—	—	—	—	90 m	120 m[e]	120 m[e]
Distance from threshold	—	—	—	—	—	—	—	60 m	60 m	60 m
Length	—	—	—	—	—	—	—	900 m	900 m	900 m
Slope								2.5%	2%	2%
APPROACH										
Length of inner edge	60 m	80 m	150 m	150 m	140 m	280 m	280 m	140 m	280 m	280 m
Distance from threshold	30 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m
Divergence (each side)	10%	10%	10%	10%	15%	15%	15%	15%	15%	15%
First section										
Length	1 600 m	2 500 m	3 000 m	3 000 m	2 500 m	3 000 m	3 000 m	3 000 m	3 000 m	3 000 m
Slope	5%	4%	3.33%	2.5%	3.33%	2%	2%	2.5%	2%	2%
Second section										
Length	—	—	—	—	—	3 600 m[b]	3 600 m[b]	12 000 m	3 600 m[b]	3 600 m[b]
Slope	—	—	—	—	—	2.5%	2.5%	3%	2.5%	2.5%
Horizontal section										
Length	—	—	—	—	—	8 400 m[b]	8 400 m[b]	—	8 400 m[b]	8 400 m[b]
Total length	—	—	—	—	—	15 000 m	15 000 m	15 000 m	15 000 m	15 000 m
TRANSITIONAL										
Slope	20%	20%	14.3%	14.3%	20%	14.3%	14.3%	14.3%	14.3%	14.3%
INNER TRANSITIONAL										
Slope	—	—	—	—	—	—	—	40%	33.3%	33.3%
BALKED LANDING SURFACE										
Length of inner edge	—	—	—	—	—	—	—	90 m	120 m[e]	120 m[e]
Distance from threshold	—	—	—	—	—	—	—	c	1 800 m[d]	1 800 m[d]
Divergence (each side)	—	—	—	—	—	—	—	10%	10%	10%
Slope	—	—	—	—	—	—	—	4%	3.33%	3.33%

a. All dimensions are measured horizontally unless specified otherwise.
b. Variable length (see 4.2.9 or 4.2.17).
c. Distance to the end of strip.
d. Or end of runway whichever is less.
e. Where the code letter is F (Table 1-1), the width is increased to 140 m except for those aerodromes that accommodate a code letter F aeroplane equipped with digital avionics that provide steering commands to maintain an established track during the go-around manoeuvre.

Note.— See Circulars 301 and 345, and Chapter 4 of the PANS-Aerodromes, Part I (Doc 9981) for further information.

Note: Table 1-1 of ICAO Annex 14 Vol I, refers to Table 2 of BAR 14 Vol I.

4.2.10. New objects or extensions of existing objects shall not be permitted above an approach surface within 3 000 m of the inner edge or above a transitional

surface except when, in the opinion of the appropriate authority, the new object or extension would be shielded by an existing immovable object.

4.2.11. **Recommendation -** New objects or extensions of existing objects should not be permitted above the approach surface beyond 3 000 m from the inner edge, the conical surface or inner horizontal surface except when, in the opinion of the appropriate authority, the object would be shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

4.2.12. **Recommendation -** Existing objects above any of the surfaces required by 4.2.7 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.

Precision approach runways

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

(a) conical surface;

(b) inner horizontal surface;

(c) approach surface; and

(d) transitional surfaces.

4.2.14. **Recommendation -** The following obstacle limitation surfaces should be established for a precision approach runway category I:

(a) inner approach surface;

(b) inner transitional surfaces; and

(c) balked landing surface.

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

(a) conical surface;

(b) inner horizontal surface;

(c) approach surface and inner approach surface;

(d) transitional surfaces;

(e) inner transitional surfaces; and

(f) balked landing surface.

4.2.16. The heights and slopes of the surfaces shall not be greater than, and their other dimensions not less than, those specified in Table 10, except in the case of the horizontal section of the approach surface (see 4.2.17).

4.2.17. The approach surface shall be horizontal beyond the point at which the 2.5 per cent slope intersects:

(a) a horizontal plane 150 m above the threshold elevation; or

(b) the horizontal plane passing through the top of any object that governs the obstacle clearance limit;

whichever is the higher.

4.2.18. Fixed objects shall not be permitted above the inner approach surface, the inner transitional surface or the balked landing surface, except for frangible objects which because of their function must be located on the strip. Mobile objects shall not be permitted above these surfaces during the use of the runway for landing.

4.2.19. New objects or extensions of existing objects shall not be permitted above an approach surface or a transitional surface except when, in the opinion of the appropriate authority, the new object or extension would be shielded by an existing immovable object.

Note. Circumstances in which the shielding principle may be appled are described in the ICAO Airport Services Manual (Doc. 9137), Part 6.

4.2.20. **Recommendation -** New objects or extensions of existing objects should not be permitted above the conical surface and the inner horizontal surface except when, in the opinion of the appropriate authority, an object would be shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

4.2.21. **Recommendation -** Existing objects above an approach surface, a transitional surface, the conical surface and inner horizontal 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 or significantly affect the regularity of operations of aeroplanes.

Runways meant for take-off

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

(a) take-off climb surface.

4.2.23. The dimensions of the surface shall be not less than the dimensions specified in Table 11, except that a lesser length may be adopted for the take-off climb surface where such lesser length would be consistent with procedural measures adopted to govern the outward flight of aeroplanes.

4.2.24. **Recommendation -** 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 11 when critical operating conditions are to be catered to. If the specified slope is reduced, corresponding adjustment in the length of the take-off climb surface shall be made so as to provide protection to a height of 300 m.

4.2.25. New objects or extensions of existing objects shall not be permitted above a take-off climb surface except when, in the opinion of the appropriate authority, the new object or extension would be shielded by an existing immovable object.

4.2.26. **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).

Table 11 Dimensions and slopes of obstacle limitation surfaces (Table 4-2 ICAO Annex 14).

RUNWAYS MEANT FOR TAKE-OFF

Surface and dimensions[a] (1)	Code number 1 (2)	2 (3)	3 or 4 (4)
TAKE-OFF CLIMB			
Length of inner edge	60 m	80 m	180 m
Distance from runway end[b]	30 m	60 m	60 m
Divergence (each side)	10%	10%	12.5%
Final width	380 m	580 m	1 200 m 1 800 m[c]
Length	1 600 m	2 500 m	15 000 m
Slope	5%	4%	2%[d]

a. All dimensions are measured horizontally unless specified otherwise.
b. The take-off climb surface starts at the end of the clearway if the clearway length exceeds the specified distance.
c. 1 800 m when the intended track includes changes of heading greater than 15° for operations conducted in IMC, VMC by night.
d. See 4.2.24 and 4.2.26.

4.2.27. **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 or significantly affect the regularity of operations of aeroplanes.

4.3. Objects outside the obstacle limitation surfaces

4.3.1. **Recommendation -** Arrangements should be made to enable the appropriate authority to be consulted concerning proposed construction beyond the limits of the obstacle limitation surfaces that extend above a height established by that authority, in order to permit an aeronautical study of the effect of such construction on the operation of aeroplanes.

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

Note. – Additional information for arrangement can be found in ICAO Doc 8168, Procedures for Air Navigation Services – Aircraft Operations Volume I and II (PANS-OPS)

4.4. Other objects

4.4.1. **Recommendation -** Objects which do not project through the approach surface but which would nevertheless adversely affect the optimum sitting or performance of visual or non-visual aids should, as far as practicable, be removed.

4.4.2. **Recommendation -** Anything which may, in the opinion of the appropriate authority after aeronautical study, endanger aeroplanes 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. – Additional information for arrangement can be found in ICAO Doc 8168, Procedures for Air Navigation Services – Aircraft Operations Volume l and ll (PANS-OPS)

Chapter 5. Visual Aids for Navigation, Denoting Obstacles and Restricted Areas

5.1. Indicators and signalling devices

5.1.1. Wind direction indicator

Application

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

Location

5.1.1.2. 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.

Characteristics

5.1.1.3. **Recommendation -** The wind direction indicator should be in the form of a truncated cone made of fabric and shall have a length of not less than 3.6 m and a diameter, at the larger end, of not less than 0.9 m. It 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.

5.1.1.4. **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.

5.1.1.5. **Recommendation -** Provision should be made for illuminating at least one wind indicator at an aerodrome intended for use at night.

5.1.2. Landing direction indicator

Location

5.1.2.1. Where provided, a landing direction indicator shall be located in a conspicuous place on the aerodrome.

Characteristics

5.1.2.2. **Recommendation -** The landing direction indicator should be in the form of a “T”.

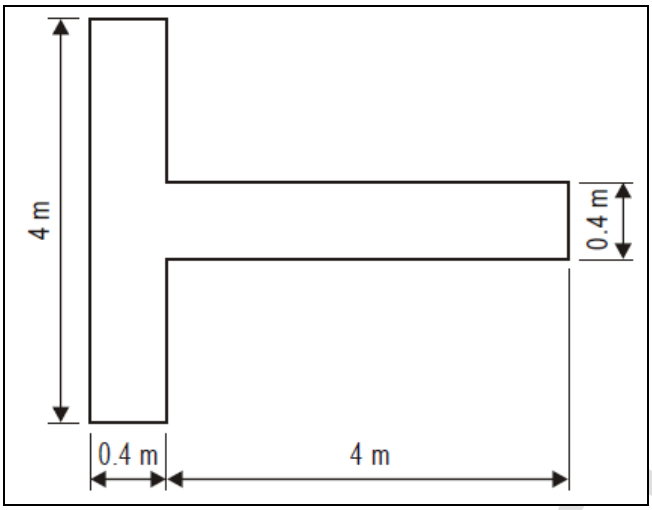


Figure 7. Landing direction indicator (Figure 5-1 ICAO Annex 14)

5.1.2.3. The shape and minimum dimensions of a landing "T" shall be as shown in Figure 7. The colour of the landing "T" shall be either white or orange, the choice being dependent on the colour that contrasts best with the background against which the indicator will be viewed. Where required for use at night the landing "T" shall either be illuminated or outlined by white lights.

5.1.3. Signalling lamp

Application

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

Characteristics

5.1.3.2. **Recommendation -** A signalling lamp should be capable of producing red, green and white signals, and of:

(1) being aimed manually at any target as required;

(2) giving a signal in any one colour followed by a signal in either of the two other colours; and

(3) 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.

5.1.3.3. **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.

5.1.4. Signal panels and signal area

Location of signal area

5.1.4.1. **Recommendation -** The signal area should be located so as to be visible for all angles of azimuth above an angle of 10° above the horizontal when viewed from a height of 300 m.

Characteristics of signal area

5.1.4.2. The signal area shall be an even horizontal surface at least 9 m square.

5.1.4.3. **Recommendation -** The colour of the signal area should be chosen to contrast with the colours of the signal panels used, and it shall be surrounded by a white border not less than 0.3 m wide.

5.2. Markings

5.2.1. General

Interruption of runway markings

5.2.1.1. At an intersection of two (or more) runways the markings of the more important runway, except for the runway side stripe marking, shall be displayed and the markings of the other runway(s) shall be interrupted. The runway side stripe marking of the more important runway may be either continued across the intersection or interrupted.

5.2.1.2. **Recommendation -** The order of importance of runways for the display of runway markings should be as follows:

1st — precision approach runway;

2nd — non-precision approach runway; and

3rd — non-instrument runway.

5.2.1.3. 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.

Colour and conspicuity

5.2.1.4. Runway markings shall be white.

Note .— It has been found that, on runway surfaces of light colour, the conspicuity of white markings can be improved by outlining them in black.

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

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

5.2.1.7. **Recommendation -** At aerodromes where operations take place at night, pavement markings should be made with reflective materials designed to enhance the visibility of the markings.

Note.— Guidance on reflective materials is given in the Aerodrome Design Manual (Doc 9157), Part 4.

Unpaved taxiways

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

5.2.2. Runway designation marking

Application

5.2.2.1. A runway designation marking shall be provided at the thresholds of a paved runway.

5.2.2.2. **Recommendation -** A runway designation marking should be provided, so far as practicable, at the thresholds of an unpaved runway.

Location

5.2.2.3. A runway designation marking shall be located at a threshold as shown in Figure 8 as appropriate.

Characteristics

5.2.2.4. 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. On four or more parallel runways, one set of adjacent runways shall be numbered to the nearest one-tenth magnetic azimuth and the other set of adjacent runways numbered to the next nearest one-tenth of the magnetic azimuth. When the above rule would give a single digit number, it shall be preceded by a zero.

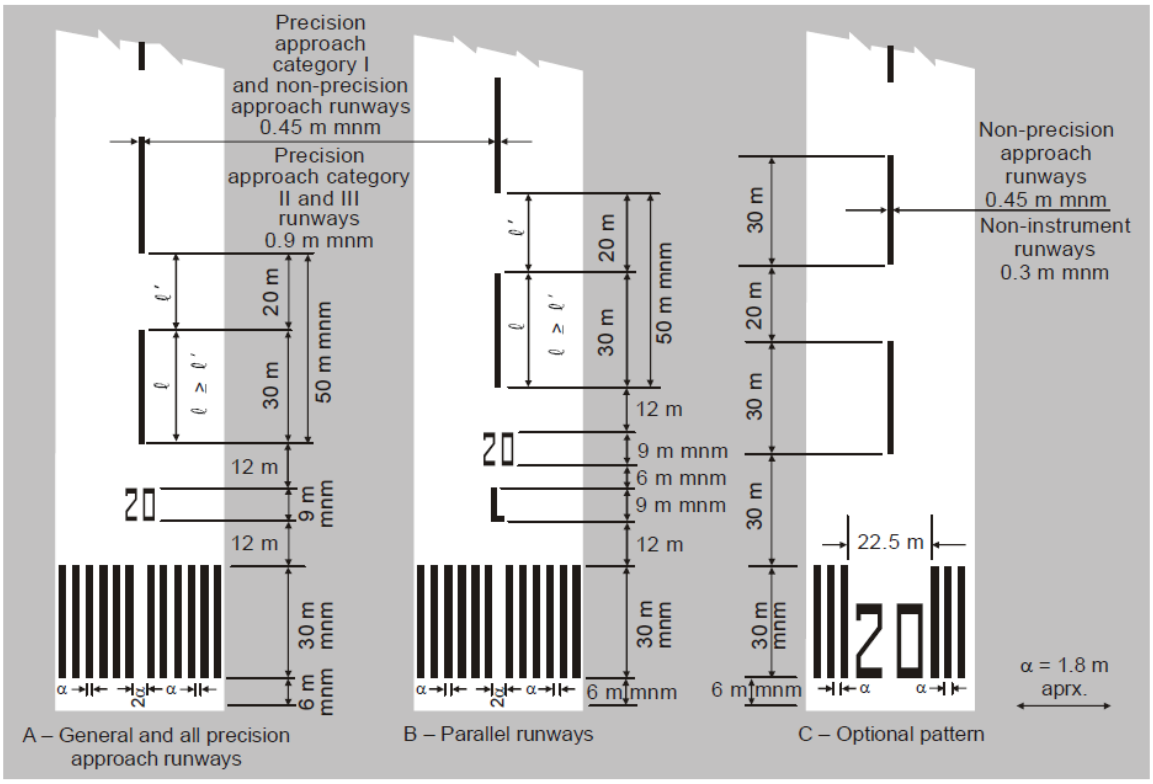


Figure 8. Runway designation, centre line and threshold markings (Figure 5-2 ICAO Annex 14)

5.2.2.5. In the case of parallel runways, each runway designation number shall be supplemented by a letter as follows, in the order shown from left to right when viewed from the direction of approach:

— for two parallel runways: “L” “R”;

— for three parallel runways: “L” “C” “R”;

— for four parallel runways: “L” “R” “L” “R”;

— for five parallel runways: “L” “C” “R” “L” “R” or “L” “R” “L” “C” “R”; and

— for six parallel runways: “L” “C” “R” “L” “C” “R”.

5.2.2.6. The numbers and letters shall be in the form and proportion shown in Figure 9. The dimensions shall be not less than those shown in Figure 9, 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.

5.2.3. Runway centre line marking

Application

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

Location

5.2.3.2. A runway centre line marking shall be located along the centre line of the runway between the runway designation markings as shown in Figure 8, except when interrupted in compliance with 5.2.1.1.

Characteristics

5.2.3.3. A runway centre line marking shall consist of a line of uniformly spaced stripes and gaps. The length of a stripe plus a gap shall be not less than 50 m or more than 75 m. The length of each stripe shall be at least equal to the length of the gap or 30 m, whichever is greater.

5.2.3.4. The width of the stripes shall be not less than:

- 0.90 m on precision approach category II and III runways;
- 0.45 m on non-precision approach runways where the code number is 3 or 4, and precision approach category I runways; and
- 0.30 m on non-precision approach runways where the code number is 1 or 2, and on non-instrument runways.

5.2.4. Threshold marking

Application

5.2.4.1. A threshold marking shall be provided at the threshold of a paved instrument runway, and of a paved non-instrument runway where the code number is 3 or 4 and the runway is intended for use by international commercial air transport.

5.2.4.2. **Recommendation -** A threshold marking should be provided at the threshold of a paved non-instrument runway where the code number is 3 or 4 and the runway is intended for use by other than international commercial air transport.

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

Location

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

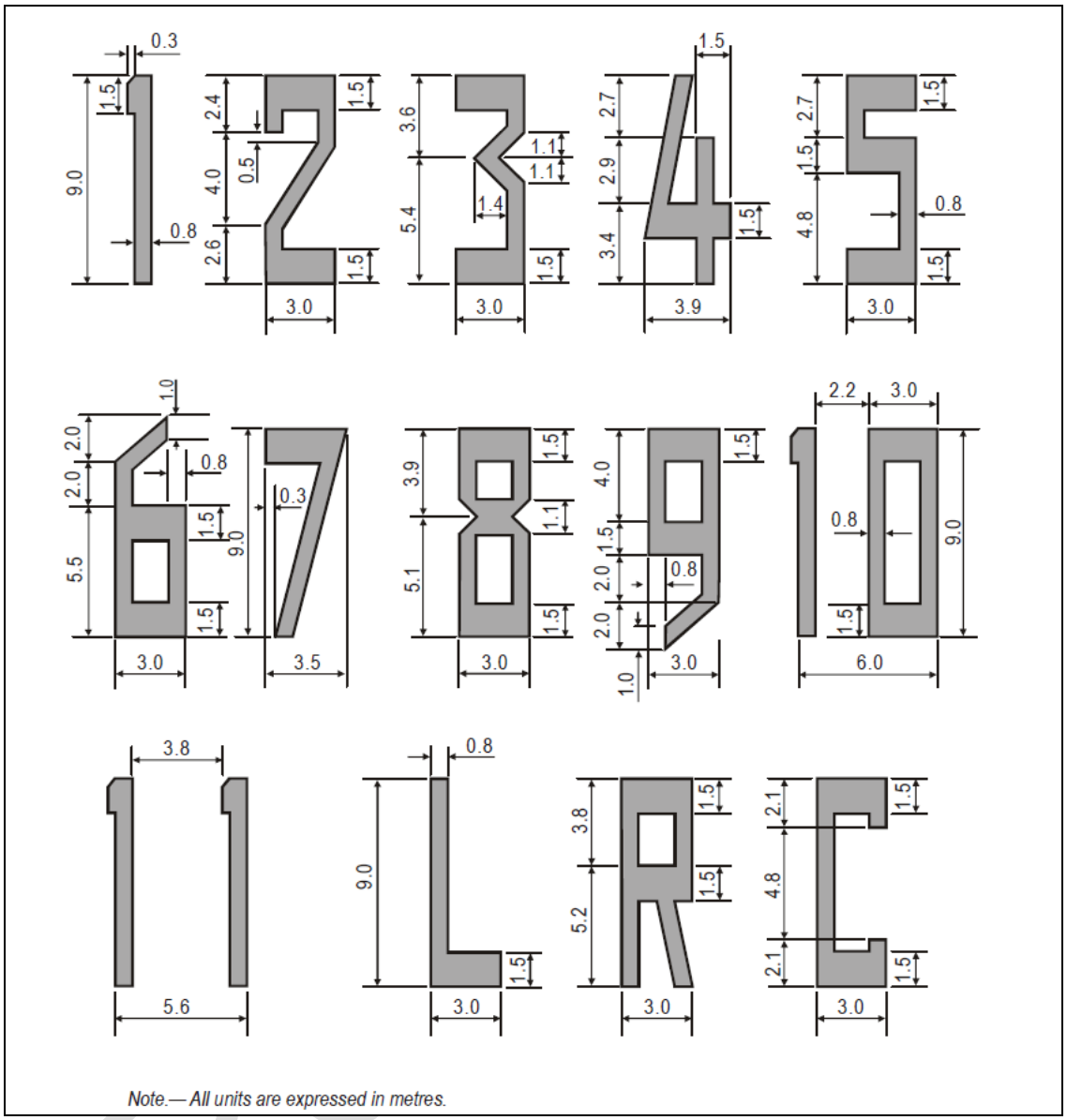


Figure 9. Form and proportion of numbers and letters for runway designation markings (Figure 5-3 ICAO Anne x 14)

Characteristics

5.2.4.5. 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 8 (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

Runway width	Number of stripes
45 m	12
60 m	16

except that on non-precision approach and non-instrument runways 45 m or greater in width, they may be as shown in Figure 8 (C).

5.2.4.6. The stripes shall extend laterally to within 3 m of the edge of a runway or to a distance of 27 m on either side of a runway centre line, whichever results in the smaller lateral distance. Where a runway designation marking is placed within a threshold marking there shall be a minimum of three stripes on each side of the centre line of the runway. Where a runway designation marking is placed above a threshold marking, the stripes shall be continued across the runway. The stripes shall be at least 30 m long and approximately 1.80 m wide with spacings of approximately 1.80 m between them except that, where the stripes are continued across a runway, a double spacing shall be used to separate the two stripes nearest the centre line of the runway, and in the case where the designation marking is included within the threshold marking this spacing shall be 22.5 m.

Transverse stripe

5.2.4.7. **Recommendation -** Where a threshold is displaced from the extremity of a runway or where the extremity of a runway is not square with the runway centre line, a transverse stripe as shown in Figure 10 (B) should be added to the threshold marking.

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

Arrows

5.2.4.9. Where a runway threshold is permanently displaced, arrows conforming to Figure 10 (B) shall be provided on the portion of the runway before the displaced threshold.

5.2.4.10. When a runway threshold is temporarily displaced from the normal position, it shall be marked as shown in Figure 10 (A) or 10 (B) and all markings prior to the displaced threshold shall be obscured except the runway centre line marking, which shall be converted to arrows.

Note 1.— In the case where a threshold is temporarily displaced for only a short period of time, it has been found satisfactory to use markers in the form and colour of a displaced threshold marking rather than attempting to paint this marking on the runway.

Note 2.— When the runway before a displaced threshold is unfit for the surface movement of aircraft, closed markings,as described in 7.1.1 of this BAR 14 Vol.I, are required to be provided.

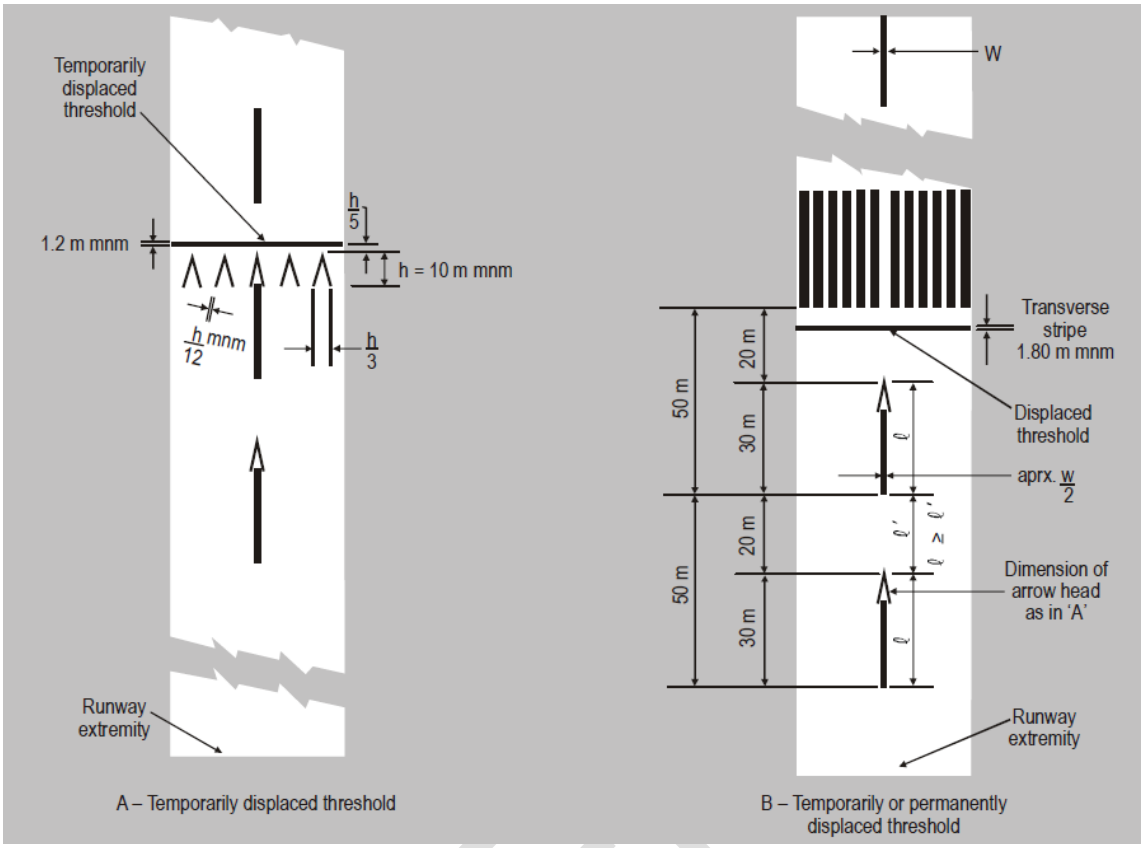


Figure 10. Displaced threshold markings (Figure 5-4 ICAO Annex 14)

5.2.5. Aiming point marking

Application

5.2.5.1. An aiming point marking shall be provided at each approach end of a paved instrument runway where the code number is 2, 3 or 4.

5.2.5.2. **Recommendation -** An aiming point marking should be provided at each approach end of:

(1) a paved non-instrument runway where the code number is 3 or 4;

(2) a paved instrument runway where the code number is 1;

when additional conspicuity of the aiming point is desirable.

Location

5.2.5.3. The aiming point marking shall commence no closer to the threshold than the distance indicated in the appropriate column of Table 5-1, except that, on a runway equipped with a visual approach slope indicator system, the beginning of the marking shall be coincident with the visual approach slope origin.

5.2.5.4. An aiming point marking shall consist of two conspicuous stripes. The dimensions of the stripes and the lateral spacing between their inner sides shall be in accordance with the provisions of the appropriate column of Table 12. Where a touchdown zone marking is provided, the lateral spacing between the markings shall be the same as that of the touchdown zone marking.

5.2.6. Touchdown zone marking

Application

5.2.6.1. A touchdown zone marking shall be provided in the touchdown zone of a paved precision approach runway where the code number is 2, 3 or 4.

5.2.6.2. **Recommendation -** A touchdown zone marking should 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.

Table 12. Location and dimension of aiming point marking (Table 5-1 ICAO Annex 14).

	Landing distance available			
Location and dimensions (1)	Less than 800 m (2)	800 m up to but not including 1 200 m (3)	1 200 m up to but not including 2 400 m (4)	2 400 m and above (5)
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[c]	9 m[c]	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.
c. These figures were deduced by reference to the outer main gear wheel span which is element 2 of the aerodrome reference code at Chapter 1, Table 1-1.

Note: Table 1-1 of ICAO Annex 14 Vol I, should refers to Table 2 of BAR 14 Vol I.

Location and characteristics

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

Landing distance available or the distance between thresholds	Pair(s) of markings
less than 900 m	1
900 m up to but not including 1 200 m	2
1 200 m up to but not including 1 500 m	3
1 500 m up to but not including 2 400 m	4
2 400 m or more	6

5.2.6.4. A touchdown zone marking shall conform to either of the two patterns shown in Figure 11. For the pattern shown in Figure 11 (A), the markings shall be not less than 22.5 m long and 3 m wide. For the pattern shown in Figure 11 (B), each stripe of each marking shall be not less than 22.5 m long and 1.8 m wide with a spacing of 1.5 m between adjacent stripes. The lateral spacing between the inner sides of the rectangles shall be equal to that of the aiming point marking where

provided. Where an aiming point marking is not provided, the lateral spacing between the inner sides of the rectangles shall correspond to the lateral spacing specified for the aiming point marking in Table 12 (columns 2, 3, 4 or 5, as appropriate). The pairs of markings shall be provided at longitudinal spacings of 150 m beginning from the threshold, except that pairs of touchdown zone markings coincident with or located within 50 m of an aiming point marking shall be deleted from the pattern.

5.2.6.5. **Recommendation -** On a non-precision approach runway where the code number is 2, an additional pair of touchdown zone marking stripes should be provided 150 m beyond the beginning of the aiming point marking.

5.2.7. Runway side stripe marking

Application

5.2.7.1. A runway side stripe marking shall be provided between the thresholds of a paved runway where there is a lack of contrast between the runway edges and the shoulders or the surrounding terrain.

5.2.7.2. **Recommendation -** A runway side stripe marking should be provided on a precision approach runway irrespective of the contrast between the runway edges and the shoulders or the surrounding terrain.

Location

5.2.7.3. **Recommendation -** A runway side stripe marking should consist of two stripes, one placed along each edge of the runway with the outer edge of each stripe approximately on the edge of the runway, except that, where the runway is greater than 60 m in width, the stripes should be located 30 m from the runway centre line.

5.2.7.4. **Recommendation -** Where a runway turn pad is provided, the runway side stripe marking should be continued between the runway and the runway turn pad.

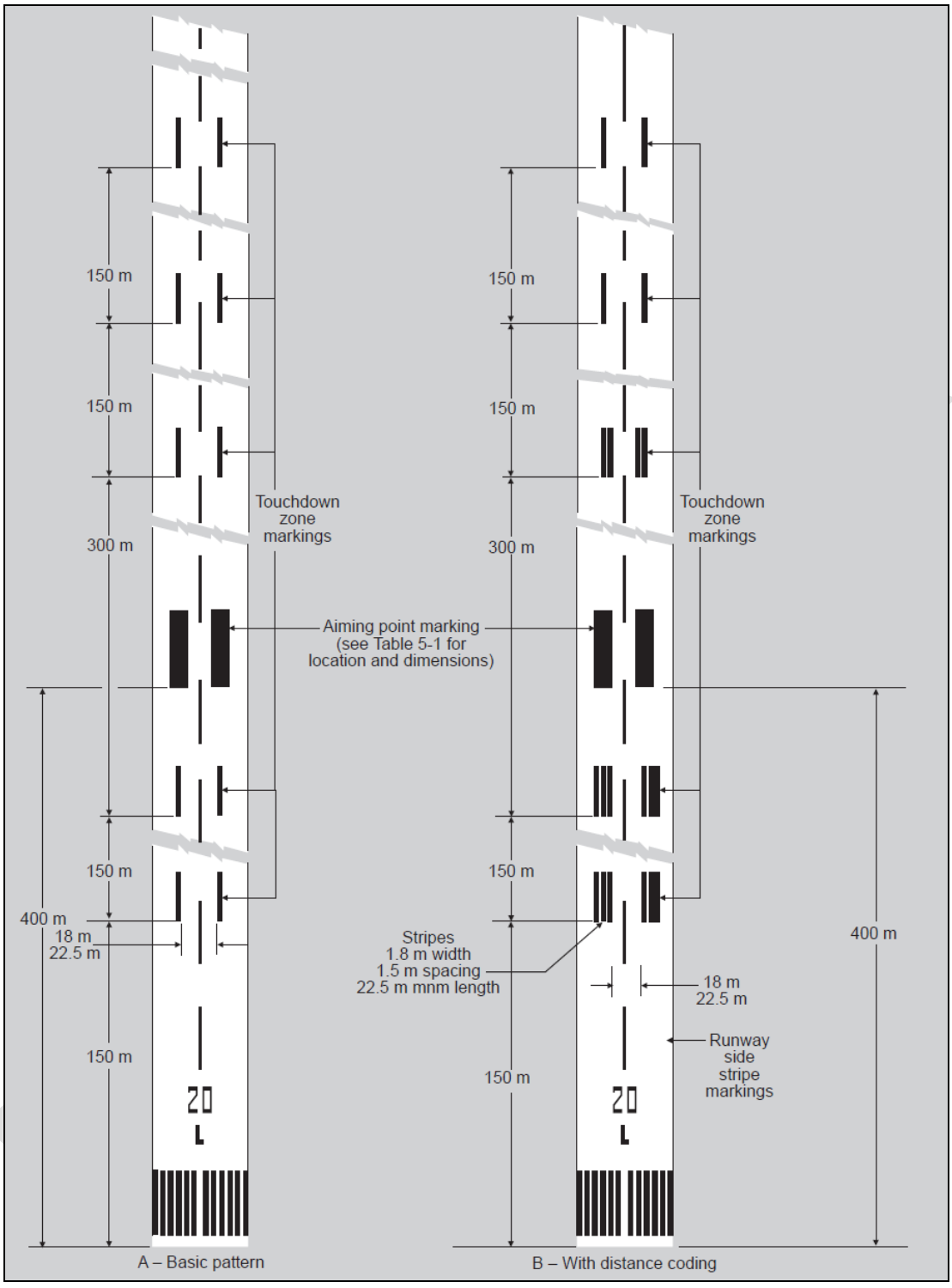


Figure 11. Aiming point and touchdown zone markings (illustrated for a runway with a length of 2.400 m or more) (Figure 5-5 ICAO Annex 14).

Characteristics

5.2.7.5. **Recommendation -** A runway side stripe should have an overall width of at least 0.9 m on runways 30 m or more in width and at least 0.45 m on narrower runways.

5.2.8. Taxiway centre line marking

Application

5.2.8.1. Taxiway centre line marking shall be provided on a paved taxiway, de-icing/anti-icing facility and apron where the code number is 3 or 4 in such a way as to provide continuous guidance between the runway centre line and aircraft stands.

5.2.8.2. **Recommendation -** Taxiway centre line marking should be provided on a paved taxiway, de-icing/anti-icing facility and apron where the code number is 1 or 2 in such a way as to provide continuous guidance between the runway centre line and aircraft stands.

5.2.8.3. Taxiway centre line marking shall be provided on a paved runway when the runway is part of a standard taxi- route and:

(1) there is no runway centre line marking; or

(2) where the taxiway centre line is not coincident with the runway centre line.

5.2.8.4. **Recommendation -** Where it is necessary to denote the proximity of a runway-holding position, enhanced taxiway centre line marking should be provided.

5.2.8.5. Where provided on any taxiway on an aerodrome, enhanced taxiway centre line marking shall be installed at each taxiway/runway intersection.

Location

5.2.8.6. **Recommendation -** On a straight section of a taxiway the taxiway centre line marking should 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.

5.2.8.7. **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 Figures 12 and 29. 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.

5.2.8.8. **Recommendation -** Where taxiway centre line marking is provided on a runway in accordance with 5.2.8.3, the marking should be located on the centre line of the designated taxiway.

5.2.8.9. Where provided:

(1) An enhanced taxiway centre line marking shall extend from the runway-holding position Pattern A (as defined in Figure 12, Taxiway markings) to a distance of up to 47 m in the direction of travel away from the runway. See Figure 13 (a).

(2) If the enhanced taxiway centre line marking intersects another runway-holding position marking, such as for a precision approach category II or III runway that is located within 47 m of the first runway-holding position marking the enhanced taxiway centre line marking shall be interrupted 0.9 m prior to and after the intersected runway-holding position marking. The enhanced taxiway centre line marking shall continue beyond the intersected runway-holding position marking for at least three dashed line segments or 47 m from start to finish, whichever is greater. See Figure 13 (b).

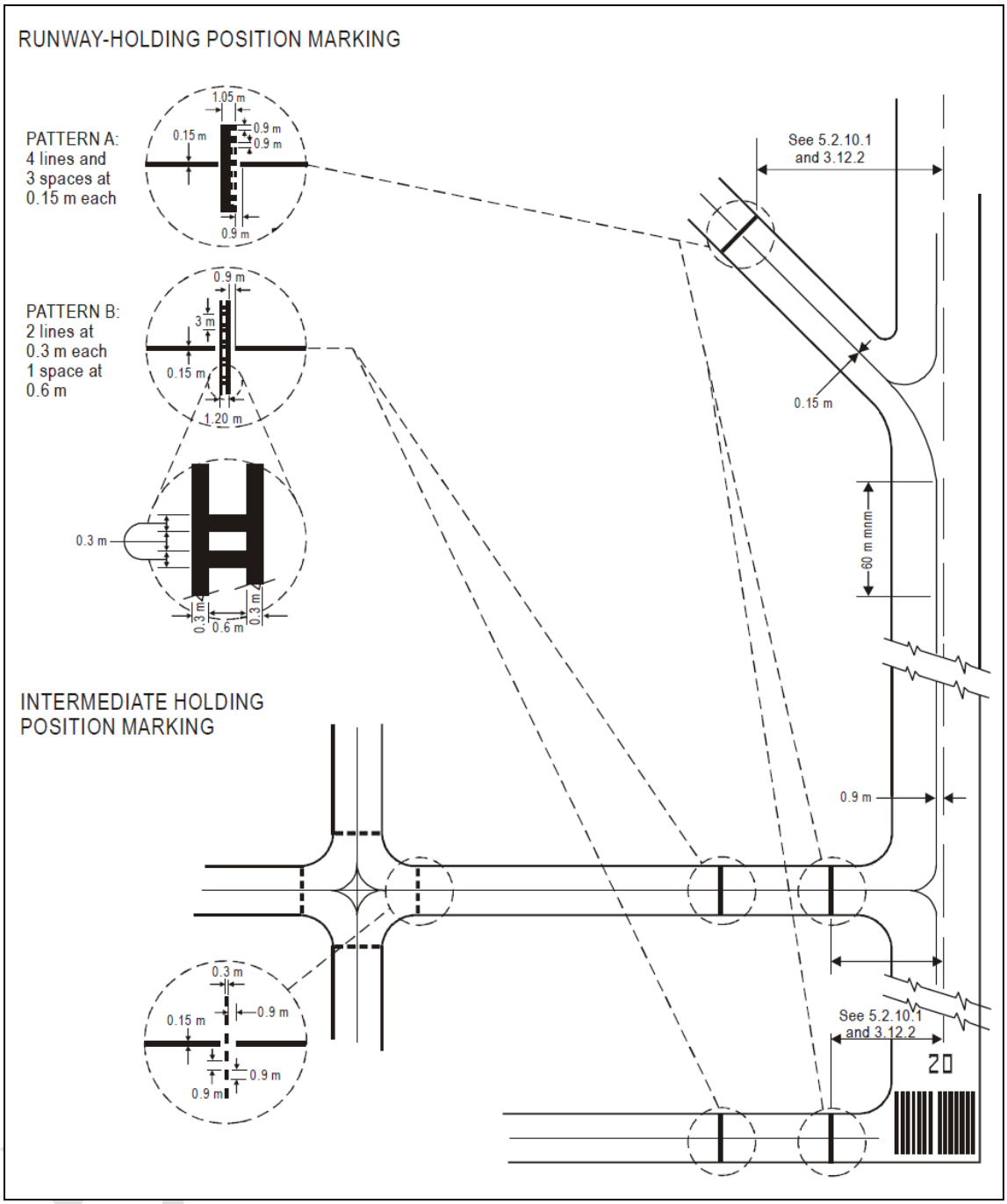


Figure 12. Taxiway markings (shown with basic runway markings) (Figure 5-6 ICAO Annex 14)

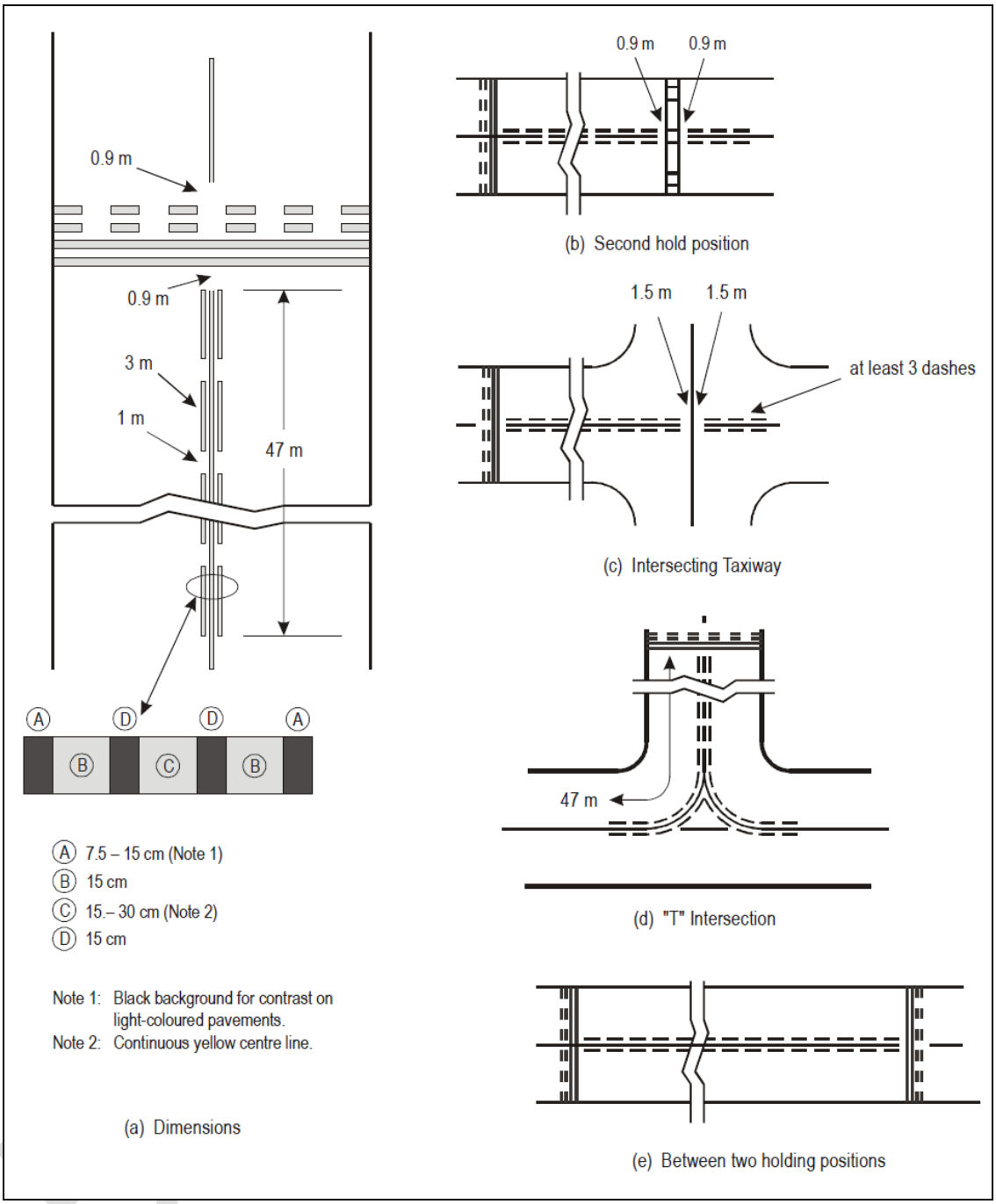


Figure 13. Enhanced taxiway line marking (Figure 5-7 ICAO Annex 14)

(3) If the enhanced taxiway centre line marking continues through a taxiway/taxiway intersection that is located within 47 m of the runway-holding position marking, the enhanced taxiway centre line marking shall be interrupted 1.5 m prior to and after the point where the intersected taxiway centre line crosses the enhanced taxiway centre line. The enhanced taxiway centre line marking shall continue beyond the taxiway/taxiway intersection for at least three dashed line segments or 47 m from start to finish, whichever is greater. See Figure 13 (c).

(4) Where two taxiway centre lines converge at or before the runway-holding position marking, the inner dashed line shall not be less than 3 m in length. See Figure 13 (d).

(5) Where there are two opposing runway-holding position markings and the distance between the markings is less than 94 m, the enhanced taxiway centre line markings shall extend over this entire distance. The enhanced taxiway centre line markings shall not extend beyond either runway-holding position marking. See Figure 13 (e).

Characteristics

5.2.8.10. A taxiway centre line marking shall be at least 15 cm in width and continuous in length except where it intersects with a runway-holding position marking or an intermediate holding position marking as shown in Figure 12.

5.2.8.11. Enhanced taxiway centre line marking shall be as shown in Figure 13.

5.2.9. **Runway turn pad marking**

Application

5.2.9.1. 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

5.2.9.2. **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.

5.2.9.3. **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.

5.2.9.4. **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.

5.2.9.5. **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.

5.2.9.6. **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 3.3.6.

Characteristics

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

5.2.10. **Runway-holding position marking**

Application and location

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

Characteristics

5.2.10.2. 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 12, pattern A.

5.2.10.3. Where a single runway-holding position is provided at an intersection of a taxiway and a precision approach category I, II or III runway, the runway-holding position marking shall be as shown in Figure 12, pattern A. Where two or three runway-holding positions are provided at such an intersection, the runway-holding position marking closer (closest) to the runway shall be as shown in Figure 12, pattern A and the markings farther from the runway shall be as shown in Figure 12, pattern B.

5.2.10.4. The runway-holding position marking displayed at a runway-holding position established in accordance with 3.12.3 shall be as shown in Figure 12, pattern A.

5.2.10.5. Where increased conspicuity of the runway-holding position is required, the runway- holding position marking shall be as shown in Figure 12, pattern A or pattern B, as appropriate.

5.2.10.6. **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.

5.2.10.7. 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 14, pattern A.

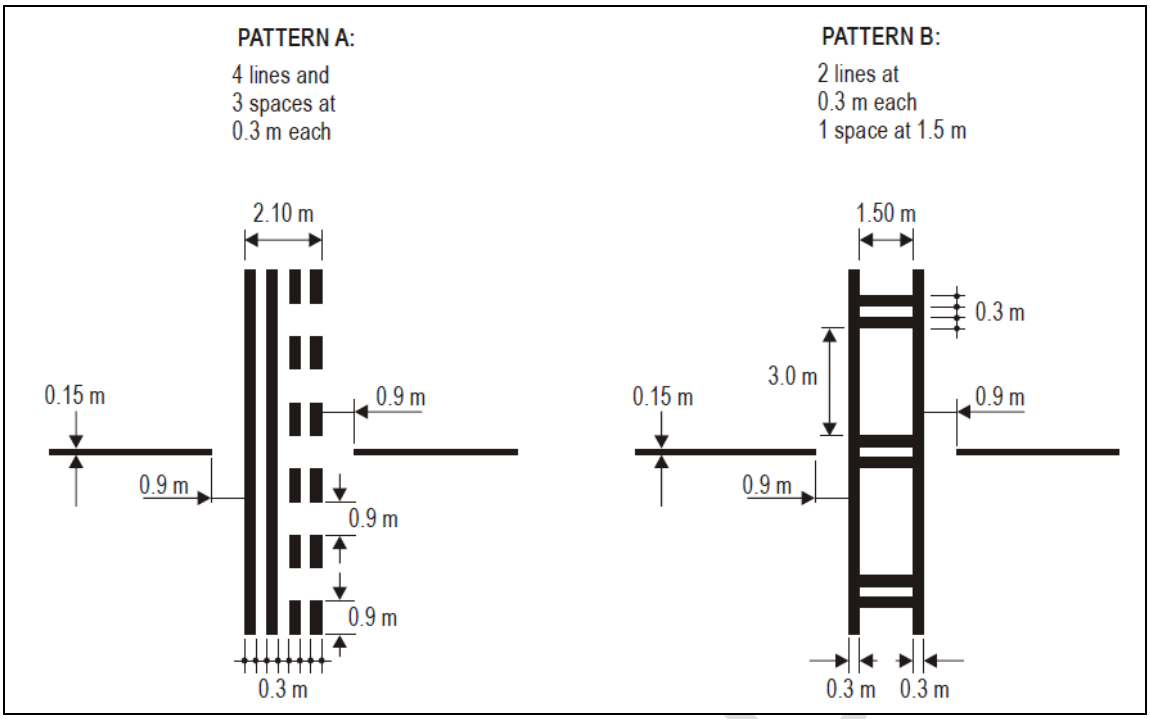


Figure 14. Runway holding position markings (Figure 5-8 ICAO Annex 14).

5.2.11. **Intermediate holding position marking**

Application and location

5.2.11.1. **Recommendation -** An intermediate holding position marking should be displayed along an intermediate holding position.

5.2.11.2. **Recommendation -** An intermediate holding position marking should be displayed at the exit boundary of a remote de-icing/anti-icing facility adjoining a taxiway.

5.2.11.3. Where an intermediate holding position marking is displayed at an intersection of two paved taxiways, it shall be located across the taxiway at sufficient distance from the near edge of the intersecting taxiway to ensure safe clearance between taxiing aircraft. It shall be coincident with a stop bar or intermediate holding position lights, where provided.

5.2.11.4. The distance between an intermediate holding position marking at the exit boundary of a remote de-icing/ anti-icing facility and the centre line of the adjoining taxiway shall not be less than the dimension specified in Table 7, column 11.

Characteristics

5.2.11.5. An intermediate holding position marking shall consist of a single broken line as shown in Figure 12.

5.2.12. **VOR aerodrome checkpoint marking**

Application

5.2.12.1. When a VOR aerodrome checkpoint is established, it shall be indicated by a VOR aerodrome checkpoint marking and sign.

5.2.12.2. Site selection

Note. Guidance on the selection of sites of VOR aerodrome checkpoints is given in ICAO Annex 10, Volume I, Attachment E.

Location

5.2.12.3. A VOR aerodrome checkpoint marking shall be centred on the spot at which an aircraft is to be parked to receive the correct VOR signal.

Characteristics

5.2.12.4. A VOR aerodrome checkpoint marking shall consist of a circle 6 m in diameter and have a line width of 15 cm (see Figure 15 (A)).

5.2.12.5. **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 5-9 (B)).

5.2.12.6. **Recommendation -** A VOR aerodrome checkpoint marking should preferably be white in colour but shall differ from the colour used for the taxiway markings.

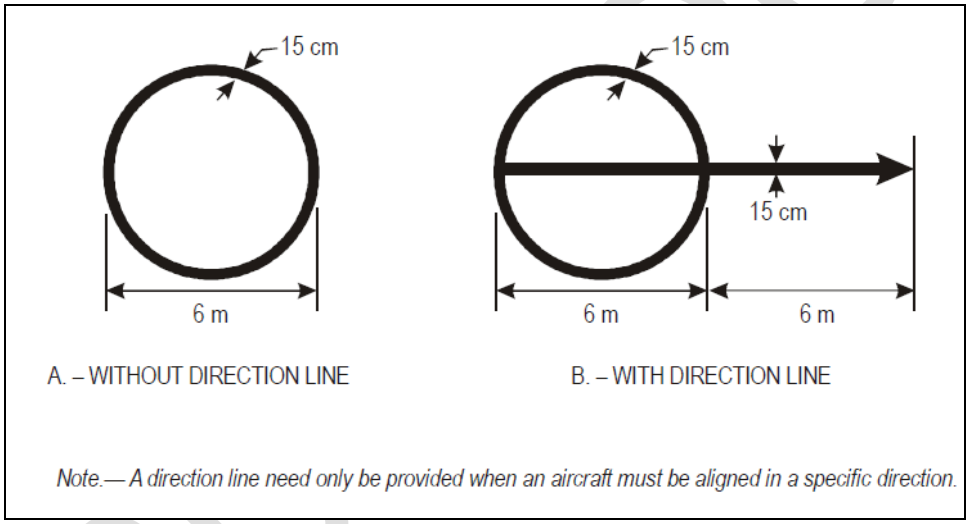


Figure 15. VOR aerodrome checkpoint marking (Figure 5-9 ICAO Annex 14)

5.2.13. **Aircraft stand marking**

Application

5.2.13.1. **Recommendation -** Aircraft stand markings should be provided for designated parking positions on a paved apron and on a de-icing/anti-icing facility.

Location

5.2.13.2. **Recommendation -** Aircraft stand markings on a paved apron and on a de-icing/anti-icing facility should be located so as to provide the clearances specified in 3.13.6 and in 3.15.9, respectively, when the nose wheel follows the stand marking.

Characteristics

5.2.13.3. **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.

5.2.13.4. **Recommendation -** An aircraft stand identification (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.

5.2.13.5. **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.

5.2.13.6. **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.

5.2.13.7. **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.

5.2.13.8. **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.

5.2.13.9. **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 shall have a length and width of not less than 6 m and 15 cm, respectively, and include an arrowhead to indicate the direction of turn.

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

5.2.13.11. **Recommendation -** An alignment bar shoud 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.

5.2.13.12. **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.

5.2.14. **Apron safety lines**

Application

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

Location

5.2.14.2. 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

5.2.14.3. **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.

5.2.14.4. **Recommendation -** An apron safety line should be continuous in length and at least 10 cm in width.

5.2.15. Road-holding position marking

Application

5.2.15.1. A road-holding position marking shall be provided at all road entrances to a runway.

Location

5.2.15.2. The road-holding position marking shall be located across the road at the holding position.

Characteristics

5.2.15.3. The road-holding position marking shall be in accordance with the local road traffic requirements, except that yellow may not be used to mark any part or edge of a road on an aerodrome.

5.2.16. Mandatory instruction marking

Application

5.2.16.1. Where it is impracticable to install a mandatory instruction sign in accordance with 5.4.2.1, a mandatory instruction marking shall be provided on the surface of the pavement.

5.2.16.2. **Recommendation -** Where operationally required, such as on taxiways exceeding 60 m in width, or to assist in the prevention of a runway incursion, a mandatory instruction sign should be supplemented by a mandatory instruction marking.

Location

5.2.16.3. The mandatory instruction marking on taxiways where the code letter is A, B, C or D shall be located across the taxiway equally placed about the taxiway centre line and on the holding side of the runway-holding position marking as shown in Figure 16 (A). The distance between the nearest edge of the marking and the runway-holding position marking or the taxiway centre line marking shall be not less than 1 m.

5.2.16.4. The mandatory instruction marking on taxiways where the code letter is E or F shall be located on both sides of the taxiway centre line marking and on the holding side of the runway-holding position marking as shown in Figure 16 (B). The distance between the nearest edge of the marking and the runway-holding position marking or the taxiway centre line marking shall be not less than 1 m.

5.2.16.5. **Recommendation -** Except where operationally required, a mandatory instruction marking should not be located on a runway.

Characteristics

5.2.16.6. A mandatory instruction marking shall consist of an inscription in white on a red background. Except for a NO ENTRY marking, the inscription shall provide information identical to that of the associated mandatory instruction sign.

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

5.2.16.8. Where there is insufficient contrast between the marking and the pavement surface, the mandatory instruction marking shall include an appropriate border, preferably white or black.

5.2.16.9. **Recommendation -** The character height should be 4 m for inscriptions where the code letter is C, D, E or F, and 2 m where the code letter is A or B. The inscriptions should be in the form and proportions shown in ICAO Annex 14, Volume I, Appendix 3.

5.2.16.10. The background shall be rectangular and extend a minimum of 0.5 m laterally and vertically beyond the extremities of the inscription.

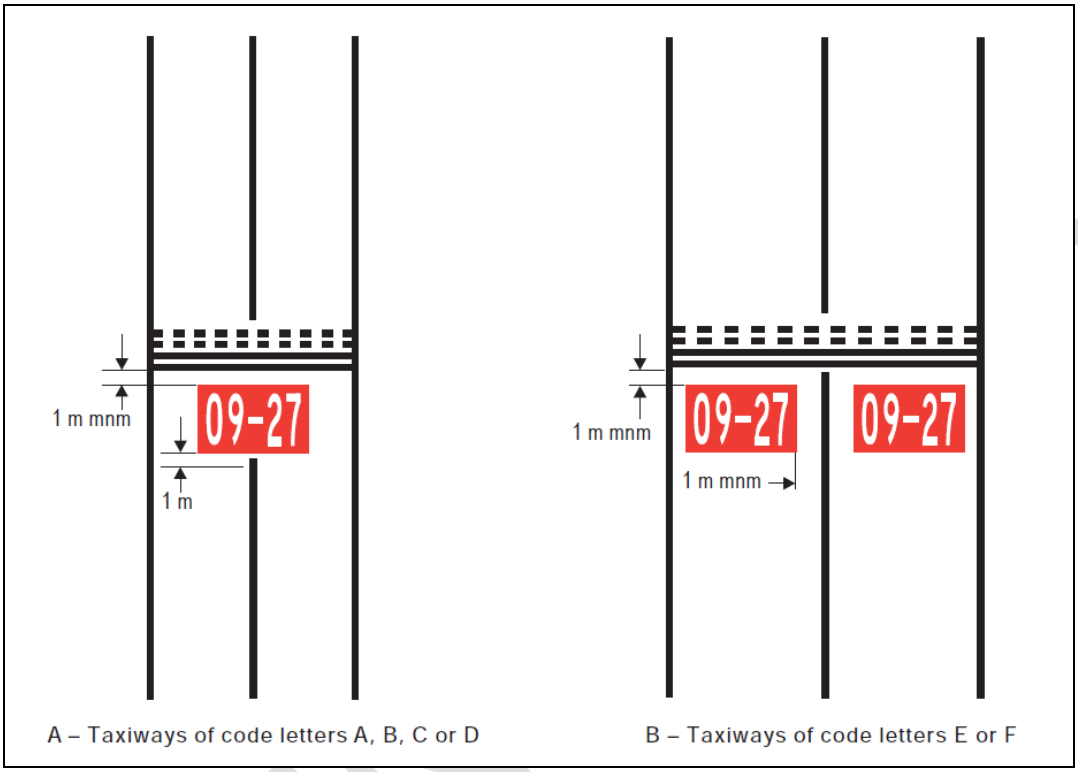


Figure 16. Mandatory instruction marking (Figure 5-10 ICAO Annex 14)

5.2.17. Information marking

Application

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

5.2.17.2. **Recommendation -** Where operationally required an information sign should be supplemented by an information marking.

5.2.17.3. **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.

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

Location

5.2.17.5. **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

5.2.17.6. An information marking shall consist of:

(1) an inscription in yellow upon a black background, when it replaces or supplements a location sign; and

(2) an inscription in black upon a yellow background, when it replaces or supplements a direction or destination sign.

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

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

(2) a yellow border where the inscriptions are in yellow.

5.2.17.8. **Recommendation -** The character height should be 4 m. The inscriptions should be in the form and proportions shown in Appendix 3.

5.3. Lights

5.3.1. General

Lights which may endanger the safety of aircraft

5.3.1.1. 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 which may endanger the safety of aircraft

Note. Additional information guidance on the establishment of laser beam free flight zone is given in ICAO Doc 9815

5.3.1.2. **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 flight zone (LCFZ)
- a laser-beam sensitive flight zone (LSFZ).

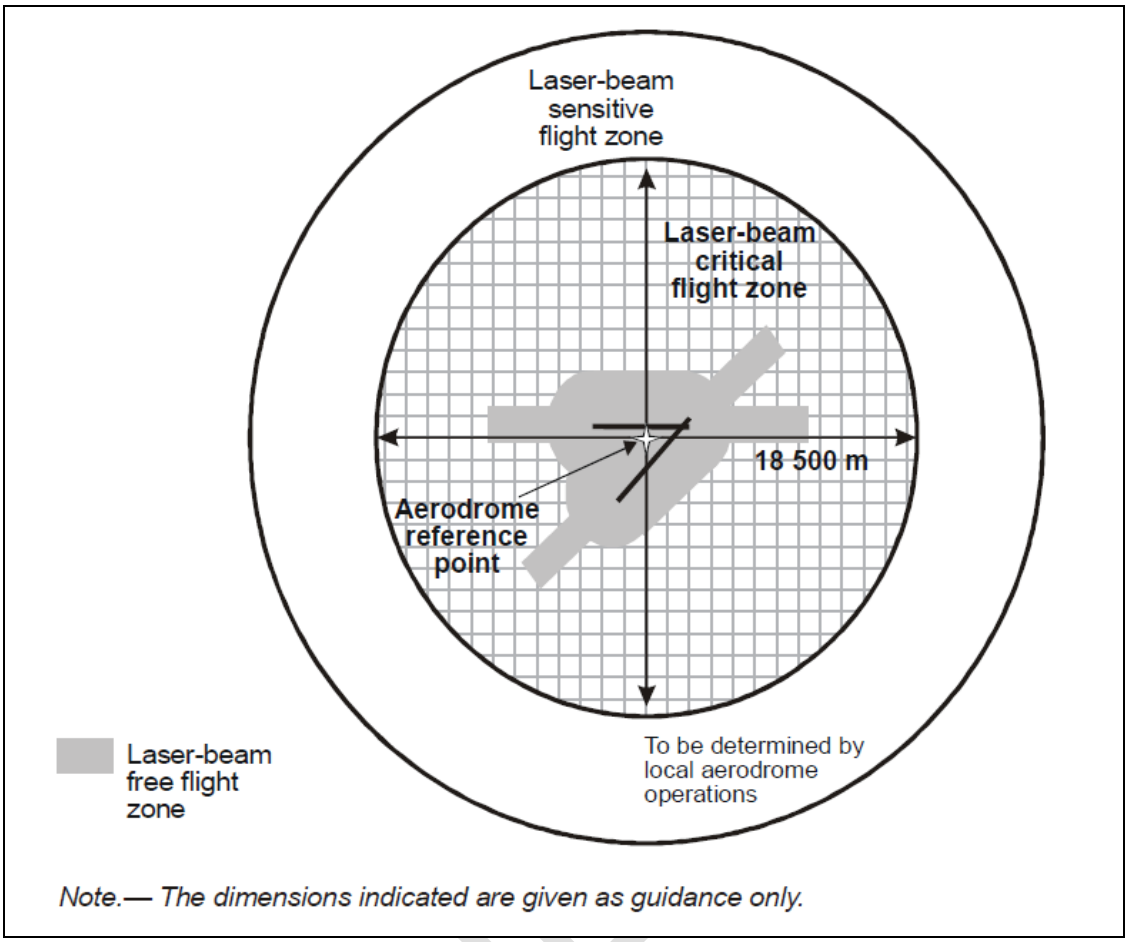


Figure 17. Protected Flight Zones (Figure 5-11 ICAO Annex 14)

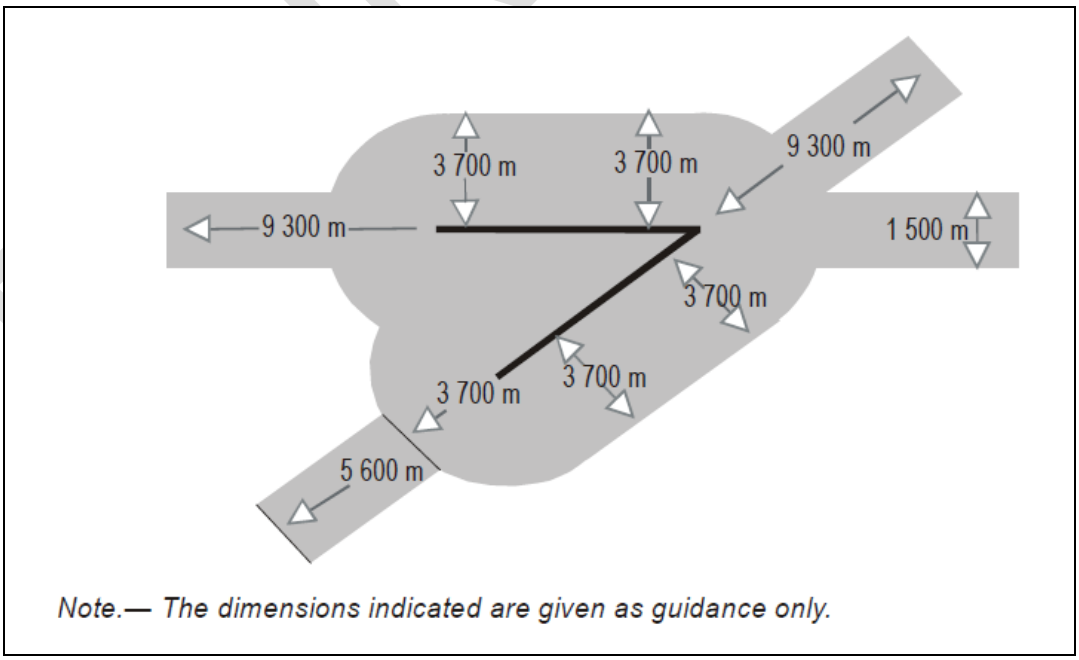


Figure 18. Multiple runway laser-bean free flight zone (Figure 5-12 ICAO Annex 14)

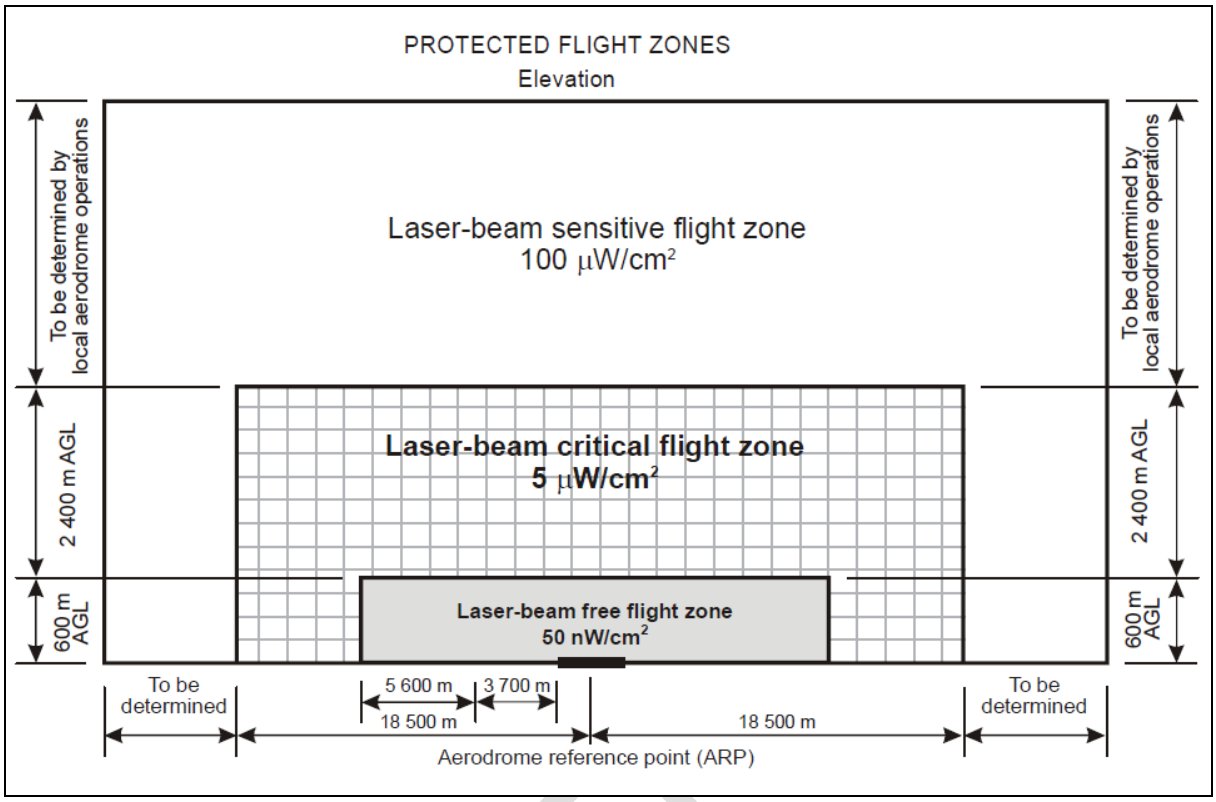


Figure 19. Protected Flight Zones with indication of maximum irradiance levels for vehicle laser beams (Figure 5-13 ICAO Annex 14)

Lights which may cause confusion

5.3.1.3. **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:

(1) 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.

(2) Instrument runway — code number 2 or 3:

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

(3) 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 para. 9.9 for information regarding siting of equipment and installations on operational areas, and the ICAO Aerodrome Design Manual (Doc 9157), Part 6, for guidance on frangibility of light fixtures and supporting structures.

Elevated approach lights

5.3.1.4. 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:

(1) where the height of a supporting structure exceeds 12 m, the frangibility requirement shall apply to the top 12 m only; and

(2) where a supporting structure is surrounded by non-frangible objects, only that part of the structure that extends above the surrounding objects shall be frangible.

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

Elevated lights

5.3.1.6. 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

5.3.1.7. Light fixtures inset in the surface of runways, stopways, taxiways and aprons shall be so designed and fitted as to withstand being run over by the wheels of an aircraft without damage either to the aircraft or to the lights themselves.

5.3.1.8. **Recommendation -** The temperature produced by conduction or radiation at the interface between an installed inset light and an aircraft tire should not exceed 160°C during a 10-minute period of exposure.

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. (See Attachment A, Section 16, *and the ICAO* Aerodrome Design Manual *(Doc 9157), Part 4).*

5.3.1.9. The intensity of runway lighting shall be adequate for the minimum conditions of visibility and ambient light in which use of the runway is intended, and compatible with that of the nearest section of the approach lighting system when provided.

5.3.1.10. Where a high-intensity lighting system is provided, a suitable intensity control shall be incorporated to allow for adjustment of the light intensity to meet the prevailing conditions. Separate intensity controls or other suitable methods shall be provided to ensure that the following systems, when installed, can be operated at compatible intensities:

- approach lighting system;
- runway edge lights;
- runway threshold lights;
- runway end lights;
- runway centre line lights;
- runway touchdown zone lights; and
- taxiway centre line lights

5.3.1.11 On the perimeter of and within the ellipse defining the main beam in ICAO Annex 14 Volume I, Appendix 2, Figures A2-1 to A2-10, the maximum light intensity value shall not be greater than three times the minimum light intensity value measured in accordance with Appendix 2, collective notes for Figures A2-1 to A2-11, Note 2.

5.3.1.12 On the perimeter of and within the rectangle defining the main beam in ICAO Annex 14 Volume I, Appendix 2, Figures A2-12 to A2-20, the maximum light intensity value shall not be greater than three times the minimum light intensity value measured in accordance with Appendix 2, collective notes for Figures A2-12 to A2-21, Note 2.

5.3.2. Emergency lighting

Application

5.3.2.1. **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.

Location

5.3.2.2. **Recommendation -** When installed on a runway the emergency lights should, as a minimum, conform to the configuration required for a non-instrument runway.

Characteristics

5.3.2.3. **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.

5.3.3. Aeronautical beacons

Application

5.3.3.1. Where operationally necessary an aerodrome beacon or an identification beacon shall be provided at each aerodrome intended for use at night.

5.3.3.2. The operational requirement shall be determined having regard to the requirements of the air traffic using the aerodrome, the conspicuity of the aerodrome features in relation to its surroundings and the installation of other visual and non-visual aids useful in locating the aerodrome.

Aerodrome beacon

5.3.3.3. An aerodrome beacon shall be provided at an aerodrome intended for use at night if one or more of the following conditions exist:

(1) aircraft navigate predominantly by visual means;

(2) reduced visibilities are frequent; or

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

Location

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

5.3.3.5. **Recommendation -** The location of the beacon should be such that the beacon is not shielded by objects in significant directions and does not dazzle a pilot approaching to land.

Characteristics

5.3.3.6. The aerodrome beacon shall show either coloured flashes alternating with white flashes, or white flashes only. The frequency of total flashes shall be from 20 to 30 per minute. Where used, the coloured flashes emitted by beacons at land aerodromes shall be green, and coloured flashes emitted by beacons at water aerodromes shall be yellow. In the case of a combined water and land aerodrome, coloured flashes, if used, shall have the colour characteristics of whichever section of the aerodrome is designated as the principal facility.

5.3.3.7. The light from the beacon shall show at all angles of azimuth. The vertical light distribution shall extend upwards from an elevation of not more than 1° to an elevation determined by the appropriate authority to be sufficient to provide guidance at the maximum elevation at which the beacon is intended to be used, and the effective intensity of the flash shall be not less than 2 000 cd.

Note: At locations where a high ambient background lighting level cannot be avoided, the effective intensity of the flash may be increased by a factor up to a value of 10.

Identification beacon

Application

5.3.3.8. An identification beacon shall be provided at an aerodrome which is intended for use at night and cannot be easily identified from the air by other means.

Location

5.3.3.9. The identification beacon shall be located on the aerodrome in an area of low ambient background lighting.

5.3.3.10. **Recommendation -** The location of the beacon should be such that the beacon is not shielded by objects in significant directions and does not dazzle a pilot approaching to land.

Characteristics

5.3.3.11. An identification beacon at a land aerodrome shall show at all angles of azimuth. The vertical light distribution shall extend upwards from an elevation of not more than 1° to an elevation determined by the appropriate authority to be sufficient to provide guidance at the maximum elevation at which the beacon is

intended to be used, and the effective intensity of the flash shall be not less than 2 000 cd.

Note: At locations where a high ambient background lighting level cannot be avoided, the effective intensity of the flash may be increased by a factor up to a value of 10.

5.3.3.12. An identification beacon shall show flashing-green at a land aerodrome and flashing-yellow at a water aerodrome.

5.3.3.13. The identification characters shall be transmitted in the International Morse Code.

5.3.3.14. **Recommendation -** The speed of transmission should be between six and eight words per minute, the corresponding range of duration of the Morse dots being from 0.15 to 0.2 seconds per dot.

5.3.4. **Approach lighting systems**

Application

5.3.4.1. Application

A.— Non-instrument runway

Recommendation - Where physically practicable, a simple approach lighting system as specified in 5.3.4.2 to 5.3.4.9 should be provided to serve a non-instrument runway where the code number is 3 or 4 and intended for use at night, except when the runway is used only in conditions of good visibility and sufficient guidance is provided by other visual aids.

B.— Non-precision approach runway

Where physically practicable, a simple approach lighting system as specified in 5.3.4.2 to 5.3.4.9 shall be provided to serve a non-precision approach runway, except when the runway is used only in conditions of good visibility or sufficient guidance is provided by other visual aids.

C.— Precision approach runway category I

Where physically practicable, a precision approach category I lighting system as specified in 5.3.4.10 to 5.3.4.21 shall be provided to serve a precision approach runway category I.

D.— Precision approach runway categories II and III

A precision approach category II and III lighting system as specified in 5.3.4.22 to 5.3.4.39 shall be provided to serve a precision approach runway category II or III.

Simple approach lighting system

Location

5.3.4.2. A simple approach lighting system shall consist of a row of lights on the extended centre line of the runway extending, whenever possible, over a distance of not less than 420 m from the threshold with a row of lights forming a crossbar 18 m or 30 m in length at a distance of 300 m from the threshold.

5.3.4.3. 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.

5.3.4.4. The lights forming the centre line shall be placed at longitudinal intervals of 60 m, except that, when it is desired to improve the guidance, an interval of 30 m may be used. The innermost light shall be located either 60 m or 30 m from the threshold, depending on the longitudinal interval selected for the centre line lights.

5.3.4.5. **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 shall then consist of a barrette at least 3 m in length. Subject to the approach system having a crossbar at 300 m from the threshold, an additional crossbar may be provided at 150 m from the threshold.

5.3.4.6. 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

5.3.4.7. The lights of a simple approach lighting system shall be fixed lights and the colour of the lights shall be such as to ensure that the system is readily distinguishable from other aeronautical ground lights, and from extraneous lighting if present. Each centre line light shall consist of either:

(a) a single source; or

(b) a barrette at least 3 m in length.

5.3.4.8. **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.

5.3.4.9. **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

5.3.4.10. 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.

5.3.4.11. 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.

5.3.4.12. The lights forming the centre line shall be placed at longitudinal intervals of 30 m with the innermost light located 30 m from the threshold.

5.3.4.13. 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

5.3.4.14. The centre line and crossbar lights of a precision approach category I lighting system shall be fixed lights showing variable white. Each centre line light position shall consist of either:

(a) a single light source in the innermost 300 m of the centre line, two light sources in the central 300 m of the centre line and three light sources in the outer 300 m of the centre line to provide distance information; or

(b) a barrette.

5.3.4.15. Where the serviceability level of the approach lights specified as a maintenance objective in 10.5.10 can be demonstrated to the satisfaction of the Brunei DCA, each centre line light position may consist of either:

(a) a single light source; or

(b) a barrette.

5.3.4.16. The barrettes shall be at least 4 m in length. When barrettes are composed of lights approximating to point sources, the lights shall be uniformly spaced at intervals of not more than 1.5 m.

5.3.4.17. **Recommendation -** If the centre line consists of barrettes as described in 5.3.4.14 b) or 5.3.4.15 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.

5.3.4.18. Each capacitor discharge light as described in 5.3.4.17 shall be flashed twice a second in sequence, beginning with the outermost light and progressing toward the threshold to the innermost light of the system. The design of the electrical circuit shall be such that these lights can be operated independently of the other lights of the approach lighting system.

5.3.4.19. If the centre line consists of lights as described in 5.3.4.14 a) or 5.3.4.15 a), additional crossbars of lights to the crossbar provided at 300 m from the threshold shall be provided at 150 m, 450 m, 600 m and 750 m from the threshold. The lights forming each crossbar shall be as nearly as practicable in a horizontal straight line at right angles to, and bisected by, the line of the centre

line lights. The lights shall be spaced so as to produce a linear effect, except that gaps may be left on each side of the centre line. These gaps shall be kept to a minimum to meet local requirements and each shall not exceed 6 m.

5.3.4.20. Where the additional crossbars described in 5.3.4.19 are incorporated in the system, the outer ends of the crossbars shall lie on two straight lines that either are parallel to the line of the centre line lights or converge to meet the runway centre line 300 m from threshold.

5.3.4.21. The lights shall be in accordance with the specification of ICAO Annex 14 Volume I, Appendix 2, Figure A2-1.

Precision approach category II and III lighting system

Location

5.3.4.22. 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 20. Where the serviceability level of the approach lights specified as maintenance objectives in 10.5.7 can be demonstrated, the system may have two side rows of lights, extending 240 m from the threshold, and two crossbars, one at 150 m and one at 300 m from the threshold, all as shown in Figure 21.

5.3.4.23. The lights forming the centre line shall be placed at longitudinal intervals of 30 m with the innermost lights located 30 m from the threshold.

5.3.4.24. The lights forming the side rows shall be placed on each side of the centre line, at a longitudinal spacing equal to that of the centre line lights and with the first light located 30 m from the threshold. Where the serviceability level of the approach lights specified as maintenance objectives in 10.5.7 can be demonstrated, lights forming the side rows may be placed on each side of the centre line, at a longitudinal spacing of 60 m with the first light located 60 m from the threshold. The lateral spacing (or gauge) between the innermost lights of the side rows shall be not less than 18 m nor more than 22.5 m, and preferably 18 m, but in any event shall be equal to that of the touchdown zone lights.

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

5.3.4.26. The crossbar provided at 300 m from the threshold shall extend on both sides of the centre line lights to a distance of 15 m from the centre line.

5.3.4.27. If the centre line beyond a distance of 300 m from the threshold consists of lights as described in 5.3.4.31 b) or 5.3.4.32 b), additional crossbars of lights shall be provided at 450 m, 600 m and 750 m from the threshold.

5.3.4.28. Where the additional crossbars described in 5.3.4.27 are incorporated in the system, the outer ends of these crossbars shall lie on two straight lines that either are parallel to the centre line or converge to meet the runway centre line 300 m from the threshold.

5.3.4.29. 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.

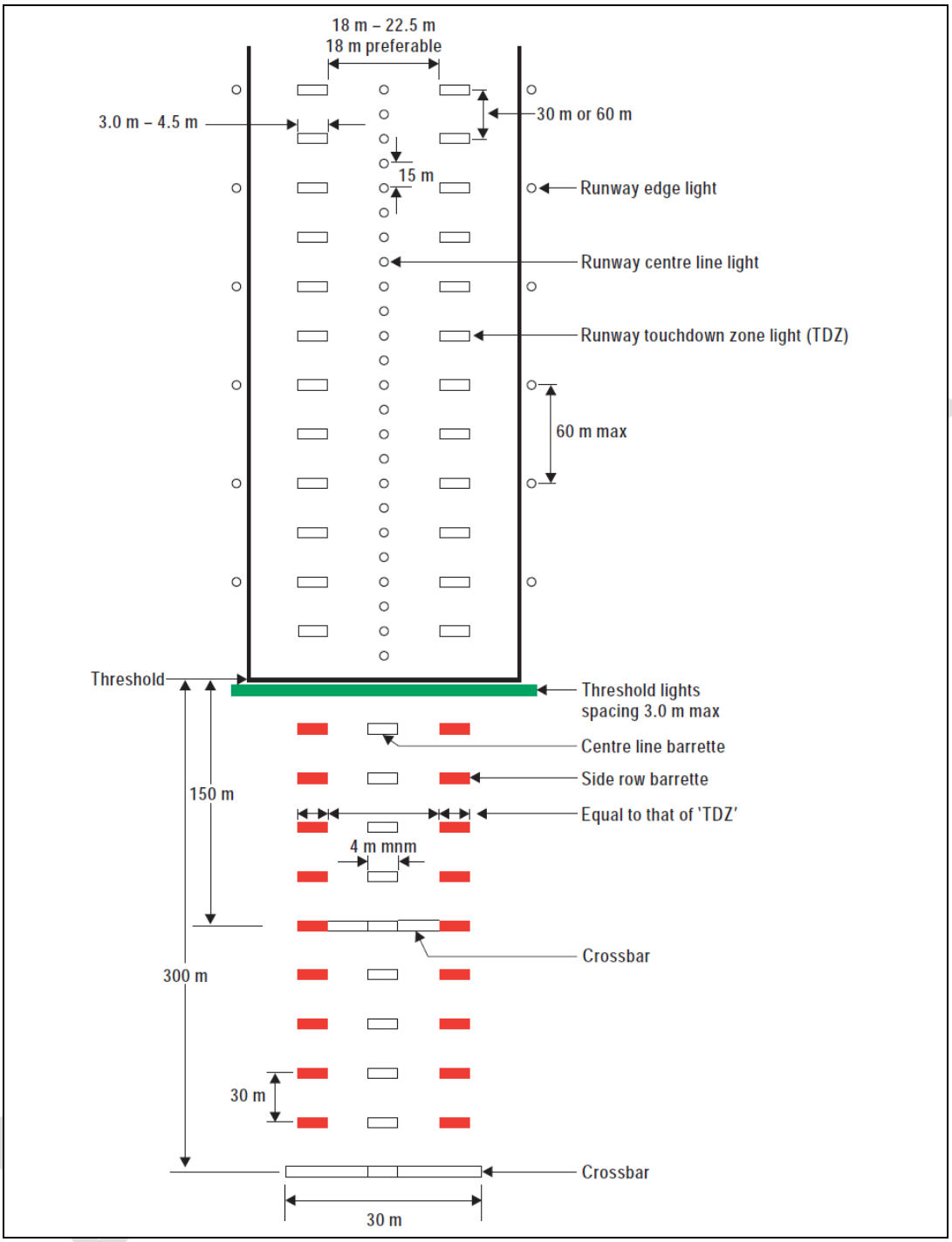


Figure 20. Inner 300m approach and runway lighting for precision approach runways, categories II and III (Figure 5-14 ICAO Annex 14).

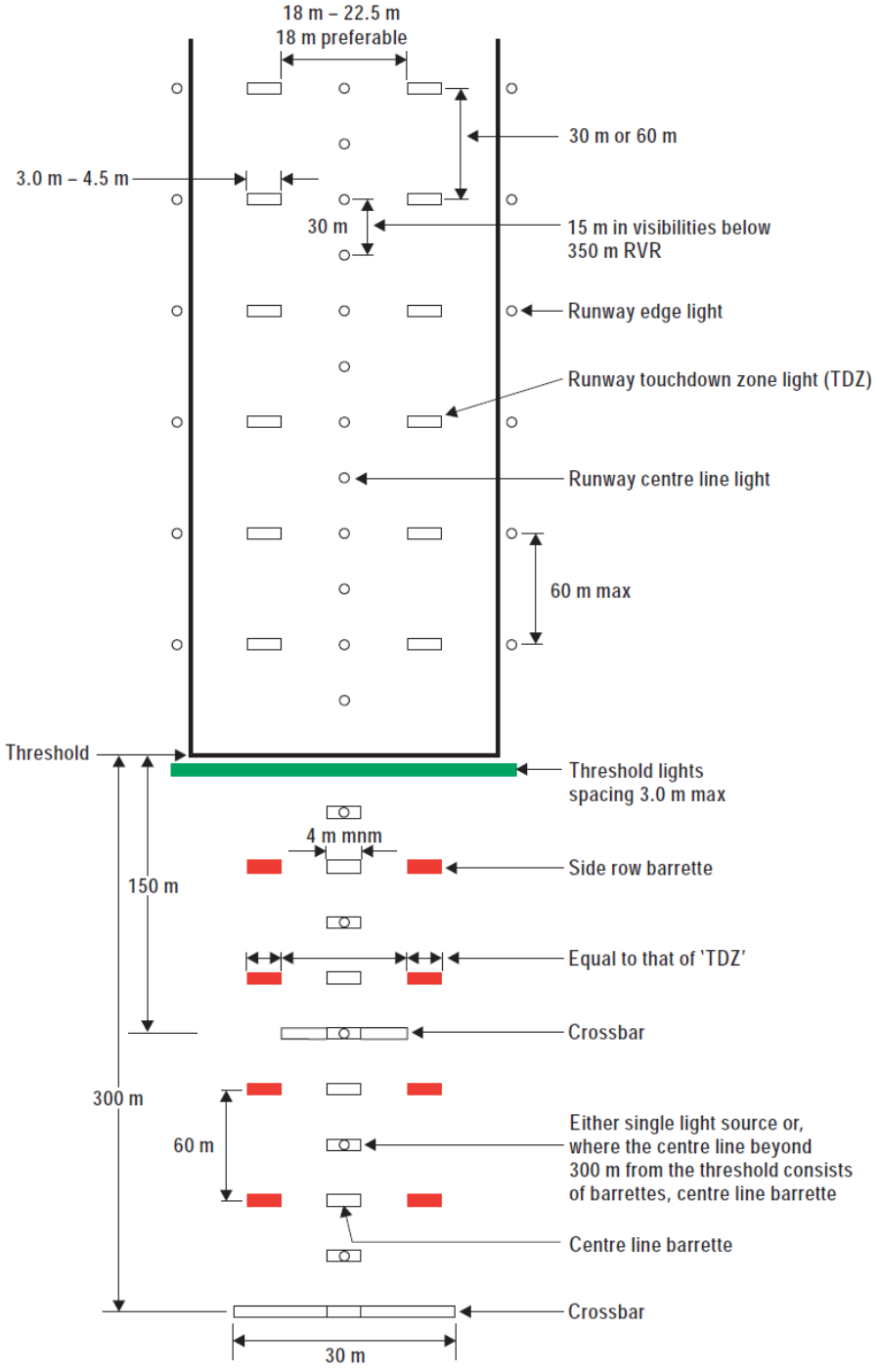


Figure 21: Inner 300 m approach and runway lighting for precision approach runways, categories II and III, where the serviceability levels of the lights specified as maintenance objectives in Chapter 10 can be demonstrated (Figure 5-15 ICAO Annex 14)

Characteristics

5.3.4.30. The centre line of a precision approach category II and III lighting system for the first 300 m from the threshold shall consist of barrettes showing variable white, except that, where the threshold is displaced 300 m or more, the centre line may consist of single light sources showing variable white. Where the serviceability level of the approach lights specified as maintenance objectives in

10.5.7 can be demonstrated to the satisfaction of the Brunei DCA, the centre line of a precision approach category II and III lighting system for the first 300 m from the threshold may consist of either:

(a) barrettes, where the centre line beyond 300 m from the threshold consists of barrettes as described in 5.3.4.32 a); or

(b) alternate single light sources and barrettes, where the centre line beyond 300 m from the threshold consists of single light sources as described in 5.3.4.32 b), with the innermost single light source located 30 m and the innermost barrette located 60 m from the threshold; or

(c) single light sources where the threshold is displaced 300 m or more;

all of which shall show variable white.

5.3.4.31. Beyond 300 m from the threshold each centre line light position shall consist of either:

(a) a barrette as used on the inner 300 m; or

(b) two light sources in the central 300 m of the centre line and three light sources in the outer 300 m of the centre line;

all of which shall show variable white.

5.3.4.32. Where the serviceability level of the approach lights specified as maintenance objectives in 10.5.7 can be demonstrated, beyond 300 m from the threshold each centre line light position may consist of either:

(a) a barrette; or

(b) a single light source;

all of which shall show variable white.

5.3.4.33. The barrettes shall be at least 4 m in length. When barrettes are composed of lights approximating to point sources, the lights shall be uniformly spaced at intervals of not more than 1.5 m.

5.3.4.34. **Recommendation -** If the centre line beyond 300 m from the threshold consists of barrettes as described in 5.3.4.31 a) or 5.3.4.32 a), each barrette beyond 300 m 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.

5.3.4.35. 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.

5.3.4.36. The side row shall consist of barrettes showing red. The length of a side row barrette and the spacing of its lights shall be equal to those of the touchdown zone light barrettes.

5.3.4.37. The lights forming the crossbars shall be fixed lights showing variable white. The lights shall be uniformly spaced at intervals of not more than 2.7 m.

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

5.3.5. Visual approach slope indicator systems

Application

5.3.5.1. A visual approach slope indicator system shall be provided to serve the approach to a runway whether or not the runway is served by other visual approach aids or by non-visual aids, where one or more of the following conditions exist:

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

(b) the pilot of any type of aeroplane may have difficulty in judging the approach due to:

(1) inadequate visual guidance such as is experienced during an approach over water or featureless terrain by day or in the absence of sufficient extraneous lights in the approach area by night; or

(2) misleading information such as is produced by deceptive surrounding terrain or runway slopes;

(c) the presence of objects in the approach area may involve serious hazard if an aeroplane descends below the normal approach path, particularly if there are no non-visual or other visual aids to give warning of such objects;

(d) physical conditions at either end of the runway present a serious hazard in the event of an aeroplane undershooting or overrunning the runway; and

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

5.3.5.2. The standard visual approach slope indicator systems shall consist of the following:

(a) T-VASIS and AT-VASIS conforming to the specifications contained in 5.3.5.6 to 5.3.5.22 inclusive;

(b) PAPI and APAPI systems conforming to the specifications contained in 5.3.5.23 to 5.3.5.40 inclusive;

as shown in Figure 5-22.

5.3.5.3. PAPI, T-VASIS or AT-VASIS shall be provided where the code number is 3 or 4 when one or more of the conditions specified in 5.3.5.1 exist.

5.3.5.4. PAPI or APAPI shall be provided where the code number is 1 or 2 when one or more of the conditions specified in 5.3.5.1 exist.

5.3.5.5. **Recommendation -** Where a runway threshold is temporarily displaced from the normal position and one or more of the conditions specified in 5.3.5.1 exist, a PAPI should be provided except that where the code number is 1 or 2 an APAPI may be provided.

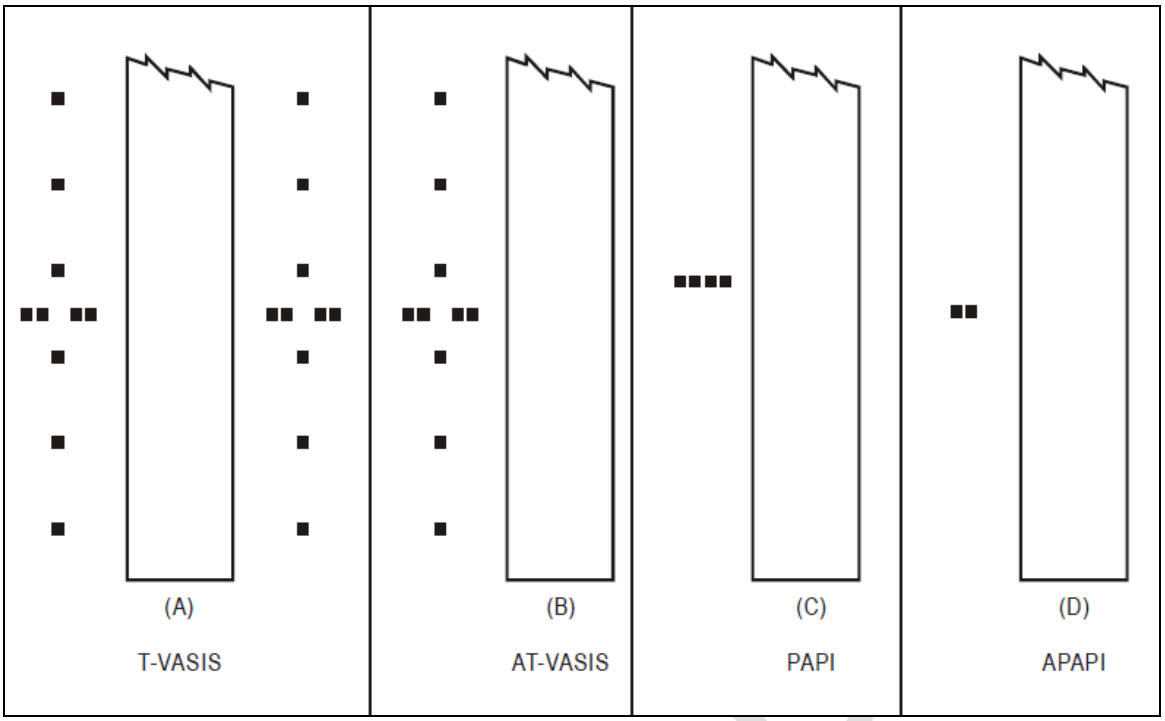


Figure 22. Visual approach slope indicator system (Figure 5-16 ICAO Annex 14)

T-VASIS and AT-VASIS

Description

5.3.5.6. The T-VASIS shall consist of twenty light units symmetrically disposed about the runway centre line in the form of two wing bars of four light units each, with bisecting longitudinal lines of six lights, as shown in Figure 23.

5.3.5.7. The AT-VASIS shall consist of ten light units arranged on one side of the runway in the form of a single wing bar of four light units with a bisecting longitudinal line of six lights.

5.3.5.8. The light units shall be constructed and arranged in such a manner that the pilot of an aeroplane during an approach will:

(a) when above the approach slope, see the wing bar(s) white, and one, two or three fly-down lights, the more fly-down lights being visible the higher the pilot is above the approach slope;

(b) when on the approach slope, see the wing bar(s) white; and

(c) when below the approach slope, see the wing bar(s) and one, two or three fly-up lights white, the more fly-up lights being visible the lower the pilot is below the approach slope; and when well below the approach slope, see the wing bar(s) and the three fly-up lights red.

When on or above the approach slope, no light shall be visible from the fly-up light units; when on or below the approach slope, no light shall be visible from the fly-down light units.

Siting

5.3.5.9. The light units shall be located as shown in Figure 23, subject to the installation tolerances given therein.

Characteristics of the light units

5.3.5.10. The systems shall be suitable for both day and night operations.

5.3.5.11. The light distribution of the beam of each light unit shall be of fan shape showing over a wide arc in azimuth in the approach direction. The wing bar light units shall produce a beam of white light from 1°54' vertical angle up to 6° vertical angle and a beam of red light from 0° to 1°54' vertical angle. The fly-down light units shall produce a white beam extending from an elevation of 6° down to approximately the approach slope, where it shall have a sharp cut-off. The fly-up light units shall produce a white beam from approximately the approach slope down to 1°54' vertical angle and a red beam below a 1°54' vertical angle. The angle of the top of the red beam in the wing bar units and fly-up units may be increased to comply with 5.3.5.21.

5.3.5.12. The light intensity distribution of the fly-down, wing bar and fly-up light units shall be as shown in ICAO Annex 14, Appendix 2, Figure A2-22.

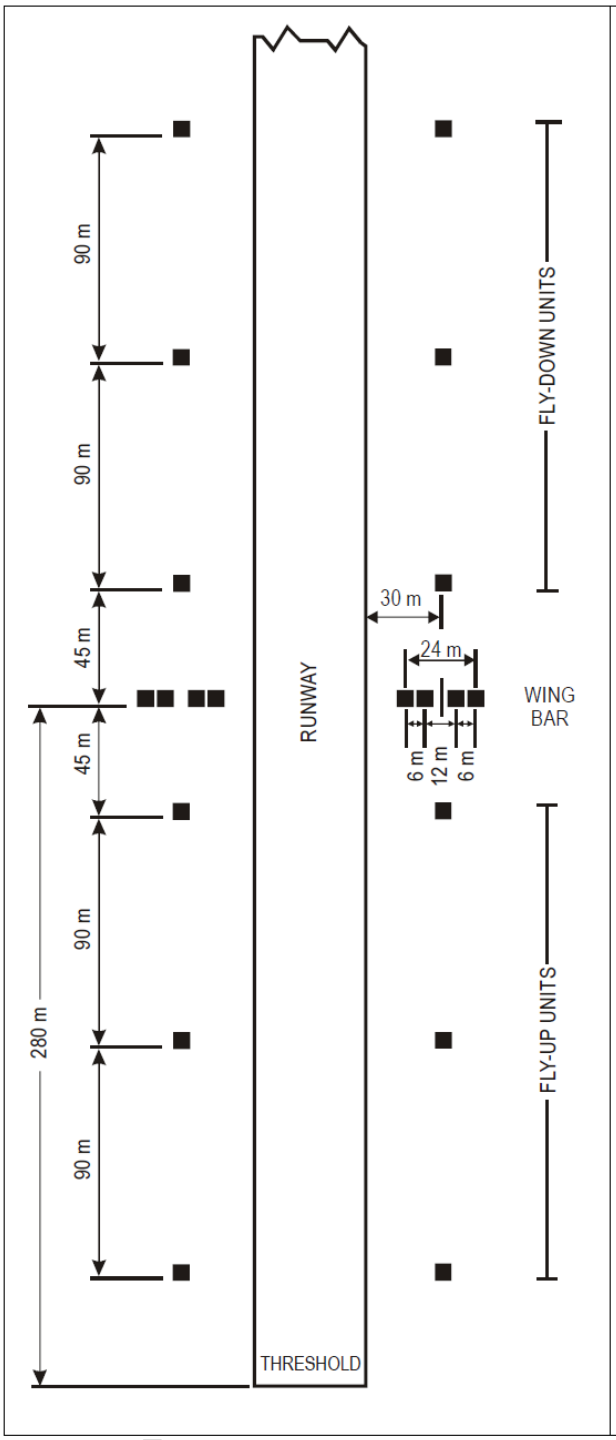
5.3.5.13. The colour transition from red to white in the vertical plane shall be such as to appear to an observer, at a distance of not less than 300 m, to occur over a vertical angle of not more than 15'.

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

5.3.5.15. A suitable intensity control shall be provided to allow adjustments to meet the prevailing conditions and to avoid dazzling the pilot during approach and landing.

5.3.5.16. The light units forming the wing bars, or the light units forming a fly-down or a fly-up matched pair, shall be mounted so as to appear to the pilot of an approaching aeroplane to be substantially in a horizontal line. The light units shall be mounted as low as possible and shall be frangible.

5.3.5.17. The light units shall be so designed that deposits of condensation, dirt, etc., on optically transmitting or reflecting surfaces shall interfere to the least possible extent with the light signals and shall in no way affect the elevation of the beams or the contrast between the red and white signals. The construction of the light units shall be such as to minimize the probability of the slots being wholly or partially blocked by snow or ice where these conditions are likely to be encountered.



INSTALLATION TOLERANCES

The appropriate authority may:

a) vary the nominal eye height over the threshold of the on-slope signal between the limits of 12 m and 16 m, except in cases where a standard ILS glide path and/or MLS minimum glide path is available; the height over threshold should be varied to avoid any conflict between the visual approach slope indications and the usable portion of the ILS glide path and/or MLS minimum glide path indications;

b) vary the longitudinal distance between individual light units or the overall length of the system by not more than 10 per cent;

c) vary the lateral displacement of the system from the runway edge by not more than ±3 m;

Note.— The system must be symmetrically displaced about the runway centre line.

d) where there is a longitudinal slope of the ground, adjust the longitudinal distance of a light unit to compensate for its difference in level from that of the threshold; and

e) where there is a transverse slope in the ground, adjust the longitudinal distance of two light units or two wing bars to compensate for the difference in level between them as necessary to meet the requirements of 5.3.5.16.

The distance between the wing bar and the threshold is based on an approach slope of 3° to a level runway with a nominal eye height over the threshold of 15 m. In practice, the threshold to wing bar distance is determined by:

a) the selected approach slope;

b) the longitudinal slope of the runway; and

c) the selected nominal eye height over the threshold.

Figure 23. Siting of light units for T-VASIS (Figure 5-17 ICAO Annex 14)

Approach slope and elevation setting of light beams

5.3.5.18. The approach slope shall be appropriate for use by the aeroplanes using the approach.

5.3.5.19. When the runway on which a T-VASIS is provided is equipped with an ILS and/or MLS, the siting and elevations of the light units shall be such that the visual approach slope conforms as closely as possible with the glide path of the ILS and/or the minimum glide path of the MLS, as appropriate.

5.3.5.20. The elevation of the beams of the wing bar light units on both sides of the runway shall be the same. The elevation of the top of the beam of the fly-up light unit nearest to each wing bar, and that of the bottom of the beam of the fly-down light unit nearest to each wing bar, shall be equal and shall correspond to the approach slope. The cut-off angle of the top of the beams of successive fly-up light units shall decrease by 5' of arc in angle of elevation at each successive unit away from the wing bar. The cut-in angle of the bottom of the beam of the fly-down light units shall increase by 7' of arc at each successive unit away from the wing bar (see Figure 24).

5.3.5.21. The elevation setting of the top of the red light beams of the wing bar and fly-up light units shall be such that, during an approach, the pilot of an aeroplane to whom the wing bar and three fly-up light units are visible would clear all objects in the approach area by a safe margin if any such light did not appear red.

5.3.5.22. The azimuth spread of the light beam shall be suitably restricted where an object located outside the obstacle protection surface of the system, but within the lateral limits of its light beam, is found to extend above the plane of the obstacle protection surface and an aeronautical study indicates that the object could adversely affect the safety of operations. The extent of the restriction shall be such that the object remains outside the confines of the light beam.

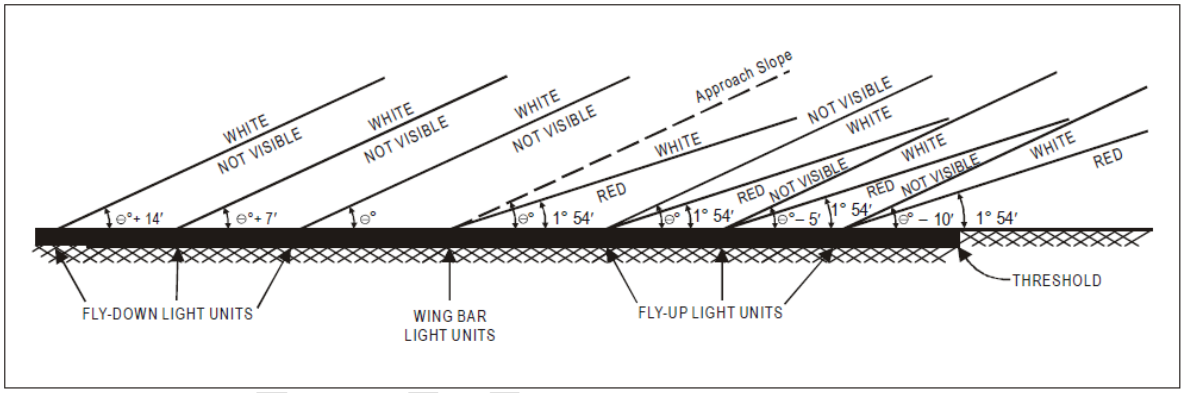


Figure 24. Light Beams and Elevation Settings og T-VASIS and AT-VASIS (Figure 5-18 ICAO Annex 14)

PAPI and APAPI

Description

5.3.5.23. The PAPI system shall consist of a wing bar of four sharp transition multi-lamp (or paired single lamp) units equally spaced. The system shall be located on the left side of the runway unless it is physically impracticable to do so.

5.3.5.24. The APAPI system shall consist of a wing bar of two sharp transition multi-lamp (or paired single lamp) units. The system shall be located on the left side of the runway unless it is physically impracticable to do so.

5.3.5.25. The wing bar of a PAPI shall be constructed and arranged in such a manner that a pilot making an approach will:

(a) when on or close to the approach slope, see the two units nearest the runway as red and the two units farthest from the runway as white;

(b) when above the approach slope, see the one unit nearest the runway as red and the three units farthest from the runway as white; and when further above the approach slope, see all the units as white; and

(c) when below the approach slope, see the three units nearest the runway as red and the unit farthest from the runway as white; and when further below the approach slope, see all the units as red.

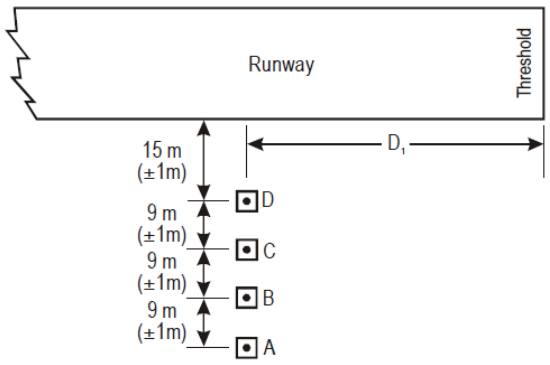
5.3.5.26. The wing bar of an APAPI shall be constructed and arranged in such a manner that a pilot making an approach will:

(a) when on or close to the approach slope, see the unit nearer the runway as red and the unit farther from the runway as white;

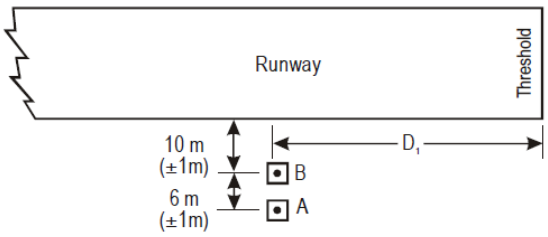
(b) when above the approach slope, see both the units as white; and c) when below the approach slope, see both the units as red.

Siting

5.3.5.27. The light units shall be located as in the basic configuration illustrated in Figure 25, subject to the installation tolerances given therein. The units forming a wing bar shall be mounted so as to appear to the pilot of an approaching aeroplane to be substantially in a horizontal line. The light units shall be mounted as low as possible and shall be frangible.



Typical PAPI wing bar



Typical APAPI wing bar

INSTALLATION TOLERANCES

a) Where a PAPI or APAPI is installed on a runway not equipped with an ILS or MLS, the distance D_1 shall be calculated to ensure that the lowest height at which a pilot will see a correct approach path indication (Figure 5-20, angle B for a PAPI and angle A for an APAPI) provides the wheel clearance over the threshold specified in Table 5-2 for the most demanding amongst aeroplanes regularly using the runway.

b) Where a PAPI or APAPI is installed on a runway equipped with an ILS and/or MLS, the distance D_1 shall be calculated to provide the optimum compatibility between the visual and non-visual aids for the range of eye-to-antenna heights of the aeroplanes regularly using the runway. The distance shall be equal to that between the threshold and the effective origin of the ILS glide path or MLS minimum glide path, as appropriate, plus a correction factor for the variation of eye-to-antenna heights of the aeroplanes concerned. The correction factor is obtained by multiplying the average eye-to-antenna height of those aeroplanes by the cotangent of the approach angle. However, the distance shall be such that in no case will the wheel clearance over the threshold be lower than that specified in column (3) of Table 5-2.

Note.— See Section 5.2.5 for specifications on aiming point marking. Guidance on the harmonization of PAPI, ILS and/or MLS signals is contained in the *Aerodrome Design Manual* (Doc 9157), Part 4.

c) If a wheel clearance, greater than that specified in a) above is required for specific aircraft, this can be achieved by increasing D_1.

d) Distance D_1 shall be adjusted to compensate for differences in elevation between the lens centres of the light units and the threshold.

e) To ensure that units are mounted as low as possible and to allow for any transverse slope, small height adjustments of up to 5 cm between units are acceptable. A lateral gradient not greater than 1.25 per cent can be accepted provided it is uniformly applied across the units.

f) A spacing of 6 m (±1 m) between PAPI units should be used on code numbers 1 and 2. In such an event, the inner PAPI unit shall be located not less than 10 m (±1 m) from the runway edge.

Note.— Reducing the spacing between light units results in a reduction in usable range of the system.

g) The lateral spacing between APAPI units may be increased to 9 m (±1 m) if greater range is required or later conversion to a full PAPI is anticipated. In the latter case, the inner APAPI unit shall be located 15 m (±1 m) from the runway edge.

Figure 25. Sitting of PAPI and APAPI (Figure 5-19 ICAO Annex 14)

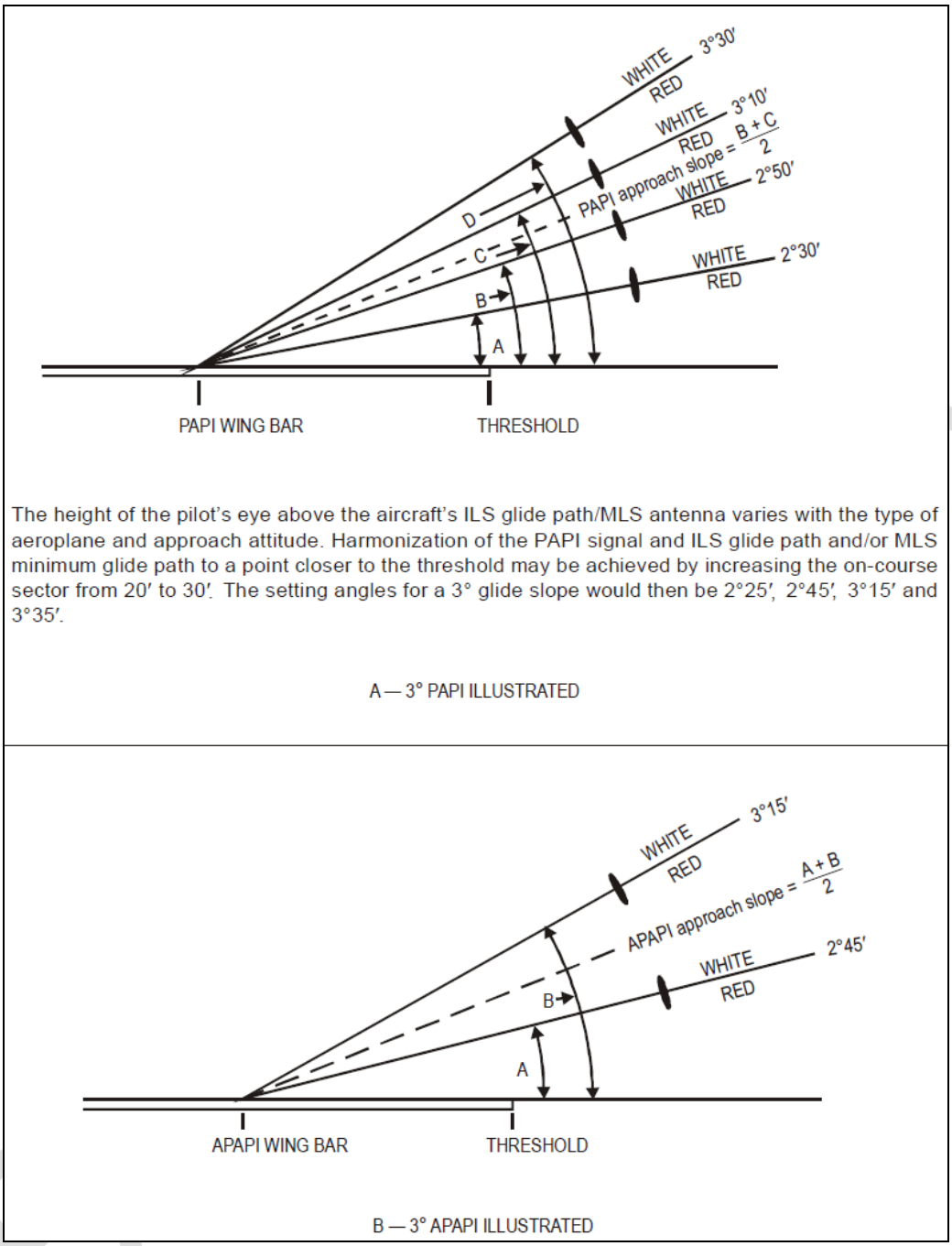


Figure 26. Light beams and angle of elevation setting of PAPI and APAPI (Figure 5-20 ICAO Annex 14).

Table 13. Wheel clearance over threshold for PAPI and APAPI (Table 5-2 ICAO Annex 14)

Eye-to-wheel height of aeroplane in the approach configuration[a]	Desired wheel clearance (metres)[b,c]	Minimum wheel clearance (metres)[d]
(1)	(2)	(3)
up to but not including 3 m	6	3[e]
3 m up to but not including 5 m	9	4
5 m up to but not including 8 m	9	5
8 m up to but not including 14 m	9	6

a. In selecting the eye-to-wheel height group, only aeroplanes meant to use the system on a regular basis shall be considered. The most demanding amongst such aeroplanes shall determine the eye-to-wheel height group.
b. Where practicable the desired wheel clearances shown in column (2) shall be provided.
c. The wheel clearances in column (2) may be reduced to no less than those in column (3) where an aeronautical study indicates that such reduced wheel clearances are acceptable.
d. When a reduced wheel clearance is provided at a displaced threshold it shall be ensured that the corresponding desired wheel clearance specified in column (2) will be available when an aeroplane at the top end of the eye-to-wheel height group chosen overflies the extremity of the runway.
e. This wheel clearance may be reduced to 1.5 m on runways used mainly by light-weight non-turbojet aeroplanes.

Characteristics of the light units

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

5.3.5.29. The colour transition from red to white in the vertical plane shall be such as to appear to an observer, at a distance of not less than 300 m, to occur within a vertical angle of not more than 3′.

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

5.3.5.31. The light intensity distribution of the light units shall be as shown in Appendix 2, Figure A2-23 of ICAO Annex 14.

5.3.5.32. Suitable intensity control shall be provided so as to allow adjustment to meet the prevailing conditions and to avoid dazzling the pilot during approach and landing.

5.3.5.33. Each light unit shall be capable of adjustment in elevation so that the lower limit of the white part of the beam may be fixed at any desired angle of elevation between 1°30′ and at least 4°30′ above the horizontal.

5.3.5.34. The light units shall be so designed that deposits of condensation, snow, ice, dirt, sand, 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

5.3.5.35. The approach slope as defined in Figure 26 shall be appropriate for use by the aeroplanes using the approach.

5.3.5.36. When the runway is equipped with an ILS and/or MLS, the sitting and the angle of elevation of the light units shall be such that the visual approach slope conforms as closely as possible with the glide path of the ILS and/or the minimum glide path of the MLS, as appropriate.

5.3.5.37. The angle of elevation settings of the light units in a PAPI wing bar shall be such that, during an approach, the pilot of an aeroplane observing a signal of one white and three reds will clear all objects in the approach area by a safe margin (see Table 13).

5.3.5.38. The angle of elevation settings of the light units in an APAPI wing bar shall be such that, during an approach, the pilot of an aeroplane observing the lowest onslope signal, i.e. one white and one red, will clear all objects in the approach area by a safe margin (see Table 13).

5.3.5.39. 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.

5.3.5.40. 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.

Obstacle protection surface

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

5.3.5.42. 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 14 and in Figure 27.

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

5.3.5.44. Existing objects above an obstacle protection surface shall be removed except when, in the opinion of the appropriate authority, the object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety of operations of aeroplanes.

Table 14. Dimensions and slopes of the obstacle protection surface (Table 5-3 ICAO Annex 14)

	Runway type/code number							
	Non-instrument Code number				Instrument Code number			
Surface dimensions	1	2	3	4	1	2	3	4
Length of inner edge	60 m	80 m[a]	150 m	150 m	150 m	150 m	300 m	300 m
Distance from threshold	30 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m
Divergence (each side)	10%	10%	10%	10%	15%	15%	15%	15%
Total length	7 500 m	7 500 m[b]	15 000 m	15 000 m	7 500 m	7 500 m[b]	15 000 m	15 000 m
Slope								
a) T-VASIS and AT-VASIS	–[c]	1.9°	1.9°	1.9°	–	1.9°	1.9°	1.9°
b) PAPI[d]	–	A–0.57°	A–0.57°	A–0.57°	A–0.57°	A–0.57°	A–0.57°	A–0.57°
c) APAPI[d]	A–0.9°	A–0.9°	–	–	A–0.9°	A–0.9°	–	–

a. This length is to be increased to 150 m for a T-VASIS or AT-VASIS.
b. This length is to be increased to 15 000 m for a T-VASIS or AT-VASIS.
c. No slope has been specified if a system is unlikely to be used on runway type/code number indicated.
d. Angles as indicated in Figure 5-20.

5.3.5.45. Where an aeronautical study indicates that an existing object extending above an obstacle protection surface could adversely affect the safety of operations of aeroplanes 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 5°;

(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.

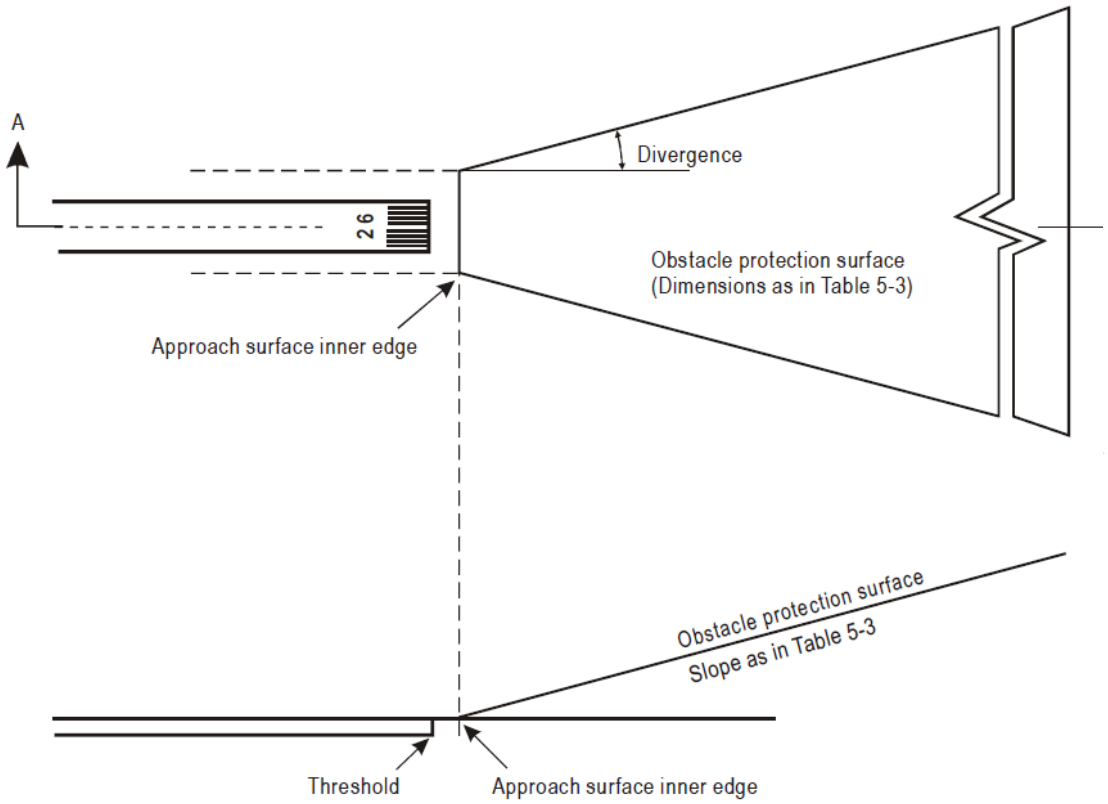


Figure 27 Obstacle protection surface for visual approach slope indicator systems.

5.3.6. Circling guidance lights

Application

5.3.6.1. **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

5.3.6.2. **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.

5.3.6.3. **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 (Doc 9157),Part 4.

Characteristics

5.3.6.4. **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 shall be white, and the steady lights either white or gaseous discharge lights.

5.3.6.5. **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.

5.3.7. **Runway lead-in lighting systems**

Application

5.3.7.1. **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

5.3.7.2. **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 shall not exceed approximately 1 600 m.

5.3.7.3. **Recommendation -** A runway lead-in lighting system should extend from a point as determined by the appropriate authority, up to a point where the approach lighting system, if provided, or the runway or the runway lighting system is in view.

Characteristics

5.3.7.4. **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.

5.3.7.5. **Recommendation -** The flashing lights should be white, and the steady burning lights gaseous discharge lights.

5.3.7.6. **Recommendation -** Where practicable, the flashing lights in each group should flash in sequence towards the runway.

5.3.8. **Runway threshold identification lights**

Application

5.3.8.1. **Recommendation -** Runway threshold identification lights should be installed:

(a) at the threshold of a non-precision approach runway when additional threshold conspicuity is necessary or where it is not practicable to provide other approach lighting aids; and

(b) where a runway threshold is permanently displaced from the runway extremity or temporarily displaced from the normal position and additional threshold conspicuity is necessary.

Location

5.3.8.2. 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

5.3.8.3. **Recommendation -** Runway threshold identification lights should be flashing white lights with a flash frequency between 60 and 120 per minute.

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

5.3.9. Runway edge lights

Application

5.3.9.1. Runway edge lights shall be provided for a runway intended for use at night or for a precision approach runway intended for use by day or night.

5.3.9.2. **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

5.3.9.3. Runway edge lights shall be placed along the full length of the runway and shall be in two parallel rows equidistant from the centre line.

5.3.9.4. Runway edge lights shall be placed along the edges of the area declared for use as the runway or outside the edges of the area at a distance of not more than 3 m.

5.3.9.5. **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.

5.3.9.6. The lights shall be uniformly spaced in rows at intervals of not more than 60 m for an instrument runway, and at intervals of not more than 100 m for a non-instrument runway. The lights on opposite sides of the runway axis shall be on lines at right angles to that axis. At intersections of runways, lights may be spaced irregularly or omitted, provided that adequate guidance remains available to the pilot.

Characteristics

5.3.9.7. 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 when no centre line is available.

5.3.9.8. The runway edge lights shall show at all angles in azimuth necessary to provide guidance to a pilot landing or taking off in either direction. When the runway edge lights are intended to provide circling guidance, they shall show at all angles in azimuth (see 5.3.6.1).

5.3.9.9. In all angles of azimuth required in 5.3.9.8, runway edge lights shall show at angles up to 15° above the horizontal with an intensity adequate for the conditions of visibility and ambient light in which use of the runway for take-off or landing is intended. In any case, the intensity shall be at least 50 cd except that at an aerodrome without extraneous lighting, the intensity of the lights may be reduced to not less than 25 cd to avoid dazzling the pilot.

5.3.9.10. Runway edge lights on a precision approach runway shall be in accordance with the specifications of Appendix 2, Figure A2-9 or A2-10 of ICAO Annex 14.

5.3.10. **Runway threshold and wing bar lights** (see Figure 28)

Application of runway threshold lights

5.3.10.1. 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

5.3.10.2. When a threshold is at the extremity of a runway, the threshold lights shall be placed in a row at right angles to the runway axis as near to the extremity of the runway as possible and, in any case, not more than 3 m outside the extremity.

5.3.10.3. When a threshold is displaced from the extremity of a runway, threshold lights shall be placed in a row at right angles to the runway axis at the displaced threshold.

5.3.10.4. Threshold lighting shall consist of:

(a) on a non-instrument or non-precision approach runway, at least six lights;

(b) on a precision approach runway category I, at least the number of lights that would be required if the lights were uniformly spaced at intervals of 3 m between the rows of runway edge lights; and

(c) on a precision approach runway category II or III, lights uniformly spaced between the rows of runway edge lights at intervals of not more than 3 m.

5.3.10.5. **Recommendation -** The lights prescribed in 5.3.10.4 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 groups, with the lights uniformly spaced in each group and with a gap between the groups equal to the gauge of the touchdown zone marking or lighting, where such is provided, or otherwise not more than half the distance between the rows of runway edge lights.

Application of wing bar lights

5.3.10.6. **Recommendation -** Wing bar lights should be provided on a precision approach runway when additional conspicuity is considered desirable.

5.3.10.7. 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

5.3.10.8. Wing bar lights shall be symmetrically disposed about the runway centre line at the threshold in two groups, i.e. wing bars. Each wing bar shall be formed by at least five lights extending at least 10 m outward from, and at right angles to, the line of the runway edge lights, with the innermost light of each wing bar in the line of the runway edge lights.

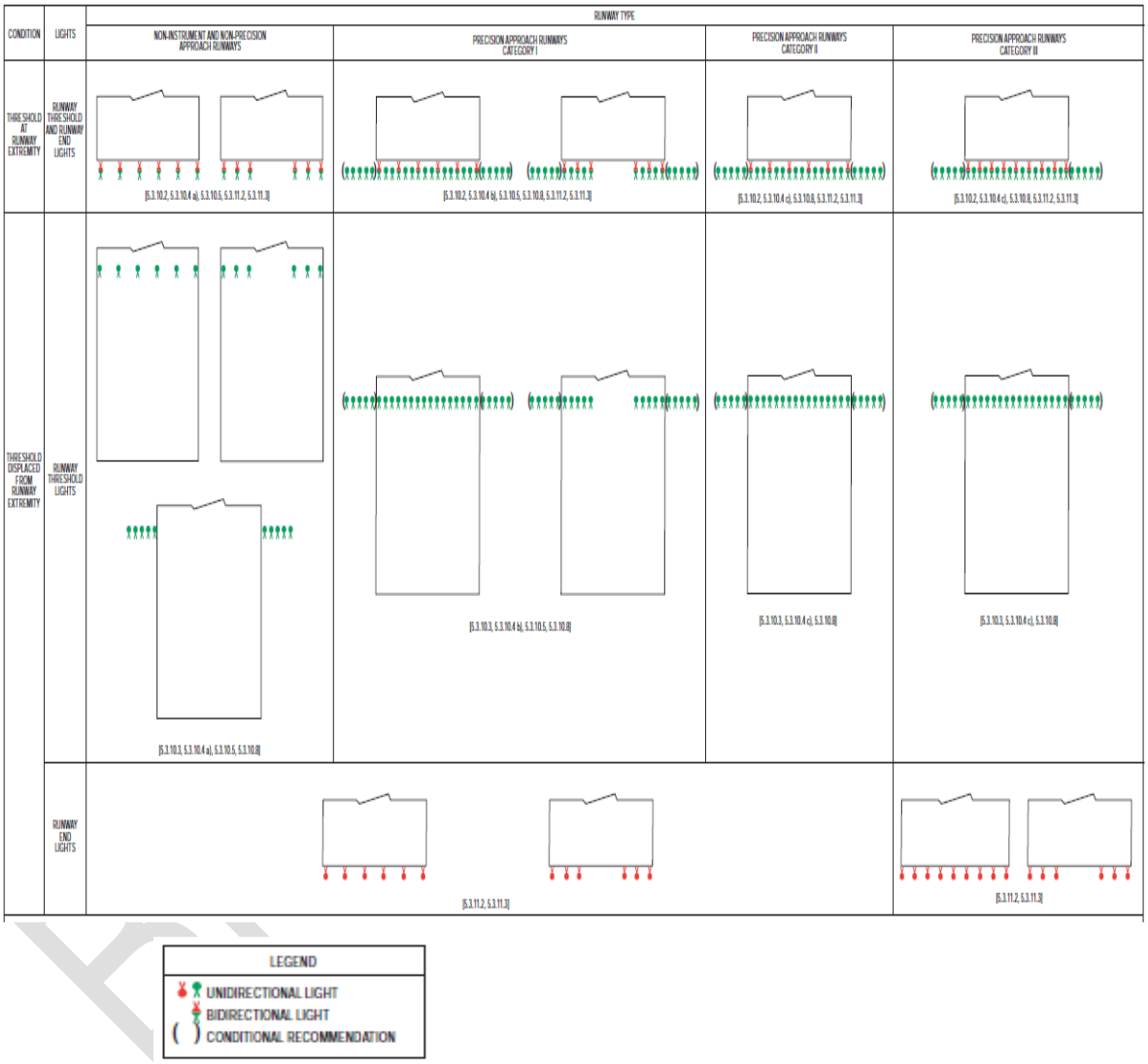


Figure 28 Arrangement of runway threshold and runway end light (Figure 5-22 ICAO Annex 14).

Note: The minimum number of lights is shown for a runway 45 m wide with runway edge lights installed at the edge.

Characteristics of runway threshold and wing bar lights

5.3.10.9. Runway threshold and wing bar lights shall be fixed unidirectional lights showing green in the direction of approach to the runway. The intensity and beam spread of the lights shall be adequate for the conditions of visibility and ambient light in which use of the runway is intended.

5.3.10.10. Runway threshold lights on a precision approach runway shall be in accordance with the specifications of Appendix 2, Figure A2-3 of ICAO Annex 14.

5.3.10.11. Threshold wing bar lights on a precision approach runway shall be in accordance with the specifications of Appendix 2, Figure A2-4 of ICAO Annex 14.

5.3.11. **Runway end lights** (see Figure 28)

Application

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

Location

5.3.11.2. Runway end lights shall be placed on a line at right angles to the runway axis as near to the end of the runway as possible and, in any case, not more than 3 m outside the end.

5.3.11.3. **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

5.3.11.4. Runway end lights shall be fixed unidirectional lights showing red in the direction of the runway. The intensity and beam spread of the lights shall be adequate for the conditions of visibility and ambient light in which use of the runway is intended.

5.3.11.5. Runway end lights on a precision approach runway shall be in accordance with the specifications of Appendix 2, Figure A2-8 of ICAO Annex 14.

5.3.12. **Runway centre line lights**

Application

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

5.3.12.2. **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.

5.3.12.3. Runway centre line lights shall be provided on a runway intended to be used for take-off with an operating minimum below an RVR of the order of 400 m.

5.3.12.4. **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

5.3.12.5. Runway centre line lights shall be located along the centre line of the runway, except that the lights may be uniformly offset to the same side of the runway centre line by not more than 60 cm where it is not practicable to locate them along the centre line. The lights shall be located from the threshold to the end at longitudinal spacing of approximately 15 m. Where the serviceability level of the runway centre line lights specified as maintenance objectives in 10.5.7 or 10.5.11, as appropriate, can be demonstrated and the runway is intended for use in runway visual range conditions of 350 m or greater, the longitudinal spacing may be approximately 30 m.

5.3.12.6. **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 in length and spaced at uniform intervals of 30 m, as shown in Figure 29, 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

5.3.12.7. Runway centre line lights shall be fixed lights showing variable white from the threshold to the point 900 m from the runway end; alternate red and variable white from 900 m to 300 m from the runway end; and red from 300 m to the runway end, except that for runways less than 1 800 m in length, the alternate red and variable white lights shall extend from the midpoint of the runway usable for landing to 300 m from the runway end.

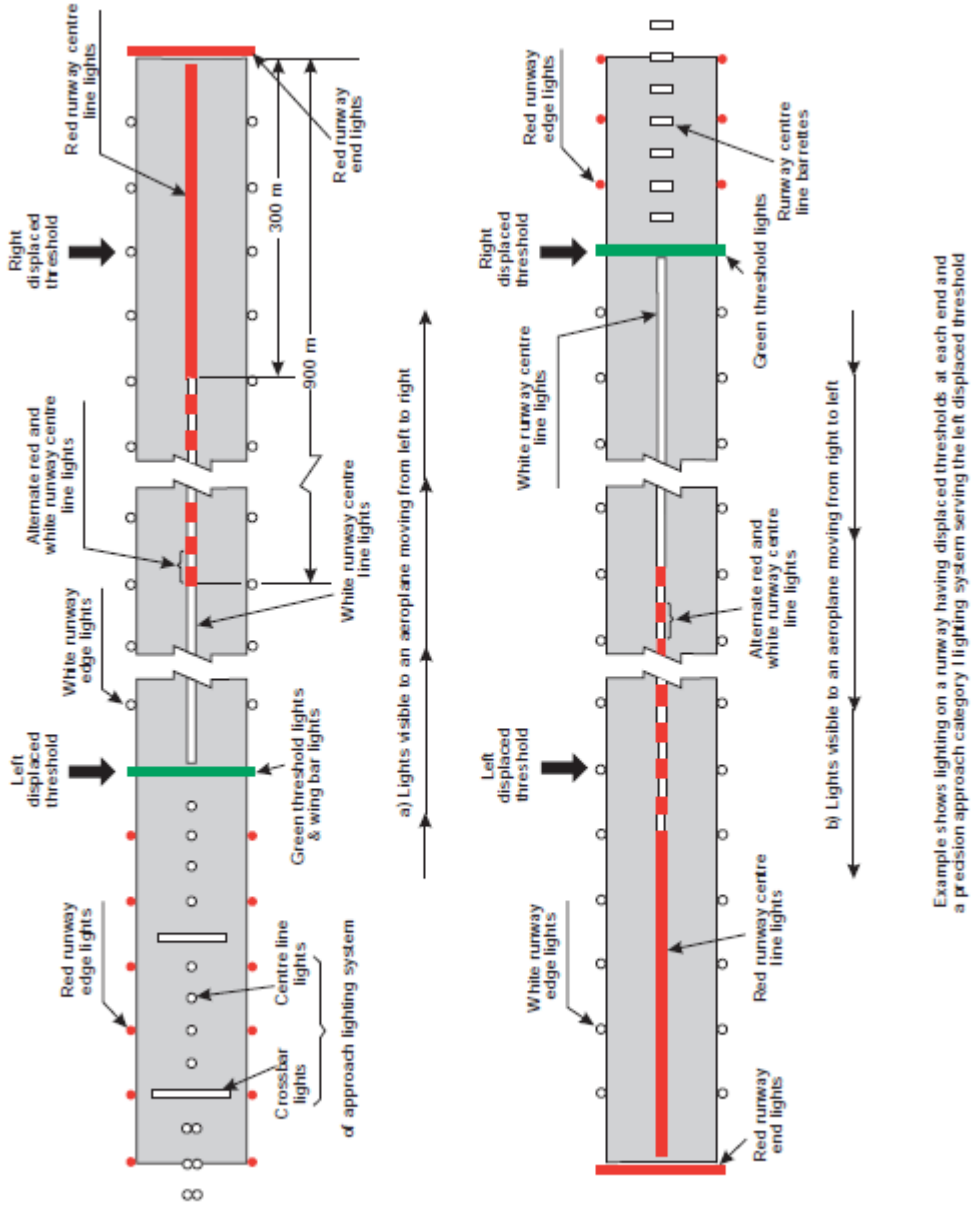


Figure 29. Example of approach and runway lighting for runway with displayed thresholds (Figure 5-23 ICAO Annex 14).

5.3.12.8. Runway centre line lights shall be in accordance with the specifications of Appendix 2, Figure A2-6 or A2-7 of ICAO Annex 14.

5.3.13. Runway touchdown zone lights

Application

5.3.13.1. Touchdown zone (TDZ) lights shall be provided in the touchdown zone of a precision approach runway category II or III.

Location

5.3.13.2. Touchdown zone lights shall extend from the threshold for a longitudinal distance of 900 m, except that, on runways less than 1 800 m in length, the system shall be shortened so that it does not extend beyond the midpoint of the runway. The pattern shall be formed by pairs of barrettes symmetrically

located about the runway centre line. The lateral spacing between the innermost lights of a pair of barrettes shall be equal to the lateral spacing selected for the touchdown zone marking. The longitudinal spacing between pairs of barrettes shall be either 30 m or 60 m.

Characteristics

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

5.3.13.4. **Recommendation -** A barrette should be not less than 3 m nor more than 4.5 m in length.

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

5.3.13.6. Touchdown zone lights shall be in accordance with the specifications of Appendix 2, Figure A2-5 of ICAO Annex 14.

5.3.14. **Simple touchdown zone lights**

Application

5.3.14.1. **Recommendation -** Except where TDZ lights are provided in accordance with paragraph 5.3.13, at an aerodrome where the approach angle is greater than 3.5 degrees and/or the Landing Distance Available combined with other factors increases the risk of an overrun, simple touchdown zone lights should be provided.

Location

5.3.14.2. Simple touchdown zone lights shall be a pair of lights located on each side of the runway centreline 0.3 m beyond the upwind edge of the final touchdown zone marking. The lateral spacing between the inner lights of the two pairs of lights shall be equal to the lateral spacing selected for the touchdown zone marking. The spacing between the lights of the same pair shall not be more than 1.5 m or half the width of the touchdown zone marking, whichever is greater. (See Figure 30.)

5.3.14.3. **Recommendation -** Where provided on a runway without TDZ markings, simple touchdown zone lights should be installed in such a position that provides the equivalent TDZ information.

Characteristics

5.3.14.4. Simple touchdown zone lights shall be fixed unidirectional lights showing variable white, aligned so as to be visible to the pilot of a landing aeroplane in the direction of approach to the runway.

5.3.14.5. Simple touchdown zone lights shall be in accordance with the specifications in Appendix 2, Figure A2-5 of ICAO Annex 14.

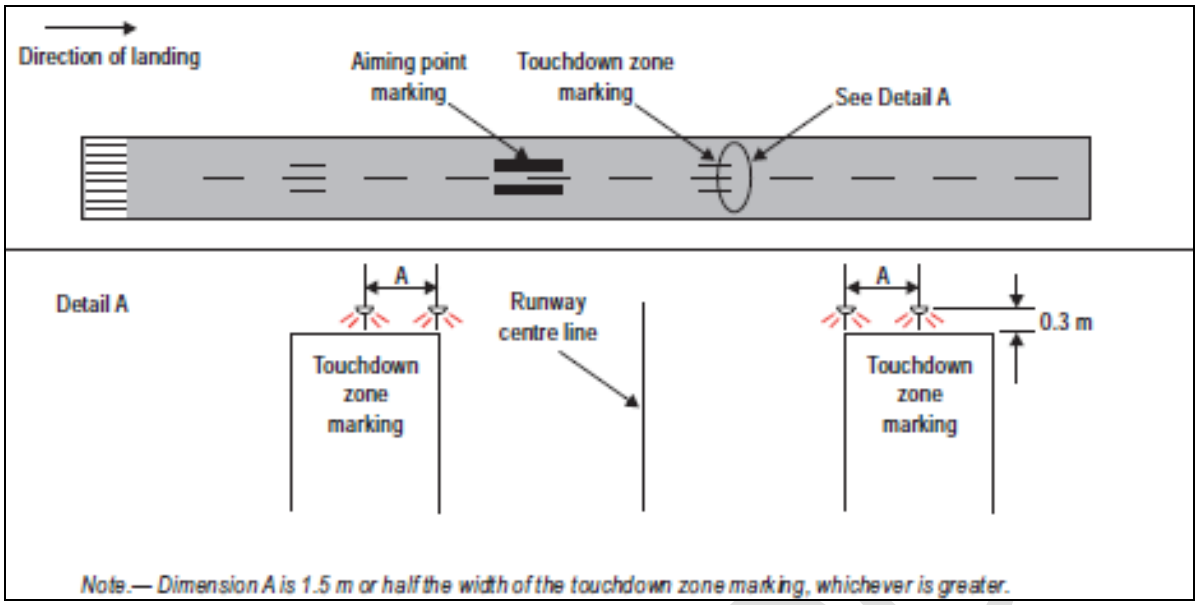


Figure 30. Single touchdown zone lighting (5-24 ICAO Annex 14)

5.3.15. Rapid exit taxiway indicator lights

Application

5.3.15.1. **Recommendation -** Rapid exit taxiway indicator lights should be provided on a runway intended for use in runway visual range conditions less than a value of 350 m and/or where the traffic density is heavy.

5.3.15.2. Rapid exit taxiway indicator lights shall not be displayed in the event of any lamp failure or other failure that prevents the display of the light pattern depicted in Figure 31, in full.

Location

5.3.15.3. A set of rapid exit taxiway indicator lights shall be located on the runway on the same side of the runway centre line as the associated rapid exit taxiway, in the configuration shown in Figure 31. In each set, the lights shall be located 2 m apart and the light nearest to the runway centre line shall be displaced 2 m from the runway centre line.

5.3.15.4. Where more than one rapid exit taxiway exists on a runway, the set of rapid exit taxiway indicator lights for each exit shall not overlap when displayed.

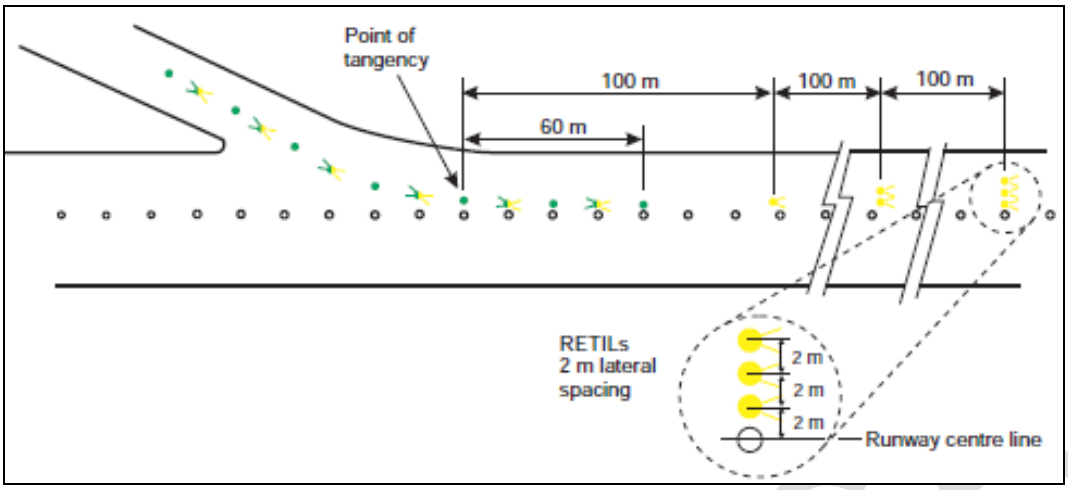


Figure 31. .Rapid Exit Indicator Lights (RETILs) (5-25 ICAO Annex 14)

Characteristics

5.3.15.5. Rapid exit taxiway indicator lights shall be fixed unidirectional yellow lights, aligned so as to be visible to the pilot of a landing aeroplane in the direction of approach to the runway.

5.3.15.6. Rapid exit taxiway indicator lights shall be in accordance with the specifications in Appendix 2, Figure A2-6 or Figure A2-7 of ICAO Annex 14, as appropriate.

5.3.15.7. **Recommendation -** Rapid exit taxiway indicator lights should be supplied with power on a separate circuit to other runway lighting so that they may be used when other lighting is switched off.

5.3.16. Stopway lights

Application

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

Location

5.3.16.2. 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

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

5.3.17. Taxiway centre line lights

Application

5.3.17.1. Taxiway centre line lights shall be provided on an exit taxiway, taxiway, de-icing/anti-icing facility and apron intended for use in runway visual range conditions less than a value of 350 m in such a manner as to provide

continuous guidance between the runway centre line and aircraft stands, except that these lights need not be provided where the traffic density is light and taxiway edge lights and centre line marking provide adequate guidance.

5.3.17.2. **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 the traffic density is light and taxiway edge lights and centre line marking provide adequate guidance.

5.3.17.3. **Recommendation -** Taxiway centre line lights should be provided on an exit taxiway, taxiway, de-icing/anti-icing facility and apron in all visibility conditions where specified as components of an advanced surface movement guidance and control system in such a manner as to provide continuous guidance between the runway centre line and aircraft stands.

5.3.17.4. Taxiway centre line lights shall be provided on a runway forming part of a standard taxi-route and intended for taxiing in runway visual range conditions less than a value of 350 m, except that these lights need not be provided where the traffic density is light and taxiway edge lights and centre line marking provide adequate guidance.

5.3.17.5. **Recommendation -** Taxiway centre line lights should be provided in all visibility conditions on a runway forming part of a standard taxi-route where specified as components of an advanced surface movement guidance and control system.

Characteristics

5.3.17.6. Except as provided for in 5.3.17.8, taxiway centre line lights on a taxiway other than an exit taxiway and on a runway forming part of a standard taxi-route shall be fixed lights showing green with beam dimensions such that the light is visible only from aeroplanes on or in the vicinity of the taxiway.

5.3.17.7. Taxiway centre line lights on an exit taxiway shall be fixed lights. Alternate taxiway centre line lights shall show green and yellow from their beginning near the runway centre line to the perimeter of the ILS/MLS critical/sensitive area or the lower edge of the inner transitional surface, whichever is farthest from the runway; and thereafter all lights shall show green (Figure 32). The first light in the exit centre line shall always show green, and the light nearest to the perimeter shall always show yellow.

5.3.17.8. **Recommendation -** Where it is necessary to denote the proximity to a runway, taxiway centre line lights should be fixed lights showing alternating green and yellow from the perimeter of the ILS/MLS critical/sensitive area or the lower edge of the inner transitional surface, whichever is farthest from the runway, to the runway and continue alternating green and yellow until:

(a) their end point near the runway centre line; or

(b) in the case of the taxiway centre line lights crossing the runway, to the opposite perimeter of the ILS/MLS critical/sensitive area or the lower edge of the inner transitional surface, whichever is farthest from the runway.

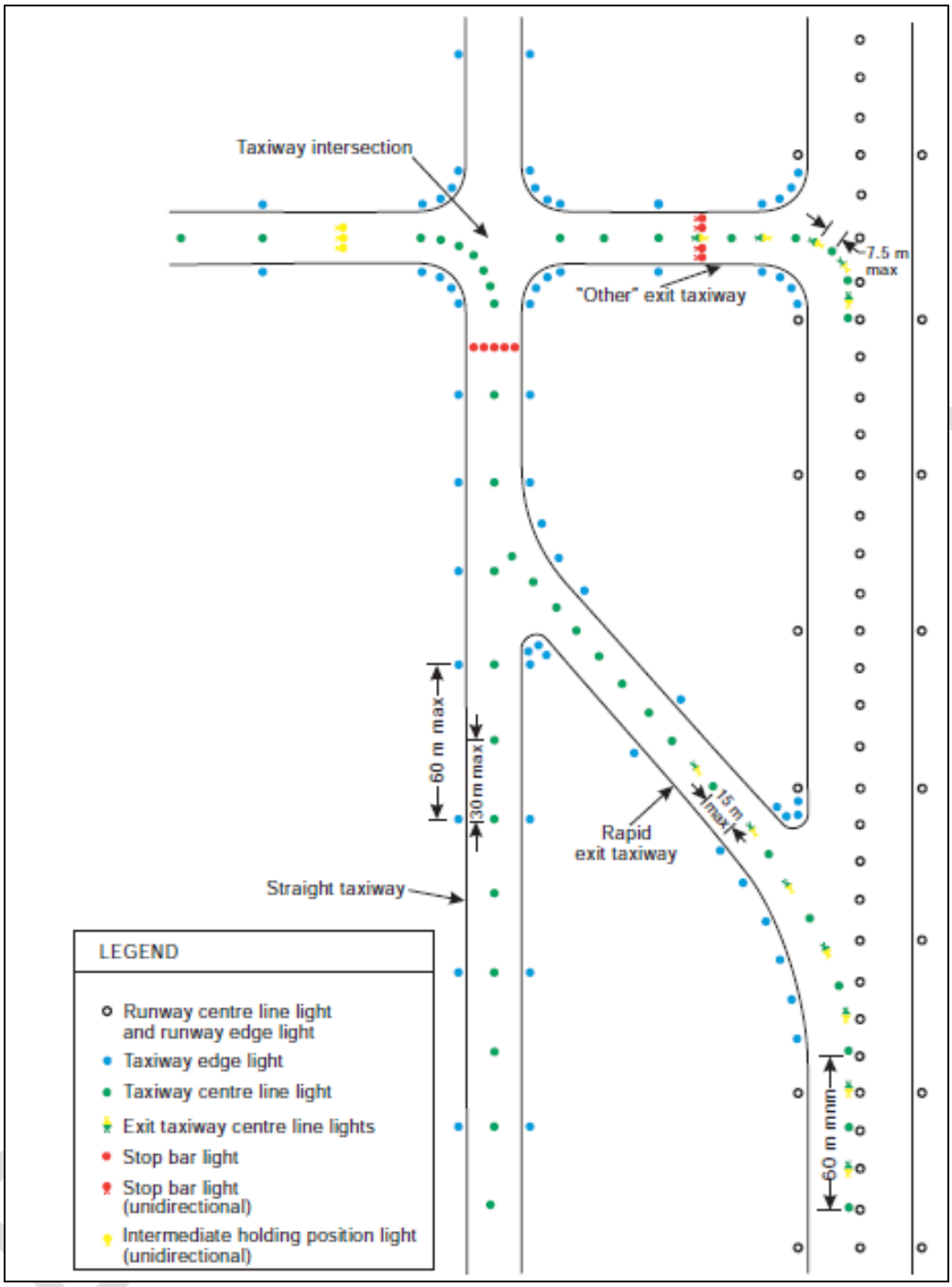


Figure 32. Taxiway Lighting (5-26 ICAO Annex 14)

5.3.17.9. Taxiway centre line lights shall be in accordance with the specifications of:

(a) Appendix 2, Figure A2-12, A2-13, or A2-14 of ICAO Annex 14, for taxiways intended for use in runway visual range conditions of less than a value of 350 m; and

(b) Appendix 2, Figure A2-15 or A2-16 of ICAO Annex 14, for other taxiways.

5.3.17.10. **Recommendation -** Where higher intensities are required, from an operational point of view, taxiway centre line lights on rapid exit taxiways intended for use in runway visual range conditions less than a value of 350 m should be in

accordance with the specifications of Appendix 2, Figure A2-12 of ICAO Annex 14. The number of levels of brilliancy settings for these lights should be the same as that for the runway centre line lights.

5.3.17.11. **Recommendation -** Where taxiway centre line lights are specified as components of an advanced surface movement guidance and control system and where, from an operational point of view, higher intensities are required to maintain ground movements at a certain speed in very low visibilities or in bright daytime conditions, taxiway centre line lights should be in accordance with the specifications of Appendix 2, Figure A2-17, A2-18 or A2-19 of ICAO Annex 14.

Location

5.3.17.12. **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

5.3.17.13. **Recommendation -** Taxiway centre line lights on a straight section of a taxiway should be spaced at longitudinal intervals of not more than 30 m, except that:

(a) larger intervals not exceeding 60 m may be used where, because of the prevailing meteorological conditions, adequate guidance is provided by such spacing;

(b) intervals less than 30 m shall be provided on short straight sections; and

(c) on a taxiway intended for use in RVR conditions of less than a value of 350 m, the longitudinal spacing shall not exceed 15 m.

5.3.17.14. **Recommendation -** Taxiway centre line lights on a taxiway curve should continue from the straight portion of the taxiway at a constant distance from the outside edge of the taxiway curve. The lights should be spaced at intervals such that a clear indication of the curve is provided.

5.3.17.15. **Recommendation -** On a taxiway intended for use in RVR conditions of less than a value of 350 m, the lights on a curve should not exceed a spacing of 15 m, and on a curve of less than 400 m radius the lights should be spaced at intervals of not greater than 7.5 m. This spacing should extend for 60 m before and after the curve.

Taxiway centre line lights on rapid exit taxiways

Location

5.3.17.16. **Recommendation -** Taxiway centre line lights on a rapid exit taxiway should commence at a point at least 60 m before the beginning of the taxiway centre line curve and continue beyond the end of the curve to a point on the centre line of the taxiway where an aeroplane can be expected to reach normal taxiing speed. The lights on that portion parallel to the runway centre line should always be at least 60 cm from any row of runway centre line lights, as shown in Figure 33.

5.3.17.17. **Recommendation -** 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

5.3.17.18. **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, as shown in Figure 33.

5.3.17.19. **Recommendation -** The lights should be spaced at longitudinal intervals of not more than 7.5 m.

Taxiway centre line lights on runways

Location

5.3.17.20. **Recommendation -** Taxiway centre line lights on a runway forming part of a standard taxi-route and intended for taxiing in runway visual range conditions less than a value of 350 m should be spaced at longitudinal intervals not exceeding 15 m.

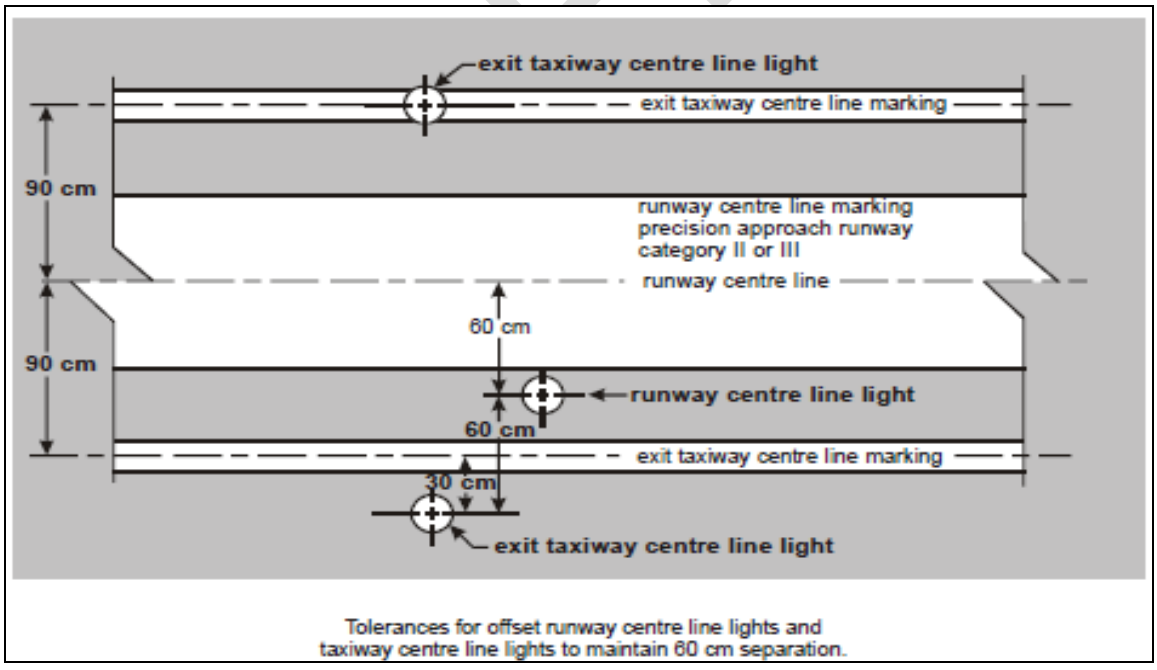


Figure 33. Offset Runway and Taxiway Centre Line Lights (5-27 ICAO Annex 14)

5.3.18. **Taxiway edge lights**

Application

5.3.18.1. Taxiway edge lights shall be provided at the edges of a runway turn pad, holding bay, de-icing/anti-icing facility, 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.

5.3.18.2. Taxiway edge lights shall be provided on a runway forming part of a standard taxi-route and intended for taxiing at night where the runway is not provided with taxiway centre line lights.

Location

5.3.18.3. **Recommendation -** Taxiway edge lights on a straight section of a taxiway and on a runway forming part of a standard taxi-route should be spaced at uniform longitudinal intervals of not more than 60 m. The lights on a curve shall be spaced at intervals less than 60 m so that a clear indication of the curve is provided.

5.3.18.4. **Recommendation -** Taxiway edge lights on a holding bay, de-icing/anti-icing facility, apron, etc., should be spaced at uniform longitudinal intervals of not more than 60 m.

5.3.18.5. **Recommendation -** Taxiway edge lights on a runway turn pad should be spaced at uniform longitudinal intervals of not more than 30 m.

5.3.18.6. **Recommendation -** The lights should be located as near as practicable to the edges of the taxiway, runway turn pad, holding bay, de-icing/anti-icing facility, apron or runway, etc., or outside the edges at a distance of not more than 3 m.

Characteristics

5.3.18.7. Taxiway edge lights shall be fixed lights showing blue. The lights shall show up to at least 75° above the horizontal and at all angles in azimuth necessary to provide guidance to a pilot taxiing in either direction. At an intersection, exit or curve the lights shall be shielded as far as practicable so that they cannot be seen in angles of azimuth in which they may be confused with other lights.

5.3.18.8. The intensity of taxiway edge lights shall be at least 2 cd from 0° to 6° vertical, and 0.2 cd at any vertical angles between 6° and 75°.

5.3.19. Runway turn pad lights

Application

5.3.19.1. Runway turn pad lights shall be provided for continuous guidance on a runway turn pad intended for use in runway visual range conditions less than a value of 350 m, to enable an aeroplane to complete a 180-degree turn and align with the runway centre line.

5.3.19.2. **Recommendation -** Runway turn pad lights should be provided on a runway turn pad intended for use at night.

Location

5.3.19.3. **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.

5.3.19.4. **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.

5.3.19.5. **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

5.3.19.6. Runway turn pad lights shall be unidirectional fixed lights showing green with beam dimensions such that the light is visible only from aeroplanes on or approaching the runway turn pad.

5.3.19.7. Runway turn pad lights shall be in accordance with the specifications of Appendix 2, Figure A2-13, A2-14 or A2-15 of ICAO Annex 14, as appropriate.

5.3.20. **Stop bars**

Application

5.3.20.1. 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 350 m, except where:

(a) appropriate aids and procedures are available to assist in preventing inadvertent incursions of traffic onto the runway; or

(b) operational procedures exist to limit, in runway visual range conditions less than a value of 550 m, the number of:

(1) aircraft on the manoeuvring area to one at a time; and

(2) vehicles on the manoeuvring area to the essential minimum.

Note: where a stop bar is provided it shall be operated for all aircraft and vehicles required to cross the stop bar. The aerodrome operator shall have a contingency plan for use in the event that a stop bar is defective.

5.3.20.2. 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 traffic onto the runway; or

(b) operational procedures exist to limit, in runway visual range conditions less than a value of 550 m, the number of:

(1) aircraft on the manoeuvring area to one at a time; and

(2) vehicles on the manoeuvring area to the essential minimum.

5.3.20.3. Where there is more than one stop bar associated with a taxiway/runway intersection, only one shall be illuminated at any given time.

5.3.20.4. **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.

Location

5.3.20.5. Stop bars shall be located across the taxiway at the point where it is desired that traffic stop. Where the additional lights specified in 5.3.20.7 are provided, these lights shall be located not less than 3 m from the taxiway edge.

Characteristics

5.3.20.6. Stop bars shall consist of lights spaced at uniform intervals of no more than 3 m across the taxiway, showing red in the intended direction(s) of approach to the intersection or runway-holding position.

5.3.20.7. **Recommendation -** A pair of elevated lights should be added to each end of the stop bar where the in- pavement stop bar lights might be obscured from a pilot's view, for example, by snow or rain, or where a pilot may be required to stop the aircraft in a position so close to the lights that they are blocked from view by the structure of the aircraft.

5.3.20.8. Stop bars installed at a runway-holding position shall be unidirectional and shall show red in the direction of approach to the runway.

5.3.20.9. Where the additional lights specified in 5.3.20.7 are provided, these lights shall have the same characteristics as the lights in the stop bar, but shall be visible to approaching aircraft up to the stop bar position.

5.3.20.10. The intensity in red light and beam spreads of stop bar lights shall be in accordance with the specifications in Appendix 2, Figures A2-12 through A2-16 of ICAO Annex 14, as appropriate.

5.3.20.11. **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 2, Figure A2-17, A2-18 or A2-19 of ICAO Annex 14.

5.3.20.12. **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 2, Figure A2-17 or A2-19 of ICAO Annex 14.

5.3.20.13. The lighting circuit shall be designed so that:

(a) stop bars located across entrance taxiways are selectively switchable;

(b) stop bars located across taxiways intended to be used only as exit taxiways are switchable selectively or in groups;

(c) when a stop bar is illuminated, any taxiway centre line lights installed beyond the stop bar shall be extinguished for a distance of at least 90 m; and

(d) stop bars are interlocked with the taxiway centre line lights so that when the centre line lights beyond the stop bar are illuminated the stop bar is extinguished and vice versa.

5.3.21. **Intermediate holding position lights**

Application

5.3.21.1. Except where a stop bar has been installed, intermediate holding position lights shall be provided at an intermediate holding position intended for use in runway visual range conditions less than a value of 350 m.

5.3.21.2. **Recommendation -** Intermediate holding position lights should be provided at an intermediate holding position where there is no need for stop-and-go signals as provided by a stop bar.

Location

5.3.21.3. 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

5.3.21.4. Intermediate holding position lights shall consist of three fixed unidirectional lights showing yellow in the direction of approach to the intermediate holding position with a light distribution similar to taxiway centre line lights if provided. The lights shall be disposed symmetrically about and at right angle to the taxiway centre line, with individual lights spaced 1.5 m apart.

5.3.22. De-icing/anti-icing facility exit lights

Application

5.3.22.1. **Recommendation -** De-icing/anti-icing facility exit lights should be provided at the exit boundary of a remote de-icing/anti-icing facility adjoining a taxiway.

Location

5.3.22.2. De-icing/anti-icing facility exit lights shall be located 0.3 m inward of the intermediate holding position marking displayed at the exit boundary of a remote de-icing/anti-icing facility.

Characteristics

5.3.22.3. De-icing/anti-icing facility exit lights shall consist of in-pavement fixed unidirectional lights spaced at intervals of 6 m showing yellow in the direction of the approach to the exit boundary with a light distribution similar to taxiway centre line lights (see Figure 34).

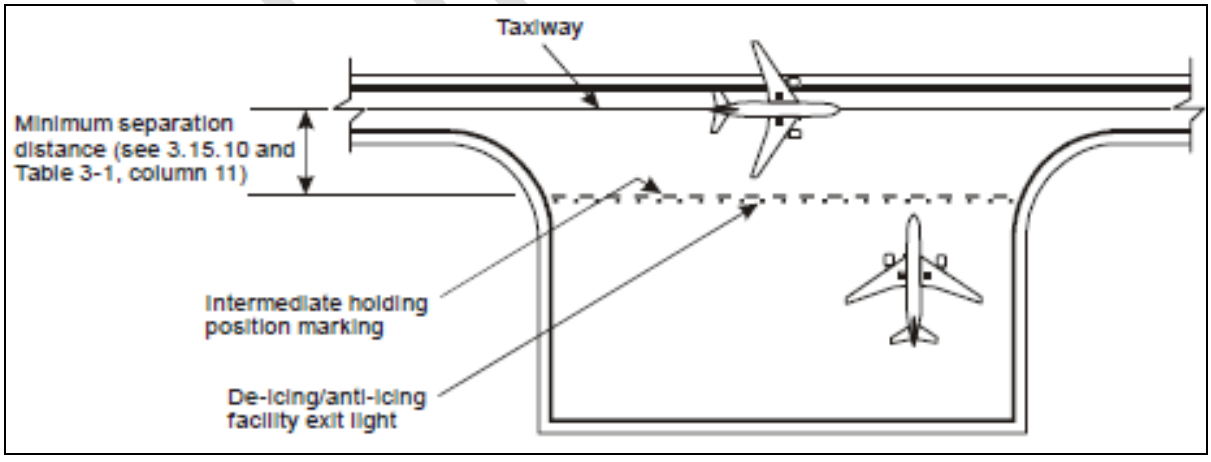


Figure 34. Typical remote de-icing/anti-icing facility (5-28 ICAO Annex 14)

5.3.23. Runway guard lights

Application

5.3.23.1. Runway guard lights, Configuration A, shall be provided at each taxiway/runway intersection associated with a runway intended for use in:

(a) runway visual range conditions less than a value of 550 m where a stop bar is not installed; and

(b) runway visual range conditions of values between 550 m and 1 200 m where the traffic density is heavy.

5.3.23.2. **Recommendation -** As part of runway incursion prevention measures, runway guard lights, Configuration A or B, should be provided at each taxiway/runway intersection where runway incursion hot spots have been identified, and used under all weather conditions during day and night.

5.3.23.3. **Recommendation -** Configuration B runway guard lights should not be collocated with a stop bar.

Location

5.3.23.4. Runway guard lights, Configuration A, shall be located at each side of the taxiway at a distance from the runway centre line not less than that specified for a take-off runway in Table 8.

5.3.23.5. Runway guard lights, Configuration B, shall be located across the taxiway at a distance from the runway centre line not less than that specified for a take-off runway in Table 8.

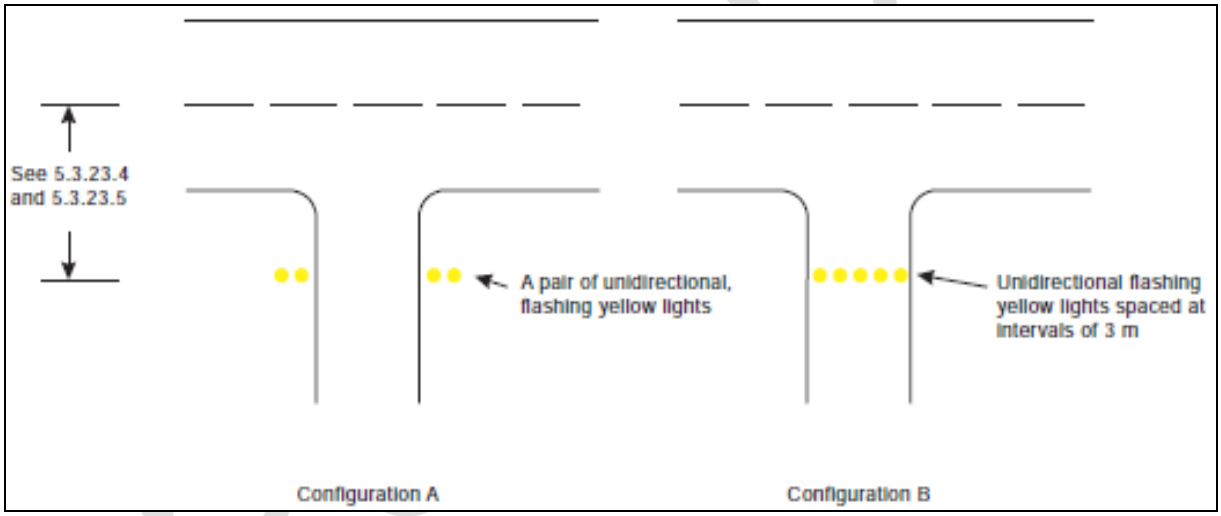


Figure 35. Runway guard lights (5-29 ICAO Annex 14)

Characteristics

5.3.23.6. Runway guard lights, Configuration A, shall consist of two pairs of yellow lights.

5.3.23.7. **Recommendation -** Where there is a need to enhance the contrast between the on and off state of runway guard lights, Configuration A, intended for use during the day, a visor of sufficient size to prevent sunlight from entering the lens without interfering with the function of the fixture should be located above each lamp.

5.3.23.8. Runway guard lights, Configuration B, shall consist of yellow lights spaced at intervals of 3 m across the taxiway.

5.3.23.9. The light beam shall be unidirectional and aligned so as to be visible to the pilot of an aeroplane taxiing to the holding position.

5.3.23.10. **Recommendation -** The intensity in yellow light and beam spreads of lights of Configuration A should be in accordance with the specifications in Appendix 2, Figure A2-24 of ICAO Annex 14.

5.3.23.11. **Recommendation -** Where runway guard lights are intended for use during the day, the intensity in yellow light and beam spreads of lights of Configuration A should be in accordance with the specifications in Appendix 2, Figure A2-25 of ICAO Annex 14.

5.3.23.12. **Recommendation -** Where runway guard lights are specified as components of an advanced surface movement guidance and control system where higher light intensities are required, the intensity in yellow light and beam spreads of lights of Configuration A should be in accordance with the specifications in Appendix 2, Figure A2-25 of ICAO Annex 14.

5.3.23.13. **Recommendation -** The intensity in yellow light and beam spreads of lights of Configuration B should be in accordance with the specifications in Appendix 2, Figure A2-12 of ICAO Annex 14.

5.3.23.14. **Recommendation -** Where runway guard lights are intended for use during the day, the intensity in yellow light and beam spreads of lights of Configuration B should be in accordance with the specifications in Appendix 2, Figure A2-20 of ICAO Annex 14.

5.3.23.15. **Recommendation -** Where runway guard lights are specified as components of an advanced surface movement guidance and control system where higher light intensities are required, the intensity in yellow light and beam spreads of lights of Configuration B should be in accordance with the specifications in Appendix 2, Figure A2-20 of ICAO Annex 14.

5.3.23.16. The lights in each unit of Configuration A shall be illuminated alternately.

5.3.23.17. For Configuration B, adjacent lights shall be alternately illuminated and alternative lights shall be illuminated in unison.

5.3.23.18. The lights shall be illuminated between 30 and 60 cycles per minute and the light suppression and illumination periods shall be equal and opposite in each light.

5.3.24. **Apron floodlighting** (see also 5.3.17.1 and 5.3.18.1)

Application

5.3.24.1. **Recommendation -** Apron floodlighting should be provided on an apron, on a de-icing/anti-icing facility and on a designated isolated aircraft parking position intended to be used at night.

Location

5.3.24.2. **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

5.3.24.3. The spectral distribution of apron floodlights shall be such that the colours used for aircraft marking connected with routine servicing, and for surface and obstacle marking, can be correctly identified.

5.3.24.4. **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.

5.3.25. **Visual docking guidance system**

Application

5.3.25.1. A visual docking guidance system shall be provided when it is intended to indicate, by a visual aid, the precise positioning of an aircraft on an aircraft stand and other alternative means, such as marshoulders, are not practicable.

Characteristics

5.3.25.2. The system shall provide both azimuth and stopping guidance.

5.3.25.3. The azimuth guidance unit and the stopping position indicator shall be adequate for use in all weather, visibility, background lighting and pavement conditions for which the system is intended, both by day and night, but shall not dazzle the pilot.

5.3.25.4. The azimuth guidance unit and the stopping position indicator shall be of a design such that:

(a) a clear indication of malfunction of either or both is available to the pilot; and

(b) they can be turned off.

5.3.25.5. The azimuth guidance unit and the stopping position indicator shall be located in such a way that there is continuity of guidance between the aircraft stand markings, the aircraft stand manoeuvring guidance lights, if present, and the visual docking guidance system.

5.3.25.6. The accuracy of the system shall be adequate for the type of loading bridge and fixed aircraft servicing installations with which it is to be used.

5.3.25.7. **Recommendation -** The system should be usable by all types of aircraft for which the aircraft stand is intended, preferably without selective operation.

5.3.25.8. If selective operation is required to prepare the system for use by a particular type of aircraft, then the system shall provide an identification of the selected aircraft type to both the pilot and the system operator as a means of ensuring that the system has been set properly.

Azimuth guidance unit

Location

5.3.25.9. The azimuth guidance unit shall be located on or close to the extension of the stand centre line ahead of the aircraft so that its signals are visible from the cockpit of an aircraft throughout the docking manoeuvre and aligned for use at least by the pilot occupying the left seat.

5.3.25.10. **Recommendation -** The azimuth guidance unit should be aligned for use by the pilots occupying both the left and right seats.

Characteristics

5.3.25.11. The azimuth guidance unit shall provide unambiguous left/right guidance which enables the pilot to acquire and maintain the lead-in line without over-controlling.

5.3.25.12. When azimuth guidance is indicated by colour change, green shall be used to identify the centre line and red for deviations from the centre line.

Stopping position indicator

Location

5.3.25.13. The stopping position indicator shall be located in conjunction with, or sufficiently close to, the azimuth guidance unit so that a pilot can observe both the azimuth and stop signals without turning the head.

5.3.25.14. The stopping position indicator shall be usable at least by the pilot occupying the left seat.

5.3.25.15. **Recommendation -** The stopping position indicator should be usable by the pilots occupying both the left and right seats.

Characteristics

5.3.25.16. The stopping position information provided by the indicator for a particular aircraft type shall account for the anticipated range of variations in pilot eye height and/or viewing angle.

5.3.25.17. The stopping position indicator shall show the stopping position for the aircraft for which guidance is being provided and shall provide closing rate information to enable the pilot to gradually decelerate the aircraft to a full stop at the intended stopping position.

5.3.25.18. **Recommendation -** The stopping position indicator should provide closing rate information over a distance of at least 10 m.

5.3.25.19. When stopping guidance is indicated by colour change, green shall be used to show that the aircraft can proceed and red to show that the stop point has been reached ,except that for a short distance prior to the stop point a third colour may be used to warn that the stopping point is close.

5.3.26. **Advanced visual docking guidance system**

Application

5.3.26.1. **Recommendation -** An A-VDGS should be provided where it is operationally desirable to confirm the correct aircraft type for which guidance is being provided and/or to indicate the stand centre line in use, where more than one is provided for.

5.3.26.2. The A-VDGS shall be suitable for use by all types of aircraft for which the aircraft stand is intended.

5.3.26.3. The A-VDGS shall be used only in conditions in which its operational performance is specified.

5.3.26.4. The docking guidance information provided by an A-VDGS shall not conflict with that provided by a conventional visual docking guidance system on an aircraft stand if both types are provided and are in operational use. A method of indicating that the A-VDGS is not in operational use or is unserviceable shall be provided.

Location

5.3.26.5. The A-VDGS shall be located such that unobstructed and unambiguous guidance is provided to the person responsible for, and persons assisting, the docking of the aircraft throughout the docking manoeuvre.

Characteristics

5.3.26.6. The A-VDGS shall provide, at minimum, the following guidance information at the appropriate stage of the docking manoeuvre:

(a) an emergency stop indication;

(b) the aircraft type and model for which the guidance is provided;

(c) an indication of the lateral displacement of the aircraft relative to the stand centre line;

(d) the direction of azimuth correction needed to correct a displacement from the stand centre line;

(e) an indication of the distance to the stop position;

(f) an indication when the aircraft has reached the correct stopping position; and

(g) a warning indication if the aircraft goes beyond the appropriate stop position.

5.3.26.7. The A-VDGS shall be capable of providing docking guidance information for all aircraft taxi speeds encountered during the docking manoeuvre.

5.3.26.8. The time taken from the determination of the lateral displacement to its display shall not result in a deviation of the aircraft, when operated in normal conditions, from the stand centre line greater than 1 m.

5.3.26.9. **Recommendation -** The information on displacement of the aircraft relative to the stand centre line and distance to the stopping position, when displayed, should be provided with the accuracy specified in Table 16.

5.3.26.10. Symbols and graphics used to depict guidance information shall be intuitively representative of the type of information provided.

5.3.26.11. Information on the lateral displacement of the aircraft relative to the stand centre line shall be provided at least 25 m prior to the stop position.

5.3.26.12. Continuous closure distance and closure rate shall be provided from at least 15 m prior to the stop position.

5.3.26.13. **Recommendation -** Where provided, closure distance displayed in numerals should be provided in metre integers to the stop position and displayed to 1 decimal place at least 3 m prior to the stop position.

Table 15. A-VDGS recommended displacement accuracy (Table 5-4 ICAO Annex 14)

Guidance information	Maximum deviation at stop position (stop area)	Maximum deviation at 9 m from stop position	Maximum deviation at 15 m from stop position	Maximum deviation at 25 m from stop position
Azimuth	±250 mm	±340 mm	±400 mm	±500 mm
Distance	±500 mm	±1 000 mm	±1 300 mm	Not specified

5.3.26.14. Throughout the docking manoeuvre, an appropriate means shall be provided on the A-VDGS to indicate the need to bring the aircraft to an immediate halt. In such an event, which includes a failure of the A-VDGS, no other information shall be displayed.

5.3.26.15. Provision to initiate an immediate halt to the docking procedure shall be made available to personnel responsible for the operational safety of the stand.

5.3.26.16. **Recommendation -** The word “stop” in red characters should be displayed when an immediate cessation of the docking manoeuvre is required.

5.3.27. Aircraft stand manoeuvring guidance lights

Application

5.3.27.1. **Recommendation -** Aircraft stand manoeuvring guidance lights should be provided to facilitate the positioning of an aircraft on an aircraft stand on a paved apron or on a de-icing/anti-icing facility intended for use in poor visibility conditions, unless adequate guidance is provided by other means.

Location

5.3.27.2. Aircraft stand manoeuvring guidance lights shall be collocated with the aircraft stand markings.

Characteristics

5.3.27.3. Aircraft stand manoeuvring guidance lights, other than those indicating a stop position, shall be fixed yellow lights, visible throughout the segments within which they are intended to provide guidance.

5.3.27.4. **Recommendation -** The lights used to delineate lead-in, turning and lead-out lines should be spaced at intervals of not more than 7.5 m on curves and 15 m on straight sections.

5.3.27.5. The lights indicating a stop position shall be fixed unidirectional lights showing red.

5.3.27.6. **Recommendation -** The intensity of the lights should be adequate for the condition of visibility and ambient light in which the use of the aircraft stand is intended.

5.3.27.7. **Recommendation -** The lighting circuit should be designed so that the lights may be switched on to indicate that an aircraft stand is to be used and switched off to indicate that it is not to be used.

5.3.28. Road-holding position light

Application

5.3.28.1. A road-holding position light shall be provided at each road-holding position serving a runway when it is intended that the runway will be used in runway visual range conditions less than a value of 350 m.

5.3.28.2. **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

5.3.28.3. A road-holding position light shall be located adjacent to the holding position marking 1.5 m (±0.5 m) from one edge of the road, i.e. left or right as appropriate to the local traffic requirements.

Characteristics

5.3.28.4. The road-holding position light shall comprise:

(a) a controllable red (stop)/green (go) traffic light; or

(b) a flashing-red light.

5.3.28.5. The road-holding position light beam shall be unidirectional and aligned so as to be visible to the driver of a vehicle approaching the holding position.

5.3.28.6. 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.

5.3.28.7. The flash frequency of the flashing-red light shall be between 30 and 60 flashes per minute.

5.3.29. No-entry bar

Application

5.3.29.1. **Recommendation -** A no-entry bar should be provided across a taxiway which is intended to be used as an exit only taxiway to assist in preventing inadvertent access of traffic to that taxiway.

Location

5.3.29.2. **Recommendation -** A no-entry bar should be located across the taxiway at the end of an exit only taxiway where it is desired to prevent traffic from entering the taxiway in the wrong direction.

Characteristics

5.3.29.3. **Recommendation -** A no-entry bar should consist of unidirectional lights spaced at uniform intervals of no more than 3 m showing red in the intended direction(s) of approach to the runway.

5.3.29.4. **Recommendation -** A pair of elevated lights should be added to each end of the no-entry bar where the in- pavement no entry bar lights might be obscured from a pilot's view, for example, by snow or rain, or where a pilot may be required to stop the aircraft in a position so close to the lights that they are blocked from view by the structure of the aircraft.

5.3.29.5. The intensity in red light and beam spreads of no-entry bar lights shall be in accordance with the specifications in Appendix 2, Figures A2-12 through A2-16 of ICAO Annex 14, as appropriate.

5.3.29.6. **Recommendation -** Where no-entry bars are specified as components of an advanced surface movement guidance and control system and where, from an operational point of view, higher intensities are required to maintain ground movements at a certain speed in very low visibilities or in bright daytime conditions, the intensity in red light and beam spreads of no-entry bar lights should be in accordance with the specifications of Appendix 2, Figure A2-17, A2-18 or A2-19 of ICAO Annex 14.

5.3.29.7. **Recommendation -** Where a wide beam fixture is required, the intensity in red light and beam spreads of no-entry bar lights should be in accordance with the specifications of Appendix 2, Figure A2-17 or A2-19 of ICAO Annex 14.

5.3.29.8. The lighting circuit shall be designed so that:

(a) no-entry bars are switchable selectively or in groups;

(b) when a no-entry bar is illuminated, any taxiway centre line lights installed beyond the no-entry bar, when viewed towards the runway, shall be extinguished for a distance of at least 90 m; and

(c) when a no-entry bar is illuminated, any stop bar installed between the no-entry bar and the runway shall be extinguished.

5.4. Signs

General Application

5.4.1.1. Signs shall be provided to convey a mandatory instruction, information on a specific location or destination on a movement area or to provide other information to meet the requirements of 9.8.1.

5.4.1.2. **Recommendation -** A variable message sign should be provided where:

(a) the instruction or information displayed on the sign is relevant only during a certain period of time; and/or

(b) there is a need for variable predetermined information to be displayed on the sign to meet the requirements of 9.8.1.

Characteristics

5.4.1.3. 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 16.

5.4.1.4. Signs shall be rectangular, as shown in Figures 36 and 37 with the longer side horizontal.

5.4.1.5. The only signs on the movement area utilizing red shall be mandatory instruction signs.

5.4.1.6. The inscriptions on a sign shall be in accordance with the provisions of Appendix 4 of ICAO Annex 14.

Table 16. Location distances for taxiing guidance signs including runway exit signs (Table 5-5 ICAO Annex 14)

Sign height (mm)				Perpendicular distance from defined taxiway pavement edge to near side of sign	Perpendicular distance from defined runway pavement edge to near side of sign
Code number	Legend	Face (min.)	Installed (max.)		
1 or 2	200	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

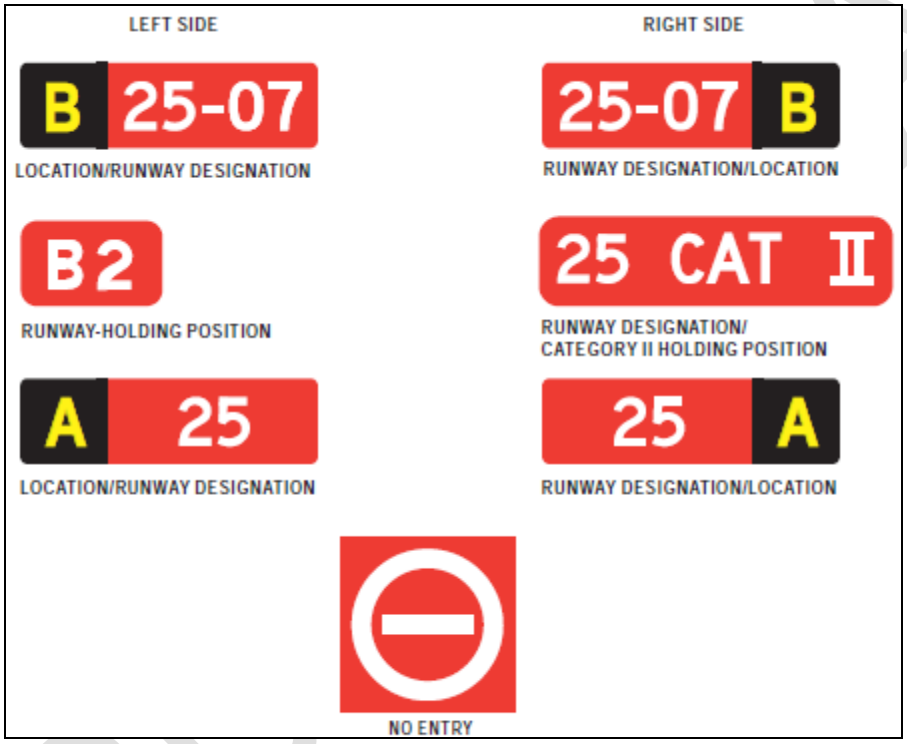


Figure 36. Mandatory instruction signs (Figure 5-30 ICAO Annex 14)

5.4.1.7. Signs shall be illuminated in accordance with the provisions of Appendix 4 when intended for use:

(a) in runway visual range conditions less than a value of 800 m; or

(b) at night in association with instrument runways; or

(c) at night in association with non-instrument runways where the code number is 3 or 4.

5.4.1.8. Signs shall be retroreflective and/or illuminated in accordance with the provisions of Appendix 4 of ICAO Annex 14 when intended for use at night in association with non-instrument runways where the code number is 1 or 2.

5.4.1.9. A variable message sign shall show a blank face when not in use.

5.4.1.10. In case of failure, a variable message sign shall not provide information that could lead to unsafe action from a pilot or a vehicle driver.

5.4.1.11. **Recommendation -** The time interval to change from one message to another on a variable message sign should be as short as practicable and shall not exceed 5 seconds.

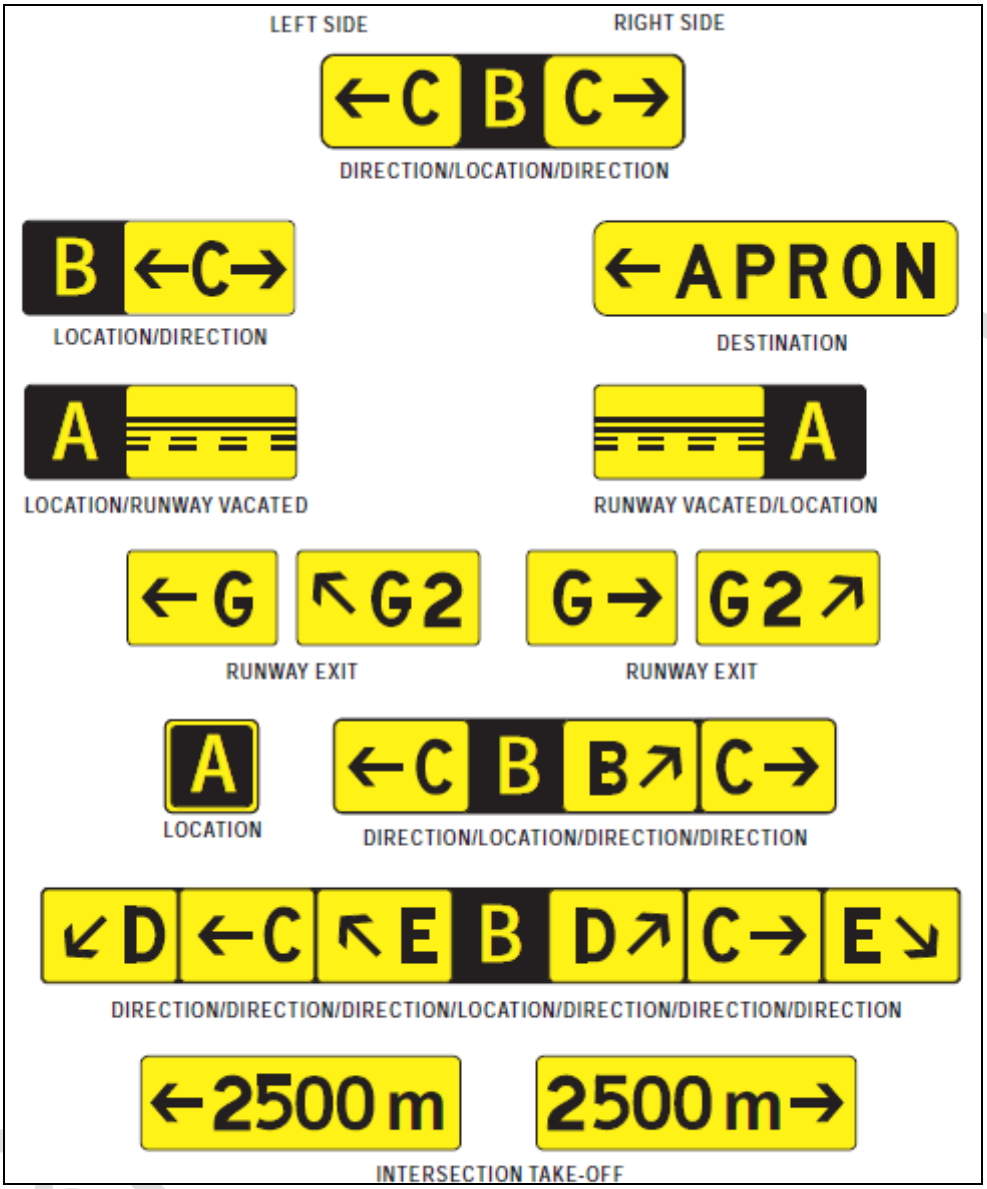


Figure 37. Information signs (Figure 5-31 ICAO Annex 14)

5.4.2. Mandatory instruction signs

Application

5.4.2.1. A mandatory instruction sign shall be provided to identify a location beyond which an aircraft taxiing or vehicle shall not proceed unless authorized by the aerodrome control tower.

5.4.2.2. Mandatory instruction signs shall include runway designation signs, category I, II or III holding position signs, runway-holding position signs, road-holding position signs and NO ENTRY signs.

5.4.2.3. A pattern “A” runway-holding position marking shall be supplemented at a taxiway/runway intersection or a runway/runway intersection with a runway designation sign.

5.4.2.4. A pattern “B” runway-holding position marking shall be supplemented with a category I, II or III holding position sign.

5.4.2.5. A pattern “A” runway-holding position marking at a runway-holding position established in accordance with 3.12.3 shall be supplemented with a runway-holding position sign.

5.4.2.6. **Recommendation -** A runway designation sign at a taxiway/runway intersection should be supplemented with a location sign in the outboard (farthest from the taxiway) position, as appropriate.

5.4.2.7. A NO ENTRY sign shall be provided when entry into an area is prohibited.

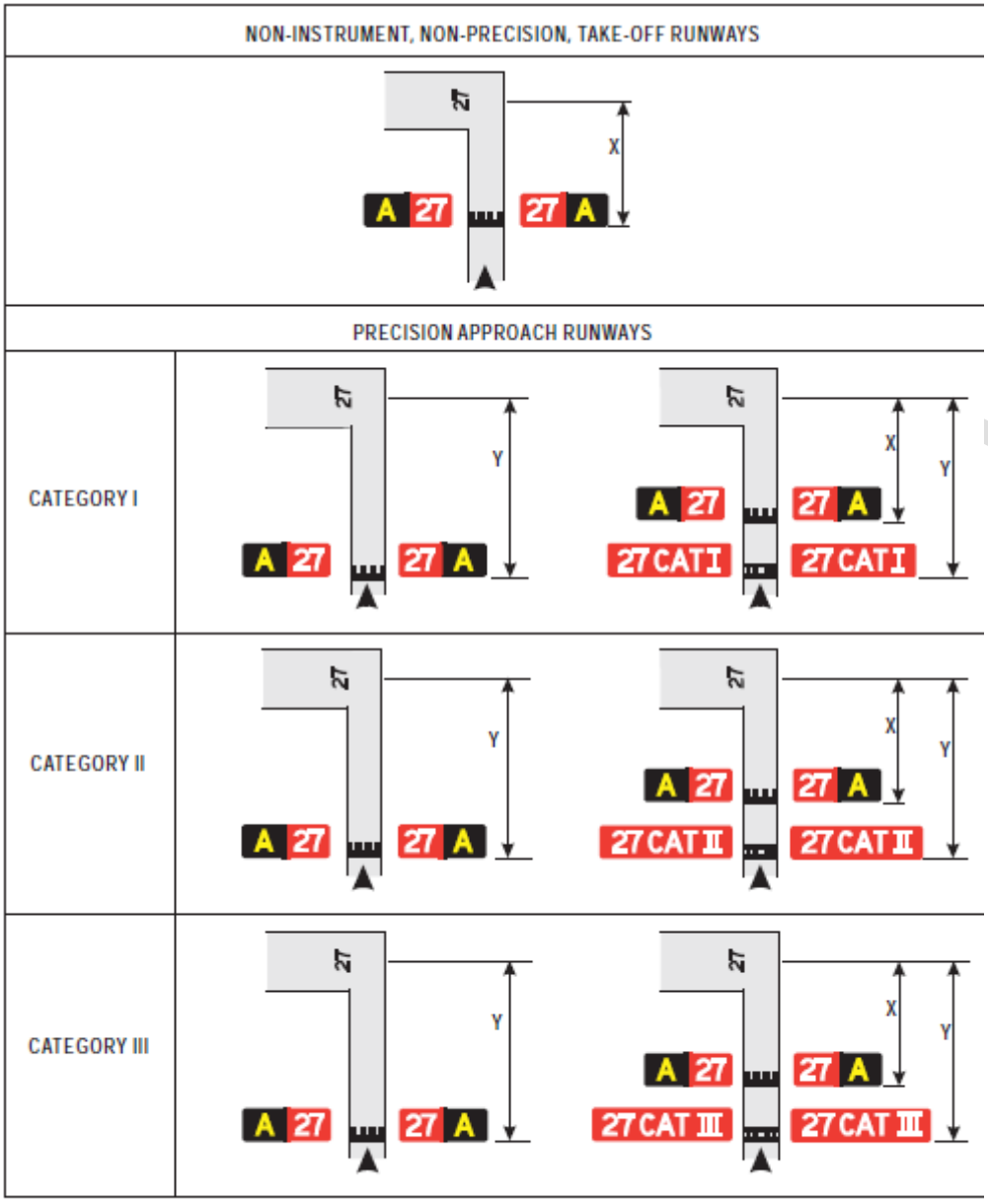
Location

5.4.2.8. A runway designation sign at a taxiway/runway intersection or a runway/runway intersection shall be located on each side of the runway-holding position marking facing the direction of approach to the runway.

5.4.2.9. A category I, II or III holding position sign shall be located on each side of the runway-holding position marking facing the direction of the approach to the critical area.

5.4.2.10. A NO ENTRY sign shall be located at the beginning of the area to which entrance is prohibited on each side of the taxiway as viewed by the pilot.

5.4.2.11. A runway-holding position sign shall be located on each side of the runway-holding position established in accordance with 3.12.3, facing the approach to the obstacle limitation surface or ILS/MLS critical/sensitive area, as appropriate.



Note.— Distance X is established in accordance with Table 3-2. Distance Y is established at the edge of the ILS/MLS critical/sensitive area.

Figure 38. Examples of sign position at taxiway/runway intersections (Figure 5-12 ICAO Annex 14)

Characteristics

5.4.2.12. A mandatory instruction sign shall consist of an inscription in white on a red background.

5.4.2.13. **Recommendation -** Where, owing to environmental or other factors, the conspicuity of the inscription on a mandatory instruction sign needs to be enhanced, the outside edge of the white inscription should be supplemented by a black outline measuring 10 mm in width for runway code numbers 1 and 2, and 20 mm in width for runway code numbers 3 and 4.

5.4.2.14. The inscription on a runway designation sign shall consist of the runway designations of the intersecting runway properly oriented with respect to the viewing position of the sign, except that a runway designation sign installed in

the vicinity of a runway extremity may show the runway designation of the concerned runway extremity only.

5.4.2.15. The inscription on a category I, II, III or joint II/III holding position sign shall consist of the runway designator followed by CAT I, CAT II, CAT III or CAT II/III, as appropriate.

5.4.2.16. The inscription on a NO ENTRY sign shall be in accordance with Figure 5-30 of ICAO Annex 14.

5.4.2.17. The inscription on a runway-holding position sign at a runway-holding position established in accordance with 3.12.3 shall consist of the taxiway designation and a number.

5.4.2.18. Where appropriate, the following inscriptions/symbol shall be used:

Inscription/symbol	Use
Runway designation of a runway extremity	To indicate a runway-holding position at a runway extremity
OR	
Runway designation of both extremities of a runway	To indicate a runway-holding position located at other taxiway/runway intersections or runway/runway intersections
25 CAT I (Example)	To indicate a category I runway-holding position at the threshold of runway 25
25 CAT II (Example)	To indicate a category II runway-holding position at the threshold of runway 25
25 CAT III (Example)	To indicate a category III runway-holding position at the threshold of runway 25
25 CAT II/III (Example)	To indicate a joint category II/III runway-holding position at the threshold of runway 25
NO ENTRY symbol	To indicate that entry to an area is prohibited
B2 (Example)	To indicate a runway-holding position established in accordance with 3.12.3

5.4.3. Information signs

Application

5.4.3.1. An information sign shall be provided where there is an operational need to identify by a sign, a specific location, or routing (direction or destination) information.

5.4.3.2. Information signs shall include: direction signs, location signs, destination signs, runway exit signs, runway vacated signs and intersection take-off signs.

5.4.3.3. A runway exit sign shall be provided where there is an operational need to identify a runway exit.

5.4.3.4. A runway vacated sign shall be provided where the exit taxiway is not provided with taxiway centre line lights and there is a need to indicate to a pilot leaving a

runway the perimeter of the ILS/MLS critical/sensitive area or the lower edge of the inner transitional surface, whichever is farther from the runway centre line.

5.4.3.5. **Recommendation -** An intersection take-off sign should be provided when there is an operational need to indicate the remaining take-off run available (TORA) for intersection take-offs.

5.4.3.6. **Recommendation -** Where necessary, a destination sign should be provided to indicate the direction to a specific destination on the aerodrome, such as cargo area, general aviation, etc.

5.4.3.7. A combined location and direction sign shall be provided when it is intended to indicate routing information prior to a taxiway intersection.

5.4.3.8. A direction sign shall be provided when there is an operational need to identify the designation and direction of taxiways at an intersection.

5.4.3.9. **Recommendation -** A location sign should be provided at an intermediate holding position.

5.4.3.10. A location sign shall be provided in conjunction with a runway designation sign except at a runway/runway intersection.

5.4.3.11. A location sign shall be provided in conjunction with a direction sign, except that it may be omitted where an aeronautical study indicates that it is not needed.

5.4.3.12. **Recommendation -** Where necessary, a location sign should be provided to identify taxiways exiting an apron or taxiways beyond an intersection.

5.4.3.13. **Recommendation -** Where a taxiway ends at an intersection such as a ‘‘T’’ and it is necessary to identify this, a barricade, direction sign and/or other appropriate visual aid should be used.

Location

5.4.3.14. Except as specified in 5.4.3.16 and 5.4.3.24 information signs shall, wherever practicable, be located on the left-hand side of the taxiway in accordance with Table 16.

5.4.3.15. 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.

5.4.3.16. A runway exit sign shall be located on the same side of the runway as the exit is located (i.e. left or right) and positioned in accordance with Table 16.

5.4.3.17. 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.

5.4.3.18. A runway vacated sign shall be located at least on one side of the taxiway. The distance between the sign and the centre line of a runway shall be not less than the greater of the following:

(a) the distance between the centre line of the runway and the perimeter of the ILS/MLS critical/sensitive area; or

(b) the distance between the centre line of the runway and the lower edge of the inner transitional surface.

5.4.3.19. Where provided in conjunction with a runway vacated sign, the taxiway location sign shall be positioned outboard of the runway vacated sign.

5.4.3.20. An intersection take-off sign shall be located at the left-hand side of the entry taxiway. The distance between the sign and the centre line of the runway shall be not less than 60 m where the code number is 3 or 4, and not less than 45 m where the code number is 1 or 2.

5.4.3.21. A taxiway location sign installed in conjunction with a runway designation sign shall be positioned outboard of the runway designation sign.

5.4.3.22. **Recommendation -** A destination sign should not normally be collocated with a location or direction sign.

5.4.3.23. An information sign other than a location sign shall not be collocated with a mandatory instruction sign.

5.4.3.24. **Recommendation -** A direction sign, barricade and/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

5.4.3.25. An information sign other than a location sign shall consist of an inscription in black on a yellow background.

5.4.3.26. A location sign shall consist of an inscription in yellow on a black background and where it is a stand-alone sign shall have a yellow border.

5.4.3.27. The inscription on a runway exit sign shall consist of the designator of the exit taxiway and an arrow indicating the direction to follow.

5.4.3.28. The inscription on a runway vacated sign shall depict the pattern A runway-holding position marking as shown in Figure 5-31 of ICAO Annex 14..

5.4.3.29. The inscription on an intersection take-off sign shall consist of a numerical message indicating the remaining take-off run available in metres plus an arrow, appropriately located and oriented, indicating the direction of the take-off as shown in Figure 5-31 of ICAO Annex 14.

5.4.3.30. The inscription on a destination sign shall comprise an alpha, alphanumerical or numerical message identifying the destination plus an arrow indicating the direction to proceed as shown in Figure 5-31 of ICAO Annex 14.

5.4.3.31. The inscription on a direction sign shall comprise an alpha or alphanumerical message identifying the taxiway(s) plus an arrow or arrows appropriately oriented as shown in Figure 5-31 of ICAO Annex 14.

5.4.3.32. The inscription on a location sign shall comprise the designation of the location taxiway, runway or other pavement the aircraft is on or is entering and shall not contain arrows.

5.4.3.33. **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.

5.4.3.34. Where a location sign and direction signs are used in combination:

(a) all direction signs related to left turns shall be placed on the left side of the location sign, and all direction signs related to right turns shall be placed on the right side of the location sign, except that where the junction

consists of one intersecting taxiway, the location sign may alternatively be placed on the left-hand side;

(b) the direction signs shall be placed such that the direction of the arrows departs increasingly from the vertical with increasing deviation of the corresponding taxiway;

(c) an appropriate direction sign shall be placed next to the location sign where the direction of the location taxiway changes significantly beyond the intersection; and

(d) adjacent direction signs shall be delineated by a vertical black line as shown in Figure 5-31 of ICAO Annex 14.

5.4.3.35. A taxiway shall be identified by a designator comprising a letter, letters or a combination of a letter or letters followed by a number.

5.4.3.36. **Recommendation -** When designating taxiways, the use of the letters I, O or X and the use of words such as inner and outer should be avoided wherever possible to avoid confusion with the numerals 1, 0 and closed marking.

5.4.3.37. The use of numbers alone on the manoeuvring area shall be reserved for the designation of runways.

5.4.4. VOR aerodrome checkpoint sign

Application

5.4.4.1. When a VOR aerodrome checkpoint is established, it shall be indicated by a VOR aerodrome checkpoint marking and sign.

Location

5.4.4.2. A VOR aerodrome checkpoint sign shall be located as near as possible to the checkpoint and so that the inscriptions are visible from the cockpit of an aircraft properly positioned on the VOR aerodrome checkpoint marking.

Characteristics

5.4.4.3. A VOR aerodrome checkpoint sign shall consist of an inscription in black on a yellow background.

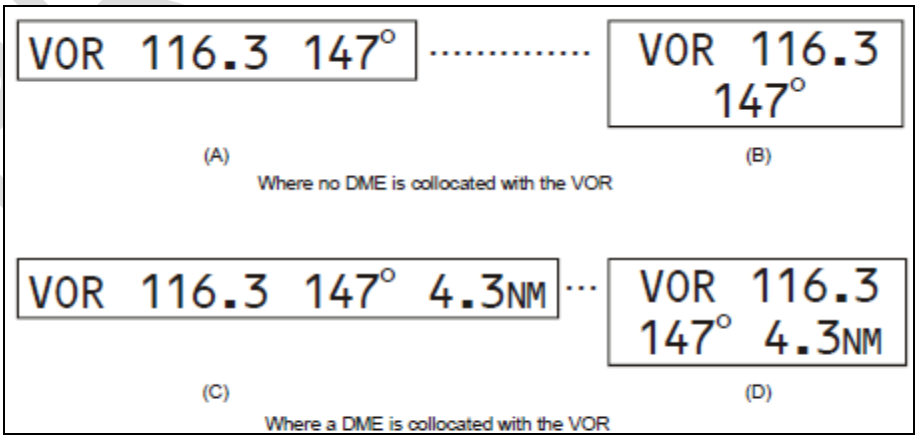


Figure 39. VOR aerodrome checkpoint sign (Figure 5-33 ICAO Annex 14)

5.4.4.4. **Recommendation -** The inscriptions on a VOR checkpoint sign should be in accordance with one of the alternatives shown in Figure 39 in which:

VOR	is an abbreviation identifying this as a VOR checkpoint;
116.3	is an example of the radio frequency of the VOR concerned;
147°	is an example of the VOR bearing, to the nearest degree, which shall be indicated at the VOR checkpoint; and
4.3 NM	is an example of the distance in nautical miles to a DME collocated with the VOR concerned.

5.4.5. Aerodrome identification sign

Application

5.4.5.1. **Recommendation -** An aerodrome identification sign should be provided at an aerodrome where there is insufficient alternative means of visual identification.

Location

5.4.5.2. **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

5.4.5.3. The aerodrome identification sign shall consist of the name of the aerodrome.

5.4.5.4. **Recommendation -** The colour selected for the sign should give adequate conspicuity when viewed against its background.

5.4.5.5. **Recommendation -** The characters should have a height of not less than 3 m.

5.4.6. Aircraft stand identification signs

Application

5.4.6.1. **Recommendation -** An aircraft stand identification marking should be supplemented with an aircraft stand identification sign where feasible.

Location

5.4.6.2. **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

5.4.6.3. **Recommendation -** An aircraft stand identification sign should consist of an inscription in black on a yellow background.

5.4.7. Road-holding position sign

5.4.7.1. A road-holding position sign shall be provided at all road entrances to a runway.

Location

5.4.7.2. The road-holding position sign shall be located 1.5 m from one edge of the road (left or right as appropriate to the local traffic requirements) at the holding position.

Characteristics

5.4.7.3. A road-holding position sign shall consist of an inscription in white on a red background.

5.4.7.4. The inscription on a road-holding position sign shall be in the national language, be in conformity with the local traffic requirements and include the following:

(a) a requirement to stop; and

(b) where appropriate:

(1) a requirement to obtain ATC clearance; and

(2) location designator.

5.4.7.5. A road-holding position sign intended for night use shall be retroreflective or illuminated.

5.5. Markers

5.5.1. General

Markers shall be frangible. Those located near a runway or taxiway shall be sufficiently low to preserve clearance for propellers and for the engine pods of jet aircraft.

5.5.2. Unpaved runway edge markers

Application

5.5.2.1. **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

5.5.2.2. **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 shall be placed so as to delimit the runway clearly.

Characteristics

5.5.2.3. **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.

5.5.3. Stopway edge markers

Application

5.5.3.1. **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

5.5.3.2. 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.

5.5.4. Edge markers for snow-covered runways

Application

5.5.4.1. **Recommendation -** Edge markers for snow-covered runways should be used to indicate the usable limits of a snow-covered runway when the limits are not otherwise indicated.

Location

5.5.4.2. Edge markers for snow-covered runways should be placed along the sides of the runway at intervals of not more than 100 m, and should be located symmetrically about the runway centre line at such a distance from the centre line that there is adequate clearance for wing tips and powerplants. Sufficient markers should be placed across the threshold and end of the runway.

Characteristics

5.5.4.3. Edge markers for snow-covered runways should consist of conspicuous objects such as evergreen trees about 1.5 m high, or light-weight markers.

5.5.5. Taxiway edge markers

Application

5.5.5.1. **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

5.5.5.2. **Recommendation -** Taxiway edge markers should be installed at least at the same locations as would the taxiway edge lights had they been used.

Characteristics

5.5.5.3. A taxiway edge marker shall be retroreflective blue.

5.5.5.4. **Recommendation -** The marked surface as viewed by the pilot should be a rectangle and shall have a minimum viewing area of 150 cm^2.

5.5.5.5. Taxiway edge markers shall be frangible. Their height shall be sufficiently low to preserve clearance for propellers and for the engine pods of jet aircraft.

5.5.6. Taxiway centre line markers

Application

5.5.6.1. **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.

5.5.6.2. **Recommendation -** Taxiway centre line markers should be provided on a taxiway where the code number is 3 or 4 and taxiway centre line lights are not provided if there is a need to improve the guidance provided by the taxiway centre line marking.

Location

5.5.6.3. **Recommendation -** Taxiway centre line markers should be installed at least at the same location as would taxiway centre line lights had they been used.

5.5.6.4. **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

5.5.6.5. A taxiway centre line marker shall be retroreflective green.

5.5.6.6. **Recommendation -** The marked surface as viewed by the pilot should be a rectangle and should have a minimum viewing area of 20 cm^2.

5.5.6.7. Taxiway centre line markers shall be so designed and fitted as to withstand being run over by the wheels of an aircraft without damage either to the aircraft or to the markers themselves.

5.5.7. Unpaved taxiway edge markers

Application

5.5.7.1. **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

5.5.7.2. **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.

5.5.8. Boundary markers

Application

5.5.8.1. Boundary markers shall be provided at an aerodrome where the landing area has no runway.

Location

5.5.8.2. Boundary markers shall be spaced along the boundary of the landing area at intervals of not more than 200 m, if the type shown in Figure 40 is used, or approximately 90 m, if the conical type is used with a marker at any corner.

Characteristics

5.5.8.3. **Recommendation -** Boundary markers should be of a form similar to that shown in Figure 37, or in the form of a cone not less than 50 cm high and not less than 75 cm in diameter at the base. The markers should be coloured to contrast with the background against which they will be seen. A single colour, orange or red, or two contrasting colours, orange and white or alternatively red and white, should be used, except where such colours merge with the background.

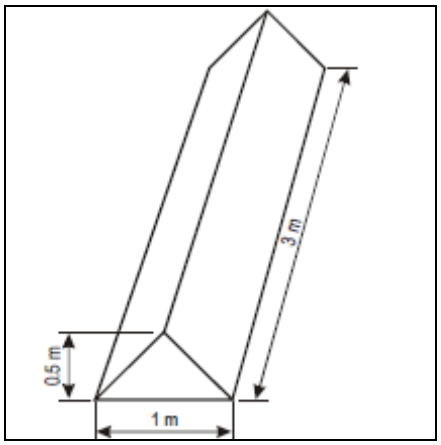


Figure 40. Boundary Markers (Figure 5-34 ICAO Annex 14)

Chapter 6. Visual Aids For Denoting Obstacles

6.1. Objects to be marked and/or lighted

6.1.1. Objects within the lateral boundaries of the obstacle limitation surfaces

6.1.1.1. Vehicles and other mobile objects, excluding aircraft, on the movement area of an aerodrome are obstacles and shall be marked and, if the vehicles and aerodrome are used at night or in conditions of low visibility, lighted, except that aircraft servicing equipment and vehicles used only on aprons may be exempt.

6.1.1.2. Elevated aeronautical ground lights within the movement area shall be marked so as to be conspicuous by day. Obstacle lights shall not be installed on elevated ground lights or signs in the movement area.

6.1.1.3. All obstacles within the distance specified in Table 7, column 11 or 12, from the centre line of a taxiway, an apron taxiway or aircraft stand taxilane shall be marked and, if the taxiway, apron taxiway or aircraft stand taxilane is used at night, lighted.

6.1.1.4. **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 obstacle is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m;

(c) the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day; and

(d) the lighting may be omitted where the obstacle is a lighthouse and an aeronautical study indicates the lighthouse light to be sufficient.

6.1.1.5. **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 object is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m; or

(b) the object is lighted by high-intensity obstacle lights by day.

6.1.1.6. A fixed obstacle that extends above an approach surface within 3 000 m of the inner edge or above a transitional surface shall be marked and, if the runway is used at night, lighted, except that:

(a) such marking and lighting may be omitted when the obstacle is shielded by another fixed obstacle;

(b) the marking may be omitted when the obstacle is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m;

(c) the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day; and

(d) the lighting may be omitted where the obstacle is a lighthouse and an aeronautical study indicates the lighthouse light to be sufficient.

6.1.1.7. **Recommendation -** A fixed obstacle that extends above a horizontal surface should be marked and, if the aerodrome is used at night, lighted, except that:

(a) such marking and lighting may be omitted when:

(1) the obstacle is shielded by another fixed obstacle; or

(2) for a circuit extensively obstructed by immovable objects or terrain, procedures have been established to ensure safe vertical clearance below prescribed flight paths; or

(3) an aeronautical study shows the obstacle not to be of operational significance;

(b) the marking may be omitted when the obstacle is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m;

(c) the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day; and

(d) the lighting may be omitted where the obstacle is a lighthouse and an aeronautical study indicates the lighthouse light to be sufficient.

6.1.1.8. A fixed object that extends above an obstacle protection surface shall be marked and, if the runway is used at night, lighted.

6.1.1.9. **Recommendation -** Other objects inside the obstacle limitation surfaces should be marked and/or lighted if an aeronautical study indicates that the object could constitute a hazard to aircraft (this includes objects adjacent to visual routes e.g. waterway or highway).

6.1.1.10. **Recommendation -** Overhead wires, cables, etc., crossing a river, waterway, 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.

6.1.2. Objects outside the lateral boundaries of the obstacle limitation surfaces

6.1.2.1. **Recommendation -** Obstacles in accordance with 4.3.2 should be marked and lighted, except that the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day.

6.1.2.2. **Recommendation -** Other objects outside the obstacle limitation surfaces should be marked and/or lighted if an aeronautical study indicates that the object could constitute a hazard to aircraft (this includes objects adjacent to visual routes e.g. waterway, highway).

6.1.2.3. **Recommendation -** Overhead wires, cables, etc., crossing a river, waterway, 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.

6.2. Marking and/or lighting of objects

6.2.1. General

6.2.1.1. The presence of objects which must be lighted, as specified in 6.1, shall be indicated by low-, medium- or high- intensity obstacle lights, or a combination of such lights.

6.2.1.2. Low-intensity obstacle lights, Types A B, C and D, medium-intensity obstacle lights, Types A, B and C, high- intensity obstacle lights Type A and B, shall be in accordance with the specifications in Table 17 and Appendix 1 of ICAO Annex 14.

6.2.1.3. The number and arrangement of low-, medium- or high-intensity obstacle lights at each level to be marked shall be such that the object is indicated from every angle in azimuth. Where a light is shielded in any direction by another part of the object, or by an adjacent object, additional lights shall be provided on that adjacent object or the part of the object that is shielding the light, in such a way as to retain the general definition of the object to be lighted. If the shielded light does not contribute to the definition of the object to be lighted, it may be omitted.

6.2.2. Mobile objects

Marking

6.2.2.1. All mobile objects to be marked shall be coloured or display flags.

Marking by colour

6.2.2.2. **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.

Marking by flags

6.2.2.3. Flags used to mark mobile objects shall be displayed around, on top of, or around the highest edge of the object. Flags shall not increase the hazard presented by the object they mark.

6.2.2.4. Flags used to mark mobile objects shall not be less than 0.9 m on each side and shall consist of a chequered pattern, each square having sides of not less than 0.3 m. The colours of the pattern shall contrast each with the other and with the background against which they will be seen. Orange and white or alternatively red and white shall be used, except where such colours merge with the background.

Table 17. Characteristics of obstacle lights (Table 6.1 ICAO Annex 14)

1	2	3	4	5	6	7
Light Type	Colour	Signal type/ (flash rate)	Peak intensity (cd) at given Background Luminance (b)			Light Distribution Table
			Day (Above 500 cd/m^2)	Twilight (50-500 cd/m^2)	Night (Below 50 cd/m^2)	
Low-intensity, Type A (fixed obstacle)	Red	Fixed	N/A	N/A	10	Table 6-2
Low-intensity, Type B (fixed obstacle)	Red	Fixed	N/A	N/A	32	Table 6-2
Low-intensity, Type C (mobile obstacle)	Yellow/Blue (a)	Flashing (60-90 fpm)	N/A	40	40	Table 6-2
Low-intensity, Type D (follow-me vehicle)	Yellow	Flashing (60–90 fpm)	N/A	200	200	Table 6-2
Medium-intensity, Type A	White	Flashing (20–60 fpm)	20 000	20 000	2 000	Table 6-3
Medium-intensity, Type B	Red	Flashing (20–60 fpm)	N/A	N/A	2 000	Table 6-3
Medium-intensity, Type C	Red	Fixed	N/A	N/A	2 000	Table 6-3
High-intensity, Type A	White	Flashing (40–60 fpm)	200 000	20 000	2 000	Table 6-3
High-intensity, Type B	White	Flashing (40–60 fpm)	100 000	20 000	2 000	Table 6-3

a) See 6.2.2.6

b) For flashing lights, effective intensity as determined in accordance with the *Aerodrome Design Manual* (Doc 9157), Part 4.

Table 18. Light distribution for low-intensity obstacle lights (Table 6.2 ICAO Annex 14)

	Minimum intensity (a)	Maximum intensity (a)	Vertical beam spread (f)	
			Minimum beam spread	Intensity
Type A	10 cd (b)	N/A	10°	5 cd
Type B	32 cd (b)	N/A	10°	16 cd
Type C	40 cd (b)	400 cd	12° (d)	20 cd
Type D	200 cd (c)	400 cd	N/A (e)	N/A

Note. This table does not include recommended horizontal beam spreads. 6.2.1.3 requires 360° coverage around an obstacle.

Therefore, the number of lights needed to meet this requirement will depend on the horizontal beam spreads of each light as well as the shape of the obstacle. Thus, with narrower beam spreads, more lights will be required.

(a) 360° horizontal. For flashing lights, the intensity is read into effective intensity, as determined in accordance with the Aerodrome Design Manual (Doc 9157), Part 4.

(b) Between 2 and 10° vertical. Elevation vertical angles are referenced to the horizontal when the light is levelled.

(c) Between 2 and 20° vertical. Elevation vertical angles are referenced to the horizontal when the light is levelled.

(d) Peak intensity shall be located at approximately 2.5° vertical.

(e) Peak intensity shall be located at approximately 17° vertical.

(f) Beam spread is defined as the angle between the horizontal plane and the directions for which the intensity exceeds that mentioned in the “intensity” column.

Table 19. Light distribution for medium- and high-intensity obstacle lights according to benchmark intensities of Table 17 (Table 6-3 ICAO Annex 14)

Benchmark intensity	Minimum requirements					Recommendations				
	Vertical elevation angle (b)			Vertical beam spread (c)		Vertical elevation angle (b)			Vertical beam spread (c)	
	0°		-1°			0°	-1°	-10°		
	Minimum average intensity (a)	Minimum intensity (a)	Minimum intensity (a)	Minimum beam spread	Intensity (a)	Maximum intensity (a)	Maximum intensity (a)	Maximum intensity (a)	Maximum beam spread	Intensity (a)
200 000	200 000	150 000	75 000	3°	75 000	250 000	112 500	7 500	7°	75 000
100 000	100 000	75 000	37 500	3°	37 500	125 000	56 250	3 750	7°	37 500
20 000	20 000	15 000	7 500	3°	7 500	25 000	11 250	750	N/A	N/A
2 000	2 000	1 500	750	3°	750	2 500	1 125	75	N/A	N/A

Note.— This table does not include recommended horizontal beam spreads. 6.2.1.3 requires 360° coverage around an obstacle.

Therefore, the number of lights needed to meet this requirement will depend on the horizontal beam spreads of each light as well as the shape of the obstacle. Thus, with narrower beam spreads, more lights will be required.

(a) 360° horizontal. All intensities are expressed in Candela. For flashing lights, the intensity is read into effective intensity, as determined in accordance with the Aerodrome Design Manual (Doc 9157), Part 4.

(b) Elevation vertical angles are referenced to the horizontal when the light unit is levelled.

(c) Beam spread is defined as the angle between the horizontal plane and the directions for which the intensity exceeds that mentioned in the “intensity” column.

Note.— An extended beam spread may be necessary under specific configuration and justified by an aeronautical study.

Lighting

6.2.2.5. Low-intensity obstacle lights, Type C, shall be displayed on vehicles and other mobile objects excluding aircraft.

6.2.2.6. Low-intensity obstacle lights, Type C, displayed on vehicles associated with emergency or security shall be flashing-blue and those displayed on other vehicles shall be flashing-yellow.

6.2.2.7. Low-intensity obstacle lights, Type D, shall be displayed on follow-me vehicles.

6.2.2.8. Low-intensity obstacle lights on objects with limited mobility such as aerobridges shall be fixed-red, and as a minimum be in accordance with the specifications for low-intensity obstacle lights, Type A, in Table 17. The intensity of the lights shall be sufficient to ensure conspicuity considering the intensity of the adjacent lights and the general levels of illumination against which they would normally be viewed.

6.2.3. Fixed objects

Note.— The fixed objects of wind turbines are addressed separately in 6.2.4 and the fixed objects of overhead wires, cables, etc., and supporting towers are addressed separately in 6.2.5.

Marking

6.2.3.1. All fixed objects to be marked shall, whenever practicable, be coloured, but if this is not practicable, markers or flags shall be displayed on or above them, except that objects that are sufficiently conspicuous by their shape, size or colour need not be otherwise marked.

Marking by colour

6.2.3.2. **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 41).

6.2.3.3. **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 41 and 42.)

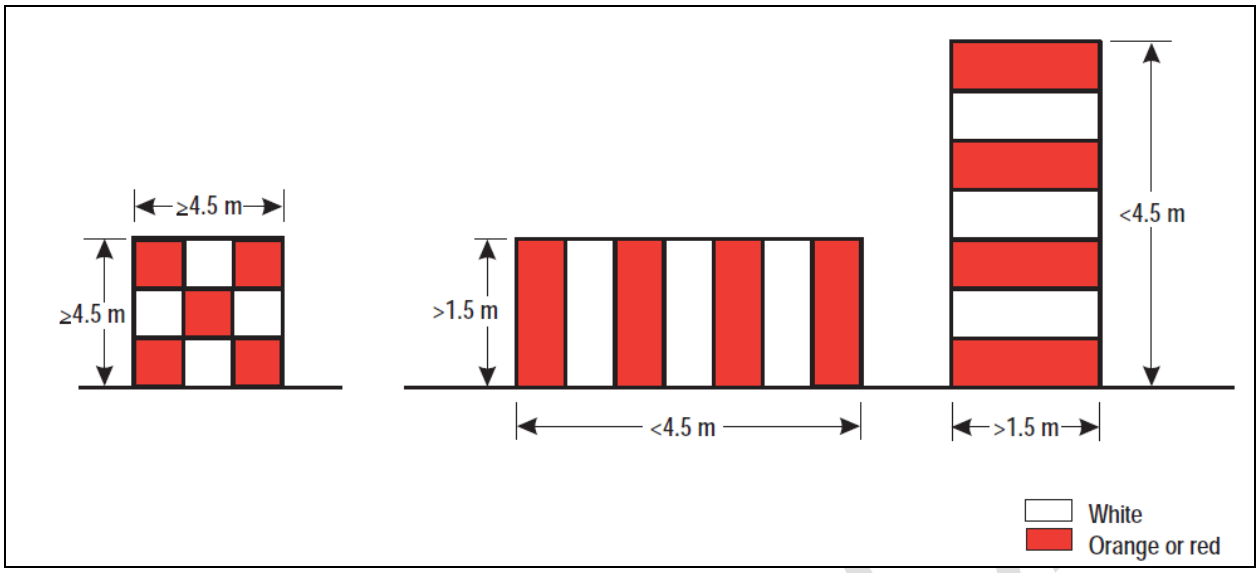


Figure 41. Basic marking patterns (Figure 6-1 ICAO Annex 14)

Table 20. Marking band widths (Table 6-4 ICAO Annex 14)

Longest dimension		
Greater than	Not exceeding	Band width
1.5 m	210 m	1/7 of longest dimension
210 m	270 m	1/9 '' '' ''
270 m	330 m	1/11 '' '' ''
330 m	390 m	1/13 '' '' ''
390 m	450 m	1/15 '' '' ''
450 m	510 m	1/17 '' '' ''
510 m	570 m	1/19 '' '' ''
570 m	630 m	1/21 '' '' ''

6.2.3.4. **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.

Marking by flags

6.2.3.5. Flags used to mark fixed objects shall be displayed around, on top of, or around the highest edge of, the object. When flags are used to mark extensive objects or groups of closely spaced objects, they shall be displayed at least every 15 m. Flags shall not increase the hazard presented by the object they mark.

6.2.3.6. Flags used to mark fixed objects shall not be less than 0.6 m on each side

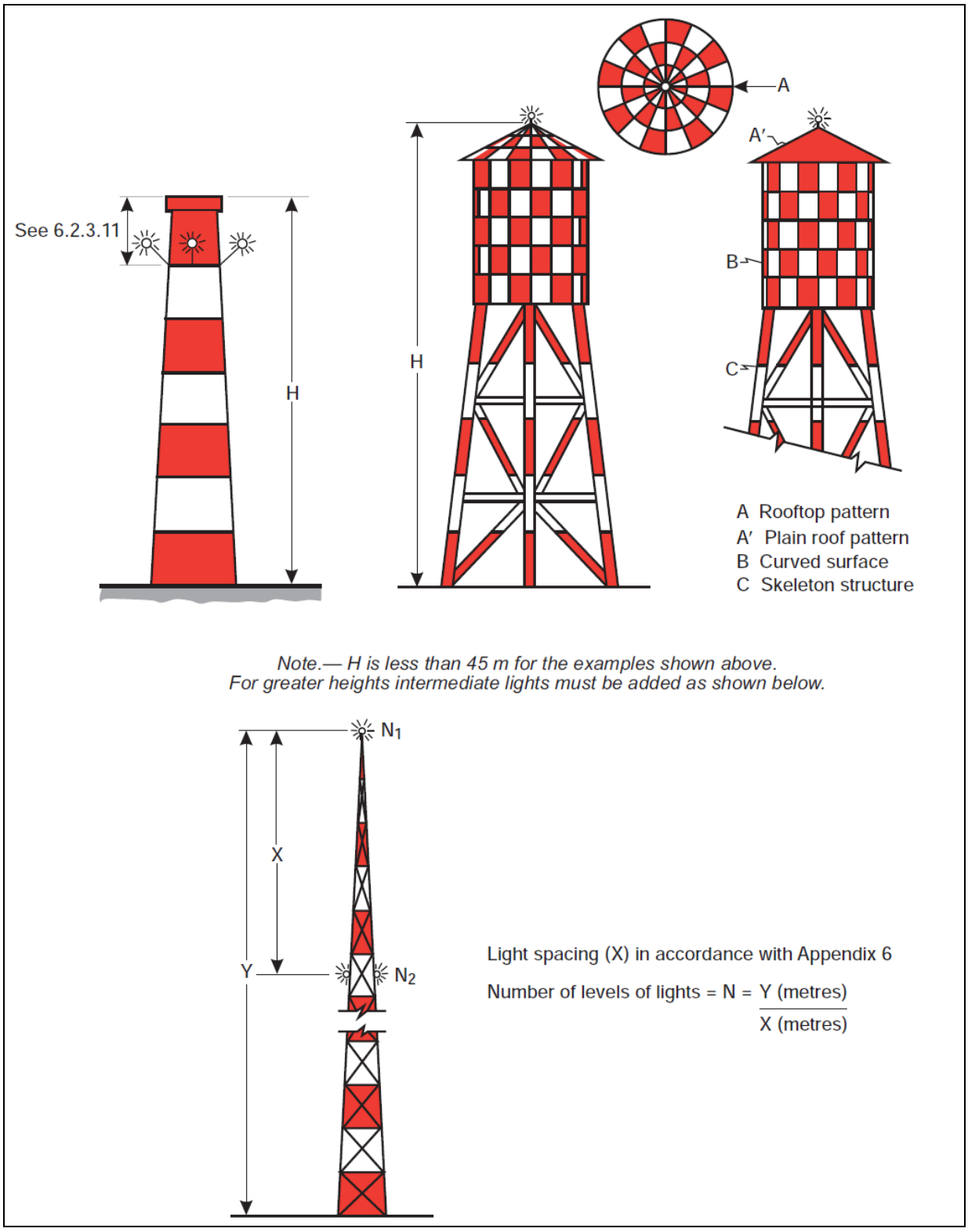


Figure 42. Examples of marking lighting of tall structures (Figure 6-2 ICAO Annex 14)

6.2.3.7. **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.

Marking by markers

6.2.3.8. Markers displayed on or adjacent to objects shall be located in conspicuous positions so as to retain the general definition of the object and shall be recognizable in clear weather from a distance of at least 1 000 m for an object to be viewed from the air and 300 m for an object to be viewed from the ground in all directions in which an aircraft is likely to approach the object. The shape of markers shall be distinctive to the extent necessary to ensure that they are not mistaken for markers employed to convey other information, and they shall be such that the hazard presented by the object they mark is not increased.

6.2.3.9. **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.

Lighting

6.2.3.10. In the case of an object to be lighted, one or more low-, medium- or high-intensity obstacle lights shall be located as close as practicable to the top of the object.

6.2.3.11. **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 Figure 42).

6.2.3.12. In the case of a tower or antenna structure indicated by high-intensity obstacle lights by day with an appurtenance, such as a rod or an antenna, greater than 12 m where it is not practicable to locate a high-intensity obstacle light on the top of the appurtenance, such a light shall be located at the highest practicable point and, if practicable, a medium-intensity obstacle light, Type A, mounted on the top.

6.2.3.13. In the case of an extensive object or of a group of closely spaced objects to be lighted that are:

(a) penetrating a horizontal obstacle limitation surface (OLS) or located outside an OLS, the top lights shall be so arranged as to at least indicate the points or edges of the object highest in relation to the obstacle limitation surface or above the ground, and so as to indicate the general definition and the extent of the objects; and

(b) penetrating a sloping OLS, the top lights shall be so arranged as to at least indicate the points or edges of the object highest in relation to the OLS, and so as to indicate the general definition and the extent of the objects. If two or more edges are of the same height, the edge nearest the landing area shall be marked.

6.2.3.14. **Recommendation -** When the obstacle limitation surface concerned is sloping and the highest point above the OLS is not the highest point of the object, additional obstacle lights should be placed on the highest point of the object.

6.2.3.15. Where lights are applied to display the general definition of an extensive object or a group of closely spaced objects, and

(a) low-intensity lights are used, they shall be spaced at longitudinal intervals not exceeding 45 m; and

(b) medium-intensity lights are used, they shall be spaced at longitudinal intervals not exceeding 900 m.

6.2.3.16. High-intensity obstacle lights, Type A, and medium-intensity obstacle lights, Types A and B, located on an object shall flash simultaneously.

6.2.3.17. **Recommendation -** The installation setting angles for high-intensity obstacle lights, Type A, should be in accordance with Table 21.

6.2.3.18. **Recommendation -** Where, in the opinion of the appropriate authority, the use of high-intensity obstacle lights, Type A, or medium-intensity obstacle lights, Type A, at night may dazzle pilots in the vicinity of an aerodrome (within approximately 10 000 m radius) or cause significant environmental concerns, a dual obstacle lighting system should be provided. This system should be composed of high-intensity obstacle lights, Type A, or medium-intensity obstacle lights, Type A, as appropriate, for daytime and twilight use and medium-intensity obstacle lights, Type B or C, for night-time use.

Lighting of objects with a height less than 45 m above ground level

6.2.3.19. **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.

6.2.3.20. **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.

6.2.3.21. **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 6.2.3.22.

6.2.3.22. **Recommendation -** Medium-intensity obstacle lights, Type A, B or C, should be used where the object is an extensive one. 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.

Lighting of objects with a height 45 m to a height less than 150 m above ground level

6.2.3.23. **Recommendation -** Medium-intensity obstacle lights, Type A, B or C, should be used. 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.

6.2.3.24. Where an object is indicated by medium-intensity obstacle lights, Type A, and the top of the object is more than 105 m above the level of the surrounding ground or the elevation of tops of nearby buildings (when the object to be marked is surrounded by buildings), additional lights shall be provided at intermediate levels. These additional intermediate lights shall be spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 105 m.

6.2.3.25. Where an object is indicated by medium-intensity obstacle lights, Type B, and the top of the object is more than 45 m above the level of the surrounding ground or the elevation of tops of nearby buildings (when the object to be marked is surrounded by buildings), additional lights shall be provided at intermediate levels. These additional intermediate lights shall be alternately low-

intensity obstacle lights, Type B, and medium-intensity obstacle lights, Type B, and shall be spaced as equally as practicable between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 52 m.

6.2.3.26. Where an object is indicated by medium-intensity obstacle lights, Type C, and the top of the object is more than 45 m above the level of the surrounding ground or the elevation of tops of nearby buildings (when the object to be marked is surrounded by buildings), additional lights shall be provided at intermediate levels. These additional intermediate lights shall be spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 52 m.

6.2.3.27. Where high-intensity obstacle lights, Type A, are used, they shall be spaced at uniform intervals not exceeding 105 m between the ground level and the top light(s) specified in 6.2.3.10, except that where an object to be marked is surrounded by buildings, the elevation of the tops of the buildings may be used as the equivalent of the ground level when determining the number of light levels.

Lighting of objects with a height 150 m or more above ground level

6.2.3.28. **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.

6.2.3.29. Where high-intensity obstacle lights, Type A, are used, they shall be spaced at uniform intervals not exceeding 105 m between the ground level and the top light(s) specified in 6.2.3.10, except that where an object to be marked is surrounded by buildings, the elevation of the tops of the buildings may be used as the equivalent of the ground level when determining the number of light levels.

6.2.3.30. **Recommendation -** Where, in the opinion of the appropriate authority, the use of high-intensity obstacle lights, Type A, at night may dazzle pilots in the vicinity of an aerodrome (within approximately 10 000 m radius) or cause significant environmental concerns, medium-intensity obstacle lights, Type C, 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.

6.2.3.31. Where an object is indicated by medium-intensity obstacle lights, Type A, additional lights shall be provided at intermediate levels. These additional intermediate lights shall be spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 105 m.

6.2.3.32. Where an object is indicated by medium-intensity obstacle lights, Type B, additional lights shall be provided at intermediate levels. These additional intermediate lights shall be alternately low-intensity obstacle lights, Type B, and medium-intensity obstacle lights, Type B, and shall be spaced as equally as practicable between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 52 m.

6.2.3.33. Where an object is indicated by medium-intensity obstacle lights, Type C, additional lights shall be provided at intermediate levels. These additional intermediate lights shall be spaced as equally as practicable, between the top

lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 52 m.

6.2.4. Wind turbines

Markings

6.2.4.1. A wind turbine shall be marked and/or lighted if it is determined to be an obstacle.

6.2.4.2. **Recommendation -** The rotor blades, nacelle and upper 2/3 of the supporting mast of wind turbines should be painted white, unless otherwise indicated by an aeronautical study.

Lighting

6.2.4.3. When lighting is deemed necessary, medium-intensity obstacle lights should be used. In the case of a wind farm, i.e. a group of two or more wind turbines, it should be regarded as an extensive object and the lights should be installed:

(a) to identify the perimeter of the wind farm;

(b) respecting the maximum spacing, in accordance with 6.2.3.15, between the lights along the perimeter, unless a dedicated assessment shows that a greater spacing can be used;

(c) so that, where flashing lights are used, they flash simultaneously; and

(d) so that, within a wind farm, any wind turbines of significantly higher elevation are also identified wherever they are located.

6.2.4.4. The obstacle lights should be installed on the nacelle in such a manner as to provide an unobstructed view for aircraft approaching from any direction.

6.2.5. Overhead wires, cables, etc., and supporting towers

Marking

6.2.5.1. **Recommendation -** The wires, cables, etc., to be marked should be equipped with markers; the supporting tower shall be coloured.

Marking by colours

6.2.5.2. **Recommendation -** The supporting towers of overhead wires, cables, etc., that require marking should be marked in accordance with 6.2.3.1 to 6.2.3.4, except that the marking of the supporting towers may be omitted when they are lighted by high-intensity obstacle lights by day.

Marking by markers

6.2.5.3. Markers displayed on or adjacent to objects shall be located in conspicuous positions so as to retain the general definition of the object and shall be recognizable in clear weather from a distance of at least 1 000 m for an object to be viewed from the air and 300 m for an object to be viewed from the ground in all directions in which an aircraft is likely to approach the object. The shape of markers shall be distinctive to the extent necessary to ensure that they are not mistaken for markers employed to convey other information, and they shall be such that the hazard presented by the object they mark is not increased.

6.2.5.4. **Recommendation -** A marker displayed on an overhead wire, cable, etc., should be spherical and have a diameter of not less than 60 cm.

6.2.5.5. **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 shall be located not lower than the level of the highest wire at the point marked.

6.2.5.6. **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.

6.2.5.7. **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.

Lighting

6.2.5.8. **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.

6.2.5.9. 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.

6.2.5.10. **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.

6.2.5.11. **Recommendation -** Where, in the opinion of the appropriate authority, the use of high-intensity obstacle lights, Type B, at night may dazzle pilots in the vicinity

of an aerodrome (within approximately 10 000 m radius) or cause significant environmental concerns, a dual obstacle lighting system should be provided. This system should be composed of high-intensity obstacle lights, Type B, for daytime and twilight use and medium-intensity obstacle lights, Type B, for night-time use. Where medium-intensity lights are used they should be installed at the same level as the high-intensity obstacle light Type B.

6.2.5.12. **Recommendation -** The installation setting angles for high-intensity obstacle lights, Type B, should be in accordance with Table 21.

Table 21. Installation setting angles for high-intensity obstacle lights (Table 6-5 ICAO Annex 14)

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°

Chapter 7. Visual Aids For Denoting Restricted Use Areas

7.1. Closed runways and taxiways, or parts thereof

Application

7.1.1. A closed marking shall be displayed on a runway or taxiway or portion thereof which is permanently closed to the use of all aircraft.

7.1.2. **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

7.1.3. 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

7.1.4. The closed marking shall be of the form and proportions as detailed in Figure 43, Illustration a), when displayed on a runway, and shall be of the form and proportions as detailed in Figure 43, 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.

7.1.5. When a runway or taxiway or portion thereof is permanently closed, all normal runway and taxiway markings shall be obliterated.

7.1.6. Lighting on a closed runway or taxiway or portion thereof shall not be operated, except as required for maintenance purposes.

7.1.7. In addition to closed markings, when the runway or taxiway or portion thereof closed is intercepted by a usable runway or taxiway which is used at night, unserviceability lights shall be placed across the entrance to the closed area at intervals not exceeding 3 m (see 7.4.4).

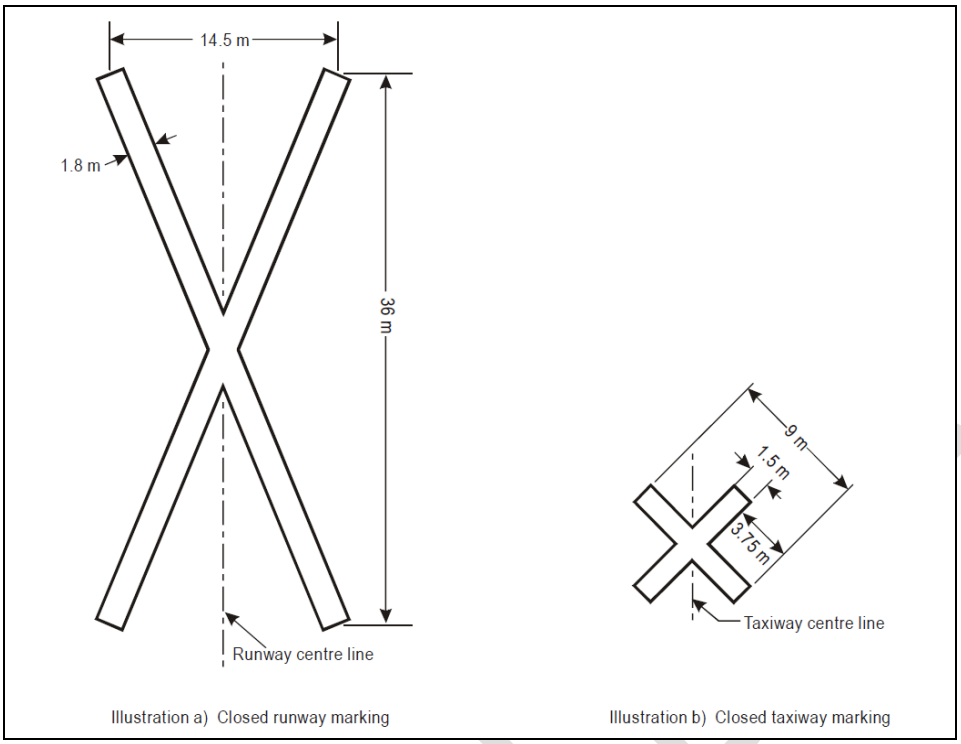


Figure 43. Closed runway and taxiway markings (Figure 7-1 ICAO Annex 14)

7.2. Non-load-bearing surfaces

Application

7.2.1. 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

7.2.2. **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

7.2.3. **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.

7.3. Pre-threshold area

Application

7.3.1. **Recommendation -** 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 should be marked with a chevron marking.

Location

7.3.2. **Recommendation -** A chevron marking should point in the direction of the runway and be placed as shown in Figure 44.

Characteristics

7.3.3. **Recommendation -** A chevron marking should be of conspicuous colour and contrast with the colour used for the runway markings; it should preferably be yellow. It should have an overall width of at least 0.9 m.

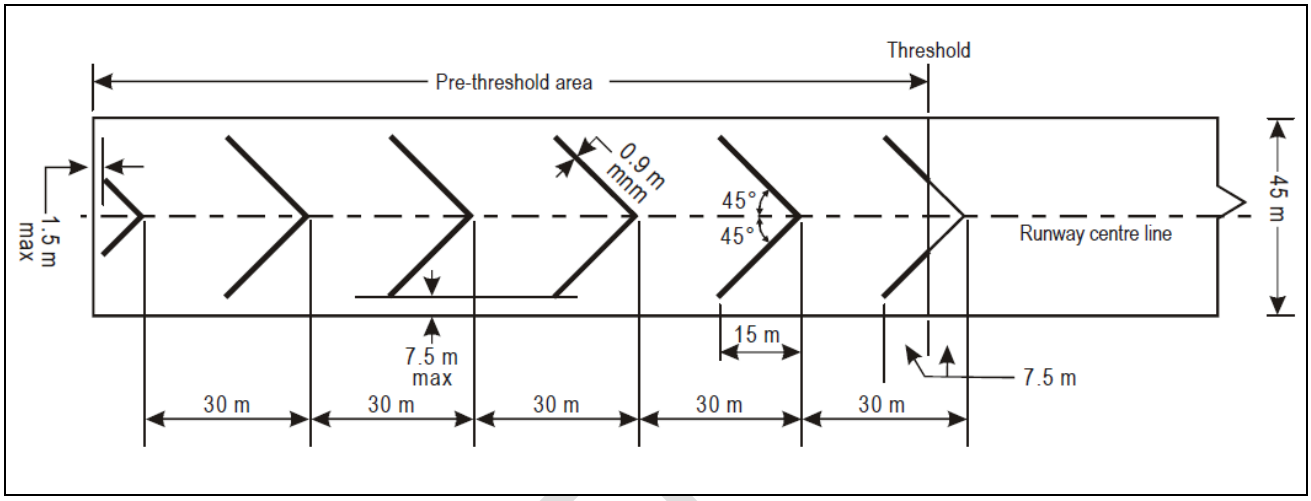


Figure 44. Pre-threshold marking (Figure 7-2 ICAO Annex 14)

7.4. Unserviceable areas

Application

7.4.1. 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.

Location

7.4.2. Unserviceability markers and lights shall be placed at intervals sufficiently close so as to delineate the unserviceable area.

Characteristics of unserviceability markers

7.4.3. Unserviceability markers shall consist of conspicuous upstanding devices such as flags, cones or marker boards.

Characteristics of unserviceability lights

7.4.4. An unserviceability light shall consist of a red fixed light. The light shall have an intensity sufficient to ensure conspicuity considering the intensity of the adjacent lights and the general level of illumination against which it would normally be viewed. In no case shall the intensity be less than 10 cd of red light.

Characteristics of unserviceability cones

7.4.5. **Recommendation -** An unserviceability cone should be at least 0.5 m in height and red, orange or yellow or any one of these colours in combination with white.

Characteristics of unserviceability flags

7.4.6. **Recommendation -** An unserviceability flag should be at least 0.5 m square and red, orange or yellow or any one of these colours in combination with white.

Characteristics of unserviceability marker boards

7.4.7. **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 orange and white vertical stripes.

Chapter 8. Electrical systems

8.1. Electrical power supply systems for air navigation facilities

8.1.1. Adequate primary power supply shall be available at aerodromes for the safe functioning of air navigation facilities.

8.1.2. 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.

8.1.3. **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 primary source of power.

8.1.4. **Recommendation -** The time interval between failure of the primary source of power and the complete restoration of the services required by 8.1.10 should be as short as practicable, except that for visual aids associated with non-precision, precision approach or take-off runways the requirements of Table 22 for maximum switch-over times should apply.

8.1.5. 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 22 for maximum switch-over times as defined in Chapter 1.

Visual aids

Application

8.1.6. For a precision approach runway, a secondary power supply capable of meeting the requirements of Table 22 for the appropriate category of precision approach runway shall be provided. Electric power supply connections to those facilities for which secondary power is required shall be so arranged that the facilities are automatically connected to the secondary power supply on failure of the primary source of power.

8.1.7. For a runway meant for take-off in runway visual range conditions less than a value of 800 m, a secondary power supply capable of meeting the relevant requirements of Table 22 shall be provided.

8.1.8. **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 22 should be provided except that a secondary power supply for visual aids need not be provided for more than one non-precision approach runway.

8.1.9. **Recommendation -** At an aerodrome where the primary runway is a non-instrument runway, a secondary power supply capable of meeting the requirements of 8.1.4 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 5.3.2 is provided and capable of being deployed in 15 minutes.

8.1.10. **Recommendation -** The following aerodrome facilities should be provided with a secondary power supply capable of supplying power when there is a failure of the primary power supply:

(a) the signalling lamp and the minimum lighting necessary to enable air traffic services personnel to carry out their duties;

(b) all obstacle lights which, in the opinion of the appropriate authority, are essential to ensure the safe operation of aircraft;

(c) approach, runway and taxiway lighting as specified in 8.1.6 to 8.1.9;

(d) meteorological equipment;

(e) essential security lighting, if provided in accordance with 9.11;

(f) essential equipment and facilities for the aerodrome responding emergency agencies;

(g) floodlighting on a designated isolated aircraft parking position if provided in accordance with 5.3.24.1; and

(h) illumination of apron areas over which passengers may walk.

8.1.11. **Recommendation -** Requirements for a secondary power supply should 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.

Table 22. Secondary power supply requirements (Table 8-1 ICAO Annex 14)

Runway	Lighting aids requiring power	Maximum switch-over time
Non-instrument	Visual approach slope indicators[a]	See 8.1.4 and 8.1.9
	Runway edge[b]	
	Runway threshold[b]	
	Runway end[b]	
	Obstacle[a]	
Non-precision approach	Approach lighting system	15 seconds
	Visual approach slope indicators[a, d]	15 seconds
	Runway edge[d]	15 seconds
	Runway threshold[d]	15 seconds
	Runway end	15 seconds
	Obstacle[a]	15 seconds
Precision approach category I	Approach lighting system	15 seconds
	Runway edge[d]	15 seconds
	Visual approach slope indicators[a, d]	15 seconds
	Runway threshold[d]	15 seconds
	Runway end	15 seconds
	Essential taxiway[a]	15 seconds
	Obstacle[a]	15 seconds
Precision approach category II/III	Inner 300 m of the approach lighting system	1 second
	Other parts of the approach lighting system	15 seconds
	Obstacle[a]	15 seconds
	Runway edge	15 seconds
	Runway threshold	1 second
	Runway end	1 second
	Runway centre line	1 second
	Runway touchdown zone	1 second
	All stop bars	1 second
	Essential taxiway	15 seconds
Runway meant for take-off in runway visual range conditions less than a value of 800 m	Runway edge	15 seconds[c]
	Runway end	1 second
	Runway centre line	1 second
	All stop bars	1 second
	Essential taxiway[a]	15 seconds
	Obstacle[a]	15 seconds

a. Supplied with secondary power when their operation is essential to the safety of flight operation.
b. See Chapter 5, 5.3.2, regarding the use of emergency lighting.
c. One second where no runway centre line lights are provided.
d. One second where approaches are over hazardous or precipitous terrain.

8.2. System design

8.2.1. For a runway meant for use in runway visual range conditions less than a value of 550 m, the electrical systems for the power supply, lighting and control of the lighting systems included in Table 22 shall be so designed that an equipment failure will not leave the pilot with inadequate visual guidance or misleading information.

8.2.2. Where the secondary power supply of an aerodrome is provided by the use of duplicate feeders, such supplies shall be physically and electrically separate so as to ensure the required level of availability and independence.

8.2.3. Where a runway forming part of a standard taxi-route is provided with runway lighting and taxiway lighting, the lighting systems shall be interlocked to preclude the possibility of simultaneous operation of both forms of lighting.

8.3. **Monitoring**

Note.— Guidance on this subject is given in the Aerodrome Design Manual (Doc 9157), Part 5.

8.3.1. A system of monitoring shall be employed to indicate the operational status of the lighting systems.

8.3.2. Where lighting systems are used for aircraft control purposes, such systems shall be monitored automatically so as to provide an indication of any fault which may affect the control functions. This information shall be automatically relayed to the air traffic services unit.

8.3.3. **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.

8.3.4. **Recommendation -** For a runway meant for use in runway visual range conditions less than a value of 550 m, the lighting systems detailed in Table 22 should be monitored automatically so as to provide an indication when the serviceability level of any element falls below the minimum serviceability level specified in 10.5.7 to 10.5.11, as appropriate. This information should be automatically relayed to the maintenance crew.

8.3.5. **Recommendation -** For a runway meant for use in runway visual range conditions less than a value of 550 m, the lighting systems detailed in Table 22 should be monitored automatically to provide an indication when the serviceability level of any element falls below the minimum level specified by the appropriate authority below which operations should not continue. This information should be automatically relayed to the air traffic services unit and displayed in a prominent position.

Note.— Guidance on air traffic control interface and visual aids monitoring is included in the Aerodrome Design Manual (Doc 9157), Part 5.

Chapter 9. Aerodrome Operational Services, Equipment and Installation

9.1. Aerodrome emergency planning

9.1.1. An aerodrome emergency plan shall be established at an aerodrome, commensurate with the aircraft operations and other activities conducted at the aerodrome.

9.1.2. The aerodrome emergency plan shall provide for the coordination of the actions to be taken in an emergency occurring at an aerodrome or in its vicinity

9.1.3. The plan shall coordinate the response or participation of all existing agencies which, in the opinion of the Brunei DCA, could be of assistance in responding to an emergency.

9.1.4. **Recommendation -** The plan should provide for cooperation and coordination with the rescue coordination centre, as necessary.

9.1.5. **Recommendation -** The aerodrome emergency plan document should include at least the following:

(a) types of emergencies planned for;

(b) agencies involved in the plan;

(c) responsibility and role of each agency, the emergency operations centre and the command post, for each type of emergency;

(d) information on names and telephone numbers of offices or people to be contacted in the case of a particular emergency; and

(e) a grid map of the aerodrome and its immediate vicinity.

9.1.6. The plan shall observe Human Factors principles to ensure optimum response by all existing agencies participating in emergency operations.

Note.— Guidance material on Human Factors principles can be found in the Human Factors Training Manual (Doc 9683).

Emergency operations centre and command post

9.1.7. **Recommendation -** A fixed emergency operations centre and a mobile command post should be available for use during an emergency.

9.1.8. **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.

9.1.9. **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.

9.1.10. **Recommendation -** A person should be assigned to assume control of the emergency operations centre and, when appropriate, another person the command post.

Communication system

9.1.11. **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

9.1.12. The aerodrome operator's aerodrome emergency plan shall contain procedures for periodic testing of the adequacy of the plan and for reviewing the results in order to improve its effectiveness.

9.1.13. The plan shall be tested by conducting:

(a) a full-scale aerodrome emergency exercise at intervals not exceeding two years and partial emergency exercises in the intervening year to ensure that any deficiencies found during the full-scale aerodrome emergency exercise have been corrected; or

(b) a series of modular tests commencing in the first year and concluding in a full-scale aerodrome emergency exercise at intervals not exceeding three years;

and reviewed thereafter, or after an actual emergency, so as to correct any deficiency found during such exercises or actual emergency.

Where an actual incident/accident has occurred to which the response could be said to have tested all parts of the plan, an aerodrome operator can request in writing to the Brunei DCA to defer the periodic exercise.

The aerodrome certificate holder shall notify the Brunei DCA well in advance of an intention to conduct an exercise.

Emergencies in difficult environments

9.1.14. The plan shall include the ready availability of, and coordination with, appropriate specialist rescue services to be able to respond to emergencies where an aerodrome is located close to water and/or swampy areas and where a significant portion of approach or departure operations takes place over these areas.

9.1.15. **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 predetermined response for the specialist rescue services.

9.1.16. **Recommendation -** An assessment of the approach and departure areas within 1 000 m of runway thresholds should be carried out to determine the options available for intervention.

Note.— Guidance material on assessing approach and departure areas within 1 000 m of runway thresholds can be found in Chapter 13 of the Airport Services Manual (Doc 9137), Part 1.

9.2. Rescue and fire fighting

Application

9.2.1. Rescue and fire fighting equipment and services shall be provided at an aerodrome.

9.2.2. 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.

Level of protection to be provided

9.2.3. The level of protection provided at an aerodrome for rescue and fire fighting shall be appropriate to the aerodrome category determined using the principles in paragraphs 9.2.5 and 9.2.6, except that, where the number of movements of the aeroplanes in the highest category normally using the aerodrome is less than 700 in the busiest consecutive three months, the level of protection provided shall be not less than one category below the determined category.

9.2.4. **Recommendation -** The level of protection provided at an aerodrome for rescue and fire fighting should be equal to the aerodrome category determined using the principles in 9.2.5 and 9.2.6.

9.2.5. The aerodrome category shall be determined from Table 23 and shall be based on the longest aeroplanes normally using the aerodrome and their fuselage width.

9.2.6. If, after selecting the category appropriate to the longest aeroplane's overall length, that aeroplane's fuselage width is greater than the maximum width in Table 23, column 3, for that category, then the category for that aeroplane shall actually be one category higher.

Note 1.— See guidance in the Airport Services Manual (Doc 9137), Part 1, for categorizing aerodromes, including those or all-cargo aircraft operations, for rescue and firefighting purposes.

Note 2.— Guidance on training of personnel, rescue equipment for difficult environments and other facilities and services for rescue and firefighting is given in ICAO Annex 14 Vol.I, Attachment A, Section 18, and in the Airport Services Manual (Doc 9137),Part 1.

9.2.7. During anticipated periods of reduced activity, the level of protection available shall be no less than that needed for the highest category of aeroplane planned to use the aerodrome during that time irrespective of the number of movements.

Table 23. Aerodrome category for rescue and fire fighting (Table 9-1 ICAO Annex 14)

Aerodrome Category (1)	Aeroplane overall length (2)	Maximum fuselage width (3)
1	0 m up to but not including 9 m	2 m
2	9 m up to but not including 12 m	2 m
3	12 m up to but not including 18 m	3 m
4	18 m up to but not including 24 m	4 m
5	24 m up to but not including 28 m	4 m
6	28 m up to but not including 39 m	5 m
7	39 m up to but not including 49 m	5 m

8	49 m up to but not including 61 m	7 m
9	61 m up to but not including 76 m	7 m
10	76 m up to but not including 90 m	8 m

Extinguishing Agents

9.2.8. **Recommendation -** Both principal and complementary agents should normally be provided at an aerodrome.

Note. Descriptions of the agents may be found in the ICAO Airport Services Manual (Doc 9137), Part 1.

9.2.9. **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 foam meeting the minimum performance level C; or

(d) a combination of these agents;

except that the principal extinguishing agent for aerodromes in categories 1 to 3 should preferably meet a performance level B or C foam.

9.2.10. **Recommendation -** The complementary extinguishing agent should be a dry chemical powder suitable for extinguishing hydrocarbon fires.

Note. Information on extinguishing agents is given in the ICAO Airport Services Manual (Doc 9137), Part 1.

9.2.11. 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 determined under 9.2.3, 9.2.4, 9.2.5, 9.2.6 and Table 24, except that for aerodrome categories 1 and 2 up to 100 per cent of the water may be substituted with complementary agent.

For the purpose of agent substitution, 1 kg of complementary agent shall be taken as equivalent to 1.0 L of water for production of a foam meeting performance level A.

9.2.12. **Recommendation -** At aerodromes where operations by aeroplanes larger than the average size in a given category are planned, the quantities of water should be recalculated and the amount of water for foam production and the discharge rates for foam solution should be increased accordingly.

9.2.13. From 1 January 2015, at aerodromes where operations by aeroplanes larger than the average size in a given category are planned, the quantities of water shall be recalculated and the amount of water for foam production and the discharge rates for foam solution shall be increased accordingly.

Table 24. Minimum usable amounts of extinguishing agents (Table 9-2 ICAO Annex 14)

	Foam meeting performance level A		Foam meeting performance level B		Foam meeting performance level C		Complementary agents	
Aerodrome category	Water (L)	Discharge rate foam solution/ minute (L)	Water (L)	Discharge rate foam solution/ minute (L)	Water (L)	Discharge rate foam solution/ minute (L)	Dry chemical powders (kg)	Discharge Rate (kg/second)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	350	350	230	230	160	160	45	2.25
2	1 000	800	670	550	460	360	90	2.25
3	1 800	1 300	1 200	900	820	630	135	2.25
4	3 600	2 600	2 400	1 800	1 700	1 100	135	2.25
5	8 100	4 500	5 400	3 000	3 900	2 200	180	2.25
6	11 800	6 000	7 900	4 000	5 800	2 900	225	2.25
7	18 200	7 900	12 100	5 300	8 800	3 800	225	2.25
8	27 300	10 800	18 200	7 200	12 800	5 100	450	4.5
9	36 400	13 500	24 300	9 000	17 100	6 300	450	4.5
10	48 200	16 600	32 300	11 200	22 800	7 900	450	4.5

Note.— The quantities of water shown in columns 2, 4 and 6 are based on the average overall length of aeroplanes in a given category.

9.2.14. The quantity of foam concentrates separately provided on vehicles for foam production shall be in proportion to the quantity of water provided and the foam concentrate selected.

9.2.15. **Recommendation -** The amount of foam concentrate provided on a vehicle should be sufficient to produce at least two loads of foam solution.

9.2.16. **Recommendation -** Supplementary water supplies, for the expeditious replenishment of rescue and fire fighting vehicles at the scene of an aircraft accident, should be provided.

9.2.17. **Recommendation -** When a combination of different performance level foams are provided at an aerodrome, the total amount of water to be provided for foam production should be calculated for each foam type and the distribution of these quantities should be documented for each vehicle and applied to the overall rescue and fire fighting requirement.

9.2.18. The discharge rate of the foam solution shall not be less than the rates shown in Table 24.

9.2.19. The complementary agents shall comply with the appropriate specifications of the International Organization for Standardization (ISO).*

Note.- * See ISO Publication 7202 (Powder).

9.2.20. **Recommendation -** The discharge rate of complementary agents should be no less than the values shown in Table 24.

9.2.21. **Recommendation -** Dry chemical powders should only be substituted with an agent that has equivalent or better fire fighting capabilities for all types of fires where complementary agent is expected to be used.

Note.— Guidance on the use of complementary agents can be found in the Airport Services Manual (Doc 9137), Part 1.

9.2.22. **Recommendation -** A reserve supply of foam concentrate, equivalent to 200 per cent of the quantities identified in Table 24, should be maintained on the aerodrome for vehicle replenishment purposes.

9.2.23. **Recommendation -** A reserve supply of complementary agent, equivalent to 100 per cent of the quantity identified in Table 24, should be maintained on

the aerodrome for vehicle replenishment purposes. Sufficient propellant gas should be included to utilize this reserve complementary agent.

9.2.24. **Recommendation -** Category 1 and 2 aerodromes that have replaced up to 100 per cent of the water with complementary agent should hold a reserve supply of complementary agent of 200 per cent.

9.2.25. **Recommendation -** Where a major delay in the replenishment of the supplies is anticipated, the amount of reserve supply in 9.2.22, 9.2.23 and 9.2.24 should be increased as determined by a risk assessment.

Note.— See the Airport Services Manual (Doc 9137), Part 1 for guidance on the conduct of a risk analysis to determine the quantities of reserve extinguishing agents.

Rescue equipment

9.2.26. **Recommendation -** Rescue equipment commensurate with the level of aircraft operations should be provided on the rescue and fire fighting vehicle(s).

Response time

9.2.27. 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.

9.2.28. **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.

9.2.29. **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 1.— Response time is considered to be the time between the initial call to the rescue and firefighting service, and the time when the first responding vehicle(s) is (are) in position to apply foam at a rate of at least 50 per cent of the discharge rate specified in Table 24.

Note 2.— Optimum visibility and surface conditions are defined as daytime, good visibility, no precipitation with normal response route free of surface contamination, e.g. water, ice or snow.

9.2.30. **Recommendation -** To meet the operational objective as nearly as possible in less than optimum conditions of visibility, especially during low visibility operations, suitable guidance, equipment and/or procedures for rescue and fire fighting services should be provided.

9.2.31. Any vehicles, other than the first responding vehicle(s), required to deliver the amounts of extinguishing agents specified in Table 24 shall ensure continuous agent application and shall arrive no more than four minutes from the initial call.

9.2.32. **Recommendation -** Any vehicles, other than the first responding vehicles(s), required to deliver the amounts of extinguishing agents specified in Table 24 should ensure continuous agent application and shall arrive no more than three minutes from the initial call.

9.2.33. **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

9.2.34. **Recommendation -** Emergency access roads should 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.

9.2.35. **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.

9.2.36. **Recommendation -** When the surface of the road is indistinguishable from the surrounding area, or in areas where snow may obscure the location of the roads, edge markers should be placed at intervals of about 10 m.

Facilities & Communications

Fire stations

9.2.37. **Recommendation -** 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.

9.2.38. **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

9.2.39. **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.

9.2.40. **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.

Number of rescue and fire fighting vehicles

9.2.41. **Recommendation -** The minimum number of rescue and fire fighting vehicles provided at an aerodrome should be in accordance with the following table:

Table 25. Number of RFFS vehicles by aerodrome category

Aerodrome Category	Rescue and fire fighting vehicles
2	1
3	1

Aerodrome Category	Rescue and fire fighting vehicles
4	1
5	1
6	2
7	2
8	3
9	3
10	3

Personnel & equipment.

Personnel

9.2.42. All rescue and fire fighting personnel shall be properly trained to perform their duties in an efficient manner and shall participate in live fire drills commensurate with the types of aircraft and type of rescue and fire fighting equipment in use at the aerodrome, including pressure-fed fuel fires.

Note.— Guidance to assist the appropriate authority in providing proper training is given in Attachment A, Section 18, and the Airport Services Manual (Doc 9137), Part 1.

9.2.43. The rescue and fire fighting personnel training programme shall include training in human performance, including team coordination.

Note.— Guidance material to design training programmes on human performance and team coordination can be found in the Human Factors Training Manual (Doc 9683).

9.2.44. **Recommendation -** During flight operations, sufficient trained and competent personnel should be designated to be readily available to ride the rescue and fire fighting vehicles and to operate the equipment at maximum capacity. These personnel should be deployed in a way that ensures that minimum response times can be achieved and that continuous agent application at the appropriate rate can be fully maintained. Consideration should also be given for personnel to use hand lines, ladders and other rescue and fire fighting equipment normally associated with aircraft rescue and fire fighting operations.

9.2.45. **Recommendation -** In determining the minimum number of rescue and fire fighting personnel required, a task resource analysis should be completed and the level of staffing documented in the Aerodrome Manual.

Note.— Guidance on the use of a task resource analysis can be found in the Airport Services Manual (Doc 9137), Part 1.

9.2.46. All responding rescue and fire fighting personnel shall be provided with protective clothing and respiratory equipment to enable them to perform their duties in an effective manner.

9.3. Disabled aircraft removal

Note.— Guidance on removal of a disabled aircraft, including recovery equipment, is given in the Airport Services Manual (Doc 9137), Part 5. See also Annex 13 — Aircraft Accident and Incident Investigation concerning protection of evidence, custody and removal of aircraft.

9.3.1. **Recommendation -** A plan for the removal of an aircraft disabled on, or adjacent to, the movement area should be established for an aerodrome, and a coordinator designated to implement the plan, when necessary.

9.3.2. **Recommendation -** The disabled aircraft removal plan should be based on the characteristics of the aircraft that may normally be expected to operate at the aerodrome, and include among other things:

(a) a list of equipment and personnel on, or in the vicinity of, the aerodrome which would be available for such purpose; and

(b) arrangements for the rapid receipt of aircraft recovery equipment kits available from other aerodromes.

9.3.3. **Recommendation** - The information of disabled aircraft removal plan and the characteristics (types) of the aircraft that may normally be expected to operate at the aerodrome should be included into AIP.

9.4. Wildlife strike hazard reduction

Note.—The presence of wildlife (birds and animals) on and in the aerodrome vicinity poses a serious threat to aircraft operational safety.

9.4.1. The wildlife strike hazard on, or in the vicinity of, an aerodrome shall be assessed through:

(a) the establishment of a procedure by the aerodrome operator for recording and reporting wildlife strikes to aircraft;

(b) the collection of information from aircraft operators, aerodrome personnel and other sources on the presence of wildlife on or around the aerodrome constituting a potential hazard to aircraft operations; and

(c) an ongoing evaluation of the wildlife hazard by competent personnel.

Note.— See Annex 15, Chapter 5.

9.4.2. Wildlife strike reports shall be collected by the aerodrome operator. These reports shall include but not limited to the following information:

(a) date and local time of occurrence,

(b) aircraft type,

(c) runway,

(d) phase of flight,

(e) wildlife species,

(f) effect on flight, and

(g) whether pilots warned of wildlife activity.

Note.1 - Hardcopies/ softcopies of these reports shall be submitted monthly to the DCA Brunei Regulation Division for inclusion in ICAO Bird Strike Information System (IBIS) database and to be forwarded to ICAO. A sample of the wildlife strike reporting form is shown in Appendix IV attached in this document.

Note.2 – The IBIS is designed to collect and disseminate information on wildlife strikes to aircraft. Information on the system is included in the Manual on the ICAO Bird Strike Information System (IBIS).

9.4.3. Action shall be taken to decrease the risk to aircraft operations by adopting measures to minimize the likelihood of collisions between wildlife and aircraft.

Note.— Guidance on effective measures for establishing whether or not wildlife, on or near an aerodrome, constitute a potential hazard to aircraft operations, and on methods for discouraging their presence, is given in the Airport Services Manual (Doc 9137), Part 3.

9.4.4. The aerodrome operator shall take action to eliminate or to prevent the establishment of garbage disposal dumps or any other source which may attract wildlife to the aerodrome, or its vicinity, unless an appropriate wildlife assessment indicates that they are unlikely to create conditions conducive to a wildlife hazard problem. Where the elimination of existing sites is not possible, the appropriate authority shall ensure that any risk to aircraft posed by these sites is assessed and reduced to as low as reasonably practicable.

9.4.5. **Recommendation –** Aerodrome operator should give due consideration to aviation safety concerns related to land developments in the vicinity of the aerodrome that may attract wildlife. A documented process should be established in managing potential conflicts between land use and aviation authorities to ensure aircraft safety is not compromised. The airport operator should establish process for the management of potential conflicts between environmental and aviation safety requirement.

9.5. Apron management service

9.5.1. **Recommendation -** When warranted by the volume of traffic and operating conditions, an appropriate apron management service should be provided on an apron by an aerodrome 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 requirement of other activities.

9.5.2. **Recommendation -** When the aerodrome control tower does not participate in the apron management service, 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 (Doc 9137), Part 8, and in the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476).

9.5.3. An apron management service shall be provided with radiotelephony communications facilities.

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

9.5.5. An emergency vehicle responding to an emergency shall be given priority over all other surface movement traffic.

9.5.6. 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 requirements.

9.5.7. An aircraft stand shall be visually monitored to ensure that the recommended clearance distances are provided to an aircraft using the stand.

9.6. Ground servicing of aircraft

9.6.1. An Aerodrome operator shall establish procedures for ground handling activities such as aircraft handling operations and require that these procedures be complied with by ground handling service providers, including fixed-base operators, ground handling agents and other organisations that perform aircraft handling operations, so that these activities are conducted safely at its aerodromes.

9.6.2. During ground servicing of aircraft,

(a) 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 rescue and fire fighting service in the event of a fire or major fuel spill.

(b) When aircraft refuelling operations take place while passengers are embarking, on board or disembarking, ground equipment shall be positioned so as to allow:

(i) the use of a sufficient number of exits for expeditious evacuation; and

(ii) a ready escape route from each of the exits to be used in an emergency.

9.7. Aerodrome vehicle operations

Note.1 — Guidance on aerodrome vehicle operations is contained in ICAO Annex 14 Vol. I, Attachment A, Section 19 and on traffic rules and regulations for vehicles is contained in the ICAO Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476).

Note. 2 — It is intended that roads located on the movement area be restricted to the exclusive use of aerodrome personnel and other authorized persons, and that access to the public buildings by an unauthorized person will not require use of such roads.

9.7.1. 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.

9.7.2. 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.

9.7.3. The driver of a vehicle on the movement area shall comply with all mandatory instructions conveyed by lights.

9.7.4. 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.

9.7.5. The driver of a radio-equipped vehicle shall establish satisfactory two-way radio communication with the aerodrome control tower before entering the manoeuvring area and with the appropriate designated authority before entering the apron. The driver shall maintain a continuous listening watch on the assigned frequency when on the movement area.

9.8. Surface movement guidance and control systems (SMGCS)

Application

9.8.1. A surface movement guidance and control system (SMGCS) 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) (Doc 9476).

Characteristics

9.8.2. **Recommendation -** The design of an SMGCS 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.

9.8.3. **Recommendation -** The visual aid components of an SMGCS, i.e. markings, lights and signs, should be designed to conform with the relevant specifications in 5.2, 5.3 and 5.4 of this BAR 14 Vol.I, respectively.

9.8.4. **Recommendation -** An SMGCS should be designed to assist in the prevention of inadvertent incursions of aircraft and vehicles onto an active runway.

9.8.5. **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 (Doc 9157), Part 4.

9.8.6. Where an SMGCS is provided by selective switching of stop bars and taxiway centre line lights, the following requirements shall be met:

(a) taxiway routes which are indicated by illuminated taxiway centre line lights shall be capable of being terminated by an illuminated stop bar;

(b) the control circuits shall be so arranged that when a stop bar located ahead of an aircraft is illuminated, the appropriate section of taxiway centre line lights beyond it is suppressed; and

(c) the taxiway centre line lights are activated ahead of an aircraft when the stop bar is suppressed.

Note 1.— See Sections 5.3.17 and 5.3.20 of this BAR 14 Vol.I for specifications on taxiway centre line lights and stop bars, respectively.

Note 2.— Guidance on installation of stop bars and taxiway centre line lights in SMGCSs is given in the Aerodrome Design Manual (Doc 9157), Part 4.

9.8.7. **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.

9.8.8. **Recommendation -** Surface movement radar for the manoeuvring area should be provided at an aerodrome other than that in 9.8.7 when traffic density and operating conditions are such that regularity of traffic flow cannot be maintained by alternative procedures and facilities.

Note.— Guidance on the use of surface movement radar is given in the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476) and in the Air Traffic Services Planning Manual (Doc 9426).

9.9. Sitting of equipment and installations on operational areas

Note 1.— Requirements for obstacle limitation surfaces are specified in 4.2 of this BAR 14 Vol.I.

Note 2.— The design of light fixtures and their supporting structures, light units of visual approach slope indicators, signs, and markers, is specified in 5.3.1, 5.3.5, 5.4.1 and 5.5.1 of this BAR 14 Vol.I, respectively. Guidance on the frangible design of visual and non-visual aids for navigation is given in the Aerodrome Design Manual (Doc 9157), Part 6.

9.9.1. Unless its function requires it to be there for air navigation or for aircraft safety purposes, no equipment or installation shall be:

(a) on a runway strip, a runway end safety area, a taxiway strip or within the distances specified in Table 7, column 11, if it would endanger an aircraft; or

(b) on a clearway if it would endanger an aircraft in the air.

9.9.2. Any equipment or installation required for air navigation or for aircraft safety purposes which must be located:

(a) on that portion of a runway strip within:

(1) 75 m of the runway centre line where the code number is 3 or 4; or

(2) 45 m of the runway centre line where the code number is 1 or 2; or

(b) on a runway end safety area, a taxiway strip or within the distances specified in Table 7; or

(c) on a clearway and which would endanger an aircraft in the air;

shall be frangible and mounted as low as possible.

9.9.3. **Recommendation -** Any equipment or installation required for air navigation or for aircraft safety purposes which must be located on the non-graded portion of a runway strip should be regarded as an obstacle and should be frangible and mounted as low as possible.

9.9.4. Unless its function requires it to be there for air navigation or for aircraft safety purposes, no equipment or installation shall be located within 240 m from the end of the strip and within:

(a) 60 m of the extended centre line where the code number is 3 or 4; or

(b) 45 m of the extended centre line where the code number is 1 or 2;

of a precision approach runway category I, II or III.

9.9.5. Any equipment or installation required for air navigation or for aircraft safety purposes which must be located on or near a strip of a precision approach runway category I, II or III and which:

(a) is situated 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.

9.9.6. **Recommendation -** Any equipment or installation required for air navigation or for aircraft safety purposes which is an obstacle of operational significance in accordance with 4.2.4, 4.2.11, 4.2.20 or 4.2.27 of this BAR 14 Vol.I should be frangible and mounted as low as possible.

9.10. Fencing

Application

9.10.1. A fence or other suitable barrier shall be provided on an aerodrome to prevent the entrance to the movement area of animals large enough to be a hazard to aircraft.

9.10.2. A fence or other suitable barrier shall be provided on an aerodrome to deter the inadvertent or premeditated access of an unauthorized person onto a non-public area of the aerodrome.

Note.— This is intended to include the barring of sewers, ducts, tunnels, etc., where necessary to prevent access.

9.10.3. 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

9.10.4. The fence or barrier shall be located so as to separate the movement area and other facilities or zones on the aerodrome vital to the safe operation of aircraft from areas open to public access.

9.10.5. **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.

9.11. Security lighting

Recommendation - At an aerodrome where it is deemed desirable for security reasons, a fence or other barrier provided for the protection of international civil aviation 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.

9.12. Autonomous runway incursion warning system

Note 1.— The inclusion of detailed specifications for an autonomous runway incursion warning system (ARIWS) in this section is not intended to imply that an ARIWS has to be provided at an aerodrome.

Note 2.— The implementation of an ARIWS is a complex issue deserving careful consideration by aerodrome operators, air traffic services and States, and in coordination with the aircraft operators.

Note 3.— Attachment A, Section 21, provides a description of an ARIWS and information on its use.

Characteristics

9.12.1 Where an ARIWS is installed at an aerodrome:

a) it shall provide autonomous detection of a potential incursion or of the occupancy of an active runway and a direct warning to a flight crew or vehicle operator;

b) it shall function and be controlled independently of any other visual system on the aerodrome;

c) its visual aid components, i.e. lights, shall be designed to conform with the relevant specifications in 5.3; and

d) failure of part or all of it shall not interfere with normal aerodrome operations. To this end, provision shall be made to allow the ATC unit to partially or entirely shut down the system.

Note 1.— An ARIWS may be installed in conjunction with enhanced taxiway centre line markings, stop bars or runway guard lights.

Note 2.— It is intended that the system(s) be operational under all weather conditions, including low visibility.

Note 3.— An ARIWS may share common sensory components of an SMGCS or A-SMGCS, however, it operates independently of either system.

9.12.2 Where an ARIWS is installed at an aerodrome, information on its characteristics and status shall be provided to the appropriate aeronautical information services for promulgation in the AIP with the description of the aerodrome surface movement guidance and control system and markings as specified in Annex 15.

Note.— Detailed specifications concerning the AIP are contained in PANS-AIM (Doc 10066).

Chapter 10. Aerodrome maintenance

10.1. General

10.1.1. 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 1.— Preventive maintenance is programmed maintenance work done in order to prevent a failure or degradation of facilities.

Note 2.— "Facilities" are intended to include such items as pavements, visual aids, fencing, drainage systems, electrical systems and buildings.

10.1.2. **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 (Doc 9683) and in the Airport Services Manual (Doc 9137), Part 8.

10.2. Pavements

10.2.1. The surfaces of all movement areas including pavements (runways, taxiways and aprons) and adjacent areas shall be inspected and their conditions monitored regularly as part of an aerodrome preventive and corrective maintenance programme with the objective of avoiding and eliminating any loose objects/debris that might cause damage to aircraft or impair the operation of aircraft systems.

Note 1.— See 2.9.3 for inspections of movement areas.

Note 2.— Guidance on carrying out daily inspections of the movement area is given in the Airport Services Manual (Doc 9137), Part 8, the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476) and the Advanced Surface Movement Guidance and Control Systems (A-SMGCS) Manual (Doc 9830).

Note 3.— Additional guidance on sweeping/cleaning of surfaces is contained in the Airport Services Manual (Doc 9137), Part 9.

Note 4.— Guidance on precautions to be taken in regard to the surface of shoulders is given in Attachment A, Section 9, and the Aerodrome Design Manual (Doc 9157), Part 2.

Note 5.— Where the pavement is used by large aircraft or aircraft with tire pressures in the upper categories referred to in 2.6.6 c), particular attention shall be given to the integrity of light fittings in the pavement and pavement joints.

10.2.2. The surface of a runway shall be maintained in a condition such as to prevent formation of harmful irregularities.

10.2.3. A paved runway shall be maintained in a condition so as to provide surface friction characteristics at or above the minimum friction level specified by the State.

Note. The Airport Services Manual (Doc 9137), Part 2, contains further information on this subject, on improving surface friction characteristics of runways.

10.2.4. Runway surface friction characteristics for maintenance purposes shall be periodically measured with a continuous friction measuring device using self-wetting features and documented. The frequency of these measurements shall

be sufficient to determine the trend of the surface friction characteristics of the runway.

Note 1. Guidance on evaluating the friction characteristics of a runway is included in the Airport Services Manual (Doc 9137), Part 2.

Note 2. The objective of 10.2.3 to 10.2.6 is to ensure that the surface friction characteristics for the entire runway remain at or above a minimum friction level specified by the State.

Note 3. Guidance for the determination of the required frequency is provided in Attachment A, Section 7 and in the Airport Services Manual (Doc 9137), Part 2, Appendix 5.

10.2.5. Corrective maintenance action shall be taken to prevent the runway surface friction characteristics for either the entire runway or a portion thereof from falling below a minimum friction level specified by the State.

Note. A portion of runway in the order of 100 m long may be considered significant for maintenance or reporting action.

10.2.6. **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 surface 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.

10.2.7. **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 this is given in the Aerodrome Design Manual (Doc 9157), Part 2.

10.2.8 Notification shall be given to aerodrome users when the friction level of a paved runway or portion thereof is less than that specified by the State in accordance with 10.2.3.

Note.— Guidance on conducting a runway surface friction characteristics evaluation programme that includes determining and expressing the minimum friction level is provided in the ICAO Annex 14 Vol.I, Attachment A, Section 7.

10.3. Removal of contaminants

10.3.1. Snow, slush, ice, standing water, mud, dust, sand, oil, rubber deposits and other contaminants shall be removed from the surface of runways in use as rapidly and completely as possible to minimize accumulation.

Note. The above requirement does not imply that winter operations on compacted snow and ice are prohibited. Guidance on snow removal and ice control and removal of other contaminants is given in the Aerodrome Services Manual (Doc 9137), Parts 2 and 9.

10.3.2. **Recommendation -** Taxiways should be kept clear of snow, slush, ice, etc., to the extent necessary to enable aircraft to be taxied to and from an operational runway.

10.3.3. **Recommendation -** Aprons should be kept clear of snow, slush, ice, etc., to the extent necessary to enable aircraft to manoeuvre safely or, where appropriate, to be towed or pushed.

10.3.4. **Recommendation -** Whenever the clearance of snow, slush, ice, etc., from the various parts of the movement area cannot be carried out simultaneously, the order of priority after the runway(s) in use should be set in consultation with the affected parties such as rescue and fire fighting service and documented in a snow plan.

Note 1. See PANS-AIM (Doc 10066), Appendix 2, Part 3, AD 1.2.2 for information to be promulgated in anconcerning a snow plan. The Aeronautical Information Services Manual (Doc 8126), Chapter 5 contains guidance on the description of a snow plan including general policy concerning operational priorities established for the clearance of movement areas.

Note 2. The ICAO Airport Services Manual (Doc 9137), Part 8, Chapter 6, specifies that an aerodrome snow plan clearly defines, inter alia, the priority of surfaces to be cleared.

10.3.5. **Recommendation -** Chemicals to remove or to prevent the formation of ice and frost on aerodrome pavements should be used when conditions indicate their use could be effective. Caution should be exercised in the application of the chemicals so as not to create a more slippery condition.

Note. Guidance on the use of chemicals for aerodrome pavements is given in the Airport Services Manual (Doc 9137), Part 2.

10.3.6. Chemicals which may have harmful effects on aircraft or pavements, or chemicals which may have toxic effects on the aerodrome environment, shall not be used.

10.4. Runway pavement overlays

Note. The following specifications are intended for runway pavement overlay projects when the runway is to be returned temporarily to an operational status before resurfacing is complete. This may necessitate a temporary ramp between the new and old runway surfaces. Guidance on overlaying pavements and assessing their operational status is given in the Aerodrome Design Manual (Doc 9157), Part 3.

10.4.1. The longitudinal slope of the temporary ramp, 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.

10.4.2. **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.

10.4.3. **Recommendation -** The entire width of the runway should be overlaid during each work session.

10.4.4. **Recommendation -** Before a runway being overlaid is returned to a temporary operational status, a runway centre line marking conforming to the specifications in Section 5.2.3 shall be provided. Additionally, the location of any temporary threshold shall be identified by a 3.6 m wide transverse stripe.

10.4.5. **Recommendation -** The overlay should be constructed and maintained above the minimum friction level specified in 10.2.3.

10.5. Visual aids

10.5.1. A light shall be deemed to be unserviceable when the main beam average intensity is less than 50% of the value specified in the appropriate figure in ICAO Annex 14 Volume I Appendix 2. For light units where the designed main beam average

intensity is above the value shown in Appendix 2, the 50% value shall be related to that design value.

10.5.2. A system of preventive maintenance of visual aids shall be employed to ensure lighting and marking systems reliability.

10.5.3. **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.

10.5.4. **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 ICAO Annex 14, Volume I, Appendix 2.

10.5.5. **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 analyse the characteristics of the individual lights.

10.5.6. **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.

10.5.7. 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% of the lights are serviceable in each of the following particular significant elements:

1) precision approach category II and III lighting system, the inner 450 m;

2) runway centre line lights;

3) runway threshold lights; and

4) runway edge lights;

b) 90% of the lights are serviceable in the touchdown zone lights;

c) 85% of the lights are serviceable in the approach lighting system beyond 450 m; and

d) 75% of the lights are serviceable in the runway end lights.

In order to provide continuity of guidance, the allowable percentage of unserviceable lights shall not be permitted in such a way as to alter the basic

pattern of the lighting system. Additionally, an unserviceable light shall not be permitted adjacent to another unserviceable light, except in a barrette or a crossbar where two adjacent unserviceable lights may be permitted.

10.5.8. The system of preventive maintenance employed for a stop bar provided at a runway-holding position used in conjunction with a runway intended for operations in runway visual range conditions less than a value of 350 m shall have the following objectives:

a) no more than two lights will remain unserviceable; and

b) two adjacent lights will not remain unserviceable unless the light spacing is significantly less than that specified.

10.5.9. The system of preventive maintenance employed for a taxiway intended for use in runway visual range conditions less than a value of 350 m shall have as its objective that no two adjacent taxiway centre line lights be unserviceable.

10.5.10. 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% 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.

10.5.11. The system of preventive maintenance employed for a runway meant for take-off in runway visual range conditions less than a value of 550 m shall have as its objective thjat, during any period of operations, all runway lights are serviceable and that in any event:

a) At least 95% of the lights are serviceable in the runway centre lights (where provided) and in the runway edge lights; and

b) At least 75% of the lights are serviceable in the runway end lights.

In order to provide continuity of guidance an unserviceable light shall not be permitted adjacent to another unserviceable light.

10.5.12. 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% of the lights are serviceable in the runway edge lights and runway end lights. In order to provide continuity of guidance, an unserviceable light shall not be permitted adjacent to another unserviceable light.

10.5.13. During low visibility procedures the appropriate authority shall restrict construction or maintenance activities in the proximity of aerodrome electrical systems.

Chapter 11. Aviation Fuel

11.1. **Aviation fuel management**

The aerodrome operator shall verify that organisations involved in the storage and dispensing of fuel to aircraft have procedures to ensure that aircraft are provided with uncontaminated fuel and of the correct specification. (See Appendix V – Aircraft Fuelling and Fuel Installation Management and Appendix VI – Aircraft Refueling and Defueling in this document for additional material)

Note. ICAO Document 9137 Part 1 (Chapter 16) provides guidance for the aerodrome operator, the aircraft operator and the fuel supplier on their responsibilities for safety measures to be taken during aircraft fuelling/defuelling operations.

Chapter 12. Contracted Activities

12.1. **Contracted activities (eg. Ground Handling)**

(a) Contracted activities include all activities within the aerodrome operator's scope in accordance with the terms of the certificate that are performed by other organisations either itself certified to carry out such activity or if not certified, working under the aerodrome operator's approval. The aerodrome operator shall ensure that when contracting or purchasing any part of its activity, the contracted or purchased service or equipment or system conforms to the applicable requirements.

(b) When an aerodrome operator contracts any part of its activity to an organisation that is not itself certified in accordance with this Part to carry out such activity, the contracted organisation shall work under the approval and oversight of the aerodrome operator. The aerodrome operator shall ensure that the Brunei DCA is given access to the contracted organisation, to determine continued compliance with the applicable requirements.

Chapter 13. Safeguarding

13.1. Safeguarding of aerodrome surroundings

(a) The aerodrome operator shall ensure that consultations are conducted with regard to safety impacts of constructions proposed to be built within the limits of the obstacle limitation and protection surfaces as well as other surfaces associated with an aerodrome.

(b) The aerodrome operator shall ensure that consultations are conducted with regard to safety impacts of constructions proposed to be built beyond the limits of the obstacle limitation and protection surfaces as well as other surfaces associated with an aerodrome and which exceed the height established by the Brunei DCA.

(c) The aerodrome operator shall ensure coordination of the safeguarding of aerodromes located near national borders with other States.

13.2. Monitoring of aerodrome surroundings

(a) The aerodrome operator shall ensure that consultations are conducted with regard to human activities and land use such as:

(1) any development or change in land use in the aerodrome area;

(2) any development which may create obstacle-induced turbulence that could be hazardous to aircraft operations;

(3) the use of hazardous, confusing and misleading lights;

(4) the use of highly reflective surfaces which may cause dazzling;

(5) the creation of areas that might encourage wildlife activity harmful to aircraft operations;

(6) Sources of non-visible radiation or the presence of moving or fixed objects which may interfere with, or adversely affect, the performance of aeronautical communications, navigation and surveillance systems.

13.3 Detailed guidance on the safeguarding and monitoring of aerodrome surroundings can be found in ICAO Doc 9137, Part 6 Control of Obstacles.

Note. – Additional information aerodrome safeguarding can be found in ICAO Doc 8168, Procedures for Air Navigation Services – Aircraft Operations Volume l and ll (PANS-OPS)

Chapter 14 Water Aerodromes

14.1 General provisions

Not in use

Appendix I Particulars to be included in an Aerodrome Manual

1. An aerodrome operator must include in its Aerodrome Manual all the material listed in ICAO Doc 9774, Appendix 1 – Schedule of the Aerodrome Certification Requirements and ICAO Doc 9981 Procedures for Air Navigation Services — Aerodromes (PANS-AERODROMES).

   Note.- The contains information as detailed in guidance material ADR 013 Aerodrome Manual Checklist provided on DCA website.

2. An Aerodrome Manual shall be arranged under the following Parts.

   Part 1. General information.

   Part 2. Particulars of the aerodrome site.

   Part 3. Particulars of the aerodrome required to be reported to the aeronautical information service (AIS).

   Part 4. Particulars of the aerodrome operating procedures and safety measures.

   Part 5. Details of the aerodrome administration and the safety management system.

3. The intent of a safety management system is to have in place an organised and orderly approach in the management of aerodrome safety by the aerodrome operator. Annex 19 – Safety Management and BAR 19 – Safety Management contains the safety management provisions applicable to certified aerodromes.

Appendix II Application for an Aerodrome Certificate

1. **An applicant for the grant or amendment of an aerodrome certificate shall apply to the Brunei DCA by supplying:**

   (a) the applicant's name and address;

   (b) the aerodrome name and location;

   (c) the name and position of the accountable manager;

   (d) the Aerodrome Manual required by Chapter 2 paragraph 2.2;

   (e) evidence that the requirements in paragraph (b) have been met;

   (f) such other particulars relating to the applicant and the aerodrome as may be required by the Brunei DCA; and

   (g) Payment of any applicable fee required by the appropriate requirements.

2. **The applicant for an aerodrome certificate shall satisfy the Brunei DCA that:**

   (a) the applicant and his/her staff have the necessary competence and experience to operate and maintain the aerodrome;

   (b) the Aerodrome Manual prepared for the aerodrome contains all of the relevant information;

   (c) the aerodrome facilities, services and equipment meet the required standards;

   (d) the aerodrome operating procedures ensure the safe operations of aircraft and/or the safety of air navigation;

   (e) acceptable safety and quality management systems are in place to ensure continued compliance with, and the adequacy of, the requirements of this BAR and the safe operation of the aerodrome;

   (f) appropriate arrangements are in place for the provision of:

      (i) the Air Traffic Services;

      (ii) the Aeronautical Information Service; and

      (iii) the Meteorological Service

   (g) The Rescue and Fire Fighting Services provided for the aerodrome meet the requirements of BAR 14 Volume I – Aerodromes para 9.2.1 to 9.2.46.

3. An application form for an Aerodrome Certificate ADR 019 that should be used by the aerodrome operator is shown below under Appendix 2 of this document.

Brunei Department of Civil Aviation
Director of Civil Aviation
Aerodrome Standards Section

Brunei Department of Civil Aviation
Ministry of Transport and Infocommunications
Brunei International Airport
Bandar Seri Begawan
BB 2513 Brunei Darussalam
Email: aerodrome.regulatory@civil-aviation.gov.bn
Website: www.mtic.gov.bn/dca

BAR 14 Volume I – Aerodromes **Appendix 2**

ADR 019 Issue No: 02	APPLICATION FORM FOR AN AERODROME CERTIFICATE

Application for an Aerodrome Certificate

NOTES:

1. Please print, then complete in **BLOCK CAPITALS** using black or blue ink, sign and submit as instructed.
2. **Uncompleted application will be rejected** and the Authority will inform the Applicant accordingly.
3. This application **MUST be accompanied by a Ordnance Survey map, size A4,** showing by means of a red line the exact boundary of the proposed certificated area of the aerodrome or heliport, and its location with regards to local roads, towns and populous areas. This map will be a Schedule attached to the Certificate.

1. Particulars of the Applicant

NOTE: **The intended certificate holder must be a legal entity. If the certificate holder is a group or club and is not incorporated, the name(s) of the person(s) who will hold the certificate and be responsible for giving effect to the conditions of the certificate should be stated.**

Full Name of the Organisation: .....

Address: .....

.....

..... Postal Code: .....

Phone: ..... Fax: ..... E-mail: .....

Authorised Representative Full Name: .....

Position: .....

Phone: ..... Fax: ..... Email: .....

2. Particulars of the Aerodrome Site

(e.g Brunei International Airport)

Aerodrome Name: .....

Geographical Coordinates of the Aerodrome Reference Point (ARP): (In degrees, minutes and tenths of minutes and in WGS-84 format)

Latitude: ..... Longitude: .....

ARP Elevation above mean sea level [meter]: .....

ARP Bearing and Distance from Nearest Town or Populous Area (in nautical miles): .....
(e.g NNW 3.2nm of Bandar Seri Begawan, East 0.5nm of Rimba Housing Area)
.....

3. Is the Applicant the Owner of the Aerodrome Site?

YES ☐ NO ☐

If No, provide:
a) Details of Rights Held in Relation to the Site;
b) The period/ or dates Applicants holds these Rights; and
c) Name and address of the owner of the site and written evidence to show that permission has been obtained for the site to be used by the applicant as an aerodrome.

Brunei Department of Civil Aviation
Director of Civil Aviation
Aerodrome Standards Section

Brunei Department of Civil Aviation
Ministry of Transport and Infocommunications
Brunei International Airport
Bandar Seri Begawan
BB 2513 Brunei Darussalam
Email: aerodrome.regulatory@civil-aviation.gov.bn
Website: www.mtic.gov.bn/dca

4. Details of Aerodrome (as required to be shown on the certificate)

Intended commencement date of aerodrome operations: ..... *(e.g already operating)*

Operating hours: ..... *(e.g open 24 hours 7 days)*

Type of aircraft to be operated at aerodrome: Aeroplanes ☐ Helicopters ☐ Others (specify): .....

Largest type of aircraft expected to operate at aerodrome: .....

Intended aerodrome reference code: ..... *(e.g Code 4E)*

Intended type of runway: Non-instrument: ☐ Non-precision ☐

Precision CAT I ☐ CAT II ☐ CAT III ☐

Expected number of traffic movement per calendar month of heaviest aircraft.
[One movement is one take-off or one landing] : ..... per month

5. Is the Aerodrome to be Used for Regular Public Transport Operations?

YES ☐ NO ☐

6. Details of the Aerodrome (as required to be shown on the certificate)

Aerodrome Name: .....

Aerodrome Operator: .....

Aerodrome Address : .....

.....

.....

7. Aerodrome Manual

Has an Aerodrome Manual been submitted to DCA? (See Notes below) YES ☐ NO ☐
If NO, please indicate below when this is likely to be submitted

.....

NOTES:

1 An aerodrome certificate will not be granted until a completed Aerodrome Manual has been received and accepted by the DCA Brunei Regulatory. The Aerodrome Manual should be submitted 1 softcopy (.pdf) to aerodrome.regulatory@civil-aviation.gov.bn AND 2 hardcopies to Director of DCA Brunei Regulatory.

2 Documentary evidence in support of all matters in this application may be requested.

8. AIP Requirements

NOTE:

The Aeronautical Information Publication (AIP) is identified as the publication used for the provision of aeronautical information/data necessary for the regularity and efficiency of air navigation. The holder of an aerodrome certificate should ensure that all information relating to the aerodrome and its facilities, which is significant for the conduct of flights to and from the aerodrome, is available to users of the aerodrome.

Brunei Department of Civil Aviation
Director of Civil Aviation
Aerodrome Standards Section

Brunei Department of Civil Aviation
Ministry of Transport and Infocommunications
Brunei International Airport
Bandar Seri Begawan
BB 2513 Brunei Darussalam
Email: aerodrome.regulatory@civil-aviation.gov.bn
Website: www.mtic.gov.bn/dca

9. Key Management Personnel (please enter and complete the details when applicable)

SECTION 9 TO BE COMPLETED BY ALL APPLICANTS

The aerodrome's accountable manager:

Name: .....

Job Title: .....

Telephone: ..... E-mail: .....

The person in charge of day-to-day operation of the aerodrome:

Name: .....

Job Title: .....

Telephone: ..... E-mail: .....

The person responsible for aerodrome safety:

Name: .....

Job Title: .....

Telephone: ..... E-mail: .....

Person responsible for overseeing the day-to-day provision of Rescue & Fire Fighting Services (RFFS):

Name: .....

Job Title: .....

Telephone: ..... E-mail: .....

Provider of the Air Traffic Control Service:

Name: .....

Address: .....

.....

.....

Person responsible for overseeing the day-to-day provision of the Air Traffic Control Service:

Name: .....

Job Title: .....

Telephone: ..... E-mail: .....

Brunei Department of Civil Aviation
Director of Civil Aviation
Aerodrome Standards Section

Brunei Department of Civil Aviation
Ministry of Transport and Infocommunications
Brunei International Airport
Bandar Seri Begawan
BB 2513 Brunei Darussalam
Email: aerodrome.regulatory@civil-aviation.gov.bn
Website: www.mtic.gov.bn/dca

10. Certification Declaration

Note: This application is to be signed by a person or persons authorised by the organisation named above to act on behalf of it. Evidence of the authorisation to act on behalf of the organisation should be provided with the application.

On behalf of the aerodrome operator shown above, I hereby apply for a certificate to operate the aerodrome.

My authority to act on behalf of the applicant is:

. . . . . .

. . . . . .

I hereby declare that to the best of my knowledge the particulars entered on this application are accurate.

Official Stamp

Signed: . . . . . Date: . . . . . / . . . . . / . . . . .

Full Name of person making the declaration: . . . . . .

Application for an Aerodrome Certificate – GUIDANCE NOTES

Information:

1. 1 Softcopy (.pdf) AND 2 hard copies of the aerodrome manuals, prepared in accordance with the regulations and commensurate with the aircraft activities expected at the aerodrome, are required as part of the application as instructed.
2. The application should be submitted to the Director of Department of Civil Aviation Brunei.
3. The fee of processing this application is currently not applicable until further notice.
4. Documentary evidence in support of all matters in this application may be requested.
5. For Air Traffic Permissions, Radio Licensing and Aerodrome Traffic Zone (ATZ), applicant should apply separately to the Director of Civil Aviation Department or other authorities.

Notes:

It is important that applicant answer all relevant questions as fully as possible as this will help to avoid delays in processing the application. Applicant's responses to these questions should provide the DCA Brunei with the information it needs to give proper consideration to Applicant's application.

It may be helpful to explain why this information is required. The DCA Brunei may grant a certificate only if it is satisfied that both the aerodrome and the applicant meet the safety-related requirements for certificate issue. This will involve an inspection and assessment of the aerodrome against internationally agreed criteria as laid out in Brunei Aviation Requirements, BAR 14 Volume 1 - Aerodromes and BAR 14 Volume 2 Heliports, appropriate to the nature and scale of operations proposed. The DCA Brunei also has to satisfy itself that the applicant is competent to provide a safe operating environment for aircraft.

Appendix III Aeronautical Studies

1. An Aeronautical Study is a study conducted by an aerodrome operator to assess the impact of deviations from the aerodrome requirements of BAR 14 Volume I – Aerodromes to present alternative means of compliance that ensure the safety of aircraft operations, to estimate the effectiveness of each alternative and to recommend procedures to compensate for the deviation.

2. An aeronautical study may be carried out when aerodrome requirements cannot be met as a result of development. Such a study is most frequently undertaken during the planning of a new airport or during the certification of an existing aerodrome. It may also be carried out when the aerodrome standards cannot be met as a result of development.

3. Aeronautical studies may not be conducted in cases of deviations from requirements if not specifically recommended in BAR 14 Volume I Aerodromes.

4. Technical analysis will provide justification for a deviation on the grounds that an equivalent level of safety can be attained by other means. It is generally applicable in situations where the cost of correcting a problem that violates a requirement is excessive but where the unsafe effects of the problem can be overcome by some procedural means which offers both practical and reasonable solutions.

5. In conducting a technical analysis, an aerodrome operator should draw upon their practical experience and specialized knowledge. The aerodrome operator may also consult other specialists in relevant areas. When considering alternative procedures in the deviation approval process, it is essential to bear in mind the safety objective of the aerodrome certification requirements and the applicable standards so that the intent of the requirements is not circumvented.

6. Approval of deviations. In some instances, the only reasonable means of providing an equivalent level of safety is to adopt suitable procedures and to require as a condition of certification, that cautionary advice be published in the appropriate AIS publication.

7. The determination to require caution will be primarily dependent on two considerations
   i. A pilot's need to be made aware of potentially hazardous conditions, and
   ii. The responsibility of the Brunei DCA to publish deviations from these requirements that would otherwise be assumed under certificate status.

8. Detailed guidance on the methodology to be used for Aeronautical Studies can be found in ICAO Circular 329, Assessment, Measurement and Reporting of Runway Surface Condition, Chapters 5 and 7.

Appendix IV Bird Strike Occurrence Report Form

Brunei Department of Civil Aviation

Director of Civil Aviation

Aerodromes Standards Section

Department of Civil Aviation
Ministry of Transport and Infocommunications
Brunei International Airport
Bandar Seri Begawan
BB2513 Brunei Darussalam
Email: aerodrome.regulatory@civil-aviation.gov.bn
Website: www.mtic.gov.bn/dca

Birdstrike/Wildlife Occurrence Form

To be completed on discovering evidence that a birdstrike has occurred.
To be completed for all confirmed, unconfirmed, or 'near miss' birdstrike occurrences, in accordance with the guidance and information in BAR 14.

Reporter Details
Name..... Role.....
Employer .....
Tel no ..... Date .....
Email.....
Birdstrike Details:
Confirmed ☐ Unconfirmed ☐ Near Miss ☐
Aircraft Operator.....
Aircraft type & series.....
Aircraft reg. .....
Date (dd/mm/yy) ...../...../.....
Time (local) .....: .....Hrs (24 hr)
Dawn ☐ Day ☐ Dusk ☐ Night ☐
Precipitation:
None ☐ Fog ☐ Rain ☐ Sleet/Snow ☐
Aerodrome (or Enroute) .....
Runway in use .....
Height (agl) ..... ft
Speed (IAS) ..... kt
Phase of Flight

Taxi	☐	Descent	☐
Take-off run	☐	Approach	☐
Climb	☐	Landing roll	☐
En Route	☐	Ground checks	☐
Go Around	☐		

Part(s) of Aircraft	Struck	Damaged
Radome	☐	☐
Windshield	☐	☐
Nose (if not one of the above)	☐	☐
Engine nos: 1	☐	☐
2	☐	☐
3	☐	☐
4	☐	☐
Propeller	☐	☐
Wing/rotor (inc high lift devices)	☐	☐
Fuselage	☐	☐
Landing Gear	☐	☐
Tail	☐	☐
Lights	☐	☐
Other (specify in remarks field)	☐	☐

Send to:
Brunei DCA Aerodrome Standards Section
Email: aerodrome.regulatory@civil-aviation.gov.bn

Effect on flight

None	☐	Returned	☐
Aborted t/off	☐	Diverted	☐
Loss or malfunction of any essential service			☐
Other	☐		

Other Reports raised
Mandatory Occurrence Report (MOR) ☐
Other (specify) ☐

It is important to identify the species of bird whenever possible.
Bird Species/description (e.g. Egret, Swallow, Eagle)
.....

Any Remains Found Yes ☐ No ☐

If you are not *certain* of the bird species, please send a *copy* of this form and a digital image of the remains (even the smallest of remains are useful) to:
Brunei DCA Aerodromes Standards Section.

Bird remains sent for identification Yes ☐ No ☐

Number of birds

	seen	struck *(enter actual number if known)*
1	☐	☐
2-10	☐	☐
11-100	☐	☐
100+	☐	☐

Pilot warned of birds Yes ☐ No ☐

Note 1: The reporter should ensure, irrespective of this report having been filed, that details of this birdstrike occurrence are notified to the appropriate airline or aerodrome operator, as soon as practicable.

Remarks and other relevant information:

Should this form be used for any other form of wildlife strike please provide details here (e.g Dog, Cat, Deer, Fox etc.):

Appendix V Aircraft Fuelling and Fuel Installation Management

1. General

1.1. Introduction

1.1.1. Negligence or errors made in the receipt, storage and handling of fuel can endanger an aircraft and the lives of all on board. It is essential that the correct grade and quantity of fuel is supplied and that it is in a condition fit for use in aircraft.

1.1.2. Aviation Fuel and Service Provider (AFSP) shall develop a safety programme, and shall be included in the organization safety manual.

1.1.3. Aviation Fuel and Service Provider (AFSP) that have facilities for the storage of fuel at aerodromes within Brunei Darussalam, are required to establish procedures to ensure that, throughout the processes of receiving, storing, managing, and distributing fuel, it is at all stages fit for use in aircraft.

1.1.4. Aerodrome Authority and AFSP managers shall ensure they are familiar with the requirements and the preparation of procedures for the operation of fuel installations. In this context, AFSP shall note:-

(a) that this document does not differentiate between single or multiple installations at the aerodrome, nor does it make distinction as to ownership of the installation(s);

(b) that the meaning of the term “aviation fuel installation” is any apparatus or container, including a vehicle, designed, manufactured or adapted for the storage of aviation fuel or for the delivery of such fuel to an aircraft; and

(c) that the Aerodrome Manual or the appropriate parts of it shall be made available to those whose work involves processes contained within it.

1.1.5. AFSP managers shall be required to satisfy themselves that:-

(a) Fuel received at an installation is fit for use in aircraft;

(b) The installation and the storage and dispensing processes will not render it unfit;

(c) The fuel storage and delivery system is appropriately labelled;

(d) The fuel shall be sampled on delivery into the installation; and

(e) The fuel shall be of the correct grade for the installation.

1.1.6. Brunei DCA aerodrome inspectors may seek confirmation of compliance with this document and may carry out inspections with reasonable notice period.

1.1.7. This document has been compiled in conjunction with representatives of Brunei Darussalam aviation fuel and service provider.

1.2. Scope

1.2.1. This document (BAR 14 VolumeI – Aerodromes Appendix V) is intended to provide instructions to Aviation Fuel and Service Provider (AFSP) having facilities for fuel storage within the aerodrome, regardless of how complex or simple these facilities may be. These instructions are intended to assist them in the production of procedures for fuel storage, management, handling, and distribution, and for the safe delivery of fuel to an aircraft in a condition that is fit for use. Other personnel who have a responsibility towards any part of the safe storage, management,

handling, or distribution of aviation fuel are encouraged to develop similar appropriate procedures.

1.2.2. Where an aerodrome fuel installation is managed by a third party or parties, and the appropriate published procedures of that third party meet the requirements of this document, those procedures can be used for that purpose, provided they are made available to Brunei DCA, and reference to this is made in the Aerodrome Manual.

1.2.3. The technical aspects of fuel installation construction lie outside the scope of this document, but are covered by codes of practice supported by the petroleum industry including:

(a) The Institute of Petroleum (IP), London, UK;

(b) Joint Inspection Group (JIG) London, UK; and

(c) International Air Transport Association (IATA) Technical Fuel Group (TFG)

1.2.4. Fuel installation managers shall seek the advice of the groups listed in paragraph 1.2.3 on the technical aspects of installing a fuel installation, and the procedures to be followed for maintaining it, and any associated fuel equipment, in a manner that will ensure compliance of safe operations.

1.2.5. Guidance material agreed between the major supply companies and endorsed by IATA, entitled “Guidelines for Aviation Fuel Quality Control and Operating Procedures”, may be useful to managers of fuel installations of all sizes. For further information on this document, and on the codes of best practice of the IP and the JIG, licensees may wish to contact the addressees referred to in paragraph 1.2.3 of this Appendix.

1.2.6. AFSP shall be aware that in addition to aviation-oriented requirement, the management, storage, distribution and handling of aviation fuel is subject to statutory legislation required of other regulatory bodies.

1.2.7. For technical and safety reasons Motot Gasoline shall not be dispensed into piston engine aircraft

2. Fuel Storage, Management, Handling and Distribution

2.1. General

2.1.1. AFSP shall consider:-

(a) The fire risk associated with the handling of fuel, e.g. fuel leaks, sprays, or vapour emissions;

(b) The possibility of fuel quality deterioration, e.g. contamination by; other liquids or solid particles; the passage of time; poorly maintained fuel installations and storage equipment and inappropriate handling procedures; and

(c) The risks associated with delivery to the aircraft and apron safety.

Note. AFSP shall note that fuel vapour will be released from aircraft vents during fuelling, and from fuelling vehicle vents during de-fuelling.

2.1.2. AFSP shall also consider the risks associated with those stages of the fuel handling and distribution process that relate in particular to personnel e.g. passengers and

crew, apron staff, and fuelling operatives; to fuel installations and fuel equipment; and in so doing, AFSP shall:-

(a) Identify the key responsibilities of individuals involved in the management and distribution of fuel;

(b) Ensure that all personnel involved in the processes of receiving, storing, and dispensing of fuel are suitably trained or experienced to carry out the associated tasks; and

(c) Perform periodic audits of all fuel installations on the aerodrome to ensure compliance and safe operation. The Brunei DCA aerodrome inspector may wish to see records of these audits.

2.1.3. AFSP shall provide quality control and maintenance procedures for preventing the deterioration or contamination of fuel stored in the fuel installation, procedures for the safe delivery into an aircraft of fuel fit for use, and procedures for the retention of records as required by this document.

2.1.4. Fuel management procedures shall include, but not be limited to, the following elements:-

(a) Fuel reception, storage, and quality maintenance;

(b) The assessment of fuel quality;

(c) The safe delivery into an aircraft of fuel fit for the purpose;

(d) The taking and storing of fuel samples;

(e) The onward distribution of fuel;

(f) 'Incident' prevention;

(g) 'Incident' management;

(h) Preventing or minimizing electrostatic discharge during the handling of fuel;

(i) Handling fuel during extremes of weather e.g. electric storms in the aerodrome vicinity or in high ambient temperatures;

(j) The actions to be taken shall fuel be found to be contaminated; and

(k) Regular and periodic maintenance and cleaning of fuel installations and equipment.

2.2. **Apron Safety Management**

2.2.1. In general, passengers shall be disembarked prior to the commencement of fuelling; however circumstances might prevail where this is deemed to be impractical. In these cases, fuelling/defuelling may be carried out provided:-

(a) Such fuelling/defuelling is permitted by the aerodrome authority and is requested by the airline, preferably in writing;

(b) The airline shall accepts sole responsibility for ensuring that:-

(1) The provisions relating to fuelling/defuelling in BAR 6 as amended, are carried out;

(2) Instructions are issued to its employees for the safety of all passengers during fuelling/defuelling and that these instructions are strictly observed;

(3) Passengers joining or leaving the aircraft are moved under the supervision of a responsible person over a safe rout, and are not allowed to smoke or linger, and are kept at a maximum distance from the fuelling operation;

(4) In the case of medical flights, taking into account the ability, or inability, of the patient and attendant staff to effect a rapid evacuation from the aircraft;

(5) Taking into account the ability of those whose mobility is impaired to effect a rapid evacuation from the aircraft;

(6) The ground area into which passengers would evacuate is kept clear of equipment and obstacles;

(7) Vehicles attending the aircraft do not impede access to the site by Rescue and Fire Fighting Service (RFFS) vehicles and personnel, or the egress of passengers evacuating the aircraft. and;

(8) To consider the attendance of the appropriate RFFS;

(c) Fuelling/defuelling shall be stopped if a hazardous situation, such as spillage, arises, or there is any infringement of these instructions and measures, which could lead to a dangerous incident.

Note 1. Fuelling with passenger embarkation is not permitted for commercial airplane as per BAR 6.

Note 2. Fuelling of any Avgas aircraft whilst passengers are on board is not permitted.

*Refer to Appendix VI of this document

2.2.2. Aircraft operating companies shall appoint a competent person to supervise the observance of correct aircraft fuelling procedures, and to liaise with the fuel supplier's operatives. The Fuelling Supervisor shall be aware of the requirements, the responsibilities and the safety measures of the fuelling supervisory task, and shall remain in the apron area while fuelling is taking place.

2.2.3. AFSP, airline operators, airline owners, and airport authority shall ensure that all personnel who work in the vicinity of aircraft are aware:-

(a) Of their responsibilities following an accident or incident in the Safety Area and of the appropriate actions to be taken;

(b) That shall the need arise when fuelling is taking place with passengers boarding, disembarking, or remaining on the aircraft, escape slides may be used to evacuate those on board; and

(c) That the areas into which escape slides would deploy and the immediate surrounding area shall be kept clear to enable rapid egress of passengers from the aircraft vicinity.

2.2.4. AFSP shall provide:-

(a) A “STOP” button close to each hydrant fuelling point to stop the flow of fuel immediately;

(b) The stand area emergency equipment including fire extinguishers; and

(c) The training needs associated with the use of this equipment.

2.2.5. Vehicles (including fuelling vehicles) and equipment shall be positioned so that:-

(a) They do not obstruct access by RFFS vehicles;

(b) They do not inhibit the rapid removal of the fuelling vehicle from the apron, or aircraft fuelling/parking areas shall this become necessary;

(c) They can easily and rapidly be removed;

(d) The deployment of escape slides and the egress of passengers from the area into which these slides would deploy are not obstructed; and

(e) The settling of the aircraft as its weight increases with the uplift of fuel and payload does not impinge on them.

2.2.6. Some aircraft have the facility to be fuelled through more than one fuelling point simultaneously, which may require fuel equipment to be positioned on both sides of the aircraft. In these circumstances fuelling /De-Fuelling shall not be permitted with passengers on board or embarking/disembarking the aircraft.

2.3. Helicopters

2.3.1. A helicopter shall not be refuelled when passengers are embarking, on board or disembarking or when the rotor is turning unless it is attended by the pilot-in-command or other qualified personnel ready to initiate and direct an evacuation of the helicopter by the most practical and expeditious means available.

2.3.2. When refuelling with passengers embarking, on board or disembarking, two- way communications shall be maintained by helicopter intercommunications system or other suitable means between the ground crew supervising the refuelling and the pilot-in-command or other qualified personnel required by 2.3.1 of this Appendix.

Note 1. Provisions concerning aircraft refuelling are contained in Annex 14, Volume I, and guidance on safe refuelling practices is contained in the Airport Services Manual (Doc 9137), Parts 1 and 8.

Note 2. Additional precautions are required when refuelling with fuels other than aviation kerosene or when refuelling results in a mixture of aviation kerosene with other aviation turbine fuels, or when an open line is used.

2.4. De-fuelling

2.4.1. Before de-fuelling is commenced, samples shall be taken from the drain cocks of each aircraft tank involved in the de-fuelling operation. Unsatisfactory samples do not preclude de-fuelling, but will call for particular attention and thoroughness in the cleaning of vehicles and tank installation after disposal of the fuel.

2.4.2. Until satisfactory quality checks have been completed, fuel removed from an aircraft shall be segregated from uncontaminated fuel, preferably by de- fuelling into an empty fuelling vehicle or storage tank. This potentially contaminated fuel shall be checked for water, sediment and compatibility, in order to ensure that any resultant blend with existing contents of the next receiving installation meets the appropriate product specification.

2.4.3. Chapter 4, paragraph 4.3.2 in this Appenidx lists details of the records relating to de-fuelling that shall be kept.

3. Risk Evaluation

3.1. Fire Risks

3.1.1. AFSP shall address the fire risk associated with the processes involved in the handling of fuel, taking into account the volatility of the fuels involved, the method of delivery and the potential for a hazardous fuel/air mixture and a heat/ ignition source to be present at the same time.

3.1.2. Fuel storage, management, handling, and distribution procedures required shall be developed to improve Health and Safety at Work areas to the best practice of fuelling industry codes.

3.1.3. Fuelling zone is defined in Appendix VI of this BAR, in which a potentially explosive atmosphere might exist. AFSP shall establish the circumstances in which such an atmosphere might be present in the process of fuel storage, management, handling, and distribution at the aerodrome, and shall develop procedures to mitigate the associated risks.

3.1.4. The use of any equipment with the potential to create or induce a source of ignition, shall be identified, and excluded from any Fuelling Zone. Equipment maintenance, repairs, and testing procedures, including the operation of switches, radios and other devices, with the potential to create a source of ignition within the Fuelling Zone, shall be deferred until fuelling has finished.

3.1.5. Procedures shall be established to prevent fuel ignition from other heat sources e.g. aircraft Auxiliary Power Unit exhausts, overheated wheel brakes, jet efflux from other aircraft etc.

3.1.6. AFSP shall be aware that a spark of sufficient intensity to ignite fuel vapour may be produced by the discharge of electrostatic energy (static) created either from the movement of the fuel in the aircraft tank during the fuelling process, or its accumulation on the surface of aircraft or vehicles. A description of each type together with the practices used to prevent its occurrence is given below:-

Surface accumulation: A static charge may be accumulated on the surface of the aircraft or fuelling vehicle, when conditions are favourable. Bonding can eliminate this hazard (see paragraph 3.1.7 of this Appendix).

Fuel movement accumulation: A static charge may build up in the fuel during the fuelling operation, and if of sufficiently high potential, it can cause sparking within the aircraft or storage tank. The charge density in the fuel and the possibility of sparks inside the tanks are not affected by bonding. However, the use of static dissipater additives in fuel can contribute materially to reducing the risk involved (see paragraphs 3.1.9 and 3.1.10 of this Appendix).

3.1.7. Bonding connections shall be made to designate points or to clean unpainted metal surfaces, and shall connect the installation delivering the fuel, with the aircraft or installation receiving the fuel. All connections shall be made before filler caps are removed i.e. Prior to the start of fuelling, and not broken until fuelling is complete and the filler caps have been replaced where applicable. On no account shall either the fuelling vehicle (including hydrant dispenser) or the aircraft be bonded to a fuel hydrant pit.

3.1.8. Hoses (including so called “conductive” hoses) are not considered to be suitable substitutes for dedicated clips and wires designed to provide effective bonding.

3.1.9. Fuel suppliers shall be consulted on whether the fuel being supplied contains a static dissipater additive, and on the adoption of operating procedures and engineering safeguards to minimise the hazards associated with the accumulation of static.

3.1.10. When fuelling with turbine fuels not containing a static dissipater, or where wide-cut fuels are involved, a substantial reduction in fuel flow rate is advisable to avoid fuel ignition in the tank due to electrostatic discharge. Wide-cut fuel is considered to be 'involved' when it is being supplied or when it is already present in the aircraft tanks. It is recommended that when wide-cut fuel has been used the next two uplifts of fuel shall be treated as though they too were wide-cut.

3.1.11. When initially filling a filter separator vessel the fuel flow shall be regulated to prevent an excessive build up of static electricity.

3.1.12. Mixtures of wide-cut and kerosene turbine fuels can result in the air-fuel mixture in the tank being in the combustible range at common ambient temperatures during fuelling.

3.1.13. The means for alerting the aerodrome RFFS shall be readily available. AFSP, airline operators, and aerodrome authority shall ensure that the circumstances under which the RFFS would be required e.g. fuel fire; fuel spill, over-heated wheel brakes, and the means by which it can be alerted are fully understood by those who work on the apron, or in aircraft fuelling or parking areas.

3.2. **Portable Electronic Devices (PEDs)**

3.2.1. There are three primary risks associated with the use of PEDs, such as mobile phones, pagers, and any other electronic devices which are not certified to be used in dangerous environment in the vicinity of aircraft: Fire, Distraction, and Aircraft System Interference.

3.2.1.1. Fire: The risk of a PED creating or inducing a spark of sufficient intensity to ignite fuel vapour released during fuelling is extremely remote under normal circumstances. However, licensees shall be aware of the proliferation of below-specification mobile telephone batteries that have the potential to fail dangerously. It is not known whether such a failure would be of sufficient magnitude to ignite a fuel/ air mixture, but licensees shall be aware that such a possibility exists. It is recommended that they consider the circumstances under which such an event might occur on the apron, and mitigate the associated risks accordingly.

3.2.1.2. Distraction: The known potential for a PED user to be distracted presents three associated risks:-

(a) physical contact with the aircraft by the distracted PED user could cause damage or injury;

(b) equipment being operated by a distracted PED user could cause damage to an aircraft; and

(c) PED users, distracted while performing essential safety related tasks, could leave those tasks incomplete or unattended.

Note. Aerodrome Authorities and AFSP shall be aware that the hazards at 3.2.1.2b) and 3.2.1.2c) of this Appendix are associated with actions or inactions by apron staff, and carry the potential for the effect to be concealed until a stage of flight where the safety of the aircraft could be compromised.

3.2.1.3. Aircraft System Interference: Reports have been received that the use of PEDs close to modern aircraft can interfere with fuel gauges, some navigation equipment, and can cause spurious fire warnings in cargo/baggage holds. Such interference could contribute to the risks associated with any of the following:

(a) An overweight take-off due to excessive fuel;

(b) A flight with insufficient fuel;

(c) Navigational errors; and

(d) A degradation of confidence, in the aircraft fire warning system

3.2.2. The use of PEDs on the apron area shall not be permitted, and their use shall be restricted to clearly defined and promulgated circumstances that mitigate the risks associated with their use. These mitigations shall be considered against:

(a) The volatility of the fuel type involved;

(b) The proximity of vehicle and aircraft vents, the circumstances under which they may be operated;

(c) The category of the hazard, and;

(d) The provision of an alternative non-interfering communication system

Passengers boarding or disembarking the aircraft shall be discouraged from using PEDs when outside, but in the vicinity of the aircraft.

4. Detection and Prevention of Fuel Contamination

4.1. Samples/Sampling Checks

4.1.1. Sampling checks shall be made throughout the fuel handling, storage and distribution process to ensure that the fuel is free from water and solid particle contamination, is of the appropriate grade, and is in a state fit for use by aircraft.

4.1.2. When fuel has been delivered into a fuel installation a settling period shall be allowed before a sample is taken. If a fuel sample proves to be unsatisfactory then the sampling procedure shall be repeated. If a third sample is necessary and proves to be unsatisfactory, then action shall be taken to identify the cause of contamination and no fuel shall be dispensed to aircraft from the installation concerned. It would, in this case, be advisable to inform and seek advice from the fuel supplier concerned.

4.1.3. Samples shall be taken and retained for a minimum of seven days:-

(a) from fuel stored in a bulk tank,

(b) Whenever laboratory testing is required e.g. When Jet A-1 has been stored and not added to for a period of six months or when aviation gasoline AVGAS has been stored and not added to for a period of three months.

4.1.4. In addition to when they are required by other processes, fuel samples shall be taken at the following times:-

(a) immediately before receipt into the fuel installation;

(b) after receipt of fuel into the fuel installation (after settling time);

(c) each day before the first delivery from the fuel installation;

(d) after prolonged heavy rainfall or;

(e) after de-fuelling;

(f) after vehicle washing;

(g) Immediately prior to fuelling an aircraft.

4.1.5. Fuel samples from above ground storage tanks and aircraft fuelling vehicles shall be drawn from sampling or drain cocks. A thief pump / or any other approved means shall be used for obtaining samples from buried tanks and barrelled supplies.

4.1.6. All sampling equipment shall be kept in a scrupulously clean condition. Clear glass jars with necks and screw caps shall be used for sample examination and retention. Prior to a sample being taken, the pipeline shall be “flushed” to an extent that will remove residual fuel from within it. AFSP shall seek the advice of the fuel supplier on the quantity required to achieve a satisfactory check. Fuel that is not to be retained and is found to be free of contamination can be returned to the tank.

4.1.7. Samples of fuel taken shall be clearly labelled, and retained as evidence that the fuel stored in the installation is fit for use in aircraft. They will be of particular value in demonstrating compliance following an accident occurring to an aircraft that had received fuel from the installation.

4.1.8. If samples are taken on occasions other than that shown in paragraph 4.1.3 of this Appendix they shall be drawn into similar containers. Where fuel is drawn into buckets or other metal containers e.g. for flushing, they shall be manufactured from stainless steel, and they shall be bonded to the fuel line by cable and clip prior to and during the process.

4.1.9. All retained samples shall be kept cool and stored out of daylight and be labelled with the following information:-

(a) grade of fuel;

(b) reason for sample;

(c) date and time of sample;

(d) place taken;

(e) name of sampling person.

4.1.10. It shall be noted that the use of equipment e.g. tanks, drums, filter systems and hoses intended for substances other than aviation fuels may increase the risk of contamination by water, solid particles or chemical deterioration. Where necessary the advice of the petroleum industry organizations shall be sought.

4.1.11. All fuel equipment and fuel installations shall be fully segregated from other products. Different grades of fuels shall also be segregated and ideally installations shall have separate delivery and suction lines.

4.1.12. To identify the grade of fuel they contain, all tanks and pipelines shall be labelled and colour coded in accordance with codes of practice promulgated by the petroleum industry organizations.

4.1.13. As an additional measure to avoid fuelling errors at delivery, hoses or pipes shall be marked with the appropriate grade markings or painted with a band of the appropriate primary grade indicator colour as close as practicable to the delivery nozzle, but not on the nozzle itself. Only a material that will not flake or separate from the nozzle whilst in general use, e.g. a securely attached plastic sleeve or ring shall be applied to the delivery nozzle.

4.1.14. A change of fuel grade in storage tanks can pose a risk of contamination of the new grade by residues of the previous fuel stored and therefore, where possible, such changes shall be avoided. If this is not practicable, it is recommended that guidance information to be obtained from the fuel supplier concerned or from the petroleum industry organizations.

4.2. **Visual Examination and Testing for Contamination**

4.2.1. Fuel shall be considered unfit for use in aircraft if a visual examination shows any of the following:-

(a) more than a trace of sediment;

(b) globules of water;

(c) cloudiness;

(d) a positive reaction to water-finding paste, paper or a chemical detector.

4.2.2. The following shall serve as a guide to the visual assessment of fuels:-

(a) Colour. AVGAS is available in red, blue and green, while Jet A-1 turbine fuel is un-dyed and can vary in appearance between the colour of clear water to straw yellow. The terms 'clear' and 'bright' are independent of the natural colour of the fuel. 'Clear' refers to the absence of sediment or emulsion. 'Bright' refers to the sparkling appearance of fuel free from cloud or haze.

(b) Turbine fuels shall be checked using a chemical water detector. The presence of free or suspended water is indicated by a distinct change in the colour of the paste, paper or detector element. When a single, clear, apparently colourless liquid is drawn from a container believed to contain aviation gasoline, visual testing alone is inadequate to determine whether it is pure fuel or pure water. Testing by hydrometer or water detecting paste, paper or detector element is required.

(c) Un-dissolved water (free water) will appear as droplets on the sides or as bulk water on the bottom of the sample vessel. Free water will separate quickly from AVGAS. When the fuel has water in suspension the sample will appear hazy or cloudy.

4.2.3. Solid particle contamination generally consists of small amounts of rust, sand, dust, scale etc. suspended in the fuel or settled out on the bottom of the sample vessel.

4.2.4. Water-finding paste applied to the end of a dipstick or dip tape shall be used for direct checking of turbine fuel in bulk storage, or barrels, and may be used similarly for AVGAS. Fresh paste shall be used for each check and the dipstick shall be allowed to rest on the bottom of the container for up to but no longer than 10 seconds.

4.3. **Record Keeping**

4.3.1. Written records shall be kept of:-

(a) All deliveries into fuel installations, these records shall include the grade and quantity of the fuel, the delivery date, and shall include copies of release notes or certificates of conformity.

(b) The particulars of the maintenance, including any associated rectification, and cleaning of the fuel installation. These shall include details of:-

(1) Inspections and tests;

(2) Pressure, purging, equipment, and filter checks; and

(3) Hose inspections.

(c) The particulars of fuel samples taken and the results of tests of those samples.

(d) All barrel deliveries, and of the associated decanting and dispensing of fuel, and of sampling checks.

4.3.2. Written records of de-fuelling operations shall include details of:-

(a) the aircraft registration;

(b) the date of de-fuelling;

(c) the results of sampling checks;

(d) the quantity and grade of fuel drawn; and

(e) the disposal of the fuel drawn.

4.3.3. The records referred to above shall be preserved for twelve months, or more as the Brunei DCA may in a particular case direct. They shall include details of consequential action where a defect or deficiency has been revealed and, on request, such records shall be produced to an authorized person within a reasonable time.

Appendix VI Aircraft Refuelling and Defueling

1. Fuelling Zone

The fuelling zone shall be regarded as extending not less than 6 metres radially from the filling and venting points on the aircraft and the fuelling equipment and, when applicable, from the hydrant valve in use for the fuelling. When defuelling is taking place, the vehicle will be venting and will generate a fuelling zone radiating from the tank vent.

Precautions Prior to Fuelling

(a) During fuelling operations, air and fuel vapour are displaced from the aircraft fuel tanks. This potentially explosive vapour is expelled via vent points.

(b) Within the fuelling zone, smoking and the use of naked lights shall be prohibited. Radios, radio telephones and pagers and the operation of switches on lighting systems of other than intrinsically safe types shall be forbidden. Personnel working within the fuelling zone and those engaged in fuelling shall not carry matches or other means of ignition or wear foot-wear with exposed iron or steel studs, nails or tips.

(c) Only authorized persons, vehicles shall be permitted within the fuelling zone, and the numbers of these shall be kept to a minimum. Passengers shall not be allowed within the fuelling zone and baggage/passenger reconciliation checks shall be carried out away from the fuelling zone.

(d) Unless fuelling takes place in a designated No Smoking Area, 'No Smoking' signs shall be displayed not less than 15 metres from the fuelling equipment and aircraft tank vents.

(e) Equipment with all-metal wheels or metal studded tyres capable of producing sparks shall not be moved in the fuelling zone whilst fuelling is in progress.

(f) The airline or aircraft operator shall ensure that all personnel working on, inside or in the immediate vicinity of the aircraft are made aware that fuelling is taking place.

(g) All hand torches and inspection lamps and their cable connections used within the fuelling zone shall be certified for use in such an environment or 'Intrinsically Safe.'

(h) Vehicle engines shall not be left running unnecessarily in the fuelling zones.

2. Fuelling with Passengers onboard, or Disembarking

The following are Additional Precautions for Fuelling with Passengers Onboard, or disembarking as per BAR 6.

(a) Aircraft may be fuelled with passengers onboard, or disembarking under the following conditions:

(b) A qualified Flight Crew member shall be on board and stationed in the flight deck during fuelling/ defuelling operations;

(c) In order to ensure that crew members receive prompt notification of a situation threatening safety such as a major fuel spill or a fire, two way

communication is to be maintained between the ground crew supervising the fuelling /defuelling and the Flight Crew member on board the aircraft so that the aircraft can be deplaned or evacuated as necessary;

(d) A means of communication among the Flight Crew on board the aircraft, ground/maintenance crews and fuelling/defuelling agencies is determined and established and the procedures are provided to the appropriate personnel;

(e) The aircraft engines shall not be running;

(f) During the fuelling/defuelling process:-

(1) Aircraft ground power generators or other electrical ground power supplies shall not to be connected or disconnected;

(2) Known high energy equipment such as High Frequency (HF) radios shall not be operated, unless it is in accordance with the aircraft manufacturer's approved flight manual where the manual contains procedures for the use of this equipment during fuelling/defuelling;

(3) Weather-mapping radar equipment in the aircraft shall not be operated, unless it is in accordance with the manufacturer's approved aircraft flight manual where the manual contains procedures for use, during fuelling/defuelling;

(4) Aircraft batteries shall not be removed or installed;

(5) External battery chargers shall not be connected, operated or disconnected;

(6) Aircraft-borne auxiliary power units which have an efflux discharging into the zone shall not be started after filler caps are removed or fuelling/defuelling connections are made;

(7) If an auxiliary power unit (APU) is stopped for any reason during fuelling/refuelling it shall not be restarted until the flow of fuel has ceased and there is no risk of igniting fuel vapours, however, the APU may be operated in accordance with the manufacturer's approved aircraft flight manual if the manual contains procedures for starting the APU during fuelling/defuelling;

(8) Electric tools or similar tools likely to produce sparks or arcs shall not be used;

(9) The use of electrical cabin cleaning equipment shall be kept to a minimum, and;

(10) Photographic equipment shall not be used within 3 meters of the fuelling/defueling equipment or the fill or vent points of the aircraft fuel systems.

(g) Fuelling/defuelling shall be immediately suspended when there are lightning discharges within 8 km of the airport;

(h) The aircraft shall be fuelled/defueled in accordance with manufacturer’s procedures for that type of aircraft;

(i) The aircraft emergency lighting system shall be armed or on;

(j) "No Smoking" signs on board the aircraft shall be illuminated and the "Fasten Seat Belt" signs on board the aircraft shall not be illuminated;

(k) Procedures are established to ensure that passengers do not smoke, operate portable electronic devices, or otherwise produce sources of ignition;

(l) A minimum of two exits are designated evacuation exits during fuelling/defuelling; one of which must be the entry doors through which the passengers embarked;

(m) The designated evacuation exits during fuelling/defuelling shall be identified by aircraft type and published in the Company Operations Manual, and are clear and available for immediate use by passengers and crew members shall an evacuation be required;

(n) The Air Operator shall have procedures in place to ensure that there is a ready escape route from each designated evacuation exit during fuelling/defuelling, and that designated evacuation exits which are equipped with slides have the slides armed or a crew member is in the immediate vicinity to arm the slides if required;

(o) The ready escape routes leading to each designated evacuation exit shall be kept clear and unobstructed at all time. When cleaning staff are performing their duties their presence within the ready escape routes must be kept to a minimum;

(p) A means of evacuation such as a deployed integral stair, a loading stair or a loading bridge is in place at the aircraft door used for the embarking and disembarking of passengers and is free of obstruction and available for immediate use by the aircraft occupants if necessary;

(q) The minimum number of Cabin Crew Members for the aircraft type shall be on board and positioned at or near each designated evacuation exit during fuelling/defuelling. Cabin Crew Members may be replaced by an equivalent number of other staff provided that they have successfully completed the Air Operator's approved emergency evacuation procedures training for that aircraft type;

(r) Crew members shall inform the Senior Cabin Crew Member when they are leaving the aircraft;

(s) Where desirable for climatic reasons and provided a Flight Crew member is on board, and a means of communication are available to the Cabin Crew Members. An aircraft embarking door, that is inward opening or that can be fully opened to the exterior without repositioning of loading stairs or loading bridge, may be closed and latched if necessary to keep it closed, but may not be locked; and

(t) Procedures are established to ensure that Cabin Crew Members or qualified persons replacing Cabin Crew Members in accordance with paragraph 2(q) of this Appendix are made aware of when fuelling/defuelling will take place.

Appendix VII Colours for Aeronautical Ground Lights, Markings, Signs and Panels

See Appendix 1 from ICAO Annex 14, Volume I - Aerodromes for the detailed specifications

Appendix VIII Aeronautical Ground Light Characteristics

See Appendix 2 from ICAO Annex 14, Volume I - Aerodromes for the detailed specifications

Appendix IX Mandatory Instruction Markings and Information Markings

See Appendix 3 from ICAO Annex 14, Volume I - Aerodromes for the detailed specifications

Appendix X Requirements Concerning Design of Taxiing Guidance Signs

See Appendix 4 from ICAO Annex 14, Volume I - Aerodromes for the detailed specifications

Appendix XI Location of Lights on Obstacles

See Appendix 5 from ICAO Annex 14, Volume I - Aerodromes for the detailed specifications

Appendix XII Calculation of Declared Distance

The information given below are as per Attachment A Section 3 (ATT A-3) Guidance Material Supplementary from ICAO Annex 14, Volume I, Aerodromes for the detailed specifications

3. Calculation of declared distances

3.1 The declared distances to be calculated for each runway direction comprise: the take-off run available (TORA), take-off distance available (TODA), accelerate-stop distance available (ASDA), and landing distance available (LDA).

3.2 Where a runway is not provided with a stopway or clearway and the threshold is located at the extremity of the runway, the four declared distances should normally be equal to the length of t he runway, as shown in Figure A-1 (A). (see in the next page)

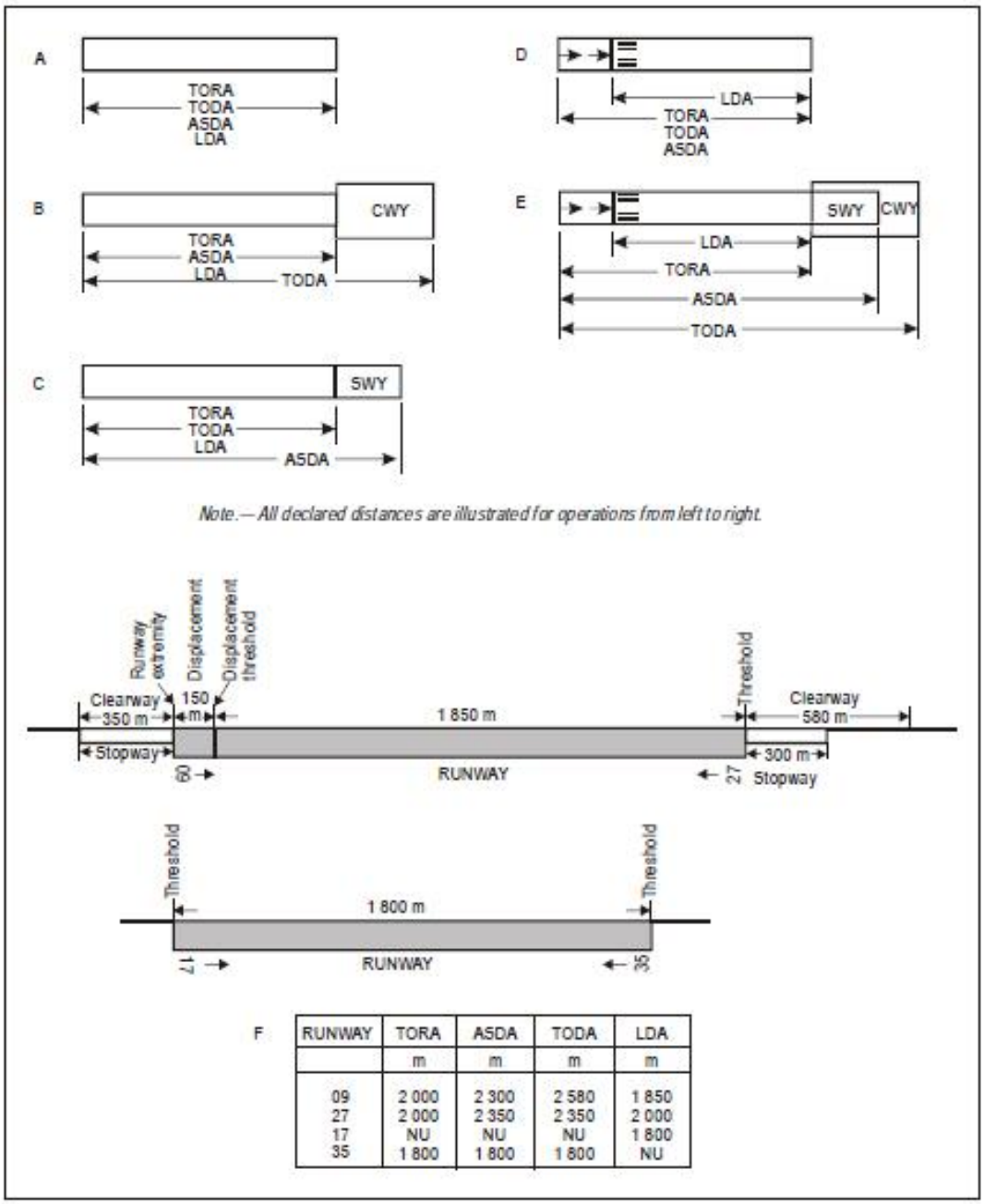
3.3 Where a runway is provided with a clearway (CWY), then the TODA will include the length of clearway, as shown in Figure A-1 (B). (see in the next page)

3.4 Where a runway is provided with a stopway (SWY), then the ASDA will include the length of stopway, as shown in Figure A-1 (C). (see in the next page)

3.5 Where a runway has a displaced threshold, then the LDA will be reduced by the distance the threshold is displaced, as shown in Figure A-1 (D). A displaced threshold affects only the LDA for approaches made to that threshold; all declared distances for operations in the reciprocal direction are unaffected. (Figure A-1 (D)see in the next page)

3.6 Figures A-1 (B) through A-1 (D) illustrate a runway provided with a clearway or a stopway or having a displaced threshold. Where more than one of these features exist, then more than one of the declared distances will be modified — but the modification will follow the same principle illustrated. An example showing a situation where all these features exist is shown in Figure A-1 (E). (see in the next page)

3.7 A suggested format for providing information on declared distances is given in Figure A-1 (F). If a runway direction cannot be used for take-off or landing, or both, because it is operationally forbidden, then this should be declared and the words “not usable” or the abbreviation “NU” entered. (Figure A-1 (F) see in the next page)



F

RUNWAY	TORA	ASDA	TODA	LDA
	m	m	m	m
09	2 000	2 300	2 580	1 850
27	2 000	2 350	2 350	2 000
17	NU	NU	NU	1 800
35	1 800	1 800	1 800	NU

Figure A-1. Illustration of declared distances

Appendix XIII Cross Reference between BAR 14 and ICAO and other provisions.

This Appendix serves two purposes. Firstly, it records the source of all the provisions in BAR 14 Volume 1. This is important when potential amendments are evaluated. Secondly, it records any differences between the provisions of BAR 14 Volume 1 and to those of the latest amendment ICAO Annex 14 Volume 1. The identification of differences is required under Article 38 of the Chicago Convention.

To enable Brunei to complete the ICAO Continuous Monitoring Approach, Compliance Checklist, any differences are marked as either A, B or C where A is where a difference is less demanding, B is where an alternative means of compliance is employed and C where a difference is more demanding.

Where there is no difference, this is listed as 'No'. However, where provisions exist in BAR 14 and there is no equivalent ICAO provision (such as the provisions for Water Aerodromes) this is listed as 'n/a'.

BAR 14 Ref.	Source	Title	Difference
Chapter 1		**General**	
1.1	Annex 14 Vol. 1	Definitions	No
1.2	CAAi	Applicability	n/a
1.3	CAAi	Purpose	n/a
1.4	CAAs	Standards and Recommended Practices	n/a
1.5	CAAi	ICAO Ann 14 Compliance	n/a
1.6	CAAi	Exemptions	n/a
1.7	Annex 14 Vol. I	Aerodrome Reference Code	No
1.8	Annex 14 Vol. I	Aerodrome Dimensions and related information	No
1.9	Annex 14 Vol. I	Strength of Pavements	No
1.10	Annex 14 Vol. I	Aeronautical Data	No
1.11	Annex 14 Vol. I	Common Reference Systems	No
1.12	Annex 14 Vol. I	Airport Design	No
1.13	Annex 14 Vol. I	Aerodrome and Runway Elevations	No
1.14	Annex 14 Vol. I	Aerodrome Reference Temperatures	No

1.15	Annex 14 Vol. I	Condition of the Movement Area and Related Facillities	No
1.16	Annex 14 Vol. I	Coordination between Aeronautical Information Services and Aerodrome Authorities	No
Chapter 2		**Aerodrome**	
2.1 – 2.3	ICAO Doc 9774	Manual on Certification	n/a
Chapter 3		**Physical Characteristics**	
3.1 – 3.15	Annex 14 Vol. 1		No
Chapter 4		**Obstacle Restriction & removal**	
4.1 – 4.4	Annex 14 Vol. 1		No
Chapter 5		**Visual Aids for Navigation Denoting Obstacles & Restricted Area**	
5.1 – 5.5	Annex 14 Vol. 1		No
Chapter 6		**Visual Aids for Denoting Obstacles**	
6.1 – 6.2	Annex 14 Vol. 1		No
Chapter 7		**Visual Aids for Denoting Restricted Areas**	
7.1 – 7.4	Annex 14 Vol. 1		No
Chapter 8		**Electrical Systems**	
8.1 – 8.3	Annex 14 Vol. 1		No
Chapter 9		**Aerodrome Operational Services, Equipment & Installation**	
9.1 – 9.11	Annex 14 Vol. 1		No
Chapter 10		**Aerodrome Maintenance**	
10.1 – 10.5	Annex 14 Vol. 1		No
Chapter 11		**Aviation Fuel**	
11.1	EU Commission Reg 139/2014	ADR.OPS.B.055 Fuel Quality	n/a

Chapter 12		**Contracted Activities**	
12.1	EU Commission Reg 139/2014	ADR.OR.D.010 Contracted Activities	n/a
Chapter 13		**Safeguarding**	
13.1	EU Commission Reg 139/2014	Article 8	n/a
13.2	EU Commission Reg 139/2014	Article 9	n/a
Chapter 14		**Water Aerodromes**	
14.1		No in use	n/a
Appendix I		**Particulars to be included in Aerodrome Manual**	
	ICAO Doc.9774	Appendix 1	No
Appendix II		**Application for Aerodrome Certification**	
	ICAO Doc. 9774	Appendix 2	No
Appendix III		**Aeronautical Studies**	
	ICAO Doc. 9774	Appendix 3	No
Appendix IV		**Bird Strike Occurrence Report Form**	
	CAAi	Standard Form	n/a
Appendix V		**Aircraft Fuelling & Fuel Installation Management**	
	CAAi	Best practice material	n/a
Appendix VI		**Aircraft Refuelling & Defuelling**	
	CAAi	Best practice material	n/a
Appendix VII		**Colours for Aeronautical Ground Lights, Markings, Signs and Panels**	
	Annex 14 Vol. 1 - App 1,		No
Appendix VIII		**Aeronautical Ground Light Characteristics,**	

	Annex 14 Vol. 1 - App 2,		No
Appendix IX		**Mandatory Instruction Markings and Information Markings**	
	Annex 14 Vol. 1 - App 3		No
Appendix X		**Requirements Concerning Design of Taxiing Guidance Signs**	
	Annex 14 Vol. 1 - App 4		No
Appendix XI		**Location of Lights on Obstacles**	
	Annex 14 Vol 1. - App 5		No
Appendix XII		**Calculation of Declared Distance**	
	Annex 14 Vol. 1 – ATT A-3		No