STATE OF LIBYA
MINISTRY OF TRANSPORT
CIVIL AVIATION AUTHORITY

دولة ليبيا
وزارة المواصلات
مصلحة الطيران المدني

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Part-139 Volume I
Aerodrome Design, Certification & Operations

Third issue, May 2023

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RECORD OF REVISIONS

No.	Date	Description / Highlights
Issue 01	2010	Initial issue
Issue 02	February 2018	New issue
Issue 03	May 2023	- New issue integrating updates of ICAO Annex 14 Ninth Edition of July 2022 - Integration of AMC & GM

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FOREWORD

1. The regulation contained herein is adopted under the provision of Article N5 of Libyan Civil Aviation Law N6 of 2005 and issued and signed up by the President of Libyan Civil Aviation by virtue of powers vested from the Minister of Transport under the resolution N154 issued on 13.05.2015.

2. This Part-139 of Libyan Civil Aviation Regulation establishes technical requirements and administrative procedures for the design, certification and operations of Aerodromes as well as certification and operating requirements for organizations providing training for aerodrome staff.

1. This Third issue of LYCAR Part-139 integrates the latest updates of ICAO Annex 14 Ninth Edition of July 2022. This regulation is in compliance with ICAO SARPs and it has also adapted regulation, associated compliance or interpretative material issued by EASA as Acceptable Means of Compliance (AMCs) and Guidance Materials (GMs) whenever possible.

2. The information contained herein is subject to constant review in the light of changing regulations and requirements. No subscriber or other reader should act on the basis of any such information without taking appropriate professional advice when/as indicated/required. Although, every effort has been made to ensure accuracy, the Libyan Civil Aviation Authority (LYCAA) shall not be held responsible for loss or damage caused by errors, omissions, misprints or misinterpretation of the content hereof.

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

4. Copies of this regulation can be obtained from the Airport Office of the LYCAA or can be downloaded on the official website: www.caa.gov.ly

5. Transition Period: The Libyan civil aviation industry is required to meet the compliancy requirements of this regulation within three months after its official publication. All new applications, after the publication of this regulation, will meet the requirements of this issue of regulation.

Dr. Mohamed Shlibek
President of LYCAA
31st of May 2023

State of Libya / Ministry of Transport ★ Civil Aviation Authority ★ Director General

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Abbreviations

ACN	Aircraft classification number
ADP	Airside driving permit
APAPI	Abbreviated Precision Approach Path Indicator
Aprx	Approximately
ASDA	Accelerate-stop distance available
ATS	Air traffic services
C	Degree Celsius
CBR	California Bearing Ratio
cd	Candela
CIE	Commission Internationale de l'Éclairage
cm	Centimeter
DME	Distance measuring equipment
E	Modulus of elasticity
FOD	Foreign object debris
ft	Foot
ILS	Instrument landing system
IMC	Instrument meteorological conditions
K	Degree Kelvin
kg	Kilogram
km	Kilometer
km/h	Kilometer per hour
kt	Knot
L	Liter
LDA	Landing distance available
LYCAA	Libyan Civil Aviation Authority
m	Meter
max	Maximum
MLS	Microwave landing system
mm	Millimeter
mnm	Minimum
MN	Meganewton
MOWP	Method of work plan
MPa	Megapascal
N/A	Not applicable
NM	Nautical mile
NU	Not usable
OCA/H	Obstacle clearance altitude/ height
OFZ	Obstacle free zone
OLS	Obstacle limitation surface
OMGWS	Outer main gear wheel span
PAPI	Precision approach path indicator
PCN	Pavement classification number
PTB	Passenger terminal building
RESA	Runway end safety area
RPAS	Remotely-piloted aircraft system
RST	Runway Safety Team
RVR	Runway visual range
TODA	Take-off distance available
TORA	Take-off run available
VMC	Visual meteorological conditions
VOR	Very high frequency omnidirectional radio range
WHMP	Wildlife hazard management program
WIP	Work in progress

Chapter 1. General

1.1. Definitions

For the purpose of this Part, when the following terms are used, they have the following meanings:

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 Civil Aviation Authority under applicable regulations 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 mapping data (AMD). Data collected for the purpose of compiling aerodrome mapping information for aeronautical uses.

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

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

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

Aerodrome traffic density. The number of movements in the mean busy hour:

- **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 of the order of 26 or more per runway or typically more than 35 total aerodrome movements.

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

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

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

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

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

Note: Guidance material of this Part-139, provides information on the concept of balanced field length and the Airworthiness Manual (Doc 9760) contains detailed guidance on matters related to take-off distance.

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

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

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

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

Arresting System. A system designed to decelerate an airplane overrunning the runway.

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

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

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

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

Certified aerodrome. An aerodrome whose operator has been granted an aerodrome certificate by the Civil Aviation Authority.

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

Continuing oversight. The tasks which are conducted for the implementation of the oversight program at any time by the Civil Aviation Authority (CAA) to verify that the conditions under which a certificate has been granted continue to be fulfilled during its period of validity.

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

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

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

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

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

Declared distances:

- **Take-off run available (TORA)**. The length of runway declared available and suitable for the ground run of an airplane 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 airplane landing.

Dependent parallel approaches. Simultaneous approaches to parallel or near-parallel instrument runways where radar separation minima between aircraft on adjacent extended runway center 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 color 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.

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

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

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

Note: Guidance on design for frangibility is contained in the Aerodrome Design Manual (Doc9157), 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.

Holdover time. The estimated time the anti-icing fluid (treatment) will prevent the formation of ice and frost and the accumulation of snow on the protected (treated) surfaces of an airplane.

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

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

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

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

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

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

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

- **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 of 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.

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

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

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

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

Near-parallel runways. Non-intersecting runways whose extended center 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 or an instrument approach procedure to a point beyond which the approach may continue in visual meteorological conditions.

Note: Visual meteorological conditions (VMC) are described in Chapter 3 of Annex 2.

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
- Extend above a defined surface intended to protect aircraft in flight; or
- 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.

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 MSL elevation.

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

Precision approach runway. See Instrument runway.

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

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

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

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

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

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

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

Note: The purpose of the runway condition code is to permit an operational airplane performance calculation by the flight crew. Procedures for the determination of the runway condition code are described in the regulation.

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

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

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

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

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

Runway Safety Team. A team comprised of representatives from [the aerodrome operator], air traffic service providers, airlines or aircraft operators, pilot and air traffic controller’s associations and any other group with a direct involvement in runway operations [at a specific aerodrome,] that advise the appropriate management on the potential runway [safety] issues and recommend mitigation strategies.

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

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

Note 2- Aircraft de-icing chemicals and other contaminants are also reported but are not included in the list of runway surface condition descriptors because their effect on runway surface friction characteristics and the runway condition code cannot be evaluated in a standardized manner.

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

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

- Slippery wet runway. A wet runway where the surface friction characteristics of a significant portion of the runway has been determined to be degraded.

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

- Standing water. Water of depth greater than 3 mm.

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

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

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

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

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 predetermined messages or no message, as applicable.

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

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

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

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

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

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

- 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 airplanes to turn off at higher speeds than are achieved on other exit taxiways thereby minimizing runway occupancy times.

Taxiway intersection. A junction of two or more taxiways.

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

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

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

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 crosswind component.

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

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

1.2. Applicability

1.2.1. The specifications, unless otherwise indicated in a particular context, shall apply to all aerodromes open to public use in accordance with the requirements of Article 15 of the Convention. The specifications of Chapter 3, shall apply only to land aerodromes. The specifications in this Regulation shall apply, where appropriate, to heliports but shall not apply to stolports.

1.2.2. Wherever a color is referred to in this Part-139, the specifications for that color given in Appendix 1 shall apply.

1.3. Common reference systems

1.3.1. Horizontal reference system

1.3.2. 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.

1.3.3. Vertical reference system

1.3.4. 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.

1.3.5. Temporal reference system

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

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

1.4. Certification of aerodromes

1.4.1. An operator of an aerodrome, in the State of Libya, that is used by an air operator for the purpose of international civil aviation shall be in possession of an aerodrome certificate issued by LYCAA.

1.4.2. An operator of an aerodrome, in the State of Libya, that is used by an air operator for the purpose of a 30-seat scheduled service for the transport of passengers shall be in possession of an aerodrome License issued by LYCAA.

1.4.3. Any other operator of an aerodrome, in the State of Libya, other than aerodrome referred to in 1.4.1 and 1.4.2, in respect of which LYCAA is of the opinion that meeting the requirements of a certified aerodrome is necessary in the interest of public safety shall be in possession of an aerodrome License issued by LYCAA.

1.4.4. As part of the certification process, LYCAA must be satisfied that an aerodrome manual which will include all pertinent information on the aerodrome site, facilities, services, equipment, operating procedures, including a safety management system, and organization structure is submitted by the applicant for approval/acceptance prior to granting the aerodrome certificate.

1.4.5. The regulatory framework for Aerodrome Certification is given in Chapter 11 of this Part-139.

1.4.6. Content and general guidelines for the preparation of the Aerodrome manual are given in Chapter 12 of this Part-139.

1.5. Airport design & master plan

1.5.1. A master plan containing detailed plans for the development of aerodrome infrastructure shall be established for aerodromes as required by LYCAA.

Note: A master plan represents the development plan of a specific aerodrome. It is developed by the aerodrome operator based on economic feasibility, traffic forecasts, and current and future requirements provided by, among others, aircraft operators.

1.5.2. The master plan shall:

a. contain a schedule of priorities including a phased implementation plan; and
b. be reviewed periodically to take into account current and future aerodrome traffic.

1.5.3. Architectural and infrastructure-related requirements for the optimum implementation of international civil aviation security measures shall be integrated into the design and construction of new facilities and alterations to existing facilities at an aerodrome.

1.5.4. The design of aerodromes shall take into account, where appropriate, land-use and environmental control measures.

1.6. Reference code

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

1.6.2. The code number for element 1 shall be determined from Table 1-1, column 1, selecting the code number corresponding to the highest value of the airplane reference field lengths of the airplanes for which the runway is intended.

1.6.3. The code letter for element 2 shall be determined from Table 1-1, column 3, by selecting the code letter which corresponds to the greatest wingspan, of the airplanes for which the facility is intended.

Table 1-1. Aerodrome reference code

Code element 1		Code element 2	
Code Number	**Airplane reference fixed length**	**Code Letter**	**Wing Span**
1	less than 800 m	A	Up to but not including 15 m
2	800 m up to but not including 1 200 m	B	15 m up to but not including 24 m
3	1 200 m up to but not including 1 800 m	C	24 m up to but not including 36 m
4	1 800 m and over	D	36 m up to but not including 52 m
		E	52 m up to but not including 65 m
		F	65 m up to but not including 80 m

1.7. Specific Procedures for Aerodrome Operations

1.7.1. These relate mainly to minimum clearance requirements and guidance is given in ICAO Aerodrome Design Manual Parts 1 and 2. However, where movement area facilities are built for future larger airplanes, the aerodrome operator must liaise with the Aerodrome Safety Department of the LYCAA to determine the interim notification of airplane reference code and maintenance arrangements. Provisions for the accommodation of more demanding aircraft at existing aerodromes can be found in the Procedure Manual. Guidance on some possible effects of future aircraft on these specifications is given in the Aerodrome Design Manual (Doc 9157), Part 2.

1.7.2. Information concerning alternative measures, operational procedures and operating restrictions implemented at an aerodrome arising from 1.7.1 shall be promulgated.

1.8. Oversight of aerodromes

1.8.1. LYCAA is provided, by this Regulation, with the necessary powers and responsibilities for the continuing oversight of aerodromes, as well as personnel and organizations involved therein, including certification of international and domestic aerodromes.

1.8.2. During the oversight activities, LYCAA shall verify:

a. compliance with the certification requirements applicable to aerodrome operators prior to the issue of a certificate;

b. continued compliance with the certification requirements of aerodrome operators subject to declaration obligation; and

c. implementation of the corrective action plan or the appropriate safety measures fixed by the aerodrome operator related to risk assessment or to a safety problem.

1.8.3. Personnel authorized by LYCAA to carry out certification and/or continuing oversight tasks are empowered to perform at least the following tasks:

a. examine the records, data, procedures and any other material relevant to the execution of the certification and/or oversight task;

b. take away copies of or extracts from such records, data, procedures and other material;

c. ask for an oral explanation on-site;

d. enter aerodromes, relevant premises, operating sites or other relevant areas and means of transport;

e. perform audits, investigations, tests, exercises, assessments and inspections;

f. take, initiate or recommend enforcement measures as appropriate.

1.8.4. LYCAA shall establish for each aerodrome operator a continued oversight program in such a way as to ensure that each subject covered by the scope of certification is subject to oversight. LYCAA shall also apply an appropriate oversight planning cycle, not exceeding 24 months.

1.8.5. The oversight program shall:

a. include within each oversight planning cycle, audits and inspections, including random inspections, as appropriate.

b. include records of the dates when audits and inspections are due and when audits and inspections have been carried out.

1.9. Demonstration of compliance

1.9.1. The aerodrome operator shall:

a. perform and document all actions, inspections, tests, safety assessments or exercises necessary, and shall demonstrate to LYCAA:

1. compliance with the notified certification requirements contained in Part-139.

2. that the aerodrome, as well as its obstacle limitation and protection surfaces and other areas associated with the aerodrome, have no features or characteristics making it unsafe for operation; and

3. that the flight procedures of the aerodrome have been approved.

b. provide to the LYCAA the means by which compliance has been demonstrated; and

c. use the checklist in the Procedure Manual to conduct a self-assessment prior to LYCAA audit certification. The result of self-assessment and the related evidences shall be sent to LYCAA prior the issuance or renewal of the certificate.

1.9.2. Relevant design information, including drawings, inspection, test and other relevant reports, shall be held and kept by the aerodrome operator at the disposal of LYCAA.

1.10. Civil Use of Military Aerodromes

1.10.1. If the national aircraft operator intends to operate a non-certified military airport, a formal application shall be submitted to LYCAA for acceptance.

1.10.2. As part of the acceptance process, LYCAA will conduct an initial assessment in coordination with the military authority in order to assess the aerodrome facilities, services, equipment, operating procedures in accordance with in the Procedure Manual and relevant parts of this regulation.

1.10.3. Where CUMA is established, the widest possible application of civil aviation regulation provisions as far as ANS, CNS and ground services and infrastructure are concerned should be pursued with regard to services provided to civil aircraft.

1.10.4. Existing differences between ICAO and specific military provisions shall be identified and addressed to allow the safe and efficient conduct of both civil and military air and ground operations.

Chapter 2. Aerodrome Data

2.1. Aeronautical data

2.1.1. 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.

2.1.2. Aerodrome mapping data shall be made available to the aeronautical information services for aerodromes deemed relevant by LYCAA where safety and/or performance-based operations suggest possible benefits.

2.1.3. Where made available in accordance with 2.1.2, the selection of the aerodrome mapping data features to be collected shall be made with consideration of the intended applications.

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

2.2. Aerodrome reference point

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

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

2.2.3. The position of the aerodrome reference point shall be measured and reported to the aeronautical information services authority in degrees, minutes and seconds.

2.3. Aerodrome and runway elevations

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

2.3.2. 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 meter or foot and reported to the aeronautical information services authority.

2.3.3. 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 meter or foot and reported to the aeronautical information services authority.

2.4. Aerodrome reference temperature

2.4.1. An aerodrome operator shall determine an aerodrome reference temperature for an aerodrome in degrees Celsius.

2.4.2. The aerodrome reference temperature shall be the monthly mean of the daily maximum temperatures for the hottest month of the year (the hottest month being that which has the highest monthly mean temperature). This temperature shall be averaged over a period of at least 5 years.

2.5. Aerodrome dimensions and related information

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

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

b. Strip, runway end safety area, stopway - length, width to the nearest meter or foot, surface type, and arresting system - location (which runway end) and description;

c. Taxiway - designation, width, surface type;

d. Apron - surface type, aircraft stands;

e. The boundaries of the air traffic control service;

f. Clearway — length to the nearest meter or foot, ground profile;

g. Visual aids for approach procedures, marking and lighting of runways, taxiways and aprons, other visual guidance and control aids on taxiways and aprons, including taxi holding positions and stop bars, and location and type of visual docking guidance systems;

h. Location and radio frequency of any VOR aerodrome checkpoint;

i. Location and designation of standard taxi-routes; and

j. Distances to the nearest meter or foot of localizer and glide path elements comprising an instrument landing system (ILS) or azimuth and elevation antenna of a microwave landing system (MLS) in relation to the associated runway extremities.

2.5.2. The geographical coordinates of each threshold shall be measured and reported to the aeronautical information services authority in degrees, minutes, seconds and hundredths of seconds.

2.5.3. The geographical coordinates of appropriate taxiway center line points shall be measured and reported to the aeronautical information services authority in degrees, minutes, seconds and hundredths of seconds.

2.5.4. The geographical coordinates of each aircraft stand shall be measured and reported to the aeronautical information services authority in degrees, minutes, seconds and hundredths of seconds.

2.5.5. The geographical coordinates of obstacles in Area 2 (the part within the aerodrome boundary) and in Area 3 shall be measured and reported to the aeronautical information services authority in degrees, minutes, seconds and tenths of seconds. In addition, the top elevation, type, marking and lighting (if any) of obstacles shall be reported to the aeronautical information services authority.

2.6. Strength of pavements

2.6.1. The bearing strength of a pavement shall be determined.

2.6.2. The bearing strength of a pavement intended for aircraft of apron (ramp) mass greater than 5 700 kg shall be made available using the aircraft classification number - pavement classification number (ACN-PCN) method by reporting all of the following information:

a. 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.

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

2.6.4. The ACN of an aircraft shall be determined in accordance with the standard procedures associated with the ACN-PCN method.

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

2.6.6. Information on pavement type for ACN-PCN determination, subgrade strength category, maximum allowable tire pressure category and evaluation method shall be reported using the following codes:

a) Pavement type for ACN-PCN determination	**Code**
Rigid pavement	R
Flexible pavement	F

b) Subgrade strength category	**Code**
High strength: characterized by K = 150 MN/m3 and representing all K values above120 MN/m3 for rigid pavements, and by CBR = 15 and representing all CBR values above 13 for flexible pavements.	A
Medium strength: characterized by K = 80 MN/m3 and representing a range in K of 60 to 120 MN/m3 for rigid pavements, and by CBR = 10 and representing a range in CBR of 8 to 13 for flexible pavements.	B
Low strength: characterized by K = 40 MN/m3 and representing a range in K of 25 to 60 MN/m3 for rigid pavements, and by CBR = 6 and representing a range in CBR of 4 to 8 for flexible pavements.	C
Ultra-low strength: characterized by K = 20 MN/m3 and representing all K values below 25 MN/m3 for rigid pavements, and by CBR = 3 and representing all CBR values below 4 for flexible pavements.	D

c) Maximum allowable tire pressure category	
Unlimited: no pressure limit	W
High: pressure limited to 1.75 MPa	X
Medium: pressure limited to 1.25 MPa	Y
Low: pressure limited to 0.50 MPa	Z

d) Evaluation method	**Code**
Technical evaluation: representing a specific study of the pavement characteristics and application of pavement behavior technology.	T
Using aircraft experience: representing a knowledge of the specific type and mass of aircraft satisfactorily being supported under regular use.	U

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

Example 1:

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

PCN 80 / R / B / W / T

Example 2:

the bearing strength of a composite pavement, behaving like a flexible pavement and resting on a high strength subgrade, has been assessed by using aircraft experience to be PCN 50 and the maximum tire pressure allowable is 1.25 MPa, then the reported information would be:

PCN 50 / F / A / Y / U

Note: Composite construction.

Example 3:

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

PCN 40 / F / B / 0.80 MPa /T

Example 4:

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

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

2.6.7. Libyan Civil Aviation Authority shall prepare guidance material to regulate the use of a pavement by an aircraft with an ACN higher than the PCN reported for that pavement in accordance with 2.6.2 and 2.6.3.

2.6.8. The bearing strength of a pavement intended for aircraft of apron (ramp) mass equal to or less than 5 700 kg shall be made available by reporting the following information:

a. Maximum allowable aircraft mass; and

b. Maximum allowable tire pressure.

Example: 4 000 kg/0.50 MPa.

Strength of pavements

Applicable as of 28 November 2024.

2.6.1 The bearing strength of a pavement shall be determined.

2.6.2 The bearing strength of a pavement intended for aircraft of apron (ramp) mass greater than 5.700 kg shall be made available using the aircraft classification rating-pavement classification rating (ACR-PCR) method by reporting all of the following information:

a) pavement classification rating (PCR) and numerical value;

b) pavement type for ACR-PCR determination;

c) subgrade strength category;

d) maximum allowable tire pressure category or maximum allowable tire pressure value; and

e) evaluation method.

2.6.3 The PCR reported shall indicate that aircraft with an aircraft classification rating (ACR) equal to or less than the reported PCR may operate on the pavement subject to any limitation on the tire pressure or aircraft all-up mass for specified aircraft type(s).

2.6.4 The ACR of an aircraft shall be determined in accordance with the standard procedures associated with the ACR-PCR method.

2.6.5 For the purposes of determining the ACR, the behavior of a pavement shall be classified as equivalent to a rigid or flexible construction.

2.6.6 Information on pavement type for ACR-PCR determination, subgrade strength category, maximum allowable tire pressure category and evaluation method shall be reported using the following codes:

a) Pavement type for ACR-PCR determination	Code
Rigid pavement	R
Flexible pavement	F

b) Subgrade strength category	Code
High strength: characterized by E = 200 MPa and representing all E values equal to or above150 MPa, for rigid and flexible pavements.	A
Medium strength: characterized by E = 120 MPa and representing a range in E values equal to or above 100 MPa and strictly less than 150 MPa, for rigid and flexible pavements.	B
Low strength: characterized by E = 80 MPa and representing a range in E values equal to or above 60 MPa and strictly less than 100 MPa, for rigid and flexible pavements.	C
Ultra-low strength: characterized by E = 50 MPa and representing all E values strictly less than 60 MPa, for rigid and flexible pavements.	D

c) Maximum allowable tire pressure category	Code
Unlimited: no pressure limit	W
High: pressure limited to 1.75 MPa	X
Medium: pressure limited to 1.25 MPa	Y
Low: pressure limited to 0.50 MPa	Z

d) Evaluation method	Code
Technical evaluation: representing a specific study of the pavement characteristics and the types of aircraft which the pavement is intended to serve.	T
Using aircraft experience: representing a knowledge of the specific type and mass of aircraft satisfactorily being supported under regular use.	U

Example 1: If the bearing strength of a rigid pavement, resting on a medium-strength subgrade, has been assessed by technical evaluation to be PCR 760 and there is no tire pressure limitation, then the reported information would be:

PCR 760 / R / B / W / T

Example 2: If the bearing strength of a composite pavement, behaving like a flexible pavement and resting on a high strength subgrade, has been assessed by using aircraft experience to be PCR 550 and the maximum allowable tire pressure is1.25 MPa, then the reported information would be:

PCR 550 / F / A / Y / U

2.6.7 Criteria shall be established to regulate the use of a pavement by an aircraft with an ACR higher than the PCR reported for that pavement in accordance with 2.6.2 and 2.6.3.

2.6.8 The bearing strength of a pavement intended for aircraft of apron (ramp) mass equal to or less than 5.700 kg shall be made available by reporting the following information:

a) maximum allowable aircraft mass; and

b) maximum allowable tire pressure.

Example: 4 800 kg/0.60 MPa.

2.7. Pre-flight altimeter check location

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

2.7.2. A pre-flight check location shall be located on an apron.

2.7.3. The elevation of a pre-flight altimeter check location shall be given as the average elevation, rounded to the nearest meter or foot, of the area on which it is located. The elevation of any portion of a pre-flight altimeter check location shall be within 3 m (10 ft) of the average elevation for that location.

2.8. Declared distances

The following distances shall be calculated to the nearest meter or foot for a runway intended for use by international commercial air transport:

a. Take-off run available;

b. Take-off distance available;

c. Accelerate-stop distance available; and

d. Landing distance available.

2.9. Condition of the movement area and related facilities

2.9.1. 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.

2.9.2. 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. Water on the runway, a taxiway or an apron;

d. other temporary hazards, including parked aircraft;

e. failure or irregular operation of part or all of the aerodrome visual aids; and

f. failure of the normal or secondary power supply.

2.9.3. To facilitate compliance with 2.9.1 and 2.9.2, the following inspections shall be carried out each day:

a. for the movement area, at least once where the aerodrome reference code number is 1 or 2 and at least twice where the aerodrome reference code number is 3 or 4; and

b. for the runway(s), inspections in addition to a) whenever the runway surface conditions may have changed significantly due to meteorological conditions.

2.9.4. Personnel assessing and reporting runway surface conditions required in 2.9.2 and 2.9.5 shall be trained and competent to perform their duties

Runway surface condition(s) for use in the runway condition report

2.9.5. The runway surface condition shall be assessed and reported through a runway condition code (RWYCC) and a description using the following terms:

- Dry
- Standing water
- Wet
- Chemically treated
- Loose sand

2.9.6. Whenever an operational runway is contaminated, an assessment of the contaminant depth and coverage over each third of the runway shall be made and reported.

2.9.7. Information that a runway or portion thereof is slippery wet shall be made available.

Test equipment	Test tire Type	Test tire Pressure (kPa)	Test speed (km/h)	Test water depth (mm)	Design objective for new surface	Maintenance planning level	Minimum friction level
(1)	(2)		(3)	(4)	(5)	(6)	(7)
Mu-meter Trailer	A	70	65	1.0	0.72	0.52	0.42
	A	70	95	1.0	0.66	0.38	0.26
Skiddometer Trailer	B	210	65	1.0	0.82	0.60	0.50
	B	210	95	1.0	0.74	0.47	0.34
Surface Friction Tester Vehicle	B	210	65	1.0	0.82	0.60	0.50
	B	210	95	1.0	0.74	0.47	0.34
Runway Friction Tester Vehicle	B	210	65	1.0	0.82	0.60	0.50
	B	210	95	1.0	0.74	0.54	0.41
TATRA Friction Tester Vehicle	B	210	65	1.0	0.76	0.57	0.48
	B	210	95	1.0	0.67	0.52	0.42
RUNAR Trailer	B	210	65	1.0	0.69	0.52	0.45
	B	210	95	1.0	0.63	0.42	0.32
GRIPTESTER Trailer	C	140	65	1.0	0.74	0.53	0.43
	C	140	95	1.0	0.64	0.36	0.24

Table 2-1 Runway surface condition levels

2.9.8. Notification shall be given to relevant aerodrome users when the friction level of a paved runway or portion thereof is less than the minimum friction level specified by the LYCAA in accordance with 10.2.3.

2.10. Disabled aircraft removal

2.10.1. The telephone number of the office of the aerodrome coordinator of operations for the removal of an aircraft disabled on or adjacent to the movement area shall be made available, on request, to aircraft operators.

2.10.2. Information concerning the capability to remove an aircraft disabled on or adjacent to the movement area shall be made available in the Aerodrome Manual and AIP.

2.11. Rescue and firefighting

2.11.1. Information concerning the level of protection provided at an aerodrome for aircraft rescue and firefighting purposes shall be made available in the Aerodrome Manual and AIP.

2.11.2. The level of protection normally available at an aerodrome shall be expressed in terms of the category of the rescue and firefighting services as described in 9.2 and in accordance with the types and amounts of extinguishing agents normally available at the aerodrome.

2.11.3. Changes in the level of protection normally available at an aerodrome for rescue and firefighting shall be notified to the appropriate air traffic services units and aeronautical information services units to enable those units to provide the necessary information to arriving and departing aircraft. When such a change has been corrected, the above units shall be advised accordingly.

2.11.4. A change shall be expressed in terms of the new category of the rescue and firefighting service available at the aerodrome.

2.12. Visual approach slope indicator systems

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

a. Associated runway designation number;

b. Type of system according to 5.3.5.2. For PAPI or APAPI installation, the side of the runway on which the lights are installed, i.e., left or right, shall be given;

c. Where the axis of the system is not parallel to the runway center line, the angle of displacement and the direction of displacement, i.e., left or right, shall be indicated;

d. Nominal approach slope angle(s). For a PAPI and an APAPI this shall be angle (B + C) ÷ 2 and (A + B) ÷ 2, respectively as in Figure 5-18; and

e. Minimum eye height(s) over the threshold of the on-slope signal(s). For a PAPI this shall be the setting angle of the third unit from the runway minus 2′, i.e., angle B minus 2′, and for an APAPI this shall be the setting angle of the unit farther from the runway minus 2′, i.e., angle A minus 2′.

f. Evidence of calculations of approach slope angle and its correlation with instrument approach procedure, and of MHT.

2.13. Coordination between aeronautical information services & aerodrome authorities

2.13.1. 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 of aeronautical information services unit, after LYCAA approval, with a minimum of delay:

a. Information on the status of certification of aerodromes and aerodrome conditions (ref. 1.4, 2.9, 2.10, 2.11 and 2.12);

b. The operational status of associated facilities, services and navigation aids within their area of responsibility.

2.13.2. Before introducing changes to the air navigation system and after LYCAA approval, 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.

2.13.3. 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 and Appendix 4. The predetermined, internationally agreed AIRAC effective dates in addition to 14 days postage time shall be observed by the responsible aerodrome services when submitting the raw information/data to aeronautical information services.

2.13.4. 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 required to meet the needs of the end-user of aeronautical data.

Chapter 3. Physical characteristics

3.1. Runways

3.1.1. The number and orientation of runways at an aerodrome shall be such that the usability factor of the aerodrome is not less than 95% for the airplanes that the aerodrome is intended to serve.

3.1.2. The siting and orientation of runways at an aerodrome shall, 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. Choice of maximum permissible crosswind components:

In the application of 3.1.1, it shall be assumed that landing or take-off of airplanes is, in normal circumstances, precluded when the crosswind component exceeds:

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

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

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

3.1.4. Data to be used

The selection of data to be used for the calculation of the usability factor shall be based on reliable wind distribution statistics that extend over not less than five years. The observations used shall be made at least eight times daily and spaced at equal intervals of time.

Location of threshold

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

3.1.6. When it is necessary to displace a threshold, either permanently or temporarily, from its normal location, account shall be taken of the various factors which may have a bearing on the location of the threshold. Where this displacement is due to an unserviceable runway condition, a cleared and graded area of at least 60 m in length shall be available between the unserviceable area and the displaced threshold. Additional distance shall also be provided to meet the requirements of the runway end safety area as appropriate.

Actual length of runways

3.1.7. Primary runway

Except as provided in 3.1.9, the actual runway length to be provided for a primary runway shall be adequate to meet the operational requirements of the airplanes for which the runway is intended and shall be not less than the longest length determined by applying the corrections for local conditions to the operations and performance characteristics of the relevant airplanes.

3.1.8. Secondary runway

The length of a secondary runway shall be determined similarly to primary runways except that it needs only to be adequate for those airplanes 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. Runways with stopways or clearways

Where a runway is associated with a stopway or clearway, an actual runway length less than that resulting from application of 3.1.7 or 3.1.8, as appropriate, may be considered satisfactory, but in such a case any combination of runway, stopway and clearway provided shall permit compliance with the operational requirements for take-off and landing of the airplanes the runway is intended to serve.

Width of runways

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

	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
1a	18m	18m	23m	--
2a	23m	23m	30m	--
3	30m	30m	30m	45m
4	--	--	45m	45m

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

Minimum distance between parallel runways

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

- 210 m where the higher code number is 3 or 4;
- 150 m where the higher code number is 2; and
- 120 m where the higher code number is 1.

3.1.12. 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 center lines shall be:

- 1 035 m for independent parallel approaches;
- 915 m for dependent parallel approaches;
- 760 m for independent parallel departures;
- 760 m for segregated parallel operations;

Except that:

a. For segregated parallel operations, the specified minimum distance:

  i. 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

  ii. shall be increased by 30 m for each 150 m that the arrival runway is staggered away from the arriving aircraft;

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

Slopes on runways

3.1.13. Longitudinal slopes

The slope computed by dividing the difference between the maximum and minimum elevation along the runway center line by the runway length shall not exceed:

- 1 per cent where the code number is 3 or 4; and
- 2 Per cent where the code number is 1 or 2.

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

- 1.25 per cent where the code number is 4, except that for the first and last quarter of the length of the runway the longitudinal slope shall not exceed 0.8 per cent;
- 1.5 per cent where the code number is 3, except that for the first and last quarter of the length of a precision approach runway category II or III the longitudinal slope shall not exceed 0.8 per cent; and
- 2 Per cent where the code number is 1 or 2.

3.1.15. Longitudinal slope changes

Where slope changes cannot be avoided, a slope change between two consecutive slopes shall not exceed:

- 1.5 per cent where the code number is 3 or 4; and
- 2 Per cent where the code number is 1 or 2.

3.1.16. The transition from one slope to another shall be accomplished by a curved surface with a rate of change not exceeding:

- per cent per 30 m (minimum radius of curvature of 30 000 m) where the code number is 4;
- per cent per 30 m (minimum radius of curvature of 15 000 m) where the code number is 3; and
- per cent per 30 m (minimum radius of curvature of 7 500 m) where the code number is 1 or 2.

3.1.17. Sight distance

Where slope changes cannot be avoided, they shall be such that there will be an unobstructed line of sight from:

- any point 3 m above a runway to all other points 3 m above the runway within a distance of at least half the length of the runway where the code letter is C, D, E or F;
- any point 2 m above a runway to all other points 2 m above the runway within a distance of at least half the length of the runway where the code letter is B; and
- any point 1.5 m above a runway to all other points 1.5 m above the runway within a distance of at least half the length of the runway where the code letter is A.

3.1.18. Distance between slope changes

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

1. The sum of the absolute numerical values of the corresponding slope changes multiplied by the appropriate value as follows:

   - 30 000 m where the code number is 4;
   - 15 000 m where the code number is 3; and
   - 5 000 m where the code number is 1 or 2; or

2. b) 45 m;

Whichever is greater.

3.1.19. Transverse slopes

To promote the most rapid drainage of water, the runway surface shall, if practicable, be cambered except where a single cross fall from high to low in the direction of the wind most frequently associated with rain would ensure rapid drainage. The transverse slope shall ideally be:

- 1.5 per cent where the code letter is C, D, E or F; and
- 2 per cent where the code letter is A or B;

But in any event shall not exceed 1.5 per cent or 2 per cent, as applicable, nor be less than 1 per cent except at runway or taxiway intersections where flatter slopes may be necessary.

For a cambered surface the transverse slope on each side of the center line shall be symmetrical.

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

Strength of runways

3.1.21. A runway shall be capable of withstanding the traffic of airplanes 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 airplane.

3.1.23. A paved runway shall be so constructed or resurfaced as to provide surface friction characteristics at or above the minimum friction levels stated in Table 2-1 (refer to 2.9.7).

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

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

3.1.26. The average surface texture depth of a new surface is recommended to be not less than 1.0 mm.

3.1.27. When the surface is grooved or scored, the grooves or scorings shall be either perpendicular to the runway center line or parallel to non-perpendicular transverse joints, where applicable.

3.2. Runway Shoulders

General

3.2.1. Runway Shoulders shall be provided for a runway where the code letter is D, E or F

Width of runway Shoulders

3.2.2. For airplanes with OMGWS from 9 m up to but not including 15 m, the runway Shoulders shall extend symmetrically on each side of the runway so that the overall width of the runway and its Shoulders is not less than:

- 60 m where the code letter is D or E;
- 75 m where the code letter is F

Slopes on runway Shoulders

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

Strength of runway Shoulders

3.2.4. The portion of a runway Shoulder between the runway edge and a distance of 30 m from the runway centerline shall be prepared or constructed so as to be capable, in the event of an airplane running off the runway, of supporting the airplane without inducing structural damage to the airplane and of supporting ground vehicles which may operate on the Shoulder.

Surface of runway Shoulders

3.2.5. A runway Shoulder shall be paved so as to resist erosion and the ingestion of the surface material by airplane engines.

3.2.6. Runway Shoulders for code letter F airplanes shall be paved to a minimum overall width of runway and Shoulder of not less than 60 m.

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 airplanes.

3.3.2. Where the end of a runway is not served by a taxiway or a taxiway turnaround and where the code letter is A, B or C, a runway turn pad shall be provided to facilitate a 180-degree turn of airplanes.

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

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

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

Outer Main Gear Wheel Span (OMGWS)				
	Up to but not including 4.5 m	4.5 m up to but not including 6 m	6 m up to but not including 9 m	9 m up to but not including 15 m
Clearance	1.50m	2.25m	3m* or 4m**	4m

- *: If the turn pad is intended to be used by airplanes with a wheel base less than 18 m.
- **: If the turn pad is intended to be used by airplanes with a wheel base equal to or greater than 18 m.

Slopes on runway turn pads

3.3.7. The longitudinal and transverse slopes on a runway turn pad shall be sufficient to prevent the accumulation of water on the surface and facilitate rapid drainage of surface water. The slopes shall be the same as those on the adjacent runway pavement surface.

Strength of runway turn pads

3.3.8. The strength of a runway turn pad shall be at least equal to that of the adjoining runway which it serves, due consideration being given to the fact that the turn pad will be subjected to slow-moving traffic making hard turns and consequent higher stresses on the pavement.

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 airplane using the turn pad.

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

Shoulders for runway turn pads

3.3.11. The runway turn pads shall be provided with Shoulders of such width as is necessary to prevent surface erosion by the jet blast of the most demanding airplane for which the turn pad is intended, and any possible foreign object damage to the airplane engines.

3.3.12. The strength of runway turn pad Shoulders shall be capable of withstanding the occasional passage of the airplane it is designed to serve without inducing structural damage to the airplane 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:

- 60 m where the code number is 2, 3 or 4;
- 60 m where the code number is 1 and the runway is an instrument one; and
- 30 m where the code number is 1 and the runway is a non-instrument one.

Width of runway strips

3.4.3. A strip including a precision approach runway shall extend laterally to a distance of:

- 140 m where the code number is 3 or 4; and
- 70 m where the code number is 1 or 2;

On each side of the center line of the runway and its extended center line throughout the length of the strip.

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

- 140 m where the code number is 3 or 4; and
- 70 m where the code number is 1 or 2;

On each side of the center line of the runway and its extended center line throughout the length of the strip.

3.4.5. A strip including a non- instrument runway shall extend on each side of the center line of the runway and its extended center line throughout the length of the strip, to a distance of at least:

- 75 m where the code number is 3 or 4;
- 40 m where the code number is 2; and
- 30 m where the code number is 1.

Objects on runway strips

3.4.6. An object situated on a runway strip which may endanger airplanes shall be regarded as an obstacle and shall, 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 any part of a runway strip of a precision approach runway delineated by the lower edges of the inner transitional surfaces.

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

Grading of runway strips

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

- 75 m where the code number is 3 or 4; and
- 40 m where the code number is 1 or 2;

From the center line of the runway and its extended center line shall provide a graded area for airplanes which the runway is intended to serve in the event of an airplane running off the runway.

3.4.9. That portion of a strip of a non-instrument runway within a distance of at least:

- 75 m where the code number is 3 or 4;
- 40 m where the code number is 2; and

- 30 m where the code number is 1;

From the center line of the runway and its extended center line shall provide a graded area for airplanes which the runway is intended to serve in the event of an airplane 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. That portion of a strip to at least 30 m before the start of a runway shall be prepared against blast erosion in order to protect a landing airplane from the danger of an exposed edge.

3.4.12. Where the areas in 3.4.11 have paved surfaces, they shall be able to withstand the occasional passage of the critical airplane for runway pavement design.

Slopes on runway strips

3.4.13. Longitudinal slopes

A longitudinal slope along that portion of a strip to be graded shall not exceed:

- 1.5 per cent where the code number is 4;
- 1.75 per cent where the code number is 3; and
- 2 Per cent where the code number is 1 or 2.

3.4.14. Longitudinal slope changes

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

3.4.15. Transverse slopes

Transverse slopes on that portion of a strip to be graded shall be adequate to prevent the accumulation of water on the surface but shall not exceed:

- 2.5 per cent where the code number is 3 or 4; and
- 3 per cent where the code number is 1 or 2;

Except that to facilitate drainage the slope for the first 3 m outward from the runway, Shoulder or stopway edge shall be negative as measured in the direction away from the runway and may be as great as 5 per cent.

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

Strength of runway strips

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

- 75 m where the code number is 3 or 4; and
- 40 m where the code number is 1 or 2;

From the center line of the runway and its extended center line shall be so prepared or constructed as to minimize hazards arising from differences in load-bearing capacity to airplanes which the runway is intended to serve in the event of an airplane running off the runway.

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

- 75 m where the code number is 3 or 4;
- 40 m where the code number is 2; and
- 30 m where the code number is 1;

From the center line of the runway and its extended center line shall be so prepared or constructed as to minimize hazards arising from differences in load-bearing capacity to airplanes which the runway is intended to serve in the event of an airplane running off the runway.

3.5. Runway end safety areas

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

- The code number is 3 or 4; and
- The code number is 1 or 2 and the runway is an instrument one.

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

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:

- the code number is 3 or 4; and
- the code number is 1 or 2 and the runway is an instrument one.

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

3.5.4. Not applicable.

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

3.5.6. The width of a runway end safety area shall, wherever practicable, be equal to that of the graded portion of the associated runway strip.

Objects on runway end safety areas

3.5.7. An object situated on a runway end safety area which may endanger airplanes shall be regarded as an obstacle and shall, as far as practicable, be removed.

Clearing and grading of runway end safety areas

3.5.8. A runway end safety area shall provide a cleared and graded area for airplanes which the runway is intended to serve in the event of an airplane undershooting or overrunning the runway.

Slopes on runway end safety areas

3.5.9. General

The slopes of a runway end safety area shall be such that no part of the runway end safety area penetrates the approach or take-off climb surface.

3.5.10. Longitudinal slopes

The longitudinal slopes of a runway end safety area shall not exceed a downward slope of 5 per cent. Longitudinal slope changes shall be as gradual and avoiding abrupt changes or sudden reversals of slopes.

3.5.11. Transverse slopes

The transverse slopes of a runway end safety area shall not exceed an upward or downward slope of 5 per cent. Transitions between differing slopes shall be gradual.

Strength of runway end safety areas

3.5.12. A runway end safety area shall be prepared or constructed as to reduce the risk of damage to an airplane undershooting or overrunning the runway, enhance airplane deceleration and facilitate the movement of rescue and firefighting vehicles as required in 9.2.35 to 9.2.37.

3.6. Clearways

If a Clearway is provided then the following design specifications shall be met:

Location of clearways

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

Length of clearways

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

Width of clearways

3.6.3. A clearway shall extend laterally on each side of the extended center line of the runway, to a distance of at least:

- 75 m for instrument runways; and
- half of the width of the runway strip for non-instrument runways.

Slopes on clearways

3.6.4. The ground in a clearway shall not project above a plane having an upward slope of 1.25 per cent, the lower limit of this plane being a horizontal line which:

- Is perpendicular to the vertical plane containing the runway center line; and
- Passes through a point located on the runway center line at the end of the takeoff run available.

3.6.5. Abrupt upward changes in slope shall be avoided when the slope on the ground in a clearway is relatively small or when the mean slope is upward. In such situations, in that portion of the clearway within a distance of 22.5 m or half the runway width whichever is greater on each side of the extended center line, the slopes, slope changes and the transition from runway to clearway shall generally conform with those of the runway with which the clearway is associated.

Objects on clearways

3.6.6. An object situated on a clearway which may endanger airplanes in the air shall be regarded as an obstacle and shall 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. Slopes and changes in slope on a stopway, and the transition from a runway to a stopway, shall comply with the specifications of 3.1.13 to 3.1.19 for the runway with which the stopway is associated except that:

- 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

- 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 10.000m) for a runway where the code number is 3 or 4.

Strength of stopways

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

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. A radio altimeter operating area shall be established in the pre-threshold area of a precision approach runway.

Length of the area

3.8.2. A radio altimeter operating area shall extend before the threshold for a distance of at least 300 m.

Width of the area

3.8.3. A radio altimeter operating area shall extend laterally, on each side of the extended center 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. On a radio altimeter operating area, slope changes shall be avoided or kept to a minimum.

Where slope changes cannot be avoided, the slope changes shall be as gradual as practicable and abrupt changes or sudden reversals of slopes avoided. The rate of change between two consecutive slopes shall not exceed 2 per cent per 30 m.

3.9. Taxiways

General

3.9.1. Taxiways shall be provided to permit the safe and expeditious surface movement of aircraft.

3.9.2. Sufficient entrance and exit taxiways for a runway shall be provided to expedite the movement of airplanes 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 airplane for which the taxiway is intended remains over the taxiway center line markings, the clearance distance between the outer main wheel of the airplane and the edge of the taxiway shall be not less than that given by the following tabulation:

Outer Main Gear Wheel Span (OMGWS)				
	Up to but not including 4.5 m	4.5 m up to but not including 6 m	6 m up to but not including 9 m	9 m up to but not including 15 m
Clearance	1.50m	2.25m	3m*, ** or 4m***	4m

*: On straight portions.

**: On curved portions if the taxiway is intended to be used by airplanes with a wheel base of less than 18 m.

***: On curved portions if the taxiway is intended to be used by airplanes with a wheel base equal to or greater than 18 m.

Width of taxiways

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

Outer Main Gear Wheel Span (OMGWS)				
	Up to but not including 4.5 m	4.5 m up to but not including 6 m	6 m up to but not including 9 m	9 m up to but not including 15 m
Taxiway width	7.5m	10.5m	15m	23m

Taxiway curves

3.9.5. Changes in direction of taxiways shall be as few and small as possible. The radii of the curves shall be compatible with the maneuvering capability and normal taxiing speeds of the airplanes for which the taxiway is intended. The design of the curve shall be such that, when the cockpit of the airplane remains over the taxiway center line markings, the clearance distance between the outer main wheels of the airplane and the edge of the taxiway shall not be less than those specified in 3.9.3.

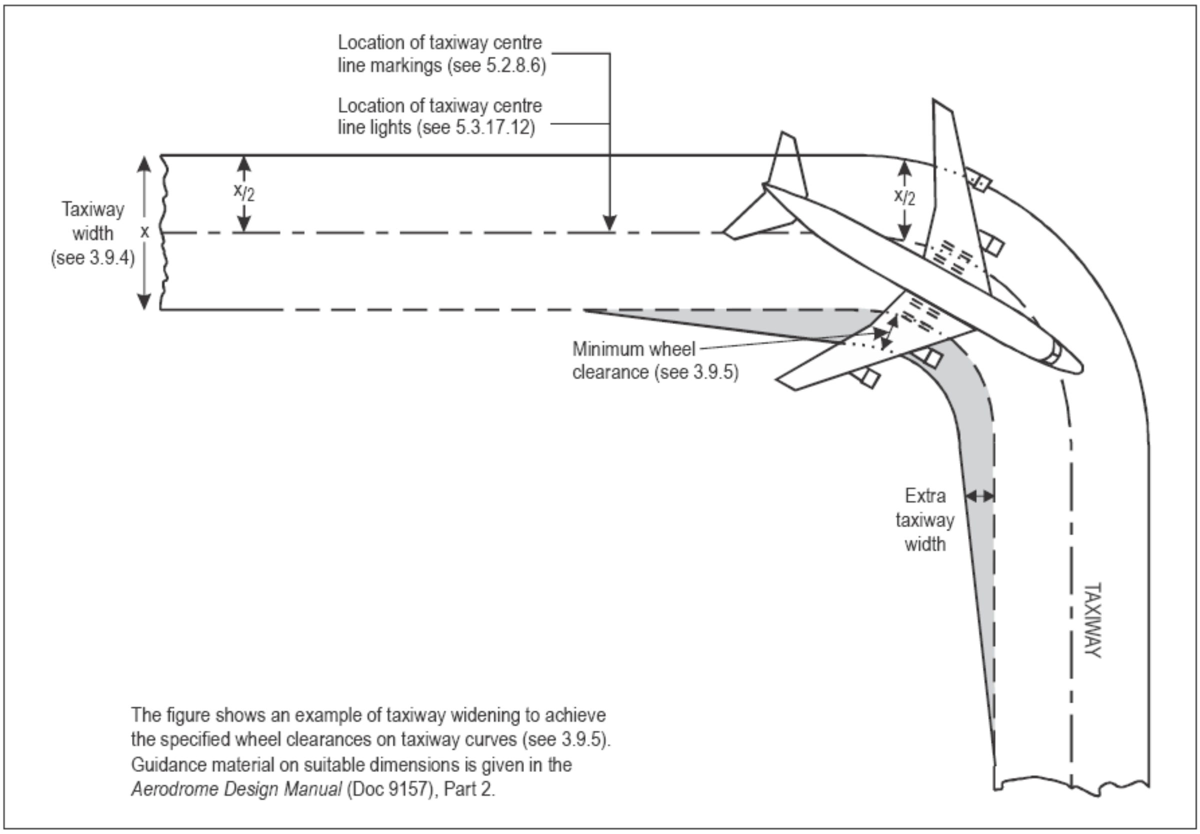


Figure 3.2. Taxiway curve

Junctions and intersections

3.9.6. To facilitate the movement of airplanes, fillets shall be provided at junctions and intersections of taxiways with runways, aprons and other taxiways. The design of the fillets shall ensure that the minimum wheel clearances specified in 3.9.3 are maintained when airplanes are maneuvering through the junctions or intersections.

Taxiway minimum separation distances

3.9.7. The separation distance between the center line of a taxiway and the center line of a runway, the center line of a parallel taxiway or an object shall not be less than the appropriate dimension specified in Table 3-1, except that it may be permissible to operate with lower separation distances at an existing aerodrome if an aeronautical study indicates that such lower separation distances would not adversely affect the safety or significantly affect the regularity of operations of airplanes.

Slopes on taxiways

3.9.8. Longitudinal slopes

The longitudinal slope of a taxiway shall not exceed:

- 1.5 per cent where the code letter is C, D, E or F; and
- 3 per cent where the code letter is A or B.

3.9.9. Longitudinal slope changes

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

- 1 per cent per 30 m (minimum radius of curvature of 3 000 m) where the code letter is C, D, E or F; and
- 1 per cent per 25 m (minimum radius of curvature of 2 500 m) where the code letter is A or B

Table 3-1 Taxiway minimum separation distances

Code letter	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							
	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

3.9.10. Sight distance

Where a change in slope on a taxiway cannot be avoided, the change shall be such that, from any point:

- 3m above the taxiway, it will be possible to see the whole surface of the taxiway for a distance of at least 300m from that point, where the code letter is C, D, E or F;
- 2m above the taxiway, it will be possible to see the whole surface of the taxiway for a distance of at least 200m from that point, where the code letter is B; and
- 1.5m above the taxiway, it will be possible to see the whole surface of the taxiway for a distance of at least 150m from that point, where the code letter is A.

3.9.11. Transverse slopes

The transverse slopes of a taxiway shall be sufficient to prevent the accumulation of water on the surface of the taxiway but shall not exceed:

- 1.5 per cent where the code letter is C, D, E or F; and
- 2 per cent where the code letter is A or B.

3.9.12. The strength of a taxiway shall 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 airplanes, to higher stresses than the runway it serves.

Surface of taxiways

3.9.13. The surface of a taxiway shall not have irregularities that cause damage to airplane structures.

3.9.14. The surface of a paved taxiway shall be so constructed or resurfaced as to provide suitable surface friction characteristics.

Rapid exit taxiways

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

- 550m where the code number is 3 or 4; and
- 275m where the code number is 1 or 2;

To enable exit speeds under wet conditions of:

- 93 km/h where the code number is 3 or 4; and

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

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

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

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

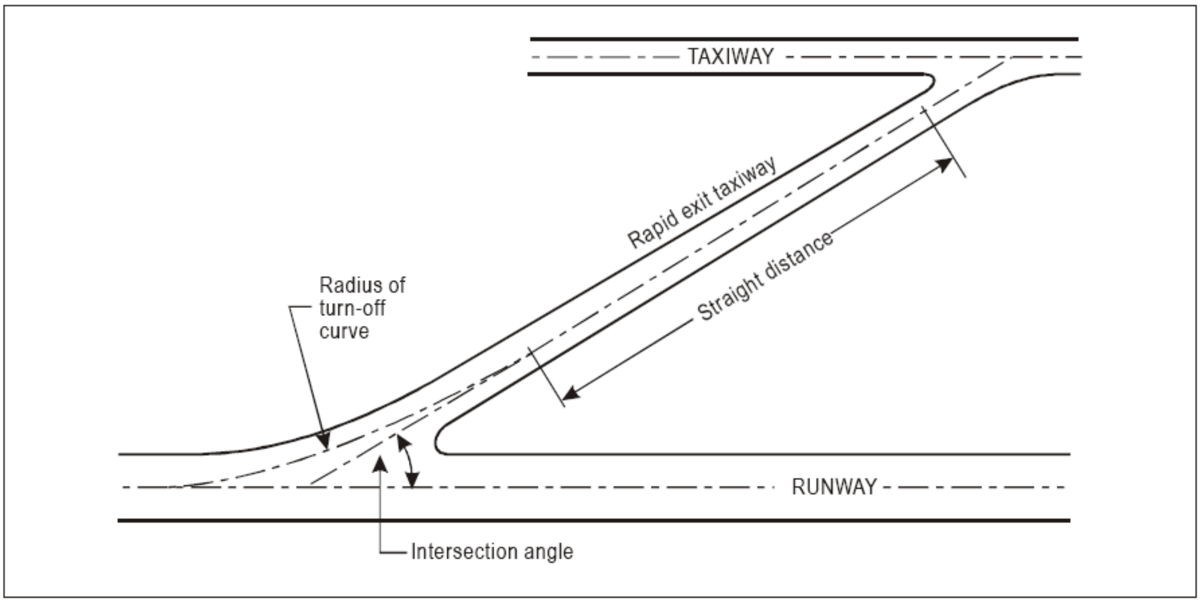


Figure 3.3. Rapid exit taxiway

Taxiways on bridges

3.9.19. The width of that portion of a taxiway bridge capable of supporting airplanes, as measured perpendicularly to the taxiway center 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 airplanes for which the taxiway is intended.

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

3.9.21. A bridge shall be constructed on a straight section of the taxiway with a straight section on both ends of the bridge to facilitate the alignment of airplanes approaching the bridge.

3.10. Taxiway Shoulders

3.10.1. Straight portions of a taxiway where the code letter is C, D, E or F shall be provided with Shoulders which extend symmetrically on each side of the taxiway so that the overall width of the taxiway and its Shoulders on straight portions is not less than:

- 44 m where the code letter is F;
- 38 m where the code letter is E;
- 34 m where the code letter is D; and
- 25 m where the code letter is C.

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

3.10.2. When a taxiway is intended to be used by turbine-engined airplanes, the surface of the taxiway Shoulder shall be so prepared as to resist erosion and the ingestion of the surface material by airplane 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. A taxiway strip shall extend symmetrically on each side of the center line of the taxiway throughout the length of the taxiway to at least the distance from the center line given in Table 3-1, column 11.

Objects on taxiway strips

3.11.3. The taxiway strip shall provide an area clear of objects which may endanger taxiing airplanes.

Grading of taxiway strips

3.11.4. The center portion of a taxiway strip shall provide a graded area to a distance from the center 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

Slopes on taxiway strips

3.11.5. The surface of the strip shall be flush at the edge of the taxiway or Shoulder, if provided, and the graded portion shall not have an upward transverse slope exceeding:

- 2.5 per cent for strips where the code letter is C, D, E or F; and
- 3 per cent for strips of taxiways where the code letter is A or B;

The upward slope being measured with reference to the transverse slope of the adjacent taxiway surface and not the horizontal. The downward transverse slope shall not exceed 5 per cent measured with reference to the horizontal.

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

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

General

3.12.1. Holding bay(s) shall be provided when justified by high traffic volume.

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

- On the taxiway, at the intersection of a taxiway and a runway; and
- 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. An intermediate holding position shall be established on a taxiway at any point other than a runway-holding position where it is desirable to define a specific holding limit.

3.12.5. 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 center line of a runway shall be in accordance with Table 3-2 and, in the case of a precision approach runway, such that a holding aircraft or vehicle will not interfere with the operation of radio navigation aids or penetrate the inner transitional surface.

3.12.7. At elevations greater than 700 m (2 300 ft), the distance of 90 m specified in Table 3-2 for a precision approach runway code number 4 shall be increased as follows:

- 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);
- 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
- 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. If a holding bay, runway-holding position or road-holding position for a precision approach runway code number 4 is at a greater elevation compared to the threshold, the distance specified in Table 3-2 shall be further increased 5 m for every meter 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 3-2 Minimum distance from the runway center line to a holding bay, runway-holding position or road-holding position

	Code Number			
Type of runway	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)
Precision approach categories II and III	--	--	90 m (a,b)	90 m (a,b)
Take-off runway	30 m	40 m	75 m	75 m

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

b. This distance may need to be increased to avoid interference with radio navigation aids, particularly the glide path and localizer facilities. Information on critical and sensitive areas of ILS and MLS is contained in Annex 10, Volume I, Attachments C and G, respectively (see also 3.12.6).

3.13. Aprons

General

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

Size of aprons

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

Strength of aprons

3.13.3. Each part of an apron shall be capable of withstanding the traffic of the aircraft it is intended to serve, due consideration being given to the fact that some portions of the apron will be subjected to a higher density of traffic and, as a result of slow moving or stationary aircraft, to higher stresses than a runway.

Slopes on aprons

3.13.4. Slopes on an apron, including those on an aircraft stand taxilane, shall be sufficient prevent accumulation of water on the surface of the apron but shall be kept as level as drainage requirements permit.

3.13.5. On an aircraft stand the maximum slope shall not exceed 1.0 per cent.

Clearance distances on aircraft stands

3.13.6. An aircraft stand shall provide the following minimum clearances between an aircraft entering or exiting the stand and any adjacent building, aircraft on another stand and other objects:

Code letter	A	B	C	D	E	F
Clearance	3 m	3 m	4.5 m	7.5 m	7.5 m	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:

- Between the terminal, including any fixed passenger bridge, and the nose of an aircraft; and
- 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. The isolated aircraft parking position shall be located at the maximum distance practicable and in any case never less than 100 m from other parking positions, buildings or public areas, etc. unless otherwise approved by the LYCAA. Care shall be taken to ensure that the position is not located over underground utilities such as gas and aviation fuel and, to the extent feasible, electrical or communication cables.

Chapter 4. Obstacle restriction and removal

The method of assessing the significance of any existing or proposed object within the aerodrome boundary or in the vicinity of the aerodrome is to establish defined obstacle limitation surfaces particular to a runway and its intended use. The purpose of this chapter is to define these obstacle limitation surfaces and their characteristics and describe the action to be taken in respect of objects which infringe them. In ideal circumstances all the surfaces will be free from obstacles but when a surface is infringed, any safety measures required by the certifying authority will have regard to:

a. The nature of the obstacle and its location relative to the surface origin, to the extended centerline of the runway or normal approach and departure paths and to existing obstructions;

b. The amount by which the surface is infringed;

c. The gradient presented by the obstacle to the surface origin;

d. The type of air traffic at the aerodrome; and

e. The instrument approach procedures published for the aerodrome.

f. Safety measures could be as follows:

- Promulgation in the AIP of appropriate information;
- Marking and/or lighting of the obstacle;
- Variation of the runway distances declared as available;
- Limitation of the use of the runway to visual approaches only;
- Restrictions on the type of traffic.

In addition to the requirements described in this chapter it may be necessary to call for other restrictions to development on and in the vicinity of the aerodrome in order to protect the performance of visual and electronic aids to navigation and to ensure that such development does not adversely affect instrument approach procedures and the associated obstacle clearance limits.

All construction within the OLS shall have prior approval from LYCAA prior to design/construction.

An aerodrome operator shall communicate with CAA to establish the required OLS for their aerodrome as stipulated in this regulation.

4.1. Obstacle limitation surfaces

Outer horizontal surface

An outer horizontal surface shall be established at an aerodrome, unless agreed with LYCAA that is not required. The dimension and elevation of the outer horizontal surface shall have a height of 150 m and a radius of 15.000 m (of the aerodrome reference point) for aerodrome reference code 3 and 4.

Conical surface

4.1.1. 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:

- Lower edge coincident with the periphery of the inner horizontal surface; and
- An upper edge located at a specific 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 in an arc radius from each runway end, joined tangentially by straight lines.

4.1.6. The height of the inner horizontal surface shall be measured above an elevation of the lowest touchdown zone existing or planned for all runways on the aerodrome, thereby using a common elevation for an aerodrome with multiple runways.

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:

- An inner edge of specified length, horizontal and perpendicular to the extended center line of the runway and located at a specified distance before the threshold coincident with the landing runway strip;
- Two sides originating at the ends of the inner edge and diverging uniformly at a specified rate from the extended center line of the runway;
- An outer edge parallel to the inner edge; and

- 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 center 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.

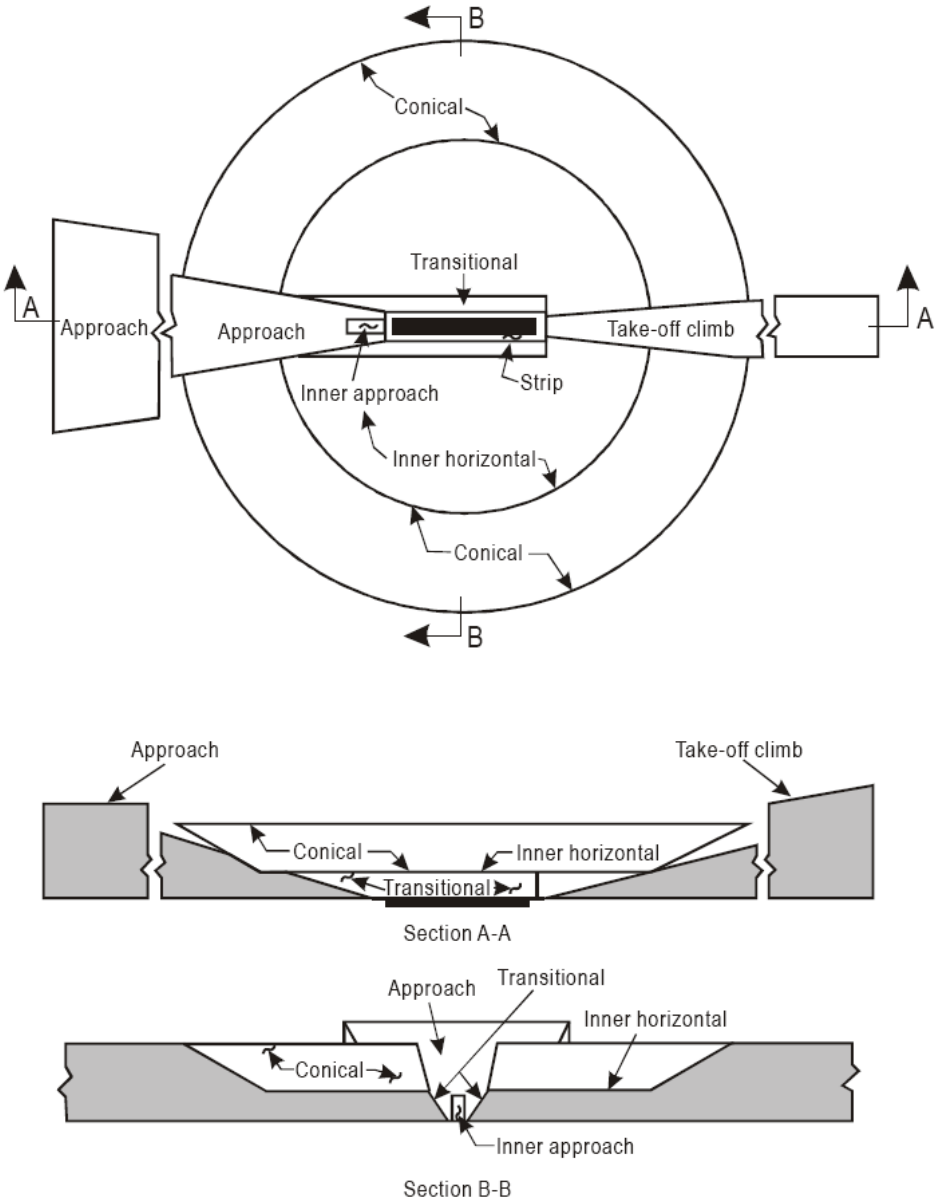
4.1.10. The slope(s) of the approach surface shall be measured in the vertical plane containing the center line of the runway and shall continue containing the center line of any lateral offset or curved ground track.

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:

- An inner edge coincident with the location of the inner edge of the approach surface but of its own specified length;
- Two sides originating at the ends of the inner edge and extending parallel to the vertical plane containing the center line of the runway; and
- An outer edge parallel to the inner edge.



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

Figure 4-1. Obstacle limitation surfaces

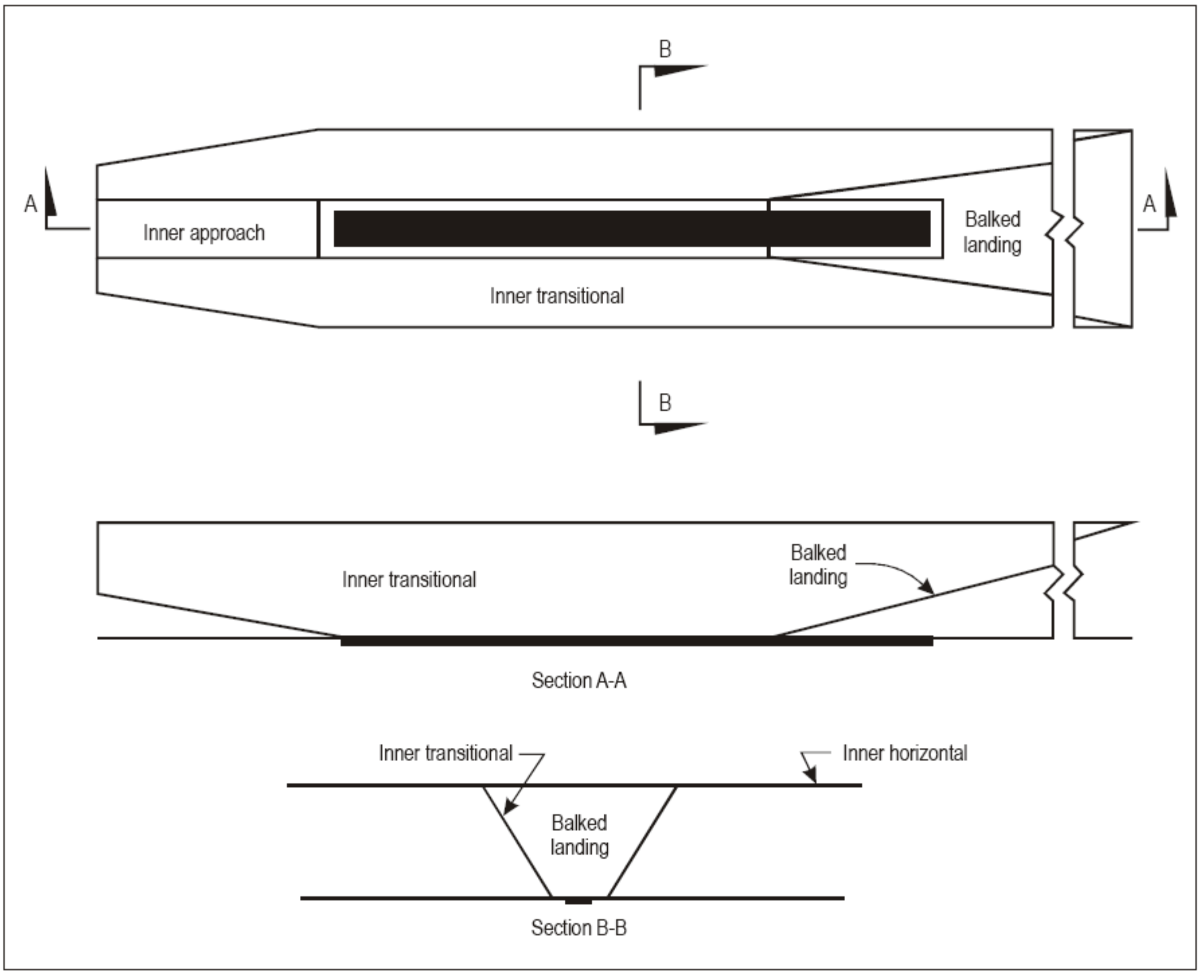


Figure 4-2. Inner approach, inner transitional and balked landing obstacle limitation surfaces

Transitional surface

4.1.13. Description-Transitional surface: Intended to be the controlling obstacle limitation for buildings, etc., and is 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 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 center line; and
- 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:

Along the side of the approach surface - equal to the elevation of the approach surface at that point; and

Along the strip - equal to the elevation of the nearest point on the center line of the runway or its extension, thereby, unless the runway is level, the lower edge of the transitional surface portion along the runway strip shall follow the runway profile, causing the upper edge to be curved where it joins the inner horizontal surface.

4.1.16. The slope of the transitional surface shall be measured in a vertical plane at right angles to the center 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 intended to be the controlling obstacle limitation surface for navigation aids, aircraft and other vehicles that must be near the runway and which shall not to be penetrated except for frangible objects.

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

- 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 center 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

- 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:

- Along the side of the inner approach surface and balked landing surface – equal to the elevation of the particular surface at that point; and

- Along the strip — equal to the elevation of the nearest point on the center 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 center 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 surface.

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

- An inner edge horizontal and perpendicular to the center line of the runway and located at a specified distance after the threshold;

- Two sides originating at the ends of the inner edge and diverging uniformly at a specified rate from the vertical plane containing the center line of the runway; and

- 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 center 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 center 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:

- An inner edge horizontal and perpendicular to the center 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;

- 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

- 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 center 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 center 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 center 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 normal to its center line, and the slope of the center 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:

- Conical surface;
- Inner horizontal surface;
- Approach surface; and
- 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 4-1.

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 LYCAA, the new object or extension would be shielded by an existing immovable object.

4.2.4. New objects or extensions of existing objects shall not be permitted above the conical surface or inner horizontal surface except when, in the opinion of LYCAA, 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 airplanes.

4.2.5. Existing objects above any of the surfaces required by 4.2.1 shall as far as practicable be removed except when, in the opinion of LYCAA, 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 airplanes.

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

Non-precision approach runways

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

- Conical surface;
- Inner horizontal surface;
- Approach surface; and
- Transitional surfaces.

4.2.8. The heights and slopes of the surfaces shall not be greater than, and their other dimensions not less than, those specified in Table 4-1, except in the case of the horizontal section of the approach surface (see 4.2.9).

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

- A horizontal plane 150 m above the threshold elevation; or
- The horizontal plane passing through the top of any object that governs the obstacle clearance altitude/height (OCA/H); whichever is the higher.

4.2.10. 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 CAA, the new object or extension would be shielded by an existing immovable object.

4.2.11. New objects or extensions of existing objects shall not be permitted above the approach surface beyond 3000 m from the inner edge, the conical surface or inner horizontal surface except when, in the opinion of CAA, 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 airplanes.

4.2.12. Existing objects above any of the surfaces required by 4.2.7 shall as far as practicable be removed except when, in the opinion of LYCAA, 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 airplanes.

	RUNWAY CLASSIFICATION									
								Precision approach category		
	Non-instrument				Non-precision approach			I		II or III
	Code number				Code number			Code number		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 (forthcoming), and Chapter 4 of the PANS-Aerodromes, Part I (Doc 9981) for further information.

Table 4-1. Dimensions and slopes of obstacle limitation surfaces — Approach runways

Precision approach runways

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

- Conical surface;
- Inner horizontal surface;
- Approach surface; and
- Transitional surfaces.

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

- Inner approach surface;
- Inner transitional surfaces; and
- Balked landing surface.

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

- Conical surface;
- Inner horizontal surface;
- Approach surface and inner approach surface;
- Transitional surfaces;
- Inner transitional surfaces; and
- Balked landing surface.

4.2.16. The heights and slopes of the surfaces shall not be greater than, and their other dimensions not less than, those specified in Table 4-1, except in the case of the horizontal section of the approach surface (see 4.2.17).

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

- A horizontal plane 150 m above the threshold elevation; or
- 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 CAA, the new object or extension would be shielded by an existing immovable object.

4.2.20. New objects or extensions of existing objects shall not be permitted above the Conical surface or the inner horizontal surface except when, in the opinion of CAA, 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 airplanes.

4.2.21. Existing objects above an approach surface, a transitional surface, the conical surface or the inner horizontal surface shall as far as practicable be removed except when, in the opinion of CAA, 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 airplanes.

Runways meant for take-off

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

- Take-off climb surface.

4.2.23. The dimensions of the surface shall be not less than the dimensions specified in table 4-2, except that a lesser length may be adopted for the take-off climb surface where such lesser length would be consistent with procedural measures adopted to govern the outward flight of airplanes.

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

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

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

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.

Table 4-2 Dimensions of Take-off climb surface

4.2.27. Existing objects that extend above a take-off climb surface shall as far as practicable be removed except when, in the opinion of LYCAA, 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 airplanes.

4.3. Objects outside the obstacle limitation surfaces

4.3.1. The LYCAA shall be consulted concerning proposed construction beyond the limits of the obstacle limitation surfaces that extend above a height established by LYCAA, in order to permit an aeronautical study of the effect of such construction on the operation of airplanes.

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

4.4. Other objects

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

4.4.2. Anything which may, in the opinion of LYCAA after aeronautical study, endanger airplanes on the movement area or in the air within the limits of the inner horizontal and conical surfaces shall be regarded as an obstacle and shall be removed in so far as practicable.

Chapter 5. Visual aids for navigation

5.1. Indicators and signaling devices

5.1.1. Wind direction indicator

Application

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

Location

5.1.1.2. The wind direction indicators 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. This location shall be approved by LYCAA.

Characteristics

5.1.1.3. The wind direction indicator shall be in the form of a truncated cone made of fabric and shall have a length of not less than 3.6 m and a diameter, at the larger end, of not less than 0.9 m. It shall be constructed so that it gives a clear indication of the direction of the surface wind and a general indication of the wind speed. The color or colors shall be so selected as to make the wind direction indicator clearly visible and understandable from a height of at least 300 m, having regard to background. Where practicable, a single color, preferably white or orange, shall be used. Where a combination of two colors is required to give adequate conspicuity against changing backgrounds, they shall preferably be orange and white, red and white, or black and white, and shall be arranged in five alternate bands, the first and last bands being the darker color. These characteristics shall be subject to approval by LYCAA.

5.1.1.4. The location of at least one wind direction indicator shall be marked by a circular band 15 m in diameter and 1.2 m wide. The band shall be centered about the wind direction indicator support and shall be in a color chosen to give adequate conspicuity, preferably white.

5.1.1.5. Provision shall be made for illuminating at least one wind indicator internally 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. The landing direction indicator shall be in the form of a “T”.

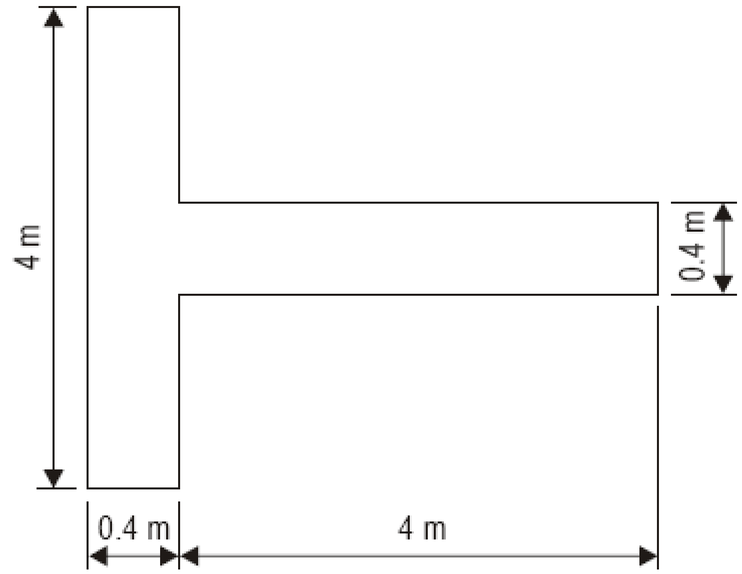


Figure 5-1. Landing direction indicator

5.1.2.3. The shape and minimum dimensions of a landing “T” shall be as shown in Figure 5-1.

The color of the landing “T” shall be either white or orange, the choice being dependent on the color 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. Signaling lamp

Application

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

Characteristics

5.1.3.2. A signaling lamp shall be capable of producing red, green and white signals, and of:

a. being aimed manually at any target as required;

b. Giving a signal in any one color followed by a signal in either of the two other colors; and

c. Transmitting a message in any one of the three colors by Morse Code up to a speed of at least four words per minute.

When selecting the green light, use shall be made of the restricted boundary of green as specified in Appendix 1, 2.1.2.

5.1.3.3. The beam spread shall be not less than 1° nor greater than 3°, with negligible light beyond 3°. When the signaling lamp is intended for use in the daytime the intensity of the colored light shall be not less than 6 000 cd.

5.1.4. Signal panels and signal area

Location of signal area

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

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. The color of the signal area shall be chosen to contrast with the colors 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. The order of importance of runways for the display of runway markings shall be as follows:

1st - Precision approach runway;

2nd - Non-precision approach runway; and

3rd - Non-instrument runway.

5.2.1.3. 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.

Color and conspicuity

5.2.1.4. Runway markings shall be white.

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 color which shall contrast with that used for aircraft stand markings for apron safety lines.

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

Unpaved taxiways

5.2.1.8. An unpaved taxiway shall 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. A runway designation marking shall 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 5-2 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.

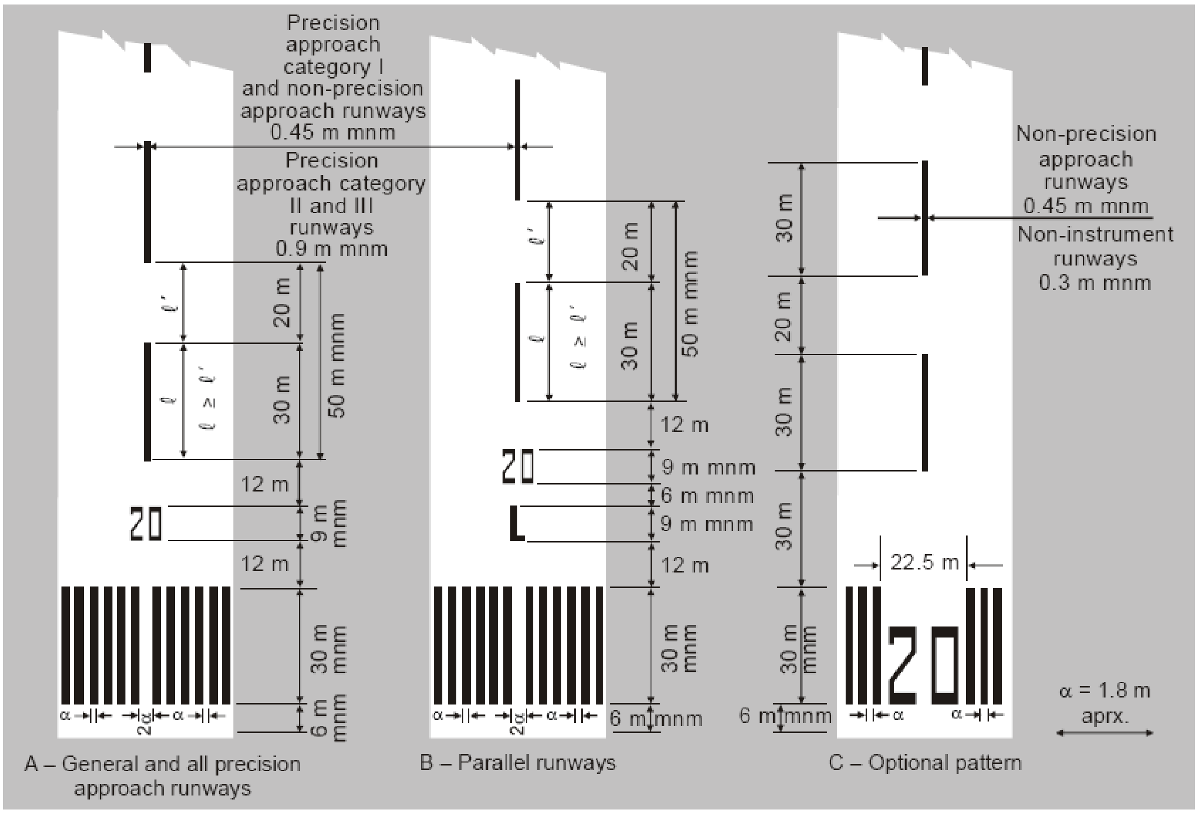


Figure 5-2. Runway designation, center line and threshold markings

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 5-3. The dimensions shall be not less than those shown in Figure 5-3, but where the numbers are incorporated in the threshold marking, larger dimensions shall be used in order to fill adequately the gap between the stripes of the threshold marking.

5.2.3. Runway center line marking

Application

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

Location

5.2.3.2. A runway center line marking shall be located along the center line of the runway between the runway designation markings as shown in Figure 5-2, except when interrupted in compliance with 5.2.1.1.

Characteristics

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

5.2.4.3. A threshold marking shall 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.

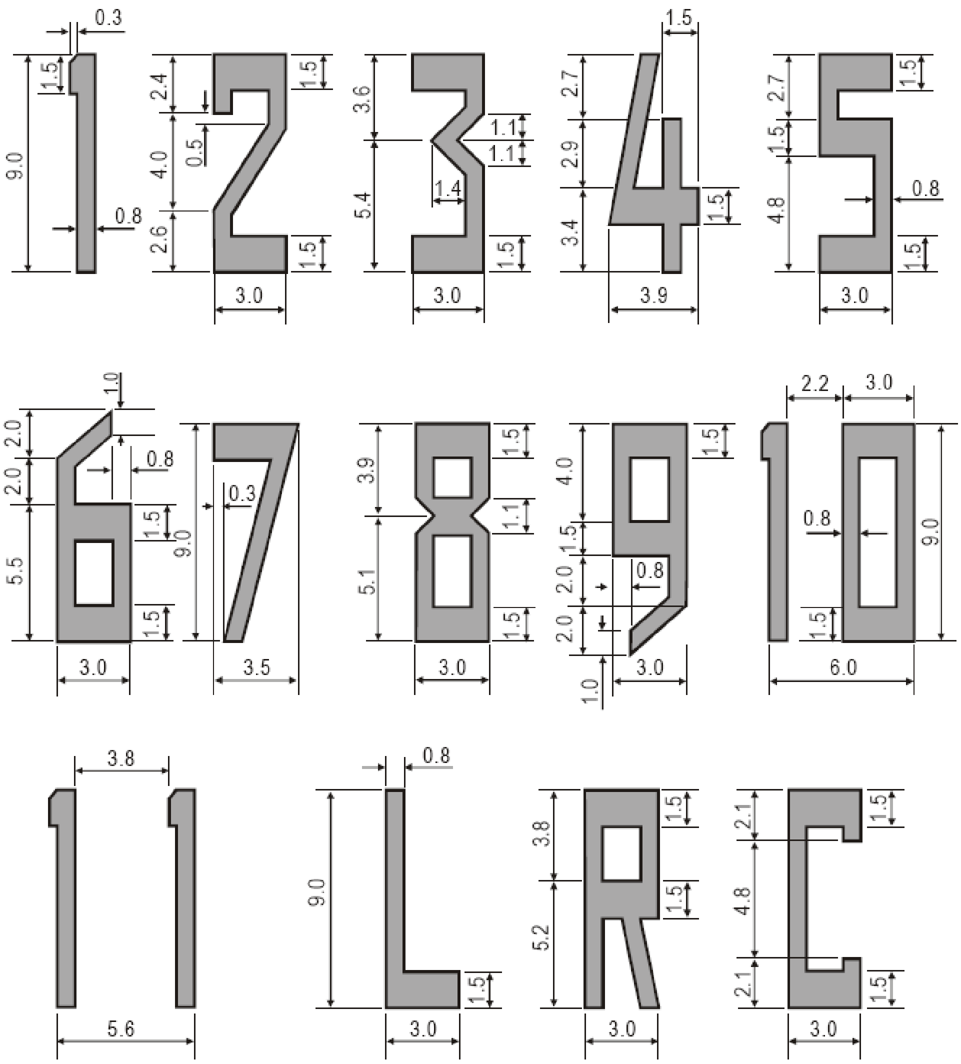
Characteristics

5.2.4.5. A runway threshold marking shall consist of a pattern of longitudinal stripes of uniform dimensions disposed symmetrically about the center line of a runway as shown in Figure 5-2 (A) and (B) for a runway width of 45 m. The number of stripes shall be in accordance with the runway width as follows:

Runway width	Number of stripes
18 m	4
23 m	6
30 m	8
45 m	12
60 m	16

Except that on non-precision approach and non-instrument runways 45 m or greater in width, they may be as shown in Figure 5-2 (C), subject to approval of LYCAA.

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 center 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 center 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 center 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.



Note.— All units are expressed in metres.

Figure 5-3. Form and proportions of numbers and letters for runway designation markings

Transverse stripe

5.2.4.7. Where a threshold is displaced from the extremity of a runway or where the extremity of a runway is not square with the runway center line, a transverse stripe as shown in Figure 5-4 (B) shall 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 5-4 (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 5-4 (A) or 5-4 (B) and all markings prior to the displaced threshold shall be obscured except the runway center line marking, which shall be converted to arrows.

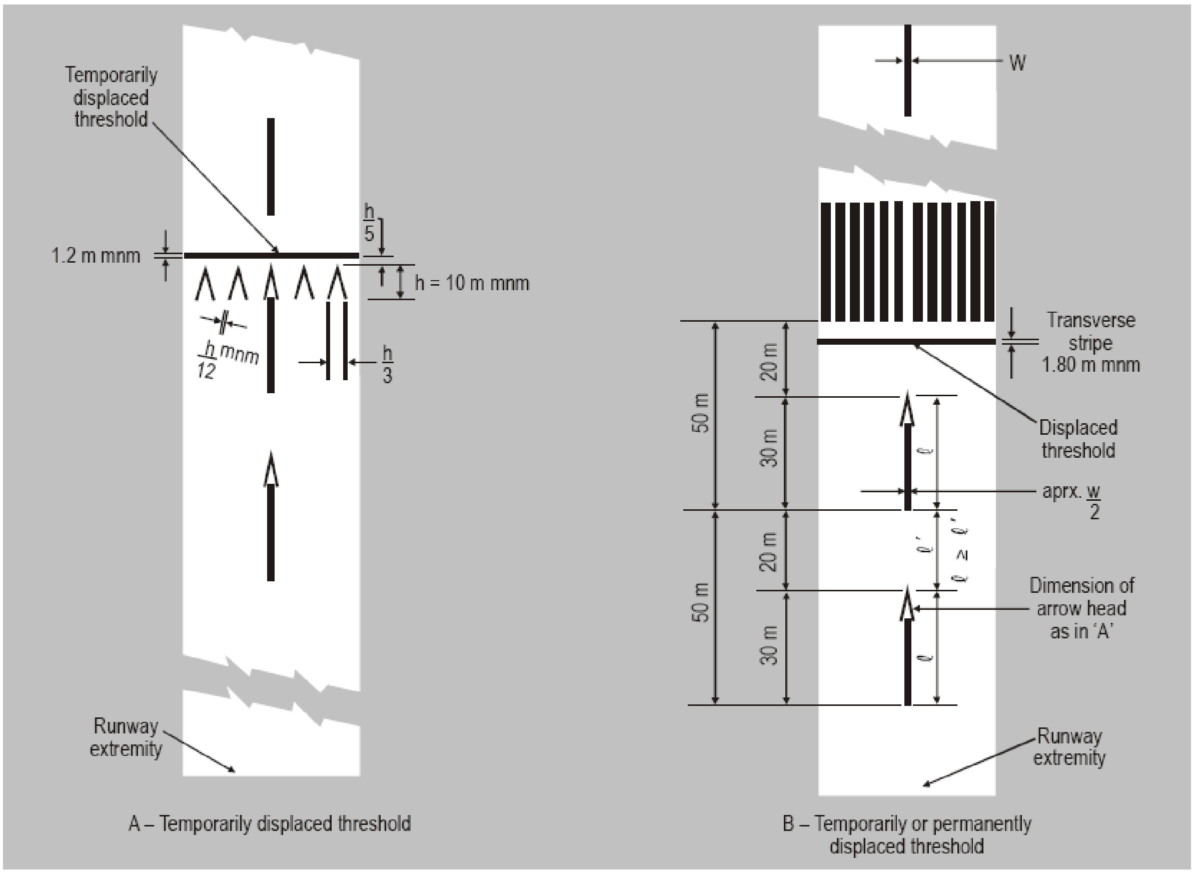


Figure 5-4. Displaced threshold markings

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. An aiming point marking shall be provided at each approach end of:

a. A paved non-instrument runway where the code number is 3 or 4;

b. A paved instrument runway where the code number is 1;

When additional conspicuity of the aiming point is desirable.

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 5-1. Where a touchdown zone marking is provided, the lateral spacing between the markings shall be the same as that of the touchdown zone marking.

Table 5-1. Location and dimensions of aiming point marking

	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.

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. A touchdown zone marking shall be provided in the touchdown zone of a paved non-precision approach or non-instrument runway where the code number is 3 or 4 and additional conspicuity of the touchdown zone is desirable.

Location and characteristics

5.2.6.3. A touchdown zone marking shall consist of pairs of rectangular markings symmetrically disposed about the runway center 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
1200 m up to but not including 1 500 m	3
1500 m up to but not including 2 400 m	4
2400 m or more (codes A, B, C, D)	6

5.2.6.4. A touchdown zone marking shall conform to either of the two patterns shown in Figure 5-5. For the pattern shown in Figure 5-5 (A), the markings shall be not less than 22.5 m long and 3 m wide. For the pattern shown in Figure 5-5 (B), each stripe of each marking shall be not less than 22.5 m long and 1.8 m wide with a spacing of 1.5 m between adjacent stripes. The lateral spacing between the inner sides of the rectangles shall be equal to that of the aiming point marking where provided. Where an aiming point marking is not provided, the lateral spacing between the inner sides of the rectangles shall correspond to the lateral spacing specified for the aiming point marking in Table 5-1 (columns 2, 3, 4 or 5, as appropriate). The pairs of markings shall be provided at longitudinal spacings of 150 m beginning from the threshold, except that pairs of touchdown zone markings coincident with or located within 50 m of an aiming point marking shall be deleted from the pattern.

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

5.2.7. Runway side stripe marking

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. A runway side stripe marking shall be provided on a precision approach runway irrespective of the contrast between the runway edges and the Shoulders or the surrounding terrain.

Location

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

5.2.7.4. Where a runway turn pad is provided, the runway side stripe marking shall be continued between the runway and the runway turn pad.

Characteristics

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

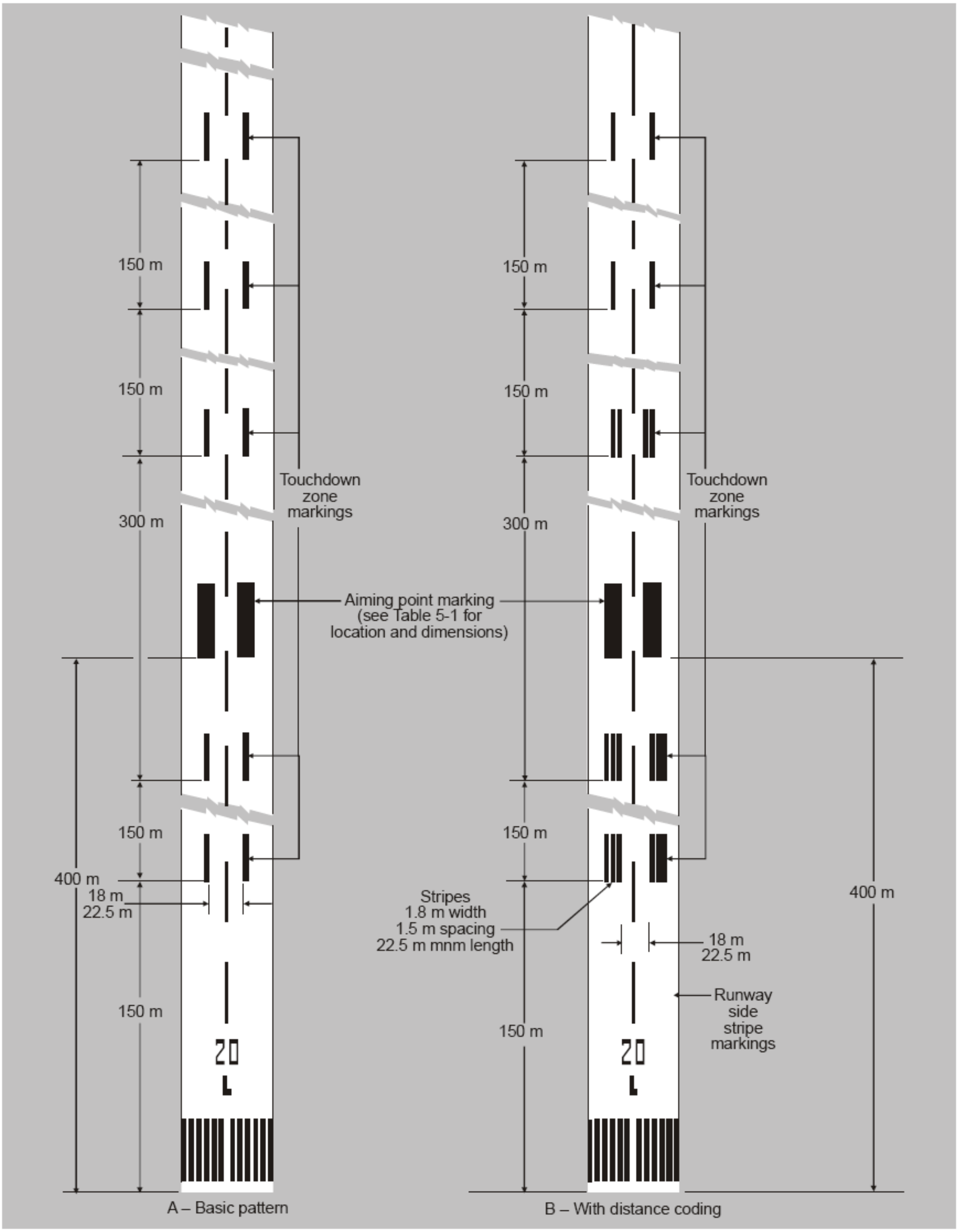


Figure 5-5. Aiming point and touchdown zone markings
(Illustrated for a runway with a length of 2 400 m or more)

5.2.8. Taxiway center line marking

Application

5.2.8.1. Taxiway center line marking shall be provided on a paved taxiway and apron where the code number is 3 or 4 in such a way as to provide continuous guidance between the runway center line and aircraft stands.

5.2.8.2. Taxiway center line marking shall be provided on a paved taxiway and apron where the code number is 1 or 2 in such a way as to provide continuous guidance between the runway center line and aircraft stands.

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

a. There is no runway center line marking; or

b. Where the taxiway center line is not coincident with the runway center line.

5.2.8.4. Where it is necessary to denote the proximity of a runway-holding position, enhanced taxiway center line marking shall be provided.

5.2.8.5. Where provided, enhanced taxiway center line marking shall be installed at all taxiway/runway intersections at that aerodrome.

Location

5.2.8.6. On a straight section of a taxiway the taxiway center line marking shall be located along the taxiway center 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. At an intersection of a taxiway with a runway where the taxiway serves as an exit from the runway, the taxiway center line marking shall be curved into the runway center line marking as shown in Figures 5-6 and 5-26. The taxiway center line marking shall be extended parallel to the runway center 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. Where taxiway center line marking is provided on a runway, in accordance with 5.2.8.3, the marking shall be located on the center line of the designated taxiway.

5.2.8.9. Where provided:

a. An enhanced taxiway center line marking shall extend from the runway-holding position pattern A (as defined in Figure 5-6, Taxiway markings) to a distance of up to 47 m in the direction of travel away from the runway. See figure 5-7 (a).

b. If the enhanced taxiway center line marking intersects another runway-holding position marking, such as for a precision approach category II or III runway, which is located within 47 m of the first runway-holding position marking, the enhanced taxiway center line marking shall be interrupted 0.9 m prior to and after the intersected runway-holding position marking. The enhanced taxiway center line marking shall continue beyond the intersected runway-holding position marking for at least three dashed line segments or 47 m from start to finish, whichever is greater. See Figure 5-7 (b).

c. If the enhanced taxiway center line marking continues through a taxiway/taxiway intersection that is located within 47 m of the runway-holding position marking, the enhanced taxiway center line marking shall be interrupted 1.5 m prior to and after the point where the intersected taxiway center line crosses the enhanced taxiway center line. The enhanced taxiway center line marking shall continue beyond the taxiway/taxiway intersection for at least three dashed line segments or 47 m from start to finish, whichever is greater. See Figure 5-7 (c).

d. Where two taxiway center lines converge at or before the runway-holding position marking, the inner dashed line shall not be less than 3 m in length. See Figure 5-7(d).

e. Where there are two opposing runway-holding position markings and the distance between the markings is less than 94 m, the enhanced taxiway center line markings shall extend over this entire distance. The enhanced taxiway center line markings shall not extend beyond either runway-holding position marking. See Figure 5-7 (e).

Characteristics

5.2.8.10. A taxiway center line marking shall be at least 15 cm in width and continuous in length except where it intersects with a runway-holding position marking or an intermediate holding position marking as shown in Figure 5-6.

5.2.8.11. Enhanced taxiway center line marking shall be as shown in Figure 5-7.

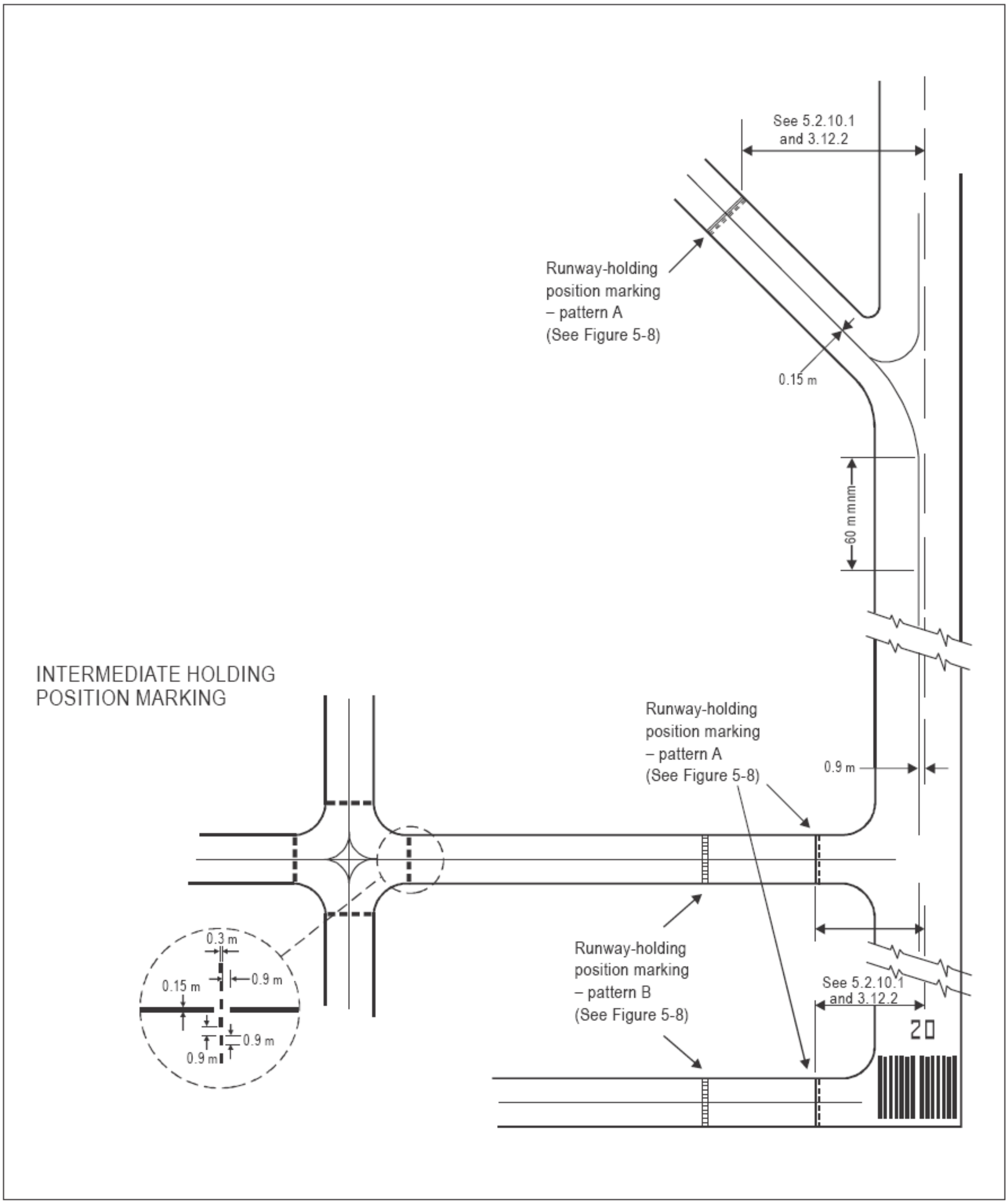


Figure 5-6. Taxiway markings
(Shown with basic runway markings)

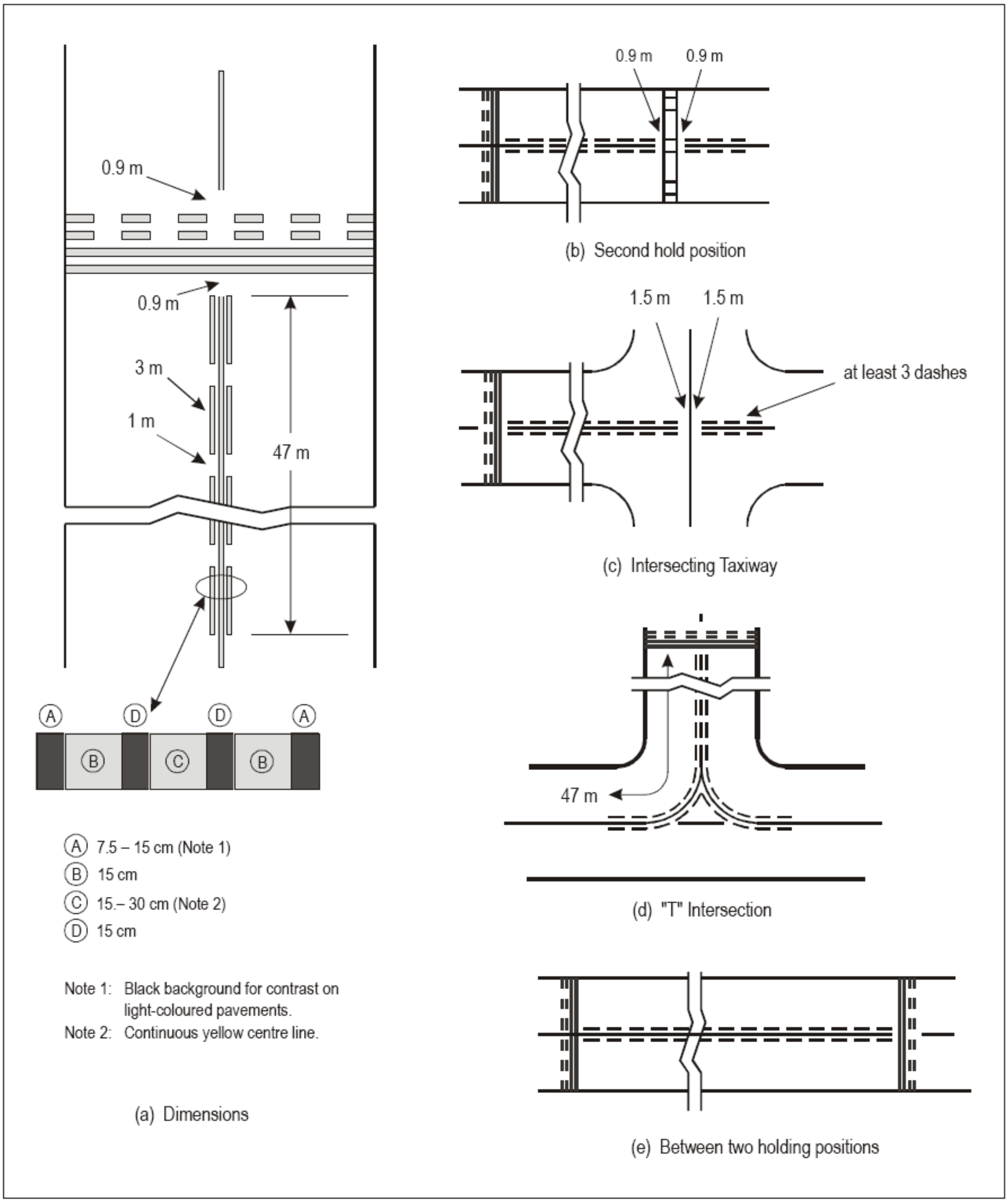


Figure 5-7. Enhanced taxiway center line marking

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 airplane to complete a 180-degree turn and align with the runway center line.

Location

5.2.9.2. The runway turn pad marking shall be curved from the runway center line into the turn pad. The radius of the curve shall be compatible with the maneuvering capability and normal taxiing speeds of the airplanes for which the runway turn pad is intended. The intersection angle of the runway turn pad marking with the runway center line shall not be greater than 30 degrees.

5.2.9.3. The runway turn pad marking shall be extended parallel to the runway center 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. A runway turn pad marking shall guide the airplane in such a way as to allow a straight portion of taxiing before the point where a 180-degree turn is to be made. The straight portion of the runway turn pad marking shall be parallel to the outer edge of the runway turn pad.

5.2.9.5. The design of the curve allowing the airplane to negotiate a 180-degree turn shall be based on a nose wheel steering angle not exceeding 45 degrees.

5.2.9.6. The design of the turn pad marking shall be such that, when the cockpit of the airplane remains over the runway turn pad marking, the clearance distance between any wheel of the airplane landing gear and the edge of the runway turn pad shall 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 takeoff runway, the runway-holding position marking shall be as shown in Figure 5-6, pattern, 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 5-6, pattern A. Where two or three runway-holding positions are provided at such an intersection, the runway-holding position marking closer (closest) to the runway shall be as shown in Figure 5-6, pattern A and the markings farther from the runway shall be as shown in Figure 5-6, pattern B.

5.2.10.4. The runway-holding position marking displayed at a runway-holding position established in accordance with 3.12.3 shall be as shown in Figure 5-6, pattern A.

5.2.10.5. Until 26 November 2026, the dimensions of runway-holding position markings shall be as shown in figure 5-8, pattern A1 (or A2) or pattern B1 (or B2), as appropriate.

5.2.10.6. As of 26 November 2026, the dimensions of runway-holding position marking shall be as shown in Figure 5-8, pattern A2 or pattern B2, as appropriate.

5.2.10.7. Where increased conspicuity of the runway-holding position is required, the dimensions of runway-holding position marking shall be as shown in Figure 5-8, pattern A2 or pattern B2, as appropriate.

5.2.10.8. Where a pattern B runway-holding position marking is located on an area where it would exceed 60 m in length, the term “CAT II” or “CAT III” as appropriate shall be marked on the surface at the ends of the runway-holding position marking and at equal intervals of 45 m maximum between successive marks. The letters shall be not less than 1.8 m high and shall be placed not more than 0.9 m beyond the holding position marking.

5.2.10.9. The runway-holding position marking displayed at a runway/runway intersection shall be perpendicular to the center line of the runway forming part of the standard taxi-route. The pattern of the marking shall be as shown in Figure 5-8, pattern A2.

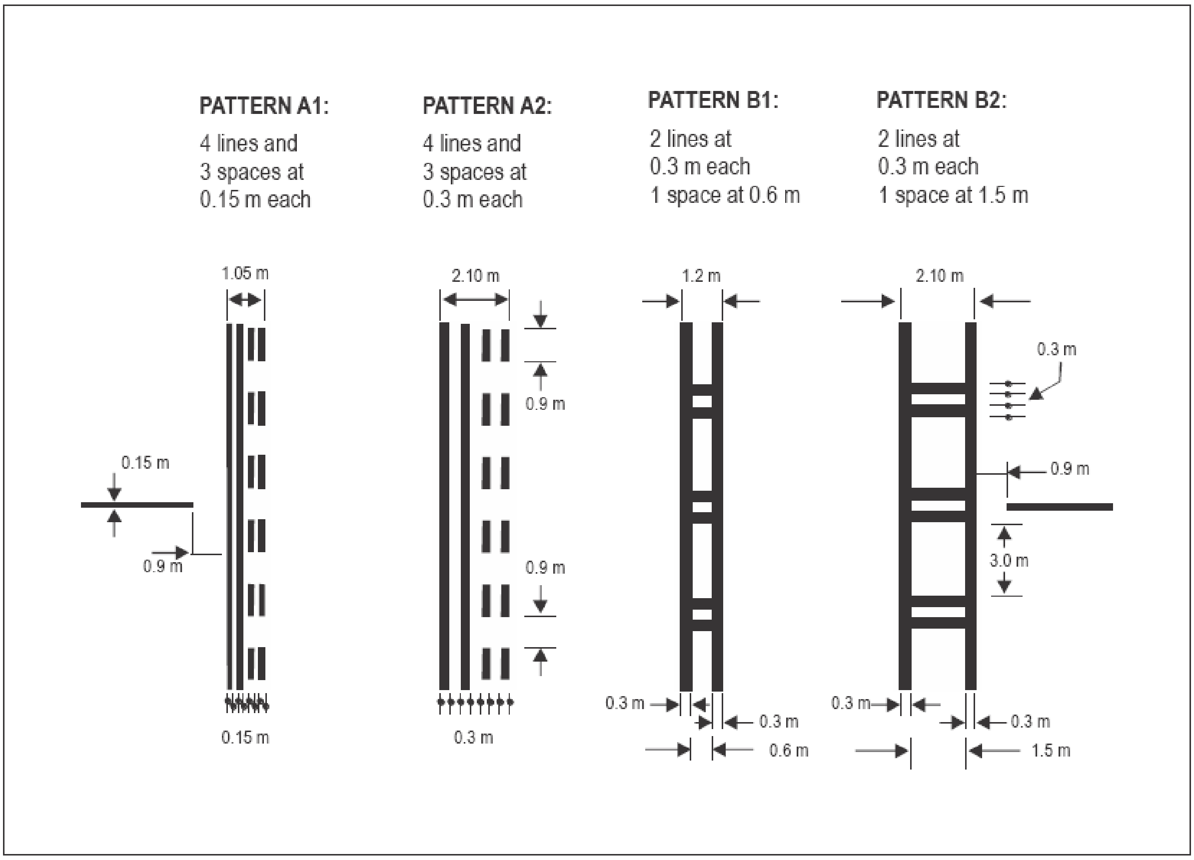


Figure 5-8. Runway-holding position markings

Note: Patterns A1 and B1 are no longer valid after 2026.

5.2.11. Intermediate holding position marking

Application and location

5.2.11.1. An intermediate holding position marking shall be displayed along an intermediate holding position.

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

Characteristics

5.2.11.3. An intermediate holding position marking shall consist of a single broken line as shown in Figure 5-6.

5.2.12. VOR aerodrome checkpoint marking

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

Location

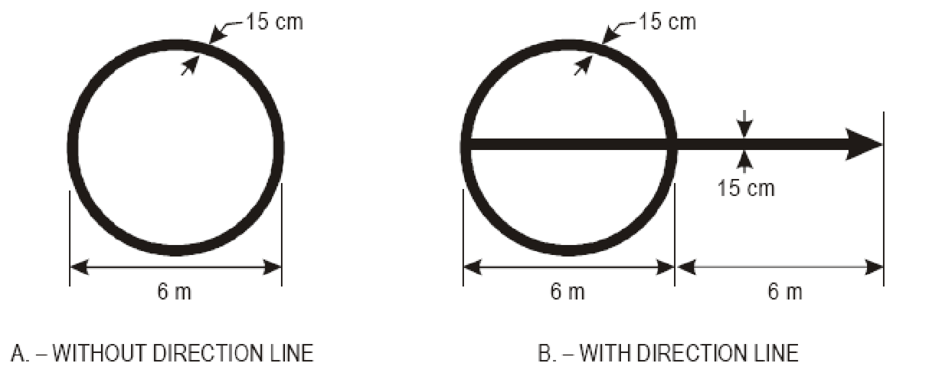
5.2.12.3.A VOR aerodrome checkpoint marking shall be centered on the spot at which an aircraft is to be parked to receive the correct VOR signal.

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 5-9 (A)).

5.2.12.5.When it is preferable for an aircraft to be aligned in a specific direction, a line shall be provided that passes through the center of the circle on the desired azimuth. The line shall extend 6 m outside the circle in the desired direction of heading and terminate in an arrowhead. The width of the line shall be 15 cm (see Figure 5-9 (B)).

5.2.12.6.A VOR aerodrome checkpoint marking shall preferably be white in color but shall differ from colors used for the taxiway markings.



Note.— A direction line need only be provided when an aircraft must be aligned in a specific direction.

Figure 5-9. VOR aerodrome checkpoint marking

5.2.13. Aircraft stand marking

Application

5.2.13.1. Aircraft stand markings shall be provided for designated parking positions on a paved apron.

Location

5.2.13.2. Aircraft stand markings on a paved apron shall be located so as to provide the clearances specified in 3.13.6, when the nose wheel follows the stand marking.

Characteristics

5.2.13.3. Aircraft stand markings shall include such elements such as stand identification, lead-in line, turn bar, turning line, alignment bar, stop line and lead-out line, as are required by the parking configuration and to complement other parking aids.

5.2.13.4. Aircraft stand identification (letter and/or number) shall be included in the lead-in line a short distance after the beginning of the lead-in line. The height of the identification shall be adequate to be readable from the cockpit of aircraft using the stand.

5.2.13.5. Where two sets of aircraft stand markings are superimposed on each other in order to permit more flexible use of the apron and it is difficult to identify which stand marking shall be followed, or safety would be impaired if the wrong marking was followed, then identification of the aircraft for which each set of markings is intended shall be added to the stand identification.

5.2.13.6. Lead-in, turning and lead-out lines shall normally be continuous in length and have a width of not less than 15 cm. Where one or more sets of stand markings are superimposed on a stand marking, the lines shall be continuous for the most demanding aircraft and broken for other aircraft.

5.2.13.7. The curved portions of lead-in, turning and lead-out lines shall have radii appropriate to the most demanding aircraft type for which the markings are intended.

5.2.13.8. Where it is intended that an aircraft proceed in one direction only, arrows pointing in the direction to be followed shall be added as part of the lead-in and lead-out lines.

5.2.13.9. A turn bar shall be located at right angles to the lead-in line, abeam the left pilot position at the point of initiation of any intended turn. It shall have a length and width of not less than 6 m and 15 cm, respectively, and include an arrowhead to indicate the direction of turn.

5.2.13.10. If more than one turn bar and/or stop line is required, they shall be coded.

5.2.13.11. An alignment bar shall be placed so as to be coincident with the extended center line of the aircraft in the specified parking position and visible to the pilot during the final part of the parking maneuver. It shall have a width of not less than 15 cm.

5.2.13.12. A stop line shall be located at right angles to the alignment bar, abeam the left pilot position at the intended point of stop. It shall have a length and width of not less than 6 m and 15 cm, respectively.

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

5.2.14.4. An apron safety line shall 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 regulations, except that yellow shall not be used for any road markings on the airside.

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, a mandatory instruction marking shall be provided on the surface of the pavement.

5.2.16.2. 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 shall 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 center line and on the holding side of the runway-holding position marking as shown in Figure 5-10 (A). The distance between the nearest edge of the marking and the runway-holding position marking or the taxiway center 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 center line marking and on the holding side of the runway holding position marking as shown in Figure 5-10 (B). The distance between the nearest edge of the marking and the runway-holding position marking or the taxiway center line marking shall be not less than 1 m.

5.2.16.5. Except where operationally required and with the approval of LYCAA, a mandatory instruction marking shall 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. The character height shall be 4 m for inscriptions where the code letter is C, D, E or F, and 2 m where the code letter is A or B. The inscriptions shall be in the form and proportions shown in Appendix 3.

5.2.16.10. The background shall be rectangular and extend a minimum of 0.5 m laterally and vertically beyond the extremities of the inscription.

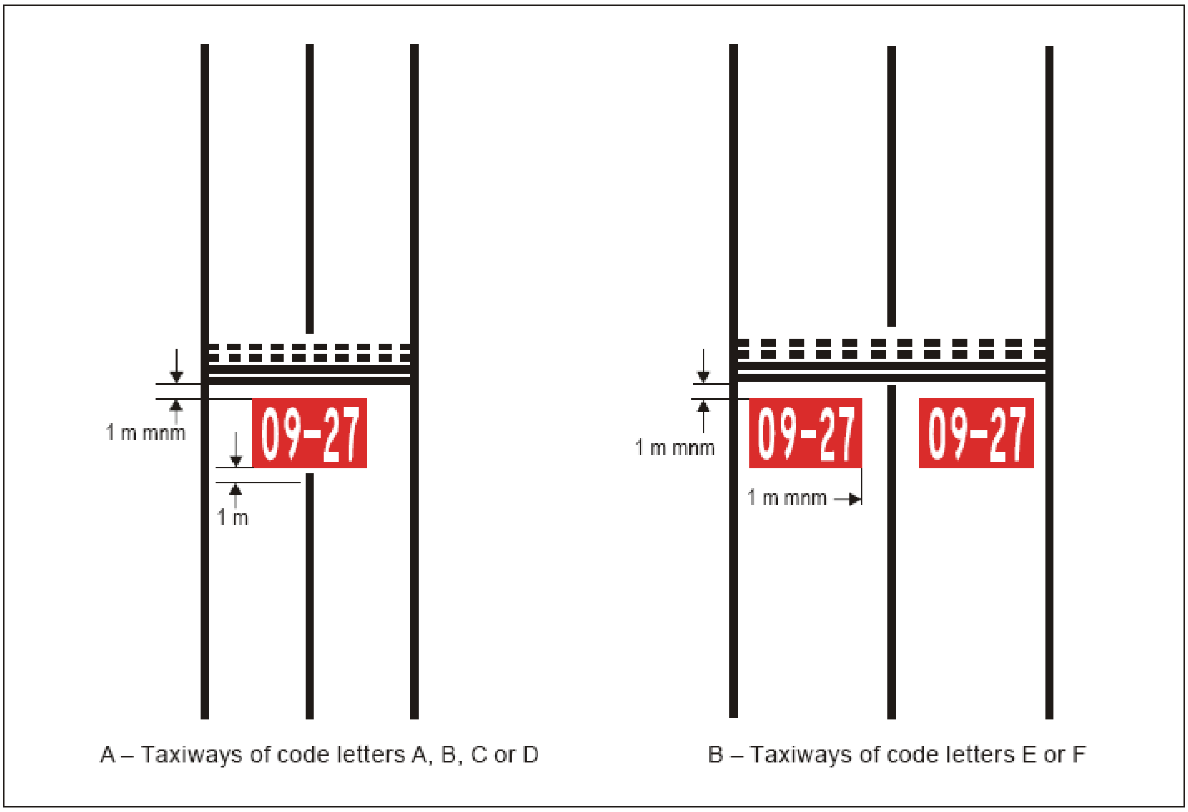


Figure 5-10. Mandatory instruction marking

5.2.17. Information marking

Application

5.2.17.1. Where an information sign would normally be installed and is agreed with LYCAA impractical to install, as determined by the Aerodrome Operator, an information marking shall be displayed on the surface of the pavement.

5.2.17.2. Where operationally required an information sign shall be supplemented by an information marking.

5.2.17.3. An information (location/direction) marking shall be displayed prior to and following complex taxiway intersections and where operational experience has indicated the addition of a taxiway location marking could assist flight crew ground navigation.

5.2.17.4. An information (location) marking shall be displayed on the pavement surface at regular intervals along taxiways of great length.

Location

5.2.17.5. The information marking shall be displayed across the surface of the taxiway or apron where necessary and positioned so as to be legible from the cockpit of an approaching aircraft.

Characteristics

5.2.17.6. An information marking shall consist of:

a. An inscription in yellow upon a black background, when it replaces or supplements a location sign; and

b. An inscription in black upon a yellow background, when it replaces or supplements a direction or destination sign.

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

a. A black border where the inscriptions are in black; and

b. A yellow border where the inscriptions are in yellow.

5.2.17.8. The character height shall be 4 m. The inscriptions shall be in the form and proportions shown in Appendix 3.

5.3. Lights

5.3.1. General

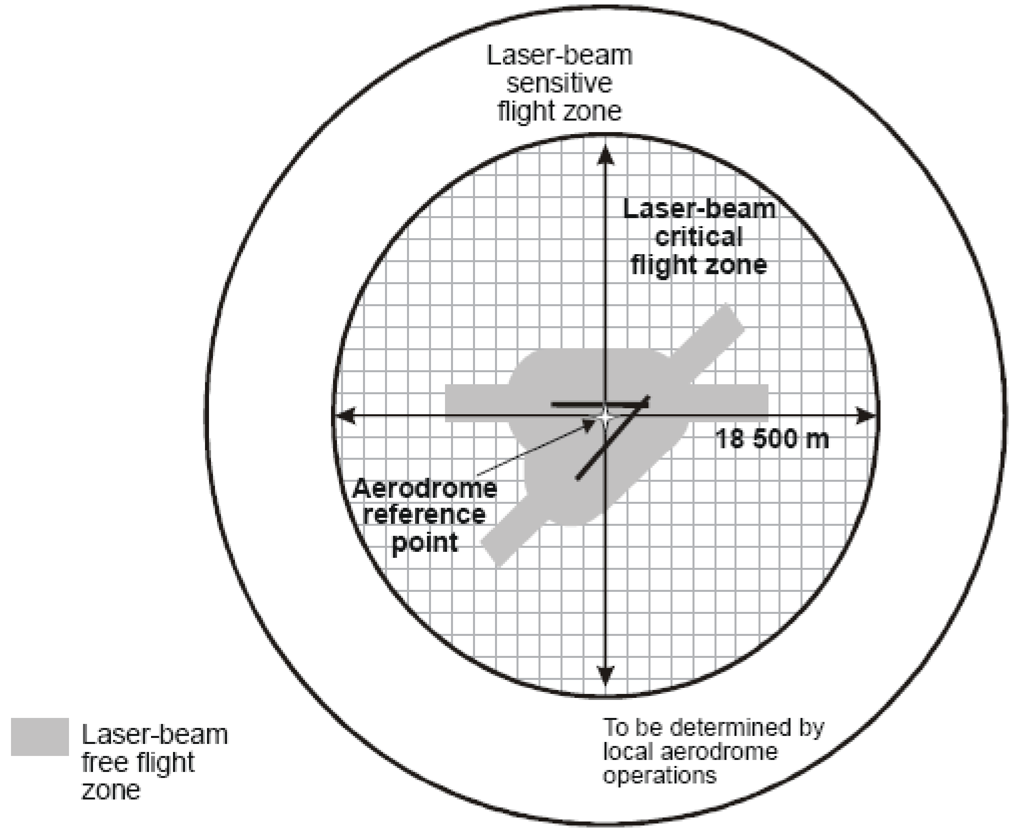
Lights which may endanger the safety of aircraft

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

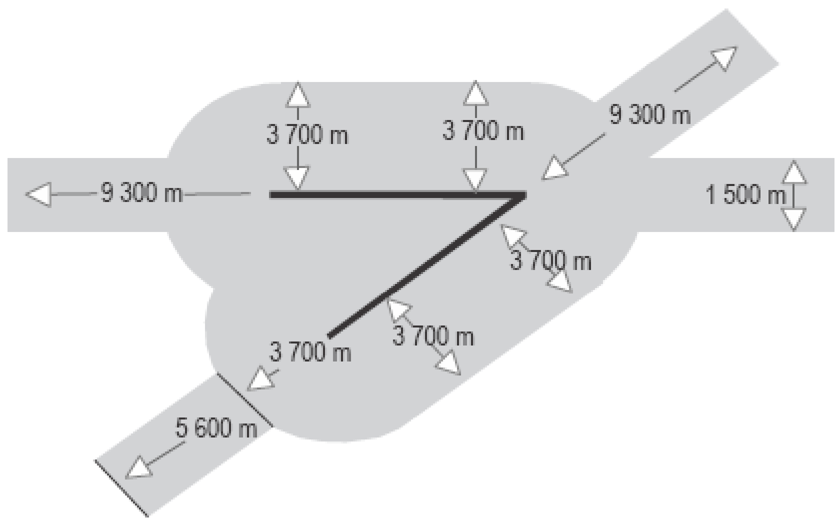
5.3.1.2. To protect the safety of aircraft against the hazardous effects of laser emitters, the following protected zones shall be established around aerodromes:

- A laser-beam free flight zone (LFFZ)
- A laser-beam critical flight zone (LCFZ)
- A laser-beam sensitive flight zone (LSFZ).



Note.— The dimensions indicated are given as guidance only.

Figure 5-11. Protected flight zones



Note.— The dimensions indicated are given as guidance only.

Figure 5-12. Multiple runway laser-beam free flight zone

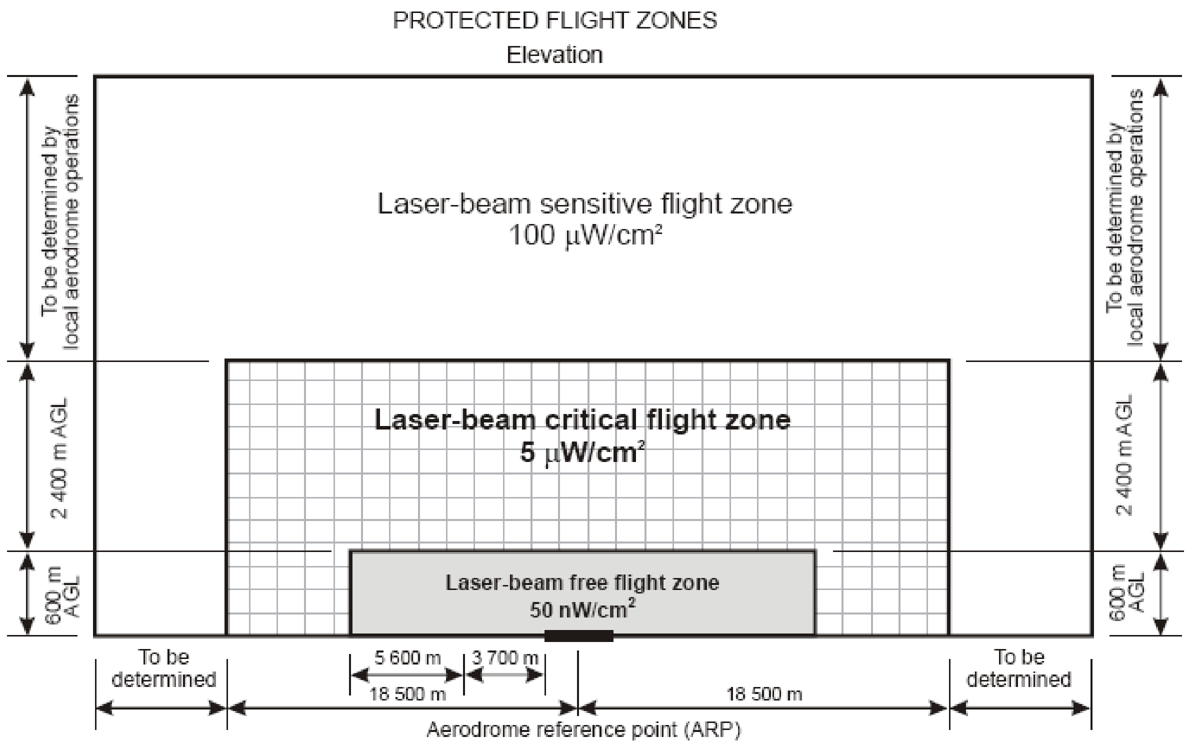


Figure 5-13. Protected flight zones with indication of maximum irradiance levels for visible laser beams

Lights which may cause confusion

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

a. Instrument runway - code number 4:
Within the areas before the threshold and beyond the end of the runway extending at least 4 500 m in length from the threshold and runway end and 750 m either side of the extended runway center line in width.

b. Instrument runway - code number 2 or 3:
As in a), except that the length shall be at least 3 000 m.

c. Instrument runway - code numbe1 and non-instrument runway:
Within the approach area.

Aeronautical ground lights which may cause confusion to mariners

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

See 9.9 for information regarding siting of equipment and installations on operational areas, and the Aerodrome Design Manual (Doc 9157), Part 6, for guidance on frangibility of light fixtures and supporting structures.

Other Lights which may cause confusion

No light shall be permitted in an aerodrome that in the opinion of LYCAA may cause glare/dazzle to airport users.

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:

a. Where the height of a supporting structure exceeds 12 m, the frangibility requirement shall apply to the top 12 m only; and

b. Where a supporting structure is surrounded by non-frangible objects, only that part of the structure that extends above the surrounding objects shall be frangible.

5.3.1.5. 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. The temperature produced by conduction or radiation at the interface between an installed inset light and an aircraft tire shall not exceed 160°C during a 10-minute period of exposure.

Light intensity and control

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 center line lights;
- Runway touchdown zone lights; and
- Taxiway center line lights.

5.3.1.11. On the perimeter of and within the ellipse defining the main beam in Appendix 2, Figures A2-1 to A2-10, the maximum light intensity value shall not be greater than three times the minimum light intensity value measured in accordance with Appendix 2, collective notes for Figures A2-1 to A2-11.

5.3.1.12. On the perimeter of and within the rectangle defining the main beam in Appendix 2, Figures A2-12 to A2-20, the maximum light intensity value shall not be greater than three times the minimum light intensity value measured in accordance with Appendix 2, collective notes for Figures A2-12 to A2-21.

5.3.2. Emergency lighting

Application

5.3.2.1. At an aerodrome, sufficient emergency lights shall be conveniently available for installation on at least the primary runway in the event of failure of the normal lighting system.

Location

5.3.2.2. When installed on a runway, the emergency lights shall, as a minimum, conform to the configuration required for a non-instrument runway.

Characteristics

5.3.2.3. The color of the emergency lights shall conform to the color requirements for runway lighting, except that, where the provision of colored 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:

a. Aircraft navigate predominantly by visual means;

b. Reduced visibilities are frequent; or

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

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. The location of the beacon shall be such that the beacon is not shielded by objects in significant directions and does not dazzle a pilot approaching to land.

Characteristics

5.3.3.6. The aerodrome beacon shall show either colored 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 colored flashes emitted by beacons at land aerodromes shall be green and colored flashes emitted by beacons at water aerodromes shall be yellow. In the case of a combined water and land aerodrome, colored flashes, if used, shall have the color 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.

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. The location of the beacon shall be such that the beacon is not shielded by objects insignificant 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.

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. The speed of transmission shall be between six and eight words per minute, the corresponding range of duration of the Morse dots being from 0.15 to 0.2 seconds per dot.

5.3.4. Approach lighting systems

Application

5.3.4.1. Application

A. Non-instrument runway

Where physically practicable, a simple approach lighting system as specified in 5.3.4.2 to 5.3.4.9 shall be provided to serve a non-instrument runway where the code number is 3 or 4 and intended for use at night, except when the runway is used only in conditions of good visibility and sufficient guidance is provided by other visual aids.

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 center 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 center 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 center 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 center 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 center line lights.

5.3.4.5. If it is not physically possible to provide a center line extending for a distance of 420 m from the threshold, it shall be extended to 300 m so as to include the crossbar. If this is not possible, the center line lights shall be extended as far as practicable, and each center 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 center line of the system; and

b. No light other than a light located within the central part of a crossbar or a center 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 color 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 center line light shall consist of either:

a. A single source; or

b. A barrette at least 3 m in length.

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

5.3.4.9. Where provided for a non-precision approach runway, the lights shall show at all angles in azimuth necessary to the pilot of an aircraft which on final approach does not deviate by an abnormal amount from the path defined by the non-visual aid. The lights shall be designed to provide guidance during both day and night in the most adverse conditions of visibility and ambient light for which it is intended that the system shall remain usable.

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 center 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 center 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 center 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 center 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 center line of the system; and

b. No light other than a light located within the central part of a crossbar or a center 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 center line and crossbar lights of a precision approach category I lighting system shall be fixed lights showing variable white. Each center line light position shall consist of either:

a. A single light source in the innermost 300 m of the center line, two light sources in the central 300 m of the center line and three light sources in the outer 300 m of the center 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 10.5.9 can be demonstrated, each center 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. If the center line consists of barrettes as described in 5.3.4.14 b) or 5.3.4.15 b), each barrette shall be supplemented by a flashing light, except where such lighting is considered unnecessary taking into account the characteristics of the system and the nature of the meteorological conditions.

5.3.4.18. Each flashing light as described in 5.3.4.17 shall be flashed twice a second in sequence, beginning with the outermost light and progressing toward the threshold to the innermost light of the system. The design of the electrical circuit shall be such that these lights can be operated independently of the other lights of the approach lighting system.

5.3.4.19. If the center 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 center 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 center 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 center line lights or converge to meet the runway center line 300 m from threshold.

5.3.4.21. The lights shall be in accordance with the specifications of 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 center line of the runway, extending, wherever possible, over a distance of 900 m from the runway threshold. In addition, the system shall have two side rows of lights, extending 270 m from the threshold, and two crossbars, one at 150 m and one at 300 m from the threshold, all as shown in Figure 5-14. Where the serviceability level of the approach lights specified as maintenance objectives in 10.5.6 can be demonstrated, the system may have two side rows of lights, extending 240 m from the threshold, and two crossbars, one at 150 m and one at 300 m from the threshold, all as shown in Figure 5-15.

5.3.4.23. The lights forming the center 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 center line, at a longitudinal spacing equal to that of the center 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 10.5.6 can be demonstrated, lights forming the side rows may be placed on each side of the center 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 center 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 center line lights to a distance of 15 m from the center line.

5.3.4.27. If the center 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 center line or converge to meet the runway center 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 center line of the system; and

b. No light other than a light located within the central part of a crossbar or a center 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.

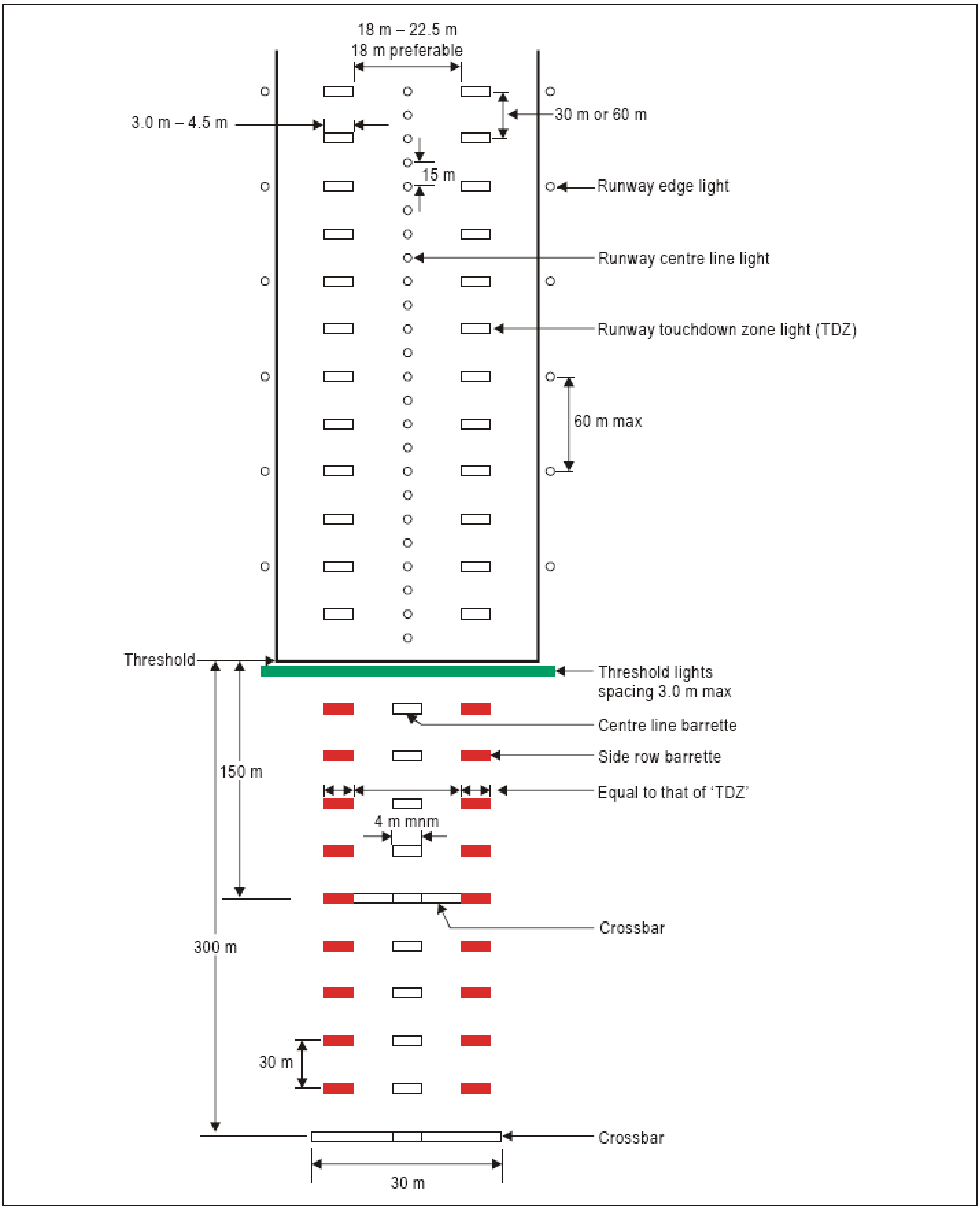


Figure 5-14. Inner 300 m approach and runway lighting for precision approach runways, categories II and III

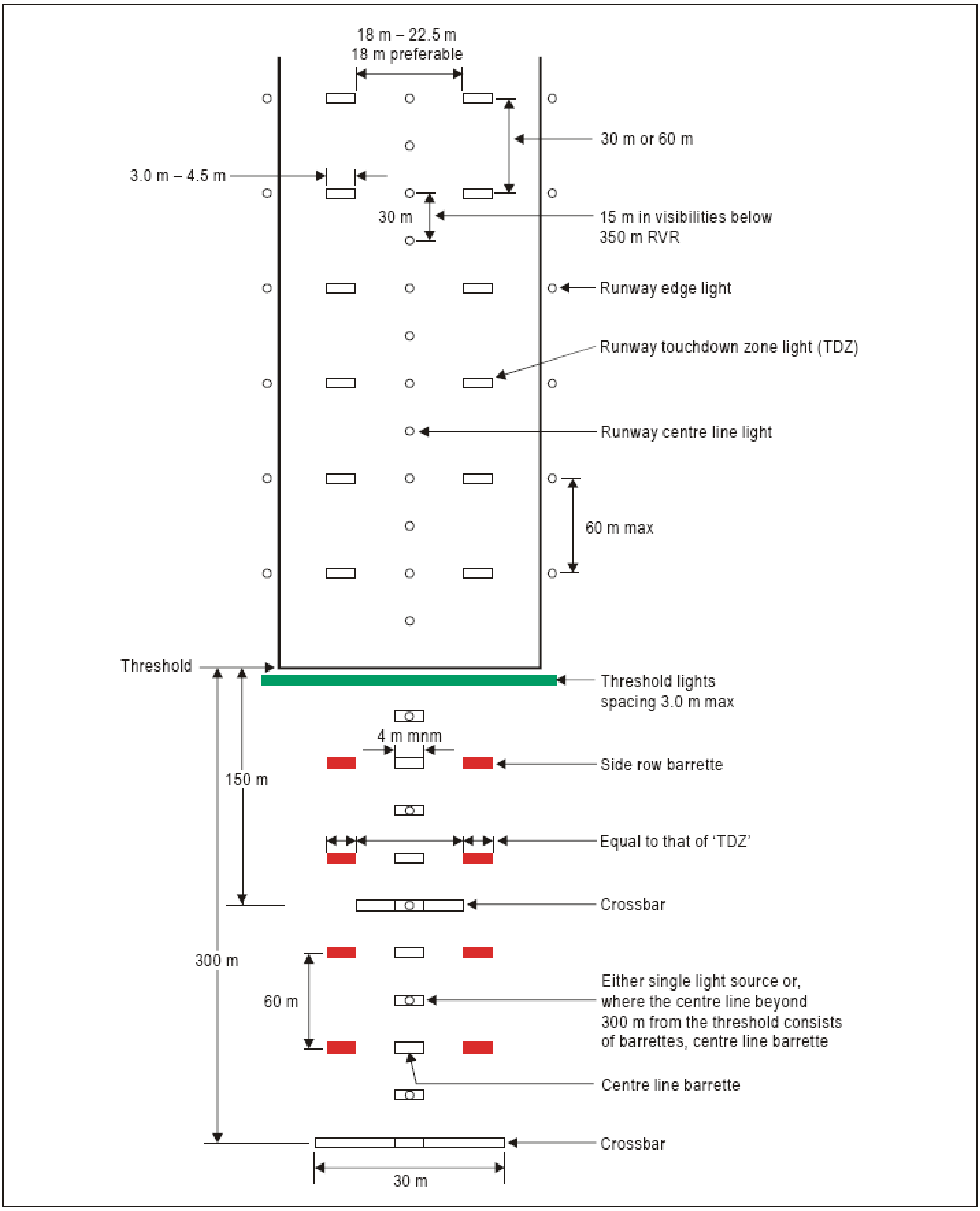


Figure 5-15. Inner 300 m approach and runway lighting for precision approach runways, categories II and III, where the serviceability levels of the lights specified as maintenance objectives in Chapter 10 can be demonstrated

Characteristics

5.3.4.30. The center 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 center line may consist of single light sources showing variable white. Where the serviceability level of the approach lights specified as maintenance objectives in 10.5.6 can be demonstrated, the center 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 center 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 center 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 center 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 center line and three light sources in the outer 300 m of the center 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 10.5.6 can be demonstrated, beyond 300 m from the threshold each center 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. If the center line beyond 300 m from the threshold consists of barrettes as described in (5.3.4.31 a) or (5.3.4.32 a), each barrette beyond 300 m shall be supplemented by a flashing light, except where such lighting is considered unnecessary taking into account the characteristics of the system and the nature of the meteorological conditions.

5.3.4.35. Each flashing light as described in 5.3.4.34 shall be flashed twice a second in sequence, beginning with the outermost light and progressing toward the threshold to the innermost light of the system. The design of the electrical circuit shall be such that these lights can be operated independently of the other lights of the approach lighting system.

5.3.4.36. 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.

5.3.4.39. The lights shall be in accordance with the specifications of Appendix 2, Figures A21 and A2-2.

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 airplanes with similar approach guidance requirements;

b. The pilot of any type of airplane 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 airplane 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 airplane undershooting or overrunning the runway; and

e. Terrain or prevalent meteorological conditions are such that the airplane may be subjected to unusual turbulence during approach.

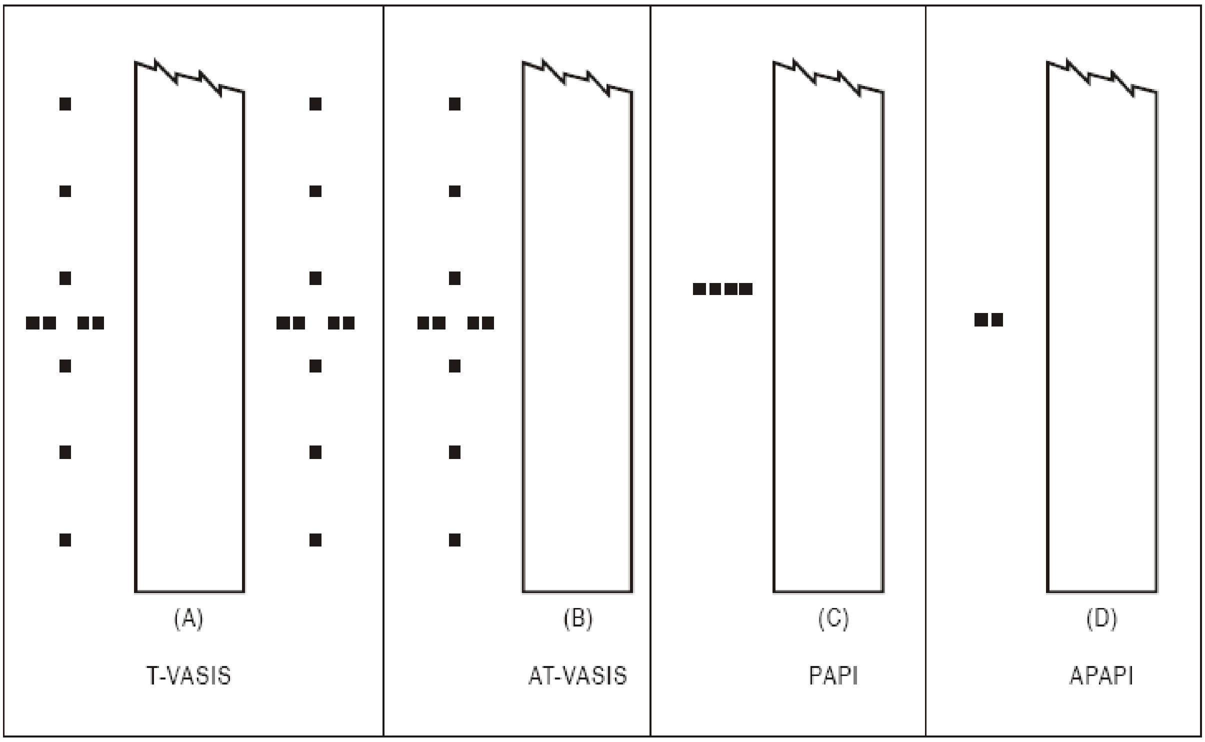


Figure 5-16. Visual Approach Slope Indicator Systems

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 5.3.5.7 to 5.3.5.23 inclusive;

b. PAPI and APAPI systems conforming to the specifications contained in 5.3.5.24 to 5.3.5.41 inclusive;

as shown in Figure 5-16.

5.3.5.3. 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. The use of T-VASIS and AT-VASIS as standard visual approach slope indicator systems shall be discontinued.

5.3.5.5. PAPI or APAPI shall be provided where the code number is 1 or 2 when one or more of the conditions specified in 5.3.5.1 exist.

5.3.5.6. Where a runway threshold is temporarily displaced from the normal position and one or more of the conditions specified in 5.3.5.1 exist, a PAPI shall be provided except that where the code number is 1 or 2 an APAPI may be provided.

T-VASIS and AT-VASIS

Description

5.3.5.7. The T-VASIS shall consist of twenty light units symmetrically disposed about the runway center line in the form of two wing bars of four light units each, with bisecting longitudinal lines of six lights, as shown in Figure 5-17.

5.3.5.8. The AT-VASIS shall consist of ten light units arranged on one side of the runway in the form of a single wing bar of four light units with a bisecting longitudinal line of six lights.

5.3.5.9. The light units shall be constructed and arranged in such a manner that the pilot of an airplane 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

5.3.5.10. The light units shall be located as shown in Figure 5-17, subject to the installation tolerances given therein.

Note: The siting of T-VASIS will provide, for a 3° slope and a nominal eye height over the threshold of 15 m (see 5.3.5.7 and 5.3.5.20), a pilot's eye height over threshold of 13 m to 17 m when only the wing bar lights are visible. If increased eye height at the threshold is required (to provide adequate wheel clearance), then the approaches may be flown with one or more fly-down lights visible. The pilot's eye height over the threshold is then of the following order:

Wing bar lights and one fly-down light visible 17 m to 22 m

Wing bar lights and two fly-down lights visible 22 m to 28 m

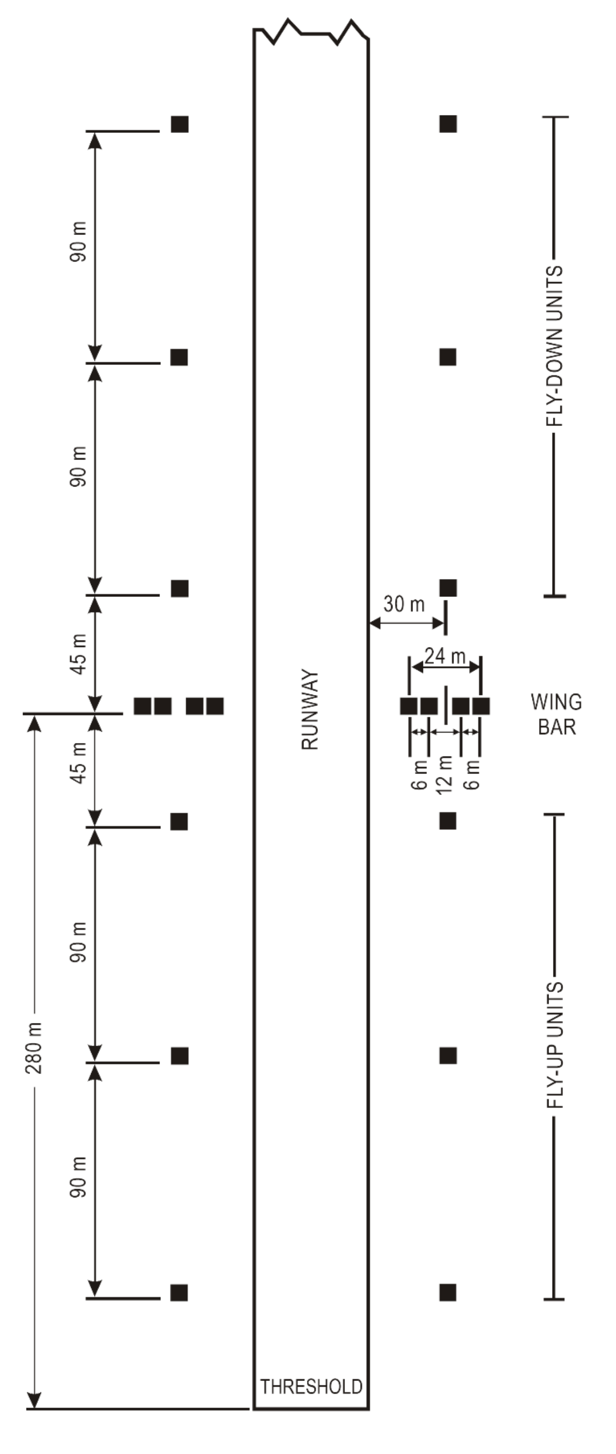
Wing bar lights and three fly-down lights visible 28 m to 54 m.

Characteristics of the light units

5.3.5.11. The systems shall be suitable for both day and night operations.

5.3.5.12. The light distribution of the beam of each light unit shall be of fan shape showing over a wide arc in azimuth in the approach direction. The wing bar light units shall produce a beam of white light from 1°54′ vertical angle up to 6° vertical angle and a beam of red light from 0° to 1°54′ vertical angle. The fly-down light units shall produce a white beam extending from an elevation of 6° down to approximately the approach slope, where it shall have a sharp cut-off. The fly-up light units shall produce a white beam from approximately the approach slope down to 1°54′ vertical angle and a red beam below a 1°54′ vertical angle. The angle of the top of the red beam in the wing bar units and fly-up units may be increased to comply with 5.3.5.22.

5.3.5.13. The light intensity distribution of the fly-down, wing bar and fly-up light units shall be as shown in Appendix 2, Figure A2-22.



INSTALLATION TOLERANCES

The appropriate authority may:

a) vary the nominal eye height over the threshold of the on-slope signal between the limits of 12 m and 16 m, except in cases where a standard ILS glide path and/or MLS minimum glide path is available; the height over threshold should be varied to avoid any conflict between the visual approach slope indications and the usable portion of the ILS glide path and/or MLS minimum glide path indications;

b) vary the longitudinal distance between individual light units or the overall length of the system by not more than 10 per cent;

c) vary the lateral displacement of the system from the runway edge by not more than ±3 m;

Note.— The system must be symmetrically displaced about the runway centre line.

d) where there is a longitudinal slope of the ground, adjust the longitudinal distance of a light unit to compensate for its difference in level from that of the threshold; and

e) where there is a transverse slope in the ground, adjust the longitudinal distance of two light units or two wing bars to compensate for the difference in level between them as necessary to meet the requirements of 5.3.5.17.

The distance between the wing bar and the threshold is based on an approach slope of 3° to a level runway with a nominal eye height over the threshold of 15 m. In practice, the threshold to wing bar distance is determined by:

a) the selected approach slope;

b) the longitudinal slope of the runway; and

c) the selected nominal eye height over the threshold.

Figure 5-17. Siting of light units for T-VASIS

5.3.5.14. The color transition from red to white in the vertical plane shall be such as to appear to an observer, at a distance of not less than 300 m, to occur over a vertical angle of not more than 15'.

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

5.3.5.16. A suitable intensity control shall be provided to allow adjustments to meet the prevailing conditions and to avoid dazzling the pilot during approach and landing.

5.3.5.17. 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 airplane to be substantially in a horizontal line. The light units shall be mounted as low as possible and shall be frangible.

5.3.5.18. 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.

Approach slope and elevation setting of light beams

5.3.5.19. The approach slope shall be appropriate for use by the airplanes using the approach.

5.3.5.20. When the runway on which a T-VASIS is provided is equipped with an ILS and/or MLS, the siting and elevations of the light units shall be such that the visual approach slope conforms as closely as possible with the glide path of the ILS and/or the minimum glide path of the MLS, as appropriate.

5.3.5.21. 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 5-18).

5.3.5.22. 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 airplane to whom the wing bar and three fly-up light units are visible would clear all objects in the approach area by a safe margin if any such light did not appear red.

5.3.5.23. 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.

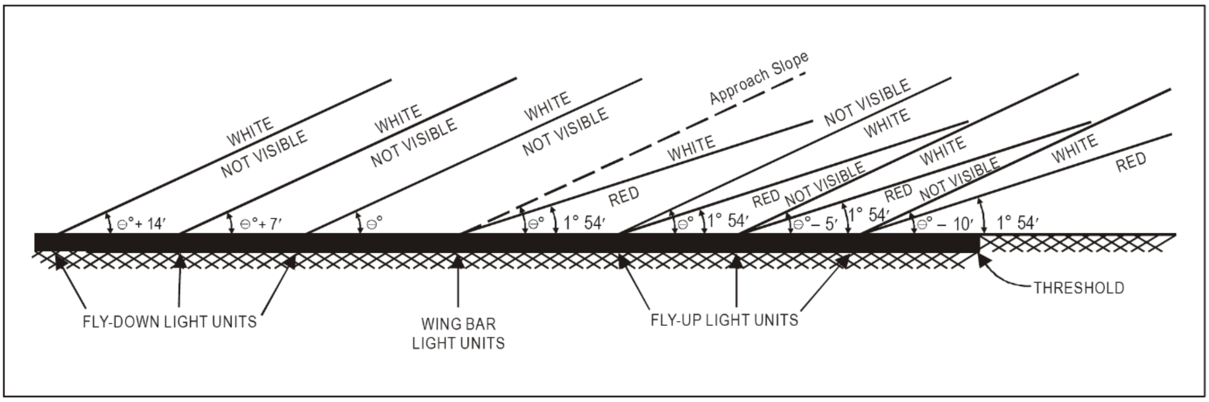


Figure 5-18. Light beams and elevation settings of T-VASIS and AT-VASIS

PAPI and APAPI

Description

5.3.5.24. 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.

5.3.5.25. 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.

5.3.5.26. The wing bar of a PAPI shall be constructed and arranged in such a manner that a pilot making an approach will:

a. When on or close to the approach slope, see the two units nearest the runway as red and the two units farthest from the runway as white.

b. When above the approach slope, see the one unit nearest the runway as red and the three units farthest from the runway as white; and when further above the approach slope, see all the units as white; and

c. When below the approach slope, see the three units nearest the runway as red and the unit farthest from the runway as white; and when further below the approach slope, see all the units as red.

5.3.5.27. 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

5.3.5.28. The light units shall be located as in the basic configuration illustrated in Figure 5-17, subject to the installation tolerances given therein. The units forming a wing bar shall be mounted to appear to the pilot of an approaching airplane to be substantially in a horizontal line. The light units shall be mounted as low as possible and shall be frangible.

Characteristics of the light units

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

5.3.5.30. The color transition from red to white in the vertical plane shall be such as to appear to an observer, at not less than 300 m, to occur within a vertical angle of not more than 3′.

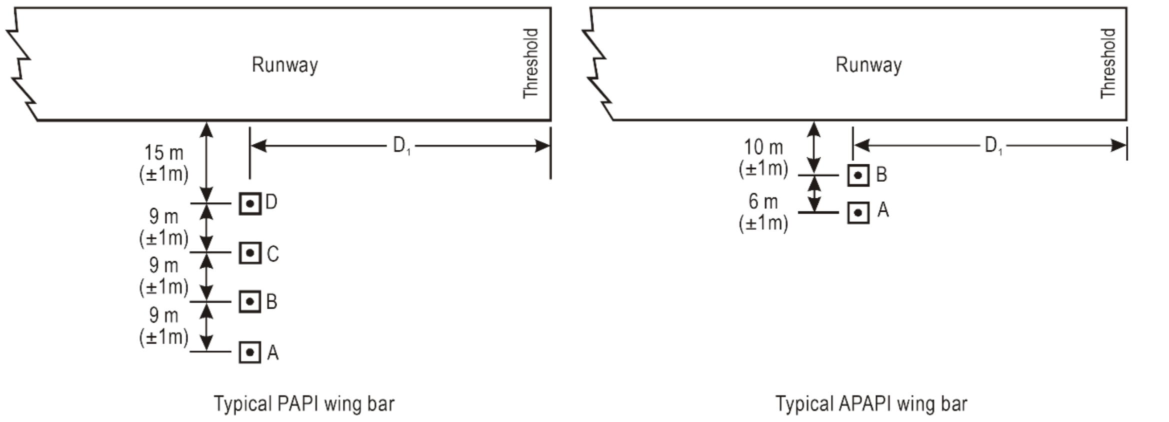
5.3.5.31. At full intensity, the red light shall have a Y coordinate not exceeding 0.320.

5.3.5.32. The light intensity distribution of the light units shall be as shown in Appendix 2, Figure A2-23.

5.3.5.33. Suitable intensity control shall be provided so as to allow adjustment to meet the prevailing conditions and to avoid dazzling the pilot during approach and landing.

5.3.5.34. Each light unit shall be capable of adjustment in elevation so that the lower limit of the white part of the beam may be fixed at any desired angle of elevation between 1°30′ and at least 4°30′ above the horizontal.

5.3.5.35. The light units shall be so designed that deposits of condensation, dirt, etc., on optically transmitting or reflecting surfaces shall interfere to the least possible extent with the light signals and shall not affect the contrast between the red and white signals and the elevation of the transition sector.



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.

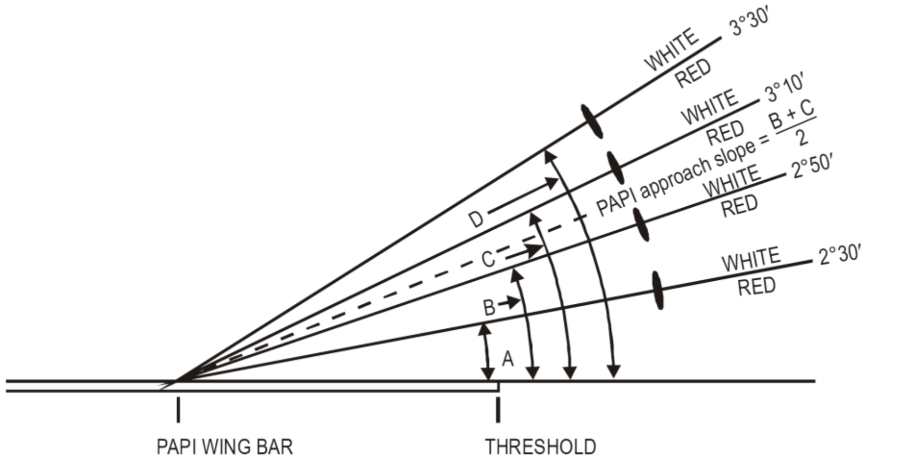
e) To ensure that units are mounted as low as possible and to allow for any transverse slope, small height adjustments of up to 5 cm between units are acceptable. A lateral gradient not greater than 1.25 per cent can be accepted provided it is uniformly applied across the units.

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.

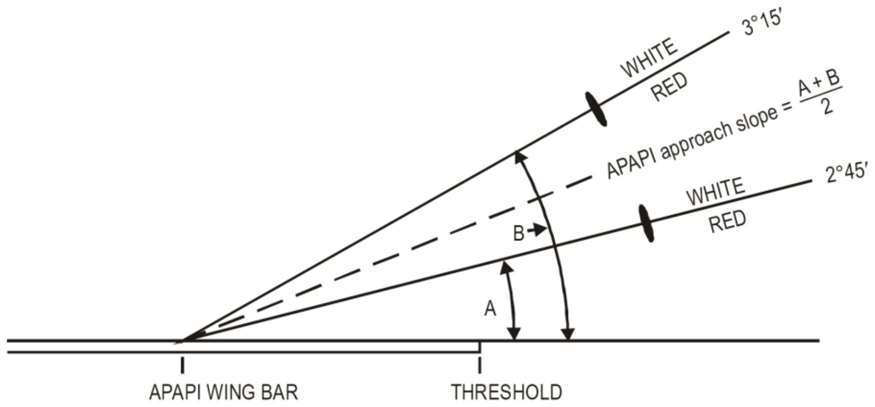
g) The lateral spacing between APAPI units may be increased to 9 m (±1 m) if greater range is required or later conversion to a full PAPI is anticipated. In the latter case, the inner APAPI unit shall be located 15 m (±1 m) from the runway edge.

Figure 5-19. Siting of PAPI and APAPI



The height of the pilot's eye above the aircraft's ILS glide path/MLS antenna varies with the type of aeroplane and approach attitude. Harmonization of the PAPI signal and ILS glide path and/or MLS minimum glide path to a point closer to the threshold may be achieved by increasing the on-course sector from 20′ to 30′. The setting angles for a 3° glide slope would then be 2°25′, 2°45′, 3°15′ and 3°35′.

A — 3° PAPI ILLUSTRATED



B — 3° APAPI ILLUSTRATED

Figure 5-20. Light beams and angle of elevation setting of PAPI and APAPI

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

Eye-to-wheel height of aeroplane in the approach configuration[a]	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.

Approach slope and elevation setting of light units

5.3.5.36. The approach slope as defined in Figure 5-18 shall be appropriate for use by the airplanes using the approach.

5.3.5.37. When the runway is equipped with an ILS and/or MLS, the siting and the angle of elevation of the light units shall be such that the visual approach slope conforms as closely as possible with the glide path of the ILS and/or the minimum glide path of the MLS, as appropriate.

5.3.5.38. 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 airplane observing a signal of one white and three reds will clear all objects in the approach area by a safe margin (see Table 5-2).

5.3.5.39. 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 airplane observing the lowest on slope signal, i.e., one white and one red, will clear all objects in the approach area by a safe margin (see Table 5-2).

5.3.5.40. The azimuth spread of the light beam shall be suitably restricted where an object located outside the obstacle protection surface of the PAPI or APAPI system, but within the lateral limits of its light beam, is found to extend above the plane of the obstacle protection surface and an aeronautical study indicates that the object could adversely affect the safety of operations. The extent of the restriction shall be such that the object remains outside the confines of the light beam.

Note: See 5.3.5.30 to 5.3.5.35 concerning the related obstacle protection surface.

5.3.5.41. 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

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

5.3.5.43. The characteristics of the obstacle protection surface, i.e., origin, divergence, length and slope, shall correspond to those specified in the relevant column of Table 5-3 and in Figure 5-19.

5.3.5.44. 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.

5.3.5.45. 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 airplanes.

	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 the visual approach slope indicator system[e]	D_1+30 m	D_1+60 m	D_1+60 m	D_1+60 m	D_1+60 m	D_1+60 m	D_1+60 m	D_1+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.
e. D_1 is the distance of the visual approach slope indicator system from threshold prior to any displacement to remedy object penetration of the OPS (refer Figure 5-19). The start of the OPS is fixed to the visual approach slope indicator system location, such that displacement of the PAPI results in an equal displacement of the start of the OPS. See 5.3.5.46 e).

Table 5-3. Dimensions and slopes of the obstacle protection surface

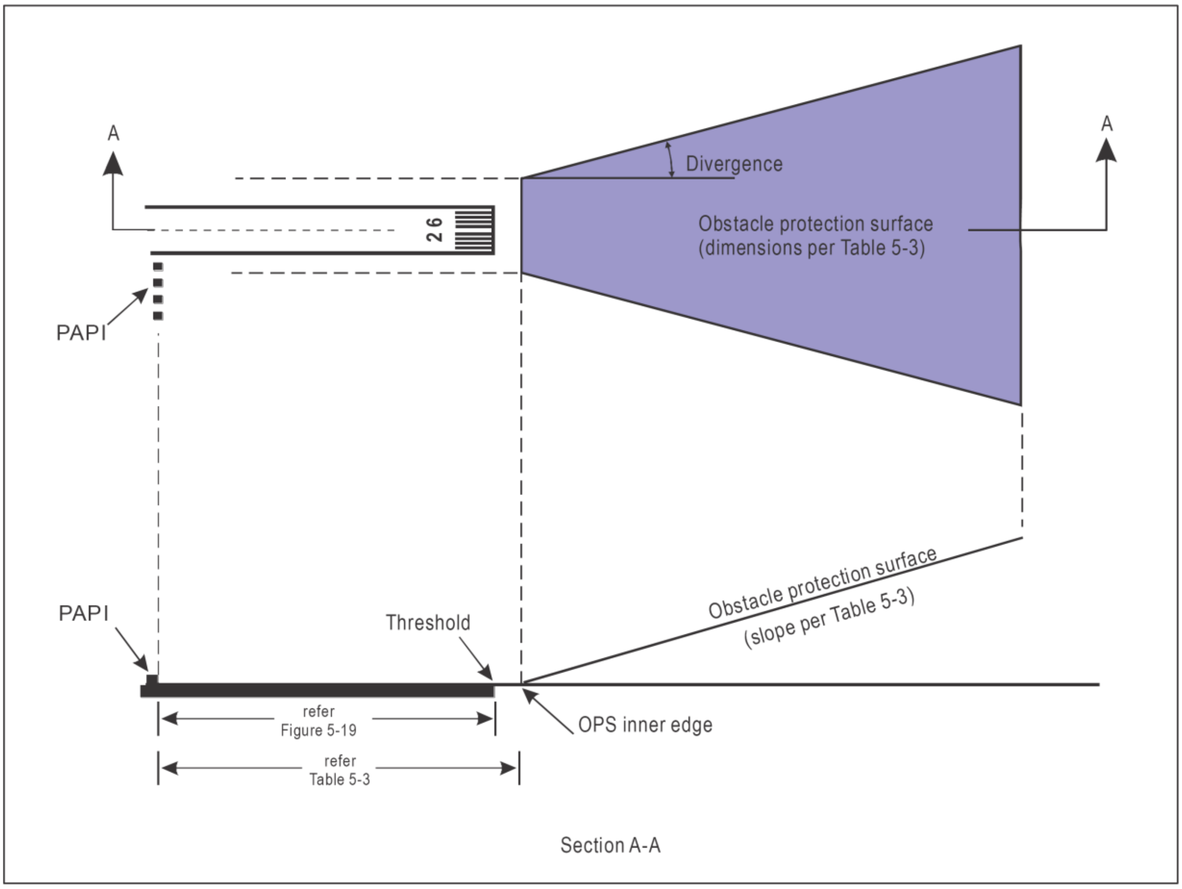


Figure 5-19. Obstacle protection surface for Visual Approach Slope Indicator Systems

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

a. Remove the object;

b. Suitably raise the approach slope of the system;

c. Reduce the azimuth spread of the system so that the object is outside the confines of the beam;

d. Displace the axis of the system and its associated obstacle protection surface by not more than 5°;

e. Suitably displace the system upwind of the threshold such that the object no longer penetrates the OPS.

5.3.6. Circling guidance lights

Application

5.3.6.1. Circling guidance lights shall be provided when existing approach and runway lighting systems do not satisfactorily permit identification of the runway and/or approach area to a circling aircraft in the conditions for which it is intended the runway be used for circling approaches.

Location

5.3.6.2. The location and number of circling guidance lights shall be adequate to enable a pilot, as appropriate, to:

a. Join the downwind leg or align and adjust the aircraft's track to the runway at a required distance from it and to distinguish the threshold in passing; and

b. Keep in sight the runway threshold and/or other features which will make it possible to judge the turn on to base leg and final approach, taking into account the guidance provided by other visual aids.

5.3.6.3. Circling guidance lights shall consist of:

a. lights indicating the extended center 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.

Characteristics

5.3.6.4. 5.3.6.4 Circling guidance lights shall be fixed or flashing lights of an intensity and beam spread adequate for the conditions of visibility and ambient light in which it is intended to make visual circling approaches. The flashing lights shall be white, and the steady lights either white or gaseous discharge lights.

5.3.6.5. The lights shall be designed and be installed in such a manner that they will not dazzle or confuse a pilot when approaching to land, taking off or taxiing.

5.3.7. Runway lead-in lighting systems

Application

5.3.7.1. A runway lead-in lighting system shall be provided where it is desired to provide visual guidance along a specific approach path, for reasons such as avoiding hazardous terrain or for purposes of noise abatement.

Location

5.3.7.2. A runway lead-in lighting system shall consist of groups of lights positioned so as to define the desired approach path and so that one group may be sighted from the preceding group. The interval between adjacent groups shall not exceed approximately 1 600 m.

5.3.7.3. A runway lead-in lighting system shall extend from a point as approved by LYCAA, 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. Each group of lights of a runway lead-in lighting system shall consist of at least three flashing lights in a linear or cluster configuration. The system may be augmented by steady burning lights where such lights would assist in identifying the system.

5.3.7.5. The flashing lights and steady burning lights shall be white.

5.3.7.6. Where practicable, the flashing lights in each group shall flash in sequence towards the runway.

5.3.8. 5.3.8 Runway threshold identification lights

Application

5.3.8.1. Runway threshold identification lights shall be installed:

a. At the threshold of a non-precision approach runway when additional threshold conspicuity is necessary or where it is not practicable to provide other approach lighting aids; and

b. Where a runway threshold is permanently displaced from the runway extremity or temporarily displaced from the normal position and additional threshold conspicuity is necessary.

Location

5.3.8.2. Runway threshold identification lights shall be located symmetrically about the runway center line, in line with the threshold and approximately 10 m outside each line of runway edge lights.

Characteristics

5.3.8.3. Runway threshold identification lights shall 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. Runway edge lights shall be provided on a runway intended for take-off with an operating minimum below an RVR of the order of 800 m by day.

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 center 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. Where the width of the area which could be declared as runway exceeds 60 m, the distance between the rows of lights shall be determined taking into account the nature of the operations, the light distribution characteristics of the runway edge lights, and other visual aids serving the runway.

5.3.9.6. 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.

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).

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.

5.3.10. Runway threshold and wing bar lights

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. (See Figure 5-20).

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 c) 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. The lights prescribed in 5.3.10.4 a) and b) shall be either:

a. Equally spaced between the rows of runway edge lights; or

b. Symmetrically disposed about the runway center 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. Wing bar lights shall 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 center 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.

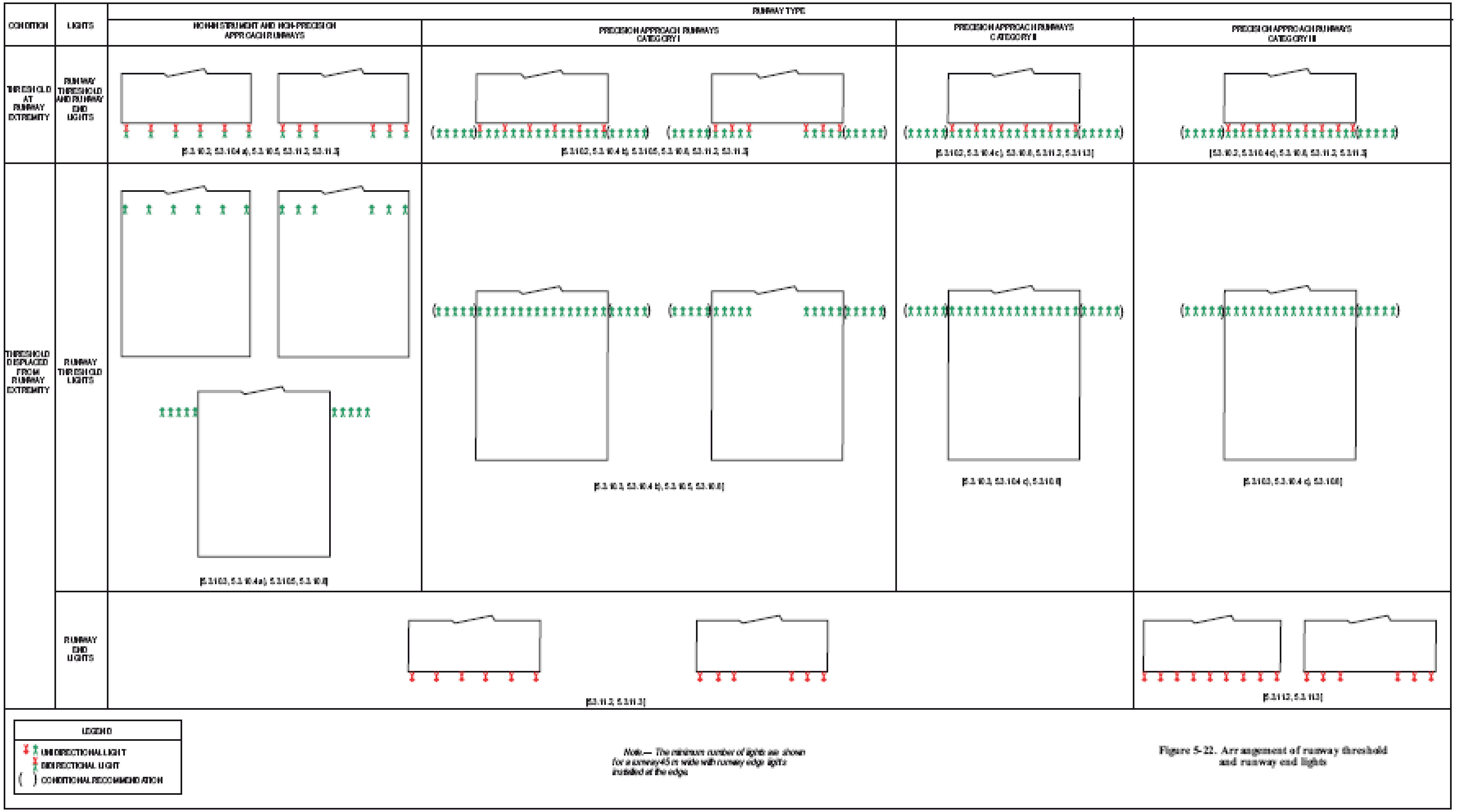
Characteristics of runway threshold and wing bar lights

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.

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.

Figure 5-20. Arrangement of runway threshold and runway end lights



5.3.11. Runway end lights

Application

5.3.11.1. Runway end lights shall be provided for a runway equipped with runway edge lights (See Figure 5-20).

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. Runway end lighting shall consist of at least six lights. The lights shall be either:

a. Equally spaced between the rows of runway edge lights; or

b. Symmetrically disposed about the runway center line in two groups with the lights uniformly spaced in each group and with a gap between the groups of not more than half the distance between the rows of runway edge lights.

For a precision approach runway category III, the spacing between runway end lights, except between the two innermost lights if a gap is used, shall not exceed 6 m.

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.

5.3.12. Runway center line lights

Application

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

5.3.12.2. Runway center line lights shall be provided on a precision approach runway category I, particularly when the runway is used by aircraft with high landing speeds or where the width between the runway edge lights is greater than 50 m.

5.3.12.3. Runway center line lights shall be provided on a runway intended to be used for takeoff with an operating minimum below an RVR of the order of 400 m.

5.3.12.4. Runway center line lights shall be provided on a runway intended to be used for takeoff with an operating minimum of an RVR of the order of 400 m or higher when used by airplanes 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 center line lights shall be located along the center line of the runway, except that the lights may be uniformly offset to the same side of the runway center line by not more than 60 cm where it is not practicable to locate them along the center 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 center line lights specified as maintenance objectives in 10.5.6 or 10.5.10, 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. Center line guidance for take-off from the beginning of a runway to a displaced threshold shall be provided by:

a. An approach lighting system if its characteristics and intensity settings afford the guidance required during take-off and it does not dazzle the pilot of an aircraft taking off; or

b. Runway center line lights; or

c. Barrettes of at least 3 m in length and spaced at uniform intervals of 30 m, as shown in Figure 5-23, designed so that their photometric characteristics and intensity setting afford the guidance required during take-off without dazzling the pilot of an aircraft taking off.

Where necessary, provision shall be made to extinguish those center line lights specified in b) or reset the intensity of the approach lighting system or barrettes when the runway is being used for landing. In no case shall only the single source runway center 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 center 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.

5.3.12.8. Runway center line lights shall be in accordance with the specifications of Appendix 2, Figure A2-6 or A2-7.

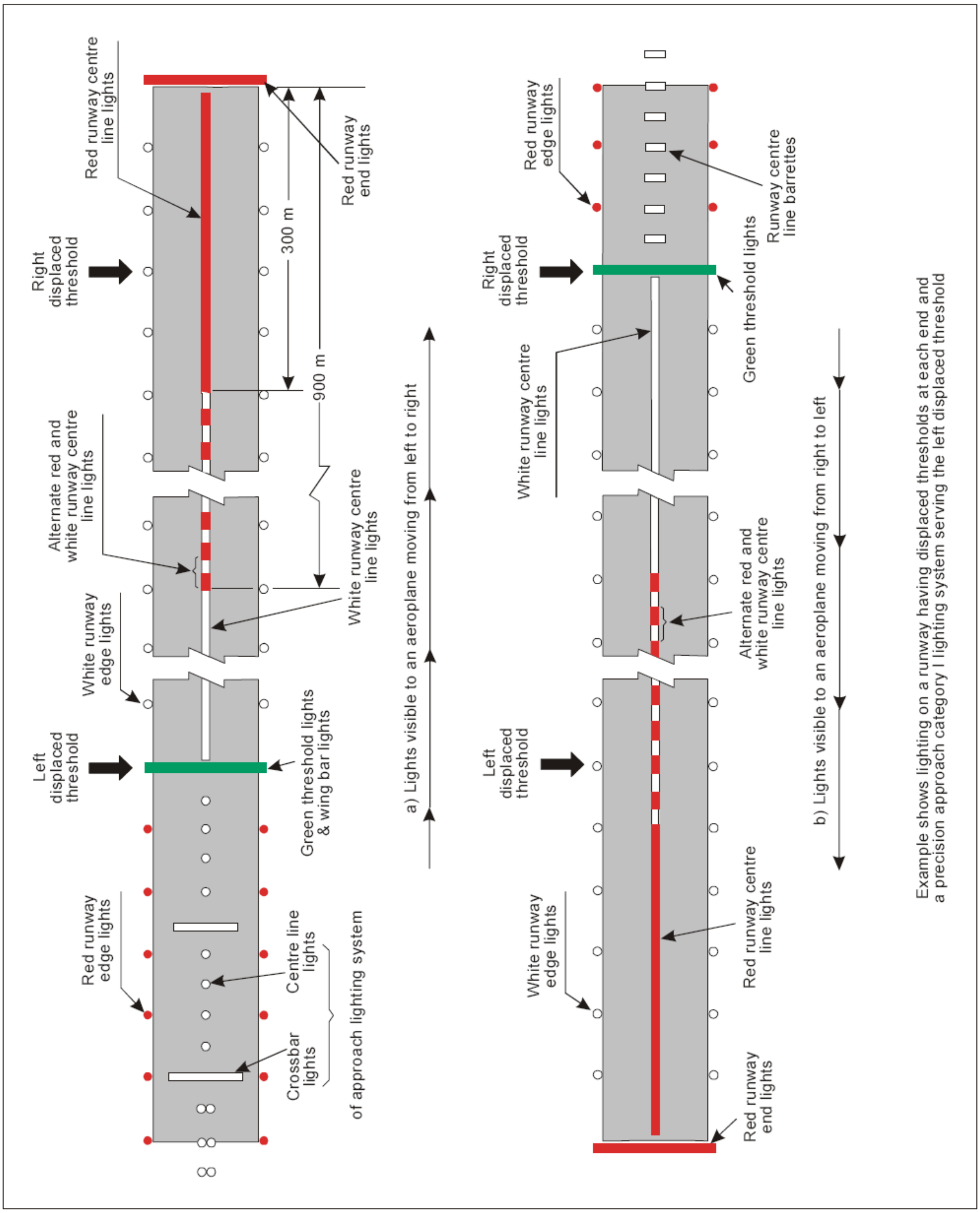


Figure 5-21. Example of approach and runway lighting for runway with displaced thresholds

5.3.13. Runway touchdown zone lights

Application

5.3.13.1. Touchdown zone 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 center 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. A barrette shall 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.

5.3.14. Simple touchdown zone lights

Application

5.3.14.1. Except where TDZ lights are provided in accordance with paragraph 5.3.13, at an aerodrome where the approach angle is greater than 3.5 degrees and/or the Landing Distance Available combined with other factors increases the risk of an overrun, simple touchdown zone lights shall be provided.

Location

5.3.14.2. Simple touchdown zone lights shall be a pair of lights located on each side of the runway centerline 0.3 m beyond the upwind edge of the final touchdown zone marking. The lateral spacing between the inner lights of the two pairs of lights shall be equal to the lateral spacing selected for the touchdown zone marking. The spacing between the lights of the same pair shall not be more than 1.5 m or half the width of the touchdown zone marking, whichever is greater. (See Figure 5-22.)

5.3.14.3. Where provided on a runway without TDZ markings, simple touchdown zone lights shall be installed in such a position that provides the equivalent TDZ information.

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 airplane 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.

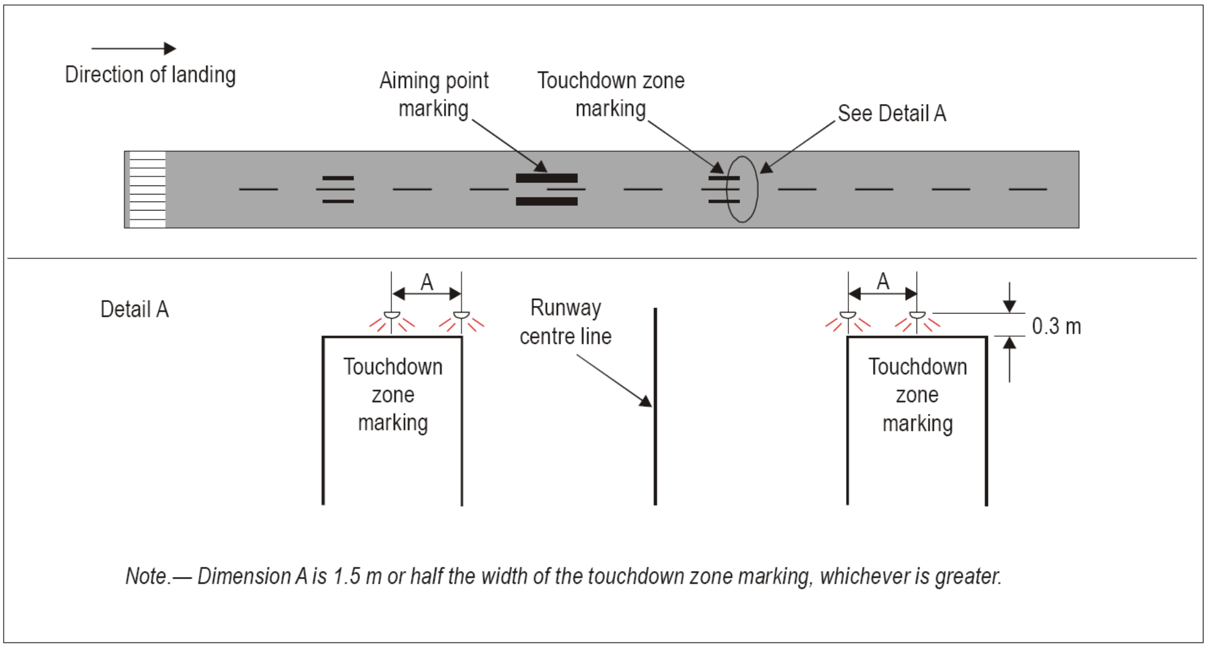


Figure 5-22. Simple touchdown zone lighting

5.3.15. Rapid exit taxiway indicator lights

Application

5.3.15.1. Rapid exit taxiway indicator lights shall be provided on a runway intended for use in runway visual range conditions less than a value of 350 m and/or where the traffic density is heavy.

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 5-23, 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 center line as the associated rapid exit taxiway, in the configuration shown in Figure 5-23. In each set, the lights shall be located 2 m apart and the light nearest to the runway center line shall be displaced 2 m from the runway center 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.

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 airplane 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, as appropriate.

5.3.15.7. Rapid exit taxiway indicator lights shall be supplied with power on a separate circuit to other runway lighting so that they may be used when other lighting is switched off.

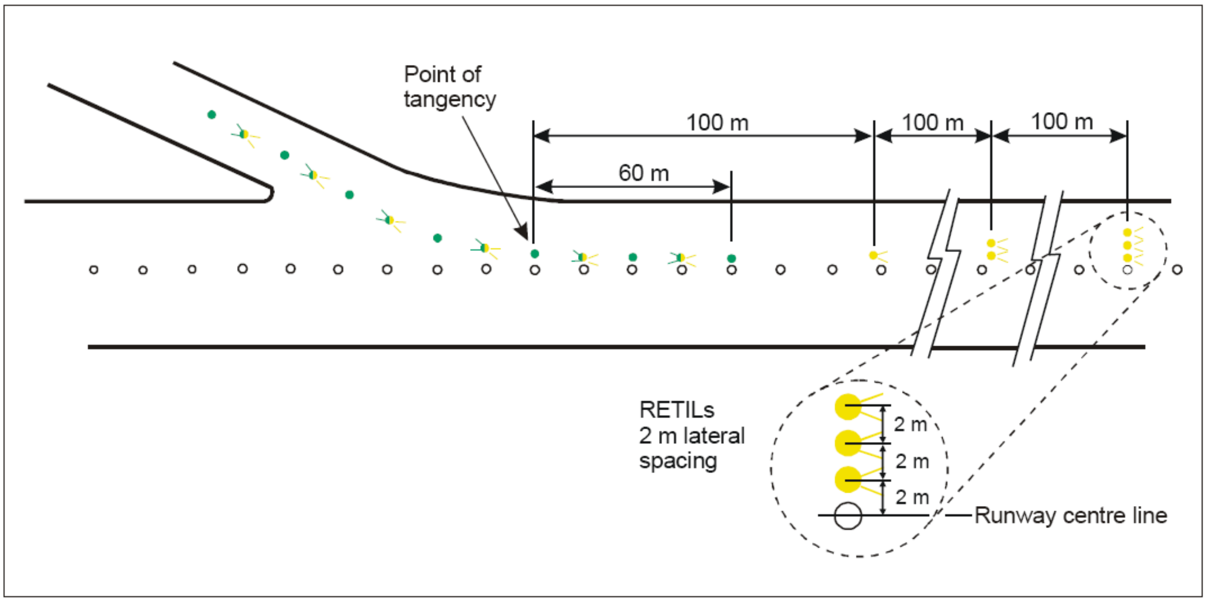


Figure 5-23. Rapid Exit Taxiway Indicator Lights (RETILS)

5.3.16. Stopway lights

Application

5.3.16.1. Stop way 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 center 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 center line lights

Application

5.3.17.1. Taxiway center line lights shall be provided on an exit taxiway, taxiway, and apron intended for use in runway visual range conditions less than a value of 350 m in such a manner as to provide continuous guidance between the runway center line and aircraft stands, except that these lights need not be provided where the traffic density is light and taxiway edge lights and center line marking provide adequate guidance.

5.3.17.2. Taxiway center line lights shall be provided on a taxiway intended for use at night in runway visual range conditions of 350 m or greater, and particularly on complex taxiway intersections and exit taxiways, except that these lights need not be provided where the traffic density is light and taxiway edge lights and center line marking provide adequate guidance.

5.3.17.3. Taxiway center line lights shall be provided on an exit taxiway, taxiway, and apron in all visibility conditions where specified as components of an advanced surface movement guidance and control system in such a manner as to provide continuous guidance between the runway center line and aircraft stands.

5.3.17.4. Taxiway center 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 center line marking provide adequate guidance.

5.3.17.5. Taxiway center line lights shall be provided in all visibility conditions on a runway forming part of a standard taxi-route where specified as components of an advanced surface movement guidance and control system.

Characteristics

5.3.17.6. Except as provided for in 5.3.17.8, taxiway center 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 airplanes on or in the vicinity of the taxiway.

5.3.17.7. Taxiway center line lights on an exit taxiway shall be fixed lights. Alternate taxiway center line lights shall show green and yellow from their beginning near the runway center line to the perimeter of the ILS/MLS critical/sensitive area or the lower edge of the inner transitional surface, whichever is farthest from the runway; and thereafter all lights shall show green (Figure 5-24). The first light in the exit center line shall always show green, and the light nearest to the perimeter shall always show yellow.

5.3.17.8. Where it is necessary to denote the proximity to a runway, taxiway center line lights shall be fixed lights showing alternating green and yellow from the perimeter of the ILS/MLS critical/sensitive area or the slower 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 center line; or

b. In the case of the taxiway center 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.

5.3.17.9. Taxiway centerline lights shall be in accordance with the specifications of:

a. Appendix 2, Figure A2-12, A2-13, or A2-14, for taxiways intended for use in runway visual range conditions of less than a value of 350 m; and

b. Appendix 2, Figure A2-15 or A2-16, for other taxiways.

5.3.17.10. Where higher intensities are required, from an operational point of view, taxiway centerline lights on rapid exit taxiways intended for use in runway visual range conditions less than a value of 350 m shall be in accordance with the specifications of Appendix 2, Figure A2-12. The number of levels of brilliancy settings for these lights shall be the same as that for the runway centerline lights.

Where taxiway centerline 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 centerline lights shall be in accordance with the specifications of Appendix 2, Figure A2-17, A2-18 or A2-19.

Location

5.3.17.11. Taxiway centerline lights shall normally be located on the taxiway centerline marking, except that they may be offset by not more than 30 cm where it is not practicable to locate them on the marking.

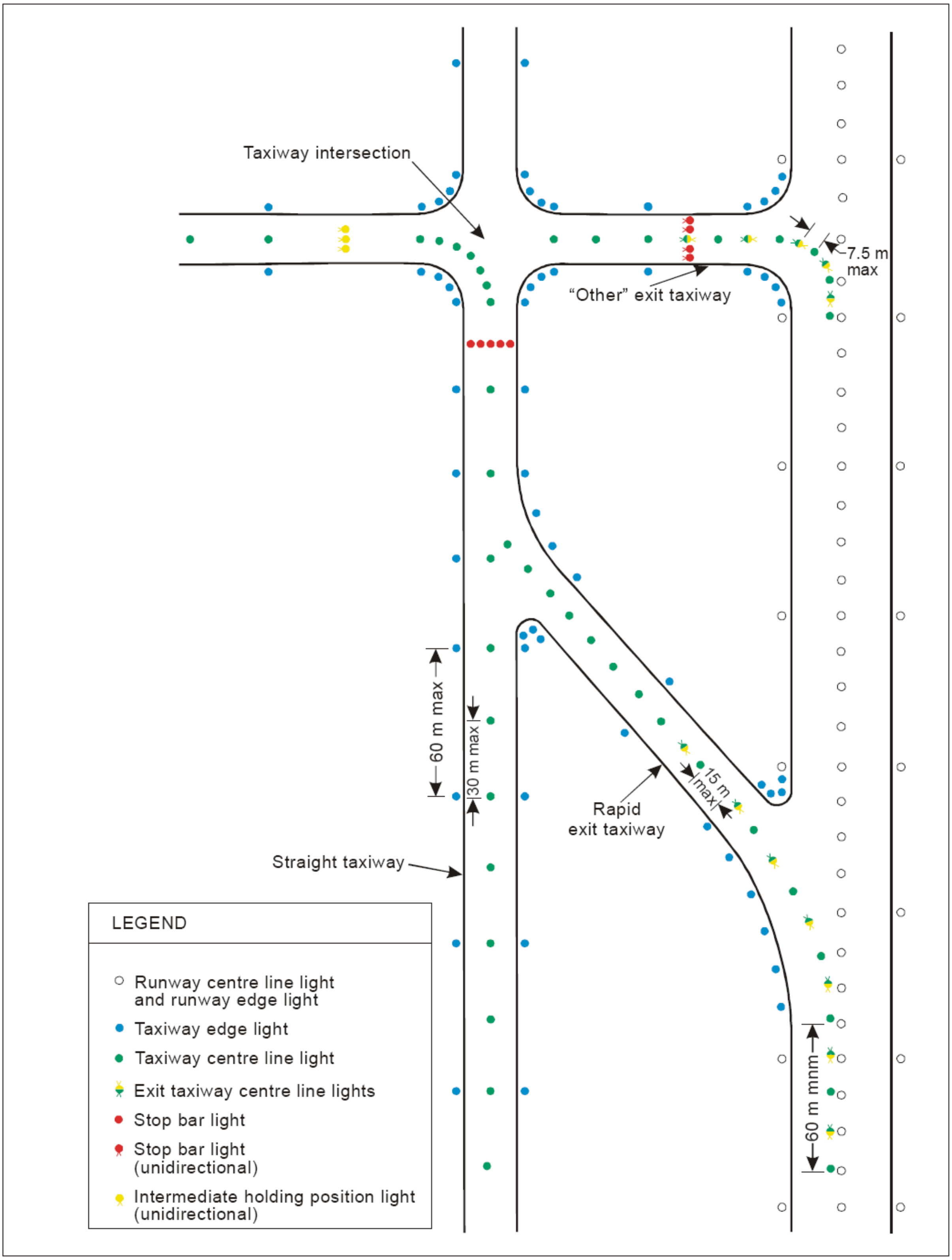


Figure 5-24. Taxiway Lighting

Taxiway centerline lights on taxiways

Location

5.3.17.12. Taxiway centerline lights on a straight section of a taxiway shall be spaced at longitudinal intervals of not more than 30 m, except that:

a. Larger intervals not exceeding 60 m may be used where, because of the prevailing meteorological conditions, adequate guidance is provided by such spacing;

b. Intervals less than 30 m shall be provided on short straight sections; and

c. On a taxiway intended for use in RVR conditions of less than a value of 350 m, the longitudinal spacing shall not exceed 15 m.

5.3.17.13. Taxiway centerline lights on a taxiway curve shall continue from the straight portion of the taxiway at a constant distance from the outside edge of the taxiway curve. The lights shall be spaced at intervals such that a clear indication of the curve is provided.

5.3.17.14. On a taxiway intended for use in RVR conditions of less than a value of 350 m, the lights on a curve shall not exceed a spacing of 15 m, and on a curve of less than 400 m radius the lights shall be spaced at intervals of not greater than 7.5 m. This spacing shall extend for 60 m before and after the curve.

Spacings on curves that have been found suitable for a taxiway intended for use in RVR conditions of 350 m or greater are:

Curve radius	**Light spacing**
up to 400 m	7.5 m
401 m to 899 m	15 m
900 m or greater	30 m

Taxiway center line lights on rapid exit taxiways

Location

5.3.17.15. Taxiway center line lights on a rapid exit taxiway shall commence at a point at least 60 m before the beginning of the taxiway center line curve and continue beyond the end of the curve to a point on the center line of the taxiway where an airplane can be expected to reach normal taxiing speed. The lights on that portion parallel to the runway center line shall always be at least 60 cm from any row of runway center line lights, as shown in Figure 5-25.

5.3.17.16. The lights shall be spaced at longitudinal intervals of not more than 15 m, except that, where runway centerline lights are not provided, a greater interval not exceeding 30 m may be used.

Taxiway centerline lights on other exit taxiways

Location

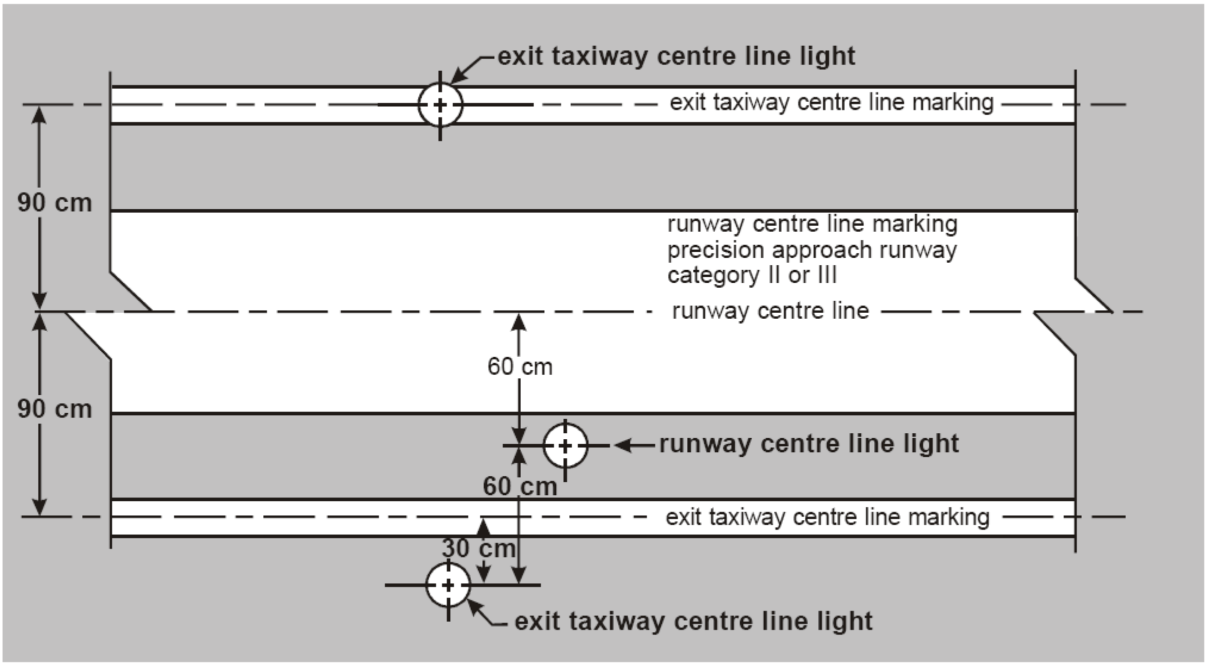
5.3.17.17. Taxiway centerline lights on exit taxiways other than rapid exit taxiways shall commence at the point where the taxiway centerline marking begins to curve from the runway centerline, and follow the curved taxiway centerline marking at least to the point where the marking leaves the runway. The first light shall be at least 60 cm from any row of runway centerline lights, as shown in Figure 5-25.

5.3.17.18. The lights shall be spaced at longitudinal intervals of not more than 7.5 m.

Taxiway centerline lights on runways

Location

5.3.17.19. Taxiway centerline lights on a runway forming part of a standard taxi-route and intended for taxiing in runway visual range conditions less than a value of 350 m shall be spaced at longitudinal intervals not exceeding 15 m.



(Tolerances for offset runway center line lights and taxiway center line lights to maintain 60 cm separation).

Figure 5-25. Offset Runway and Taxiway Center Line Lights

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, apron, etc., intended for use at night and on a taxiway not provided with taxiway centerline 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 centerline lights.

Location

5.3.18.3. Taxiway edge lights on a straight section of a taxiway and on a runway forming part of a standard taxi-route shall be spaced at uniform longitudinal intervals of not more than 60 m. The lights on a curve shall be spaced at intervals less than 60 m so that a clear indication of the curve is provided.

5.3.18.4. Taxiway edge lights on a holding bay, apron, etc., shall be spaced at uniform longitudinal intervals of not more than 60 m.

5.3.18.5. Taxiway edge lights on a runway turn pad shall be spaced at uniform longitudinal intervals of not more than 30 m.

5.3.18.6. The lights shall be located as near as practicable to the edges of the taxiway, runway turn pad, holding bay, apron or runway, etc., or outside the edges at a distance of not more than 3m.

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 airplane to complete a 180-degree turn and align with the runway centerline.

5.3.19.2. Runway turn pad lights shall be provided on a runway turn pad intended for use at night.

Location

5.3.19.3. Runway turn pad lights shall normally be located on the runway turn pad marking, except that they may be offset by not more than 30 cm where it is not practicable to locate them on the marking.

5.3.19.4. Runway turn pad lights on a straight section of the runway turn pad marking shall be spaced at longitudinal intervals of not more than 15 m.

5.3.19.5. Runway turn pad lights on a curved section of the runway turn pad marking shall 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 airplanes 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, 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 550 m, except where:

a. Appropriate aids and procedures are available to assist in preventing inadvertent incursions of aircraft and vehicles onto the runway; or

b. Operational procedures exist to limit, in runway visual range conditions less than a value of 550 m, the number of:

    1. Aircraft on the maneuvering area to one at a time; and

    2. Vehicles on the maneuvering area to the essential minimum.

5.3.20.2. Where there is more than one stop bar associated with a taxiway/runway intersection, only one shall be illuminated at any given time.

5.3.20.3. A stop bar shall be provided at an intermediate holding position when it is desired to supplement markings with lights and to provide traffic control by visual means.

Location

5.3.20.4. 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

5.3.20.5. Stop bars shall consist of lights spaced at intervals of 3 m across the taxiway, showing red in the intended direction(s) of approach to the intersection or runway-holding position.

5.3.20.6. A pair of elevated lights shall be added to each end of the stop bar where the stop bar lights might be obscured from a pilot's view, for example, by snow or rain, or where a pilot may be required to stop the aircraft in a position so close to the lights that they are blocked from view by the structure of the aircraft.

5.3.20.7. Stop bars installed at a runway-holding position shall be unidirectional and shall show red in the direction of approach to the runway.

5.3.20.8. Where the additional lights specified in 5.3.20.5 are provided, these lights shall have the same characteristics as the lights in the stop bar, but shall be visible to approaching aircraft up to the stop bar position.

5.3.20.9. The intensity in red light and beam spreads of stop bar lights shall be in accordance with the specifications in Appendix 2, Figures A2-12 through A2-16, as appropriate.

5.3.20.10. 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, it is recommended that the intensity in red light and beam spreads of stop bar lights shall be in accordance with the specifications of Appendix 2, Figure A2-17, A2-18 or A2-19.

5.3.20.11. Where a wide beam fixture is required, it is recommended that the intensity in red light and beam spreads of stop bar lights shall be in accordance with the specifications of Appendix 2, Figure A2-17 or A2-19.

5.3.20.12. 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 centerline lights installed beyond the stop bar shall be extinguished for a distance of at least 90 m; and

d. stop bars shall be interlocked with the taxiway centerline lights so that when the centerline 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. Intermediate holding position lights shall be provided at an intermediate holding position where there is no need for stop-and-go signals as provided by a stop bar.

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 centerline lights if provided. The lights shall be disposed symmetrically about and at right angle to the taxiway centerline, with individual lights spaced 1.5 m apart.

5.3.22. De-icing/anti-icing facility exit lights

Not Applicable.

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. As part of runway incursion prevention measures, runway guard lights, Configuration A or B, shall be provided at each taxiway/runway intersection where runway incursion hot spots have been identified, and used under all weather conditions during day and night.

5.3.23.3. Configuration B runway guard lights shall not be collocated with a stop bar.

5.3.23.4. Where more than one runway-holding positions exist at a runway/taxiway intersection, only the set of runway guard lights associated with the operational runway-holding position shall be illuminated.

Location

5.3.23.5. Runway guard lights, Configuration A, shall be located at each side of the taxiway on the holding side of the runway-holding position marking.

5.3.23.6. Runway guard lights, Configuration B, shall be located across the taxiway on the holding side of the runway-holding position marking.

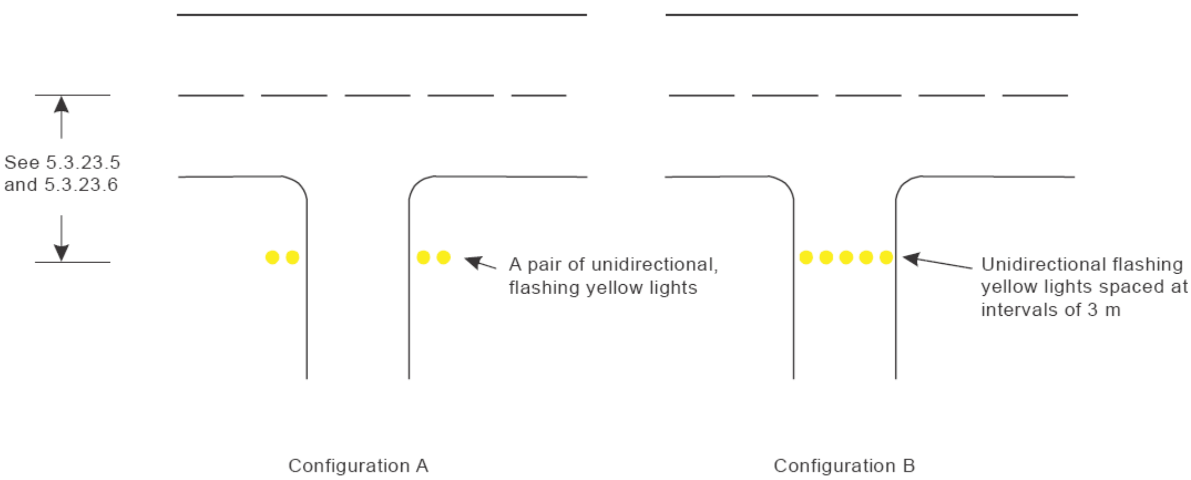


Figure 5-26. Runway Guard Light

Characteristics

5.3.23.7. Runway guard lights, Configuration A, shall consist of two pairs of yellow lights.

5.3.23.8. Where there is a need to enhance the contrast between the on and off state of runway guard lights, Configuration A, intended for use during the day, a visor of sufficient size to prevent sunlight from entering the lens without interfering with the function of the fixture shall be located above each lamp.

5.3.23.9. Runway guard lights, Configuration B, shall consist of yellow lights spaced at intervals of 3 m across the taxiway.

5.3.23.10. The light beam shall be unidirectional and shall show yellow in the direction of approach to the runway-holding position.

5.3.23.11. The intensity in yellow light and beam spreads of lights of Configuration A shall be in accordance with the specifications in Appendix 2, Figure A2-24.

5.3.23.12. Where runway guard lights are intended for use during the day it is that the intensity in yellow light and beam spreads of lights of Configuration A shall be in accordance with the specifications in Appendix 2, Figure A2-25.

5.3.23.13. Where runway guard lights are specified as components of an advanced surface movement guidance and control system where higher light intensities are required it is recommended that the intensity in yellow light and beam spreads of lights of Configuration A shall be in accordance with the specifications in Appendix 2, Figure A2-25.

5.3.23.14. The intensity in yellow light and beam spreads of lights of Configuration B shall be in accordance with the specifications in Appendix 2, Figure A2-12.

5.3.23.15. Where runway guard lights are intended for use during the day, the intensity in yellow light and beam spreads of lights of Configuration B shall be in accordance with the specifications in Appendix 2, Figure A2-20.

5.3.23.16. Where runway guard lights are specified as components of an advanced surface movement guidance and control system where higher light intensities are required, the intensity in yellow light and beam spreads of lights of Configuration B shall be in accordance with the specifications in Appendix 2, Figure A2-20.

5.3.23.17. The lights in each unit of Configuration A shall be illuminated alternately.

5.3.23.18. For Configuration B, adjacent lights shall be alternately illuminated and alternative lights shall be illuminated in unison.

5.3.23.19. 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

Application

5.3.24.1. Apron floodlighting shall be provided on an apron and on a designated isolated aircraft parking position intended to be used at night. If permanent flood lighting is not available at the isolated aircraft parking position, the aerodrome operators shall provide mobile floodlighting equipment unless otherwise exempted by LYCAA.

Location

5.3.24.2. Apron floodlights shall be located so as to provide adequate illumination on all apron service areas, with a minimum of glare to pilots of aircraft in flight and on the ground, aerodrome and apron controllers, and personnel on the apron. The arrangement and aiming of floodlights shall be such that an aircraft stand receives light from two or more directions to minimize shadows.

Characteristics

5.3.24.3. The spectral distribution of apron floodlights shall be such that the colors used for aircraft marking connected with routine servicing, and for surface and obstacle marking, can be correctly identified.

5.3.24.4. The average illuminance shall be at least the following:

Aircraft stand:

- Horizontal illuminance - 20 lux with a uniformity ratio (average to minimum) of not more than 4 to 1; and

- Vertical illuminance - 20 lux at a height of 2 m above the apron in relevant parking direction, (i.e., parallel to the airplane centerline for constantans);

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 maneuvering 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. The system shall be usable by all types of aircraft for which the aircraft stand is intended, preferably without selective operation.

5.3.25.8. 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 center line ahead of the aircraft so that its signals are visible from the cockpit of an aircraft throughout the docking maneuver and aligned for use at least by the pilot occupying the left seat.

5.3.25.10. The azimuth guidance unit shall 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 color change, green shall be used to identify the center line and red for deviations from the center 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. The stopping position indicator shall 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. The stopping position indicator shall provide closing rate information over a distance of at least 10 m.

5.3.25.19. When stopping guidance is indicated by color 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 color may be used to warn that the stopping point is close.

5.3.26. Advanced Visual Docking Guidance System (A-VDGS)

Application

5.3.26.1. An A-VDGS shall be provided where it is operationally desirable to confirm the correct aircraft type for which guidance is being provided and/or to indicate the stand center 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 maneuver.

Characteristics

5.3.26.6. The A-VDGS shall provide, at minimum, the following guidance information at the appropriate stage of the docking maneuver:

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 center line;

d. The direction of azimuth correction needed to correct a displacement from the stand center 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 maneuver.

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 center line greater than 1 m.

5.3.26.9. The information on displacement of the aircraft relative to the stand center line and distance to the stopping position, when displayed, shall be provided with the accuracy specified in Table 5-4.

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 center 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.

Table 5-4. A-VDGS recommended displacement accuracy

Guidance information	Maximum deviation at stop position (stop area)	Maximum deviation at9 m from stop position	Maximum deviation at15 m from stop position	Maximum deviation at25 m from stop position
Azimuth	±250 mm	±340 mm	±400 mm	±500 mm
Distance	±500 mm	±1 000 mm	±1 300 mm	Not specified

5.3.26.13. Where provided, closure distance displayed in numerals shall be provided in meter integers to the stop position and displayed to 1 decimal place at least 3 m prior to the stop position.

5.3.26.14. Throughout the docking maneuver, an appropriate means shall be provided on the AVDGS 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. The word “stop” in red characters shall be displayed when an immediate cessation of the docking maneuver is required.

5.3.27. Aircraft stand maneuvering guidance lights

Application

5.3.27.1. Aircraft stand maneuvering guidance lights shall be provided to facilitate the positioning of an aircraft on an aircraft stand on a paved apron facility intended for use in poor visibility conditions, unless adequate guidance is provided by other means.

Location

5.3.27.2. Aircraft stand maneuvering guidance lights shall be collocated with the aircraft stand markings.

Characteristics

5.3.27.3. Aircraft stand maneuvering 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. The lights used to delineate lead-in, turning and lead-out lines shall be spaced at intervals of not more than 7.5 m on curves and 15 m on straight sections.

5.3.27.5. The lights indicating a stop position shall be fixed unidirectional lights showing red.

5.3.27.6. The intensity of the lights shall be adequate for the condition of visibility and ambient light in which the use of the aircraft stand is intended.

5.3.27.7. The lighting circuit shall be designed so that the lights may be switched on to indicate that an aircraft stand is to be used and switched off to indicate that it is not to be used.

5.3.28. Road-holding position light

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 550 m.

5.3.28.2. Not applicable.

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 regulations. (Refer 5.4.7).

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. A no-entry bar shall be provided across a taxiway which is intended to be used as an exit only taxiway to assist in preventing inadvertent access of traffic to that taxiway.

Location

5.3.29.2. A no-entry bar shall be located across the taxiway at the end of an exit only taxiway where it is desired to prevent traffic from entering the taxiway in the wrong direction.

5.3.29.3. A no-entry bar shall be co-located with a no-entry sign and/or a no-entry marking.

Characteristics

5.3.29.4. A no-entry bar shall consist of unidirectional lights spaced at uniform intervals of no more than 3 m showing red in the intended direction(s) of approach to the runway.

5.3.29.5. A pair of elevated lights shall be added to each end of the no-entry bar where the in-pavement no entry bar lights might be obscured from a pilot's view, for example, by rain, where a pilot may be required to stop the aircraft in a position so close to the lights that they are blocked from view by the structure of the aircraft.

5.3.29.6. The intensity in red light and beam spreads of no-entry bar lights shall be in accordance with the specifications in Appendix 2, Figures A2-12 through A2-16, as appropriate.

5.3.29.7. Where no-entry bars are specified as components of an advanced surface movement guidance and control system and where, from an operational point of view, higher intensities are required to maintain ground movements at a certain speed in very low visibilities or in bright daytime conditions, the intensity in red light and beam spreads of no-entry bar lights shall be in accordance with the specifications of Appendix 2, Figure A2-17, A2-18 or A2-19.

5.3.29.8. Where a wide beam fixture is required, the intensity in red light and beam spreads of no-entry bar lights shall be in accordance with the specifications of Appendix 2, Figure A2-17 or A2-19.

5.3.29.9. Taxiway center line lights installed beyond the no-entry bar, looking in the direction of the runway, shall not be visible when viewed from the taxiway.

5.3.30. Runway status lights

Location

5.3.30.1. Where provided, RELs shall be offset 0.6 m from the taxiway center line on the opposite side to the taxiway center line lights and begin 0.6 m before the runway-holding position extending to the edge of the runway. An additional single light shall be placed on the runway 0.6 m from the runway center line and aligned with the last two taxiway RELs.

5.3.30.2. RELs shall consist of at least five light units and shall be spaced at a minimum of 3.8 m and a maximum of 15.2 m longitudinally, depending upon the taxiway length involved, except for a single light installed near the runway center line.

5.3.30.3. Where provided, THLs shall be offset 1.8 m on each side of the runway center line lights and extend, in pairs, starting at a point 115 m from the beginning of the runway and, thereafter, every 30 m for at least 450 m.

Characteristics

5.3.30.4. Where provided, RELs shall consist of a single line of fixed in-pavement lights showing red in the direction of aircraft approaching the runway.

5.3.30.5. RELs shall illuminate as an array at each taxiway/runway intersection where they are installed less than 2 seconds after the system determines a warning is needed.

5.3.30.6. Intensity and beam spread of RELs shall be in accordance with the specifications of Appendix 2, Figures A2-12 and A2-14.

5.3.30.7. Where provided, THLs shall consist of two rows of fixed in pavement lights showing red facing the aircraft taking off.

5.3.30.8. THLs shall illuminate as an array on the runway less than 2 seconds after the system determines a warning is needed.

5.3.30.9. Intensity and beam spread of THLs shall be in accordance with the specifications of Appendix 2, Figure A2-x.

5.3.30.10. RELs and THLs shall be automated to the extent that the only control over each system will be to disable one or both systems.

5.4. Signs

5.4.1. General

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. A variable message sign shall be provided where:

a. The instruction or information displayed on the sign is relevant only during a certain period of time; and/or

b. There is a need for variable predetermined information to be displayed on the sign to meet the requirements of 9.8.1.

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 5-5.

5.4.1.4. Signs shall be rectangular, as shown in Figures 5-27 and 5-28 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.

Table 5-5. Location distances for taxiing guidance signs including runway exit signs

	Sign height (mm)			Perpendicular distance from defined taxiway pavement edge to near side of sign	Perpendicular distance from defined runway pavement edge to near side of sign
Code number	Legend	Face (min.)	Installed (max.)		
1 or 2	200	300	700	5–11 m	3–10 m
1 or 2	300	450	900	5–11 m	3–10 m
3 or 4	300	450	900	11–21 m	8–15 m
3 or 4	400	600	1 100	11–21 m	8–15 m

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 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. The time interval to change from one message to another on a variable message sign shall be as short as practicable and shall not exceed 5 seconds.

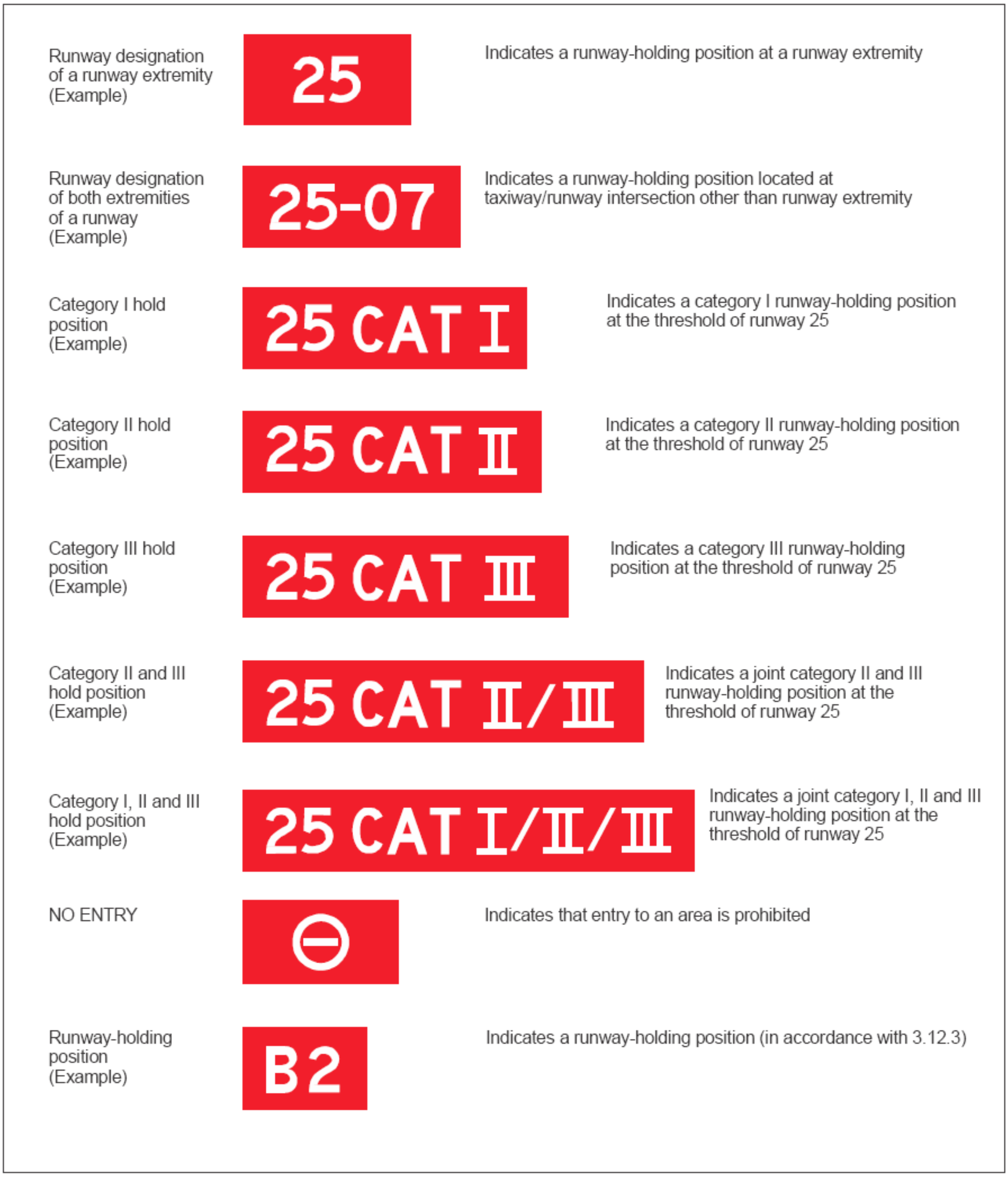


Figure 5-27. Mandatory instruction signs

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. A runway designation sign at a taxiway/runway intersection shall be supplemented with a location sign in the outboard (farthest from the taxiway) position, as appropriate.

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 signs 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.

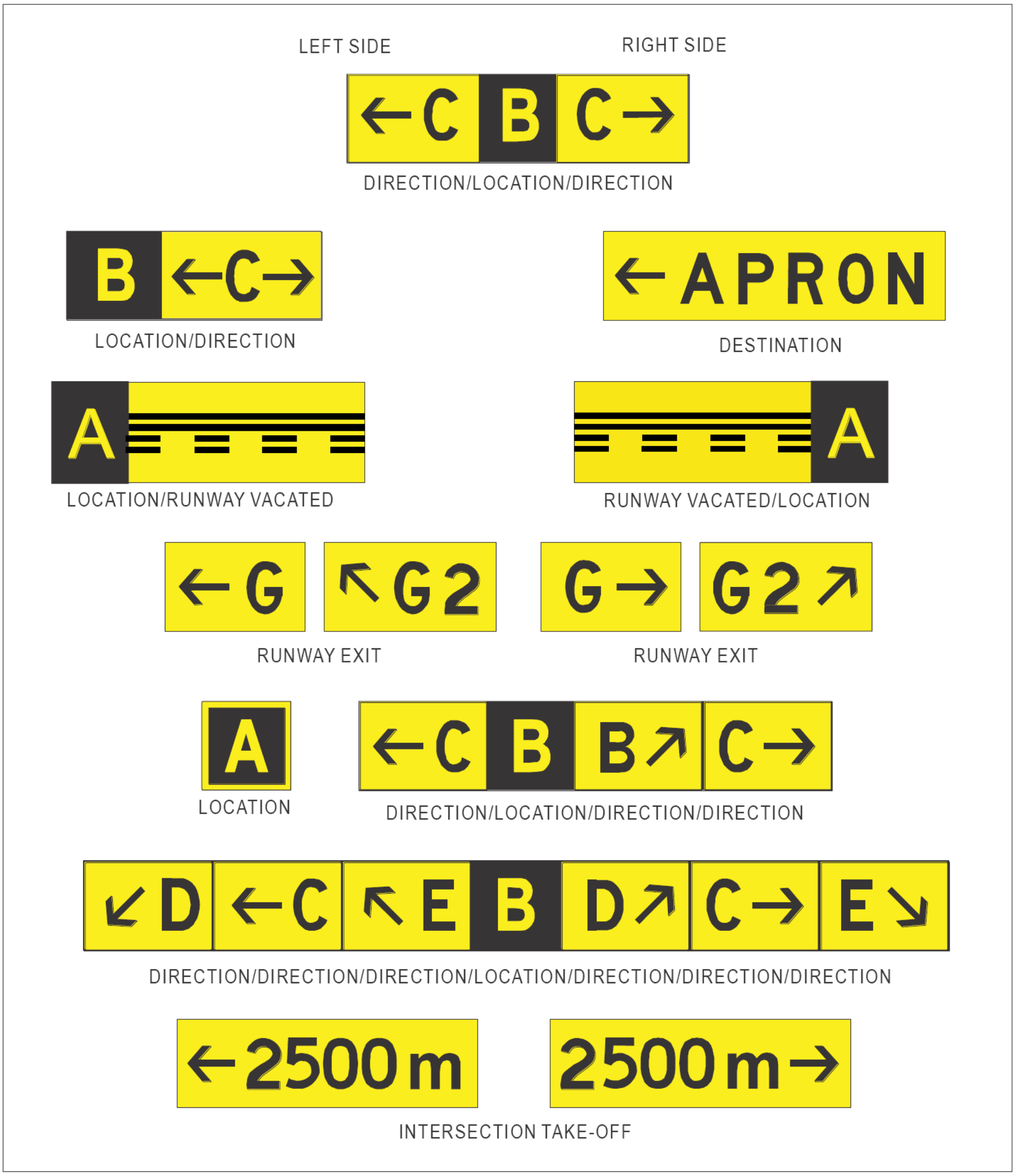
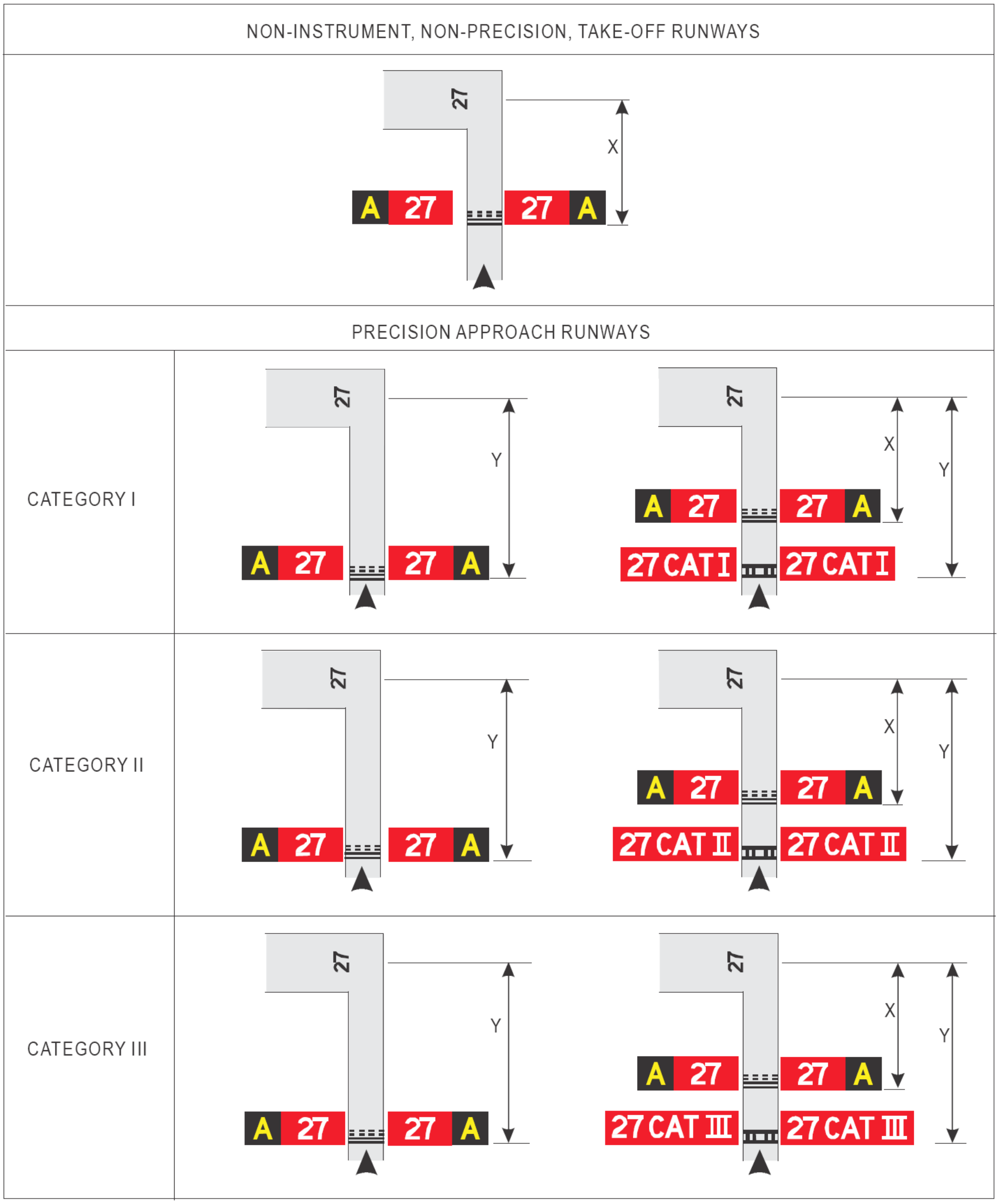


Figure 5-28. Information signs



Note.— Distance X is established in accordance with Table 3-2. Distance Y is established at the edge of the ILS/MLS critical/sensitive area.

Figure 5-29. Example of sign positions at taxiway/runway intersections

Characteristics

5.4.2.12. A mandatory instruction sign shall consist of an inscription in white on a red background.

5.4.2.13. Where, owing to environmental or other factors It is recommended that the conspicuity of the inscription on a mandatory instruction sign needs to be enhanced, the outside edge of the white inscription shall be supplemented by a black outline measuring 10 mm in width for runway code numbers 1 and 2, and 20 mm in width for runway code numbers 3 and 4.

5.4.2.14. 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, joint II/III or joint I/II/III holding position sign shall consist of the runway designator followed by CAT I, CAT II, CAT III, CAT II/III or CAT I/II/III, as appropriate.

5.4.2.16. The inscription on a NO ENTRY sign shall be in accordance with Figure 5-27.

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 installed, inscriptions/symbol of figure 5-27 shall be used.

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 center 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 center line.

5.4.3.5. An intersection take-off sign shall be provided when such operation is permitted at an Aerodrome to indicate the remaining take-off run available (TORA).

5.4.3.6. Where necessary, a destination sign shall be provided to indicate the direction to a specific destination on the aerodrome, such as cargo area, general aviation, etc.

5.4.3.7. 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. A location sign shall 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. Where necessary, a location sign shall be provided to identify taxiways exiting an apron or taxiways beyond an intersection.

5.4.3.13. Where a taxiway ends at an intersection such as a ‘’T’’ and it is necessary to identify this, a barricade, direction sign and/or other appropriate visual aid shall be used.

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 5-5.

5.4.3.15. At a taxiway intersection, information signs shall be located prior to the intersection and in line with the intermediate holding position marking. Where there is no intermediate holding position marking, the signs shall be installed at least 60 m from the center 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 5-5.

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 center line of a runway shall be not less than the greater of the following:

a. The distance between the center line of the runway and the perimeter of the ILS/MLS critical/sensitive area; or

b. The distance between the center 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 center 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. A destination sign shall 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. A direction sign, barricade and/or other appropriate visual aid used to identify a ‘’T’’ intersection shall be located on the opposite side of the intersection facing the taxiway.

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 5-28.

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 meters plus an arrow, appropriately located and oriented, indicating the direction of the take-off as shown in Figure 5-28.

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 5-28.

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 5-28.

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. Where it is necessary to identify each of a series of intermediate holding positions on the same taxiway, the location sign shall consist of the taxiway designation and a number.

5.4.3.34. 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 5-28.

5.4.3.35. A taxiway shall be identified by a designator that is used only once on an aerodrome comprising a single letter, two letters or a combination of a letter or letters followed by a number.

5.4.3.36. When designating taxiways, the use of the words such as inner and outer shall be avoided wherever possible.

5.4.3.37. When designating taxiways, the use of the letters I, O or X shall not be used to avoid confusion with the numerals 1, 0 and closed marking.

5.4.3.38. The use of numbers alone on the maneuvering area shall be reserved for the designation of runways.

5.4.3.39. Apron stand designators shall not be the same as taxiway designators.

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.

5.4.4.4. The inscriptions on a VOR checkpoint sign shall be in accordance with one of the alternatives shown in Figure 5-30 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°: s an example of the VOR bearing, to the nearest degree, which shall be indicated at the VOR checkpoint; and
- 4.3 NM: s an example of the distance in nautical miles to a DME collocated with the VOR concerned.

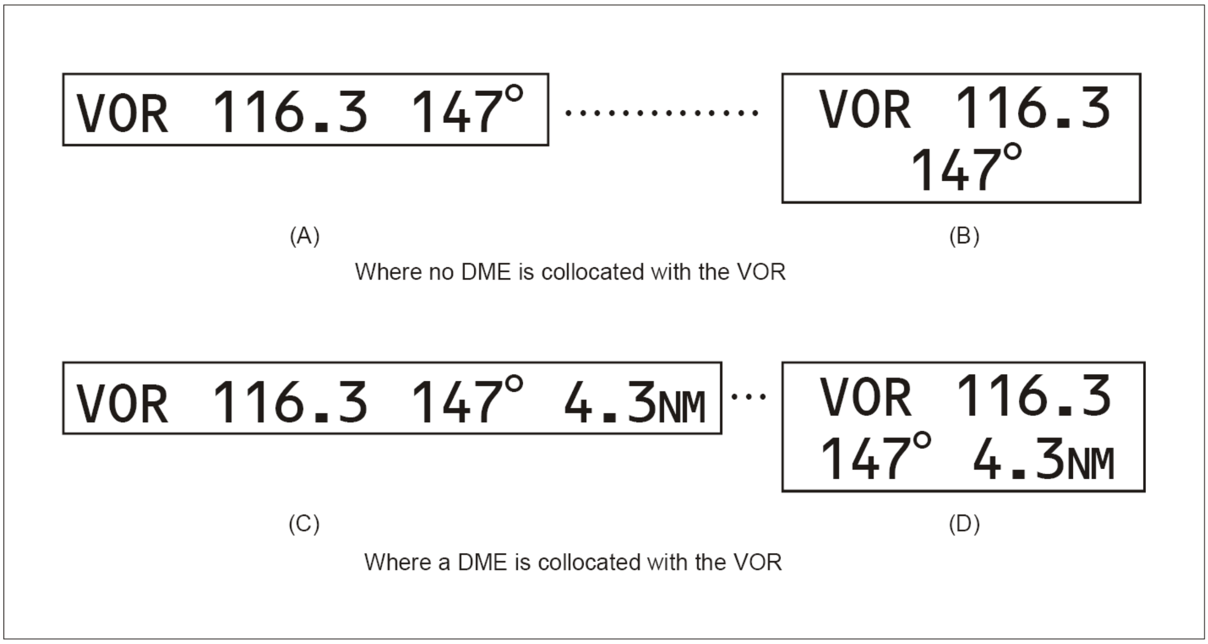


Figure 5-33. VOR aerodrome checkpoint sign

5.4.5. Aerodrome identification sign

Application

5.4.5.1. An aerodrome identification sign shall be provided at an aerodrome where there is insufficient alternative means of visual identification.

Location

5.4.5.2. The aerodrome identification sign shall be placed on the aerodrome so as to be legible, in so far as is practicable, at all angles above the horizontal.

Characteristics

5.4.5.3. The aerodrome identification sign shall consist of the name of the aerodrome.

5.4.5.4. The color selected for the sign shall give adequate conspicuity when viewed against its background.

5.4.5.5. The characters shall have a height of not less than 3 m.

5.4.6. Aircraft stand identification signs

Application

5.4.6.1. An aircraft stand identification marking shall be supplemented with an aircraft stand identification sign where feasible.

Location

5.4.6.2. An aircraft stand identification sign shall be located so as to be clearly visible from the cockpit of an aircraft prior to entering the aircraft stand.

Characteristics

5.4.6.3. An aircraft stand identification sign shall consist of an inscription in black on a yellow background or as instructed by LYCAA.

5.4.7. Road-holding position sign

5.4.7.1. A road-holding position sign shall be provided (see illustration below) at all road entrances to a runway.

Figure 5-31. Road Holding Position Sign and Lights

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 regulations) 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 regulations and include the following:

a. A requirement to stop; and

b. Where appropriate:

1. A requirement to obtain ATC clearance; and

2. Location designator.

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. Markers shall be provided when the extent of an unpaved runway is not clearly indicated by the appearance of its surface compared with that of the surrounding ground.

Location

5.5.2.2. Where runway lights are provided, the markers shall be incorporated in the light fixtures. Where there are no lights, markers of flat rectangular or conical shape shall be placed so as to delimit the runway clearly.

Characteristics

5.5.2.3. The flat rectangular markers shall have a minimum size of 1 m by 3 m and shall be placed with their long dimension parallel to the runway center line. The conical markers shall have a height not exceeding 50 cm.

5.5.3. Stopway edge markers

Application

5.5.3.1. Stopway edge markers shall be provided when the extent of a stopway is not clearly indicated by its appearance compared with that of the surrounding ground.

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

Not Applicable.

5.5.5. Taxiway edge markers

Application

5.5.5.1. Taxiway edge markers shall be provided on a taxiway where the code number is 1 or 2 and taxiway center line or edge lights or taxiway center line markers are not provided.

Location

5.5.5.2. Taxiway edge markers shall 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. The marked surface as viewed by the pilot shall be a rectangle and shall have a minimum viewing area of 150 cm2.

5.5.5.5. Taxiway edge markers 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 center line markers

Application

5.5.6.1. Taxiway center line markers shall be provided on a taxiway where the code number 1 or 2 and taxiway center line or edge lights or taxiway edge markers are not provided.

5.5.6.2. Taxiway center line markers shall be provided on a taxiway where the code number is 3 or 4 and taxiway center line lights are not provided if there is a need to improve the guidance provided by the taxiway center line marking.

Location

5.5.6.3. Taxiway center line markers shall be installed at least at the same location as would taxiway center line lights had they been used.

5.5.6.4. Taxiway center line markers shall normally be located on the taxiway center 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 center line marker shall be retroreflective green.

5.5.6.6. The marked surface as viewed by the pilot shall be a rectangle and shall have a minimum viewing area of 20 cm2.

5.5.6.7. Taxiway center 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. Were the extent of an unpaved taxiway is not clearly indicated by its appearance compared with that of the surrounding ground, markers shall be provided.

Location

5.5.7.2. Where taxiway lights are provided, the markers shall be incorporated in the light fixtures. Where there are no lights, markers of conical shape shall be placed so as to delimit the taxiway clearly.

5.5.8. Boundary markers

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 5-32 is used, or approximately 90 m, if the conical type is used with a marker at any corner.

Characteristics

5.5.8.3. Boundary markers shall be of a form similar to that shown in Figure 5-34, or in the form of a cone not less than 50 cm high and not less than 75 cm in diameter at the base. The markers shall be colored to contrast with the background against which they will be seen. A single color, orange or red, or two contrasting colors, orange and white or alternatively red and white, shall be used, except where such colors merge with the background.

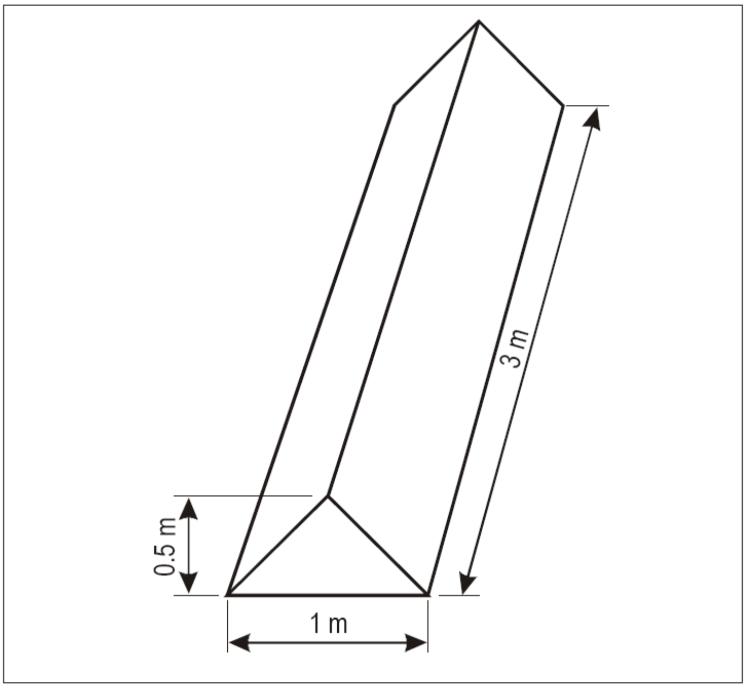


Figure 5-32. Boundary Markers

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, subject to prior approval from LYCAA.

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 3-1, column 11 or 12, from the center 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. A fixed obstacle that extends above a take-off climb surface within 3 000 m of the inner edge of the take-off climb surface shall be marked and, if the runway is used at night, lighted, except that:

a. Such marking and lighting may be omitted when the obstacle is shielded by another fixed obstacle;

b. The marking may be omitted when the obstacle is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m;

c. The marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day; and

d. The lighting may be omitted where the obstacle is a lighthouse and an aeronautical study indicates the lighthouse light to be sufficient.

6.1.1.5. A fixed object, other than an obstacle, adjacent to a take-off climb surface shall be marked and, if the runway is used at night, lighted, if such marking and lighting is considered necessary to ensure its avoidance, except that the marking may be omitted when:

a. The object is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m; or

b. The object is lighted by high-intensity obstacle lights by day.

6.1.1.6. 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. A fixed obstacle that extends above a horizontal surface shall be marked and, if the aerodrome is used at night, lighted, except that:

a. Such marking and lighting may be omitted when:

   1. The obstacle is shielded by another fixed obstacle; or

   2. For a circuit extensively obstructed by immovable objects or terrain, procedures have been established to ensure safe vertical clearance below prescribed flight paths; or

   3. An aeronautical study shows the obstacle not to be of operational significance;

b. The marking may be omitted when the obstacle is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m;

c. The marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day; and

d. The lighting may be omitted where the obstacle is a lighthouse and an aeronautical study indicates the lighthouse light to be sufficient.

6.1.1.8. 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. Other objects inside the obstacle limitation surfaces shall be marked and/or lighted if an aeronautical study indicates that the object could constitute a hazard to aircraft (this includes objects adjacent to visual routes e.g., waterway or highway).

6.1.1.10. Overhead wires, cables, shall be marked and their supporting towers marked and lighted unless an aeronautical study indicates that the wires or cables do not constitute a hazard to aircraft.

6.1.2. Objects outside the lateral boundaries of the obstacle limitation surfaces

6.1.2.1. Obstacles in accordance with 4.3.2 shall be marked and lighted, except that the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day.

6.1.2.2. Other objects outside the obstacle limitation surfaces shall be marked and/or lighted if an aeronautical study indicates that the object could constitute a hazard to aircraft (this includes objects adjacent to visual routes e.g., waterway, highway).

6.1.2.3. Overhead wires, cables, shall be marked and their supporting towers marked and lighted unless an aeronautical study indicates that the wires or cables do not 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, D and E, medium-intensity obstacle lights, Types A, B and C, high intensity obstacle lights Type A and B, shall be in accordance with the specifications in Table 6-1 and Appendix 1.

6.2.1.3. 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 Object

Marking

6.2.2.1. All mobile objects to be marked shall be colored or display flags.

Marking by color

6.2.2.2. When mobile objects are marked by color, a single conspicuous color, preferably red or yellowish green for emergency vehicles and yellow for service vehicles, shall 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 colors 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 colors merge with the background.

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 6-1. The intensity of the lights shall be sufficient to ensure conspicuity considering the intensity of the adjacent lights and the general levels of illumination against which they would normally be viewed.

Table 6-1. Characteristics of obstacle lights

1	2	3	4	5	6	7
			Peak intensity (cd) at given Background Luminance (b)			
Light Type	Colour	Signal type/ (flash rate)	Day (Above 500 cd/m²)	Twilight (50-500 cd/m²)	Night (Below 50 cd/m²)	Light Distribution Table
Low-intensity, Type A (fixed obstacle)	Red	Fixed	N/A	N/A	10	Table 6-2
Low-intensity, Type B (fixed obstacle)	Red	Fixed	N/A	N/A	32	Table 6-2
Low-intensity, Type C (mobile obstacle)	Yellow/Blue (a)	Flashing (60-90 fpm)	N/A	40	40	Table 6-2
Low-intensity, Type D (follow-me vehicle)	Yellow	Flashing (60–90 fpm)	N/A	200	200	Table 6-2
Low-intensity, Type E	Red	Flashing (c)	N/A	N/A	32	Table 6-2 (Type B)
Medium-intensity, Type A	White	Flashing (20–60 fpm)	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.

c) For wind turbine application, to flash at the same rate as the lighting on the nacelle.

Table 6-2. Light Distribution for Low-Intensity Obstacle Lights

	Minimum intensity (a)	Maximum intensity (a)	Vertical beam spread (f)	
			Minimum beam spread	Intensity
Type A	10 cd (b)	N/A	10°	5 cd
Type B	32 cd (b)	N/A	10°	16 cd
Type C	40 cd (b)	400 cd	12° (d)	20 cd
Type D	200 cd (c)	400 cd	N/A (e)	N/A

<u>Note</u>: This table does not include recommended horizontal beam spreads. 6.2.1.3 requires 360° coverage around an obstacle. Therefore, the number of lights needed to meet this requirement will depend on the horizontal beam spreads of each light as well as the shape of the obstacle. Thus, with narrower beam spreads, more lights will be required.

a) 360° horizontal. For flashing lights, the intensity is read into effective intensity, as determined in accordance with the Aerodrome Design Manual (Doc 9157), Part 4.

b) Between 2 and 10° vertical. Elevation vertical angles are referenced to the horizontal when the light is levelled.

c) Between 2 and 20° vertical. Elevation vertical angles are referenced to the horizontal when the light is levelled.

d) Peak intensity shall be located at approximately 2.5° vertical.

e) Peak intensity shall be located at approximately 17° vertical.

f) Beam spread is defined as the angle between the horizontal plane and the directions for which the intensity exceeds that mentioned in the "intensity" column.

Table 6-3. Light Distribution for Medium and High-Intensity Obstacle Lights According to Benchmark Intensities of Table 6-1

Benchmark intensity	Minimum requirements					Recommendations				
	Vertical elevation angle (b)			Vertical beam spread (c)		Vertical elevation angle (b)			Vertical beam spread (c)	
	0°		-1°			0°	-1°	-10°		
	Minimum average intensity (a)	Minimum intensity (a)	Minimum intensity (a)	Minimum beam spread	Intensity (a)	Maximum intensity (a)	Maximum intensity (a)	Maximum intensity (a)	Maximum beam spread	Intensity (a)
200 000	200 000	150 000	75 000	3°	75 000	250 000	112 500	7 500	7°	75 000
100 000	100 000	75 000	37 500	3°	37 500	125 000	56 250	3 750	7°	37 500
20 000	20 000	15 000	7 500	3°	7 500	25 000	11 250	750	N/A	N/A
2 000	2 000	1 500	750	3°	750	2 500	1 125	75	N/A	N/A

<u>Note</u>: Table 6-3. Does not include recommended horizontal beam spreads. 6.2.1.3 requires 360° coverage around an obstacle. Therefore, the number of lights needed to meet this requirement will depend on the horizontal beam spreads of each light as well as the shape of the obstacle. Thus, with narrower beam spreads, more lights will be required.

a) 360° horizontal. All intensities are expressed in Candela. For flashing lights, the intensity is read into effective intensity, as determined in accordance with the Aerodrome Design Manual (Doc 9157), Part 4.

b) Elevation vertical angles are referenced to the horizontal when the light unit is levelled.

c) Beam spread is defined as the angle between the horizontal plane and the directions for which the intensity exceeds that mentioned in the "intensity" column.

Note: An extended beam spread may be necessary under specific configuration and justified by an aeronautical study.

6.2.3. Fixed Objects

Marking

6.2.3.1. All fixed objects to be marked shall, whenever practicable, be colored, 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 color need not be otherwise marked.

Marking by color

6.2.3.2. An object shall be colored to show a chequered pattern if it has essentially unbroken surfaces and its projection on any vertical plane equals or exceeds 4.5 m in both dimensions. The pattern shall consist of rectangles of not less than 1.5 m and not more than 3 m on a side, the corners being of the darker color. The colors 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 colors merge with the background (See Figure 6-1).

6.2.3.3. An object shall be colored to show alternating contrasting bands if:

a. It has essentially unbroken surfaces and has one dimension, horizontal or vertical, greater than 1.5 m, and the other dimension, horizontal or vertical, less than 4.5 m; or

b. It is of skeletal type with either a vertical or a horizontal dimension greater than 1.5 m. The bands shall be perpendicular to the longest dimension and have a width approximately 1/7 of the longest dimension or 30 m, whichever is less. The colors of the bands shall contrast with the background against which they will be seen. Orange and white shall be used, except where such colors are not conspicuous when viewed against the background. The bands on the extremities of the object shall be of the darker color (See Figures 6-1 and 6-2).

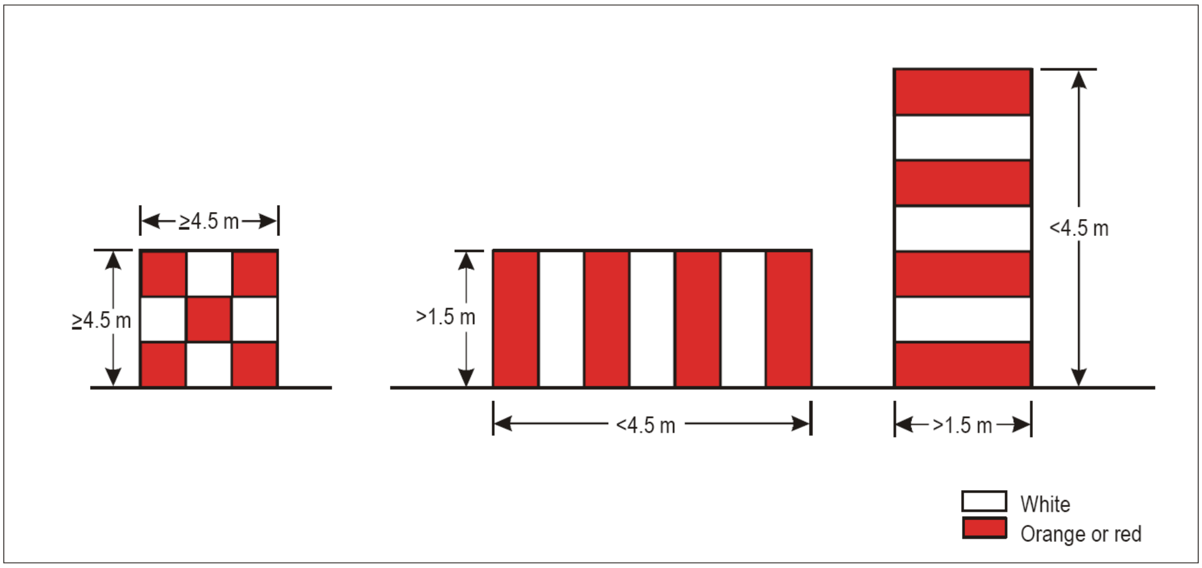


Figure 6-1. Basic Marking Patterns

Table 6 -4. Marking Band Widths

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. An object shall be colored in a single conspicuous color if its projection on any vertical plane has both dimensions less than 1.5 m. Orange or red shall be used, except where such colors merge with the background.

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.

6.2.3.7. Flags used to mark fixed objects shall be orange in color or a combination of two triangular sections, one orange and the other white, or one red and the other white, except that where such colors merge with the background, other conspicuous colors shall 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. A marker shall be of one color. When installed, white and red, or white and orange markers shall be displayed alternately. The color selected shall contrast with the background against which it will be seen.

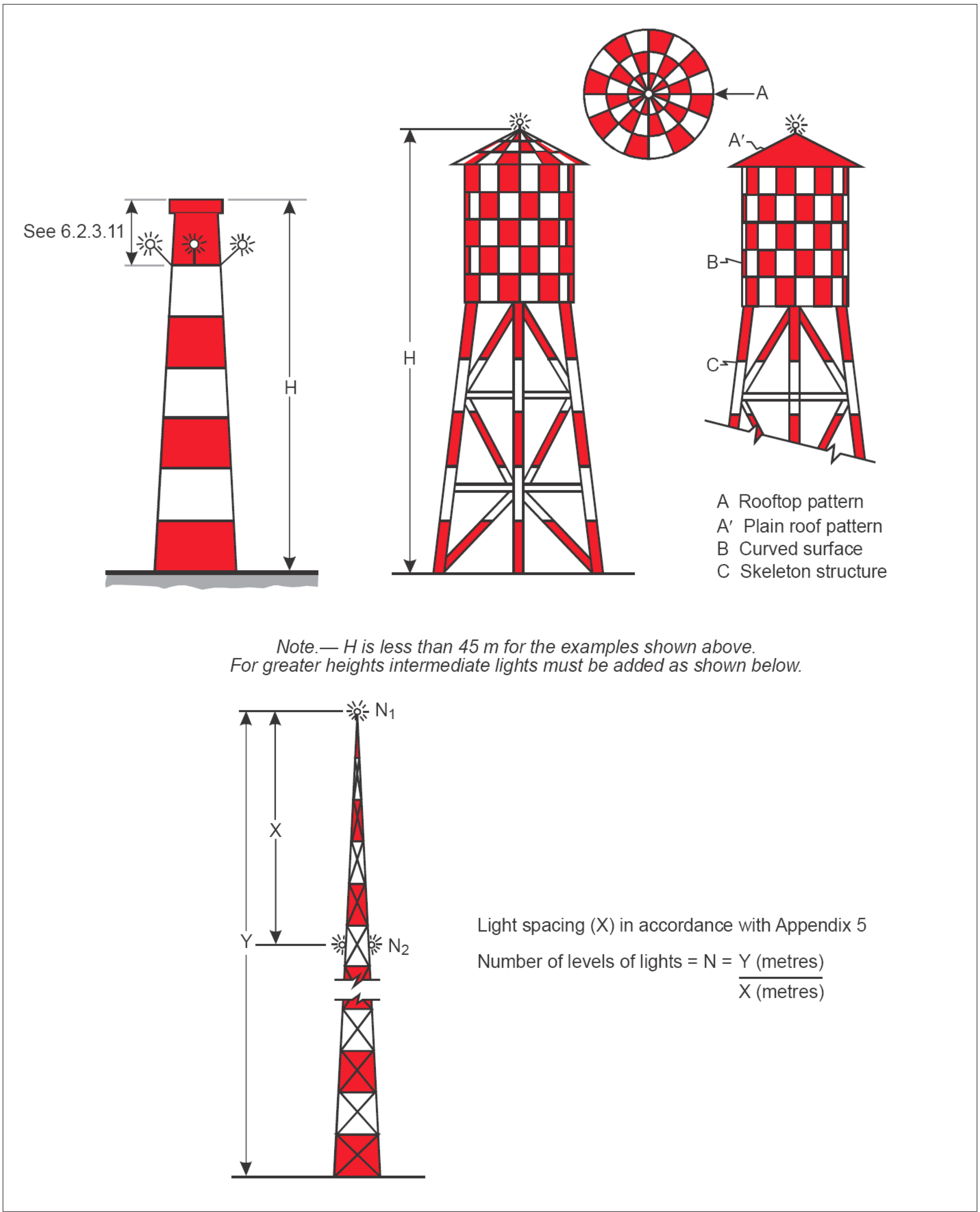


Figure 6-2. Examples of Marking and Lighting of Tall Structure

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. In the case of chimney or other structure of like function, the top lights shall be placed sufficiently below the top so as to minimize contamination by smoke, etc. (See Figure 6-2).

6.2.3.12. 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. When the obstacle limitation surface concerned is sloping and the highest point above the OLS is not the highest point of the object, additional obstacle lights shall be placed on the highest point of the object.

6.2.3.15. 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. The installation setting angles for high-intensity obstacle lights, Type A, shall be in accordance with Table 6-5.

6.2.3.18. Where, in the opinion of LYCAA, the use of high-intensity obstacle lights, Type A, or medium-intensity obstacle lights, Type A, at night may dazzle pilots in the vicinity of an aerodrome (within approximately 10 000 m radius) or cause significant environmental concerns, a dual obstacle lighting system shall be provided. This system shall be composed of high intensity obstacle lights, Type A, or medium-intensity obstacle lights, Type A, as appropriate, for daytime and twilight use and medium-intensity obstacle lights, Type B or C, for night-time use.

Lighting of objects with a height less than 45 m above ground level

6.2.3.19. Low-intensity obstacle lights, Type A or B, shall be used where the object is a less extensive one and its height above the surrounding ground is less than 45 m.

6.2.3.20. Where the use of low-intensity obstacle lights, Type A or B, would be inadequate or an early special warning is required, then medium- or high-intensity obstacle lights shall be used.

6.2.3.21. Low-intensity obstacle lights, Type B, shall be used either alone or in combination with medium-intensity obstacle lights, Type B, in accordance with 6.2.3.22.

6.2.3.22. Medium-intensity obstacle lights, Type A, B or C, shall be used where the object is an extensive one. Medium-intensity obstacle lights, Types A and C, shall be used alone, whereas medium-intensity obstacle lights, Type B, shall be used either alone or in combination with low intensity obstacle lights, Type B.

Lighting of objects with a height 45 m to a height less than 150 m above ground level

6.2.3.23. Medium-intensity obstacle lights, Type A, B or C, shall be used. Medium-intensity obstacle lights, Types A and C, shall be used alone, whereas medium-intensity obstacle lights, Type B, shall be used either alone or in combination with low-intensity obstacle lights, Type B.

6.2.3.24. 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. High-intensity obstacle lights, Type A, shall be used to indicate the presence of an object if its height above the level of the surrounding ground exceeds 150 m and an aeronautical study indicates such lights to be essential for the recognition of the object by day.

6.2.3.29. 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. Where, in the opinion of CAA, the use of high-intensity obstacle lights, Type A, at night may dazzle pilots in the vicinity of an aerodrome (within approximately 10 000 m radius) or cause significant environmental concerns, medium-intensity obstacle lights, Type C, shall be used alone, whereas medium intensity obstacle lights, Type B, shall be used either alone or in combination with low-intensity obstacle lights, Type B.

6.2.3.31. 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

6.2.4.1. A wind turbine shall be marked and/or lighted if it is determined to be an obstacle.

Markings

6.2.4.2. The rotor blades, nacelle and upper 2/3 of the supporting mast of wind turbines shall be painted white, unless otherwise indicated by an aeronautical study.

Lighting

6.2.4.3. When lighting is deemed necessary in the case of a wind farm, i.e., a group of two or more wind turbines, the wind farm shall be regarded as an extensive object and the lights shall be installed:

a. To identify the perimeter of the wind farm;

b. Respecting the maximum spacing, in accordance with 6.2.3.15, between the lights along the perimeter, unless a dedicated assessment shows that a greater spacing can be used;

c. So that, where flashing lights are used, they flash simultaneously throughout the wind farm;

d. So that, within a wind farm, any wind turbines of significantly higher elevation are also identified wherever they are located; and

e. At locations prescribed in a), b) and d), respecting the following criteria:

   i. For wind turbines of less than 150 m in overall height (hub height plus vertical blade height), medium intensity lighting on the nacelle shall be provided;

   ii. For wind turbines from 150 m to 315 m in overall height, in addition to the medium intensity light installed on the nacelle, a second light serving as an alternate shall be provided in case of failure of the operating light. The lights shall be installed to assure that the output of either light is not blocked by the other; and

   iii. In addition, for wind turbines from 150 m to 315 m in overall height, an intermediate level at half the nacelle height of at least 3 low intensity Type E lights, as specified in 6.2.1.3 shall be provided. If an aeronautical study shows that low intensity type E lights are not suitable, low-intensity type A or B lights may be used.

6.2.4.4. The obstacle lights shall be installed on the nacelle in such a manner as to provide an unobstructed view for aircraft approaching from any direction.

6.2.4.5. Where lighting is deemed necessary for a single wind turbine or short line of wind turbines, the installation shall be in accordance with 6.2.4.3(e) or as determined by an aeronautical study.

6.2.5. Overhead wires, cables, etc., and supporting towers

Marking

6.2.5.1. The wires, cables, etc., to be marked shall be equipped with markers; the supporting tower shall be colored.

Marking by colors

6.2.5.2. The supporting towers of overhead wires, cables, etc., that require marking shall be marked in accordance with 6.2.3.1 to 6.2.3.4, except that the marking of the supporting towers may be omitted when they are lighted by high-intensity obstacle lights by day.

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. A marker displayed on an overhead wire, cable, etc., shall be spherical and have a diameter of not less than 60 cm.

6.2.5.5. The spacing between two consecutive markers or between a marker and a supporting tower shall be appropriate to the diameter of the marker, but in no case shall the spacing exceed:

a. 30 m where the marker diameter is 60 cm progressively increasing with the diameter of the marker to

b. 35 m where the marker diameter is 80 cm and further progressively increasing to a maximum of

c. 40 m where the marker diameter is of at least 130 cm.

Where multiple wires, cables, etc., are involved, a marker shall be located not lower than the level of the highest wire at the point marked.

6.2.5.6. A marker shall be of one color. When installed, white and red, or white and orange markers shall be displayed alternately. The color selected shall contrast with the background against which it will be seen.

6.2.5.7. When it has been determined that an overhead wire, cable, etc., needs to be marked but it is not practicable to install markers on the wire, cable, etc., then high-intensity obstacle lights, Type B, shall be provided on their supporting towers.

Lighting

6.2.5.8. High-intensity obstacle lights, Type B, shall be used to indicate the presence of a tower supporting overhead wires, cables, etc., where:

a. An aeronautical study indicates such lights to be essential for the recognition of the presence of wires, cables, etc.; or

b. It has not been found practicable to install markers on the wires, cables, etc.

6.2.5.9. 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. High-intensity obstacle lights, Type B, indicating the presence of a tower supporting overhead wires, cables, etc., shall flash sequentially; first the middle light, second the top light and last, the bottom light. The intervals between flashes of the lights shall approximate the following ratios:

Flash interval between	**Ratio of cycle time**
Middle and top light	1/13
Top and bottom light	2/13
Bottom and middle light	10/13

6.2.5.11. Where, in the opinion of LYCAA, the use of high-intensity obstacle lights, Type B, at night may dazzle pilots in the vicinity of an aerodrome (within approximately 10 000 m radius) or cause significant environmental concerns, a dual obstacle lighting system shall be provided. This system shall be composed of high-intensity obstacle lights, Type B, for daytime and twilight use and medium-intensity obstacle lights, Type B, for nighttime use. Where medium-intensity lights are used they shall be installed at the same level as the high-intensity obstacle light Type B.

6.2.5.12. The installation setting angles for high-intensity obstacle lights, Type B, shall be in accordance with Table 6-5.

Table 6-5. Installation setting angles for high-intensity obstacle lights

Height of light unit above terrain (AGL)		Angle of the peak of the beam above the horizontal
Greater than	Not exceeding	
151 m		0°
122 m	151 m	1°
92 m	122 m	2°
	92 m	3°

Chapter 7. Visual aids for denoting restricted use areas

7.1. Closed runways and taxiways or parts thereof

Application

7.1.1. A closed marking or elevated illuminated sign shall be displayed on a runway or taxiway or portion thereof which is permanently closed to the use of all aircraft.

7.1.2. A closed marking or elevated illuminated sign shall be displayed on a temporarily closed runway or taxiway or/portion thereof, except that such marking may be omitted when the closing is of short duration and adequate warning by air traffic services is provided.

Location

7.1.3. On a runway, a closed marking or elevated illuminated sign 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 or elevated illuminated sign shall be of the form and proportions as detailed in (Figure 7-1, Illustration a), when displayed on a runway, and shall be of the form and proportions as detailed in (Figure 7-1, Illustration b), when displayed on a taxiway. The marking shall be white when displayed on a runway and shall be yellow when displayed on a taxiway.

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, and on a permanently closed runway the lighting shall be removed.

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).

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.

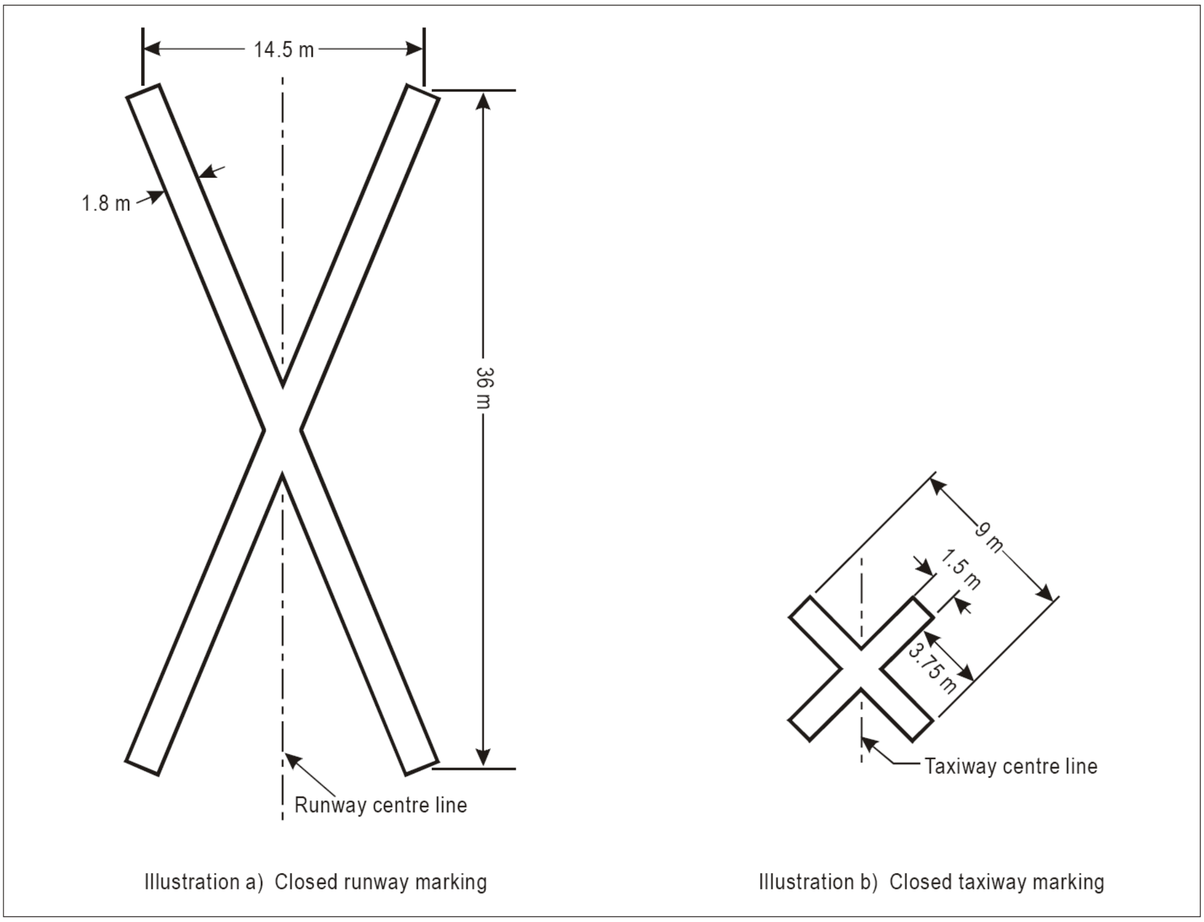


Figure 7-1. Closed runway and taxiway markings

Figure 7-3. Figure A7-4 Illuminated white X

Location

7.2.2. A taxi side stripe marking shall be placed along the edge of the load-bearing pavement, with the outer edge of the marking approximately on the edge of the load-bearing pavement.

Characteristics

7.2.3. A taxi side stripe marking shall consist of a pair of solid lines, each 15 cm wide and spaced 15 cm apart and the same color as the taxiway center line marking.

7.3. Pre-threshold area

Application

7.3.1. When the surface before a threshold is paved and exceeds 60 m in length and is not suitable for normal use by aircraft, the entire length before the threshold shall be marked with a chevron marking.

Location

7.3.2. A chevron marking shall point in the direction of the runway and be placed as shown in Figure 7-4.

Characteristics

7.3.3. A chevron marking shall be yellow. It shall have an overall width of at least 0.9 m.

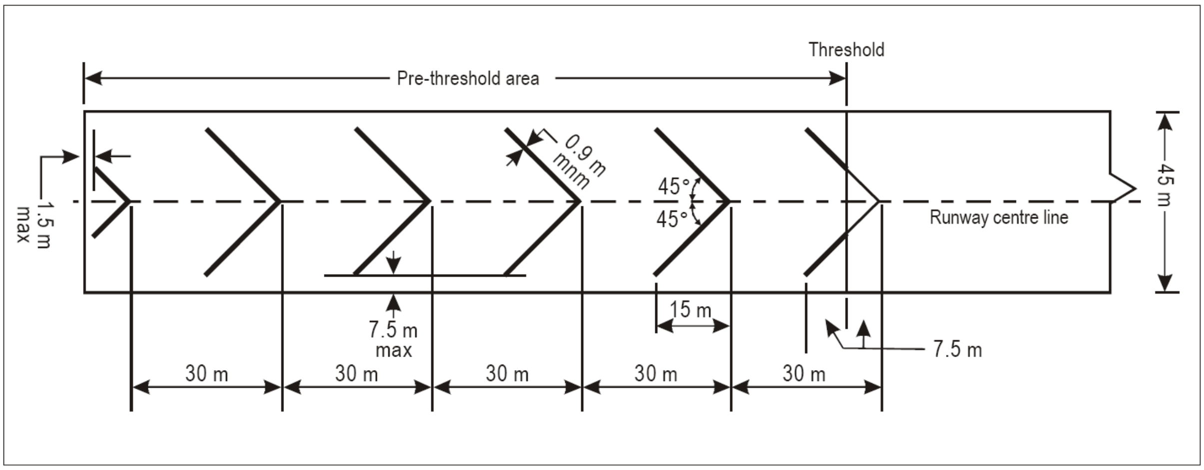


Figure 7-4. Pre-threshold marking

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. An unserviceability cone shall be at least 0.5 m in height and red, orange or yellow or any one of these colors in combination with white.

Characteristics of unserviceability flags

7.4.6. An unserviceability flag shall be at least 0.5 m square and red, orange or yellow or any one of these colors in combination with white.

Characteristics of unserviceability marker boards

7.4.7. An unserviceability marker board shall be at least 0.5 m in height and 0.9 m in length, with alternate red and white or orange and white vertical stripes.

Chapter 8. Electrical systems

8.1. Electrical power supply systems for air navigation facilities

8.1.1. Adequate primary power supply shall be available at aerodromes for the safe functioning of air navigation facilities. Two independent incoming power sources are desirable for major aerodromes, instead of a single primary power source. They shall come from widely separated sections of the electricity network beyond the aerodrome with each supplying separate circuits that would provide integrity of facilities if one failed preferably, these sources will have separate feeders from separate substations and will also be from different generators. Other supply arrangements may be used depending on the security, reliability, statistics, or economics applicable to a particular situation.

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. Electric power supply connections to those facilities for which secondary power is required shall be so arranged that the facilities are automatically connected to the secondary power supply on failure of the primary source of power.

8.1.4. The time interval between failure of the primary source of power and the complete restoration of the services required by 8.1.10 shall be as short as practicable, except that for visual aids associated with non-precision, precision approach or take-off runways the requirements of Table 8-1 for maximum switch-over times shall apply.

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 8-1 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 8-1 for the appropriate category of precision approach runway shall be provided. Electric power supply connections to those facilities for which secondary power is required shall be so arranged that the facilities are automatically connected to the secondary power supply on failure of the primary source of power.

8.1.7. For a runway meant for take-off in runway visual range conditions less than a value of 800m, a secondary power supply capable of meeting the relevant requirements of Table 8-1 shall be provided.

8.1.8. At an aerodrome where the primary runway is a non-precision approach runway, a secondary power supply capable of meeting the requirements of Table 8-1 shall be provided except that a secondary power supply for visual aids need not be provided for more than one non-precision approach runway.

8.1.9. At an aerodrome where the primary runway is a non-instrument runway, a secondary power supply capable of meeting the requirements of 8.1.4 shall be provided, except that a secondary power supply for visual aids need not be provided when an emergency lighting system in accordance with the specification of 5.3.2 is provided and capable of being deployed in 15 minutes.

8.1.10. The following aerodrome facilities shall be provided with a secondary power supply capable of supplying power when there is a failure of the primary power supply:

a. The signaling lamp and the minimum lighting necessary to enable air traffic services personnel to carry out their duties;

   Note: The requirement for minimum lighting may be met by other than electrical means.

b. All obstacle lights which, in the opinion of LYCAA, 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 5.3.23.1;

h. Illumination of apron areas over which passengers may walk;

i. RFFS and other emergency alerting and communication systems.

8.1.11. Requirements for a secondary power supply shall be met by either of the following:

- Independent public power, which is a source of power supplying the aerodrome service from a substation other than the normal substation through a transmission line following a route different from the normal power supply route and such that the possibility of a simultaneous failure of the normal and independent public power supplies is extremely remote; or

- Standby power unit(s), which are engine generators, batteries, etc., from which electric power can be obtained.

Table 8-1. Secondary Power Supply Requirement

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 8-1 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

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 control and maintenance unit

8.3.3. Where a change in the operational status of lights has occurred, an indication shall be provided within two seconds for a stop bar at a runway-holding position and within five seconds for all other types of visual aids.

8.3.4. For a runway meant for use in runway visual range conditions less than a value of 550 m, the lighting systems detailed in Table 8-1 shall be monitored automatically so as to provide an indication when the serviceability level of any element falls below the minimum serviceability level specified in 10.5.7 to 10.5.11, as appropriate. This information shall be automatically relayed to the maintenance unit.

8.3.5. For a runway meant for use in runway visual range conditions less than a value of 550 m, the lighting systems detailed in Table 8-1 shall be monitored automatically to provide an indication when the serviceability level of any element falls below the minimum level specified in 10.5.7 to 10.5.11 below which operations shall not continue. This information shall be automatically relayed to the air traffic services unit and displayed in a prominent position.

Chapter 9. Aerodrome operational services, equipment & installations

9.1. Aerodrome emergency planning

General

9.1.1. The Aerodrome Operator shall establish an aerodrome emergency plan at an aerodrome, commensurate with the aircraft operations and other activities conducted at the aerodrome. The aerodrome operator shall establish and chair an Aerodrome Emergency Committee (AEC), including agencies on and off the aerodrome that could assist in an emergency. The AEC must develop the Aerodrome Emergency Plan (AEP), including procedures for coordinating the responses of assisting agencies. Currency and adequacy of the AEP shall be reviewed at least once every twelve months or in accordance with LYCAA directives.

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 LYCAA, could be of assistance in responding to an emergency.

9.1.4. The plan shall provide for cooperation and coordination with the rescue coordination center, as necessary.

9.1.5. The aerodrome emergency plan document shall include at least the following:

a. Types of emergencies planned for;

b. Agencies involved in the plan;

c. Responsibility and role of each agency, the emergency operations center 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.

Emergency Operations Center (EOC) and command post

9.1.7. A fixed Emergency Operations Center and a mobile command post should be available for use during an emergency.

9.1.8. The emergency operations center shall be a part of the aerodrome facilities and shall be responsible for the overall coordination and general direction of the response to an emergency.

9.1.9. The command post shall be a facility capable of being moved rapidly to the site of an emergency, when required, and shall undertake the local coordination of those agencies responding to the emergency.

9.1.10. A person shall be assigned to assume control of the emergency operations center and, when appropriate, another person the command post.

Communication system

9.1.11. Adequate communication systems linking the command post and the emergency operations center with each other and with the participating agencies shall be provided in accordance with the plan and consistent with the particular requirements of the aerodrome.

Aerodrome emergency exercise

9.1.12. The 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. Full-scale aerodrome or 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 exercise have been corrected; or

b. A series of modular test commencing in the first year and concluding in a full-scale aerodrome emergency exercise at intervals not exceeding three years.

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. At those aerodromes located close to water and/or swampy areas, or difficult terrain, the aerodrome emergency plan shall include the establishment, testing and assessment at regular intervals of a predetermined response for the specialist rescue services.

9.1.16. An assessment of the approach and departure areas within 1.000 m of the runway threshold shall be carried out to determine the options available for intervention.

9.2. Rescue and fire fighting

General

Application

9.2.1. Rescue and firefighting 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 firefighting 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 firefighting shall be appropriate to the aerodrome category determined using the principles in 9.2.5 and 9.2.6, except that, where the number of movements of the airplanes 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 if approved by LYCAA.

9.2.4. No applicable

9.2.5. The aerodrome category shall be determined from Table 9-2 and shall be based on the longest airplanes normally using the aerodrome and their fuselage width.

9.2.6. If, after selecting the category appropriate to the longest airplane's overall length, that airplane's fuselage width is greater than the maximum width in Table 9-2, column 3, for that category, then the category for that airplane shall actually be one category higher.

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 airplane planned to use the aerodrome during that time irrespective of the number of movements.

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

Table 9-2. Aerodrome Category for rescue and fire fighting

Extinguishing agents

9.2.8. Both principal and complementary agents shall be provided at an aerodrome.

9.2.9. The principal extinguishing agent shall be:

a. A foam meeting the minimum performance level A; or

b. A foam meeting the minimum performance level B; or

c. A foam meeting the minimum performance level C; or

d. A combination of these agents;

Except that the principal extinguishing agent for aerodromes in categories 1 to 3 should preferably meet the minimum performance level B or C foam.

9.2.10. The complementary extinguishing agent shall be a dry chemical powder suitable for extinguishing hydrocarbon fires.

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 9.2.5, 9.2.6 and Table 9-3, except that for aerodrome categories 1 and 2 up to 100 per cent of the water may be substituted by 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. At aerodromes where operations by airplanes 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.

9.2.13. 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.

	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.

Table 9-3. Minimum usable amounts of extinguishing agents for foam performance levels

9.2.14. The amount of foam concentrate provided on a vehicle shall be sufficient to produce at least two loads of foam solution.

9.2.15. Supplementary water supplies, for the expeditious replenishment of rescue and firefighting vehicles at the scene of an aircraft accident, shall be provided.

9.2.16. When a combination of different performance level foams are provided at an aerodrome, the total amount of water to be provided for foam production shall be calculated for each foam type and the distribution of these quantities shall be documented for each vehicle and applied to the overall rescue and firefighting requirement.

9.2.17. The discharge rate of the foam solution shall not be less than the rates shown in Table 9-3.

9.2.18. The complementary agents shall comply with the appropriate specifications of the International Organization for Standardization (ISO). See ISO Publication 7202 (Powder).

9.2.19. The discharge rate of complementary agents shall be no less than the values shown in Table 9-3.

9.2.20. Dry chemical powders shall only be substituted with an agent that has equivalent or better firefighting capabilities for all types of fires where complementary agent is expected to be used.

9.2.21. A reserve supply of foam concentrate, equivalent to 200 per cent of the quantities identified in Table 9-3, shall be maintained on the aerodrome for vehicle replenishment purposes.

9.2.22. A reserve supply of complementary agent, equivalent to 100 per cent of the quantity identified in Table 9-3, shall be maintained on the aerodrome for vehicle replenishment purposes. Sufficient propellant gas shall be included to utilize this reserve complementary agent.

9.2.23. Category 1 and 2 aerodromes that have replaced up to 100 per cent of the water with complementary agent shall hold a reserve supply of complementary agent of 200 per cent.

9.2.24. 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 shall be increased as determined by a risk assessment.

Rescue equipment

9.2.25. An aerodrome operator shall provide rescue equipment commensurate with the level of aircraft operations on the rescue and fire fighting vehicle(s).

Response time

9.2.26. The operational objective of the rescue and firefighting service shall be to achieve a response time not exceeding three minutes for a RWY length 3500 m and above to any point of each operational runway, in optimum visibility and surface conditions.

9.2.27. The operational objective of the rescue and firefighting service shall be to achieve a response time not exceeding two minutes for a RWY length below 3500 m to any point of each operational runway, in optimum visibility and surface conditions.

9.2.28. The operational objective of the rescue and firefighting service shall be to achieve a response time not exceeding three minutes to any other part of the movement area, in optimum visibility and surface conditions.

9.2.29. To meet the operational objective as nearly as possible in less than optimum conditions of visibility, especially during low visibility operations, suitable guidance, equipment and/or procedures for rescue and firefighting services shall be provided.

9.2.30. Any vehicles, other than the first responding vehicle(s), required to deliver the amounts of extinguishing agents specified in Table 9-3 shall ensure continuous agent application and shall achieve to arrive by three minutes and not exceed a time of three minutes from the initial call.

9.2.31. A system of preventive maintenance of rescue and fire fighting vehicles shall be employed to ensure effectiveness of the equipment and compliance with the specified response time throughout the life of the vehicle.

9.2.32. An aerodrome operator shall document a procedure for undertaking response test and maintain records of such tests.

Emergency access roads

9.2.33. Emergency access roads shall be provided on an aerodrome where terrain conditions permit their construction, so as to facilitate achieving minimum response times. Particular attention shall be given to the provision of ready access to approach areas up to 1.000 m from the threshold, or at least within the aerodrome boundary. Where a fence is provided, the need for convenient access to outside areas, including both quick access emergency exit gates, and clear passage outside such gates, shall be provided.

9.2.34. Emergency access roads shall be capable of supporting the heaviest vehicles which will use them, and be usable in all weather conditions. Roads within 90 m of a runway shall be surfaced to prevent surface erosion and the transfer of debris to the runway. Sufficient vertical clearance shall be provided from overhead obstructions for the largest vehicles.

9.2.35. When the surface of the road is indistinguishable from the surrounding area, edge markers shall be placed at intervals of about 10 m.

Fire stations

9.2.36. An aerodrome operator shall normally house all rescue and fire fighting vehicles in a single fire station. For large aerodromes, multiple runways, and movement areas on both sides of a runway, satellite fire stations may be provided whenever the response time cannot be achieved from a single fire station, subject to the prior approval of the LYCAA.

9.2.37. The fire station shall 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

9.2.38. A discrete communication system shall be provided linking a fire station with the control tower, any other fire station on the aerodrome and the rescue and fire fighting vehicles.

9.2.39. An alerting system for rescue and firefighting personnel, capable of being operated from that station, shall be provided at a fire station, any other fire station on the aerodrome and the aerodrome control tower.

An aerodrome operator shall provide special telephone, two-way radio communication and general alarm systems for the rescue and firefighting service to ensure the dependable transmission of essential emergency and routine information, consistent with the individual requirements of each aerodrome or heliport to serve the following purposes:

a. Emergency signals to ensure the immediate summoning of designated personnel not on standby duty;

b. As necessary, summoning essential related services on or off the aerodrome;

c. Maintaining communication by means of two-way radio with the rescue and fire fighting vehicles in attendance at an aircraft accident or incident.

Number of rescue and fire fighting vehicles

9.2.40. The minimum number of rescue and fire fighting vehicles provided at each station hall be in accordance with the following tabulation:

Aerodrome category	Rescue and fire fighting vehicles
1	1
2	1
3	1
4	1
5	1
6	2
7	2
8	3
9	3
10	3

Personnel

9.2.41. All rescue and firefighting 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 firefighting equipment in use at the aerodrome, including pressure-fed fuel fires.

9.2.42. The rescue and firefighting personnel training program shall include training in human performance, including team coordination.

9.2.43. During flight operations, sufficient trained and competent personnel shall be designated to be readily available to ride the rescue and firefighting vehicles and to operate the equipment at maximum capacity. These personnel 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 firefighting equipment normally associated with aircraft rescue and firefighting operations.

9.2.44. In determining the minimum number of rescue and firefighting personnel required, a task resource analysis shall be completed and the level of staffing documented in the Aerodrome Manual.

9.2.45. All responding rescue and firefighting personnel shall be provided with protective clothing and respiratory equipment to enable them to perform their duties in an effective manner.

9.3. Disabled aircraft removal

9.3.1. A plan for the removal of an aircraft disabled on, or adjacent to, the movement area shall be established for an aerodrome, and a coordinator designated to implement the plan, when necessary.

9.3.2. The disabled aircraft removal plan shall be based on the characteristics of the aircraft that may normally be expected to operate at the aerodrome, and include among other things:

a. A list of equipment on, or in the vicinity of the aerodrome which would be available for such purpose; and

b. Arrangements for the rapid receipt of aircraft recovery equipment kits available from other aerodromes.

9.4. Wildlife strike hazard reduction

9.4.1. The wildlife strike hazard on, or in the vicinity of, an aerodrome shall be assessed through:

a. The establishment of a national procedure for recording and reporting 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.

9.4.2. An Aerodrome operator shall maintain a database of wildlife strikes and the wildlife strike reports form shall be forwarded to LYCAA. LYCAA will compile and forward the reports to the ICAO for inclusion in the ICAO Bird Strike Information System (IBIS) database.

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.

9.4.4. An aerodrome operator shall take action in coordination with LYCAA 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 aerodrome operator shall ensure that any risk to aircraft posed by these sites is assessed and reduced to as low as reasonably practicable.

9.4.5. An Aerodrome operator shall give due consideration to aviation safety concerns related to land developments in the vicinity of the aerodrome that may attract wildlife.

9.4.6. An aerodrome operator shall train its staff involved in wildlife strike hazard reduction to a level of competence appropriate to their duties and the equipment used.

9.4.7. Wildlife hazard management on an airport often requires communication, cooperation, and coordination among various groups on the aerodrome. This is especially true when identifying hazardous wildlife situations, executing large-scale habitat management actions, or developing management strategies for hazardous wildlife that are endangered or threatened. For that, the Aerodrome Operator shall establish an Airport wildlife committee in order to facilitate this communication, cooperation and coordination.

9.4.8. Members of the Airport Wildlife Committee shall include the following:

- Operation Manager
- Wildlife Control Coordinator
- Aircraft Operator representative
- Aerodrome maintenance
- ATC representative
- Local runway safety team representative
- Local authorities
- Depending on the organizational structure of the airport, other representatives can also be included, such as the Fire and Rescue services.

9.4.9. The Airport Wildlife Committee shall review strike data collected and observations of birds/wildlife, assess bird/wildlife risks and summarize trends in order to evaluate and determine what effective control measures should be implemented in order to manage the issues arising.

9.4.10. The airport bird/wildlife strike control coordinator (or equivalent) shall coordinate the activities of the wildlife control program with air traffic control (ATC) and other stakeholders. The coordinator's responsibilities shall allow for the time required to be involved with observations, control and reporting. The wildlife coordinator at the site shall also review strike reports, monitor daily activity records and maintenance reports to determine the requirements for short- and long-term management programs, and this information shall be passed to managers accountable for safety on a regular basis.

9.4.11. The Aerodrome operator shall also identify which stake-holders will be responsible for providing input and consultation. Stakeholders can include transportation officials (including government), aerodrome staff, airline representatives (including pilots), conservation organizations (government and non-government), local municipalities/cities, and organizations that are responsible for land management in the area surrounding the aerodrome.

9.4.12. An Aerodrome Operator shall conduct for each aerodrome an initial assessment of the existence and level of hazard posed or likely to be posed by wildlife in the vicinity of the aerodrome.

9.4.13. A Wildlife Hazard Management Plan shall be developed by the aerodrome operator to:

a. assess the potential bird strike risk;

b. reduce wildlife infestation on the aerodrome as much as practicable;

c. implement a safeguarding system to identify, and, where possible, address existing and planned developments within the vicinity of the aerodrome (within 13 kilometers from the Aerodrome Reference Point) that may have the potential to increase the bird strike risk;

d. monitor and address wildlife activity, strike events and:

e. strive to improve the effectiveness of the plan through on-going evaluation by competent personnel.

9.4.14. The Wildlife Hazard Management Plan (WHMP) is a document developed by the aerodrome operator to provide the strategy for reducing the risk that wildlife poses to safe airport operations. The plan is based on the Risk Assessment of Wildlife Hazards. An effective WHMP shall:

a. Identify the wildlife species that are a priority for risk reduction;

b. Prescribe the actions necessary to reduce the risk associated with the individual species;

c. Clearly identify of the roles and responsibilities personnel are required to fulfill;

d. Implement a safeguarding system to identify, and, where possible, address existing and planned developments within the vicinity of the aerodrome (within 13 kilometers from the Aerodrome Reference Point) that may have the potential to increase the bird strike risk;

e. Describe a Communication Strategy for ensuring that the information necessary for managing wildlife risk is shared effectively;

f. Outline a Training Program for the personnel involved in Wildlife Hazard Management;

g. Describe a monitoring and evaluation strategy for the entire WHMP;

h. Prioritize the specific research needed to advance the efficacy of wildlife hazard management on the aerodrome.

9.5. Apron management service

9.5.1. When warranted by the volume of traffic and operating conditions, an appropriate apron management service shall be provided on an apron by an aerodrome operator, ATS unit, or by a cooperative combination of these, in order to:

Regulate movement with the objective of preventing collisions between aircraft, and between aircraft and obstacles;

Regulate entry of aircraft into, and coordinate exit of aircraft from, the apron with the aerodrome control tower; and

Ensure safe and expeditious movement of vehicles and appropriate regulation of other activities.

9.5.2. When the aerodrome control tower does not participate in the apron management service, procedures shall be established by the aerodrome operator to facilitate the orderly transition of aircraft between the apron management unit and the aerodrome control tower.

9.5.3. Where an apron management service is provided, an aerodrome operator shall provide the apron management service 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.

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 regulations.

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. Fire extinguishing equipment suitable for at least initial intervention in the event of fuel fire and personnel trained in its use shall be readily available during the ground servicing of an aircraft, and there shall be a means of quickly summoning the rescue and firefighting service in the event of a fire or major fuel spill.

9.6.2. When aircraft refueling operations take place while passengers are embarking, on board or disembarking, ground equipment shall be positioned so as to allow:

a. The use of a sufficient number of exits for expeditious evacuation; and

b. A ready escape route from each of the exits to be used in an emergency.

9.7. Aerodrome vehicle operations

9.7.1. A vehicle shall be operated:

a. On a maneuvering area only as permitted by the aerodrome control tower; and

b. On an apron only as permitted by the aerodrome operator.

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 instructed by:

a. The aerodrome control tower when on the maneuvering area; or

b. The appropriate unit 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 maneuvering area; and

b. The appropriate unit, 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 maneuvering area and with the appropriate unit when required before entering the apron. The driver shall maintain a continuous listening watch on the assigned frequency when on the movement area.

9.7.6. The aerodrome operator shall establish and implement procedures for the training, assessment and authorization of all drivers operating on the movement area.

9.7.7. An aerodrome operator shall establish a system for issuing Airside driver permit (ADP), and the conditions of their renewal. A record of individual ADP issued shall be kept for a minimum 4 years for purpose of LYCAA audit or inspection.

9.7.8. Training will include, as appropriate to the driver's function, knowledge of:

a. the geography of the aerodrome;

b. aerodrome signs, markings and lights;

c. radiotelephone operating procedures, if the duties require to drive on the maneuvering area;

d. terms and phrases used in aerodrome control, including the ICAO spelling alphabet, if the duties require interaction with aerodrome control;

e. rules of air traffic services as they relate to ground operations;

f. airport rules and procedures including low visibility procedures; and

g. specialist functions in the operation of the vehicle e.g., rescue firefighting.

The aerodrome operator shall send the training material prepared to LYCAA for acceptance.

9.7.9. The aerodrome operator shall grant an Airside driver permit to persons provided that:

a. their tasks involve driving on the movement area;

b. they hold a driving license recognized by Libyan authorities;

c. they meet the medical criteria according to the National Legislation;

d. they hold a radiotelephony operating license, or have a specific training on radiotelephony if their duties involve driving on the maneuvering area;

e. they have successfully completed an airside driving theoretical course, and passed the written exams;

f. they have successfully demonstrated competency, as appropriate, in:

   i. the operation, or use of vehicle transmit/receive equipment;

   ii. understanding and complying with air traffic control and local procedures;

   iii. vehicle navigation on the aerodrome; and

   iv. special skills required for the particular function.

9.7.10. Airside driver permit shall be valid for a maximum 2 years, and renewed thereafter, provided that the driver has successfully completed a refresher training course, and meets the requirements 9.7.9 (a)– 9.7.9 (d) above.

9.7.11. The aerodrome operator shall suspend or revoke an airside driver permit when the person:

a. does not fulfil the requirements stated in 9.7.9 (a)– 9.7.9 (d);

b. has repeatedly been reported to violate movement area driving rules; and

c. has been proved to drive under the effect of alcohol or drugs.

9.7.12. It is not necessary that all operators be trained at the same level, for example, operators whose functions are restricted to the apron. For the same reason, the aerodrome operator could establish different types of ADP with different type of training in compliance with Supplement A, section 18, e.g., one Type for driving at the apron, and another one for the maneuvering area which may also have different validity periods.

9.8. Surface movement guidance and control systems

Application

9.8.1. A surface movement guidance and control system shall be provided at an aerodrome.

Note: Guidance on surface movement guidance and control systems is contained in the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476).

Characteristics

9.8.2. The design of a surface movement guidance and control system an aerodrome operator shall take into account:

a. The density of air traffic;

b. The visibility conditions under which operations are intended;

c. The need for pilot orientation;

d. The complexity of the aerodrome layout; and

e. Movements of vehicles.

9.8.3. The visual aid components of an SMGCS, i.e., markings, lights and signs, shall be designed to conform with the relevant specifications stipulated in the Part-139.

9.8.4. An SMGCS shall be designed to assist in the prevention of inadvertent incursions of aircraft and vehicles onto an active runway.

9.8.5. The system shall be designed to assist in the prevention of collisions between aircraft, and between aircraft and vehicles or objects, on any part of the movement area.

9.8.6. Where an SMGCS is provided by selective switching of stop bars and taxiway center line lights, the following requirements shall be met:

a. Taxiway routes which are indicated by illuminated taxiway center 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 center line lights beyond it is suppressed; and

c. The taxiway center line lights are activated ahead of an aircraft when the stop bar is suppressed.

9.8.7. Surface movement radar for the maneuvering area shall be provided at an aerodrome intended for use in runway visual range conditions less than a value of 350 m unless alternative procedures and facilities are in place to prevent collisions to the satisfaction of LYCAA.

9.8.8. Surface movement radar for the maneuvering area shall be provided at an aerodrome other than that in 9.8.7 when traffic density and operating conditions are such that regularity of traffic flow cannot be maintained by alternative procedures and facilities.

9.8.9. The SMGCS system shall comprise an appropriate combination of visual aids, nonvisual aids, procedures, control, regulation, management and information facilities. Systems range from the very simple at small aerodromes, with light traffic operating in good visibility conditions, to the complex systems necessary at large aerodromes with heavy traffic operating in low visibility conditions. The system selected for an aerodrome will be appropriate to the operational environment in which that aerodrome will operate.

9.9. Siting of equipment and installations on operational areas

9.9.1. Unless its function requires it to be there for air navigation purposes, no equipment or installation shall be:

a. On a runway strip, a runway end safety area, a taxiway strip or within the distances specified in Table 3-1, column 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 purposes which must be located:

a. on that portion of a runway strip within:

   1. 75 m of the runway center line where the code number is 3 or 4; or

   2. 45 m of the runway center line where the code number is 1 or 2; or

b. on a runway end safety area, a taxiway strip or within the distances specified in Table 3-1; or

c. on a clearway and which would endanger an aircraft in the air;

shall be frangible and mounted as low as possible.

9.9.3. Any equipment or installation required for air navigation or for aircraft safety purposes which must be located on the non-graded portion of a runway strip shall be regarded as an obstacle and shall be frangible and mounted as low as possible.

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 center line where the code number is 3 or 4; or

b. 45 m of the extended center 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 within 240 m from the end of the strip and within:

   1. 60 m of the extended runway center line where the code number is 3 or 4; or

   2. 45 m of the extended runway center line where the code number is 1 or 2; or

b. penetrates the inner approach surface, the inner transitional surface or the balked landing surface;

shall be frangible and mounted as low as possible.

9.9.6. Any equipment or installation required for air navigation or for aircraft safety purposes which is an obstacle of operational significance in accordance with 4.2.4, 4.2.11, 4.2.20 or 4.2.27 shall be frangible and mounted as low as possible.

9.10. Fencing

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.

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. When greater security is thought necessary, a 3 m cleared area shall be provided on both sides of the fence or barrier to facilitate the work of patrols and to make trespassing more difficult.

9.10.6. A perimeter road shall be provided inside the aerodrome fencing for the use of both maintenance personnel and security patrols.

9.11. Security lighting

9.11.1. At an aerodrome where it is deemed desirable for security reasons, at the discretion of LYCAA, an aerodrome operator shall illuminate the fence at a suitable level, barrier, and access points.

9.12. Autonomous runway incursion warning system

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.

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, Appendix 1.

9.13. Airside Safety Committee / Runway Safety Team

9.13.1. An aerodrome operator shall establish an airside safety committee / runway safety team for each aerodrome under its management.

9.13.2. The committee / team shall consist of:

a. Head or representative of air traffic control

b. Head or representative of aerodrome safety

c. Head or representative of rescue and fire fighting

d. Head or representative aerodrome security officer

e. Head or representative aerodrome maintenance

f. A member of the airlines

g. A member of the ground handling agent(s)

h. A member of the catering services

i. A member of the refueling companies

j. A representative of the joint user of the aerodrome, as per reference 9.13.3.

9.13.3. If the aerodrome is a joint user aerodrome, a representative of the joint user shall be invited to be part of the airside safety committee / runway safety team on the recommendation of LYCAA.

9.13.4. The aerodrome safety committee / runway safety team shall meet on a quarterly basis and review and discuss all airside safety concerns (including runway incursion), operational concerns and maintenance concerns.

9.13.5. The terms of reference for the aerodrome safety committee / runway safety team shall also include:

a. Evaluation of the effectiveness of all markings and signage at the aerodrome to prevent runway incursions;

b. The promotion of safety awareness through training, licensing and the publication of safety bulletins;

c. Establishing and discussing local safety procedures and guidelines;

d. Incident reporting and investigation, subsequent data analysis and dissemination of trends, common causes etc.;

e. Generation and evaluation of safety suggestions; and

f. Preparation of regular joint safety campaigns.

Chapter 10. Aerodrome maintenance

10.1. General

10.1.1. A maintenance program, 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.

10.1.2. The design and application of the maintenance program shall observe Human Factors principles.

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 program with the objective of avoiding and eliminating any foreign object debris (FOD) that might cause damage to aircraft or impair the operation of aircraft systems.

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 as stated in Table 2-1 of Chapter 2.

10.2.4. Runway surface friction characteristics for maintenance purposes shall be periodically measured at intervals not exceeding 6 months 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. Any deviation from the above regulation shall have prior approval from LYCAA.

10.2.5. When runway surface friction measurements are made for maintenance purposes using a self-wetting continuous friction measuring device, the performance of the device shall meet the standard set or agreed by the LYCAA.

10.2.6. Personnel measuring runway surface friction required in 10.2.5 shall be trained to fulfil their duties.

10.2.7. 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 Part-139.

10.2.8. The runway surface shall be visually assessed, as necessary, under natural or simulated rain conditions for ponding or poor drainage and where required, corrective maintenance action taken

10.2.9. When a taxiway is used by turbine-engine airplanes, the surface of the taxiway shoulders shall be maintained so as to be free of any loose stones or other objects that could be ingested by the airplane engines.

10.3. Removal of contaminants

10.3.1. 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.

10.3.2. Taxiways shall be kept clear of standing water, mud, dust, sand, oil etc., to the extent necessary to enable aircraft to be taxied to and from an operational runway.

10.3.3. Aprons shall be kept clear of standing water, mud, dust, sand, oil etc., to the extent necessary to enable aircraft to maneuver safely or, where appropriate, to be towed or pushed.

10.3.4. Chemicals which may have harmful effects on aircraft or pavements, or chemicals which may have toxic effects on the aerodrome environment, shall not be used.

10.4. Runway pavement overlays

10.4.1. 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. Overlaying shall proceed from one end of the runway toward the other end so that based on runway utilization most aircraft operations will experience a down ramp.

10.4.3. The entire width of the runway shall be overlaid during each work session.

10.4.4. Before a runway being overlaid is returned to a temporary operational status, a runway center 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. The overlay shall 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 per cent of the value specified in the appropriate figure in Appendix 2. For light units where the designed main beam average intensity is above the value shown in Appendix 2, the 50 per cent value shall be related to that design value.

10.5.2. A system of preventive maintenance of visual aids shall be employed to ensure lighting and marking system reliability.

10.5.3. The system of preventive maintenance employed for a precision approach runway category II or III shall include at least the following checks:

a) visual inspection and in-field measurement of the intensity, beam spread and orientation of lights included in the approach and runway lighting systems;

b) control and measurement of the electrical characteristics of each circuitry included in the approach and runway lighting systems; and

c) control of the correct functioning of light intensity settings used by air traffic control.

10.5.4. In-field measurement of intensity, beam spread and orientation of lights included in approach and runway lighting systems for a precision approach runway category II or III shall be undertaken by measuring all lights, as far as practicable, to ensure conformance with the applicable specification of Appendix 2.

10.5.5. Measurement of intensity, beam spread and orientation of lights included in approach and runway lighting systems for a precision approach runway category II or III shall be undertaken using a mobile measuring unit of sufficient accuracy to analyze the characteristics of the individual lights.

10.5.6. The frequency of measurement of lights for a precision approach runway category II or III shall be based on traffic density, the local pollution level, the reliability of the installed lighting equipment and the continuous assessment of the results of the in-field measurements but, in any event, 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 per cent of the lights are serviceable in each of the following particular significant elements:

1) precision approach category II and III lighting system, the inner 450 m;

2) runway center line lights;

3) runway threshold lights; and

4) runway edge lights;

b) 90 per cent of the lights are serviceable in the touchdown zone lights;

c) 85 per cent of the lights are serviceable in the approach lighting system beyond 450 m; and

d) 75 per cent of the lights are serviceable in the runway end lights.

In order to provide continuity of guidance, the allowable percentage of unserviceable lights shall not be permitted in such a way as to alter the basic pattern of the lighting system. Additionally, an unserviceable light shall not be permitted adjacent to another unserviceable light, except in a barrette or a crossbar where two adjacent unserviceable lights may be permitted.

With respect to barrettes, crossbars and runway edge lights, lights are considered to be adjacent if located consecutively and:

- laterally: in the same barrette or crossbar; or

- longitudinally: in the same row of edge lights or barrettes.

10.5.8. 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 center 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 per cent of the lights are serviceable in each of the following:

a) precision approach category I lighting system;

b) runway threshold lights;

c) runway edge lights; and

d) runway end lights.

In order to provide continuity of guidance an unserviceable light shall not be permitted adjacent to another unserviceable light unless the light spacing is significantly less than that specified.

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 that, during any period of operations, all runway lights are serviceable and that in any event:

a) at least 95 per cent of the lights are serviceable in the runway center line lights (where provided) and in the runway edge lights; and

b) at least 75 per cent of the lights are serviceable in the runway end lights.

In order to provide continuity of guidance, an unserviceable light shall not be permitted adjacent to another unserviceable light.

10.5.12. 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 per cent of the lights are serviceable in the runway edge lights and runway end lights. In order to provide continuity of guidance, an unserviceable light shall not be permitted adjacent to another unserviceable light.

10.5.13. During low visibility procedures the aerodrome operator shall restrict construction or maintenance activities in the proximity of aerodrome electrical systems.

Chapter 11. Aerodrome certification / Operator obligation / Use of aerodromes

11.1. Application for an aerodrome certificate

11.1.1. An applicant for an aerodrome certificate shall submit, to LYCAA, for approval:

a. An application for an aerodrome certificate,

b. Copies of the aerodrome manual including the emergency plan, safety management system,

c. Organizational structure of the aerodrome operator,

d. Rescue and firefighting service operations manual,

e. Aerodrome and obstacle survey,

f. Aerodrome chart showing all obstacles, aerodrome boundary, RFFS road/ facilities, AGL, CNS equipment, and all airside operational infrastructure,

g. Apron chart showing all aircraft parking stands, markings, dimensions and airside operational infrastructure,

b. The application referred to in paragraph (11.1) (a) shall be in a form and manner acceptable to the LYCAA and shall be signed, in ink by the applicant and include the appropriate application fee.

11.2. Issuance of Aerodrome Certificate

11.2.1. The LYCAA may issue an aerodrome certificate to an applicant authorizing the applicant to operate a certified aerodrome if:

a. The applicant and his/her staff have the necessary competence and experience to operate and maintain the aerodrome properly;

b. The proposed aerodrome manual, submitted pursuant to paragraph 11.1.1(b), is accepted by the LYCAA pursuant to 11.1 (a) and,

c. The aerodrome facilities, services and equipment are in accordance with the standards and practices specified by LYCAA;

d. The granting of the certificate is not contrary to the interests of aviation safety.

11.2.2. LYCAA shall accept a proposed aerodrome manual if it:

a. Accurately describes the physical specifications of the aerodrome; and

b. Conforms to the requirements set out in Part-139 that apply in respect of an aerodrome manual.

11.2.3. Where an aerodrome does not meet a standard set out where applicable, of Part-139, the LYCAA may specify in the aerodrome certificate such conditions relating to the subject matter of the standard as are necessary to ensure a level of safety equivalent to that established by the standard and as are necessary in the public interest and to ensure aviation safety.

11.2.4. An aerodrome certificate issued pursuant to 11.2 is effective until the date shown on the certificate.

11.2.5. An aerodrome certificate issued pursuant to 11.2 shall include the following:

a. Legal name of the aerodrome operator.

b. Name and WGS84 coordinates of the aerodrome.

c. Certificate number/ Registration.

b. Date of issue, and date of expiry.

c. Conditions, including, but not limited to, type of use, maximum aircraft size permitted to use the aerodrome based on fire category and code letter, and, if applicable, wheel base, absolute weather minima based on aeronautical ground lighting and instrument approach procedures/navigation aids, any exemptions and variations.

11.3. Transfer of Aerodrome Certificate

11.3.1. When an aerodrome certificate is transferred, it shall be transferred in accordance with this Section.

11.3.2. LYCAA shall transfer an aerodrome certificate to a transferee where:

a. The current holder of the aerodrome certificate, at least 90 days before ceasing to operate the aerodrome, notifies the LYCAA in writing that the current holder will cease to operate the aerodrome as of the date specified in the notice;

b. The current holder of the aerodrome certificate notifies the LYCAA in writing of the name of the transferee;

b. The transferee applies in writing to the LYCAA, within 90 days before the current holder ceases to operate the aerodrome, for the aerodrome certificate to be transferred to the transferee; and

c. The requirements set out in 11.2 are met.

11.3.3. An application referred to in paragraph 11.3.2 (c) shall include a copy of the notice referred to in paragraph 11.3.2 (a).

11.3.4. If the LYCAA does not consent to the transfer of an aerodrome certificate, it shall notify the transferee, in writing, of its reasons not later than 14 days after making that decision.

11.4. Interim Aerodrome Certificate

11.4.1. The LYCAA may issue to an applicant referred to in 11.2, or a transferee referred to in 11.3, an interim aerodrome certificate authorizing the applicant or transferee to operate an aerodrome if the LYCAA is satisfied that:

a. An aerodrome certificate in respect of the aerodrome will be issued to the applicant or transferred to the transferee as soon as the application procedure in respect of the issuance or transfer is completed; and

b. The issuance of the interim aerodrome certificate is in the public interest and not detrimental to aviation safety.

11.5. Amendment and Cancellation of Aerodrome Certificate

11.5.1. LYCAA may, if the requirements of 11.2 and 11.3 are met, amend an aerodrome certificate where:

a. There is a change in the use or operation of the aerodrome;

b. There is a change in the boundaries of the aerodrome;

b. The holder of the aerodrome certificate requests the amendment; or

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

11.5.2. LYCAA shall cancel an aerodrome certificate where this no longer applies in respect of the aerodrome referred to in the aerodrome certificate, as determined in accordance with 1.4.

11.6. Duration of certificate

a. An aerodrome certificate will be valid for 36 month or until the aerodrome operator surrenders it, or it is suspended or revoked by the LYCAA, whichever occurs first.

b. The holder of an aerodrome certificate that expires or is revoked shall forthwith surrender the certificate to the LYCAA.

b. The holder of an aerodrome certificate that is suspended, shall forthwith produce the certificate to LYCAA for appropriate endorsement.

11.7. Renewal of certificate

11.7.1. An application for the renewal of an aerodrome certificate shall be submitted to LYCAA before the application renewal date specified in the certificate or, if no such date is specified, not less than 90 days before the certificate expires.

11.7.2. The renewal of an aerodrome certificate depends on the satisfactory outcome of regulatory audit/surveillance activities conducted by the LYCAA during the validity and at renewal of the certificate.

11.8. Exemptions

11.8.1. The LYCAA may exempt, in writing, an aerodrome operator from complying with specific provisions of this regulation. Before LYCAA decides to exempt the aerodrome operator, they will take into account all safety related aspects, including an aeronautical study and risk assessment.

11.8.2. An exemption is subject to the aerodrome operator complying with the conditions and procedures specified by LYCAA in the aerodrome certificate as being necessary in the interest of maintaining a comparable acceptable level of safety as would be provided by a compliant aerodrome.

11.8.3. When an aerodrome does not meet the Part-139 requirement, LYCAA may determine, after reviewing aeronautical studies or risk assessment, only if and where permitted by the standards and recommended practices, the conditions and procedures that are necessary to ensure a level of safety equivalent to that established by this Regulation.

11.9. Deviations

11.9.1. The holder of an aerodrome certificate may deviate from any requirement of Part-139 only to the extent required to meet an emergency condition requiring immediate action for the protection of life or property involving carriage by air.

11.9.2. A certificate holder who deviates from a requirement of Part-139 shall provide an immediate notification to LYCAA, followed by written report to LYCAA as soon as practicable, but in any event not later than one business day after the emergency. The report shall cover the nature, extent and duration of the deviation.

11.10. Preparation of the aerodrome manual

The aerodrome operator shall have a manual, to be known as the aerodrome manual.

The aerodrome manual shall:

a. Be typewritten or printed, and signed by the aerodrome operator;

b. Be in a format that is easy to revise;

c. Have a system for recording the currency of pages and amendments thereto, including a page for logging revisions; and

d. Be organized in a manner that will facilitate the preparation, review and acceptance and approval process.

Electronic and printed copy to be provided to LYCAA.

11.11. Location of the aerodrome manual

a. The aerodrome operator shall provide the LYCAA with two complete and current copies of the aerodrome manual.

b. The aerodrome operator shall keep at least one complete and current copy of the aerodrome manual at the aerodrome and one copy at the operator's principal place of business if other than the aerodrome.

c. The aerodrome operator shall make the copy referred to in 11.11(b) available for inspection by authorized LYCAA personnel.

11.12. Information to be included in the aerodrome manual

The aerodrome operator shall include in an aerodrome manual to the extent that they are applicable to the aerodrome, information as listed in the Chapter 12 of the Part-139.

11.13. Information reporting

The information listed in the Part-139, that is required to be notified, shall be reported to the Aeronautical Information Service (AIS), in accordance with the specifications in Chapter 2, for inclusion in the Libyan AIP.

11.14. Amendment of the aerodrome manual

The aerodrome operator shall alter or amend the aerodrome manual, in order to maintain the accuracy of the information in the manual.

To maintain the accuracy of the aerodrome manual, the LYCAA may issue a written directive to an aerodrome operator requiring the operator to alter or amend the manual in accordance with that directive.

11.15. Notification of changes to the aerodrome manual

An aerodrome operator shall notify the LYCAA, as soon as possible, of any changes that the operator wishes to make to the aerodrome manual.

11.16. Acceptance and approval of the Aerodrome

LYCAA shall stamp two copies of the aerodrome manual and any amendments, after accountable manager of the aerodrome provide signed copies of the manual that meets the requirements of these regulations.

11.17. Obligations of Aerodrome Operator

11.17.1. The aerodrome operator shall ensure that each aerodrome operator holding an aerodrome certificate shall establish an internal quality system. The operator shall also:

a. Comply:

1. Subject to subparagraph (3), with the standards set out in this Part, where applicable, as they read on the date on which the aerodrome certificate was issued,
2. In respect of any part or facility of the aerodrome that has been replaced or improved, with the standards set out in this rule, where applicable, of Part-139 as they read on the date on which the part or facility was returned to service, and
3. With any conditions specified in the aerodrome certificate by the LYCAA pursuant to 11.2;

b. Without charge, at the request of an LYCAA inspector:

1. Allow access to the aerodrome facilities, equipment or operating procedures at the aerodrome for the purpose of ensuring the safety of aircraft,
2. Allow access to any part of the aerodrome or any aerodrome facilities, equipment or records,

c. review each issue of each aeronautical information publication on receipt thereof and, immediately after such review, notify the LYCAA of any inaccurate information contained therein that pertains to the aerodrome;

d. notify LYCAA in writing at least 21 days (attached with a risk assessment/aeronautical study) before any change to the aerodrome, the aerodrome facilities or the level of service at the aerodrome that has been planned in advance and that is likely to affect the accuracy of the information contained in an aeronautical information publication, or is required to be notified to the LYCAA in accordance with the conditions of the aerodrome certificate;

e. As the circumstances require for the purpose of ensuring aviation safety, inspect the aerodrome:
   1. As soon as practicable after any incident or accident,
   2. During any period of construction or repair of the aerodrome or of aerodrome facilities that are designated in the aerodrome certificate, and
   3. At any other time when there are conditions at the aerodrome that could be hazardous to aviation safety; and

f. Subject to paragraph (d), notify the LYCAA in writing of any change in aerodrome operations within 21 days after the date of the change.

11.17.2. Subject to 11.18.1 (e) (3), the aerodrome operator shall give the LYCAA, and appropriate air traffic control unit, immediate notice of any of the following circumstances of which the aerodrome operator has knowledge:

a. Any projection by an object through an obstacle limitation surface relating to the aerodrome;

b. The existence of any obstruction or hazardous condition affecting aviation safety at or near the aerodrome;

c. Any reduction in the level of services at the aerodrome that are set out in an aeronautical information publication;

d. The closure of any part of the maneuvering area of the aerodrome; and

e. Any other conditions that could be hazardous to aviation safety at the aerodrome and against which precautions are warranted.

11.17.3. Where it is not feasible for an aerodrome operator to cause notice of a circumstance referred to in subsection (2) to be received at the appropriate air traffic control unit, the aerodrome operator shall give immediate notice directly to the pilots who may be affected by that circumstance.

11.17.4. The aerodrome operator shall remove from the surface of the aerodrome any vehicle or other obstruction that is likely to be hazardous to aviation safety.

11.17.5. The aerodrome operator shall integrate architectural and infrastructure-related requirements for the optimum implementation of international civil aviation security measures into the design and construction of new facilities and alterations to existing facilities at an aerodrome.

11.17.6. In the design of aerodromes, the aerodrome operator/owner shall take into account, where appropriate, land-use and environmental control measures.

11.17.7. The aerodrome operator shall:

a. ensure that all users of the aerodrome, including ground-handling agencies and other organizations that perform activities independently at the aerodrome in relation to flight or aircraft handling, comply with the safety requirements of the aerodrome operator. The aerodrome operator monitors such compliance.

b. monitor the compliance of third parties with the safety provisions established using the appropriate means.

11.17.8. The aerodrome operator shall maintain a sufficient number of qualified and competent personnel to comply with the requirements of its aerodrome manual and the applicable standards of Part-139.

11.17.9. The Aerodrome operator shall appoint an Accountable Manager who is approved by LYCAA and has full control of the resources, final authority over operations under the certificate/approval of the organization and ultimate responsibility and accountability for the establishment, implementation and maintenance of the SMS; safety policy and the resolution of all safety issues.

11.17.10. The accountable manager shall nominate post holders, acceptable and approved by LYCAA, who are responsible for the management and supervision of safety critical aspects for the aerodrome operations.

11.17.11. When LYCAA requires competency certification, the aerodrome operator shall employ only those persons possessing such certificates.

11.17.12. The aerodrome operator shall ensure the competency of all personnel involved with aerodrome safety functions and nominated post holders, and shall obtain prior approval from LYCAA for all new appointments, including promotions and similar changes in safety related functions.

11.17.13. The aerodrome operator shall implement a program to upgrade the competency of the personnel referred to in subsection (11.17.8).

11.17.14. At the aerodrome, additional post holders, responsible for safety critical aspects for the aerodrome operation shall include the following:

a. **Aerodrome Safety** - a person who shall be the responsible individual and focal point for the development and maintenance of an effective Safety Management System;

b. **Aerodrome Operations** – a person who shall be responsible for ensuring that the aerodrome and its operation comply with the requirements of these regulations;

c. **Aerodrome Maintenance** – a person who shall be responsible for ensuring that the aerodrome's maintenance programs for safety critical infrastructure comply with the requirements of these regulations;

d. **Rescue Firefighting Service** – a person who shall be responsible for establishing and effectively managing all aspects of Rescue and Firefighting Services as per the requirements of these regulations; and

e. **Aerodrome compliance** – a person who shall be responsible for the compliance with, and the adequacy of, the procedures required by regulations, and for the continuance in improvement of standards.

11.17.15. LYCAA will assess each nominated Aerodrome Post Holder based on the Assessment Criteria in Appendix 6, conduct an interview with the nominee and may call for additional evidence of his/her suitability before deciding upon his/her acceptability.

11.17.16. The training of personal mentioned in the paragraph 11.17.14 shall be completed prior to the initial performance of their duties, or allowing them unescorted access on the movement area and other operational areas of the aerodrome, as appropriate.

11.17.17. The training program shall include Safety Management System training whose level of detail shall be appropriate to the individual's responsibility and involvement in the Safety Management System and shall also include human and organizational factors; for those persons referred to in paragraph under 11.17.14 employed by other organizations operating, or providing services at the aerodrome, the Safety Management System training may cover only the necessary elements (e.g., relevant procedures, safety reporting system, aerodrome safety programs, FOD awareness, etc.).

11.17.18. The training program shall consist of the following:

1. a process to identify training standards, including syllabi and frequency for each type of training and area of activity for the persons mentioned in paragraph 11.17.14, including for instructors and assessors, and track completion of required training;
2. a validation process that measures the effectiveness of training;
3. initial job-specific training;
4. on-the-job training; and

5. recurrent training.

11.17.19. The training program shall identify training responsibilities and contain procedures:

1. for training and checking of the trainees;
2. to be applied in the event that personnel do not achieve or maintain the required standards.

11.17.20. Training contents and syllabi shall be approved/accepted by LYCAA.

11.17.21. A training file shall be developed for each employee, including management, to assist in identifying and tracking employee training requirements, and verifying that personnel have received the planned training.

11.17.22. The methods to be used for the checking of the trainees could include:

a. practical demonstration,
b. computer-based assessment,
c. oral or written tests, or combinations of such methods, as appropriate.

11.17.23. The Aerodrome Operator shall maintain appropriate qualification training and proficiency check records to demonstrate the compliance with the requirement in the section 11.17.13.

11.17.24. The aerodrome operator shall maintain records of the training sessions that it has provided, including as a minimum the following:

1. area of training and subjects covered;
2. names of participants/signed list of participants;
3. date and duration of training; and
4. name of the instructor.

11.17.25. Training Records of individuals: The training records maintained for each individual shall include as a minimum:

1. the name of the trainee;
2. the date(s) and the duration of the training;
3. the place where the training was received;
4. the name of the organization that provided the training;
5. the subjects covered, and the methodology of the course;
6. any comments made by the instructor if applicable;
7. performance evaluation of the trainee if applicable; and
8. the name and signature of the instructor

11.18. Notification of aviation occurrence on an aerodrome

a. A holder of an aerodrome certificate, issued in accordance with this Part-139, shall notify LYCAA immediately of any aviation occurrence on or related to the aerodrome, including if the certificate holder is involved in the aviation occurrence and the occurrence is an incident, accident or is a new hazard to the safety of an aircraft operations.

b. The notification of an occurrence shall be conveyed by a means acceptable to LYCAA. The information shall be delivered as soon as possible within 24 hours and contain, where ascertainable, information in accordance with the following:

1. Date and time of the occurrence
2. Brief description of events
3. Name of the aerodrome
4. Description and the location of the reported defect or obstruction
5. Name, organization, and contact details of the person notifying the occurrence.

11.18.1. Details of occurrence

Notwithstanding the notification of a serious occurrence or an immediate hazard to the safety of an aircraft operation, the certificate holder must provide LYCAA with the applicable details of the occurrence on the form appropriate to the occurrence, namely: air traffic occurrence report, bird strike report, or hazard/occurrence/incident/accident report form the operator safety management system.

11.18.2. Investigation and reporting

A holder of a certificate is required to provide details of an occurrence to LYCAA, unless otherwise notified by LYCAA:

1) Conduct an investigation to identify the facts relating to its involvement in the occurrence and establish, so far as those facts allow, the cause or causes of the occurrence; and

2) On completion of the investigation, submit a report of the investigation to the LYCAA no later than 30 days after the occurrence.

11.19. Warning Notices

Where low flying or taxiing aircraft at or near an aerodrome are likely to be hazardous to pedestrian or vehicular traffic, the operator of the aerodrome shall immediately:

a. Post notices warning of the hazard on any road, path or sidewalk maintained for the use of members of the public, that is adjacent to the maneuvering area; or

b. Where such road, path or sidewalk is not owned or controlled by the aerodrome operator, inform the authorities responsible for posting notices that there is a hazard.

11.20. Prohibitions

No person shall:

a. operate an aerodrome referred to in 1.4 unless an aerodrome certificate is issued in respect of that aerodrome;

b. knowingly use an aerodrome in a manner contrary to a condition set out in the aerodrome certificate;

c. walk, stand, drive a vehicle, park a vehicle or aircraft or cause an obstruction on the movement area of an aerodrome, except in accordance with permission given:

   1. by the aerodrome operator, and
   2. where applicable, by the appropriate air traffic control unit;

d. operate any vessel, or cause any obstruction, on the surface of any part of a water area of an aerodrome that is to be kept clear of obstructions in the interest of aviation safety, when ordered, by signal or otherwise, to leave or not to approach that area by the appropriate air traffic control unit or by the operator of the aerodrome;

e. tow an aircraft on an active movement area at night unless the aircraft displays operating wingtip, tail and anti-collision lights or is illuminated by lights mounted on the towing vehicle and directed at the aircraft being towed;

f. park or otherwise leave an aircraft on an active maneuvering area at night unless the aircraft displays operating wingtip, tail and anti-collision lights or is illuminated by lanterns suspended from the wingtips, tail and nose of the aircraft;

g. at an aerodrome, knowingly remove, deface, extinguish or interfere with a marker, marking, light or signal that is used for the purpose of air navigation, except in accordance with permission given:

   1. by the operator of the aerodrome, and
   2. where applicable, by the appropriate air traffic control unit;

h. at or in the vicinity of an aerodrome, knowingly display a marker, marking, sign, light or signal that is likely to be hazardous to aviation safety by causing glare or by causing confusion with or preventing clear visual perception of a marker, marking, sign, light or signal that is required under this Part;

i. steal equipment of air navigation facilities or any instruments, devices or cables that are deemed necessary to ensure the safety of aviation;

j. willfully damage or obstruct installations, buildings, cables, instruments devices or equipment that are deemed necessary to ensure the safety of aviation;

k. allow a bird or other animal that is owned by the person or that is in the person's custody or control to be unrestrained within the boundaries of an aerodrome, except for the purpose of controlling other birds or animals at the aerodrome as permitted by the aerodrome operator; or

l. Discharge a firearm within or into an aerodrome without the permission of the LYCAA.

11.21. Fire Prevention

a. Subject to subsections (2), no person shall, at an aerodrome, smoke or display an open flame:

1. on an apron;
2. on an aircraft loading bridge or on a gallery or balcony that is adjacent to or that overhangs an apron; or
3. In an area where smoking or an open flame is likely to create a fire hazard that could endanger persons or property.

b. The operator of an aerodrome may, in writing, authorize maintenance or servicing operations on an apron that involve the use, production or potential development of an open flame or that involve the production or potential development of a spark where the operations are conducted in a manner that is not likely to create a fire hazard that could endanger persons or property.

c. The operator of an aerodrome may permit smoking in an enclosed building or shelter located on an apron where such smoking is not likely to create a fire hazard that could endanger persons or property.

11.22. Rain and Flood Control

a. Each aerodrome operator whose aerodrome is located where flooding conditions occur shall prepare, maintain and carry out a rain and flood control plan.

b. The rain and flood control plan shall include instructions and procedures for:

- Prompt control, as completely as practical, of floodwater on each movement area;
- Timely commencement of control operations; and
- Immediate notification of all air operators using the aerodrome when any portion of the aerodrome normally available to them could be hazardous to aviation safety.

11.23. Charges

11.23.1. LYCAA shall levy charges on certificates it issues and/or validates and on services provided for aerodrome operators.

11.23.2. The LYCAA shall determine the number of charges for the use and operation of aerodrome open for public use, or for occupying parts thereof, also for the air navigation and weather services, and any other services for users of aerodromes and their facilities. The CAA may modify these charges.

11.23.3. The LYCAA shall collect the charges on certificates it issues and/or validates and on services provided to the users of aerodrome, aerodrome operators and training organizations according to financial rules and regulations in force.

11.24. Compliance with Part-139

When an aerodrome operator fails to comply with the requirements of Part-139, their aerodrome certificate, aerodrome manual, or any document issued and/or validated by the LYCAA, the certificate can be suspended or revoked.

11.25. Use of Aerodrome

11.25.1. General

No person operating an aircraft shall:

a. Use any place certificated as an aerodrome under this Part-139 unless that person can comply with the limitations and operational conditions placed on the use of the aerodrome; or

b. Use any place for the purpose of landing at or taking off from at night unless the runway or heliport to be used at that place is equipped with lighting, and that lighting is operating; or

c. Use any maneuvering area or part of any maneuvering area that has been notified as or marked unsafe for aircraft use by the aerodrome operator.

d. Taxi on the apron or the maneuvering area of an aerodrome without the permission of either:

1. The person in charge of the aerodrome; or

2. The air traffic control unit or aerodrome flight information service unit notified as being on watch at the aerodrome.

11.25.2. Air Transport airplanes

No person operating an airplane engaged on an air transport operation shall use any place for the purpose of landing at or taking off from unless:

a. the place has physical characteristics, obstacle limitation surfaces, and visual aids commensurate with the characteristics of the airplane being used, the lowest meteorological minima to be used, and the ambient light conditions; and

b. the place is suitable for landing at and taking off; and

c. the runway used is clear of all persons, animals, vehicles or other obstructions during the landing or take-off; and

d. that person is employing a checking system to determine that the condition of the place is safe for that operation; and

e. if the airplane has a certified seating capacity of more than 30 passengers and is engaged on a scheduled flight, the place is certificated as an aerodrome under this regulation and

f. if the place is not certificated under this Part, the airplane can be maneuvered in the aerodrome traffic circuit clear of any obstructions, and not in conflict with the aerodrome traffic circuit or instrument approach procedure of any other aerodrome.

11.25.3. Non-Air Transport Aircraft other than helicopters

No person operating an aircraft, other than a helicopter, which is engaged on an operation other than an air transport operation, shall use any place for the purpose of landing at or taking off from unless:

a. The place is suitable for landing at and taking off; and

b. The runway or place used is clear of all persons, animals, vehicles or other obstructions during the landing or take off other than persons and vehicles essential to the operation; and

c. The aircraft can be maneuvered in the aerodrome traffic circuit clear of any obstructions, and not in conflict with the aerodrome traffic circuit or instrument approach procedure of any other aerodrome.

11.26. Low visibility procedures

11.26.1. Unless the supporting services, procedures equipment and facilities to support low visibility operations have been approved by LYCAA, the aerodrome operator shall not permit:

a. approaches and landings in Category II and Category III meteorological conditions;

b. take offs in RVR less than 550 meters.

11.26.2. The procedures to be established by the aerodrome operator to ensure safe aerodrome operations during low visibility conditions shall cover at least the following subjects:

a. physical characteristics of the runway environment, including pre-threshold, approach and departure areas;

b. obstacle limitation surfaces;

c. surveillance and maintenance of visual aids;

d. safeguarding of non-visual aids essential to low visibility procedures;

e. secondary power supplies;

f. movement area safety;

g. RFFS.

11.26.3. The measures required to support safe operations at an airport in Low Visibility Conditions (LVC) shall be specified in local procedures as LVP and published in the Libyan AIP.

11.27. Aeronautical study / Risk assessment

Purpose

11.27.1. An Aeronautical Study is conducted to assess the impact of proposed change or deviations to Civil Aviation Regulations; present alternative means of ensuring safety of aircraft operations; assess the effectiveness of each alternative or proposed change and to recommend procedures or mitigating measures to compensate for any safety risks that have been identified.

Applicability

11.27.2. An aerodrome operator shall monitor operations and conduct an aeronautical study workshop prior to a significant change that may affect the safety of aerodrome operations.

11.27.3. For the purpose of paragraph 11.27.2, a change requiring prior approval referred to by Libyan Civil Aviation Regulations includes:

a. any change affecting the Conditions, Scope of Operations, Specific Conditions or deviations of the Aerodrome Certificate;

b. any change significantly affecting elements of the Aerodrome Operator's management system;

c. any change where certification requirements cannot be met; and

d. where specified within these regulations

11.27.4. As part of its management system, the Aerodrome Operator proposing a change to the aerodrome, its operation, its organization, management system, equipment or proposing a deviation from Civil Aviation Regulation shall:

a) determine the interdependencies with any affected parties, plan and conduct an aeronautical study in coordination with these organizations;

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

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

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

11.27.5. Changes on an aerodrome can include changes to procedures, equipment, infrastructures, safety works, special operations, regulations, organization, etc. The assessment process Shall include:

a. identification of the scope of the change;

b. identification of hazards;

c. determination of the safety criteria applicable to the change;

d. risk assessment in relation to the harmful effects or improvements in safety related to the change;

e. risk evaluation and, if required, risk mitigation for the change to meet the applicable safety criteria;

f. verification that the change conforms to the scope that was subject to safety assessment, and meets the safety criteria, before the change is put into operation; and

g. the specification of the monitoring requirements necessary to ensure that the aerodrome and its operation will continue to meet the safety criteria after the change has taken place.

h. Consideration of the impact of the safety concern on all relevant factors determined to be safety-significant. The list below provides a number of items that may need to be considered when conducting a safety assessment. The items in this list are not exhaustive and in no particular order:

    1. aerodrome layout, including runway configurations; runway length; taxiway, taxilane and apron configurations; gates; jet bridges; visual aids; and the RFF services infrastructure and capabilities;

    2. types of aircraft, and their dimensions and performance characteristics, intended to operate at the aerodrome;

    3. traffic density and distribution;

    4. aerodrome ground services;

    5. air-ground communications and time parameters for voice and data link communications;

    6. type and capabilities of surveillance systems and the availability of systems providing controller support and alert functions;

    7. flight instrument procedures and related aerodrome equipment;

    8. complex operational procedures, such as collaborative decision-making;

    9. aerodrome technical installations, such as advanced surface movement guidance and control systems (A-SMGCS) or other air navigation aids;

    10. obstacles or hazardous activities at or in the vicinity of the aerodrome;

    11. planned construction or maintenance works at or in the vicinity of the aerodrome;

    12. any local or regional hazardous meteorological conditions (such as wind shear); and

13. airspace complexity, ATS route structure and classification of the airspace, which may change the pattern of operations or the capacity of the same airspace.

11.28. Safeguarding of aerodrome surroundings

11.28.1. The aerodrome operator shall monitor on the aerodrome and its surroundings, taking into account the planned or intended mode of operation for the runway:

a. obstacle limitation and protection surfaces as established in accordance with Chapter 4, and other surfaces and areas associated with the aerodrome, in order to take, within the safeguarded area associated with the aerodrome, appropriate action to mitigate the risks associated with the penetration of those surfaces and areas;

b. marking and lighting of obstacles in order to be able to take action within the safeguarded area associated with the aerodrome, as appropriate; and

c. hazards related to human activities and land use in order to take action within the safeguarded area associated with the aerodrome, as appropriate.

11.28.2. The aerodrome operator shall have:

a. procedures in place for assessing and mitigating the risks associated with obstacles, developments and other activities within the monitored areas that could impact on the safe operations of aircraft operating at, to or from the aerodrome;

b. agreements in place with applicable local authorities and municipalities for the continuous assessment of developments, land use and activities surrounding the aerodrome that may jeopardize the safe operation of aircraft; and

c. procedures in place for the inspection of obstacles to ensure that they remain in compliance with the requirements of chapter 4.

The inspections shall be conducted on a quarterly basis. These inspections shall be conducted from both within and outside the aerodrome boundary. The Records of the inspections shall be maintained along with reports of any follow-up action that may have been conducted following the identification of a non-serviceable obstacle light.

Chapter 12. Aerodrome manual

Aerodrome operator shall refer to the following regulations & guidance materials for the preparation of the Aerodrome manual:

1. Part-139;
2. Manual on Certification of Aerodromes (Doc 9774);
3. Annex 19, Safety Management;
4. Procedures for Air Navigation Services - Aerodromes (Doc 9981);
5. Any other publications used for cross reference published by ICAO.

In writing the procedures, clear and precise information shall be included on:

1. When, or in what circumstances, is an operating procedure to be activated;
2. How is an operating procedure activated;
3. Actions to be taken;
4. The person(s) to carry out the actions; and
5. Equipment, and access to such equipment, necessary for carrying out the actions.

If any of the procedures specific above is not relevant or applicable, the reason shall be given

12.1. Administration procedure for the aerodrome manual

12.1.1. An aerodrome operator shall include the following in an aerodrome manual:

a. Contents and/or index
b. Amendment record page
c. Amendment procedure
d. Indication of changes on amended pages
e. Abbreviations, glossary
f. Bibliography/references
g. Distribution list

12.1.2. General

An aerodrome operator shall include the following in an aerodrome manual:

a. Purpose and scope of the aerodrome manual;
b. The legal requirement for an aerodrome certificate and an aerodrome manual as prescribed in the national regulations;
c. Conditions for use of the aerodrome - a statement to indicate that the aerodrome shall at all times, when it is available for the take-off and landing of aircraft, be so available to all persons on equal terms and conditions;

d. The available aeronautical information system and procedures for its promulgation;

e. The system for recording aircraft movement, including landings and take-offs of all aircraft, and, if separately recorded, stand times;

f. Acknowledgement by the aerodrome operator of their obligations and systems to comply with standards and practices and conditions of the aerodrome certificate;

g. Acknowledgement by the aerodrome operator of their obligations and systems to allow access of LYCAA Inspectors;

h. Acknowledgement by the aerodrome operator of their obligations and systems to review aeronautical publications, including each amendment issued;

i. Acknowledgement by the aerodrome operator of their obligations and systems to notify LYCAA of any aerodrome facilities or level of service;

j. Acknowledgement by the aerodrome operator of their obligations and systems to inspect the aerodrome after an aviation occurrence or when likely hazardous operations may exist;

k. Acknowledgement by the aerodrome operator of their obligations and systems to notify AIS, LYCAA and Air traffic control of any object, hazardous condition, level of service or remove from the aerodrome surface any hazardous obstruction;

l. Acknowledgement by the aerodrome operator of their obligations and systems to remove from the aerodrome surface any vehicle or other obstruction that is likely to be hazardous to aviation safety;

m. Acknowledgement by the aerodrome operator of their obligations and systems to maintain sufficient qualified and competent personnel to comply with Part-139;

n. Acknowledgement by the aerodrome operator of their obligations and systems to ensure only personnel approved by LYCAA are involved with aerodrome safety functions;

o. Acknowledgement by the aerodrome operator of their obligations and systems to post notices of hazards on any road, path or sidewalk, where applicable.

12.2. Aerodrome site

12.2.1. An aerodrome operator shall include the following in an aerodrome manual:

a) A plan of the aerodrome showing the main aerodrome facilities for the operation of the aerodrome including, particularly, the location of each wind direction indicator;

b) A plan of the aerodrome showing the aerodrome airside/landside, movement area, and maneuvering area boundaries;

c) A plan showing the distance of the aerodrome from the nearest city, town or other populous area, and the location of any aerodrome facilities and equipment outside the boundaries of the aerodrome;

d) Particulars of the title of the aerodrome site. If the boundaries of the aerodrome are not defined in the title documents particulars of the title to, or interest in, the property on which the aerodrome is located and a plan showing the boundaries and position of the aerodrome.

12.3. Particulars of the aerodrome required to be reported to aeronautical information services (AIS)

12.3.1. General information

An aerodrome operator shall include the following in an aerodrome manual:

1. The name of the aerodrome
2. The location of the aerodrome
3. The geographical coordinates of the aerodrome reference point determined in terms of the WGS-84 reference datum
4. The aerodrome elevation
5. The aerodrome geoid undulation
6. The elevation of each threshold
7. Each threshold geoid undulation
8. Elevation of the runway end
9. Elevation of any significant high and low points along the runway
10. Elevation of the highest elevation of the touchdown zone of a precision approach runway
11. The aerodrome reference temperature
12. Details of the aerodrome beacon, if provided
13. The name of the aerodrome operator
14. The address and telephone numbers at which the aerodrome operator may be contacted at all times

12.3.2. Aerodrome dimensions and related information

An Aerodrome operator shall include the following in an aerodrome manual:

1. Runway — true bearing,
2. Runway — designation numbers
3. Runway — length, & width to the nearest meter
4. Runway — displaced threshold(s) location to the nearest meter
5. Runway — slope
6. Runway — surface type(s)
7. Runway — type of runway
8. Runway — for a precision approach runway, the existence of an obstacle free zone
9. Length, width of runway strip to the nearest meter
10. Surface type of runway strip
11. Length, width of runway end safety areas to the nearest meter
12. Surface type of runway end safety areas
13. Length, width of stopways to the nearest meter
14. Surface type of stopways
15. Length, width of taxiways to the nearest meter
16. Surface type of taxiways
17. Apron surface type
18. Apron aircraft stands
19. Clearway length to the nearest meter
20. Clearway ground profile
21. Visual aids for approach procedures, viz. approach lighting type
22. Visual aids for approach procedures, viz. visual approach slope indicator system
23. Obstacle limitation surfaces
24. Marking of runways
25. Lighting of runways
26. Marking of taxiways
27. Lighting of taxiways

28. Marking of aprons
29. Lighting of aprons
30. Other visual guidance and control aids on taxiways (including runway holding positions, intermediate holding positions and stop bars)
31. Other visual guidance and control aids on aprons, location & type of visual docking guidance system
32. Availability of standby power for lighting
33. The location and radio frequency of VOR Aerodrome checkpoints
34. The location and designation of standard taxi routes
35. The geographical coordinates of each threshold
36. The geographical coordinates of appropriate taxiway center line points
37. The geographical INS checkpoint coordinates of each aircraft stand
38. The geographical coordinates & top elevation of significant obstacles in the approach & take-off areas, in the circling area & in the vicinity of the aerodrome. (May best be shown in the form of charts such as specified in Annexes 4 and 15).
39. Pavement Surface Type
40. Pavement Classification Number: runway
41. Pavement Classification Number: taxiway
42. Pavement Classification Number: apron
43. One or more pre-flight altimeter check locations established on an apron, and runway holding position (if required for RNP), and their elevation to the nearest foot. The elevation of a pre-flight altimeter check location shall be given as the average elevation, rounded to the nearest meter or foot, of the area on which it is located. The elevation of any portion of a pre-flight altimeter check location shall be within 3 m (10 ft) of the average elevation for that location.
44. Declared distances: take-off run available (TORA), take-off distance available (TODA), accelerate-stop distance available (ASDA), landing distance available (LDA).

12.4. Aerodrome operating procedures and safety measures

12.4.1. Aerodrome reporting

An aerodrome operator shall include in the aerodrome manual particulars of the procedures for reporting any changes to aerodrome information set out in the AIP and procedures for requesting the issue of NOTAMS, including the following:

a. Arrangements for reporting any changes to AIS, ATC and LYCAA, and recording the reporting of changes during and outside the normal hours of aerodrome operations;

b. The names and roles of persons responsible for notifying the changes, their telephone numbers during and outside the normal hours of aerodrome operations, and their email addresses;

c. The address and telephone numbers, as provided by the AIS and LYCAA of the place where changes are to be reported to the AIS and LYCAA;

d. The arrangements for removal from service of any part of the maneuvering area, including the decision making and notification processes.

12.4.2. Access to the aerodrome movement area

An aerodrome operator shall include in the aerodrome manual particulars of the procedures that have been developed and are to be followed in coordination with the agency responsible for preventing unlawful interference in Civil Aviation at the aerodrome and for preventing unauthorized entry of persons, vehicles, equipment, animals and other things into the movement area including the following:

a. The role of the aerodrome operator, the aircraft operator, aerodrome fixed-base operators, the aerodrome security entity, the ATS provider, LYCAA and other government departments as applicable.

b. The names and roles of the personnel responsible for controlling access to the aerodrome, and the telephone numbers for contacting them during and after working hours, and their email addresses.

12.4.3. Aerodrome Emergency Plan (AEP)

An aerodrome operator shall establish an airport emergency plan commensurate with the aircraft operations and other activities conducted at the aerodrome, and include, in an aerodrome manual, particulars to be contained in the emergency plan, including:

1. Plans for dealing with emergencies providing for the coordination of the actions to be taken in an emergency occurring at the aerodrome or in its vicinity.
2. Contents and/or index
3. Amendment record page
4. Amendment procedure
5. Abbreviations, glossary
6. Bibliography/references
7. Distribution list
8. Aerodrome emergency committee

9. Agencies familiarity with other agencies ‘duties
10. Mutual aid agreements with the surrounding community covering initial response and subsequent support to coordinate the response or participation of all existing agencies which, in the opinion of the LYCAA, could be of assistance in responding to an emergency.
11. Aircraft accident on airport
12. Aircraft accident off airport – on land
13. Aircraft accident off airport – on water
14. Aircraft Incident aircraft in flight
15. Aircraft Incident aircraft on the ground
16. Aircraft Incident - sabotage, bomb threat
17. Aircraft Incident – unlawful seizure
18. Aircraft public health
19. Non aircraft fire – structural
20. Natural disaster
21. Emergency at airports boarding water area
22. Occurrences involving dangerous goods
23. Medical emergencies
24. Compound emergency: aircraft/structure
25. Compound emergency: aircraft/fueling facilities
26. Compound emergency: aircraft/aircraft
27. Classification of emergencies: aircraft accident
28. Classification of emergencies: full emergency
29. Classification of emergencies: local standby
30. Precautions for weather induced physical problems: victims
31. Precautions for weather induced physical problems: emergency personnel
32. Command, communication & coordination functions for execution of the plan
33. A list of responding organizations, agencies and persons, both on- and off-airport, for site roles, their telephone and facsimile numbers, e-mail, and the radio frequencies.
34. Incidents on the airport covering "during the emergency" considerations, e.g., agency responsible depending on location, developing phases

(investigation - accident/criminal), advance notification of all agencies ‘roles, responsibilities, and reporting structure.

35. Incidents on the airport covering "after the emergency" considerations; e.g., transition of LYCAA, legal factors, restoration of services, public protection
36. Emergency operations center
37. Mobile command post
38. The appointment of an on-scene commander for the overall emergency operation.
39. Triage principles planned
40. Grid map of the aerodrome and its immediate vicinity
41. Care of fatalities
42. Means of communication with both on aerodrome and external emergency and support services.
43. Procedures for preservation of evidence for accident investigation, after immediate actions for preservation of life are completed.
44. Means of communication with flight crew using frequency 121.600MHz, or other frequency as may be approved by LYCAA
45. Procedures for dealing with hazardous materials, including cargo and man-made mineral fibers in aircraft construction
46. Procedures for debriefing and record keeping after every incident
47. Coordination with rescue coordination center
48. Human factors principles to ensure optimum response

12.4.4. Rescue & Fire Fighting

An aerodrome operator shall include, in an aerodrome manual, particulars of the facilities, equipment, personnel and procedures, for meeting the rescue and fire-fighting requirements including:

1. The level of protection provided, expressed in terms of the category of the rescue and fire- fighting services, which shall be in accordance with the longest airplane normally using the aerodrome and the type and amounts of extinguishing agents normally available at the aerodrome.
2. RFFS policy including the aerodrome operator's policy regarding level of protection to be provided at different levels of air traffic, training, manning and operating standards.
3. The names and roles of the persons responsible for dealing with the rescue and firefighting services at the aerodrome.

4. Procedures for assessing the RFF category, including vehicles, media, complimentary media, equipment and manpower.
5. Details of RFFS vehicles and equipment, and policy in the event of equipment failure.
6. Procedures for RFFS medical and physical fitness, and competence training and assessment.
7. Details of tests for aerodrome facilities and equipment to be used in emergencies, including the frequency of those tests.
8. Details of exercises to test emergency plans, including the frequency of those exercises; full scale emergency exercise, not exceeding 2-year interval.
9. Details of exercises to test emergency plans, including the frequency of those exercises: partial emergency exercises in intervening year.
10. Details of exercises to test emergency plans, including the frequency of those exercises, intervening table top exercises.
11. Details of exercises to test emergency plans, including the frequency of those series of modular test commencing in the first year and concluding in a full-scale aerodrome emergency exercise at intervals not exceeding three years.

12.4.5. Inspection of the aerodrome movement area & obstacle limitation surface by the aerodrome operator

An aerodrome operator shall include, in an aerodrome manual, particulars of the procedures for the inspection of the aerodrome movement area and obstacle limitation surfaces, including the following:

a) Arrangements for carrying out inspections, including runway friction and water-depth measurements on runways and taxiways, during and outside the normal hours of aerodrome operations.

b) Arrangements and means of communicating with air traffic control during an inspection.

c) Arrangements for keeping an inspection record.

d) Details of inspection intervals and times.

e) Inspection checklist and appropriate proforma.

f) Arrangements for reporting the results of inspections and for taking prompt follow-up actions to ensure correction of unsafe conditions.

g) The names and roles of persons responsible for carrying out inspections and their telephone numbers during and after working hours, and their email addresses.

12.4.6. Visual aids and aerodrome electrical system

An aerodrome operator shall include, in the aerodrome manual, particulars of the procedures for the inspection and maintenance of aeronautical lights (including obstacle lighting), signs, markers, and aerodrome electrical systems, including the following:

a. Arrangements for carrying out inspections during and outside the normal hours of aerodrome operation, and the checklist for such inspections.

b. Arrangements for recording the result of inspections and for taking follow-up action to correct deficiencies.

c. Details of inspection schedule, type of inspection/calibration conducted.

d. Arrangements for carrying out routine maintenance and emergency maintenance.

e. Arrangements for electrical distribution system and secondary power supplies, if any, and, if applicable, the particulars of any other method of dealing with partial or total system failure including description of method of testing and frequency.

f. The names, roles and contact details of the person responsible for the inspection and maintenance of lighting during and after working hours for airfield lighting.

g. The performance level objectives of the maintenance program for different types of lighting.

h. Arrangements for conducting photometric test for Aeronautical lights.

i. A single line diagram showing as built of electrical system.

j. Description of airfield ground lighting at the aerodrome, including VDGS if applicable.

12.4.7. Maintenance of the movement area

An aerodrome operator shall include, in the aerodrome manual, particulars of the facilities and procedures for the maintenance of the movement area including:

a. Arrangements for maintaining the paved areas.

b. Arrangements for maintaining the unpaved runways and taxi ways.

c. Arrangements for maintaining the runway and taxi way strips and RESA.

d. Arrangements for the maintenance of aerodrome drainage.

e. Arrangements for friction test.

f. Arrangement for de-rubberization.

12.4.8. Aerodrome works - safety

An aerodrome operator shall include, in the aerodrome manual, particulars of the procedures for planning and carrying out construction and maintenance work safety (including work that may have been carried out at short notice) on or in the vicinity of the movement area which may extend above an obstacle limitation surface, including the following:

a. Arrangements for communicating with air traffic control during the progress of such work.

b. The names, telephone numbers, email addresses and roles of the persons and organizations responsible for planning and carrying out the work, and arrangements for contacting those persons and organizations at all times.

c. The names, telephone numbers, during and after working hours, and email addresses of the aerodrome fixed-base operators, ground handling agents and aircraft operators who are to be notified of the work.

d. A distribution list, and method of distribution for work plans, if required.

12.4.9. Apron management

An aerodrome operator shall include, in an aerodrome manual, particulars on the apron management procedures, including the following:

a. Arrangements between air traffic control and the apron management unit.

b. Arrangements for allocating aircraft parking positions.

c. Arrangements for initiating engine start.

d. Arrangements for ensuring clearance of aircraft push-back.

e. Arrangements for engine test.

f. Description of geographical area of responsibility, i.e., point of transfer of control of aircraft between aerodrome air traffic unit and Apron Management Service/Unit if applicable.

12.4.10. Apron safety management

An aerodrome operator shall include, in the aerodrome manual, particular on the apron safety management procedures, including the following:

a) Marshalling service, or other stand guidance equipment and/or procedures.

b) Leader/follow me service.

c) Protection from jet blasts.

d) Enforcement of safety precautions during aircraft refueling operations.

e) Apron sweeping.

f) Apron cleaning.

g) Arrangements for reporting incidents and accidents on an apron.

h) Arrangements for auditing the safety compliance of all personnel working on the apron.

12.4.11. Airside vehicle control

An aerodrome operator shall include, in the aerodrome manual, particulars of the procedures for the control of surface vehicles on or in the vicinity of the movement area, including the following:

a. Details of the applicable traffic rules (including speed limits and the means of enforcing the rules).

b. The method of issuing driving permits for operating vehicles in the movement area.

c. The method of issuing vehicle permits for vehicles in the movement area.

12.4.12. Wildlife hazard management

An aerodrome operator shall include the following in an aerodrome manual:

a. Arrangements for assessing wildlife hazards.

b. Arrangements for implementing wildlife control programs.

c. The names and roles of the persons responsible for dealing with wildlife hazards, and their telephone numbers during and after working hours and their email addresses.

12.4.13. Obstacle control

An aerodrome operator shall include, in the aerodrome manual, particulars setting out the procedures for:

a. Monitoring the obstacle limitation surfaces and Type A Chart for obstacles in the take-off surface.

b. Controlling obstacles within the authority of the operator.

c. Monitoring the height of buildings or structures within the boundaries of the obstacle limitation surfaces.

d. Controlling new developments in the vicinity of aerodromes.

e. Notifying the AIS of the nature and location of obstacles and any subsequent addition or removal of obstacles for action as necessary, including amendment of the AIP publications.

12.4.14. Removal of disabled aircraft

An aerodrome operator shall include, in the aerodrome manual, particulars of the procedures for removing a disabled aircraft on or adjacent to the movement area, including the following:

a. The roles of the aerodrome operator and the holder of the aircraft operator.

b. Arrangements for notifying the aircraft operator.

c. Arrangements for liaising with the air traffic control unit.

d. Arrangements for obtaining equipment and personnel to remove the disabled aircraft.

e. The names, role, telephone numbers and email addresses of persons responsible for arranging for the removal of disabled aircraft.

f. The telephone/telex/numbers and e-mail address of the aerodrome coordinator for the removal of a disabled aircraft on or adjacent to the movement area.

g. Information on the capability to remove a disabled aircraft, expressed in terms of the largest type of aircraft which the aerodrome is equipped to remove.

h. Objectives for the disabled aircraft removal operation, including time to return a runway to normal operation.

12.4.15. Handling of hazardous material

An aerodrome operator shall include, in the aerodrome manual, particulars of the procedures for the safe handling and storage of hazardous materials on the aerodrome, including the following:

a. Arrangements for special areas on the aerodrome to be set up for the storage of flammable liquids (including aviation fuels) and any other hazardous materials.

b. The method to be followed for the delivery, storage, dispensing and handling of hazardous materials.

12.4.16. Low visibility operations

An aerodrome operator shall include the following in the aerodrome manual (if applicable):

a. Particulars of the procedures for the measurement and reporting of runway visual range as and when required.

b. Particulars of the aerodrome safety procedures including the alerting and ground operations involving people, vehicles, removal of unnecessary people from airside, physical check of lighting installations and warning devices such as signage.

c. The names and telephone numbers, during and after working hours, of the persons responsible for measuring the runway visual range.

12.4.17. Protection of sites for radar and navigational aids

An aerodrome operator shall include, in the aerodrome manual, particulars of the procedures for the protection of sites for radar and navigational aids located on the aerodrome to ensure that their performance will not be degraded, including the following:

a) Arrangements for the control of activities in the vicinity of radar, navaids, and communications installations.

b) Arrangements for ground and fence maintenance in the vicinity of these installations.

c) Arrangements for the supply and installation of signs warning of hazardous radiation and/or high voltage.

d) Arrangement for the removal of any vegetation/trees.

12.5. Aerodrome administration

12.5.1. An aerodrome operator shall include the following in the aerodrome manual:

a. An aerodrome organizational chart, approved by LYCAA, showing the names and positions of key personnel, including their responsibilities.

b. The name, position and telephone number of the person who has overall responsibility for aerodrome safety.

c. Name, chairman, terms of reference of airport committees, including:

1. Aerodrome emergency committee to organize training and other preparations for dealing with emergencies
2. Safety committee
3. Runway safety team
4. Airport security committee
5. Airport facilitation committee (if applicable).

12.5.2. Exemption(s) granted by LYCAA

An aerodrome operator shall include, in the aerodrome manual, particulars of the exemption(s) granted by the LYCAA to be incorporated for reference.

12.6. Aerodrome safety management system

An aerodrome operator shall include the following in the aerodrome safety management manual:

12.6.1. Safety policy and objectives including:

a. Management commitment and responsibility (Safety policy)

b. safety responsibilities of key safety personnel;

c. safety reporting procedures (including hazard reporting) and investigation;

d. documentation control procedures;

e. emergency response planning;

12.6.2. Safety risk management Process including:

a. Hazard identification procedure

b. Risk assessment and mitigation procedure

c. Review / reassessment procedure.

12.6.3. Safety assurance

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

b. safety performance monitoring;

c. the internal safety audit and review system detailing the systems and programs for quality control of safety;

d. management of change (including organizational changes with regard to safety responsibilities).

12.6.4. Safety promotion

1. Training and education

   a. staff training and competency, including the review and evaluation of the adequacy of training provided to staff on safety-related duties and of the certification system for testing their competency;

   b. measures for safety promotion and accident prevention and a system for risk control involving analysis and handling of accidents, incidents, complaints, defects, faults, discrepancies and failures, and continuing safety monitoring.

2. Safety Communication

   SMS implementation, including facilities, methods and procedures for the effective communication of safety messages and the enforcement of safety requirements.

Chapter 13. Certification of Training Organizations

13.1. Introduction

This chapter prescribes the certification and operating requirements for organizations providing training for aerodrome staff who are involved in aerodrome safety functions, whose competency requires approval by the LYCAA. These functions include, but are not limited to:

a. Rescue and firefighting service;

b. Aeronautical ground lighting installation, maintenance, and inspection;

c. Surface friction testing;

d. operations and oversight;

e. Marshalling;

f. Airside driving;

g. Accident and incident investigation;

h. Wildlife control.

13.2. Eligibility

To be eligible for Approved Training Center Certificate, the applicant shall meet the requirements of this Chapter to the satisfaction of the LYCAA and shall submit the following to the LYCAA:

a. A legal entity.

b. Valid insurance policy with an adequate amount to cover liability in case of accidents, in particular in respect to:

- The premises;
- Students; and
- Employees and Third party.

c. Ownership or lease agreement for building(s) and workshops appropriate for the safety function training applied for and the size of the potential operations. The building(s) must be constructed and established according to a standard acceptable to the authority and at least fulfils the adequate specification of the following aspects:

- Location. An applicant for, or holder of a training center certificate must have available exclusively, for adequate period of time and at a location approved by the authority.
- Separation. The building must be separated from other activities and shall be used only for the training purposes. The separation shall be adequate enough to assure limited accessibility to the concerned people, and protection against external intruders.

- Environment. The building must be designed and constructed to assure an appropriate learning environment to the students in regard to acceptable level of noise, pollution, heating, conditioning, lighting and ventilation.
- Safety. The building must be designed and constructed to ensure adequate safety relevant aspects such as fire escape, fire protection, and enough instruction in case of accidents.

d. Ownership and operational control for all tools and equipment appropriate to the safety function(s) applied for.

13.3. Application for certificate issuance or amendment

13.3.1. An application for a training certificate and training specifications under this Part shall:

a. Be made in a form and in a manner prescribed by LYCAA;

b. Be made at least 90 calendar days before the beginning of any proposed training or 60 calendar days before effecting an amendment to any approved training;

c. Provide the proposed curriculum;

d. Provide a description and a list of the facilities and materials to be used;

13.3.2. Each applicant for a training center and training specification shall provide:

a. A list of its qualified instructors, together with their curricula vitae;

b. A statement that the minimum qualification requirements for each instrument management position are met.

c. A statement acknowledging that the applicant shall notify the LYCAA within 30 days of any change made in the assignment of persons in the required management positions and instructors.

d. A description of a recordkeeping system that will identify and document the details of training, qualification, and certification of students and instructors.

e. A statement of the maximum number of students it expects to teach at any one time. The certificate holder must file an application to amend training center certificate at least 60 calendar days prior to the applicant's proposed effective amendment date.

13.4. Issue of and duration of certificate

An applicant who meets the requirements of this Part is entitled to:

a. An LYCAA training center certificate valid for a period of twenty-four months and shall include the business name, address of the certificate holder, and service for which the certificate holder may conduct training.

b. Training specifications and limitations issued by the authority to the certificate holder containing type of the training authorized including approved courses.

c. An application for the renewal of training center certificate shall be submitted to the LYCAA of not less than 60 days before the expiry date of the certificate.

d. The holder of a certificate that is surrendered, suspended, or revoked, shall return the certificate to the LYCAA within 5 working days after being notified that the certificate is suspended, revoked, or terminated.

13.5. Certification Requirements

Personnel requirements: an applicant for the grant of a training center certificate must employ, contract, or otherwise engage:

a. A senior person identified as the Chief Executive who must:

   1. Have the authority within the applicant organization to ensure that the organization's services can be financed and provided in accordance with the requirements and standards prescribed by this Part; and

   2. Be responsible for ensuring that the organization complies with the requirements of this Part; and

b. A senior person or persons, responsible to the Chief Executive for ensuring that the applicant organization complies with the organization exposition; and

c. sufficient personnel to plan, conduct, and supervise the training courses and assessments listed in the applicant exposition.

d. The applicant shall establish a procedure for initially assessing, and a procedure for maintaining, the competence of those personnel conducting the training courses and assessments listed in the applicant exposition.

13.6. Instructor requirements

13.6.1. An applicant for a Training Center or for an additional curriculum must provide the number of instructors holding appropriate qualifications and assessed by LYCAA as deemed necessary to provide adequate instruction and supervision of the students, including at least one such instructor for each 20 students in each training course. However, the applicant may provide specialized instructors, who are not certificated but who have suitable experience, to the satisfaction of the LYCAA. The applicant is required to maintain a list of the names and qualifications of specialized instructors, and upon request, provide a copy of the list to the Authority.

13.6.2. An applicant for a Training Center certificate must designate a chief instructor for each approved course of training who is qualified and competent to perform the duties to which that instructor is assigned, and must meet the instructor qualifications requirements. Instructor qualifications: Each person designated as an instructor shall meet the following requirements:

a. Hold a certificate in the field of specialty as appropriate;

b. Has minimum experience of at least five years in the field of specialty and/or rating competency for the approved course;

c. Instructional technique, by qualification and/or experience;

d. Show proficiency in the training procedures and equipment handling of the approved training course.

13.7. Facilities, equipment, and material requirements

An applicant for a Training Center certificate and training specifications or for an amendment of the approved curriculum must have such of the following properly heated, lighted, and ventilated facilities as are appropriate to the curriculum sought and as the authority determines are appropriate for the maximum number of students expected to be taught at any time:

a. An enclosed classroom suitable for teaching theory classes.

b. Suitable enclosed space for simulators, if applicable

c. Suitable quantities of technical equipment, if applicable, for trainees to gain hands-on training experience under supervision.

13.8. Documentation

13.8.1. An applicant for a Training Center certificate shall hold current copies of all relevant technical standards and practices and any other documentation that is necessary for the provision of the training courses and assessments listed in the applicant exposition.

13.8.2. The applicant shall establish procedures to control the documentation required by paragraph (a). The procedures shall ensure:

a. All documentation is reviewed and authorized by appropriate personnel before issue; and

b. Current issues of relevant documentation are available to personnel for the provision of training courses and assessments listed in their exposition; and

c. All obsolete documentation is promptly removed from all points of issue or use; and

d. Changes to documentation are reviewed and approved by appropriate personnel.

13.9. Operating Rules

A certificated training center shall:

a. Not require any student to attend classes of instruction more than eight hours in any day or more than five days or 40 hours in any seven-day period;

b. Give appropriate tests to each student who completes a unit of instructions as shown in that training center's curriculum;

c. Not graduate a student unless he has completed all of the appropriate curriculum requirements; and

d. Use an approved system for determining final course grades and for recording student attendance. The system must show hours of absence allowed and show how the missed material will be made available to the student.

A certificated training center shall not accept the application for enrolment nor a person shall enroll in a training center unless he/she meets the training center entry requirements in terms of academic ability, medical and physical fitness, and language, as applicable to the training.

13.10. Records

A certificated training center shall:

a. Keep a current record of each student enrolled, showing:

   1. Student attendance, tests and grades received on the subject required by this Part.

   2. The instruction credited to him; and

   3. The authenticated transcript of his grades from that training center.

b. It shall retain the record for at least five years after the end of the student's enrolment, and shall make each record available for inspection by the authority during that period.

c. Keep a current progress chart or individual progress record for each of its students, showing the practical projects completed by the student in each subject.

13.11. Transcripts and graduation certificates

A certificated training center shall:

a. Upon request, provide a transcript of student's grades to each student who has graduated from that training center or who leaves it before being graduated. An official of the training center shall authenticate the transcript. The transcript shall state the curriculum in which the student was enrolled, whether the student satisfactorily completed that curriculum or not, and the final grades the student received.

b. Give a graduation certificate or a certificate of completion to each student that he graduates. An official of the training center shall authenticate the certificate. The certificate shall show the date of graduation and the approved curriculum title.

13.12. Maintenance of instructor requirements

A certificated training center shall, after certification or additional curriculum, continue adhering to the instructor requirements specified in this Part-139.

13.13. Maintenance of facilities, equipment and material

A certificated training center shall:

a. After certification or additional curriculum, continue providing facilities, equipment and material equal to the standards currently required for the issue of the certification and curriculum that it holds.

b. Not make a substantial change in facilities, equipment or material that have been approved for a particular curriculum, unless that change is approved by the LYCAA in advance.

13.14. Maintenance of curriculum requirements

A certificated training center shall:

a. Adhere to its approved curriculum.

b. Not change its approved curriculum unless the change is approved by the LYCAA in advance.

13.15. Quality of Instruction

13.15.1. An applicant for training center certificate shall appoint a senior person who has the authority within the applicant's organization to ensure that all training courses and assessment conducted by the center can be carried out in accordance with the requirements prescribed by this Part-139.

13.15.2. A certificated training center shall provide instruction of such quality that the percentage of those passing the applicable LYCAA written exams, if applicable, on their first attempt during any period of 24 calendar months is not less than 70% of its graduates.

13.16. Display of certificate

Each holder of a training center certificate must display that certificate in a place that is normally accessible to public and is not obscured.

13.17. Change of location

The holder of a training center certificate shall not make any change in the center's location unless the change is approved in advance. If the holder desires to change the location, the holder shall notify the authority, in writing, at least 30 days before the date the change is contemplated. If the holder changes the location without approval, the certificate is considered revoked.

13.18. Audit and Inspection

LYCAA may at any time, inspect a certificated training center to determine its compliance with this part to determine if the center continues to meet the requirements under which it was originally certificated. After each audit or inspection, the center shall be notified in writing of any deficiencies found during the inspection.

13.19. Advertising

13.19.1. A certificated training center shall not make any statement relating to itself that is false or is designed to mislead any person considering enrolment therein.

13.19.2. Whenever a training center indicates in advertising that it is a certificated center, it shall clearly distinguish between its approved courses and those that are not approved.

13.19.3. A certificate holder whose certificate has been surrendered, suspended, revoked, or terminated must:

1. Promptly remove all indications, including signs, wherever located, that the training center was certificated by the LYCAA;
2. Promptly cease all advertising indicating that the training center is certificated by the LYCAA.

Acceptable Means of Compliance & Guidance Material (AMC & GM)

A. AMC & GM on personnel requirements

1. Nominated Persons

1.1. Acceptance from LYCAA will be required for all persons nominated as Post Holders.

1.2. LYCAA acceptance of nominated Post Holders is based on the applicable Assessment Criteria in Tables App 6-1 through 6-6 and the applicant's demonstration of knowledge of the applicable regulations and an understanding of the proposed position.

1.3. Selection of the Post Holder is the responsibility of the applicable Aerodrome Operator. Regulation and Guidance Material aims to assist Aerodrome Operators to be satisfied that persons within the management structure possess the relevant operational safety competence, and be able to identify any gaps that may exist in the areas of competence for their particular aerodrome. The size, complexity and scale of operations of an aerodrome will be a component of the Operator's assessment process. The detailed scope of Post Holders accountabilities and responsibilities are likely to be affected by this assessment, which shall be aligned with the aerodrome's SMS.

1.4. Regulation includes specific roles for which Post Holder acceptance by LYCAA will be required. However, while the specific job title designations for the posts may differ, the scope shall include the accountabilities and responsibilities as stated in the regulation.

1.5. Cases for interviews with nominated Post Holders include the following:

a. start of operations before issuing the first Aerodrome Certificate; or

b. change of Post Holders at a Certified Aerodrome.

1.6. Purpose of the interview between LYCAA and the nominated Post Holder is as follows:

a. exchange of information between the intended nominated persons and the Authority for the latter to acquire information on the intended work areas and the applicant's competence level so as to verify their suitability for the post(s); and

b. to create good contact and understanding between the both parties, and to come to a mutual conclusion on, if necessary, possible solutions for training and personal development over time.

c. The LYCAA process in acceptance of Post Holders is based on the applicant demonstrating knowledge of the applicable regulations, having an understanding of the role applied for and of the standards required by LYCAA. The process includes a review of the submitted details to determine the suitability of the person for the role.

2. Competence of Personnel

Note: With focus on the competency of Post Holders, assessment criteria, as included in Tables 1 through 6, have been designed.

2.1. Determination of Personnel Needs and Qualifications (Reference: Chapter 11, paragraph 11.17.8)

a. The Aerodrome Operator shall determine the number of required personnel for the planned tasks.

b. The Aerodrome Operator shall determine the required personnel qualifications, in accordance with the applicable requirements. A documented system with defined responsibilities shall be in place, in order to identify any need for changes with regard to personnel qualifications.

c. Documentation shall define the method by which staffing levels are determined in relation to the operation, maintenance and management of the aerodrome.

d. Documentation shall define the training requirements and training program to ensure that personnel are adequately trained.

e. Procedures shall include the mechanisms that ensure only trained and competent personnel undertake the planned tasks and activities assigned to them.

2.2. Distribution of Rules and Procedures (Reference: Chapter 11, paragraph 11.17.8)

The Aerodrome Operator shall have a system in place to distribute the rules and procedures to personnel to enable them to exercise their duties and responsibilities safely and effectively.

2.3. Gap Analysis: Personnel Requirements (Reference: Chapter 11, paragraph 11.17.8)

The Aerodrome Operator shall conduct gap analysis in order to provide an assessment and demonstration of the following:

a. That the Aerodrome Operator has a sufficient number of qualified personnel for the planned tasks and activities being performed.

b. That there are a sufficient number of supervisors assigned to defined duties and responsibilities, taking into account the structure of the organization and the number of personnel employed.

c. Those personnel involved in the operation, maintenance and management of the aerodrome are adequately trained in accordance with the organization's training program.

2.4. Gap Analysis: Minimum Number of Personnel, Personnel Requirements and Training Needs Analysis

a. A gap analysis shall be used as a tool to compare existing operations with the requirement to provide sufficient numbers of trained personnel appropriate for the scale and complexity of the aerodrome and its operations.

b. As part of the gap analysis process, each assessment shall refer to the following categorization of “High” “Medium” or “Low” in relation to the scale, complexity and demands of the operation and for the provision of a dedicated aerodrome operations team:

High	- One or more runways - Complex in nature - Significant developments - Instrument runway - Traffic density of ATS unit: high / medium	Dedicated operations team No extraneous or ancillary duties (Other than AEP response tasks)
Medium	- One runway - Instrument runway - Traffic density of ATS unit: medium	Dedicated operations team Extraneous or ancillary duties allowable under assessment (Other than AEP response tasks)
Low	- One runway - Non-instrument runway - No shift patterns - Traffic density of ATS unit: low	Option to have a multi-tasked team allowable under assessment

c. Once the gap analysis has been completed and fully documented, the staffing levels, resources and processes that have been identified as missing or inadequate will form the basis for an implementation plan, in order to become compliant with the regulations.

d. An example of elements to consider for the gap analysis, as part of the aerodrome Safety Management System process, is as follows:

i. Aerodrome inspection requirements appropriate to the operational use of runway(s) and taxiways;

ii. Complexity of aerodrome layout, for example:

- Scale of aerodrome (geographical)
- Scale of aerodrome (number of runways and taxiways)
- Scale of aerodrome (number of aprons and stands);

iii. complexity of operations i.e., CAT I, CAT II, CAT III, number of runways, movement rates;

iv. Low visibility operations;

v. Day and night use;

vi. Duty hours for operational staff with reference to the following list:

- Compliance with the maximum allowable working hours as defined within the Libyan Labor Law;
- Sufficient break periods / rest-time;

- An awareness of the problematic fatigue issues relating to the circadian body clock, to ensure so far as is reasonably possible, fatigue does not impair operational safety;
- Environmental factors, such as extensive time spent in warm and hot weather conditions;
- Operational duties required (day);
- Operational duties required (night);
- Handover time;
- Shift patterns;
- Maximum consecutive hours for both day and night duties (not exceeded); and
- Maximum numbers of night duties worked in immediate succession (i.e., four);

vii. The number and complexity of aerodrome development projects – inspections and oversight of contractors;

viii. Aerodrome operations procedural requirements and activities, for example:

- Aerodrome inspection requirements;
- Marshaling duties;
- Wildlife hazard control duties;
- FOD management duties;
- Follow-me requirements;
- Fuel management; and
- Control and management of aeronautical data;

ix. Pavement maintenance, duties and inspections;

x. Visual aids maintenance (signs, markings and markers), duties and inspections;

xi. AGL maintenance, duties and inspections;

xii. Allowance for annual leave, public holidays (in lieu), training, OJT training, special leave and sickness; and

xiii. Sufficient operational administrative support staff (the number of support staff will depend on the complexity of the operations).

2.5. Qualification of Personnel (Reference: Chapter 11 - 11.17.8)

a) The term 'qualified' denotes fitness or fit for the purpose. This may be achieved through fulfillment of the necessary conditions such as completion of required training, or acquisition of a diploma or degree, or through the gaining of suitable experience. It, also, includes the ability, capacity, knowledge or skill that matches or suits an occupation, or makes someone eligible for a duty, office, position, privilege or status.

b) Certain posts may, by nature, be associated with the possession of certain qualifications in a specific field (e.g., rescue and firefighting, civil, mechanical or electrical engineering, wildlife biology, etc.). In such cases, the person occupying such a post is expected to possess the necessary qualifications.

Table 1. Assessment Criteria for Accountable Manager

Performance Criteria
Full control of the human resources required for the operations authorized to be conducted under the Aerodrome Certificate.
- Full control of the technical resources required for the operations authorized to be conducted under the Aerodrome Certificate; - Final authority over operations authorized to be conducted under the Aerodrome Certificate; - Ultimate responsibility and accountability for the establishment, implementation and maintenance of the Safety Management System; - Ultimate responsibility and accountability for the establishment, implementation and maintenance of the safety policies and the authority and accountability for communication and promotion of the safety policy; - Authority and accountability for establishment of the organization's safety objectives and safety targets; - Ultimate responsibility and accountability for the resolution of all safety issues Authority and accountability for establishment, implementation and maintenance of the organization's competence to learn from the analysis of data collected through its safety reporting system and others Safety Data Collection and Processes Systems (SDCPS) in place; and - Authority and accountability for establishment of a just culture which encourages safety reporting.
Knowledge Criteria
- Knowledge and understanding of the documents that prescribe relevant aerodrome safety standards; - Understanding of the requirements for competence of aerodrome management personnel so as to ensure that competent persons are in place; - Knowledge and understanding of safety, quality, and security management systems related principles and practices, and how these are applied within the organization; - Knowledge and understanding of the key issues of risk management within the aerodrome; - LYCAA regulatory framework; - LYCAA State Safety Program and Aerodrome SMS; - LYCAA Aerodrome Certification Process; - LYCAA Regulatory Oversight Process; - LYCAA Enforcement Process.
Supporting Documents
- Curriculum Vitae, Job Description and proof of relevant Training and Qualifications - Other relevant documents if requested by LYCAA

Table 2. Assessment Criteria for Aerodrome Post Holder: Aerodrome Safety

Performance Criteria
- Responsible individual and focal point for the development and maintenance of an effective Safety Management System; - Ensure that processes needed for the SMS are established, implemented and maintained; - Reporting directly to the Accountable Manager on the performance of the SMS and on any need for improvement; - Ensure safety promotion throughout the organization; - The role of Aerodrome safety Shall include but are not limited to: o managing the SMS implementation; o performing/facilitating hazard identification and safety risk analysis; o monitoring corrective actions and evaluating their results; o providing periodic reports on the organization's safety performance; o maintaining records and safety documentation; o planning and facilitating staff safety training; o providing independent advice on safety matters; o monitoring safety concerns in the aviation industry and their perceived impact on the organization's operations aimed at service delivery; o monitoring those processes for safety data collection, such as safety reporting and other safety data collection methods, are established and implemented; and o advising the Safety Review Board on safety issues. - Ensure that the safety assurance processes are developed in a documented continuous monitoring audit approach.
Knowledge Criteria
- Educated, trained and experienced in safety management; - Comprehensive Knowledge of the Aerodrome / SMS Manual; - Technical background to understand the systems that support operations; - LYCAA Regulatory framework; - LYCAA State Safety Program / Aerodrome SMS; - LYCAA Aerodrome Certification Process; - LYCAA Regulatory Oversight Process; - LYCAA Enforcement Process.
Supporting Documents
- Curriculum Vitae, Job Description and proof of relevant Training and Qualifications - Other relevant documents if requested by LYCAA.

Table 3. Assessment Criteria for Post Holder: Aerodrome Operations

Performance Criteria
- Ensure that aerodrome certification requirements are met, and that the aerodrome operates in accordance with certificate conditions and regulatory requirements; - Responsible for day-to-day aerodrome operations; - Ensure an understanding by the aerodrome management of the certification requirement for and status of the Aerodrome Manual; - Ensure basic understanding of aerodrome bird and wildlife hazard management program; - Responsible for the management of the operational services of the aerodrome; - Analyze auditing findings and inspections, and initiate actions; - Use feedback from auditing and inspections to recommend appropriate changes to airside safety management procedures and ensure implementation; - Monitor airside planning and development for compliance; and - Develop proactive working relationships with aerodrome users.
Knowledge Criteria
- Educated, trained and experienced in safety management; - Practical experience and expertise in aerodrome operations or maintenance (or similar area) respectively; - Comprehensive knowledge of the applicable requirements in the area of aerodromes; - Appropriate level of knowledge of safety management; - Comprehensive knowledge of the Aerodrome / SMS Manual; - LYCAA Regulatory Framework; - LYCAA State Safety Program / SMS; and - LYCAA Enforcement Process.
Supporting Documents
- Curriculum Vitae, Job Description and proof of relevant Training and Qualifications; - Other relevant documents if requested by LYCAA.

Table 4. Assessment Criteria for Post Holder: Aerodrome Maintenance

Performance Criteria
- Ensure that aerodrome certificating requirements are met, and that the aerodrome facilities are accurately reported (Aerodrome Manual/AIP) and in accordance with the regulatory requirements; - Ensure aerodrome facilities are compatible with sizes, types and frequency of aircraft in accordance with company and legislative requirements; - Ensure that maintenance policies, procedures and training fulfil the aims of the aerodrome and meet regulatory requirements; - Ensure understanding of regulatory requirements specific to electrical systems; - Ensure understanding of regulatory requirements specific to aeronautical ground lighting and other visual aids such as markings; - Ensure understanding of regulatory requirements specific to aerodrome pavements; - Ensure understanding of role as related to aerodrome reporting systems to include hazard identification, defect identification and reporting of safety critical information to the aerodrome Air Traffic Service Unit; - Ensure understanding of requirement for corrective and preventive maintenance program; and - Ensure understanding of competency standards and evaluation program for maintenance staff maintaining safety critical assets or working in safety critical areas (including both technical and operational competencies as necessary).
Knowledge Criteria
- Educated, trained and experienced in safety management; - Qualified in the role with appropriate education, experience and/or certification; - Practical experience and expertise in aerodrome maintenance; - Comprehensive knowledge of the applicable requirements in the areas of electrical systems, aeronautical ground lighting and pavements; - Comprehensive knowledge of the Aerodrome / SMS Manual; - Knowledge of applicable ICAO guidance materials such as Aerodrome Design Manual; - LYCAA Regulatory framework; - LYCAA State Safety Program / Aerodrome SMS; and - LYCAA Enforcement Process.
Supporting Documents
- Curriculum Vitae, Job Description and proof of relevant Training and Qualifications. - Other relevant documents if requested by the LYCAA.

Table 5. Assessment Criteria for Post Holder: Rescue Firefighting Services

Performance Criteria
- Ensure that aerodrome certificating requirements are met, and that the aerodrome operates in accordance with the regulatory requirements in the provision of RFF; - Ensure emergency fire and rescue facilities are compatible with sizes, types and frequency of aircraft in accordance with company and legislative requirements; - Ensure that rescue and firefighting, polices, procedures and training fulfil the aims of the aerodrome and meet regulatory requirements; - Ensure that procedures for auditing driver training programs are to established standards - Ensure the use of communication protocols and procedures is in accordance with regulations; - Assess the feasibility of continuing aerodrome operations in an emergency situation; - Ensure appliances and equipment meet all regulatory requirements; and - Establish an effective Incident Command & Control System.
Knowledge Criteria
- Educated, trained and experienced in safety management; - Qualified in the role with appropriate education, experience and/or certification; - Practical experience and expertise in aerodrome RFF; - Comprehensive knowledge of the applicable requirements in the areas of RFF, emergency and aerodromes; - Comprehensive Knowledge of the Aerodrome / SMS Manual; - LYCAA Regulatory framework; - LYCAA State Safety Program / Aerodrome SMS; - LYCAA Enforcement Process; and - LYCAA Process for the reporting and follow-up of accidents, incidents and emergencies on the aerodrome.
Supporting Documents
- Curriculum Vitae, Job Description and proof of relevant Training and qualifications; - Other relevant documents if requested by the LYCAA.

Table 6. Assessment Criteria for Post Holder: Aerodrome compliance

Performance Criteria
- Reportable directly to the Accountable Manager on matters affecting the aerodrome compliance in accordance with regulations; - Develop strategic plan to ensure that airports maintain the required compliance and service standards including maintenance of aerodrome manual in accordance with Part-139; - Develop and document a structured internal and external compliance monitoring program and establish systems for continuous review and improvement; - Promote safety management culture for airside operations by conducting regular audits and inspections; - Assure the implementation of the aerodrome change management process for all changes affecting the aerodrome; - Oversee and follow-up on the compliance monitoring audit schedule; - Report to management on levels of compliance and/or any issues arising from specific monitoring activities; - To ensure an internal safety audit program is implemented to audit the Aerodrome Operator’s organization for conformity with the procedures in its Aerodrome / SMS Manual and associated documentation and achievement of the goals set in its safety policy; and - To ensure preventive actions that have been identified within the system are remedied.
Knowledge Criteria
- Educated, trained and experienced in safety and quality management; - Comprehensive knowledge of the Aerodrome / SMS Manual; - Technical background to understand the systems that support operation; - LYCAA Regulatory framework; - LYCAA State Safety Program / Aerodrome SMS; - LYCAA Aerodrome Certification Process; - LYCAA Regulatory Oversight Process; and - LYCAA Enforcement Process.
Supporting Documents
- Curriculum Vitae, Job Description and proof of relevant Training and qualifications; - Other relevant documents, if requested by the LYCAA.

B. AMC & GM to Part-139 Volume 1

1. Number, siting and orientation of runways

1.1. Siting and orientation of runways

Many factors shall be taken into account in the determination of the siting and orientation of runways. Without attempting to provide an exhaustive list of these factors nor an analysis of their effects, it appears useful to indicate those which most frequently require study. These factors may be classified under four headings:

1.1.1 Type of operation

Attention shall be paid in particular to whether the aerodrome is to be used in all meteorological conditions or only in visual meteorological conditions, and whether it is intended for use by day and night or only by day.

1.1.2 Climatological conditions

A study of the wind distribution shall be made to determine the usability factor. In this regard, the following comments shall be taken into account:

Wind statistics used for the calculation of the usability factor are normally available in ranges of speed and direction, and the accuracy of the results obtained depends, to a large extent, on the assumed distribution of observations within these ranges. In the absence of any sure information as to the true distribution, it is usual to assume a uniform distribution since, in relation to the most favorable runway orientations, this generally results in a slightly conservative usability factor.

The maximum mean crosswind components given in Chapter 3, 3.1.3, refer to normal circumstances. There are some factors which may require that a reduction of those maximum values be taken into account at a particular aerodrome. These include:

a. The wide variations which may exist, in handling characteristics and maximum permissible crosswind components, among diverse types of airplanes (including future types) within each of the three groups given in 3.1.3;

b. Prevalence and nature of gusts;

c. Prevalence and nature of turbulence;

d. The availability of a secondary runway;

e. The width of runways;

f. The runway surface conditions - water on the runway materially reduce the allowable crosswind component; and

g. The strength of the wind associated with the limiting crosswind component.

A study shall also be made of the occurrence of poor visibility and/or low cloud base. Account shall be taken of their frequency as well as the accompanying wind direction and speed.

1.1.3 Topography of the aerodrome site, its approaches, and surroundings, particularly:

a. Compliance with the obstacle limitation surfaces;

b. Current and future land use. The orientation and layout shall be selected so as to protect as far as possible the particularly sensitive areas such as residential, school and hospital zones from the discomfort caused by aircraft noise;

c. Detailed information on this topic is provided in the Airport Planning Manual (Doc 9184), Part 2, and in Guidance on the Balanced Approach to Aircraft Noise Management (Doc 9829);

d. Current and future runway lengths to be provided;

e. Construction costs; and

f. Possibility of installing suitable non-visual and visual aids for approach-to-land.

1.1.4 Air traffic in the vicinity of the aerodrome, particularly:

a. Proximity of other aerodromes or ATS routes;

b. Traffic density; and

c. Air traffic control and missed approach procedures.

1.2. Number of runways in each direction:

The number of runways to be provided in each direction depends on the number of aircraft movements to be catered to.

2. Clearways and stopways

2.1. The decision to provide a stopway and/or a clearway as an alternative to an increased length of runway will depend on the physical characteristics of the area beyond the runway end, and on the operating performance requirements of the prospective airplanes. The runway, stopway and clearway lengths to be provided are determined by the airplane take-off performance, but a check shall also be made of the landing distance required by the airplanes using the runway to ensure that adequate runway length is provided for landing. The length of a clearway, however, cannot exceed half the length of take-off run available.

2.2. The airplane performance operating limitations require a length which is enough to ensure that the airplane can, after starting a take-off, either be brought safely to a stop or complete the take-off safely. For the purpose of discussion, it is supposed that the runway, stopway and clearway lengths provided at the aerodrome are only just adequate for the airplane requiring the longest take-off and accelerate-stop distances, taking into account its take-off mass, runway characteristics and ambient atmospheric conditions. Under these circumstances there is, for each take-off, a speed, called the decision speed; below this speed, the take-off must be abandoned if an engine fails, while above it the take-off must be completed. A very long take-off run and take-off distance would be required to complete a take-off when an engine fails before the decision speed is reached, because of the insufficient speed and the reduced power available. There would be no difficulty in stopping in the remaining accelerate-stop distance available provided action is taken immediately. In these circumstances the correct course of action would be to abandon the take-off.

2.3. On the other hand, if an engine fails after the decision speed is reached, the airplane will have sufficient speed and power available to complete the take-off safely in the remaining take-off distance available. However, because of the high speed, there would be difficulty in stopping the airplane in the remaining accelerate-stop distance available.

2.4. The decision speed is not a fixed speed for any airplane, but can be selected by the pilot within limits to suit the accelerate-stop and take-off distance available, airplane take-off mass, runway characteristics and ambient atmospheric conditions at the aerodrome. Normally, a higher decision speed is selected as the accelerate-stop distance available increases.

2.5. A variety of combinations of accelerate-stop distances required and take-off distances required can be obtained to accommodate a particular airplane, taking into account the airplane take-off mass, runway characteristics, and ambient atmospheric conditions. Each combination requires its particular length of take-off run.

2.6. The most familiar case is where the decision speed is such that the take-off distance required is equal to the accelerate-stop distance required; this value is known as the balanced field length. Where stopway and clearway are not provided, these distances are both equal to the runway length. However, if landing distance is for the moment ignored, runway is not essential for the whole of the balanced field length, as the take-off run required is, of course, less than the balanced field length. The balanced field length can, therefore, be provided by a runway supplemented by an equal length of clearway and stopway, instead of wholly as a runway. If the runway is used for take-off in both directions, an equal length of clearway and stopway has to be provided at each runway end. The saving in runway length is, therefore, bought at the cost of a greater overall length.

2.7. In case economic considerations preclude the provision of stopway and, as a result, only runway and clearway are to be provided, the runway length (neglecting landing requirements) shall be equal to the accelerate-stop distance required or the take-off run required, whichever is the greater. The take-off distance available will be the length of the runway plus the length of clearway.

2.8. The minimum runway length and the maximum stopway or clearway length to be provided may be determined as follows, from the data in the airplane flight manual for the airplane considered to be critical from the viewpoint of runway length requirements:

a. If a stopway is economically possible, the lengths to be provided are those for the balanced field length. The runway length is the take-off run required or the landing distance required, whichever is the greater. If the accelerate-stop distance required is greater than the runway length so determined, the excess may be provided as stopway, usually at each end of the runway. In addition, a clearway of the same length as the stopway must also be provided;

b. If a stopway is not to be provided, the runway length is the landing distance required, or if it is greater, the accelerate-stop distance required, which corresponds to the lowest practical value of the decision speed. The excess of the take-off distance required over the runway length may be provided as clearway, usually at each end of the runway.

2.9. In addition to the above consideration, the concept of clearways in certain circumstances can be applied to a situation where the take-off distance required for all engines operating exceeds that required for the engine failure case.

2.10. The economy of a stopway can be entirely lost if, after each usage, it must be regraded and compacted. Therefore, it shall be designed to withstand at least a certain number of loadings of the airplane which the stopway is intended to serve without inducing structural damage to the airplane.

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 shall normally be equal to the length of the runway, as shown in Figure A-1 (A).

3.3. Where a runway is provided with a clearway (CWY), then the TODA will include the length of clearway, as shown in Figure A-1 (B).

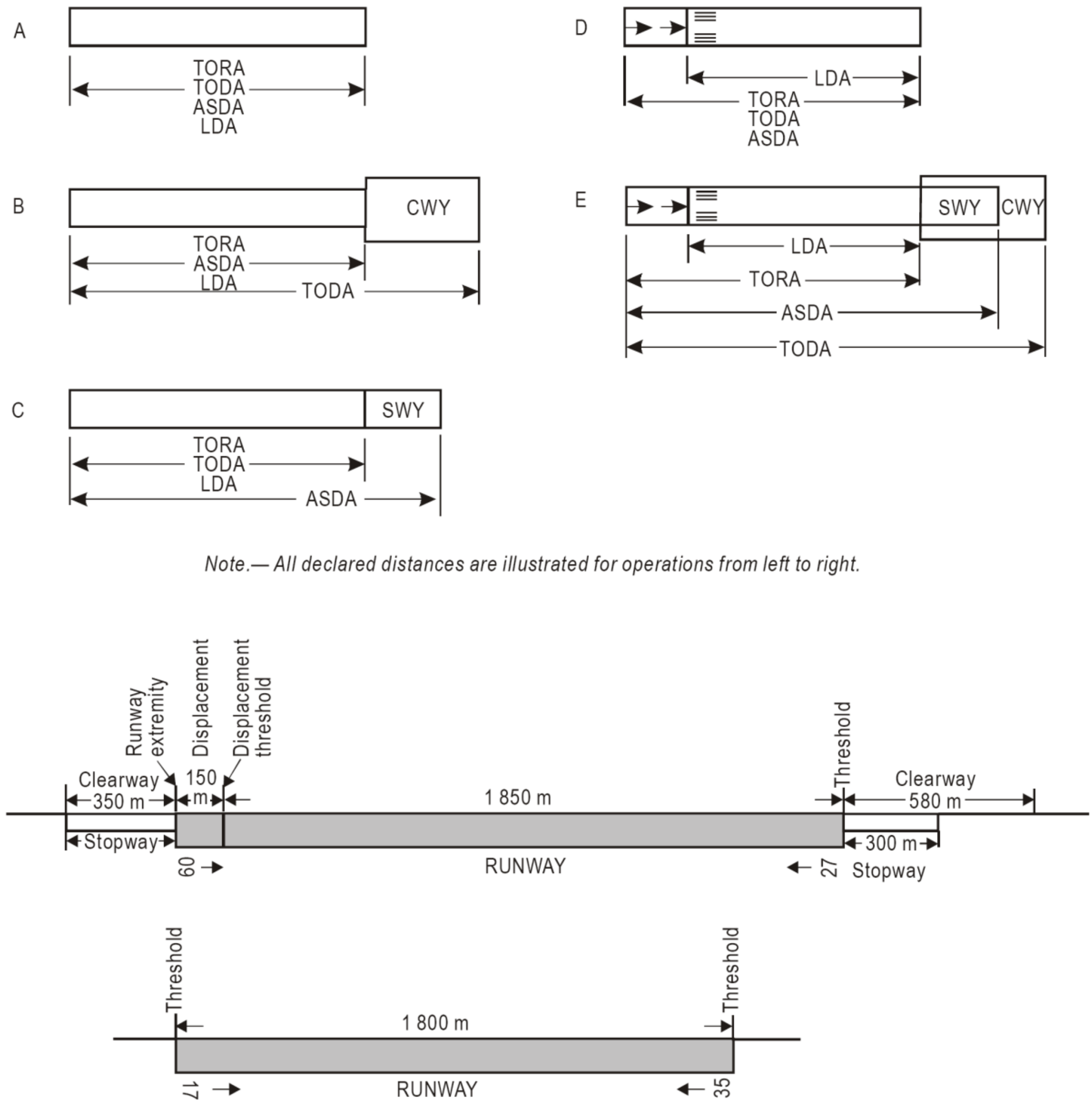
3.4. Where a runway is provided with a stopway (SWY), then the ASDA will include the length of stopway, as shown in Figure A-1 (C).

3.5. Where a runway has a displaced threshold, then the LDA will be reduced by the distance the threshold is displaced, as shown in Figure A-1 (D). A displaced threshold affects only the LDA for approaches made to that threshold; all declared distances for operations in the reciprocal direction are unaffected.

3.6. Figures A-1 (B) through A-1 (D) illustrate a runway provided with a clearway or a stopway or having a displaced threshold. Where more than one of these features exist, then more than one of the declared distances will be modified - but the modification will follow the same principle illustrated. An example showing a situation where all these features exist is shown in Figure A-1 (E).

3.7. A suggested format for providing information on declared distances is given in Figure A-1. If a runway direction cannot be used for take-off or landing, or both, because it is operationally forbidden, then this shall be declared and the words “not usable” or the abbreviation “NU” entered.

3.8. When intersection take-offs are performed, the datum line from which the reduced runway declared distances for take-off are determined, shall be defined by the intersection of the downwind edge.



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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

4. Slopes on a runway

4.1. Distance between slope changes

The following example illustrates how the distance between slope changes is to be determined (see Figure A-2):

D for a runway where the code number is 3 shall be at least:

15 000 (|x – y| + |y – z|) m

|x – y| being the absolute numerical value of x – y

|y – z| being the absolute numerical value of y – z

Assuming x = +0.01

y = –0.005

z = +0.005

Then |x – y| = 0.015

|y – z| = 0.01

To comply with the specifications, D shall be not less than:

15 000 (0.015 + 0.01) m,

That is, 15 000 × 0.025 = 375 m

4.2. Consideration of longitudinal and transverse slopes

When a runway is planned that will combine the extreme values for the slopes and changes in slope permitted under Chapter 3, 3.1.13 to 3.1.19, a study shall be made to ensure that the resulting surface profile will not hamper the operation of airplanes.

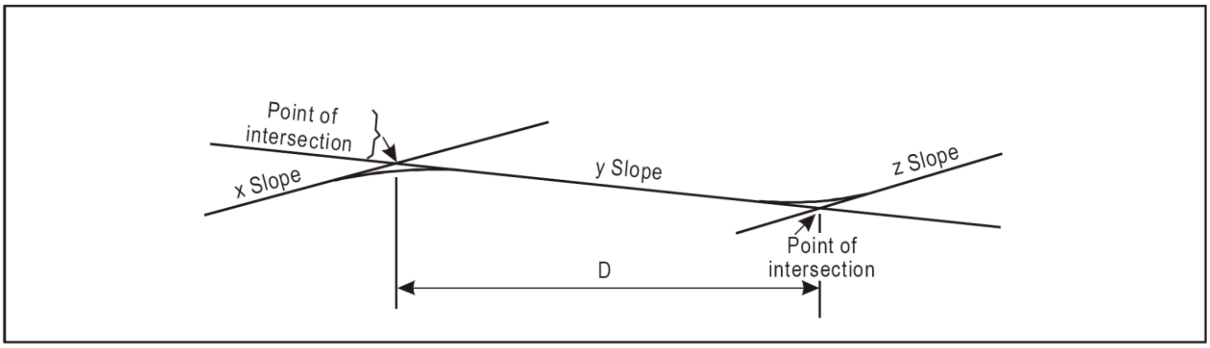


Figure A-2. Profile on center line of runway

4.3. Radio altimeter operating area

In order to accommodate airplanes making auto-coupled approaches and automatic landings (irrespective of weather conditions) it is desirable that slope changes be avoided or kept to a minimum, on a rectangular area at least 300 m long before the threshold of a precision approach runway. The area shall be symmetrical about the extended center line, 120 m wide. When special circumstances so warrant, the width may be reduced to no less than 60 m if an aeronautical study indicates that such reduction would not affect the safety of operations of aircraft. This is desirable because these airplanes are equipped with a radio altimeter for final height and flare guidance, and when the airplane is above the terrain immediately prior to the threshold, the radio altimeter will begin to provide information to the automatic pilot for auto-flare. Where slope changes cannot be avoided, the rate of change between two consecutive slopes shall not exceed 2 per cent per 30 m.

5. Runway surface evenness

5.1. In adopting tolerances for runway surface irregularities, the following standard of construction is achievable for short distances of 3 m and conforms to good engineering practice:

Except across the crown of a camber or across drainage channels, the finished surface of the wearing course is to be of such regularity that, when tested with a 3 m straight-edge placed anywhere in any direction on the surface, there is no deviation greater than 3 mm between the bottom of the straight-edge and the surface of the pavement anywhere along the straightedge.

5.2. Caution shall also be exercised when inserting runway lights or drainage grilles in runway surfaces to ensure that adequate smoothness of the surface is maintained.

5.3. The operation of aircraft and differential settlement of surface foundations will eventually lead to increases in surface irregularities. Small deviations in the above tolerances will not seriously hamper aircraft operations. In general, isolated irregularities of the order of 2.5 cm to 3 cm over a 45 m distance are acceptable, as shown in Figure A-3. Although maximum acceptable deviations vary with the type and speed of an aircraft, the limits of acceptable surface irregularities can be estimated to a reasonable extent. The following table describes acceptable tolerable and excessive limits:

a. if the surface irregularities exceed the heights defined by the acceptable limit curve but are less than the heights defined by the tolerable limit curve, at the specified minimum acceptable length, herein noted by the tolerable region, then maintenance action shall be planned. The runway may remain in service. This region is the start of possible passenger and pilot discomfort;

b. if the surface irregularities exceed the heights defined by the tolerable limit curve, but are less than the heights defined by the excessive limit curve, at the specified minimum acceptable length, herein noted by the excessive region, then maintenance corrective action is mandatory to restore the condition to the acceptable region. The runway may remain in service but be repaired within a reasonable period. This region could lead to the risk of possible aircraft structural damage due to a single event or fatigue failure over time; and

c. if the surface irregularities exceed the heights defined by the excessive limit curve, at the specified minimum acceptable length, herein noted by the unacceptable region, then the area of the runway where the roughness has been identified warrants closure. Repairs must be made to restore the condition to within the acceptable limit region and the aircraft operators may be advised accordingly. This region runs the extreme risk of a structural failure and must be addressed immediately.

Surface irregularity	Length of irregularity (m)								
	3	6	9	12	15	20	30	45	60
Acceptable surface irregularity height (cm)	2.9	3.8	4.5	5	5.4	5.9	6.5	8.5	10
Tolerable surface irregularity height (cm)	3.9	5.5	6.8	7.8	8.6	9.6	11	13.6	16
Excessive surface irregularity height (cm)	5.8	7.6	9.1	10	10.8	11.9	13.9	17	20

Note that “surface irregularity” is defined herein to mean isolated surface elevation deviations that do not lie along a uniform slope through any given section of a runway. For the purposes of this concern, a “section of a runway” is defined herein to mean a segment of a runway throughout which a continuing general uphill, downhill or flat slope is prevalent. The length of this section is generally between 30 and 60 meters, and can be greater, depending on the longitudinal profile and the condition of the pavement.

The maximum tolerable step type bump, such as that which could exist between adjacent slabs, is simply the bump height corresponding to zero bump length at the upper end of the tolerable region of the roughness criteria of Figure A-3. The bump height at this location is 1.75 cm.

5.4. Figure A-3 illustrates a comparison of the surface roughness criteria with those developed by the United States Federal Aviation Administration. Further guidance regarding temporary slopes for overlay works on operational runways can be found in Aerodrome Design Manual, Part 3 — Pavements (Doc 9157).

5.5. Deformation of the runway with time may also increase the possibility of the formation of water pools. Pools as shallow as approximately 3 mm in depth, particularly if they are located where they are likely to be encountered at high speed by landing airplanes, can induce aquaplaning, which can then be sustained on a wet runway by a much shallower depth of water. Improved guidance regarding the significant length and depth of pools relative to aquaplaning is the subject of further research. It is, of course, especially necessary to prevent pools from forming whenever there is a possibility that they might become frozen.

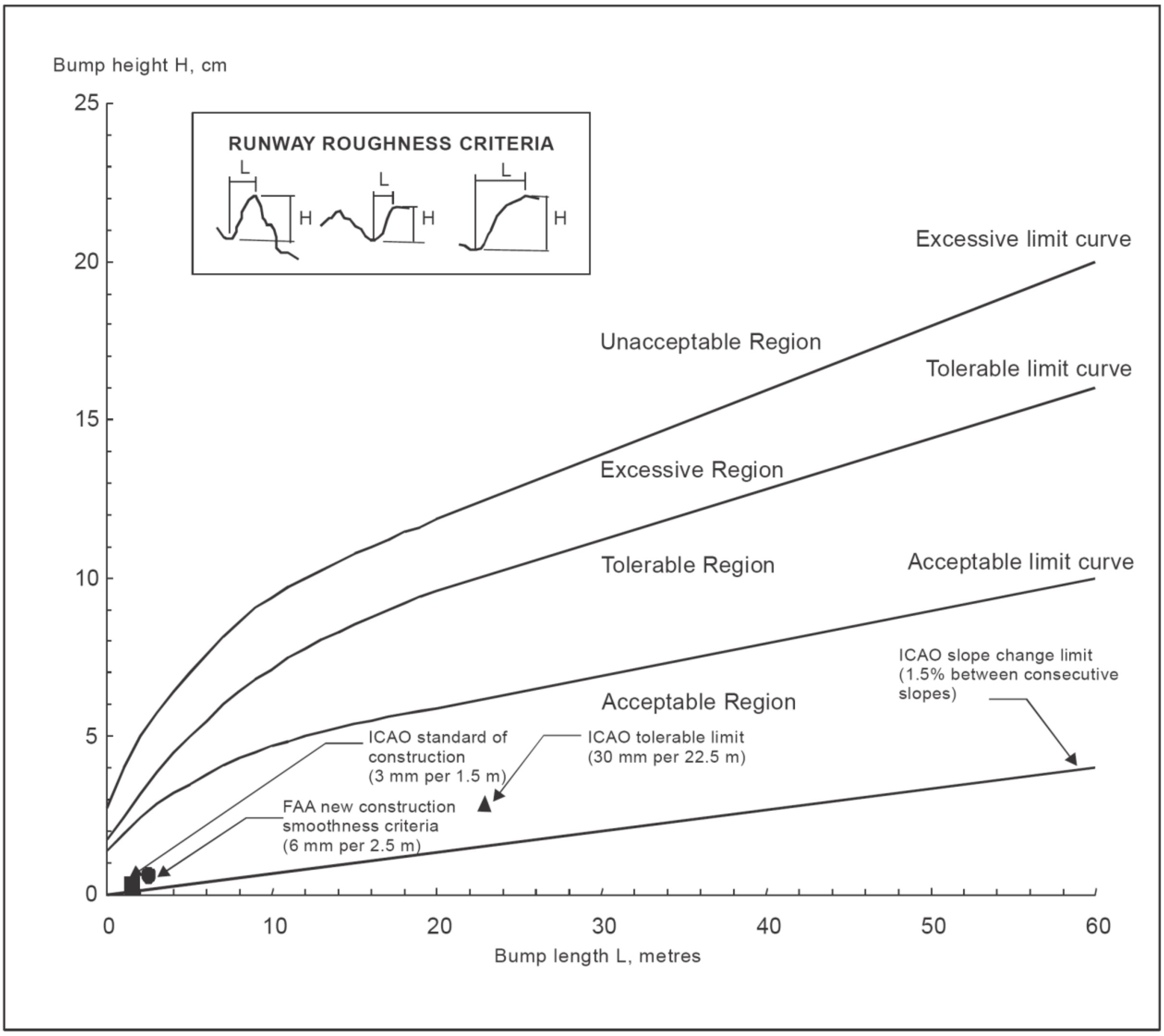


Figure A-3. Comparison of roughness criteria

Note: These criteria address single event roughness, not long wavelength harmonic effects nor the effect of repetitive surface undulations.

6. Runway condition report for reporting runway surface condition

6.1. On a global level, movement areas are exposed to a multitude of climatic conditions and consequently a significant difference in the condition to be reported. The runway condition report (RCR) describes a basic methodology applicable for all these climatic variations and is structured in such a way that LYCAA can adjust them to the climatic conditions applicable for Libya.

6.2. The concept of the RCR is premised on:

a. an agreed set of criteria used in a consistent manner for runway surface condition assessment, airplane (performance) certification and operational performance calculation;

b. a unique runway condition code (RWYCC) linking the agreed set of criteria with the aircraft landing and take-off performance table, and related to the braking action experienced and eventually reported by flight crews;

c. reporting of contaminant type and depth that is relevant to take-off performance;

d. a standardized common terminology and phraseology for the description of runway surface conditions that can be used by aerodrome operator inspection personnel, air traffic controllers, aircraft operators and flight crew; and

e. globally-harmonized procedures for the establishment of the RWYCC with a built-in flexibility to allow for local variations to match the specific weather, infrastructure and other particular conditions.

6.3. These harmonized procedures are reflected in a runway condition assessment matrix (RCAM) which correlates the RWYCC, the agreed set of criteria and the aircraft braking action which the flight crew should expect for each value of the RWYCC.

6.4. Procedures which relate to the use of the RCAM are provided in the Procedure Manual.

6.5. It is recognized that information provided by the aerodrome's personnel assessing and reporting runway surface condition is crucial to the effectiveness of the runway condition report. A misreported runway condition alone should not lead to an accident or incident. Operational margins should cover for a reasonable error in the assessment, including unreported changes in the runway condition. But a misreported runway condition can mean that the margins are no longer available to cover for other operational variance (such as unexpected tailwind, high and fast approach above threshold or long flare).

6.6. This is further amplified by the need for providing the assessed information in the proper format for dissemination, which requires insight into the limitations set by the syntax for dissemination. This in turn restricts the wording of plain text remarks that can be provided.

6.7. It is important to follow standard procedures when providing assessed information on the runway surface conditions to ensure that safety is not compromised when airplanes use wet or contaminated runways. Personnel shall be trained in the relevant fields of competence and their competence verified in a manner required by the CAA to ensure confidence in their assessments.

6.8. The training syllabus may include initial and periodic recurrent training in the following areas:

a. aerodrome familiarization, including aerodrome markings, signs and lighting;

b. aerodrome procedures as described in the aerodrome manual;

c. aerodrome emergency plan;

d. Notice to Airmen (NOTAM) initiation procedures;

e. completion of/ initiation procedures for RCR;

f. aerodrome driving rules;

g. air traffic control procedures on the movement area;
h. radiotelephone operating procedures;
i. phraseology used in aerodrome control, including the ICAO spelling alphabet;
j. aerodrome inspection procedures and techniques;
k. type of runway contaminants and reporting;
l. assessment and reporting of runway surface friction characteristics;
m. use of runway friction measurement device;
n. calibration and maintenance of runway friction measurement device;
o. awareness of uncertainties related to l) and m); and
p. low visibility procedures.

7. Determination of surface friction characteristics for construction and maintenance purposes

Note: The guidance in this section involves the functional measurement of friction-related aspects related to runway construction and maintenance. Excluded from this section is the operational, as opposed to functional, measurement of friction for contaminated runways. However, the devices used for functional measurement could also be used for operational measurement, but in the latter case, the figures given in Airport Services Manual (Doc 9137), Part 2, Table 3-1 are not relevant.

7.1. The surface friction characteristics of a paved runway shall be:

a. Assessed to verify the surface friction characteristics of new or resurfaced paved runways (Chapter 3, 3.1.25); and
b. Assessed periodically in order to determine the slipperiness of paved runways (Chapter 10, 10.2.4).

7.2. The condition of a runway pavement is generally assessed under dry conditions using a self-wetting continuous friction measuring device. Evaluation tests of runway surface friction characteristics are made on clean surfaces of the runway when first constructed or after resurfacing.

7.3. Friction tests of existing surface conditions are taken periodically in order to avoid falling below the minimum friction level specified by LYCAA. When the friction of any portion of a runway is found to be below this value, then such information is promulgated in a NOTAM specifying which portion of the runway is below the minimum friction level and its location on the runway. A corrective maintenance action must be initiated without delay. Friction measurements are taken at time intervals that will ensure the identification of runways in need of maintenance or of special surface treatment before their condition becomes serious.

7.4. The time intervals and mean frequency of measurements depend on factors such as: aircraft type and frequency of usage, climatic conditions, pavement type, and pavement service and maintenance requirements.

7.5. Friction measurements of existing, new or resurfaced runways are made with a continuous friction measuring device provided with a smooth tread tire. The device shall use self-wetting features to allow measurements of the surface friction characteristics to be made at a water depth of 1 mm.

7.6. When it is suspected that the surface friction characteristics of a runway may be reduced because of poor drainage, owing to inadequate slopes or depressions, then an additional measurement is made, but this time under natural conditions representative of a local rain. This measurement differs from the previous one in that water depths in the poorly cleared areas are normally greater in a local rain condition. The measurement results are thus more apt to identify problem areas having low friction values that could induce aquaplaning than the previous test. If circumstances do not permit measurements to be conducted during natural conditions representative of a rain, then this condition may be simulated. (See section 8.)

7.7. When conducting friction tests using a self-wetting continuous friction measuring device, it is important to note that, a wet runway produces a drop in friction with an increase in speed. However, as the speed increases, the rate at which the friction is reduced becomes less. Among the factors affecting the friction coefficient between the tire and the runway surface, texture is particularly important. If the runway has a good macro-texture allowing the water to escape beneath the tire, then the friction value will be less affected by speed. Conversely, a low macro-texture surface will produce a larger drop in friction with increase in speed.

7.8. Part-139 PART1, requires LYCAA to specify a minimum friction level below which corrective maintenance action shall be taken. As criteria for surface friction characteristics of new or resurfaced runway surfaces and its maintenance planning, LYCAA has established a maintenance planning level below which appropriate corrective maintenance action shall be initiated to improve the friction. And The Airport Services Manual (Doc 9137), Part 2, also provides guidance on establishing maintenance planning and minimum friction levels for runway surfaces in use.

8. Drainage characteristics of the movement area and adjacent areas

8.1. General

8.1.1. Rapid drainage of surface water is a primary safety consideration in the design, construction and maintenance of the movement area and adjacent areas. The objective is to minimize water depth on the surface by draining water off the runway in the shortest path possible and particularly out of the area of the wheel path. There are two distinct drainage processes taking place:

a. Natural drainage of the surface water from the top of the pavement surface until it reaches the final recipient such as rivers or other water bodies; and

b. Dynamic drainage of the surface water trapped under a moving tire until it reaches outside the tire-to-ground contact area.

8.1.2. Both processes can be controlled through:

a. Design;

b. Construction; and

c. Maintenance of the pavements in order to prevent accumulation of water on the pavement surface.

8.2. Design of pavement

8.2.1. Surface drainage is a basic requirement and serves to minimize water depth on the surface. The objective is to drain water off the runway in the shortest path. Adequate surface drainage is provided primarily by an appropriately sloped surface (in both the longitudinal and transverse directions). The resulting combined longitudinal and transverse slope is the path for the drainage run-off. This path can be shortened by adding transverse grooves.

8.2.2. Dynamic drainage is achieved through built-in texture in the pavement surface. The rolling tire builds up water pressure and squeezes the water out the escape channels provided by the texture. The dynamic drainage of the tire-to-ground contact area may be improved by adding transverse grooves provided that they are subject to rigorous maintenance.

8.3. Construction of pavement

8.3.1. Through construction, the drainage characteristics of the surface are built into the pavement. These surface characteristics are:

a. Slopes;

b. Texture:

- Microtexture;
- Macrotexture.

8.3.2. Slopes for the various parts of the movement area and adjacent parts are described in Chapter 3 and figures are given as per cent. Further guidance is given in the Aerodrome Design Manual (Doc 9157), Part 1, Chapter 5.

8.3.3. Texture in the literature is described as microtexture or macrotexture. These terms are understood differently in various parts of the aviation industry.

8.3.4. Microtexture is the texture of the individual stones and is hardly detectable by the eye. Microtexture is considered a primary component in skid resistance at slow speeds. On a wet surface at higher speeds a water film may prevent direct contact between the surface asperities and the tire due to insufficient drainage from the tireto-ground contact area.

8.3.5. Microtexture is a built-in quality of the pavement surface. By specifying crushed material that will withstand polishing microtexture, drainage of thin waterfilms are ensured for a longer period of time. Resistance against polishing is expressed in terms of the Polished Stone Values (PSV) which is in principle a value obtained from a friction measurement in accordance with international standards. These standards define the PSV minima that will enable a material with a good microtexture to be selected.

8.3.6. A major problem with microtexture is that it can change within short time periods without being easily detected. A typical example of this is the accumulation of rubber deposits in the touchdown area which will largely mask microtexture without necessarily reducing macrotexture.

8.3.7. Macrotexture is the texture among the individual stones. This scale of texture may be judged approximately by the eye. Macrotexture is primarily created by the size of aggregate used or by surface treatment of the pavement and is the major factor influencing drainage capacity at high speeds. Materials shall be selected so as to achieve good macrotexture.

8.3.8. The primary purpose of grooving a runway surface is to enhance surface drainage. Natural drainage can be slowed down by surface texture, but grooving can speed up the drainage by providing a shorter drainage path and increasing the drainage rate.

8.3.9. For measurement of macrotexture, simple methods such as the "sand and grease patch" methods described in the Airport Services Manual (Doc 9137), Part 2 were developed. These methods were used for the early research on which current airworthiness requirements are based, which refer to a classification categorizing macrotexture from A to E. This classification was developed, using sand or grease patch measuring techniques, and issued in 1971 by the Engineering Sciences Data Unit (ESDU). Runway classification based on texture information from ESDU 71026:

A	0.10 – 0.14
B	0.15 – 0.24
C	0.25 – 0.50
D	0.51 – 1.00
E	1.01 – 2.54

8.3.10. Using this classification, the threshold value between microtexture and macrotexture is 0.1 mm mean texture depth (MTD). Related to this scale, the normal wet runway aircraft performance is based upon texture giving drainage and friction qualities midway between classification B and C (0.25 mm). Improved drainage through better texture might qualify for a better aircraft performance class. However, such credit must be in accordance with airplane manufacturers' documentation and agreed by the LYCAA. Presently credit is given to grooved or porous friction course runways following design, construction and maintenance criteria acceptable to the LYCAA. The harmonized certification standards of some States refer to texture giving drainage and friction qualities midway between classification D and E (1.0 mm).

8.3.11. For construction, design and maintenance, States use various international standards. Currently ISO 13473-1: Characterization of pavement texture by use of surface profiles — Part 1: Determination of Mean Profile Depth links the volumetric measuring technique with non-contact profile measuring techniques giving comparable texture values. These standards describe the threshold value between microtexture and macrotexture as 0.5 mm. The volumetric method has a validity range from 0.25 to 5 mm MTD. The profilometry method has a validity range from 0 to 5 mm mean profile depth (MPD). The values of MPD and MTD differ due to the finite size of the glass spheres used in the volumetric technique and because the MPD is derived from a two-dimensional profile rather than a three-dimensional surface. Therefore, a transformation equation must be established for the measuring equipment used to relate MPD to MTD.

8.3.12. The ESDU scale groups runway surfaces based on macrotexture from A through E, where E represents the surface with best dynamic drainage capacity. The ESDU scale thus reflects the dynamic drainage characteristics of the pavement. Grooving any of these surfaces enhances the dynamic drainage capacity. The resulting drainage capacity of the surface is thus a function of the texture (A through E) and grooving. The contribution from grooving is a function of the size of the grooves and the spacing between the grooves. Aerodromes exposed to heavy or torrential rainfall must ensure that the pavement and adjacent areas have drainage capability to withstand these rainfalls or put limitations on the use of the pavements under such extreme situations. These airports shall seek to have the maximum allowable slopes and the use of aggregates providing good drainage characteristics. They shall also consider grooved pavements in the E classification to ensure that safety is not impaired.

8.4. Maintenance of drainage characteristics of pavement

8.4.1. Macrotexture does not change within a short timespan but accumulation of rubber can fill up the texture and as such reduce the drainage capacity, which can result in impaired safety. Furthermore, the runway structure may change overtime and give unevenness which results in ponding after rainfall. Guidance on rubber removal and unevenness can be found in the Airport Services Manual (Doc 9137), Part 2. Guidance on methods for improving surface texture can be found in the Aerodrome Design Manual (Doc 9157), Part 3.

8.4.2. When groovings are used, the condition of the grooves shall be regularly inspected to ensure that no deterioration has occurred and that the grooves are in good condition. Guidance on maintenance of pavements is available in the Airport Services Manual (Doc 9137), Part 2 — Pavement Surface Conditions and Part 9 — Airport Maintenance Practices and the Aerodrome Design Manual (Doc 9157), Part 2.

8.4.3. The pavement may be shot blasted in order to enhance the pavement macrotexture.

9. Strips

9.1. Shoulders

9.1.1. The Shoulder of a runway or stopway shall be prepared or constructed so as to minimize any hazard to an airplane running off the runway or stopway. Some guidance is given in the following paragraphs on certain special problems which may arise, and on the further question of measures to avoid the ingestion of loose stones or other objects by turbine engines.

9.1.2. In some cases, the bearing strength of the natural ground in the strip may be sufficient, without special preparation, to meet the requirements for Shoulders. Where special preparation is necessary, the method used will depend on local soil conditions and the mass of the airplanes the runway is intended to serve. Soil tests will help in determining the best method of improvement (e.g., drainage, stabilization, surfacing, light paving).

9.1.3. Attention shall also be paid when designing Shoulders to prevent the ingestion of stones or other objects by turbine engines. Similar considerations apply here to those which are discussed for the margins of taxiways in the Aerodrome Design Manual (Doc 9157), Part 2, both as to the special measures which may be necessary and as to the distance over which such special measures, if required, shall be taken.

9.1.4. Where Shoulders have been treated specially, either to provide the required bearing strength or to prevent the presence of stones or debris, difficulties may arise because of a lack of visual contrast between the runway surface and that of the adjacent strip. This difficulty can be overcome either by providing a good visual contrast in the surfacing of the runway or strip, or by providing a runway side stripe marking.

9.2. Objects on strips

Within the general area of the strip adjacent to the runway, measures shall be taken to prevent an airplane's wheel, when sinking into the ground, from striking a hard vertical face. Special problems may arise for runway light fittings or other objects mounted in the strip or at the intersection with a taxiway or another runway. In the case of construction, such as runways or taxiways, where the surface must also be flush with the strip surface, a vertical face can be eliminated by chamfering from the top of the construction to not less than 30 cm below the strip surface level. Other objects, the functions of which do not require them to be at surface level, shall be buried to a depth of not less than 30 cm.

9.3. Grading of a strip for precision approach runways Chapter 3, 3.4.8, recommends that the portion of a strip of an instrument runway within at least 75 m from the center line shall be graded where the code number is 3 or 4. For a precision approach runway, it may be desirable to adopt a greater width where the code number is 3 or 4. Figure A-4 shows the shape and dimensions of a wider strip that may be considered for such a runway. This strip has been designed using information on aircraft running off runways. The portion to be graded extends to a distance of 105 m from the center line, except that the distance is gradually reduced to 75 m from the center line at both ends of the strip, for a length of 150 m from the runway end.

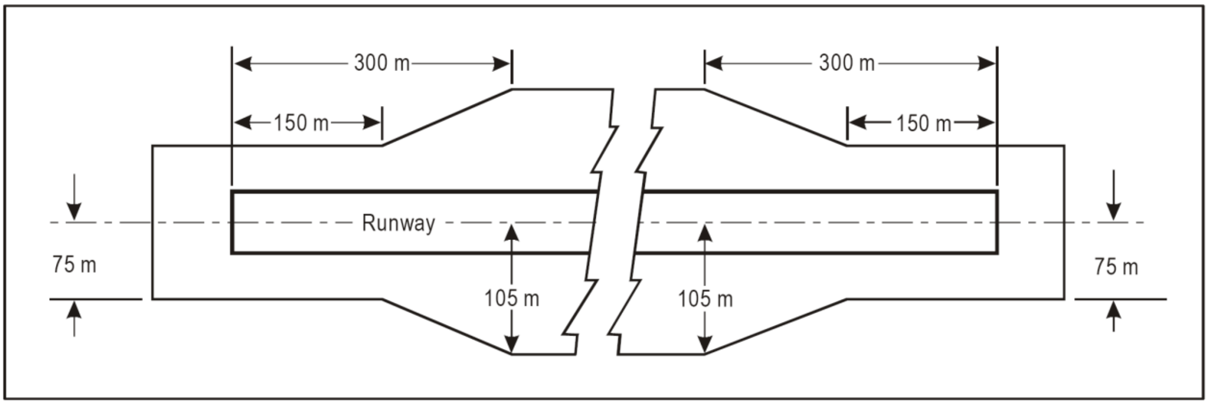


Figure A-4. Graded portion of a strip including a precision approach runway where the code number is 3 or 4

10. Runway end safety areas

10.1. Where a runway end safety area is provided in accordance with Chapter 3, consideration shall be given to providing an area long enough to contain overruns and undershoots resulting from a reasonably probable combination of adverse operational factors. On a precision approach runway, the ILS localizer is normally the first upstanding obstacle, and the runway end safety area shall extend up to this facility. In other circumstances, the first upstanding obstacle may be a road, a railroad or other constructed or natural feature. The provision of a runway end safety area shall take such obstacles into consideration.

10.2. Where provision of a runway end safety area would be particularly prohibitive to implement, consideration would have to be given to reducing some of the declared distances of the runway for the provision of a runway end safety area and installation of an arresting system.

10.3. Research programs, as well as evaluation of actual aircraft overruns into arresting systems, have demonstrated that the performance of some arresting systems can be predictable and effective in arresting aircraft overruns.

10.4. Demonstrated performance of an arresting system can be achieved by a validated design method, which can predict the performance of the system. The design and performance shall be based on the type of aircraft anticipated to use the associated runway that imposes the greatest demand upon the arresting system.

10.5. The design of an arresting system must consider multiple aircraft parameters, including but not limited to, allowable aircraft gear loads, gear configuration, tire contact pressure, aircraft center of gravity and aircraft speed. Accommodating undershoots must also be addressed. Additionally, the design must allow the safe operation of fully loaded rescue and fire fighting vehicles, including their ingress and egress.

10.6. The information relating to the provision of a runway end safety area and the presence of an arresting system shall be published in the AIP.

10.7. Additional information is contained in the Aerodrome Design Manual (Doc 9157), Part 1.

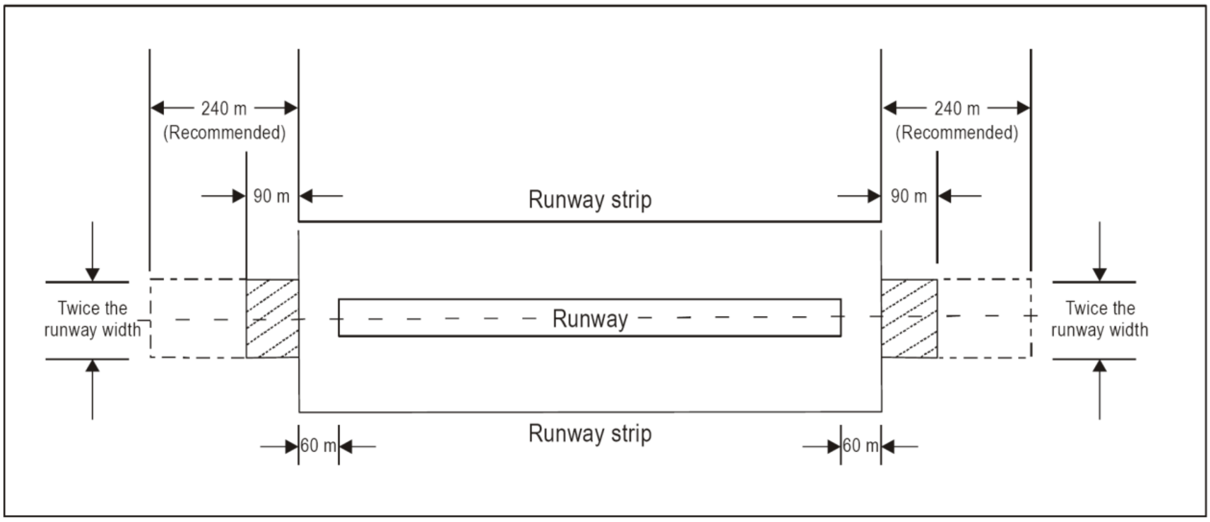


Figure A-5. Runway end safety area for a runway where the code number is 3 or 4

11. Location of threshold

11.1. General

11.1.1. The threshold is normally located at the extremity of a runway, if there are no obstacles penetrating above the approach surface. In some cases, however, due to local conditions it may be desirable to displace the threshold permanently (see below). When studying the location of a threshold, consideration shall also be given to the height of the ILS reference datum and/or MLS approach reference datum and the determination of the obstacle clearance limits. (Specifications concerning the height of the ILS reference datum and MLS approach reference datum are given in Annex 10, volume 1)

11.1.2. In determining that no obstacles penetrate above the approach surface, account shall be taken of mobile objects (vehicles on roads, trains, etc.) at least within that portion of the approach area within 1 200 m longitudinally from the threshold and of an overall width of not less than 150 m.

11.2. Displaced threshold

11.2.1. If an object extends above the approach surface and the object cannot be removed, consideration shall be given to displacing the threshold permanently.

11.2.2. To meet the obstacle limitation objectives of Chapter 4, the threshold shall ideally be displaced down the runway for the distance necessary to provide that the approach surface is cleared of obstacles.

11.2.3. However, displacement of the threshold from the runway extremity will inevitably cause reduction of the landing distance available, and this may be of greater operational significance than penetration of the approach surface by marked and lighted obstacles. A decision to displace the threshold, and the extent of such displacement, shall therefore have regard to an optimum balance between the considerations of clear approach surfaces and adequate landing distance. In deciding this question, account will need to be taken of the types of airplanes which the runway is intended to serve, the limiting visibility and cloud base conditions under which the runway will be used, the position of the obstacles in relation to the threshold and extended center line and, in the case of a precision approach runway, the significance of the obstacles to the determination of the obstacle clearance limit.

11.2.4. Notwithstanding the consideration of landing distance available, the selected position for the threshold shall not be such that the obstacle free surface to the threshold is steeper than 3.3 per cent where the code number is 4 or steeper than 5 per cent where the code number is 3.

11.2.5. In the event of a threshold being located according to the criteria for obstacle free surfaces in the preceding paragraph, the obstacle marking requirements of Chapter 6 shall continue to be met in relation to the displaced threshold.

11.2.6. Depending on the length of the displacement, the RVR at the threshold could differ from that at the beginning of the runway for take-offs. The use of red runway edge lights with photometric intensities lower than the nominal value of 10.000 cd for white lights increases that phenomenon. The impact of a displaced threshold on takeoff minima shall be assessed by the LYCAA.

11.2.7. Marking and lighting of displaced thresholds and some operational recommendations can be found in 5.2.4.9, 5.2.4.10, 5.3.5.5, 5.3.8.1, 5.3.9.7, 5.3.10.3, 5.3.10.7 and 5.3.12.6 of Part-139.

12. Approach lighting systems

12.1. Types and characteristics

12.1.1. The specifications in this volume provide for the basic characteristics for simple and precision approach lighting systems. For certain aspects of these systems, some latitude is permitted, for example, in the spacing between center line lights and crossbars. The approach lighting patterns that have been generally adopted are shown in Figures A-7 and A-8. A diagram of the inner 300 m of the precision approach category II and III lighting system is shown in Figure 5-14.

12.1.2. The approach lighting configuration is to be provided irrespective of the location of the threshold, i.e., whether the threshold is at the extremity of the runway or displaced from the runway extremity. In both cases, the approach lighting system shall extend up to the threshold. However, in the case of a displaced threshold, inset lights are used from the runway extremity up to the threshold to obtain the specified configuration. These inset lights are designed to satisfy the structural requirements specified in Chapter 5, 5.3.1.9, and the photometric requirements specified in Appendix 2, Figure A2-1 or A2-2.

12.1.3. Flight path envelopes to be used in designing the lighting are shown in Figure A-6.

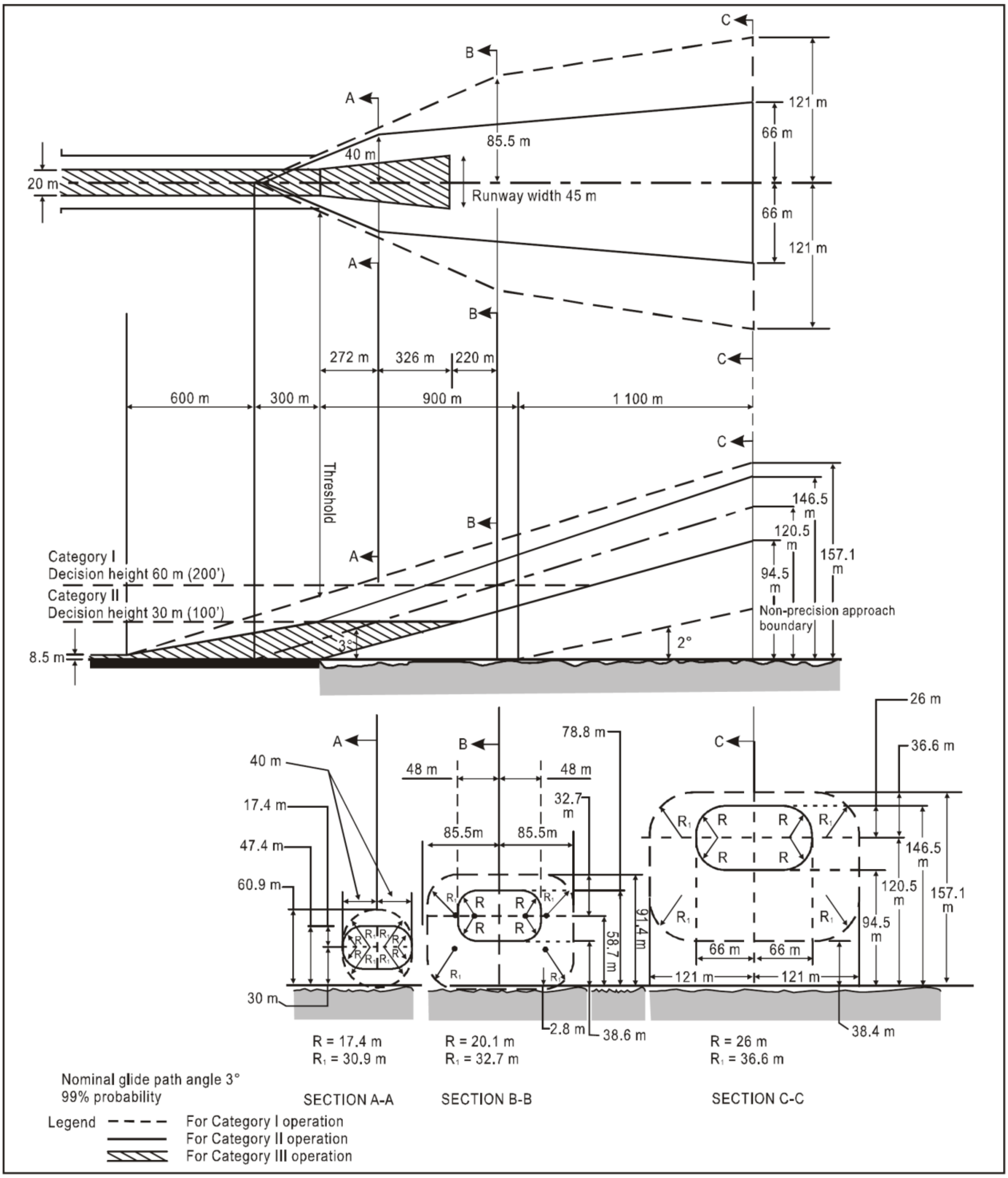


Figure A-6. Flight path envelopes to be used for lighting design for category I, II and III operations

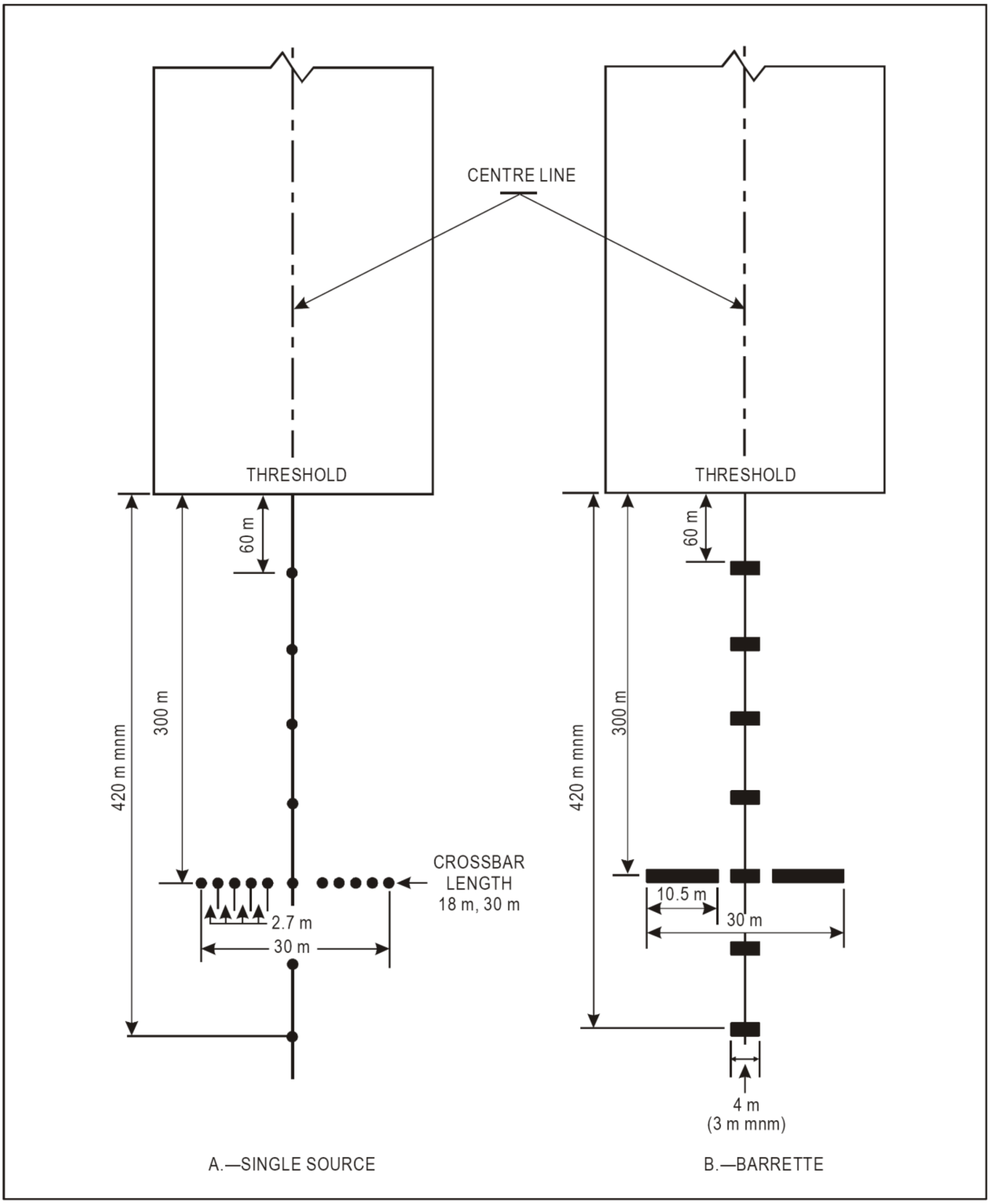


Figure A-7. Simple approach lighting systems

12.2. Installation Tolerances

Horizontal

12.2.1. The dimensional tolerances are shown in Figure A-8.

12.2.2. The center line of an approach lighting system shall be as coincident as possible with the extended center line of the runway with a maximum tolerance of ±15′.

12.2.3. The longitudinal spacing of the center line lights shall be such that one light (or group of lights) is located in the center of each crossbar, and the intervening center line lights are spaced as evenly as practicable between two crossbars or a crossbar and a threshold.

12.2.4. The crossbars and barrettes shall be at right angles to the center line of the approach lighting system with a tolerance of ±30′, if the pattern in Figure A-8 (A) is adopted or ± 2°, if Figure A-8 (B) is adopted.

12.2.5. When a crossbar has to be displaced from its standard position, any adjacent crossbar shall, where possible, be displaced by appropriate amounts in order to reduce the differences in the crossbar spacing.

12.2.6. When a crossbar in the system shown in Figure A-8 (A) is displaced from its standard position, its overall length shall be adjusted so that it remains one-twentieth of the actual distance of the crossbar from the point of origin. It is not necessary, however, to adjust the standard 2.7 m spacing between the crossbar lights, but the crossbars shall be kept symmetrical about the center line of the approach lighting.

Vertical

12.2.7. The ideal arrangement is to mount all the approach lights in the horizontal plane passing through the threshold (see Figure A-9), and this shall be the general aim as far as local conditions permit. However, buildings, trees, etc., shall not obscure the lights from the view of a pilot who is assumed to be 1° below the electronic glide path in the vicinity of the outer marker.

12.2.8. Within a stopway or clearway, and within 150 m of the end of a runway, the lights shall be mounted as near to the ground as local conditions permit in order to minimize risk of damage to airplanes in the event of an overrun or undershoot. Beyond the stopway and clearway, it is not so necessary for the lights to be mounted close to the ground, and therefore undulations in the ground contours can be compensated for by mounting the lights on poles of appropriate height.

12.2.9. It is desirable that the lights be mounted so that, as far as possible, no object within a distance of 60 m on each side of the center line protrudes through the plane of the approach lighting system. Where a tall object exists within 60 m of the center line and within 1 350 m from the threshold for a precision approach lighting system, or 900 m for a simple approach lighting system, it may be advisable to install the lights so that the plane of the outer half of the pattern clears the top of the object.

12.2.10. In order to avoid giving a misleading impression of the plane of the ground, the lights shall not be mounted below a gradient of 1 in 66 downwards from the threshold to a point 300 m out, and below a gradient of 1 in 40 beyond the 300 m point. For a precision approach category II and III lighting system, more stringent criteria may be necessary, e.g., negative slopes not permitted within 450 m of the threshold.

12.2.11. Center line. The gradients of the center line in any section (including a stopway or clearway) shall be as small as practicable, and the changes in gradients shall be as few and small as can be arranged and shall not exceed 1 in 60. Experience has shown that as one proceeds outwards from the runway, rising gradients in any section of up to 1 in 66, and falling gradients of down to 1 in 40, are acceptable.

12.2.12. Crossbars. The crossbar lights shall be so arranged as to lie on a straight line passing through the associated center line lights, and wherever possible this line shall be horizontal. It is permissible, however, to mount the lights on a transverse gradient not more than 1 in 80, if this enables crossbar lights within a stopway or clearway to be mounted nearer to the ground on sites where there is a cross-fall.

12.3. Clearance of Obstacles

12.3.1. An area, hereinafter referred to as the light plane, has been established for obstacle clearance purposes, and all lights of the system are in this plane. This plane is rectangular in shape and symmetrically located about the approach lighting system's center line. It starts at the threshold and extends 60 m beyond the approach end of the system, and is 120 m wide.

12.3.2. No objects are permitted to exist within the boundaries of the light plane which are higher than the light plane except as designated herein. All roads and highways are considered as obstacles extending 4.8 m above the crown of the road, except aerodrome service roads where all vehicular traffic is under control of the aerodrome authorities and coordinated with the aerodrome traffic control tower. Railroads, regardless of the amount of traffic, are considered as obstacles extending 5.4 m above the top of the rails.

12.3.3. It is recognized that some components of electronic landing aids systems, such as reflectors, antennas, monitors, etc., must be installed above the light plane. Every effort shall be made to relocate such components outside the boundaries of the light plane. In the case of reflectors and monitors, this can be done in many instances.

12.3.4. Where an ILS localizer is installed within the light plane boundaries, it is recognized that the localizer, or screen if used, must extend above the light plane. In such cases the height of these structures shall be held to a minimum and they shall be located as far from the threshold as possible. In general, the rule regarding permissible heights is 15 cm for each 30 m the structure is located from the threshold. As an example, if the localizer is located 300 m from the threshold, the screen will be permitted to extend above the plane of the approach lighting system by 10 × 15 = 150 cm maximum, but preferably shall be kept as low as possible consistent with proper operation of the ILS.

12.3.5. In locating an MLS azimuth antenna, the guidance contained in Annex 10 Volume I, Attachment G, shall be followed. This material, which also provides guidance on collocating an MLS azimuth antenna with an ILS localizer antenna, suggests that the MLS azimuth antenna may be sited within the light plane boundaries where it is not possible or practical to locate it beyond the outer end of the approach lighting for the opposite direction of approach. If the MLS azimuth antenna is located on the extended center line of the runway, it shall be as far as possible from the closest light position to the MLS azimuth antenna in the direction of the runway end. Furthermore, the MLS azimuth antenna phase center shall be at least 0.3 m above the light center of the light position closest to the MLS azimuth antenna in the direction of the runway end. (This could be relaxed to 0.15 m if the site is otherwise free of significant multipath problems.) Compliance with this requirement, which is intended to ensure that the MLS signal quality is not affected by the approach lighting system, could result in the partial obstruction of the lighting system by the MLS azimuth antenna. To ensure that the resulting obstruction does not degrade visual guidance beyond an acceptable level, the MLS azimuth antenna shall not be located closer to the runway end than 300 m and the preferred location is 25 m beyond the 300 m crossbar (this would place the antenna 5 m behind the light position 330 m from the runway end).

Where an MLS azimuth antenna is so located, a central part of the 300 m crossbar of the approach lighting system would alone be partially obstructed. Nevertheless, it is important to ensure that the unobstructed lights of the crossbar remain serviceable all the time.

12.3.6. Objects existing within the boundaries of the light plane, requiring the light plane to be raised in order to meet the criteria contained herein, shall be removed, lowered or relocated where this can be accomplished more economically than raising the light plane.

12.3.7. In some instances, objects may exist which cannot be removed, lowered or relocated economically. These objects may be located so close to the threshold that they cannot be cleared by the 2 per cent slope. Where such conditions exist and no alternative is

12.3.8. possible, the 2 per cent slope may be exceeded or a “stair step” resorted to in order to keep the approach lights above the objects. Such “step” or increased gradients shall be resorted to only when it is impracticable to follow standard slope criteria, and they shall be held to the absolute minimum. Under this criterion no negative slope is permitted in the outermost portion of the system.

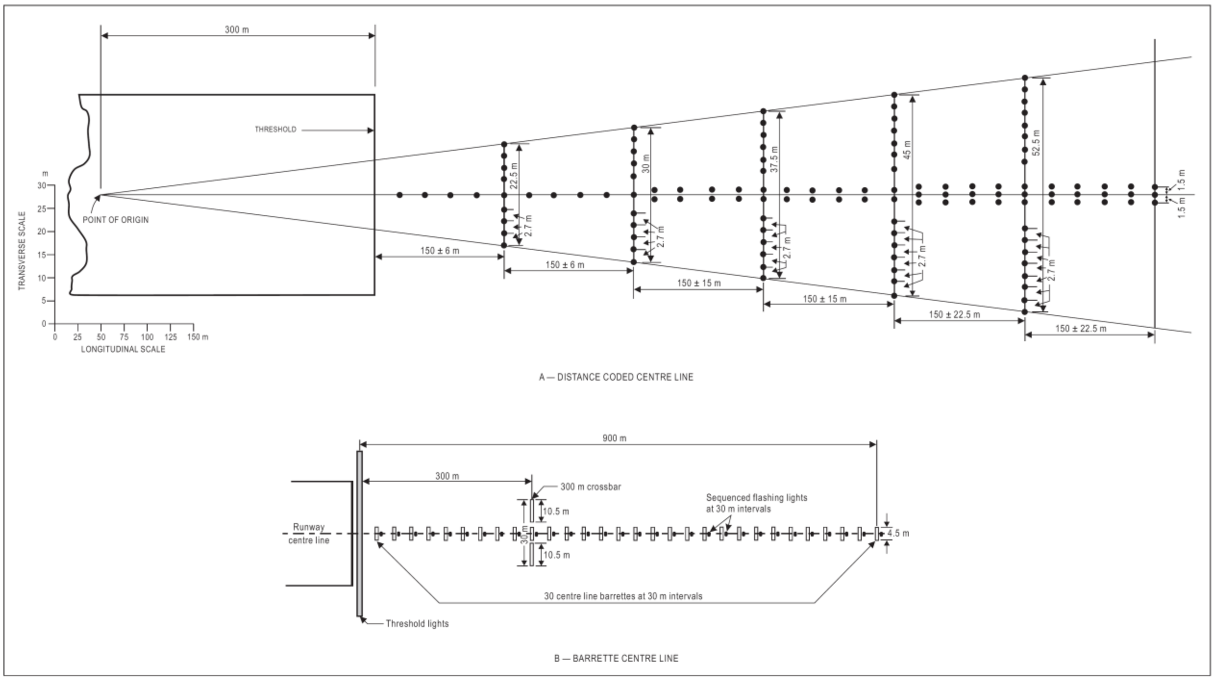


Figure A-8. Precision approach category I lighting systems

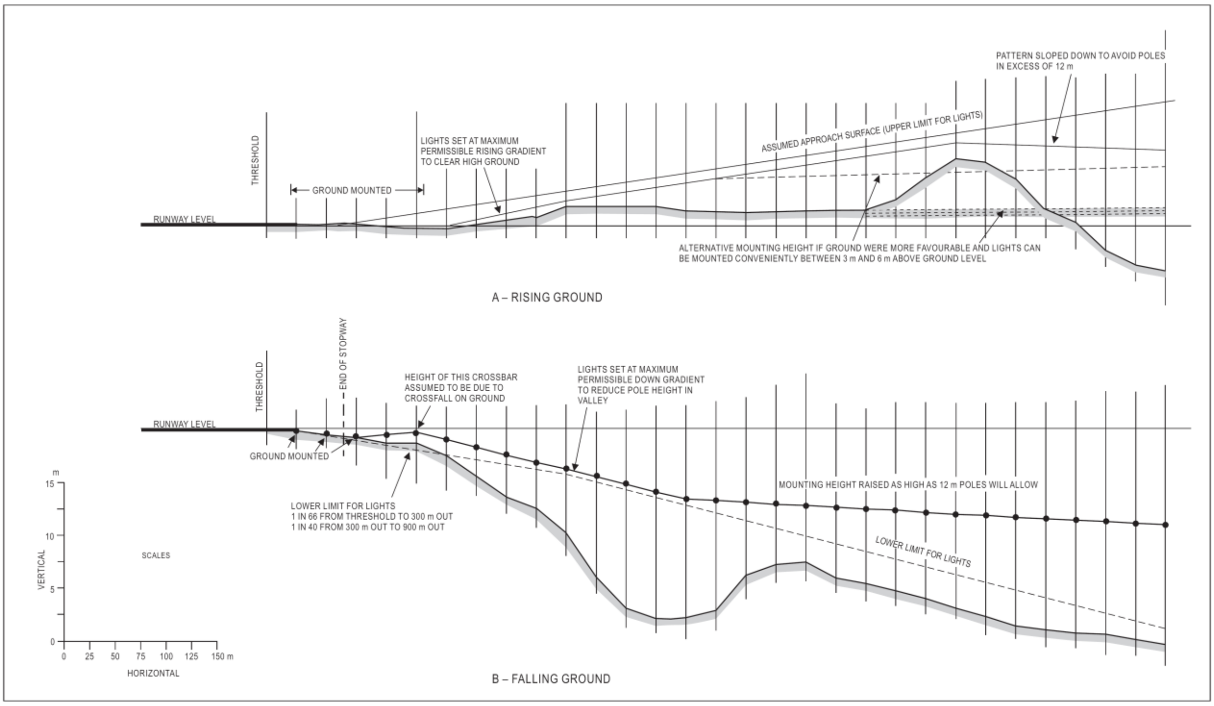


Figure A-9. Vertical installation tolerance

12.4. Consideration of the Effects of Reduced Lengths

12.4.1. The need for an adequate approach lighting system to support precision approaches where the pilot is required to acquire visual references prior to landing cannot be stressed too strongly. The safety and regularity of such operations is dependent on this visual acquisition. The height above runway threshold at which the pilot decides there are sufficient visual cues to continue the precision approach and land will vary, depending on the type of approach being conducted and other factors such as meteorological conditions, ground and airborne equipment, etc. The required length of approach lighting system which will support all the variations of such approaches is 900 m, and this shall always be provided whenever possible.

12.4.2. However, there are some runway locations where it is impossible to provide the 900 m length of approach lighting system to support precision approaches.

12.4.3. In such cases, every effort shall be made to provide as much approach lighting system as possible. The LYCAA may impose restrictions on operations to runways equipped with reduced lengths of lighting. There are many factors which determine at what height the pilot must have decided to continue the approach to land or execute a missed approach. It must be understood that the pilot does not make an instantaneous judgement upon reaching a specified height. The actual decision to continue the approach and landing sequence is an accumulative process which is only concluded at the specified height. Unless lights are available prior to reaching the decision point, the visual assessment process is impaired and the likelihood of missed approaches will increase substantially. There are many operational considerations which must be taken into account by The Civil Aviation Authority in deciding if any restrictions are necessary to any precision approach and these are detailed in Annex 6.

13. Priority of Installation of Visual Approach Slope Indicator Systems

13.1. It has been found impracticable to develop guidance material that will permit a completely objective analysis to be made of which runway on an aerodrome shall receive first priority for the installation of a visual approach slope indicator system. However, factors that must be considered when making such a decision are:

a. Frequency of use;

b. Seriousness of the hazard;

c. Presence of other visual and non-visual aids;

d. Type of airplanes using the runway; and

e. Frequency and type of adverse weather conditions under which the runway will be used.

13.2. With respect to the seriousness of the hazard, the order given in the application specifications for a visual approach slope indicator system, 5.3.5.1 b) to e) of Chapter 5, may be used as a general guide. These may be summarized as:

a. Inadequate visual guidance because of:

- approaches over water or featureless terrain, or absence of sufficient extraneous light in the approach area by night;
- deceptive surrounding terrain;

b. Serious hazard in approach;

c. Serious hazard if airplanes undershoot or overrun; and

d. Unusual turbulence.

13.3. The presence of other visual or non-visual aids is a very important factor. Runways equipped with ILS or MLS would generally receive the lowest priority for a visual approach slope indicator system installation. It must be remembered, though, that visual approach slope indicator systems are visual approach aids in their own right and can supplement electronic aids. When serious hazards exist and/or a substantial number of airplanes not equipped for ILS or MLS use a runway, priority might be given to installing a visual approach slope indicator on this runway.

13.4. Priority shall be given to runways used by turbojet airplanes.

14. Lighting of Unserviceable Areas

Where a temporarily unserviceable area exists, it may be marked with fixed-red lights. These lights shall mark the most potentially dangerous extremities of the area. A minimum of four such lights shall be used, except where the area is triangular in shape where a minimum of three lights may be employed. The number of lights shall be increased when the area is large or of unusual configuration. At least one light shall be installed for each 7.5 m of peripheral distance of the area. If the lights are directional, they shall be orientated so that as far as possible their beams are aligned in the direction from which aircraft or vehicles will approach. Where aircraft or vehicles will normally approach from several directions, consideration shall be given to adding extra lights or using omnidirectional lights to show the area from these directions. Unserviceable area lights shall be frangible. Their height shall be sufficiently low to preserve clearance for propellers and for engine pods of jet aircraft.

15. Rapid Exit Taxiway Indicator Lights

15.1. Rapid exit taxiway indicator lights (RETILs) comprise a set of yellow unidirectional lights installed in the runway adjacent to the center line. The lights are positioned in a 3-2-1 sequence at 100 m intervals prior to the point of tangency of the rapid exit taxiway center line. They are intended to give an indication to pilots of the location of the next available rapid exit taxiway.

15.2. In low visibility conditions, RETILs provide useful situational awareness cues while allowing the pilot to concentrate on keeping the aircraft on the runway center line.

15.3. Following a landing, runway occupancy time has a significant effect on achievable runway capacity. RETILs allow pilots to maintain a good roll-out speed until it is necessary to decelerate to an appropriate speed for the turn into a rapid exit turn-off. A roll-out speed of 60 knots until the first RETIL (three-light barrette) is reached is seen as the optimum.

16. Intensity Control of Approach and Runway Lights

16.1. The conspicuity of a light depends on the impression received of contrast between the light and its background. If a light is to be useful to a pilot by day when on approach, it must have an intensity of at least 2.000 or 3.000 cd, and in the case of approach lights an intensity of the order of 20 000 cd is desirable. In conditions of very bright daylight fog it may not be possible to provide lights of sufficient intensity to be effective. On the other hand, in clear weather on a dark night, an intensity of the order of 100 cd for approach lights and 50 cd for the runway edge lights may be found suitable. Even then, owing to the closer range at which they are viewed, pilots have sometimes complained that the runway edge lights seemed unduly bright.

16.2. In fog, the amount of light scattered is high. At night this scattered light increases the brightness of the fog over the approach area and runway to the extent that little increase in the visual range of the lights can be obtained by increasing their intensity beyond 2.000 or 3000 cd. In an endeavor to increase the range at which lights would first be sighted at night, their intensity must not be raised to an extent that a pilot might find excessively dazzling at diminished range.

16.3. From the foregoing will be evident the importance of adjusting the intensity of the lights of an aerodrome lighting system according to the prevailing conditions, so as to obtain the best results without excessive dazzle that would disconcert the pilot. The appropriate intensity setting on any particular occasion will depend both on the conditions of background brightness and the visibility. Detailed guidance material on selecting intensity setting for different conditions is given in the Aerodrome Design Manual (Doc 9157), Part 4.

17. Signal Area

A signal area need be provided only when it is intended to use visual ground signals to communicate with aircraft in flight. Such signals may be needed when the aerodrome does not have an aerodrome control tower or an aerodrome flight information service unit, or when the aerodrome is used by airplanes not equipped with radio. Visual ground signals may also be useful in the case of failure of two-way radio communication with aircraft. It shall be recognized, however, that the type of information which may be conveyed by visual ground signals shall normally be available in AIPs or NOTAM. The potential need for visual ground signals shall therefore be evaluated before deciding to provide a signal area.

18. Rescue and Firefighting Services

18.1. Administration

18.1.1. The rescue and firefighting service at an aerodrome shall be under the administrative control of the aerodrome management, which shall also be responsible for ensuring that the service provided is organized, equipped, staffed, trained and operated in such a manner as to fulfil its proper functions.

18.1.2. In drawing up the detailed plan for the conduct of search and rescue operations in accordance with 4.2.1 with annex 12, the aerodrome management shall coordinate its plans with the relevant rescue coordination centers to ensure that the respective limits of their responsibilities for an aircraft accident within the vicinity of an aerodrome are clearly delineated.

18.1.3. Coordination between the rescue and firefighting service at an aerodrome and public protective agencies, such as local fire brigade, police force, coast guard and hospitals, shall be achieved by prior agreement for assistance in dealing with an aircraft accident.

18.1.4. A grid map of the aerodrome and its immediate vicinity shall be provided for the use of the aerodrome services concerned. Information concerning topography, access roads and location of water supplies shall be indicated. This map shall be conspicuously posted in the control tower and fire station, and available on the rescue and fire fighting vehicles and such other supporting vehicles required to respond to an aircraft accident or incident. Copies shall also be distributed to public protective agencies as desirable.

18.1.5. Coordinated instructions shall be drawn up detailing the responsibilities of all concerned and the action to be taken in dealing with emergencies. The appropriate authority shall ensure that such instructions are promulgated and observed.

18.2. Training

The training curriculum shall include initial and recurrent instruction in at least the following areas:

a. airport familiarization;

b. aircraft familiarization;

c. rescue and firefighting personnel safety;

b. emergency communications systems on the aerodrome, including aircraft fire-related alarms;

c. use of the fire hoses, nozzles, turrets and other appliances required for compliance with Chapter 9, 9.2;

d. application of the types of extinguishing agents required for compliance with Chapter 9, 9.2;

e. emergency aircraft evacuation assistance;

f. firefighting operations;

g. adaptation and use of structural rescue and firefighting equipment for aircraft rescue and firefighting;

h. dangerous goods;

i. familiarization with fire fighters' duties under the aerodrome emergency plan; and

j. Protective clothing and respiratory protection.

18.3. Level of protection to be provided

In accordance with Chapter 9, 9.2, aerodromes shall be categorized for rescue and firefighting purposes and the level of protection provided shall be appropriate to the aerodrome category.

18.4. Rescue equipment for difficult environments

18.4.1. Suitable rescue equipment and services shall be available at an aerodrome where the area to be covered by the service includes water, swampy areas or other difficult environment that cannot be fully served by conventional wheeled vehicles. This is particularly important where a significant portion of approach/departure operations takes place over these areas.

18.4.2. The rescue equipment shall be carried on boats or other vehicles such as helicopters and amphibious or air cushion vehicles, capable of operating in the area concerned. The vehicles shall be so located that they can be brought into action quickly to respond to the areas covered by the service.

18.4.3. At an aerodrome bordering the water, the boats or other vehicles shall preferably be located on the aerodrome, and convenient launching or docking sites provided. If these vehicles are located off the aerodrome, they shall preferably be under the control of the aerodrome rescue and fire-fighting service or, if this is not practicable, under the control of another competent public or private organization working in close coordination with the aerodrome rescue and fire-fighting service (such as police, military services, harbor patrol or coast guard).

18.4.4. Boats or other vehicles shall have as high a speed as practicable so as to reach an accident site in minimum time. To reduce the possibility of injury during rescue operations, water jet-driven boats are preferred to water propeller-driven boats unless the propellers of the latter boats are ducted. Shall the water areas to be covered by the service be frozen for a significant period of the year, the equipment shall be selected accordingly. Vehicles used in this service shall be equipped with life rafts and life preservers related to the requirements of the larger aircraft normally using the aerodrome, with two-way radio communication, and with floodlights for night operations. If aircraft operations during periods of low visibility are expected, it may be necessary to provide guidance for the responding emergency vehicles.

18.4.5. The personnel designated to operate the equipment shall be adequately trained and drilled for rescue services in the appropriate environment.

18.5. Facilities

18.5.1. The provision of special telephone, two-way radio communication and general alarm systems for the rescue and firefighting service is desirable to ensure the dependable transmission of essential emergency and routine information. Consistent with the individual requirements of each aerodrome, these facilities serve the following purposes:

a. Direct communication between the activating authority and the aerodrome fire station in order to ensure the prompt alerting and dispatch of rescue and fire fighting vehicles and personnel in the event of an aircraft accident or incident;

b. Direct communication between the rescue and firefighting service and the flight crew of an aircraft in emergency;

c. Emergency signals to ensure the immediate summoning of designated personnel not on standby duty;

d. As necessary, summoning essential related services on or off the aerodrome; and

e. Maintaining communication by means of two-way radio with the rescue and fire fighting vehicles in attendance at an aircraft accident or incident.

18.5.2. The availability of ambulance and medical facilities for the removal and after-care of casualties arising from an aircraft accident shall receive the careful consideration of the appropriate authority and shall form part of the overall emergency plan established to deal with such emergencies.

19. Operators of vehicles

19.1. The authorities responsible for the operation of vehicles on the movement area shall ensure that the operators are properly qualified. This may include, as appropriate to the driver's function, knowledge of:

a. The geography of the aerodrome;

b. Aerodrome signs, markings and lights;

c. Radiotelephone operating procedures;

d. Terms and phrases used in aerodrome control including the ICAO spelling alphabet;

e. Rules of air traffic services as they relate to ground operations;

f. Airport rules and procedures; and

g. Specialist functions as required, for example, in rescue and firefighting.

19.2. The operator shall be able to demonstrate competency, as appropriate, in:

a. The operation or use of vehicle transmit/receive equipment;

b. Understanding and complying with air traffic control and local procedures;

c. Vehicle navigation on the aerodrome; and

d. Special skills required for the particular function.

In addition, as required for any specialist function, the operator shall be the holder of a license and passes issued by the aerodrome operator.

19.3. The above shall be applied as is appropriate to the function to be performed by the operator, and it is not necessary that all operators be trained to the same level, for example, operators whose functions are restricted to the apron.

19.4. If special procedures apply for operations in low visibility conditions, it is desirable to verify an operator's knowledge of the procedures through periodic checks.

19.5. Development of a Framework for a Vehicle Driver Training Program Airside Vehicle Driver:

19.5.1. The following elements shall be considered when developing programs and knowledge requirements for an airside vehicle driver training program:

a. Airside Driving Permit (ADP)

(1) the issuing authority, the validity of the permit in terms of time and conditions of use;

(2) ownership of the permit and control, and audit of permit issue;

(3) (3) local enforcement, and driving offence procedures; and

(4) (4) relationship to State driver licensing system.

b. Aerodrome Regulations and Requirements

(1) rules of the air, and ATC procedures applicable to aerodromes as they relate to vehicles, particularly rights of way;

(2) specific aerodrome regulations, requirements, and local instructions;

(3) local methods used to disseminate general information, and instructions to drivers; and

(4) local methods used to disseminate information regarding works in progress.

c. Personal responsibilities

(1) agreed national or aerodrome requirements concerning fitness to drive (medical and health standards);

(2) issue and use of personal protective equipment, such as high visibility clothing and hearing protection;

(3) general driving standards;

(4) no-smoking/no-drinking requirements airside;

(5) responsibilities with respect to foreign object debris and fuel/oil spillage; and

(6) the responsibility to ensure that a vehicle is suitable for the task, and is used correctly.

d. Vehicle standards

(1) condition and maintenance standards agreed at the aerodrome, and/or national level;

(2) the requirement to display obstruction lights and company insignia;

(3) the requirement for, and content of, daily vehicle inspections;

(4) agreed standards of aerodrome and company vehicle fault reporting and rectification; and

(5) local requirements for the issue and display of airside vehicle permits.

e. General aerodrome layout

(1) the general geography of the local aerodrome;

(2) aviation terminology used such as runway, taxiway, apron, roads, crossings, runway holding points;

(3) all aerodrome signs, markings and lighting for vehicles and aircraft;

(4) specific reference to signs, markings and lighting used to guard runways, and critical areas; and

(5) specific reference to any controlled/uncontrolled taxiway crossing procedures.

f. Hazards of general airside driving

(1) speed limits, prohibited areas, and no parking regulations;

(2) the danger zones around aircraft;

(3) engine suction/ingestion and blast, propellers, and helicopters;

(4) aircraft refueling;

(5) foreign object debris and spillages;

(6) vehicle reversing;

(7) staff and passengers walking across aprons;

(8) air bridges and other services such as fixed electrical ground power;

(9) the general aircraft turnaround process;

(10) aircraft emergency stop and fuel cut-off procedures;

(11) hazardous cargo;

(12) local vehicle towing requirements;

(13) requirements for driving at night; and

(14) requirements for driving in adverse weather conditions, particularly low visibility.

g. Local Organizations

(1) the role of the aerodrome operator in setting and maintaining standards;

(2) the national aviation safety authority and its responsibilities;

(3) the national and/or local police, and their involvement with airside driving; and

(4) other enforcement authorities dealing with vehicles, driving, health, and safety.

h. Emergency Procedures

(1) actions and responsibilities in a crisis situation (any accident or significant incident occurring on the aerodrome);

(2) action in the event of a vehicle accident;

(3) specific action in the event of a vehicle striking an aircraft;

(4) action in the event of fire;

(5) action in the event of an aircraft accident/incident; and

(6) action in the event of personal injury.

i. Communications

(1) radio procedures and phraseologies to be used if applicable;

(2) light signals used by ATC;

(3) procedures to be used by vehicle drivers if lost or unsure of position;

(4) local emergency telephone numbers; and

(5) how to contact the local aerodrome safety unit.

j. Practical training (visual familiarization)

(1) airside service roads, taxiway crossings, and any restrictions during low visibility;

(2) aprons and stands;

(3) surface paint markings for vehicles and aircraft;

(4) surface paint markings that delineate the boundary between aprons and taxiways;

(5) signs, markings and lighting used on the taxiway that indicate the runways ahead;

(6) parking areas and restrictions;

(7) speed limits and regulations; and

(8) hazards during aircraft turnarounds and aircraft movements.

19.5.2. All drivers expected to operate on the maneuvering area of the aerodrome shall obtain an ADP covering the program above. Any driver expected to drive on the maneuvering area shall, also, obtain an agreed period of experience in general airside driving before training to operate on the maneuvering area.

19.5.3. All drivers Shall be trained initially and be provided with refresher training regularly, with particular additional emphasis on the following areas:

(1) Aerodrome Regulations and Requirements

i. air traffic control rules, right of way of aircraft;

ii. the definition of movement areas, maneuvering areas, aprons, stands; and

iii. methods used to disseminate information regarding works in progress.

(2) Air Traffic Control

i. the aerodrome control function and area of responsibility;

ii. the ground movement control function and area of responsibility;

iii. normal and emergency procedures used by ATC relating to aircraft;

iv. ATC frequencies used and normal handover/transfer points for vehicles;

v. ATC call signs, vehicle call signs, phonetic alphabet, and standard phraseology; and

vi. demarcation of responsibilities between ATC and apron control if applicable.

(3) Personal Responsibilities

i. fitness to drive with particular emphasis on eyesight and color perception;

ii. correct use of personal protective equipment;

iii. responsibilities with respect to foreign object debris; and

iv. responsibilities with respect to escorting other vehicles on the maneuvering area.

(4) Vehicle Standards

i. responsibility for ensuring the vehicle used is fit for the purpose and task;

ii. requirements for daily inspection prior to operating on the maneuvering area;

iii. particular attention to the display of obstruction and general lights; and

iv. serviceability of all essential communications systems with ATC and base operations.

(5) Aerodrome Layout

i. particular emphasis on signs, markings and lighting used on the maneuvering area;

ii. special emphasis on signs, markings and lighting used to protect the runway;

iii. description of equipment essential to air navigation such as instrument landing systems (ILS);

iv. description of protected zones related to ILS antenna;

v. description of ILS protected areas, and their relation to runway-holding points;

vi. description of runway instrument/visual strip, cleared and graded area; and

vii. description of lighting used on the maneuvering area with particular emphasis on those related to low visibility operations.

(6) Hazards of Maneuvering Area Driving

i. engine suction/ingestion and blast, vortex, propellers, and helicopter operations;

ii. requirements for driving at night;

iii. requirements for operations in low visibility and other adverse weather conditions;

iv. procedures in the event of a vehicle or radio becoming unserviceable while on the maneuvering area; and

v. right of way of aircraft, towed aircraft, and rescue and fire fighting vehicles in an emergency.

(7) Emergency Procedures

i. actions to be taken in the event of a vehicle accident/incident;

ii. actions to be taken in the event of an aircraft accident/incident;

iii. actions to be taken if foreign object debris or other debris is found on runways and taxiways;

iv. procedures to be used by vehicle drivers if lost or unsure of their position; and

v. local emergency telephone numbers.

(8) Aircraft Familiarization

i. knowledge of aircraft types and ability to identify all types normally operating at the aerodrome;

ii. knowledge of airline call signs; and

iii. knowledge of aircraft terminology relating to engines, fuselage, control surfaces, undercarriage, lights, vents, etc.

(9) Practical Training (Visual Familiarization)

i. all runways (including access and exit routes), holding areas, taxiways and aprons;

ii. all signs, surface markings and lighting associated with runways, holding positions, CAT I, II, and III operations;

iii. all signs, surface markings and lighting associated with taxiways;

iv. specific markings that demarcate the boundary between aprons and maneuvering areas;

v. navigation aids such as ILS, protected area, antenna, RVR equipment, and other meteorological equipment;

vi. hazards of operating around aircraft landing, taking off or taxiing; and

vii. any locally used naming convention for particular areas or routes.

20. The ACN-PCN method of reporting pavement strength

20.1. Overload operations

20.1.1. Overloading of pavements can result either from loads too large, or from a substantially increased application rate, or both. Loads larger than the defined (design or evaluation) load shorten the design life, whilst smaller loads extend it. With the exception of massive overloading, pavements in their structural behavior are not subject to a particular limiting load above which they suddenly or catastrophically fail. Behavior is such that a pavement can sustain a definable load for an expected number of repetitions during its design life. As a result, occasional minor overloading is acceptable, when expedient, with only limited loss in pavement life expectancy and relatively small acceleration of pavement deterioration. For those operations in which magnitude of overload and/or the frequency of use do not justify a detailed analysis, the following criteria are suggested:

a. for flexible pavements, occasional movements by aircraft with ACN not exceeding 10 per cent above the reported PCN shall not adversely affect the pavement;

b. for rigid or composite pavements, in which a rigid pavement layer provides a primary element of the structure, occasional movements by aircraft with ACN not exceeding 5 per cent above the reported PCN shall not adversely affect the pavement;

c. if the pavement structure is unknown, the 5 per cent limitation shall apply; and

b. the annual number of overload movements shall not exceed approximately 5 per cent of the total annual aircraft movements.

20.1.2. Such overload movements shall not normally be permitted on pavements exhibiting signs of distress or failure. Furthermore, overloading shall be avoided during any periods of thaw following frost penetration, or when the strength of the pavement or its subgrade could be weakened by water. Where overload operations are conducted, the appropriate authority shall review the relevant pavement condition regularly, and shall also review the criteria for overload operations periodically since excessive repetition of overloads can cause severe shortening of pavement life or require major rehabilitation of pavement.

20.2. ACNs for several aircraft types

For convenience, several aircraft types currently in use have been evaluated on rigid and flexible pavements founded on the four subgrade strength categories in Chapter 2, 2.6.6 b), and the results tabulated in the Aerodrome Design Manual (Doc 9157), Part 3.

21. Autonomous Runway Incursion Warning System (ARIWS)

Note 1: These autonomous systems are generally quite complex in design and operation and, as such deserve careful consideration by all levels of the industry, from the regulating authority to the end user. This guidance is offered to provide a clearer description of the system(s) and offer some suggested actions required in order to properly implement these system(s) at an aerodrome in any State.

Note 2: The Manual on the Prevention of Runway Incursion (Doc 9870) presents different approaches for the prevention of runway incursion.

21.1. General Description

21.1.1. The operation of an ARIWS is based upon a surveillance system which monitors the actual situation on a runway and automatically returns this information to warning lights at the runway (take-off) thresholds and entrances. When an aircraft is departing from a runway (rolling) or arriving at a runway (short final), red warning lights at the entrances will illuminate, indicating that it is unsafe to enter or cross the runway. When an aircraft is aligned on the runway for take-off and another aircraft or vehicle enters or crosses the runway, red warning lights will illuminate at the threshold area, indicating that it is unsafe to start the take-off roll.

21.1.2. In general, an ARIWS consists of an independent surveillance system (primary radar, multilateration, specialized cameras, dedicated radar, etc.) and a warning system in the form of extra airfield lighting systems connected through a processor which generates alerts independent from ATC directly to the flight crews and vehicle operators.

21.1.3. An ARIWS does not require circuit interleaving, secondary power supply or operational connection to other visual aid systems.

21.1.4. In practice, not every entrance or threshold needs to be equipped with warning lights. Each aerodrome will have to assess its needs individually depending on the characteristics of the aerodrome. There are several systems developed offering the same or similar functionality.

21.2. Flight crew actions

21.2.1. It is of critical importance that flight crews understand the warning being transmitted by the ARIWS system. Warnings are provided in near real-time, directly to the flight crew because there is no time for “relay” types of communications. In other words, a conflict warning generated to ATS which must then interpret the warning, evaluate the situation and communicate to the aircraft in question, would result in several seconds being taken up where each second is critical in the ability to stop the aircraft safely, and prevent a potential collision. Pilots are presented with a globally consistent signal which means “STOP IMMEDIATELY” and must be taught to react accordingly. Likewise, pilots receiving an ATS clearance to take-off or cross a runway, and seeing the red light array, must STOP and advise ATS that they aborted/stopped because of the red lights. Again, the criticality of the timeline involved is so tight that there is no room for misinterpretation of the signal. It is of utmost importance that the visual signal be consistent around the world.

21.2.2. It must also be stressed that the extinguishing of the red lights does not, in itself, indicate a clearance to proceed. That clearance is still required from air traffic control. The absence of red warning lights only means that potential conflicts have not been detected.

21.2.3. In the event that a system becomes unserviceable, one of two things will occur. If the system fails in the extinguished condition, then no procedural changes need to be accomplished. The only thing that will happen is the loss of the automatic, independent warning system. Both ATS operations and flight crew procedures (in response to ATS clearances) will remain unchanged.

21.2.4. Procedures shall be developed to address the circumstance where the system fails in the illuminated condition. It will be up to the ATS and/or aerodrome operator to establish those procedures depending on their own circumstances. It must be remembered that flight crews are instructed to “STOP” at all red lights. If the affected portion of the system, or the entire system is shut off, the situation is reverted to the extinguished scenario described in 21.2.3 above.

21.3. Aerodromes

21.3.1. An ARIWS does not have to be provided at all aerodromes. An aerodrome considering the installation of such a system may wish to assess its needs individually, depending on traffic levels, aerodrome geometry, ground taxi patterns, etc. Local user groups such as the Local Runway Safety Team (LRST) can be of assistance in this process. Also, not every runway or taxiway needs to be equipped with the lighting array(s) and not every installation requires a comprehensive ground surveillance system to feed information to the conflict detection computer.

21.3.2. Although there may be local specific requirements, some basic system requirements are applicable to all ARIWS:

a. the control system and energy power supply of the system must be independent from any other system in use at the aerodrome, especially the other parts of the lighting system;

b. the system must operate independently from ATS communications;

c. the system must provide a globally accepted visual signal that is consistent and instantly understood by crews; and

d. Local procedures shall be developed in the case of malfunction or failure of a portion of, or the entire system.

21.4. Air Traffic Services

21.4.1. The ARIWS is designed to be complementary to normal ATS functions, providing warnings to flight crews and vehicle operators when some conflict has been unintentionally created or missed during normal aerodrome operations. The ARIWS will provide a direct warning when, for example, ground control or tower (local) control has provided a clearance to hold short of a runway but the flight crew or vehicle operator has "missed" the hold short portion of their clearance and tower has issued a take-off or landing clearance to that same runway, and the non-read back by the flight crew or vehicle operator was missed by air traffic control.

21.4.2. In the case where a clearance has been issued and a crew reports a non-compliance due to "red lights", or aborting because of "red lights", then it is imperative that the controller assess the situation and provide additional instructions as necessary. It may well be that the system has generated a false warning or that the potential incursion no longer exists; however, it may also be a valid warning. In any case, additional instructions and/or a new clearance need to be provided. In a case where the system has failed, then procedures will need to be put into place as described in 21.2.3 and 21.2.4 above. In no case shall the illumination of the ARIWS be dismissed without confirmation that, in fact, there is no conflict. It is worth noting that there have been numerous incidents avoided at aerodromes with such systems installed. It is also worth noting that there have been false warnings as well, usually as a result of the calibration of the warning software, but in any case, a confirmation of the potential conflict existence or non-existence must be done.

21.4.3. While many installations may have a visual or audio warning available to ATS personnel, it is in no way intended that ATS personnel be required to actively monitor the system. Such warnings may assist ATS personnel in quickly assessing the conflict in the event of a warning and help them to provide appropriate further instructions, but the ARIWS shall not play an active part in the normal functioning of any ATS facility.

21.4.4. Each aerodrome where the system is installed will develop procedures depending upon their unique situation. Again, it must be stressed that under no circumstances shall pilots or operators be instructed to “cross the red lights”. As indicated previously, the use of local runway safety teams can greatly assist in this development process.

21.5. Promulgation of information

21.5.1. Information on the characteristics and status of an ARIWS at an aerodrome are promulgated in the AIP section AD 2.9, in PANS-AIM (Doc 10066) and its status updated as necessary through NOTAM or ATIS in compliance with CAR 139 Part1, 2.9.1.

21.5.2. Aircraft operators are to ensure that flight crews documentation include procedures regarding ARIWS and appropriate guidance information, in compliance with Annex 6, Part I.

21.5.3. Aerodromes may provide additional sources of guidance on operations and procedures for their personnel, aircraft operators, ATS and third parties personnel who may have to deal with an ARIWS.

22. Taxiway design guidance for minimizing the potential for the runway incursions

22.1. Good aerodrome design practices can reduce the potential for runway incursions while maintaining operating efficiency and capacity. The following taxiway design guidance may be considered to be part of a runway incursion prevention program as a means to ensure that runway incursion aspects are addressed during the design phase for new runways and taxiways. Within this focused guidance, the prime considerations are to limit the number of aircraft or vehicles entering or crossing a runway, provide pilots with enhanced unobstructed views of the entire runway, and correct taxiways identified as hot spots as far as possible.

22.2. The center line of an entrance taxiway shall be perpendicular to the runway center line, where possible. This design principle provides pilots with an unobstructed view of the entire runway, in both directions, to confirm that the runway and approach are clear of conflicting traffic before proceeding towards the runway. Where the taxiway angle is such that a clear unobstructed view, in both directions, is not possible, consideration shall be given to providing a perpendicular portion of the taxiway immediately adjacent to the runway to allow for a full visual scan by the pilots prior to entering or crossing a runway.

22.3. For taxiways intersecting with runways, avoid designing taxiways wider than requirements in Part-139. This design principle offers improved recognition of the location of the runway holding position and the accompanying sign, marking, and lighting visual cues.

22.4. Existing taxiways wider than recommended in CAR 139, can be rectified by painting taxi side stripe markings to the recommended width. As far as practicable, it is preferable to redesign such locations properly rather than to repaint such locations.

22.5. Multi-taxiway entrances to a runway shall be parallel to each other and shall be distinctly separated by an unpaved area. This design principle allows each runway holding location an earthen area for the proper placement of accompanying sign, marking, and lighting visual cues at each runway holding position. Moreover, the design principle eliminates the needless costs of building unusable pavement and as well as the costs for painting taxiway edge markings to indicate such unusable pavement. In general, excess paved areas at runway holding positions reduce the effectiveness of sign, marking, and lighting visual cues.

22.6. Build taxiways that cross a runway as a single straight taxiway. Avoid dividing the taxiway into two after crossing the runway. This design principle avoids constructing "Y-shaped" taxiways known to present risk of runway incursions.

22.7. If possible, avoid building taxiways that enter at the mid-runway location. This design principle helps to reduce the collision risks at the most hazardous locations (high energy location) because normally departing aircraft have too much energy to stop, but not enough speed to take-off, before colliding with another errant aircraft or vehicle.

22.8. Provide clear separation of pavement between a rapid exit taxiway and other non-rapid taxiways entering or crossing a runway. This design principle avoids two taxiways from overlapping each other to create an excessive paved area that would confuse pilots entering a runway.

22.9. Avoid the placement of different pavement materials (asphalt and cement concrete) at or near the vicinity of the runway holding position, as far as practicable. This design principle avoids creating visual confusion as to the actual location of the runway holding position.

22.10. Perimeter taxiways. Many aerodromes have more than one runway, notably paired parallel runways (two runways on one side of the terminal), which creates a difficult problem in that either on arrival or departure an aircraft is required to cross a runway. Under such a configuration, the safety objective here is to avoid or at least keep to a minimum the number of runway crossings. This safety objective may be achieved by constructing a "perimeter taxiway". A perimeter taxiway is a taxi route that goes around the end of a runway, enabling arrival aircraft (when landings are on outer runway of a pair) to get to the terminal or departure aircraft (when departures are on outer runway of a pair) to get to the runway without either crossing a runway, or conflicting with a departing or approaching aircraft.

22.11. A perimeter taxiway would be designed according to the following criteria:

a. Sufficient space is required between the landing threshold and the taxiway center line where it crosses under the approach path, to enable the critical taxiing aircraft to pass under the approach without penetrating any approach surface.

b. The jet blast impact of aircraft taking off shall be considered in consultation with aircraft manufacturers; the extent of take-off thrust shall be evaluated when determining the location of a perimeter taxiway.

c. The requirement for a runway end safety area, as well as possible interference with landing systems and other navigation aids shall also be taken into account. For example, in the case of an Instrument Landing System, the perimeter taxiway shall be located behind the localizer antenna, not between the localizer antenna and the runway, due to the potential for severe Instrument Landing System disturbance, noting that this is harder to achieve as the distance between the localizer and the runway increases.

d. Human factors issues shall also be taken into account. Appropriate measures shall be put in place to assist pilots to distinguish between aircraft that are crossing the runway and those that are safely on a perimeter taxiway.

23. Aerodrome Mapping Data

23.1. Introduction

Chapter 2, 2.1.2 and 2.1.3, contain provisions related to the provision of aerodrome mapping data. The aerodrome mapping data features are collected and made available to the aeronautical information services for aerodromes designated by States with consideration of the intended applications. These applications are closely tied to an identified need and operational use where the application of the data would provide a safety benefit or could be used as mitigation to a safety concern.

23.2. Applications

23.2.1. Aerodrome mapping data include aerodrome geographic information that support applications which improve the user's situational awareness or supplement surface navigation, thereby increasing safety margins and operational efficiency. With appropriate data element accuracy, these data sets support collaborative decision making, common situational awareness, and aerodrome guidance applications. The data sets are intended to be used in the following air navigation applications:

a. On-board positioning and route awareness including moving maps with own aircraft position, surface guidance and navigation;

b. Traffic awareness including surveillance and runway incursion detection and alerting (such as respectively in A-SMGCS levels 1 and 2);

c. Ground positioning and route awareness including situational displays with aircraft and vehicles position and taxi route, surface guidance and navigation (such as A-SMGCS levels 3 and 4);

b. Facilitation of aerodrome-related aeronautical information, including NOTAMs;

c. Resource and aerodrome facility management; and

d. Aeronautical chart production.

23.2.2. The data may also be used in other applications such as training / flight simulators and on-board or ground enhanced vision systems (EVS), synthetic vision systems (SVS) and combined vision systems (CVS).

23.2.3. Determination of aerodromes to be considered for collection of aerodrome mapping data features

23.2.4. In order to determine which aerodromes may make use of applications requiring the collection of aerodrome mapping data features, the following aerodrome characteristics may be considered:

- safety risks at the aerodrome;
- visibility conditions;
- aerodrome layout; and
- traffic density.

Note: Further guidance on aerodrome mapping data can be found in Doc 9137, Airport Services Manual, Part 8 — Airport Operational Service.

24. Apron Management Service

24.1. General

24.1.1. The air traffic control service at an aerodrome extends throughout the maneuvering area, but no specific instructions relating to such a service cover the apron. Therefore, apron management is required to regulate the activities and movement of aircraft, vehicles and personnel on the apron (Part-139, Chapter 9).

24.1.2. There are a variety of different approaches to apron management which have been developed and which can, depending on the particular condition, accommodate the requirements of the aerodrome.

24.1.3. Apron management is an essential task at any aerodrome. However, the need to establish a dedicated apron management service is dependent upon three main operational factors. They are:

a. the traffic density;

b. the complexity of the apron layout; and

c. the visibility conditions under which the aerodrome authority plans to maintain operations.

24.1.4. Generally, it is not practicable to exercise total control over all traffic on the movement area. However, in very poor visibility conditions it may be necessary to exercise such a control at the expense of capacity. Within the field of reasonable constraint which varies according to conditions, safety and expedition depend upon aircraft and vehicles conforming to. Standard ground movement rules and regulations. The apron management must establish rules related to the operation of aircraft and ground vehicles on the aprons. These rules shall be compatible with those for the maneuvering area.

24.2. When should an apron management service be established?

24.2.1. Part-139, Chapter 9, requires that an apron management service be provided when warranted by the volume of traffic and operating conditions.

24.2.2. It is not possible to define at what levels of traffic volume and under what operating conditions an apron management service shall be established. Generally speaking, the more complex the apron layout the more comprehensive an apron management service needs to be, particularly when taxiways are included in the apron area.

24.2.3. The decision whether or not to provide an apron management service at a particular airport must rest with the aerodrome operator. If firm guidelines were given here on the conditions under which such a service shall be provided it would remove the flexibility needed by individual aerodrome operator to design an apron management service more suitable to their particular needs.

24.2.4. Most aerodromes will already have some form of apron management. This may simply be an area set aside for the parking of aircraft, with painted lines to guide pilots to self-maneuvering aircraft stands. At the other end of the scale the apron area may be a large part of the movement area with numerous nose-in stands, several terminals and complex taxiways forming part of the layout. A complex apron area such as this will need a comprehensive apron management service including radio communication facilities.

24.2.5. Aerodrome operator must therefore consider what scope of management is needed for the activity on their apron areas to ensure the safe and efficient operation of aircraft and vehicles in close proximity. This is particularly important where low visibility operations are contemplated.

24.2.6. When considering what scope of management may be needed on an apron area, the following points shall be considered:

a. Is the apron area sufficiently large, complex or busy to merit a separate staff to manage it?

b. What radiotelephony (RTF) facilities do the staff need to exercise control over their own vehicles, airline vehicles and, if necessary, over aircraft using apron taxiways?

c. If apron management staff are required to exercise control over aircraft and vehicles on the apron area to ensure safe separation, then such staff shall be properly trained and licensed by the aerodrome operator and their legal authority clearly established.

d. Will the apron management service issue its own instructions such as start-up, push back, taxi clearances, and stand allocation or will these be given by the ATS unit as an element of the apron management service?

e. How will the various airline service vehicles be regulated on the apron as well as on airside roads serving aircraft stands? Is there a need for roads, controlled or uncontrolled, crossing apron taxiways?

f. Who will be responsible for inspection, maintenance and cleanliness of the aprons?

g. What size marshalling service, including leader van service (follow-me vehicles), is required to meet aircraft parking needs?

h. Are low visibility operations contemplated at the aerodrome? If so what procedures need to be developed to ensure safety on the apron area?

i. Are there procedures to cater for contingencies such as accidents, emergencies, diversion aircraft, flow control when the stands are nearly all occupied, maintenance work, stand cleaning and security?

24.3. Who operates the apron management service?

24.3.1. Apron management services may be provided by the air traffic service unit, by a unit set up by the aerodrome operator, by the operator in the case of a ' company terminal, or by coordinated control between ATS and the aerodrome authority or operating company.

24.3.2. The system of operating aprons shall set up a traffic management control procedure in which a single unit takes over the responsibility for aircraft and vehicles at a pre-determined handover point between the apron and the maneuvering area. Generally, the edge of the maneuvering area represents the handover point. In any event, the handover point shall be clearly indicated on the ground and on appropriate charts, for example the aerodrome chart, for the benefit of aircraft/vehicle operators. The apron management unit will then assume responsibilities for managing and coordinating all aircraft traffic on the apron, issuing verbal instructions on an agreed radio frequency, and managing all apron vehicle traffic and other apron activities in order to advise aircraft of potential hazards within the apron area. By arrangement with the aerodrome ATS unit, start-up and taxi clearance to the handover point will be given to departing aircraft where the ATS unit assumes responsibility.

24.3.3. One form of the coordinated apron management service is where radio communication with aircraft requiring start-up or push-back clearance on the apron is vested in the air traffic service unit, and the control of vehicles is the responsibility of the aerodrome operator or the operator. At these aerodromes, ATS instructions to aircraft are given on the understanding that safe separation between the aircraft and vehicles not under radio control is not included in the instruction.

24.3.4. The apron management service maintains close communication with the aerodrome control service and is responsible for aircraft stand allocation, dissemination of movement information to aircraft operators by monitoring ATC frequencies, and by updating basic information continuously on aircraft arrival times, landings and take-offs. The apron management service shall ensure that the apron area is kept clean by airport maintenance and that established aircraft clearance distances are available at the aircraft stand. A marshalling service and a leader van (follow-me vehicle) service may also be provided.

24.4. Responsibilities and Functions

24.4.1. Whichever method of operating an apron management service is provided, the need for close liaison between the aerodrome operator, aircraft operator and ATS is paramount. The operational efficiency and safety of the system depends very largely on this close co-operation. The following items are of importance to both ATS and the aerodrome operator:

a) Aircraft Stand Allocation

Over-all responsibility for aircraft stand allocation is retained by the aerodrome operator instructions shall clearly state which stands may be used by which aircraft or groups of aircraft. Where considered desirable, a preferred order of use of stands shall be laid down. Apron management staff shall be given clear guidance on the stand occupancy times to be permitted and the steps to be taken to achieve compliance with the rules. The responsibility for stand allocation may be delegated to an airline where that airline has a dedicated terminal or apron area.

b) Aircraft arrival/departure times

Foreknowledge of arrival and departure times scheduled, estimated and actual is required by ATS, apron management, terminal management and the operators. A system shall be established to ensure that this information is passed between all interested parties as quickly and efficiently as possible.

c) Start-up clearances

Normally these are given by the ATC unit. Where an apron management service operates its own radio communication on the apron area procedures will need to be established between the apron management service and the ATC unit to ensure the efficient coordination and delivery of such clearances.

d) Dissemination of information to operators

A system shall be established to ensure the efficient distribution of relevant information between apron management, ATS and operators. Such information could include notification of work in progress, non-availability of facilities and low visibility procedures.

e) Security Arrangements

In addition to normal security arrangements there are security requirements which are of interest to many parties who operate on the apron. These would include contingency plans for such eventualities as baggage identification on the stand, bomb warnings and hijack threats.

f) Availability of Safety Services

The rescue and firefighting services (RFF) are normally alerted to an incident on the movement area by ATS. However, at aerodromes where aircraft on the apron area are controlled by the apron management service, a communication system needs to be established to alert the RFF when an incident occurs in the apron area of responsibility.

g) Apron Discipline

The apron management service will be responsible for ensuring compliance by all parties with regulations relating to the apron.

24.4.2. Aircraft Parking/Docking Guidance System

The apron guidance system provided will depend upon the accuracy of parking required and the types of aircraft operating on the apron. The simplest form of stand guidance, where precise accuracy is not required, will comprise stand identification and centerline paint markings.

Guidance on apron markings is given in the Aerodrome Design Manual, Part 4. The apron management service shall monitor all paint markings to ensure that they are maintained in a clean condition to retain maximum visibility. Where more accurate parking/docking is required then one of the guidance systems conforming to the specifications in Part-139, Chapter 5 must be installed. Details of these systems are given in the Aerodrome Design Manual, Part 4, Chapter 12. The apron management service should monitor these systems and associated guidance lights to ensure that they are inspected at least weekly to maintain high standards of serviceability.

24.4.3. Marshalling Service

An aerodrome marshalling service shall be provided where parking or docking guidance systems do not exist or are unserviceable or where guidance to aircraft parking is required to avoid a safety hazard and to make the most efficient use of available parking space. Proper training arrangements shall exist for marshallers and only those who have demonstrated satisfactory competence shall be permitted to marshal aircraft. Where aerodrome marshalling is provided, comprehensive instructions shall be written for marshallers including:

a. the absolute necessity for using only authorized signals (copies of these should be displayed at suitable points);

b. the need to ensure that prior to using the authorized signals the marshaller shall ascertain that the area within which an aircraft is to be guided is clear of objects which the aircraft, in complying with his signals, might otherwise strike;

c. the circumstances in which one marshaller may be used and the occasions when wing walkers are necessary;

d. the action to be taken in the event of an emergency or incident involving an aircraft and/or vehicle occurring during marshalling, e.g., collision, fire, fuel spillage;

e. the need to wear a distinctive jacket at all times. This jacket can be of the waistcoat variety colored dayglow red, reflective orange, or reflective yellow; and

f. the action to be taken when re-positioning of aircraft is to be carried out by tractor and signaling is necessary to close down engines.

24.5. Special procedures for low visibility conditions

The special procedures related to low visibility conditions are described in Chapter 5 in the Manual of Surface Movement Guidance and Control Systems (SMGCS) (Doc 9476).

24.6. Training

24.6.1. The functions of the apron management service require that its staff be appropriately trained and authorized to carry out their respective responsibilities. This applies particularly to those responsible for the operation of an apron management center or tower (if applicable), to marshallers and to leader van (follow-me vehicle) operators.

24.6.2. Staff operating an apron management center or tower (if applicable) have the responsibility for managing and, at some aerodromes, controlling aircraft movement within their area of responsibility. To a considerable extent their function is similar to that of ATC control on the maneuvering area and similar training of staff is required. Among the issues addressed by a training program will be:

a. ATS unit/apron management coordination;

b. start-up procedures;

c. push-back procedures;

d. gate holding procedures;

e. taxi clearances; and

24.6.3. To satisfy training requirements for apron management operating staff, some States utilize programs developed for ATS staff. Further, some States require that apron management staff hold ATC or other licenses or have as part of their training, experience in aerodrome control.

24.6.4. Aircraft marshallers require training to ensure that they are properly qualified to direct aircraft movements. Their training shall focus on:

a. signaling;

b. aircraft characteristics, both physical and operating, that relate to maneuvering of aircraft within the confines of the apron; and

c. personal safety around aircraft and particularly engines.

24.6.5. At aerodromes where "Follow me" vehicles are in use, local regulations shall ensure that drivers are suitably qualified in RTF procedures, know visual signals and have a suitable knowledge of taxiing speeds and correct aircraft/vehicle spacings. A thorough knowledge of the aerodrome layout with an ability to find one's way in low visibility is important.

25. Surface Movement Guidance and Control Systems

25.1. Visibility and traffic conditions

The visibility conditions under which the aerodrome operator plans to maintain operations and the traffic density are the two most important factors to be considered when selecting components for a surface movement guidance and control (SMGC) system for an airport. For the purpose of discussing SMGC systems, visibility and traffic conditions have been subdivided and defined according to the terms indicated in Table 1 bellow. Whenever these terms are used in this section, they have the meanings given to them in Table 1.

Table 1.
Visibility and Traffic Conditions Associated with SMGC Systems - Explanation of Terms

VISIBILITY CONDITIONS	
1	Visibility sufficient for the pilot to taxi and to avoid collision with other traffic on taxiways and at intersections by visual reference, and for personnel of control units to exercise control over all traffic on the basis of visual surveillance;
2	Visibility sufficient for the pilot to taxi and to avoid collision with other traffic on taxiways and at intersections by visual reference, but insufficient for personnel of control units to exercise control over all traffic on the basis of visual surveillance; and
3	Visibility less than 550 m RVR (low visibility operations).
TRAFFIC DENSITY (In the mean busy hour)	
Light	Not greater than 15 movements 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 of the order of 26 or more per runway or typically more than 35 total aerodrome movements.

25.2. Basic equipment requirements

The equipment required at a particular aerodrome for provision of an SMGC system will depend both on the density of traffic and the visibility conditions in which the operations should take place. For guidance on this, see 25.4. However, the following equipment is fundamental to any SMGC system and shall therefore be provided at all aerodromes:

Markings:

- runway center line
- taxiway center line
- taxi-holding position
- taxiway intersection
- apron
- restricted use areas

Lighting:

- runway edge
- taxiway edge
- obstacle lights
- restricted use areas

Signs:

- mandatory signs, e.g., taxi-holding position, NO ENTRY, STOP
- information signs, e.g., location and destination

Other:

- aerodrome chart
- aerodrome control service
- signaling lamp
- radiotelephony equipment.

25.3. Basic Procedural/ Administration Requirements

Procedures are an important and integral part of an SMGC system and they are implemented partly by the aerodrome operator, partly by the air traffic control unit, and partly by the pilot. As in the case of SMGC aids, the procedures to be employed at a particular aerodrome will be dictated by both traffic density and visibility conditions. For guidance on this see 25.4. However, the following procedures are fundamental to any SMGC system and should therefore be implemented at all aerodromes:

Aerodrome Operator:

- designation of taxiways

- movement area inspections
- regulation of ground staff conducts on the movement area
- regulation of ground staff radiotelephony procedures
- periodic electrical monitoring of SMGC aids
- initiation of amendment of aerodrome chart as necessary
- apron management

Air Traffic Services:

- provision of air traffic control services
- use of radiotelephony procedures and phraseology
- use of signaling lamp
- monitoring of SMGC aids

Pilot:

- adherence to ground movement traffic rules and regulations
- use of radiotelephony procedures and phraseology.

25.4. Matching Aids to Aerodrome Conditions

25.4.1. Table 2 lists the aids considered appropriate for each of the nine possible combinations of traffic and visibility conditions. It will be observed that the table includes not only the basic aids detailed in 25.2.1 but also the additional aids needed to ensure safe and expeditious movement of aircraft under different traffic and density conditions.

25.4.2. The table lists the visual docking guidance system as an essential aid for a few combinations of traffic and visibility conditions. A visual docking guidance system may be useful in other situations as well. In evaluating the need for a visual docking guidance system, the following factors merit consideration:

- the number of aircraft using the aircraft stand
- weather conditions
- space available on the apron
- precision required at the parking position
- availability and cost of alternative means.

25.4.3. Signs are a basic aid. They serve an important function in informing a pilot and reducing RTF communications. The number and quality of signs provided at an aerodrome is a variable which is not reflected in the table. As traffic increases or visibility decreases improvements in the signs provided as well as the lighting and electronic aids used for guidance and control are required.

25.4.4. Charts are another aid which cannot be precisely specified. Until recently only an aerodrome chart was defined in Annex 4. This is now recognized as insufficient, as more information about the aerodrome is often required than can be shown on the aerodrome chart. Accordingly, a ground movement chart is specified and when this too is incapable of showing all information an apron parking/docking chart is required. As the provision of these charts is related to the complexity of the aerodrome and not visibility or traffic conditions only one entry, "Charts", is included in Table 2 bellow. The aerodrome authority should assess the number of charts required in accordance with the amount of information required to be shown.

Table 2- Guidance on Selecting SMGC System Aids

Aid	Traffic condition	Light			Medium			Heavy			Reference
	Visibility condition	1	2	3	1	2	3	1	2	3	
Apron markings		×	×	×	×	×	×	×	×	×	CAR-139-chap 5, ICAO doc 9157 part 4-chap 2
Runway centre line marking		×	×	×	×	×	×	×	×	×	CAR-139-chap 5
Taxiway centre line marking		×	×	×	×	×	×	×	×	×	CAR-139-chap 5
Taxi-holding position marking		×	×	×	×	×	×	×	×	×	CAR-139-chap 5
Visual aids for denoting restricted use areas		×	×	×	×	×	×	×	×	×	CAR-139-chap 7
Runway edge lights		×	×	×	×	×	×	×	×	×	CAR-139-chap 5, ICAO doc 9157 part 5-chap 3
Taxiway edge lights		×	×	×	×	×	×	×	×	×	CAR-139-chap 5, ICAO doc 9157 part 5-chap 3
Obstacle lighting		×	×	×	×	×	×	×	×	×	CAR-139-chap5
Signs		×	×	×	×	×	×	×	×	×	CAR-139-chap 5
Taxiway intersection marking		×	×	×	×	×	×	×	×	×	CAR-139-chap 5
Charts (aerodrome, movement, apron)		×	×	×	×	×	×	×	×	×	Annex 4- chap 13,14 and 15
Aerodrome control service		×	×	×	×	×	×	×	×	×	Annex 11, PANS-RAC
Signalling lamp		×	×	×	×	×	×	×	×	×	CAR-139-chap 5
Radiotelephony equipment		×	×	×	×	×	×	×	×	×	Annex 11- chap 6
Taxi-holding position lights				×		×	×	×	×	×	CAR-139-chap 5
Clearance bars				×		×	×		×	×	CAR-139-chap 5
Electrical monitoring system for lights			×	×		×	×	×	×	×	CAR-139-chap 8, ICAO doc 9157 part 5-chap 3
Taxiway centre line lights				×			×			×	CAR-139-chap 5, ICAO doc 9157 part 5-chap 3
Stop bars				×		×	×		×	×	CAR-139-chap 5, ICAO doc 9157 part 5-chap 3
Selective switching capability for taxiway centre line lights											ICAO doc 9157, part 4, chap10 and part 5, chap 3
Selective switching capability for apron taxiway centre line lights							×			×	ICAO doc 9157, part 4, chap10 and part 5, chap 3
Surface movement radar (SMR)							×		×	×	ATS planning manual
Aircraft stand manoeuvring guidance lights				×			×			×	CAR-139-chap 5
Runway clearance aid				×			×			×	CAR-139-chap 5
Secondary power supply			×	×	×	×	×	×	×	×	CAR-139-chap 8, ICAO doc 9157 part 4-chap10
Visual docking guidance system				×			×		×	×	CAR-139, chap 5, ICAO doc 9157, part 4, chap 12

See ICAO DOC 9476- Appendix A for further information on visual aids.

25.5. Matching Procedures to Aerodrome Conditions

25.5.1. Table 3 bellow lists the procedures considered appropriate for each of the nine possible combinations of traffic density and visibility conditions. It will be observed that the table includes not only the basic procedures detailed in 25.3.1 but also the additional procedures needed to ensure safe and expeditious movement of aircraft under different traffic and visibility conditions.

25.5.2. It is to be noted that a separate section of Table 3 bellow has been devoted to apron management procedures. This has been done to conveniently isolate applicable procedures for the case where it is intended to establish a self-contained apron management unit. If no separate apron management unit is established, responsibility for these procedures will rest, in part, with the ATS unit and, in part, with the aerodrome operator.

Table 3. Guidance on Selecting SMGC System Procedures

Procedures	Traffic condition	Light			Medium			Heavy			Reference
	Visibility condition	1	2	3	1	2	3	1	2	3	
Aerodrome operator											
Periodic electrical monitoring of SMGC aids		×	×	×	×	×	×	×	×	×	CAR-139-chap8
Designation of taxiways		×	×	×	×	×	×	×	×	×	ICAO DOC 9476, chap 3
Movement area inspections and reporting		×	×	×	×	×	×	×	×	×	CAR-139-chap 2 and ICAO DOC 9476-chap 3
Regulation of ground staff conduct on the movement area		×	×	×	×	×	×	×	×	×	ICAO DOC 9476, chap 3
Initiation of amendment of aerodrome charts as necessary		×	×	×	×	×	×	×	×	×	ICAO DOC 9476, chap 6
Regulation of ground staff radiotelephony procedures		×	×	×	×	×	×	×	×	×	Annex 10, PANS-RAC
Establishment of standard taxi routes				×		×	×	×	×	×	ICAO DOC 9476, chap 3
Low visibility movement area protection measures				×			×			×	ICAO DOC 9476, chap 5
Continual electrical monitoring of SMGC aids				×			×			×	CAR-139-chap 8 and ICAO DOC 9476-chap 3
ATS											
Visual monitoring of SMGC aids		×	×	×	×	×	×	×	×	×	Annex 11-chap 8 and ICAO DOC 9476-chap 3
Use of radiotelephony procedures and phraseology		×	×	×	×	×	×	×	×	×	Annex 10, PANS-RAC
Use of signalling lamp		×	×	×	×	×	×	×	×	×	Annex 2
Control of other than aircraft traffic on the manoeuvring area		×	×	×	×	×	×	×	×	×	PANS-RAC-part 5
Operation of lighting aids		×	×	×	×	×	×	×	×	×	PANS-RAC-part 5
Determination of the taxiway route to be followed				×		×	×	×	×	×	PANS-RAC-part 5, ICAO DOC 9476-chap 3
Application of sequencing procedure				×	×	×	×	×	×	×	ICAO DOC 9476-chap 4
Initiation and termination of low visibility procedures				×			×			×	PANS-RAC-part 5, ICAO DOC 9476-chap 5
Application of separation criteria				×			×			×	PANS-RAC-part 5, ICAO DOC 9476-chap 4

Continual electrical monitoring of SMGC aids			×			×			×	Annex 11, ICAO DOC 9476-chap 3
Monitoring of surface movement on SMR						×		×	×	ICAO DOC 9476-chap 4
Selective switching of taxiway centre line lights						×			×	ICAO doc 9157 part 4, PANS-RAC-part 5
Selective switching of stop bars			×		×	×		×	×	ICAO doc 9157 part 4, PANS-RAC-part 5
Adherence to ground movement traffic rules and regulations	×	×	×	×	×	×	×	×	×	Annex 2, PANS-RAC
Use of radiotelephony procedures and phraseology	×	×	×	×	×	×	×	×	×	Annex 10, PANS-RAC and manual of radiotelephony
Apron management										
Apron regulations and procedures	×	×	×	×	×	×	×	×	×	CAR-139-chap 9, ICAO DOC 9476-chap 8
Emergency procedures	×	×	×	×	×	×	×	×	×	ICAO DOC 9476-chap 5 and 8
Communication procedures with ATS	×	×	×	×	×	×	×	×	×	ICAO DOC 9476-chap 4 and 8
Stand allocation and information	×	×	×	×	×	×	×	×	×	ICAO DOC 9476-chap 8
Apron security procedures	×	×	×	×	×	×	×	×	×	ICAO DOC 9476-chap 8
Operation of lighting and docking aids			×			×			×	ICAO DOC 9476-chap 8
Provision of discrete RTF channel						×	×	×	×	ICAO DOC 9476-chap 8
Low visibility procedures			×			×			×	ICAO DOC 9476-chap 5

25.6. Review of system and improvement

25.6.1. Regular reviews of the SMGC system should be carried out to ensure that the system is fulfilling its intended task, and to assist the aerodrome operator in planning ahead for the orderly introduction of a more advanced system and the necessary supporting facilities, as and when warranted. Ideally, a master plan will have been prepared for the aerodrome in the early stages of its development, in which case a review of the system at regular intervals will serve to monitor the development of the aerodrome in relation to the time frame employed in the master plan.

25.6.2. In all cases, the SMGC system will need to be reviewed under one or more of the following circumstances:

a. the volume of traffic increases significantly;

b. operations in lower visibility conditions are planned; and

c. the aerodrome layout is changed, i.e., new runways, taxiways, or aprons are brought into operation. It is also conceivable that ATS restructuring of the airspace surrounding the aerodrome, or other external circumstances, may affect the flow of traffic to and from the aerodrome, and consequently the pattern of movements on the runways, thereby influencing the SMGC system requirements.

25.6.3. Apart from traffic movement counts, the extent to which increased traffic volume is causing a deterioration of the effectiveness of the SMGC system may be determined by the appearance of the following symptoms:

a. a marked need for increased vigilance in the visual surveillance of surface traffic movements, generated by the number of movements occurring simultaneously throughout the aerodrome complex;

b. a marked increase in the loading on the communications channels used for SMGC;

c. an increase in the number of problems occurring at crossing points and runway/taxiway intersections, requiring intervention by the controller and thereby contributing to the increase in radio communications; and

d. the occurrence of bottlenecks, congestion and delay: in surface traffic movements.

Appendices

Appendix 1. Colors for aeronautical ground lights, markings, signs and panels

1. General

The following specifications define the chromaticity limits of colors to be used for aeronautical ground lights, markings, signs and panels. The specifications are in accord with the 1983 specifications of the International Commission on Illumination (CIE), except for the color orange in Figure A1-2.

It is not possible to establish specifications for colors such that there is no possibility of confusion. For reasonably certain recognition, it is important that the eye illumination be well above the threshold of perception, that the color not be greatly modified by selective atmospheric attenuations and that the observer's color vision be adequate. There is also a risk of confusion of color at an extremely high level of eye illumination such as may be obtained from a high-intensity source at very close range. Experience indicates that satisfactory recognition can be achieved if due attention is given to these factors.

The chromaticities are expressed in terms of the standard observer and coordinate system adopted by the International Commission on Illumination (CIE) at its Eighth Session at Cambridge, England, in 1931.

The chromaticities for solid state lighting (e.g., LED) are based upon the boundaries given in the standard S 004/E-2001 of the International Commission on Illumination (CIE), except for the blue boundary of white.

2. Colors for aeronautical ground lights

2.1. Chromaticities for lights having filament-type light sources

2.1.1. The chromaticities of aeronautical ground lights with filament-type light sources shall be within the following boundaries: CIE Equations (see Figure A1-1a):

a. Red

Purple boundary	y = 0.980 – x
Yellow boundary	y = 0.335, except for visual approach slope indicator system
Yellow boundary	y = 0.320, for visual approach slope indicator system

Note: See 5.3.5.14 and 5.3.5.30.

b. Yellow

Red boundary	y = 0.382
White boundary	y = 0.790 – 0.667x
Green boundary	y = x – 0.120

c. Green

Yellow boundary	$x = 0.360 - 0.080y$
White boundary	$x = 0.650y$
Blue boundary	$y = 0.390 - 0.171x$

d. Blue

Green boundary	$y = 0.805 x + 0.065$
White boundary	$y = 0.400 - x$
Purple boundary	$x = 0.600 y + 0.133$

e. White

Yellow boundary	$x = 0.500$
Blue boundary	$x = 0.285$
Green boundary	$y = 0.440$
	and $y = 0.150 + 0.640x$
Purple boundary	$y = 0.050$
	and $y = 0.382 + 0.750x$

f. Variable white

Yellow boundary	$x = 0.255$
	and $y = 0.790 + 0.750y - 0.667x$
Blue boundary	$x = 0.285$
Green boundary	$y = 0.440$
	and $y = 0.150 + 0.640x$
Purple boundary	$y = 0.050$
	and $y = 0.382 + 0.750x$

Note: Guidance on chromaticity changes resulting from the effect of temperature on filtering elements is given in the Aerodrome Design Manual (Doc 9157), Part 4.

2.1.2. Where dimming is not required, or where observers with defective color vision must be able to determine the color of the light, green signals shall be within the following boundaries:

Yellow boundary	$y = 0.726 - 0.726x$
White boundary	$x = 0.650y$
Blue boundary	$y = 0.390 - 0.171x$

Note: Where the color signal is to be seen from long range, it has been the practice to use colors with the boundaries of 2.1.2.

2.1.3. Where increased certainty of recognition from white, is more important than maximum visual range, green signals shall be within the following boundaries:

Yellow boundary	y = 0.726 – 0.726x
White boundary	x = 0.625y – 0.041
Blue boundary	y = 0.390 – 0.171x

2.2. Discrimination between lights having filament-type light sources

2.2.1. If there is a requirement to discriminate yellow and white from each other, they shall be displayed in close proximity of time or space as, for example, by being flashed successively from the same beacon.

2.2.2. If there is a requirement to discriminate yellow from green and/or white, as for example on exit taxiway center line lights, the y coordinates of the yellow light shall not exceed a value of 0.40.

Note: The limits of white have been based on the assumption that they will be used in situations in which the characteristics (color temperature) of the light source will be substantially constant.

2.2.3. The color variable white is intended to be used only for lights that are to be varied in intensity, e.g., to avoid dazzling. If this color is to be discriminated from yellow, the lights shall be so designed and operated that:

a. the x coordinate of the yellow is at least 0.050 greater than the x coordinate of the white; and

b. the disposition of the lights will be such that the yellow lights are displayed simultaneously and in close proximity to the white lights.

2.3. Chromaticities for lights having a solid light source

2.3.1. The chromaticities of aeronautical ground lights with solid light sources, e.g., LEDs, shall be within the following boundaries (CIE Equations, see Figure A1-1b):

a. Red

Purple boundary	y = 0.980 – x
Yellow boundary	y = 0.335, except for visual approach slope indicator system
Yellow boundary	y = 0.320, for visual approach slope indicator system

Note: See 5.3.5.14 and 5.3.5.30.

b. Yellow

Red boundary	y = 0.387

White boundary $y = 0.980 - x$

Green boundary $y = 0.727x + 0.054$

c. Green (also refer 2.3.2 and 2.3.3)

Yellow boundary $x = 0.310$

White boundary $x = 0.625y - 0.041$

Blue boundary $y = 0.400$

d. Blue

Green boundary $y = 1.141x - 0.037$

White boundary $x = 0.400 - y$

Purple boundary $x = 0.134 + 0.590y$

e. White

Yellow boundary $x = 0.440$

Blue boundary $x = 0.320$

Green boundary $y = 0.150 + 0.643x$

Purple boundary $y = 0.050 + 0.757x$

f. Variable white

The boundaries of variable white for solid state light sources are those of e) White above.

2.3.2. Where observers with defective color vision must be able to determine the color of the light, green signals shall be within the follow boundaries:

Yellow boundary $y = 0.726 - 0.726x$

White boundary $x = 0.625y - 0.041$

Blue boundary $y = 0.400$

Note: Where the color signal is to be seen from long range, it has been the practice to use colors with the boundaries of 2.1.2.

2.3.3. In order to avoid a large variation of shades of green, if colors within the boundaries below are selected, colors within the boundaries of 2.3.2 shall not be used.

Yellow boundary $x = 0.310$

White boundary $x = 0.625y - 0.041$

Blue boundary $y = 0.726 - 0.726x$

2.4. Color measurement for filament-type and solid state-type lights sources

2.4.1. The color of aeronautical ground lights shall be verified as being within the boundaries specified in Figure A1-1a or A1-1b, as appropriate, by measurement at five points within the area limited by the innermost isocandela curve (isocandela diagrams in Appendix 2 refer), with operation at rated current or voltage. In the case of elliptical or circular isocandela curves, the color measurements shall be taken at the center and at the horizontal and vertical limits. In the case of rectangular isocandela curves, the color measurements shall be taken at the center and the limits of the diagonals (corners). In addition, the color of the light shall be checked at the outermost isocandela curve to ensure that there is no color shift that might cause signal confusion to the pilot.

Note 1: For the outermost isocandela curve, a measurement of color coordinates shall be made and recorded for review and judgement of acceptability by the State.

Note 2: Certain light units may have application so that they may be viewed and used by pilots from directions beyond that of the outermost isocandela curve (e.g., stop bar lights at significantly wide runway-holding positions). In such instances, the State shall assess the actual application and, if necessary, require a check of color shift at angular ranges beyond the outermost curve.

2.4.2. In the case of visual approach slope indicator systems and other light units having a color transition sector, the color shall be measured at points in accordance with 2.4.1, except that the color areas shall be treated separately and no point shall be within 0.5 degrees of the transition sector.

3. Colors for markings, signs and panels

Note 1: The specifications of surface colors given below apply only to freshly colored surfaces. Colors used for markings, signs and panels usually change with time and therefore require renewal.

Note 2: Guidance on surface colors is contained in the CIE document entitled Recommendations for Surface Colors for Visual Signaling — Publication No. 39-2 (TC-106) 1983.

Note 3: The specifications recommended in 3.4 for transilluminated panels are interim in nature and are based on the CIE specifications for transilluminated signs. It is intended that these specifications will be reviewed and updated as and when CIE develops specifications for transilluminated panels.

3.1. The chromaticities and luminance factors of ordinary colors, colors of retroreflective materials and colors of transilluminated (internally illuminated) signs and panels shall be determined under the following standard conditions:

a. angle of illumination: 45°;

b. direction of view: perpendicular to surface; and

c. illuminant: CIE standard illuminant D65.

3.2. The chromaticity and luminance factors of ordinary colors for markings and externally illuminated signs and panels shall be within the following boundaries when determined under standard conditions. CIE Equations (see Figure A1-2):

a. Red

Purple boundary	y = 0.345 – 0.051x
White boundary	y = 0.910 – x
Orange boundary	y = 0.314 + 0.047x
Luminance factor	ß = 0.07 (mnm)

b. Orange

Red boundary	y = 0.285 + 0.100x
White boundary	y = 0.940 – x
Yellow boundary	y = 0.250 + 0.220x
Luminance factor	ß = 0.20 (mnm)

c. Yellow

Orange boundary	y = 0.108 + 0.707x
White boundary	y = 0.910 – x
Green boundary	y = 1.35x – 0.093
Luminance factor	ß = 0.45 (mnm)

d. White

Purple boundary	y = 0.010 + x
Blue boundary	y = 0.610 – x
Green boundary	y = 0.030 + x
Yellow boundary	y = 0.710 – x
Luminance factor	ß = 0.75 (mnm)

e. Black

Purple boundary	y = x – 0. 030
Blue boundary	y = 0.570 – x
Green boundary	y = 0.050 + x
Yellow boundary	y = 0.740 – x
Luminance factor	ß = 0.03 (max)

f. Yellowish green

Green boundary	y = 1.317x + 0.4
White boundary	y = 0.910 – x
Yellow boundary	y = 0.867x + 0.4

g. Green

Yellow boundary	x = 0.313
White boundary	y = 0.243 + 0.670x
Blue boundary	y = 0.493 – 0.524x
Luminance factor	ß = 0.10 (mnm)

Note: The small separation between surface red and surface orange is not sufficient to ensure the distinction of these colors when seen separately.

3.3. The chromaticity and luminance factors of colors of retroreflective materials for markings, signs and panels shall be within the following boundaries when determined under standard conditions. CIE Equations (see Figure A1-3):

a. Red

Purple boundary	y = 0.345 – 0.051x
White boundary	y = 0.910 – x
Orange boundary	y = 0.314 + 0.047x
Luminance factor	ß = 0.03 (mnm)

b. Orange

Red boundary	y = 0.265 + 0.205x
White boundary	y = 0.910 – x
Yellow boundary	y = 0.207 + 0.390x
Luminance factor	ß = 0.14 (mnm)

c. Yellow

Orange boundary	y = 0.160 + 0.540x
White boundary	y = 0.910 – x
Green boundary	y = 1.35x – 0.093
Luminance factor	ß = 0.16 (mnm)

d. White

Purple boundary	y = x
Blue boundary	y = 0.610 – x

Green boundary y = 0.040 + x

Yellow boundary y = 0.710 – x

Luminance factor ß = 0.27 (mnm)

e. Blue

Green boundary y = 0.118 +0.675x

White boundary y = 0.370 – x

Purple boundary y = 1.65x – 0.187

Luminance factor ß = 0.01 (mnm)

f. Green

Yellow boundary y = 0.711 – 1.22x

White boundary y = 0.243 + 0.670x

Blue boundary y = 0.405 – 0.243x

Luminance factor ß = 0.03 (mnm)

3.4. The chromaticity and luminance factors of colors for luminescent or transilluminated (internally illuminated) signs and panels shall be within the following boundaries when determined under standard conditions. CIE Equations (see Figure A1-4):

a. Red

Purple boundary y = 0.345 – 0.051x

White boundary y = 0.910 – x

Orange boundary y = 0.314 + 0.047x

Luminance factor (Day condition) ß = 0.07 (mnm)

Relative luminance to white (Night condition) 5% (mnm) - 20% (max)

b. Yellow

Orange boundary y = 0.108 + 0.707x

White boundary y = 0.910 – x

Green boundary y = 1.35x – 0.093

Luminance factor (Day condition) ß = 0.45 (mnm)

Relative luminance to white (Night condition) 30% (mnm) - 80% (max)

c. White

Purple boundary y = 0.010 + x

Blue boundary y = 0.610 – x

Green boundary $y = 0.030 + x$

Yellow boundary $y = 0.710 – x$

Luminance factor (Day condition) ß = 0.75 (mnm)

Relative luminance to white (Night condition) 100%

d. Black

Purple boundary $y = x – 0. 030$

Blue boundary $y = 0.570 – x$

Green boundary $y = 0.050 + x$

Yellow boundary $y = 0.740 – x$

Luminance factor (Day condition) ß = 0.03 (max)

Relative luminance to white (Night condition) 0% (mnm) 2% (max)

e. Green

Yellow boundary $x = 0.313$

White boundary $y = 0.243 + 0.670x$

Blue boundary $y = 0.493 – 0.524x$

Luminance factor (Day condition) ß = 0.10 (mnm)

Relative luminance to white (Night condition) 5% (mnm) - 30% (max)

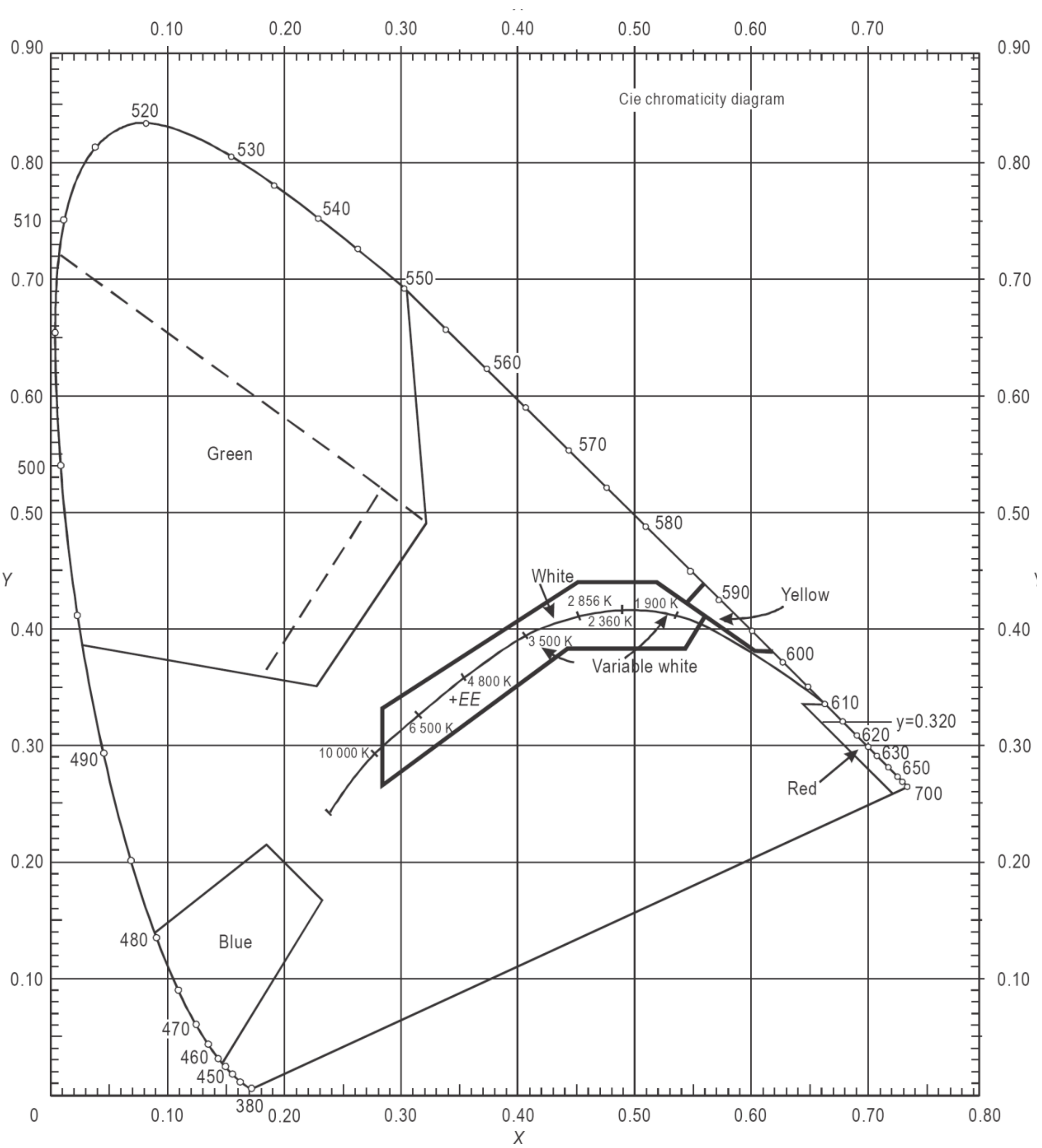


Figure A1-1a. Color for aeronautical ground lights (filament-type lamps)

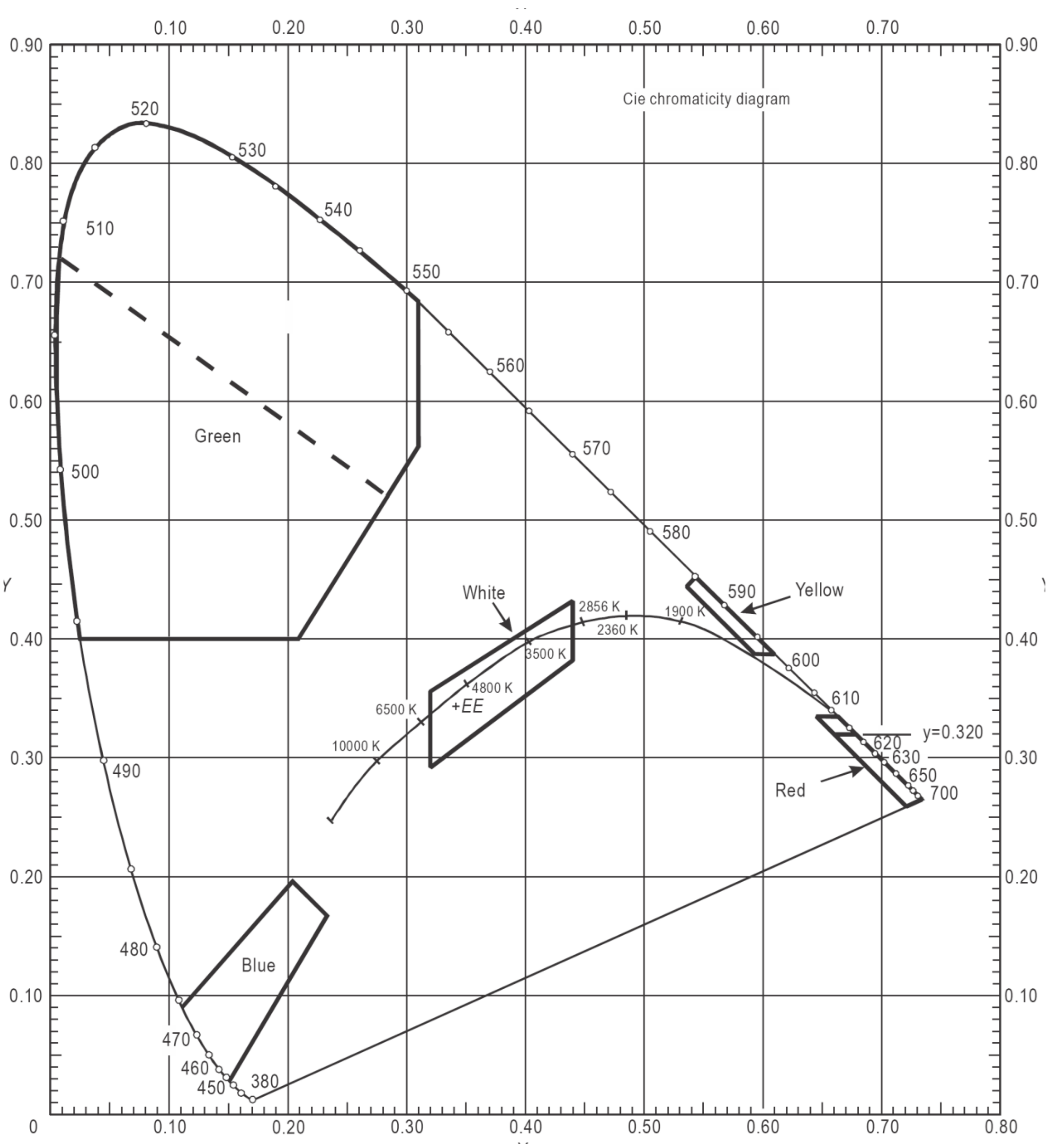


Figure A1-1b. Color for aeronautical ground lights (solid state lighting)

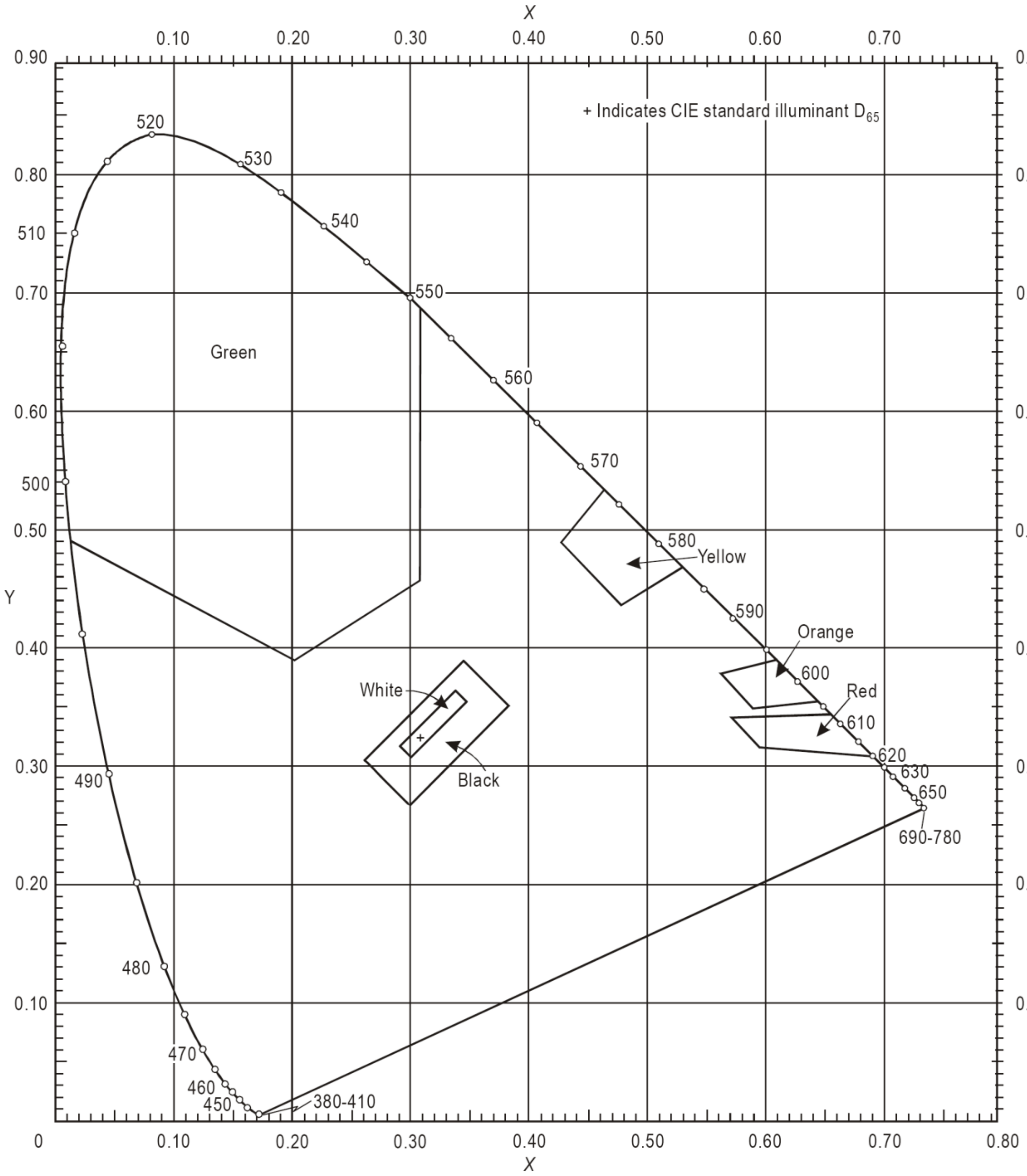


Figure A1-2. Ordinary Colors for Markings and Externally Illuminated Signs and Panels

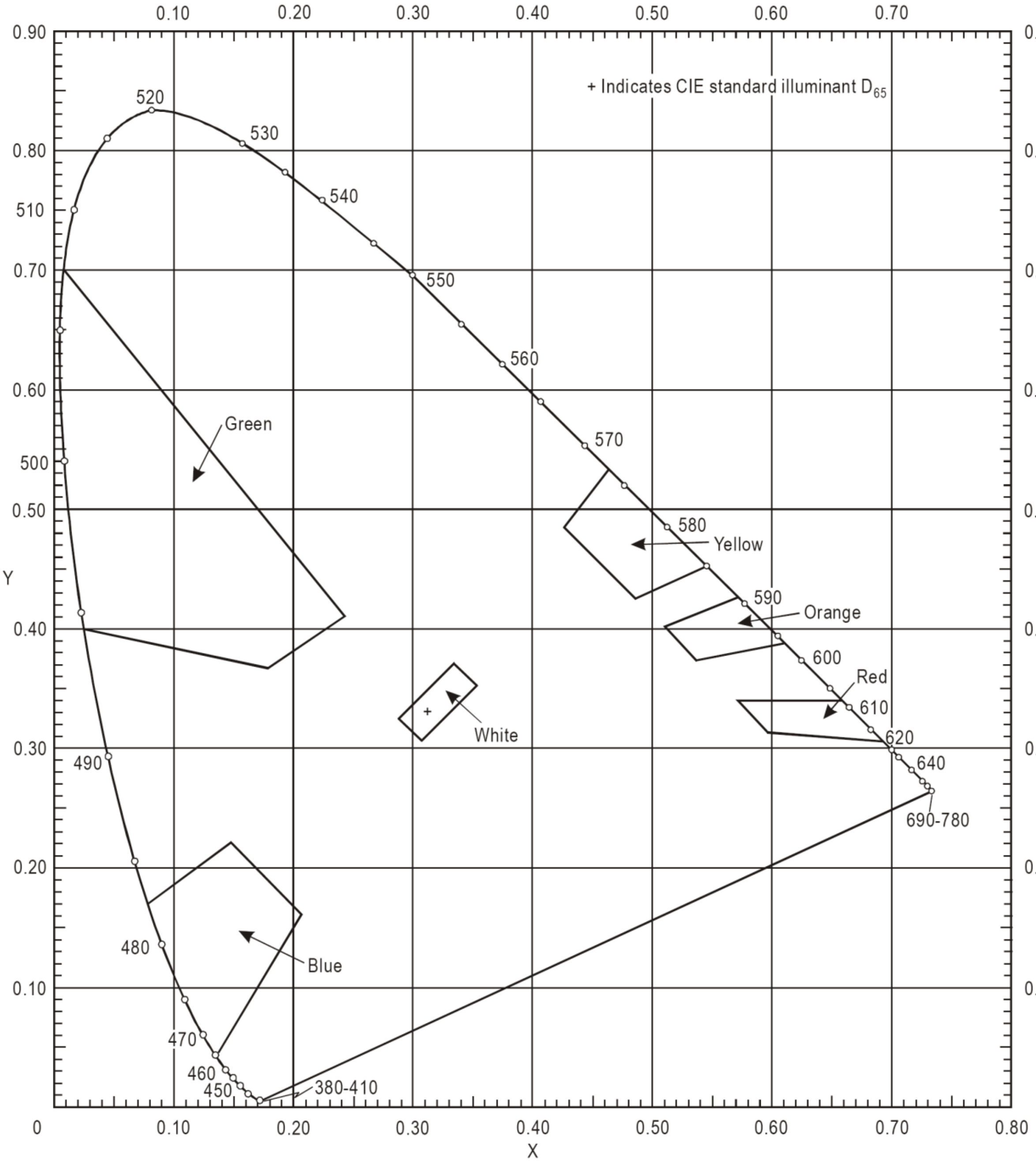


Figure A1-3. Colors of retroreflective materials for markings, signs and panels

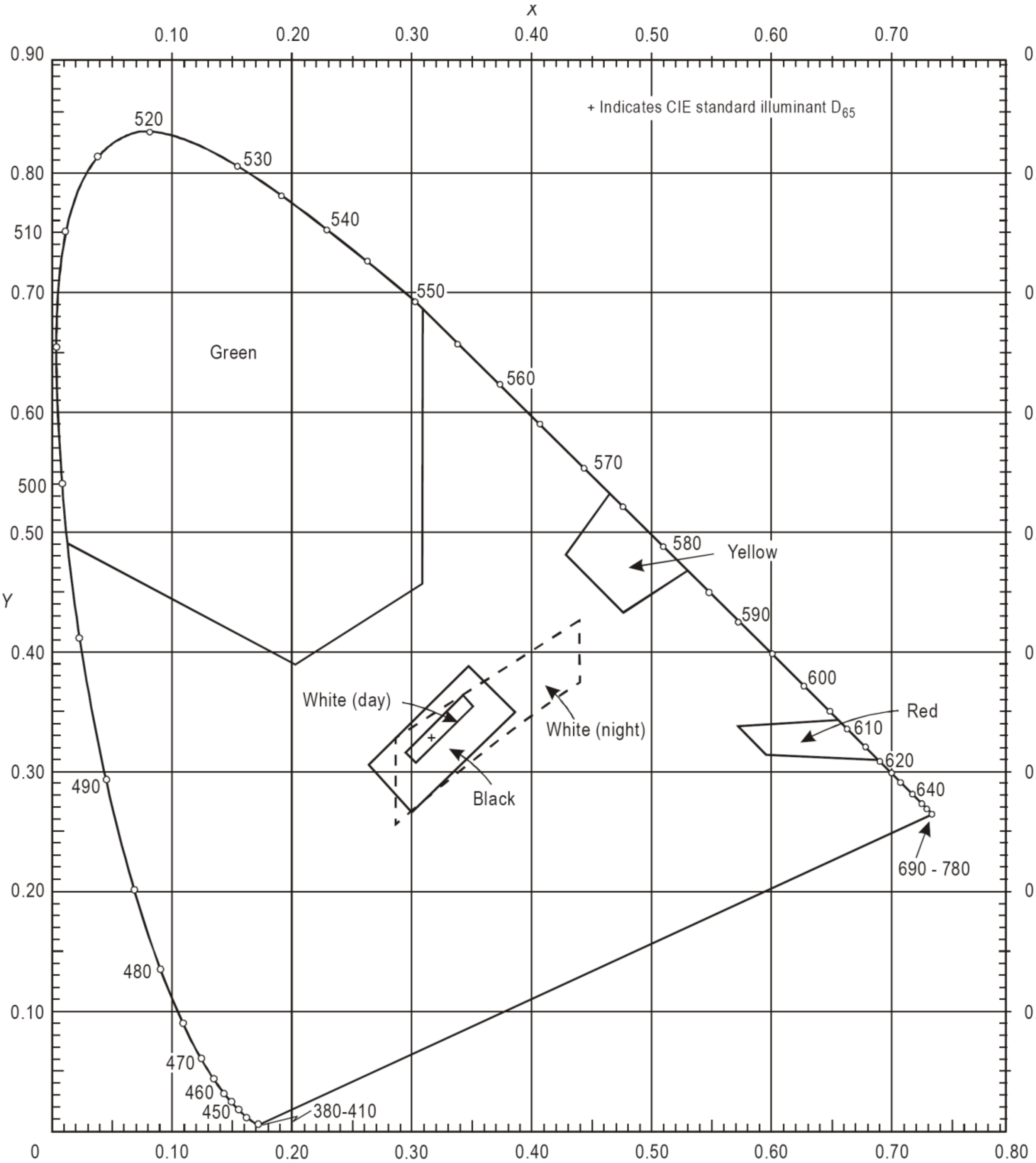
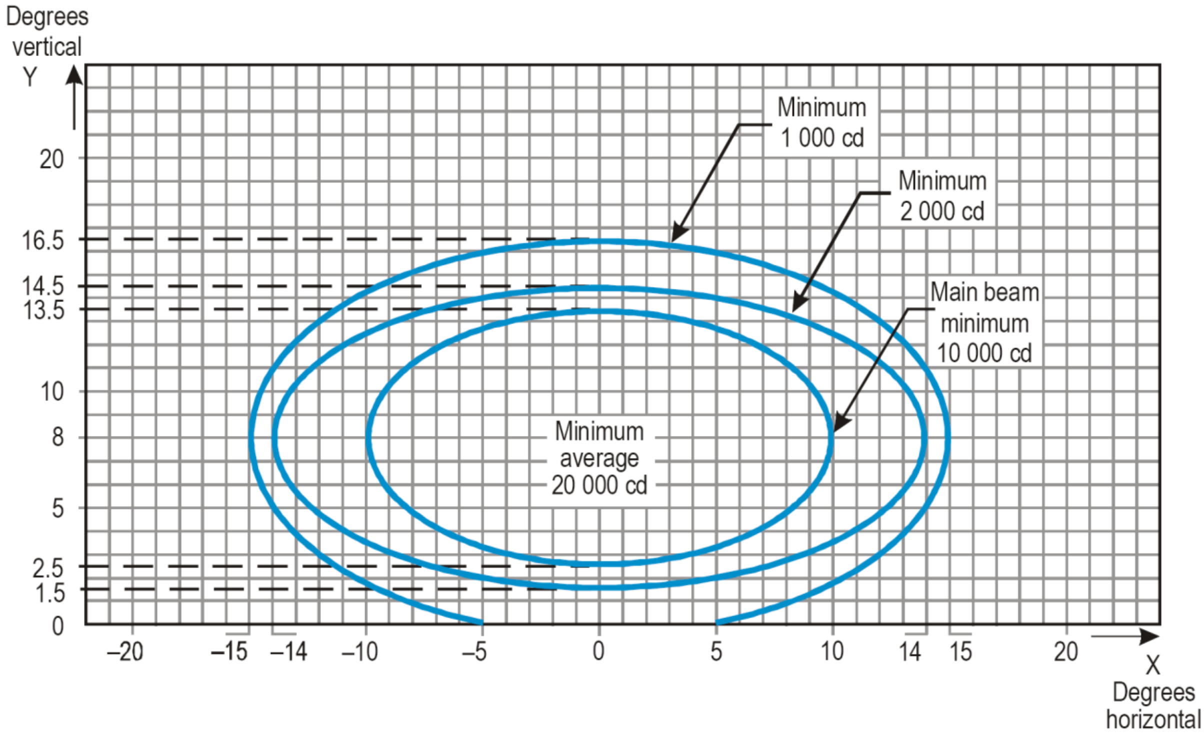


Figure A1-4. Colors of luminescent or transilluminated (internally illuminated) signs and panels

Appendix 2. Aeronautical ground light characteristics



Notes:

1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	10	14	15
b	5.5	6.5	8.5

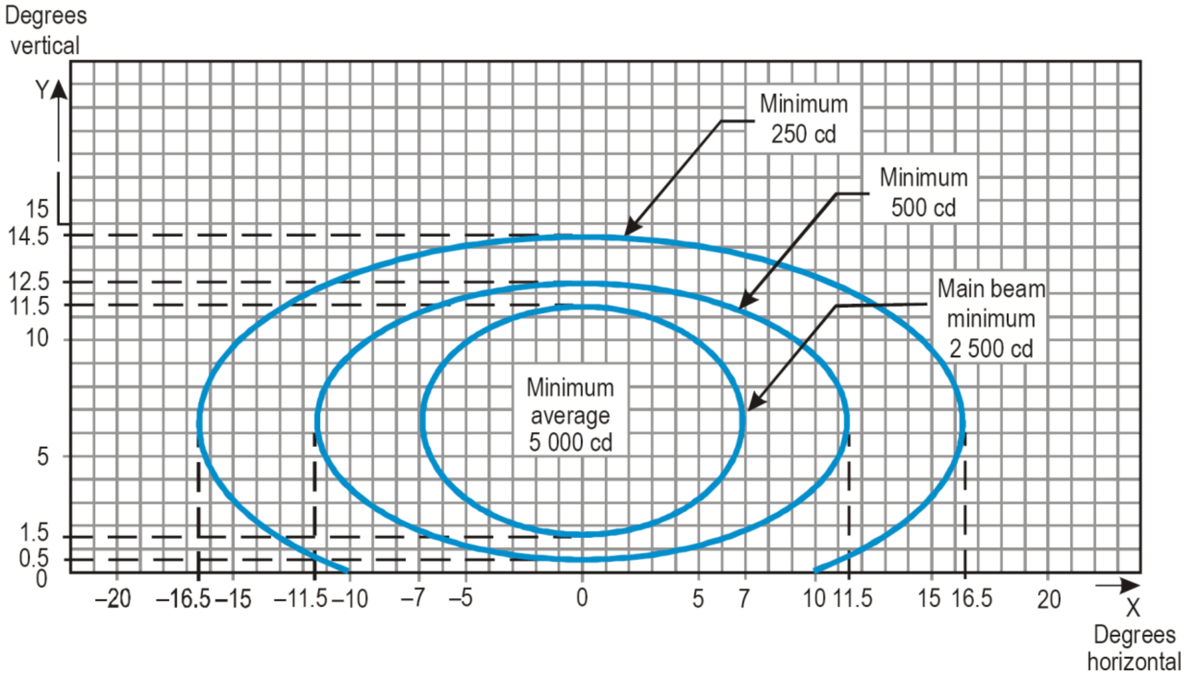
2. Vertical setting angles of the lights shall be such that the following vertical coverage of the main beam will be met:

distance from threshold	vertical main beam coverage
threshold to 315 m	0° — 11°
316 m to 475 m	0.5° — 11.5°
476 m to 640 m	1.5° — 12.5°
641 m and beyond	2.5° — 13.5° (as illustrated above)

3. Lights in crossbars beyond 22.5 m from the centre line shall be toed-in 2 degrees. All other lights shall be aligned parallel to the centre line of the runway.

4. See collective notes for Figures A2-1 to A2-11 and A2-26.

Figure A2-1. Isocandela diagram for approach center line light and crossbars (white light)



Notes:

1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	7.0	11.5	16.5
b	5.0	6.0	8.0

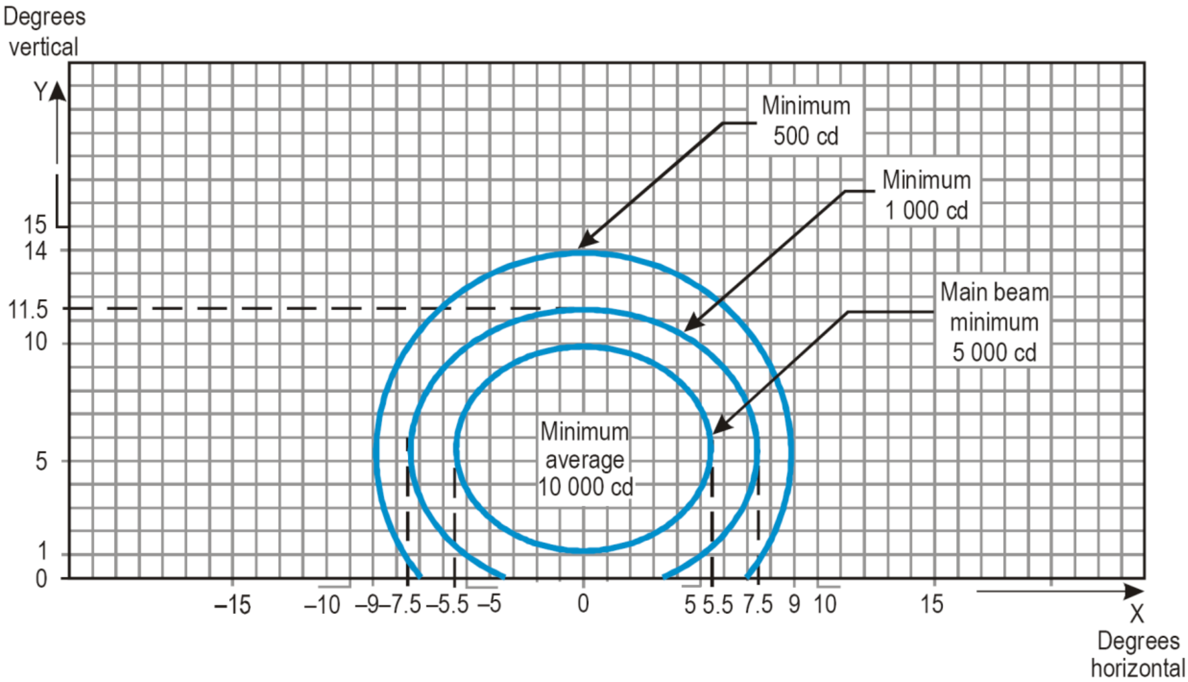
2. Toe-in 2 degrees

3. Vertical setting angles of the lights shall be such that the following vertical coverage of the main beam will be met:

distance from threshold	vertical main beam coverage
threshold to 115 m	0.5° — 10.5°
116 m to 215 m	1° — 11°
216 m and beyond	1.5° — 11.5° (as illustrated above)

4. See collective notes for Figures A2-1 to A2-11 and A2-26.

Figure A2-2. Isocandela diagram for approach side row light (red light)



Notes:

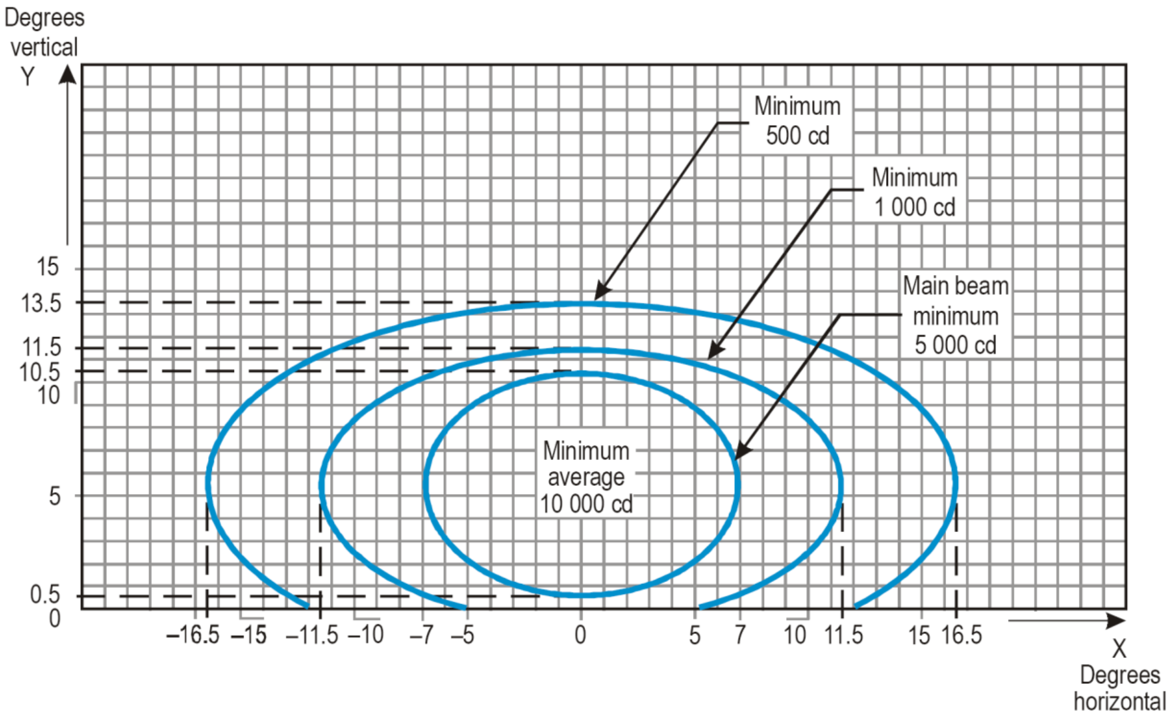
1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	5.5	7.5	9.0
b	4.5	6.0	8.5

2. Toe-in 3.5 degrees

3. See collective notes for Figures A2-1 to A2-11 and A2-26.

Figure A2-3. Isocandela diagram for threshold light (green light)



Notes:

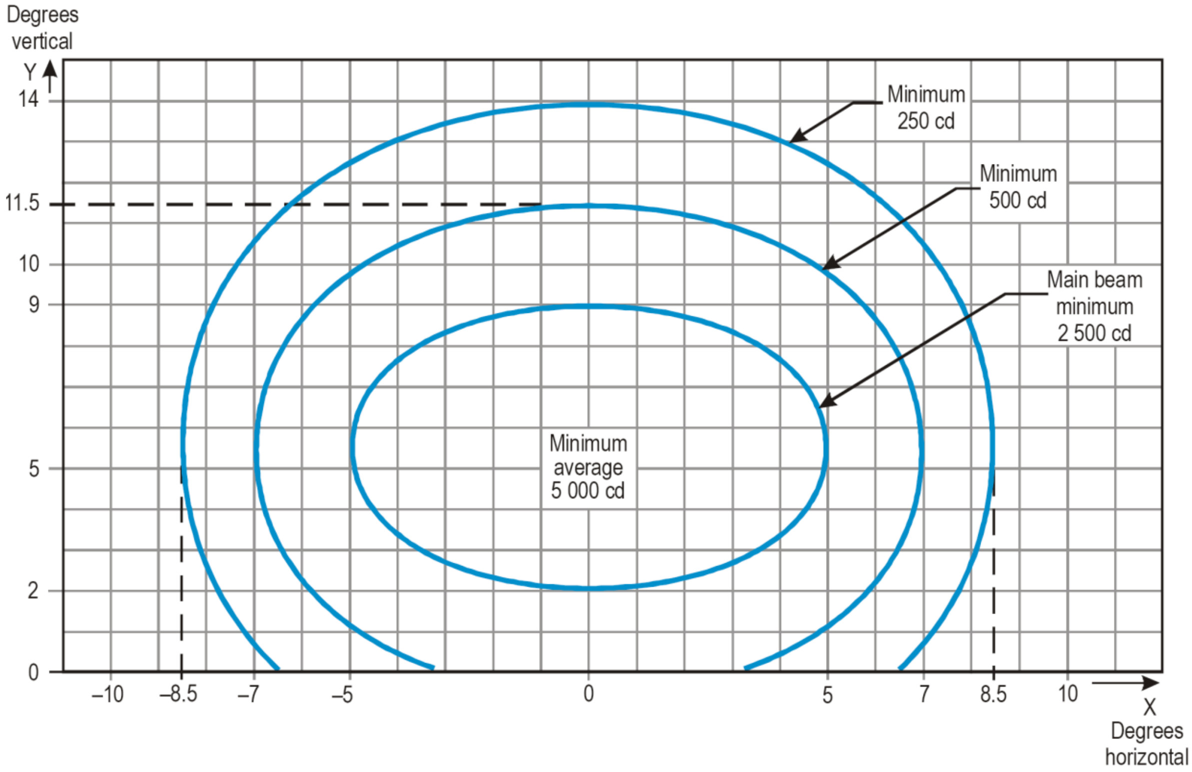
1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	7.0	11.5	16.5
b	5.0	6.0	8.0

2. Toe-in 2 degrees

3. See collective notes for Figures A2-1 to A2-11 and A2-26.

Figure A2-4. Isocandela diagram for threshold wing bar light (green light)



Notes:

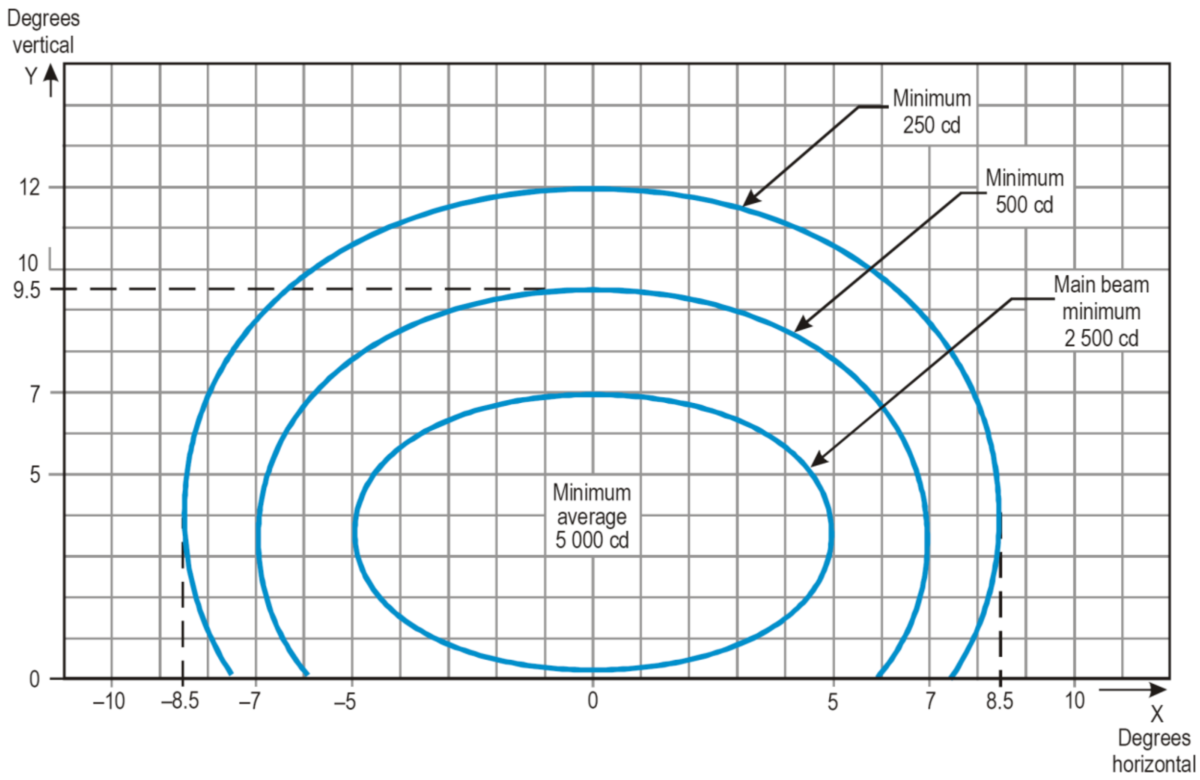
1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	5.0	7.0	8.5
b	3.5	6.0	8.5

2. Toe-in 4 degrees

3. See collective notes for Figures A2-1 to A2-11 and A2-26.

Figure A2-5. Isocandela diagram for touchdown zone light (white light)



Notes:

1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

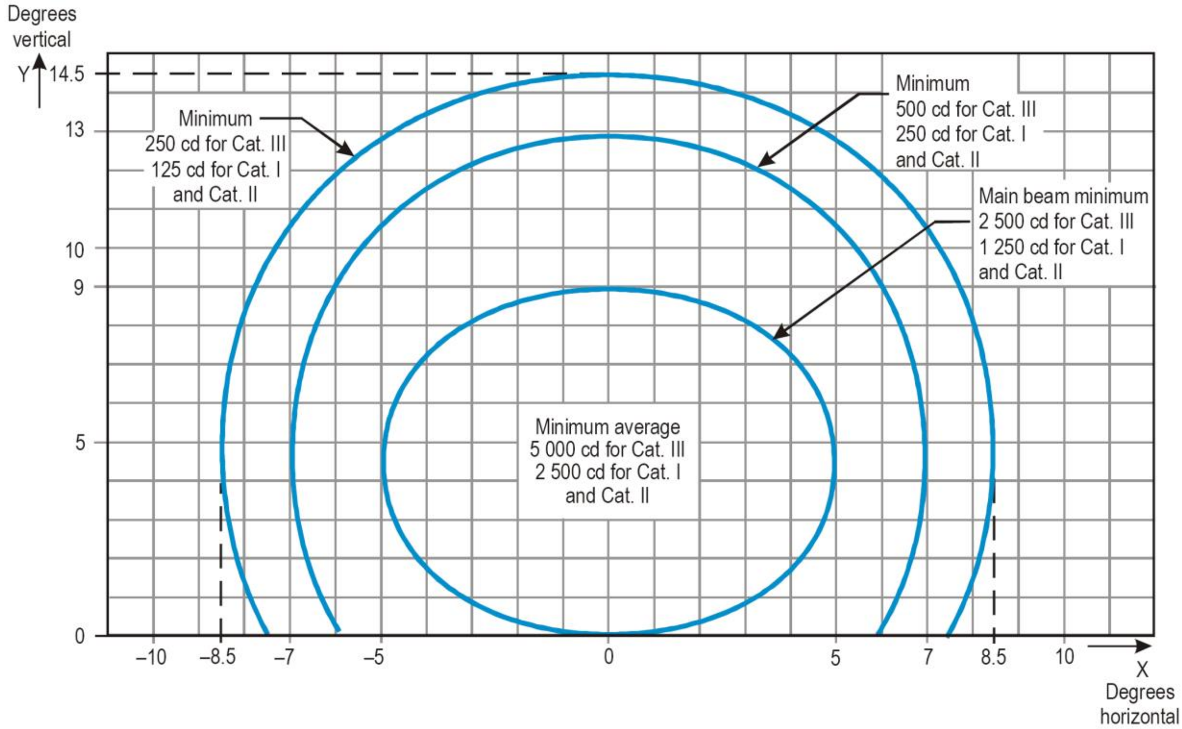
a	5.0	7.0	8.5
b	3.5	6.0	8.5

2. For red light, multiply values by 0.15.

3. For yellow light, multiply values by 0.40.

4. See collective notes for Figures A2-1 to A2-11 and A2-26.

Figure A2-6. Isocandela diagram for runway center line light with 30 m longitudinal spacing (white light) and rapid exit taxiway indicator light (yellow light)



Notes:

1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

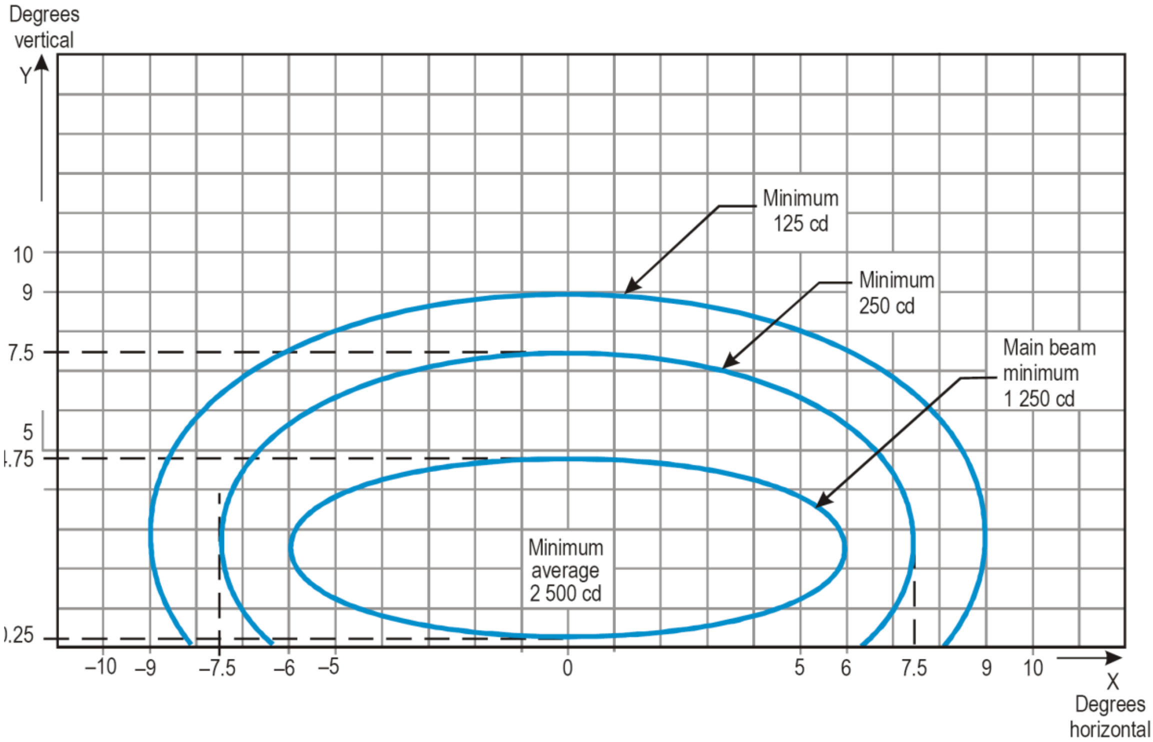
a	5.0	7.0	8.5
b	4.5	8.5	10

2. For red light, multiply values by 0.15.

3. For yellow light, multiply values by 0.40.

4. See collective notes for Figures A2-1 to A2-11 and A2-26.

Figure A2-7. Isocandela diagram for runway center line light with 15 m longitudinal spacing (white light) and rapid exit taxiway indicator light (yellow light)



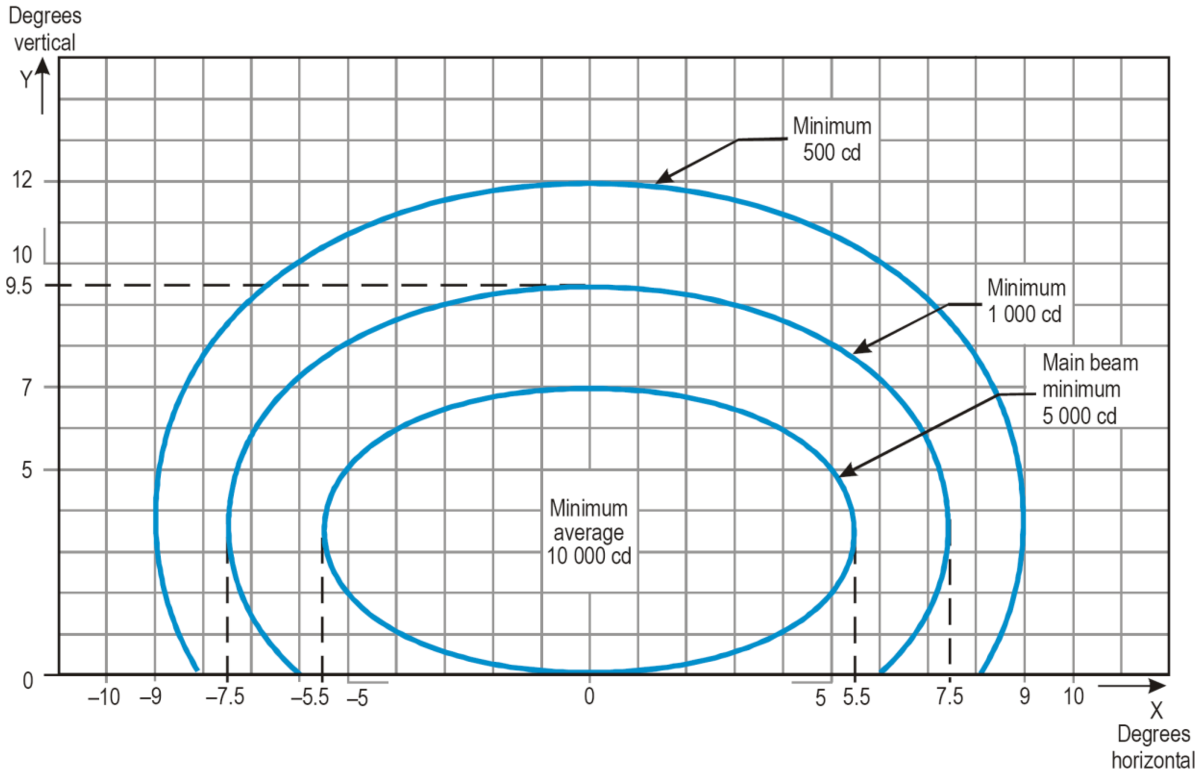
Notes:

1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	6.0	7.5	9.0
b	2.25	5.0	6.5

2. See collective notes for Figures A2-1 to A2-11 and A2-26.

Figure A2-8. Isocandela diagram for runway end light (red light)



Notes:

1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	5.5	7.5	9.0
b	3.5	6.0	8.5

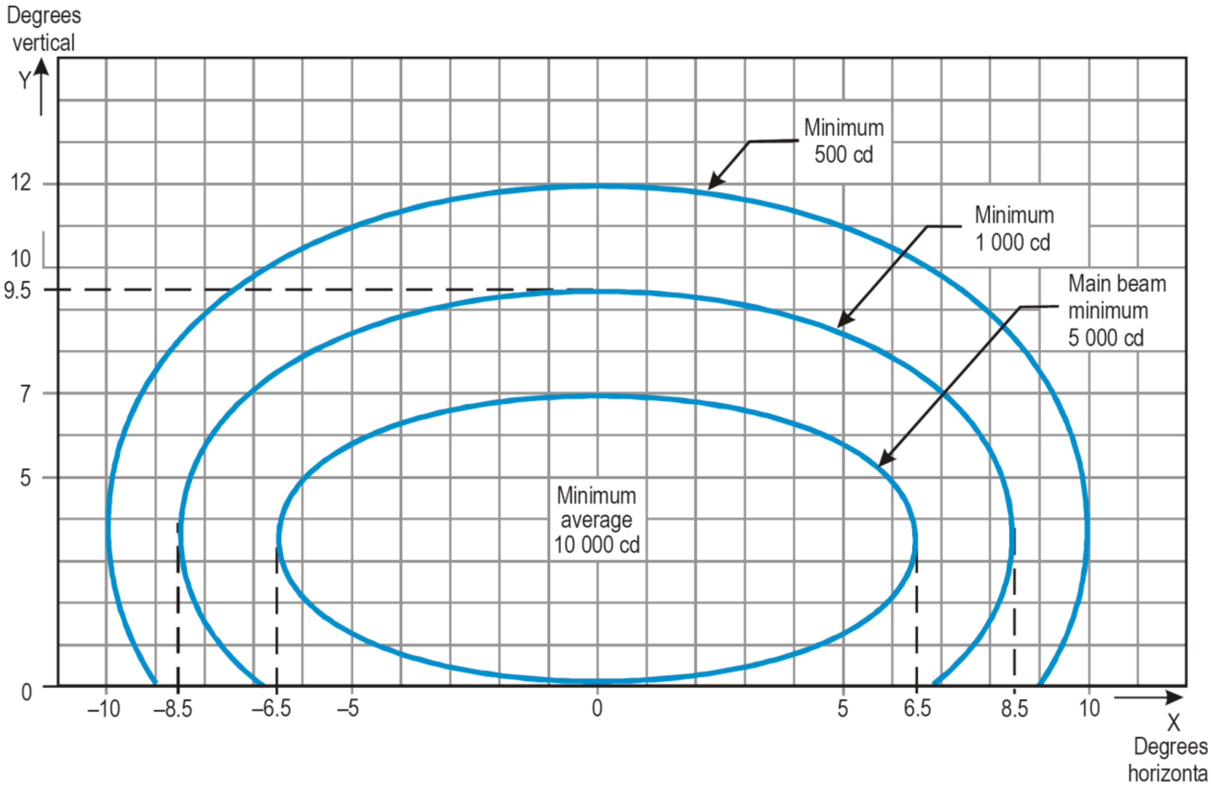
2. Toe-in 3.5 degrees

3. For red light, multiply values by 0.15.

4. For yellow light, multiply values by 0.40.

5. See collective notes for Figures A2-1 to A2-11 and A2-26.

Figure A2-9. Isocandela diagram for runway edge light where width of runway is 45 m (white light)



Notes:

1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	6.5	8.5	10.0
b	3.5	6.0	8.5

2. Toe-in 4.5 degrees
3. For red light, multiply values by 0.15.
4. For yellow light, multiply values by 0.40.
5. See collective notes for Figures A2-1 to A2-11 and A2-26.

Figure A2-10. Isocandela diagram for runway edge light where width of runway is 60 m (white light)

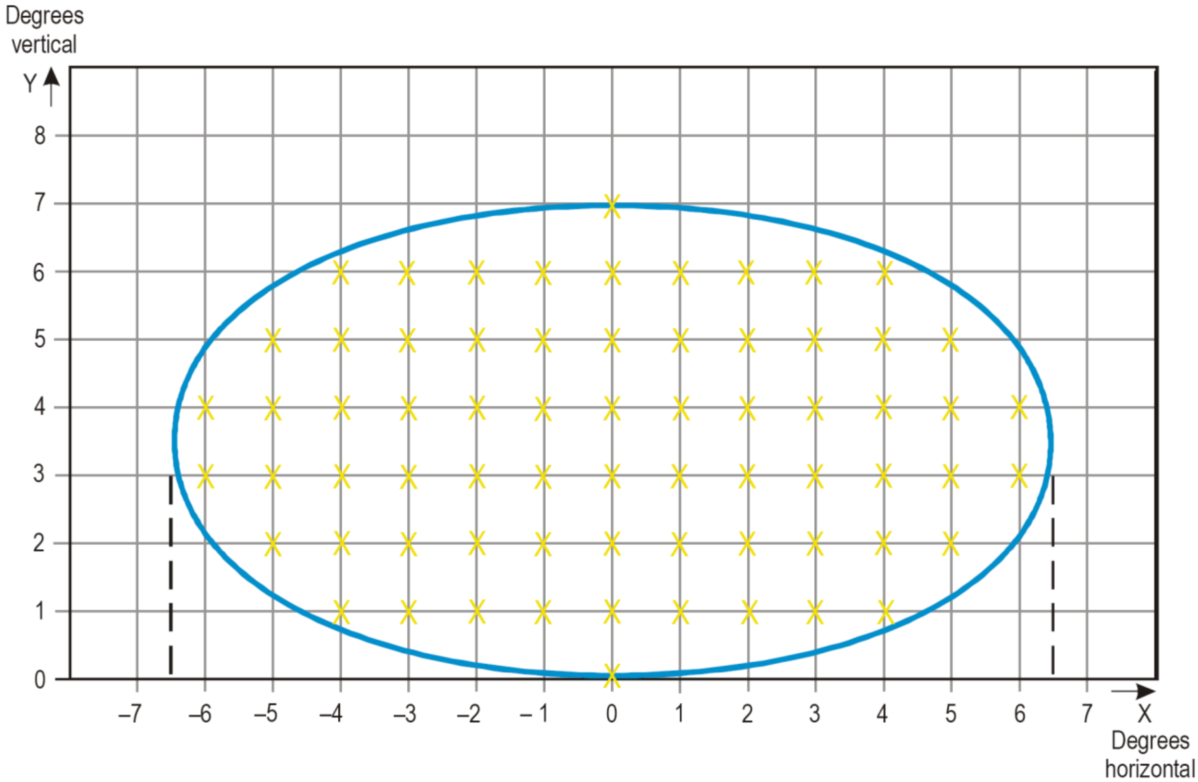


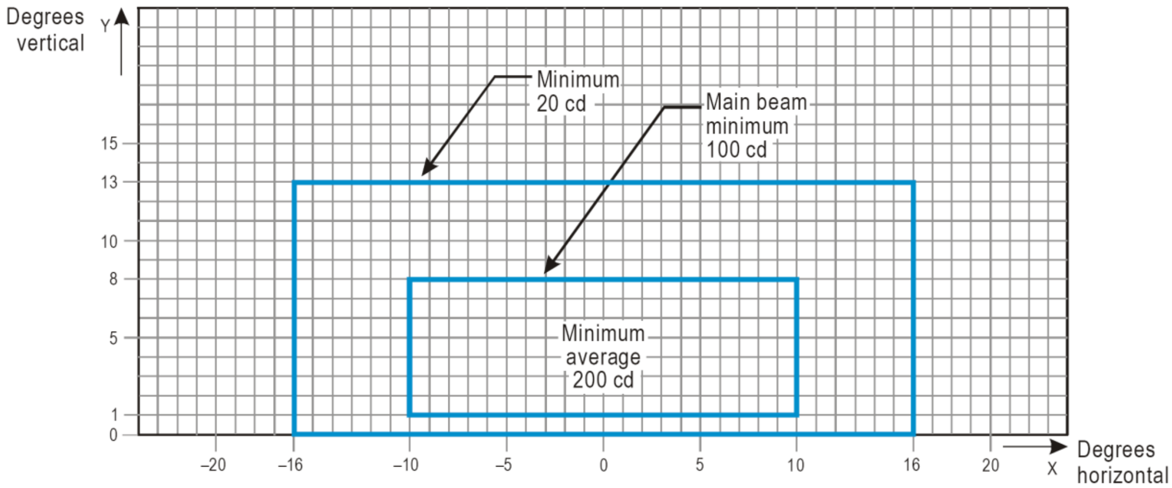
Figure A2-11. Grid points to be used for the calculation of average intensity of approach and runway lights

Collective notes to Figures A2-1 to A2-11:

1. The ellipses in each figure are symmetrical about the common vertical and horizontal axes.
2. Figures A2-1 to A2-10 show the minimum allowable light intensities. The average intensity of the main beam is calculated by establishing grid points as shown in Figure A2-11 and using the intensity value measures at all grid points located within and on the perimeter of the ellipse representing the main beam. The average value is the arithmetic average of light intensities measured at all considered grid points.
3. No deviations are acceptable in the main beam pattern when the lighting fixture is properly aimed.
4. Average intensity ratio. The ratio between the average intensity within the ellipse defining the main beam of a typical new light and the average light intensity of the main beam of a new runway edge light shall be as follows:
    - Figure A2-1 Approach center line and crossbars 1.5 to 2.0 (white light)
    - Figure A2-2 Approach side row 0.5 to 1.0 (red light)
    - Figure A2-3 Threshold 1.0 to 1.5 (green light)
    - Figure A2-4 Threshold wing bar 1.0 to 1.5 (green light)
    - Figure A2-5 Touchdown zone 0.5 to 1.0 (white light)
    - Figure A2-6 Runway center line (longitudinal spacing 30m) 0.5 to 1.0 (white light)
    - Figure A2-7 Runway center line (longitudinal spacing 15m) 0.5 to 1.0 for CAT III (white light) 0.25 to 0.5 for CAT I, II (white light)
    - Figure A2-8 Runway end 0.25 to 0.5 (red light)
    - Figure A2-9 Runway edge (45m runway width) 1.0 (white light)
    - Figure A2-10 Runway edge (60m runway width) 1.0 (white light)
5. The beam coverages in the figures provide the necessary guidance for approaches down to an RVR of the order of 150 m and take-offs down to an RVR of the order of 100 m.
6. Horizontal angles are measured with respect to the vertical plane through the runway center line. For lights other than center line lights, the direction towards the runway center line is considered positive. Vertical angles are measured with respect to the horizontal plane.
7. Where, for approach center line lights and crossbars and for approach side row lights, inset lights are used in lieu of elevated lights, e.g., on a runway with a displaced threshold, the intensity requirements can be met by installing two or three fittings (lower intensity) at each position.
8. The importance of adequate maintenance cannot be overemphasized. The average intensity shall never fall to a value less than 50 per cent of the value shown in the figures,

and it shall be the aim of airport authorities to maintain a level of light output close to the specified minimum average intensity.

9. The light unit shall be installed so that the main beam is aligned within one-half degree of the specified requirement.



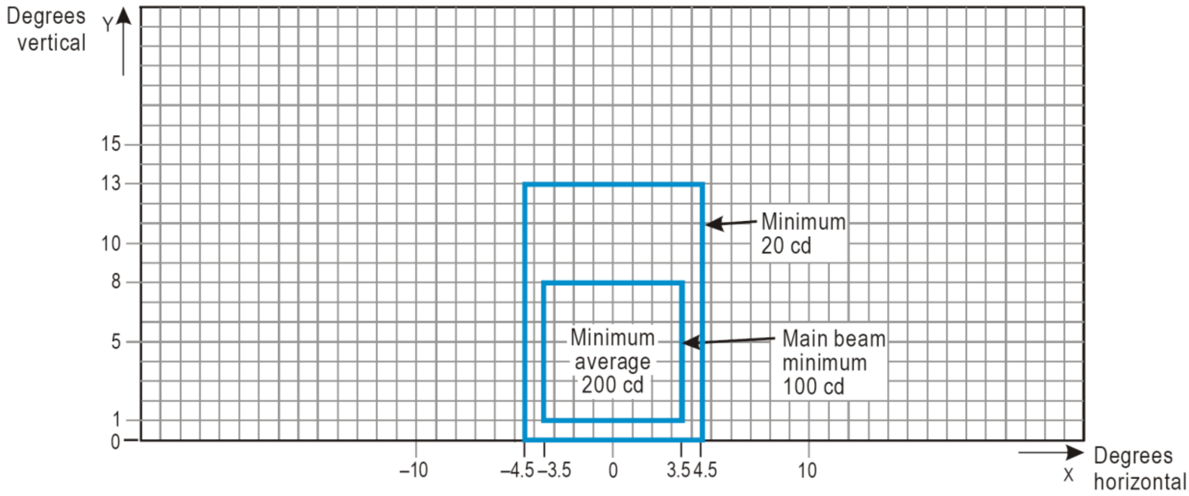
Notes:

1. These beam coverages allow for displacement of the cockpit from the centre line up to distances of the order of 12 m and are intended for use before and after curves.

2. See collective notes for Figures A2-12 to A2-21.

3. Increased intensities for enhanced rapid exit taxiway centre line lights as recommended in 5.3.16.9 are four times the respective intensities in the figure (i.e. 800 cd for minimum average main beam).

Figure A2-12. Isocandela diagram for taxiway center line (15 m spacing), RELs, no-entry bar and stop bar lights in straight sections intended for use in runway visual range conditions of less than a value of 350 m where large offsets can occur and for low-intensity runway guard lights, Configuration B

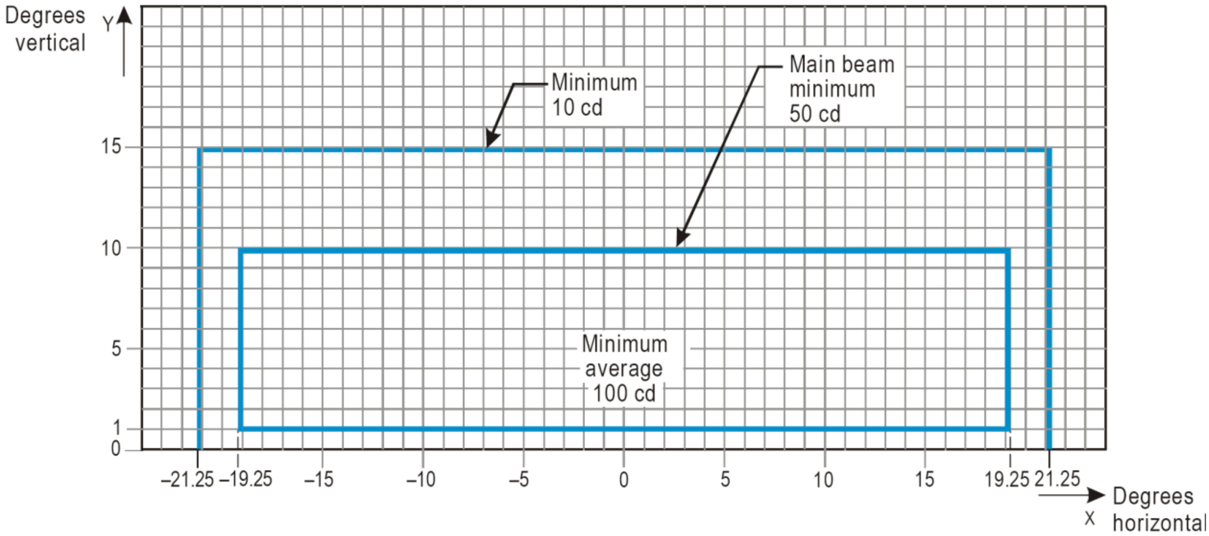


Notes:

1. These beam coverages are generally satisfactory and cater for a normal displacement of the cockpit from the centre line of approximately 3 m.

2. See collective notes for Figures A2-12 to A2-21.

Figure A2-13. Isocandela diagram for taxiway center line (15 m spacing), no-entry bar and stop bar lights in straight sections intended for use in runway visual range conditions of less than a value of 350 m



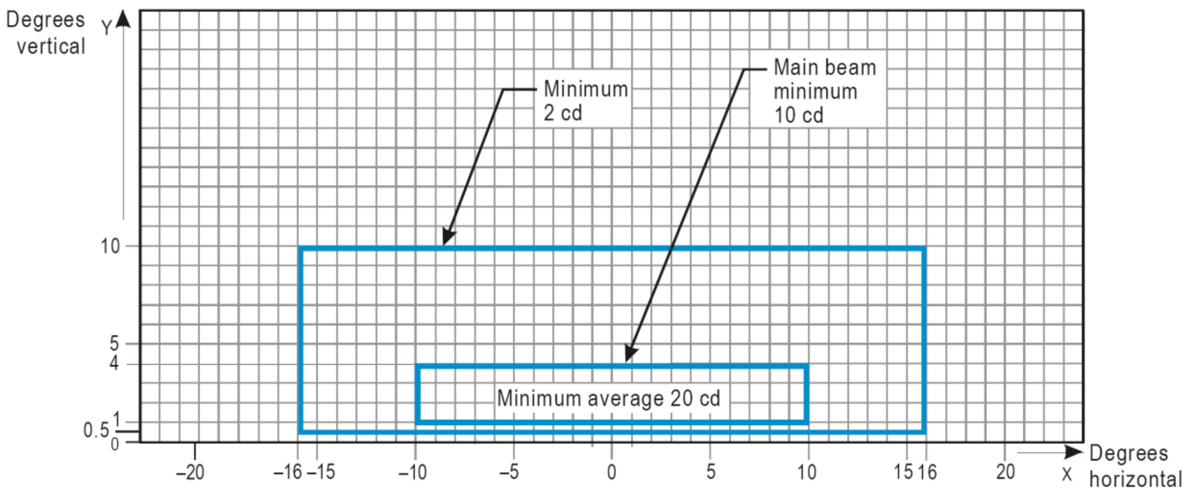
Notes:

1. Lights on curves to be toed-in 15.75 degrees with respect to the tangent of the curve. This does not apply to runway entrance lights (RELs)

2. Increased intensities for RELs shall be twice the specified intensities, i.e., minimum 20 cd, main beam minimum 100 cd and minimum average 200 cd.

3. See collective notes for Figures A2-12 to A2-21.

Figure A2-14. Isocandela diagram for taxiway center line (7.5 m spacing), RELs, no-entry bar and stop bar lights in curved sections intended for use in runway visual range conditions of less than a value of 350 m



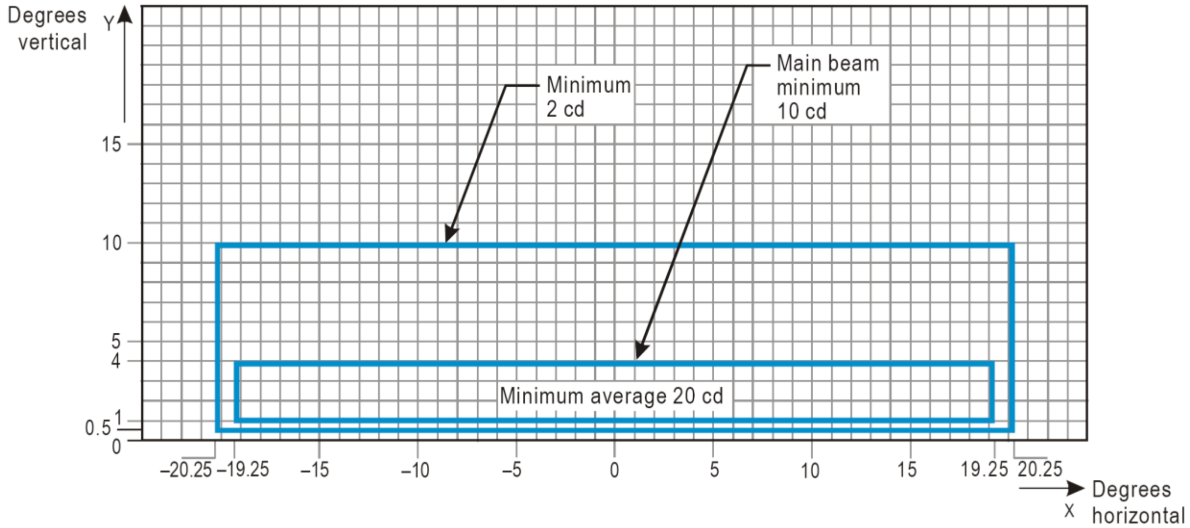
Notes:

1. At locations where high background luminance is usual and where deterioration of light output resulting from dust, snow and local contamination is a significant factor, the cd-values should be multiplied by 2.5.

2. Where omnidirectional lights are used they shall comply with the vertical beam requirements in this figure.

3. See collective notes for Figures A2-12 to A2-21.

Figure A2-15. Isocandela diagram for taxiway center line (30 m, 60 m spacing), no-entry bar and stop bar lights in straight sections intended for use in runway visual range conditions of 350 m or greater



Notes:

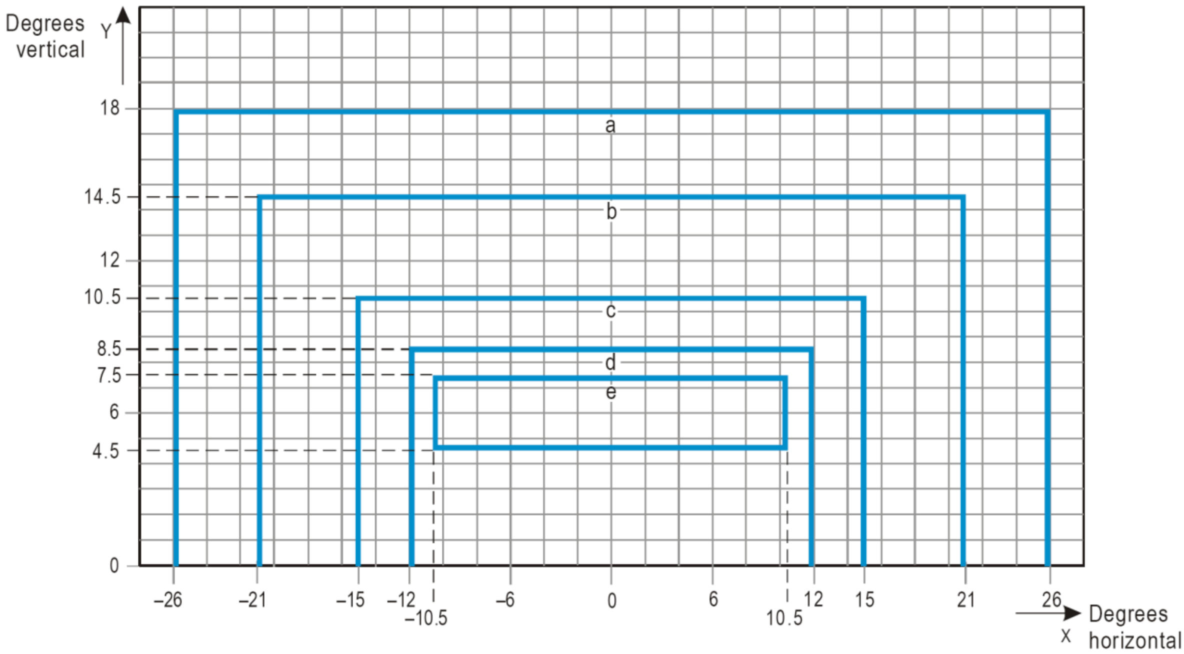
1. Lights on curves to be toed-in 15.75 degrees with respect to the tangent of the curve.

2. At locations where high background luminance is usual and where deterioration of light output resulting from dust, snow and local contamination is a significant factor, the cd-values should be multiplied by 2.5.

3. These beam coverages allow for displacement of the cockpit from the centre line up to distances of the order of 12 m as could occur at the end of curves.

4. See collective notes for Figures A2-12 to A2-21.

Figure A2-16. Isocandela diagram for taxiway center line (7.5 m, 15 m, 30 m spacing), no-entry bar and stop bar lights in curved sections intended for use in runway visual range conditions of 350 m or greater



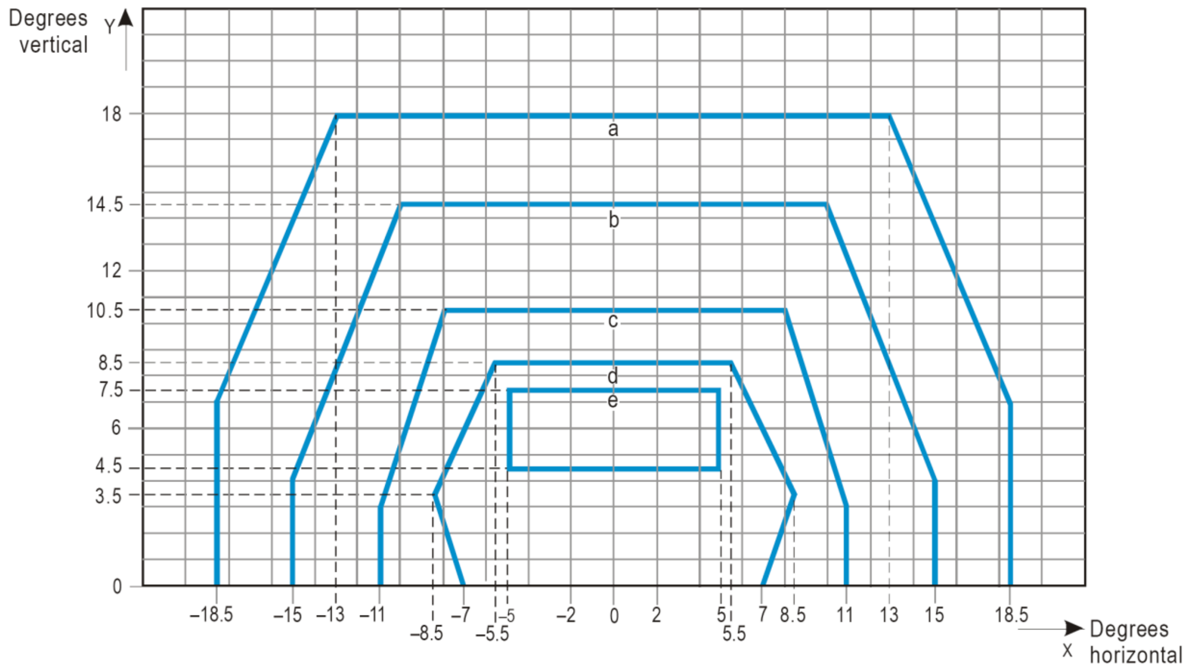
Curve	a	b	c	d	e
Intensity (cd)	8	20	100	450	1 800

Notes:

1. These beam coverages allow for displacement of the cockpit from the centre line up to distances of the order of 12 m and are intended for use before and after curves.

2. See collective notes for Figures A2-12 to A2-21.

Figure A2-17. Isocandela diagram for high-intensity taxiway center line (15 m spacing), no-entry bar and stop bar lights in straight sections intended for use in an advanced surface movement guidance and control system where higher light intensities are required and where large offsets can occur



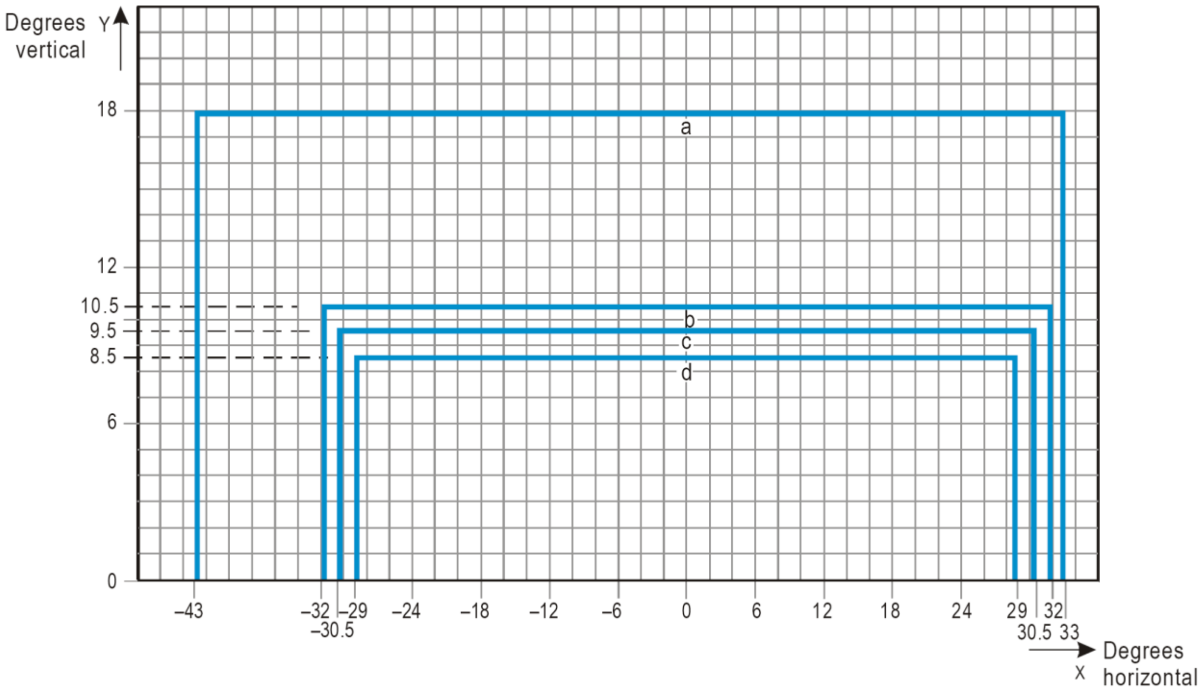
Curve	a	b	c	d	e
Intensity (cd)	8	20	100	450	1 800

Notes:

1. These beam coverages are generally satisfactory and cater for a normal displacement of the cockpit corresponding to the outer main gear wheel on the taxiway edge.

2. See collective notes for Figures A2-12 to A2-21.

Figure A2-18. Isocandela diagram for high-intensity taxiway center line (15 m spacing), no-entry bar and stop bar lights in straight sections intended for use in an advanced surface movement guidance and control system where higher light intensities are required



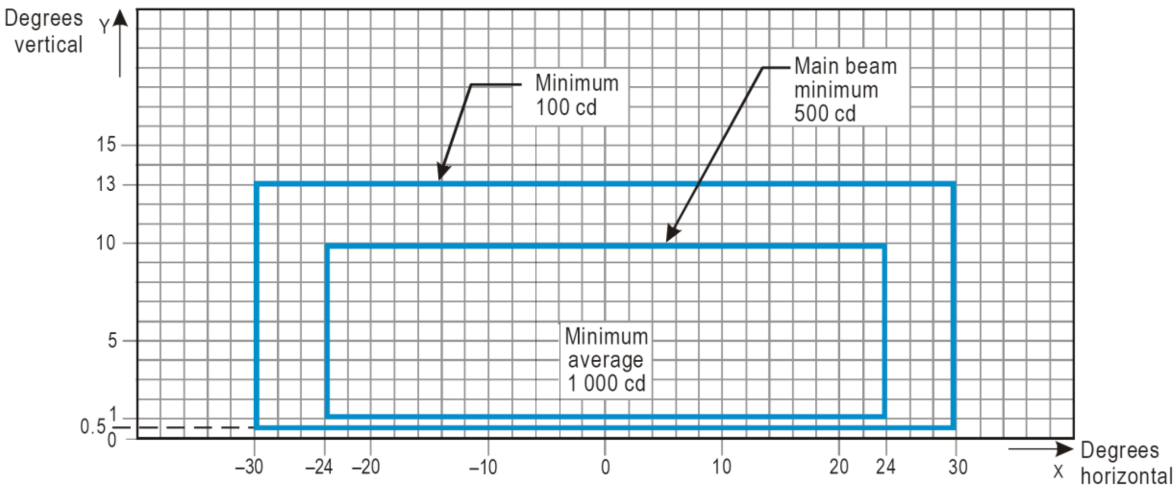
Curve	a	b	c	d
Intensity (cd)	8	100	200	400

Notes:

1. Lights on curves to be toed-in 17 degrees with respect to the tangent of the curve.

2. See collective notes for Figures A2-12 to A2-21.

Figure A2-19. Isocandela diagram for high-intensity taxiway center line (7.5 m spacing), no-entry bar and stop bar lights in curved sections intended for use in an advanced surface movement guidance and control system where higher light intensities are required



Notes:

1. Although the lights flash in normal operation, the light intensity is specified as if the lights were fixed for incandescent lamps.

2. See collective notes for Figures A2-12 to A2-21.

Figure A2-20. Isocandela diagram for high-intensity runway guard lights, Configuration B

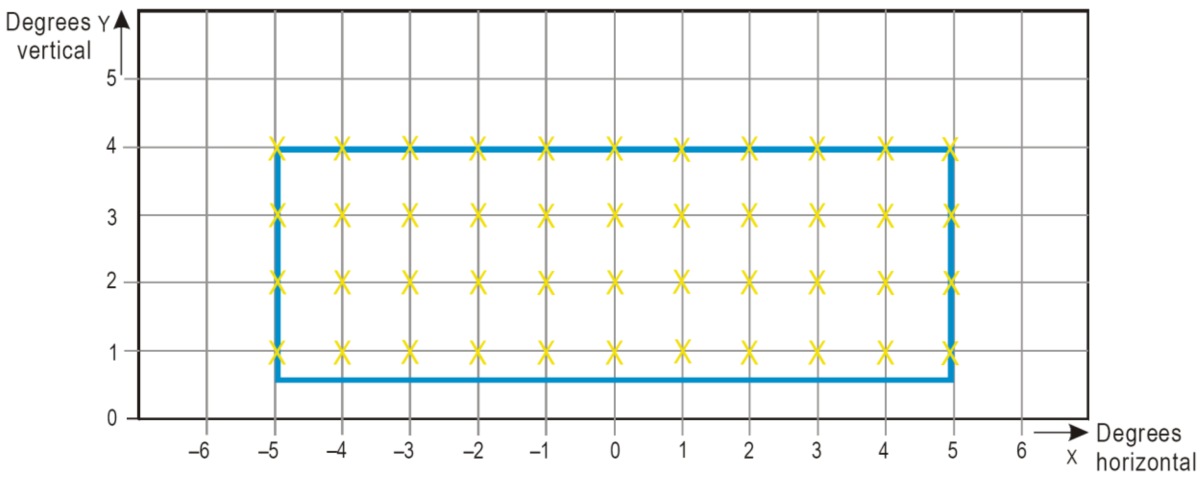


Figure A2-21. Grid points to be used for calculation of average intensity of taxiway center line and stop bar lights

Collective notes to Figures A2-12 to A2-21:

1. The intensities specified in Figures A2-12 to A2-20 are in green and yellow light for taxiway center line lights, yellow light for runway guard lights and red light for stop bar lights.
2. Figures A2-12 to A2-20 show the minimum allowable light intensities. The average intensity of the main beam is calculated by establishing grid points as shown in Figure A2-21 and using the intensity values measured at all grid points located within and on the perimeter of the rectangle representing the main beam. The average value is the arithmetic average of the light intensities measured at all considered grid points.
3. No deviations are acceptable in the main beam or in the innermost beam, as applicable, when the lighting fixture is properly aimed.
4. Horizontal angles are measured with respect to the vertical plane through the taxiway center line except on curves where they are measured with respect to the tangent to the curve.
5. Vertical angles are measured from the longitudinal slope of the taxiway surface.
6. The importance of adequate maintenance cannot be overemphasized. The intensity, either average where applicable or as specified on the corresponding isocandela curves, shall never fall to a value less than 50 per cent of the value shown in the figures, and it shall be the aim of airport authorities to maintain a level of light output close to the specified minimum average intensity.
7. The light unit shall be installed so that the main beam or the innermost beam, as applicable, is aligned within one-half degree of the specified requirement.

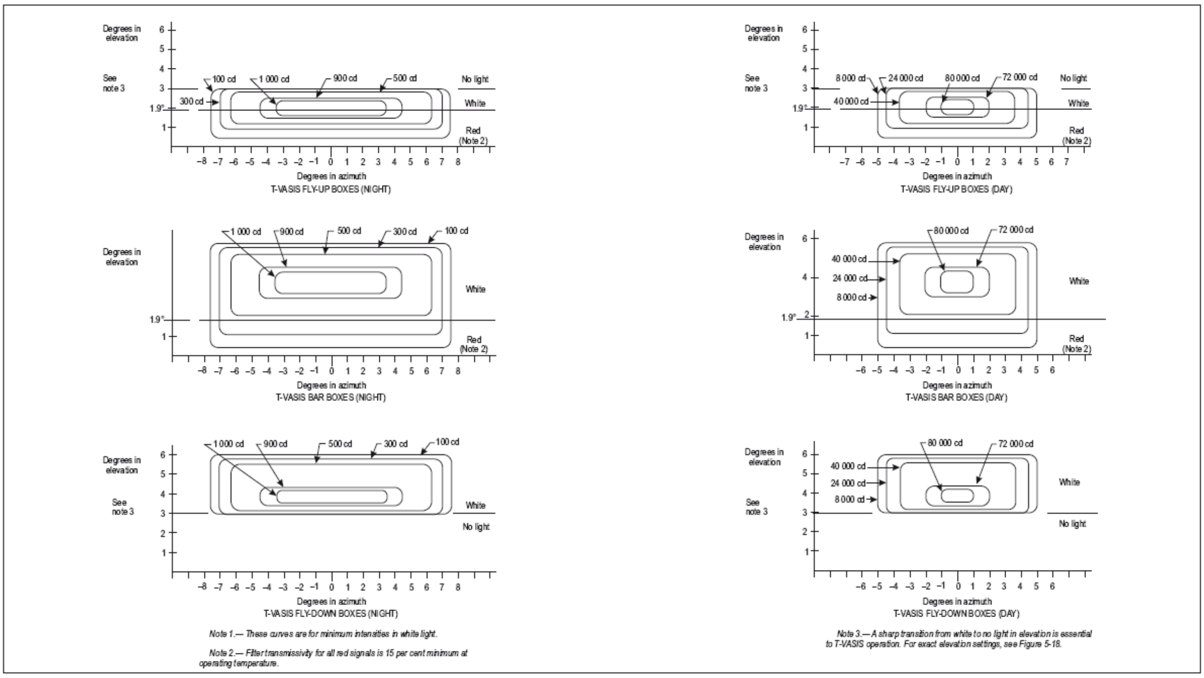
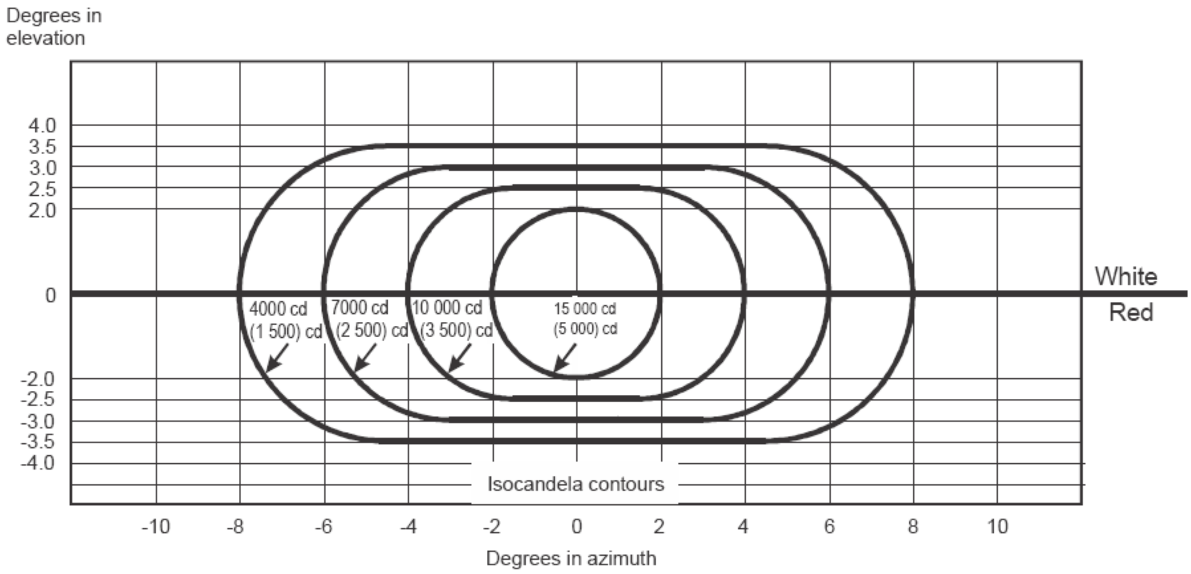


Figure A2-22. Light intensity distribution of TVASIS and AT-VASIS



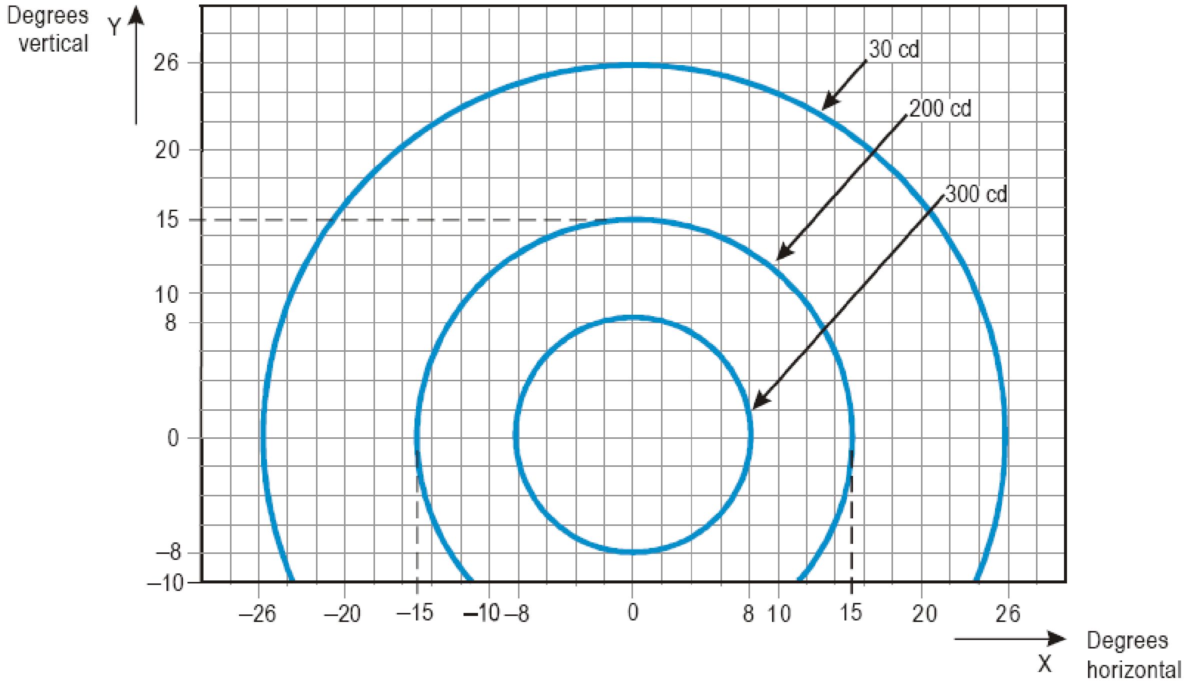
Notes:

1. These curves are for minimum intensities in red light.

2. The intensity value in the white sector of the beam is no less than 2 and may be as high as 6.5 times the corresponding intensity in the red sector.

3. The intensity values shown in brackets are for APAPI.

Figure A2-23. Light intensity distribution of PAPI and APAPI

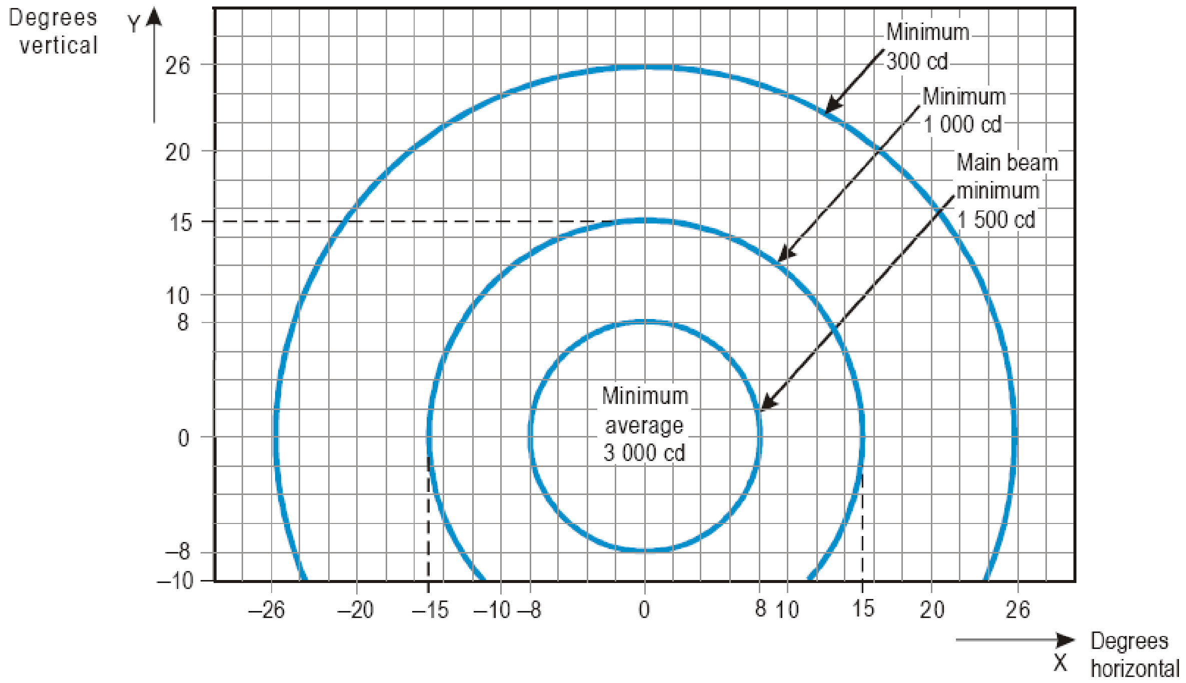


Notes:

1. Although the lights flash in normal operation, the light intensity is specified as if the lights were fixed for incandescent lamps.

2. The intensities specified are in yellow light.

Figure A2-24. Isocandela diagram for each light in low-intensity runway guard lights, Configuration A



Notes:

1. Although the lights flash in normal operation, the light intensity is specified as if the lights were fixed for incandescent lamps.

2. The intensities specified are in yellow light.

Figure A2-25. Isocandela diagram for each light in high-intensity runway guard lights, Configuration A

Appendix 3. Mandatory instruction markings and Information markings

Note 1: See Chapter 5, Sections 5.2.16 and 5.2.17 for specifications on the application, location and characteristics of mandatory instruction markings and information markings.

Note 2: This appendix details the form and proportions of the letters, numbers and symbols of mandatory instruction markings and information markings on a grid.

Note 3: The mandatory instruction markings and information markings on pavements are formed as if shadowed (i.e., stretched) from the characters of an equivalent elevated sign by a factor of 2.5 as shown in the figure below. The shadowing, however, only affects the vertical dimension. Therefore, the spacing of characters for pavement marking is obtained by first determining the equivalent elevated sign character height and then proportioning from the spacing values given in Table A41.

For example, in the case of the runway designator "10" which is to have a height of 4 000 mm (Hps), the equivalent elevated sign character height is 4 000/2.5=1 600 mm (Hes). Table A4-1(b) indicates numeral to numeral code 1 and from Table A4-1(c) this code has a dimension of 96 mm, for a character height of 400 mm. The pavement marking spacing for "10" is then (1 600/400)*96=384 mm.

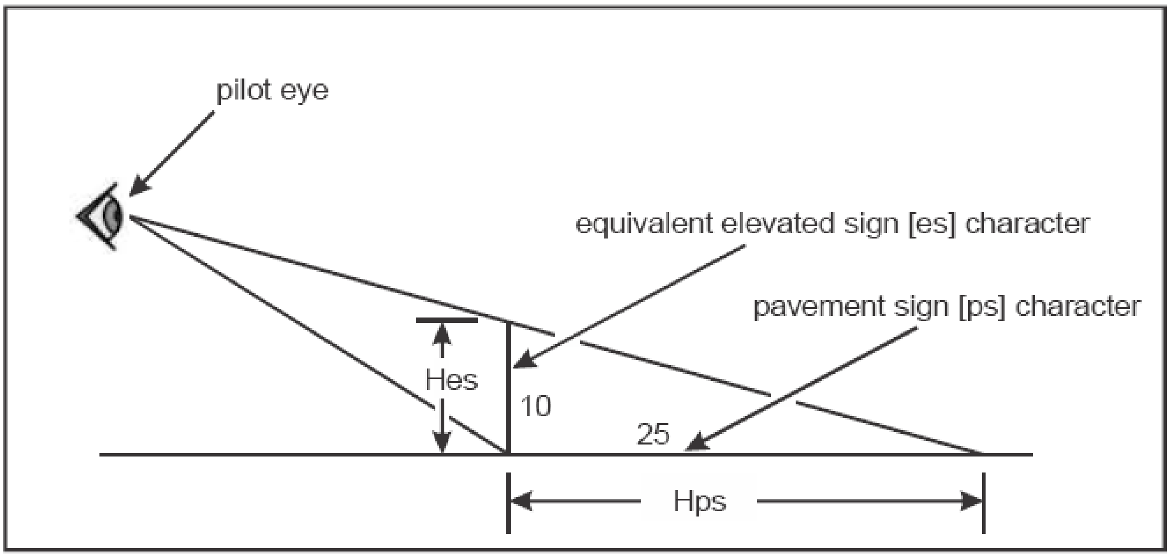
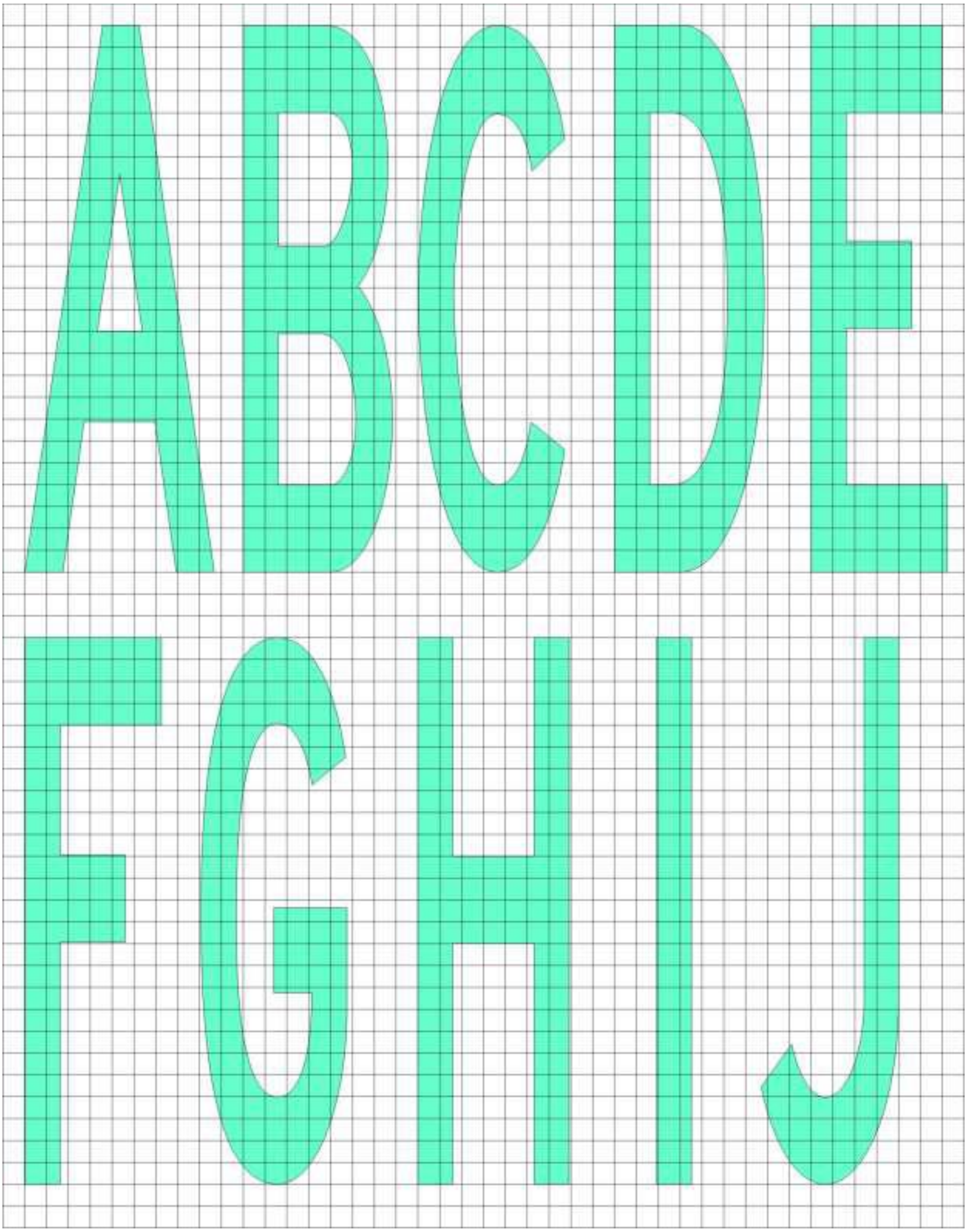
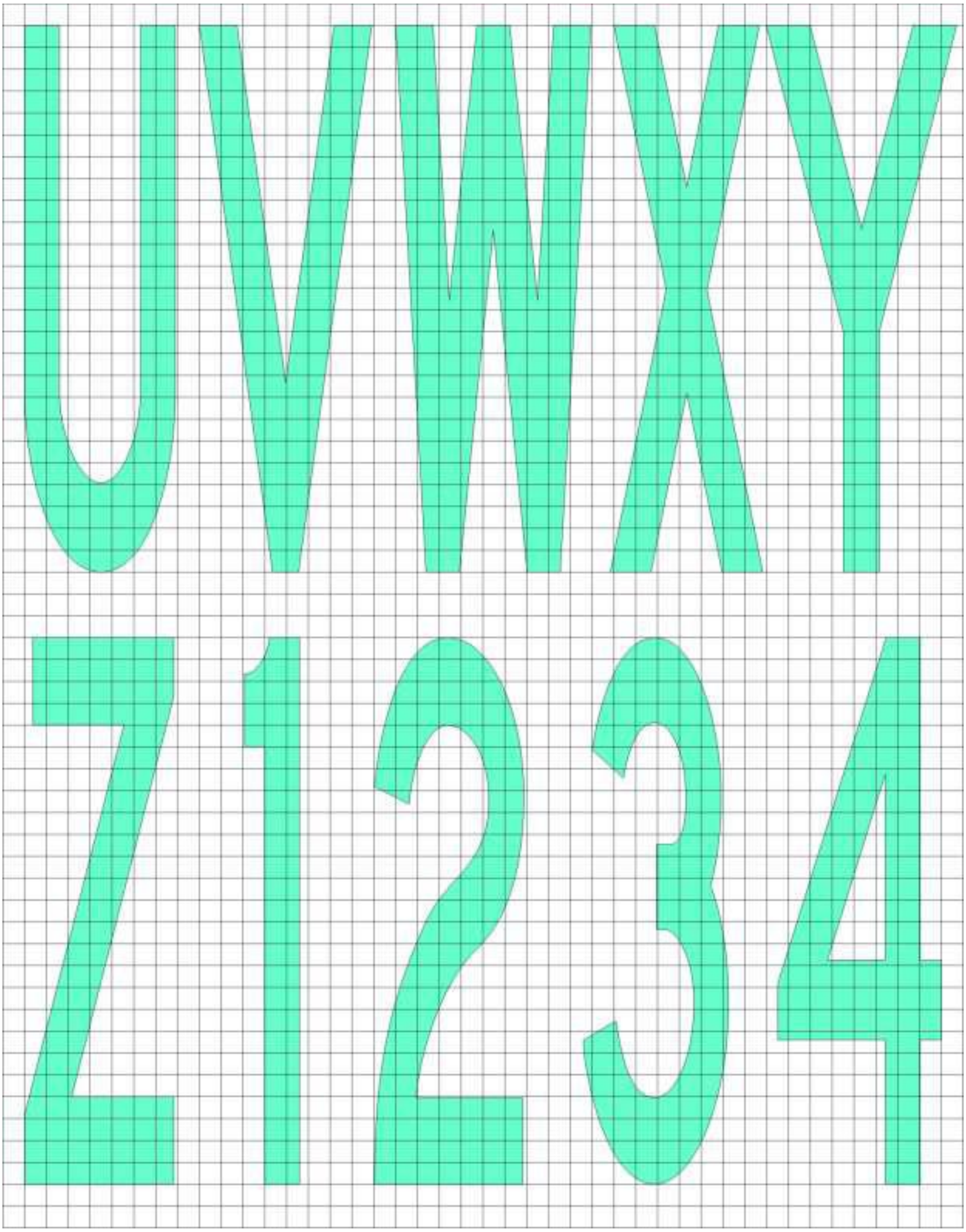
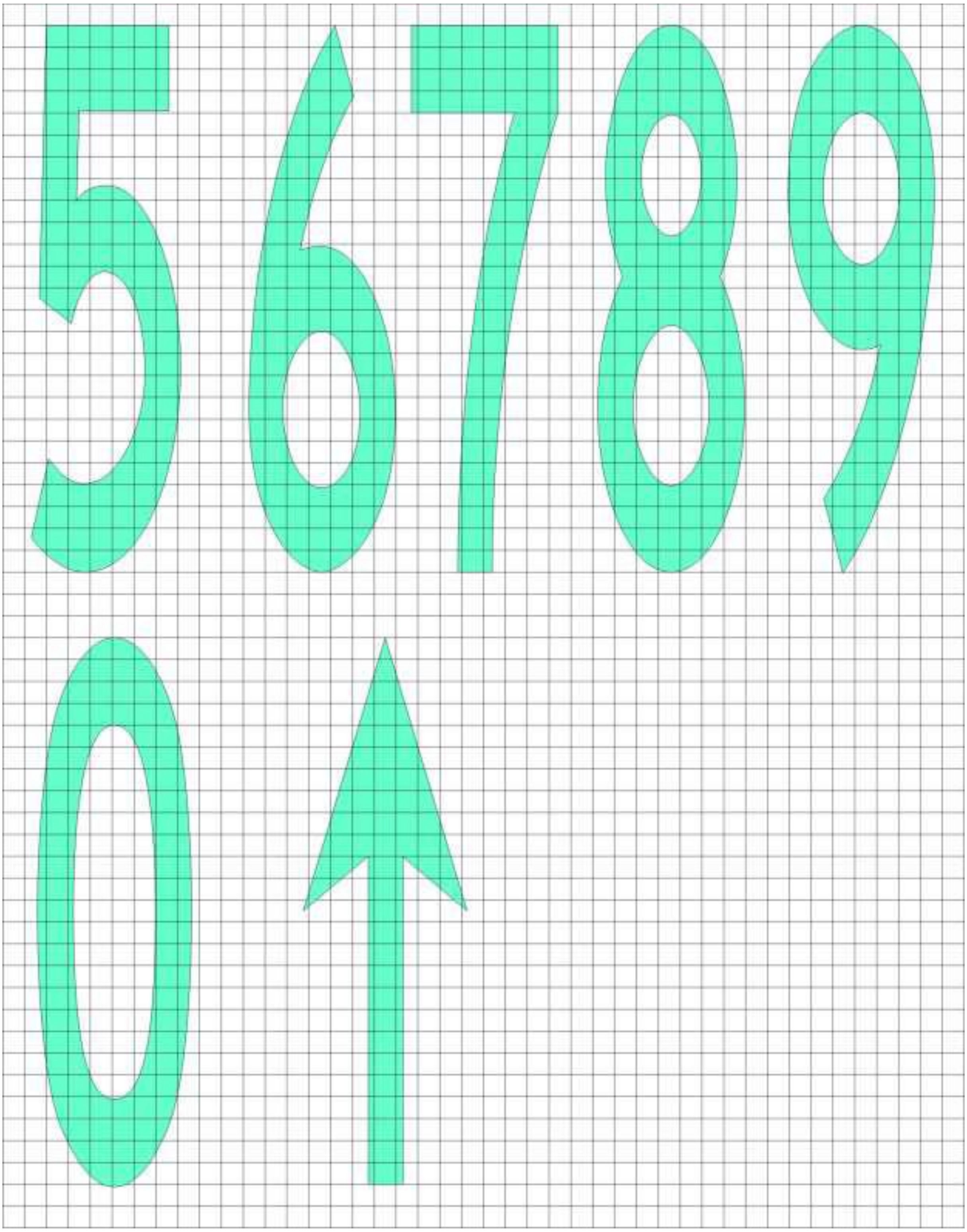


Figure A3-1


ABCDE
FGHIJ


KLMNO
PQRST


U V W X Y
Z 1 2 3 4



Appendix 4. Requirements concerning design of taxiing guidance signs

Note: See Chapter 5, Section 5.4 for specifications on the application, location and characteristics of signs.

1. Inscription heights shall conform to the following tabulation.

Runway code number	Minimum character height		
	Mandatory instruction sign	Information sign	
		Runway exit and runway vacated signs	Other signs
1 or 2	300 mm	300 mm	200 mm
3 or 4	400 mm	400 mm	300 mm

Note: Where a taxiway location sign is installed in conjunction with a runway designation sign (see 5.4.3.22), the character size shall be that specified for mandatory instruction signs.

2. Arrow dimensions shall be as follows:

Legend height	Stroke
200 mm	32 mm
300 mm	48 mm
	64 m

3. Stroke width for single letter shall be as follows:

Legend height	Stroke
200 mm	32 mm
300 mm	48 mm
400 mm	64 mm

4. Sign luminance shall be as follows:

a. Where operations are conducted in runway visual range conditions less than a value of 800 m, average sign luminance shall be at least:

Red	30 cd/m2
Yellow	150 cd/m2
White	300 cd/m2

b. Where operations are conducted in accordance with 5.4.1.7 b) and c) and 5.4.1.8, average sign luminance shall be at least:

Red	10 cd/m2
Yellow	50 cd/m2

White 100 cd/m2

Note: In runway visual range conditions less than a value of 400 m, there will be some degradation in the performance of signs.

5. The luminance ratio between red and white elements of a mandatory sign shall be between 1:5 and 1:10.

6. The average luminance of the sign is calculated by establishing grid points as shown in Figure A4-1 and using the luminance values measured at all grid points located within the rectangle representing the sign.

7. The average value is the arithmetic average of the luminance values measured at all considered grid points.

Note: Guidance on measuring the average luminance of a sign is contained in the Aerodrome Design Manual, Part 4.

8. The ratio between luminance values of adjacent grid points shall not exceed 1.5:1. For areas on the sign face where the grid spacing is 7.5 cm, the ratio between luminance values of adjacent grid points shall not exceed 1.25:1. The ratio between the maximum and minimum luminance value over the whole sign face shall not exceed 5:1.

9. The forms of characters, i.e., letters, numbers, arrows and symbols, shall conform to those shown in Figure A4-2. The width of characters and the space between individual characters shall be determined as indicated in Table A4-1.

10. The face height of signs shall be as follows:

Legend height	Face height (min)
200 mm	300 mm
300 mm	450 mm
400 mm	600 mm

11. The face width of signs shall be determined using Figure A4-4 except that, where a mandatory instruction sign is provided on one side of a taxiway only, the face width shall not be less than:

a. 1.94 m where the code number is 3 or 4; and
b. 1.46 m where the code number is 1 or 2.

Note: Additional guidance on determining the face width of a sign is contained in the Aerodrome Design Manual, Part 4.

12. Borders

a. The black vertical delineator between adjacent direction signs shall have a width of approximately 0.7 of the stroke width.
b. The yellow border on a stand-alone location sign shall be approximately 0.5 stroke width.

13. The colors of signs shall be in accordance with the appropriate specifications in Appendix 1.

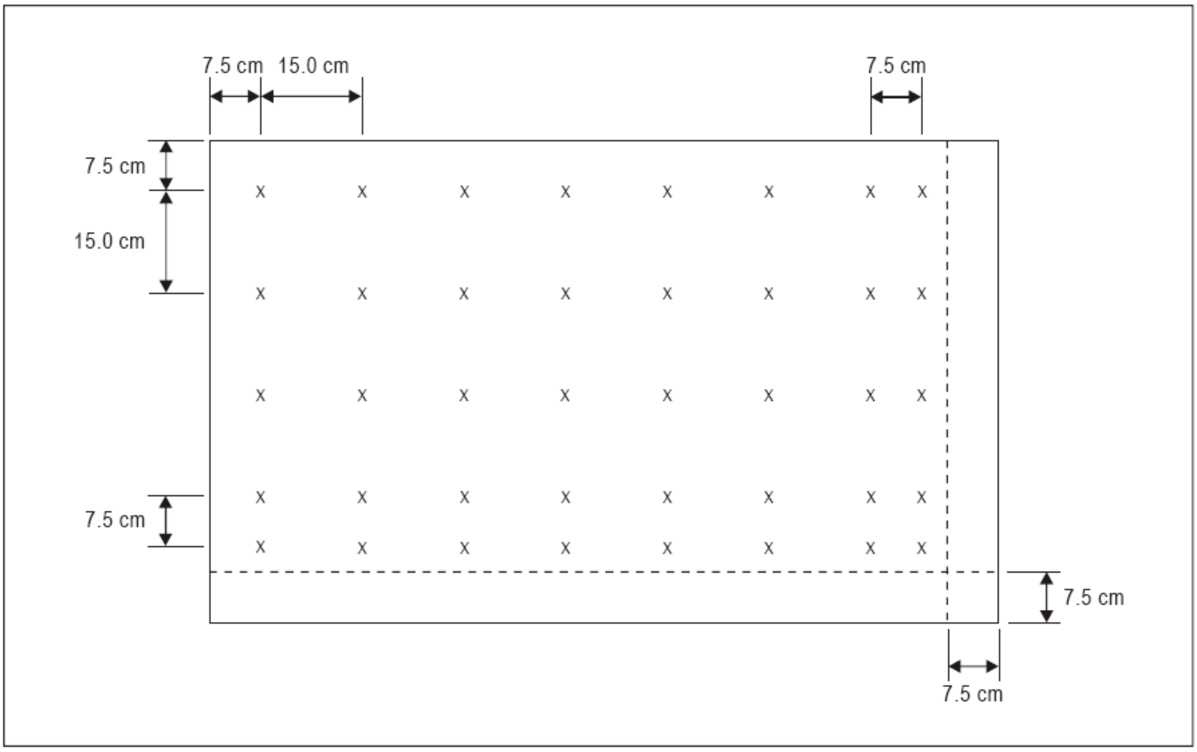


Figure A4-1. Grid points for calculating average luminance of a sign

Note 1: The average luminance of a sign is calculated by establishing grid points on a sign face showing typical inscriptions and a background of the appropriate color (red for mandatory instruction signs and yellow for direction and destination signs) as follows:

a. Starting at the top left corner of the sign face, establish a reference grid point at 7.5 cm from the left edge and the top of the sign face.
b. Create a grid of 15 cm spacing horizontally and vertically from the reference grid point. Grid points within 7.5 cm of the edge of the sign face shall be excluded.
c. Where the last point in a row/column of grid points is located between 22.5 cm and 15 cm from the edge of the sign face (but not inclusive), an additional point shall be added 7.5 cm from this point.
d. Where a grid point falls on the boundary of a character and the background, the grid point shall be slightly shifted to be completely outside the character.

Note 2: Additional grid points may be required to ensure that each character includes at least five evenly spaced grid points.

Note 3: Where one unit includes two types of signs, a separate grid shall be established for each type.

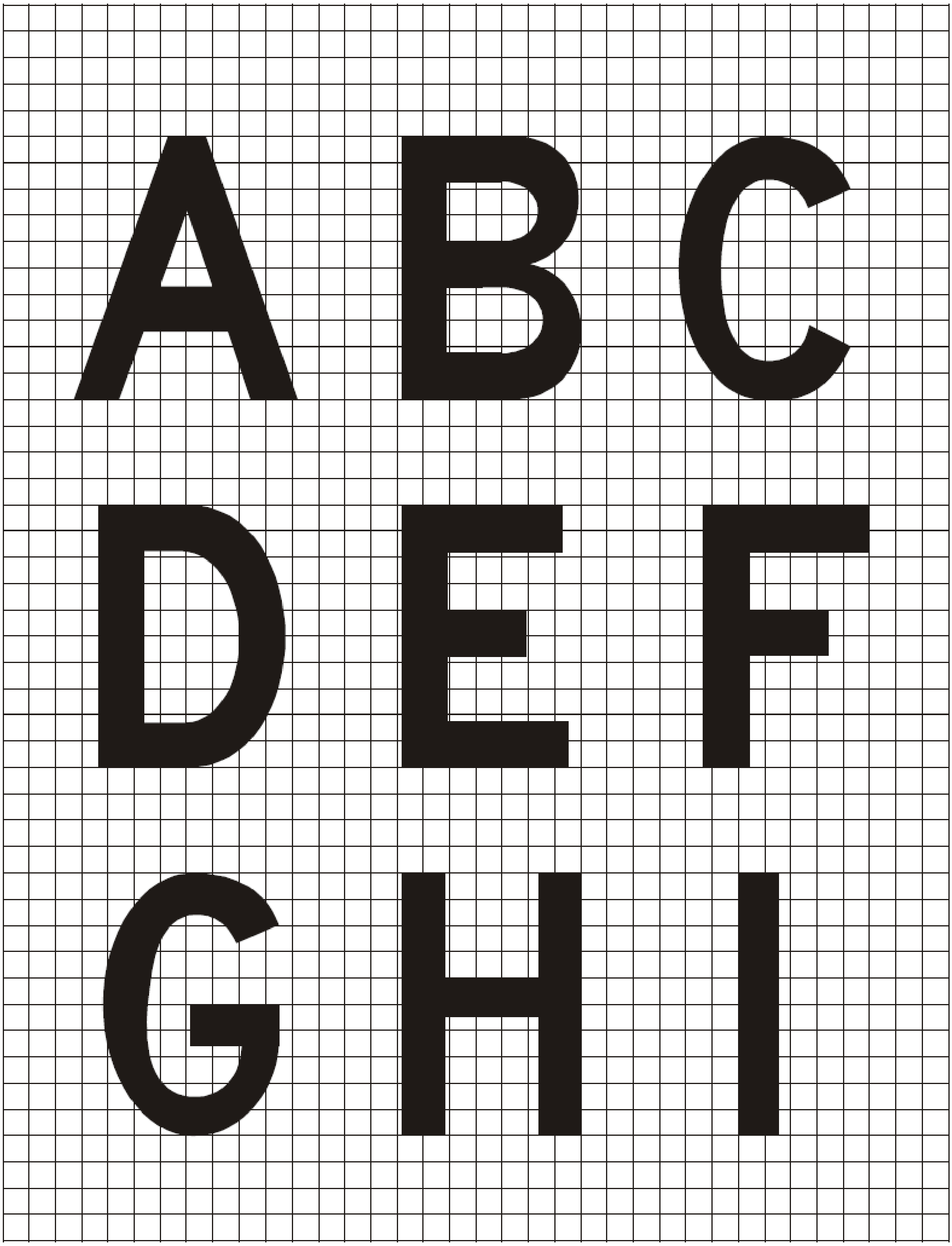


Figure A4-2. Forms of characters

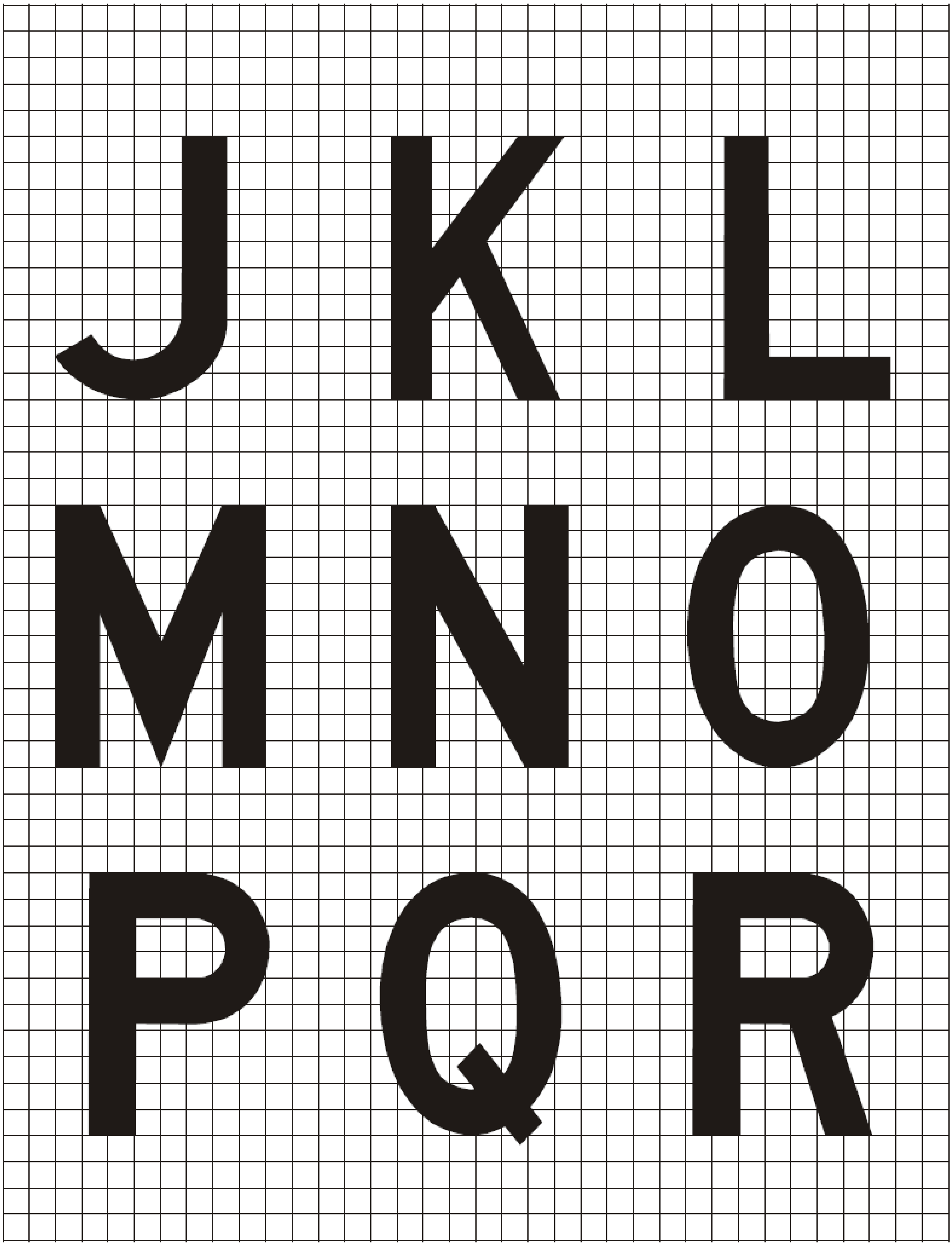


Figure A4-2. (cont.)

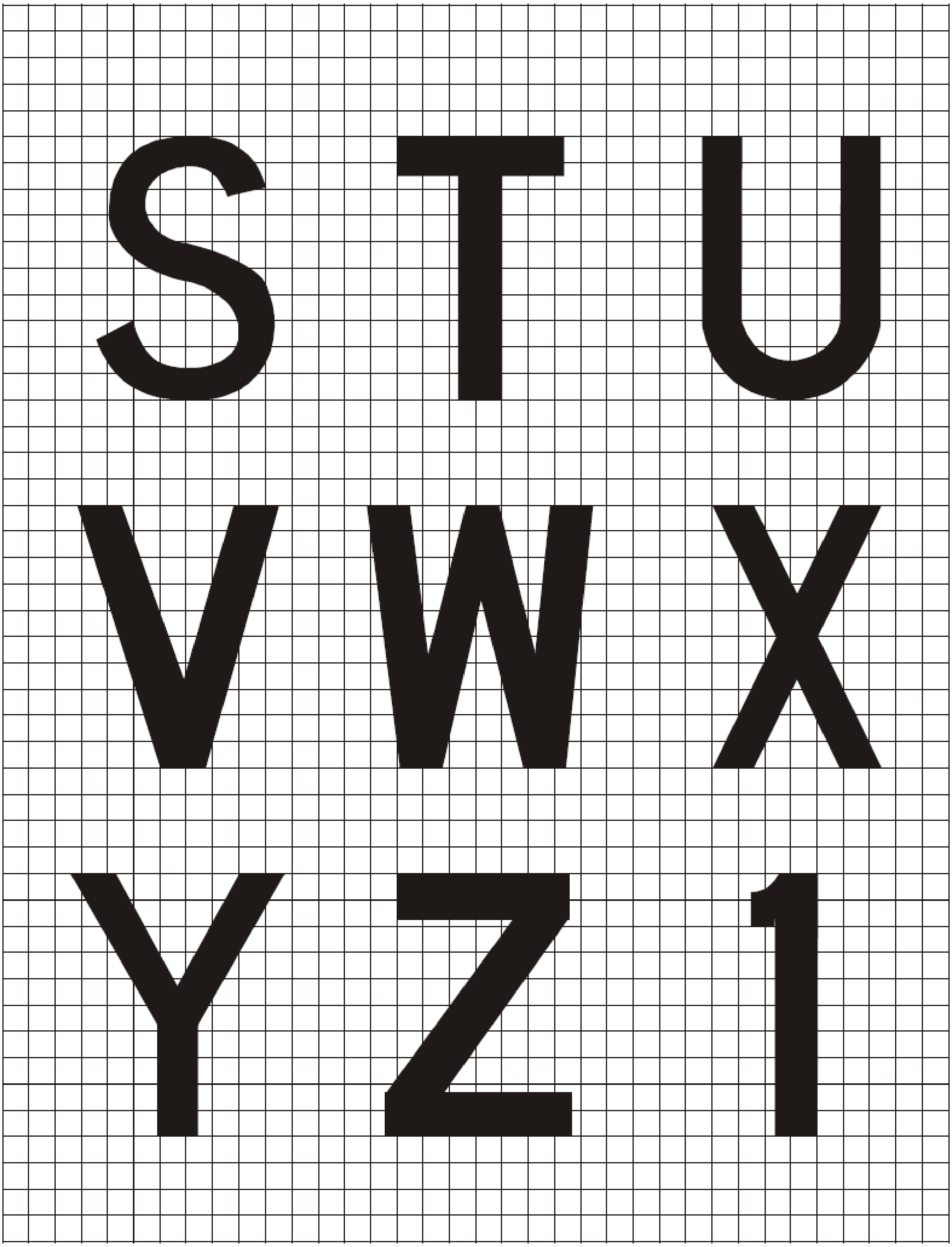


Figure A4-2. (cont.)

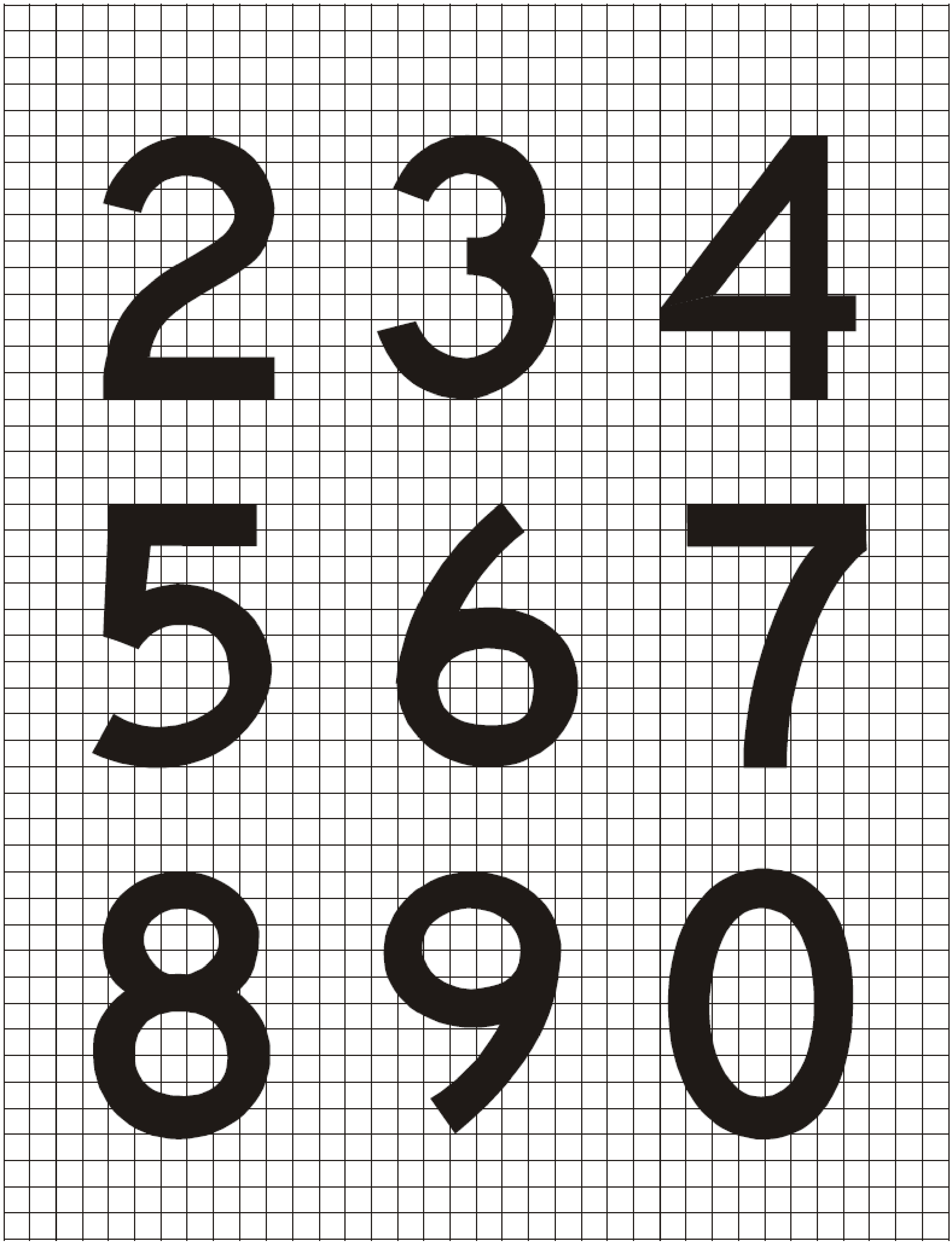


Figure A4-2. (cont.)

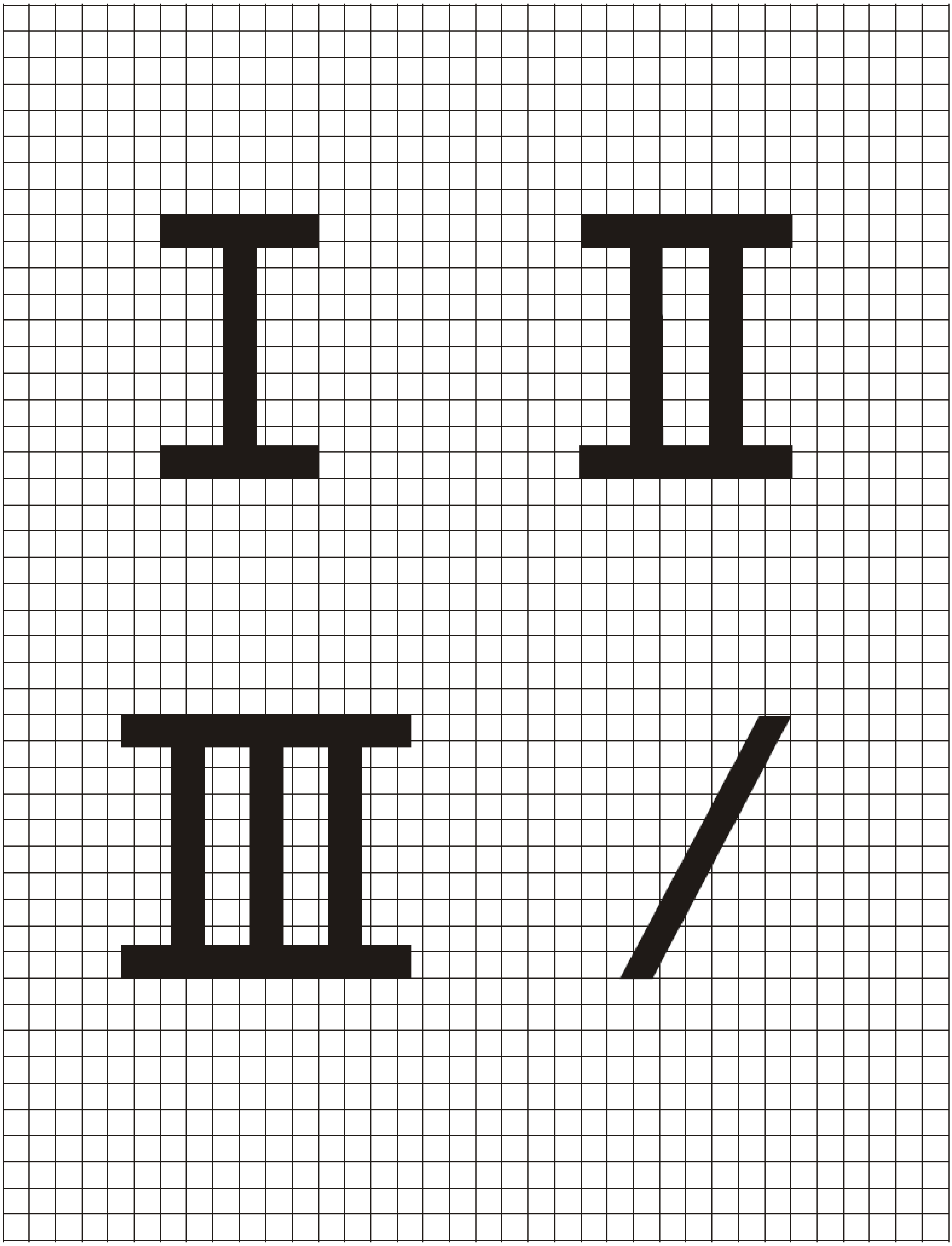
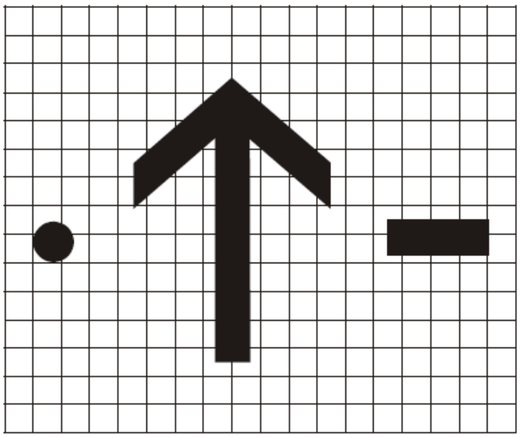


Figure A4-2. (cont.)

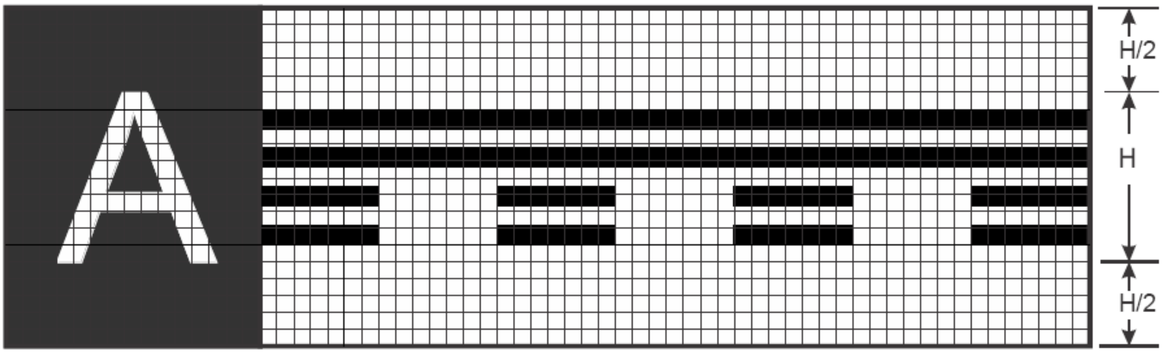


Note 1.—The arrow stroke width, diameter of the dot, and both width and length of the dash shall be proportioned to the character stroke widths.

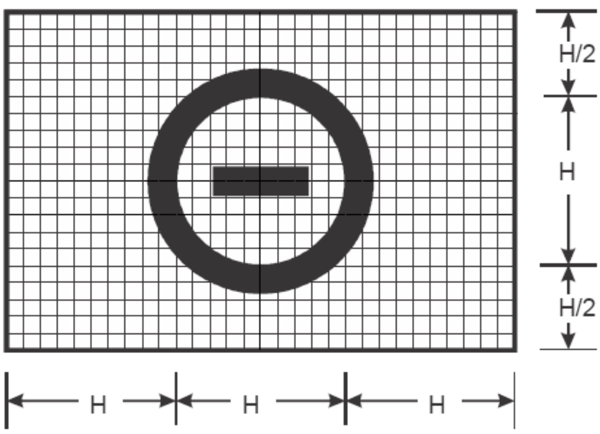
Note 2.— The dimensions of the arrow shall remain constant for a particular sign size, regardless of orientation.

Arrow, dot and dash

Figure A4-2.

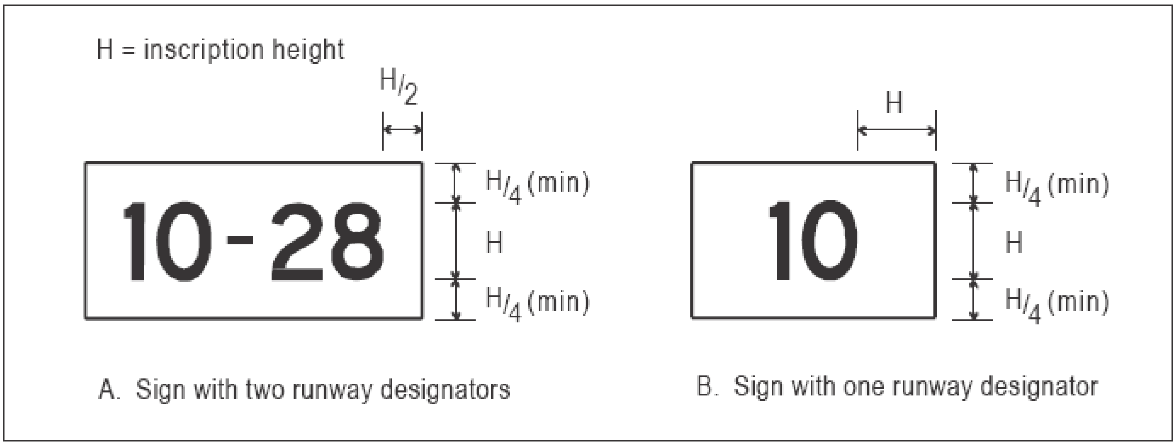


Runway vacated sign (with typical location sign)



NO ENTRY sign

Figure A4-3. Runway vacated and NO ENTRY signs



Explanatory Note to Figure A4-4: "H" stands for the inscription height.

Figure A4-4. Sign dimensions

Table A4-1. Letter and numeral widths and space between letters or numerals

a) Letter to letter code number

Preceding Letter	Following Letter: B, D, E, F, H, I, K, L, M, N, P, R, U	Following Letter: C, G, O, Q, S, X, Z	Following Letter: A, J, T, V, W, Y
	Code number		
A	2	2	4
B	1	2	2
C	2	2	3
D	1	2	2
E	2	2	3
F	2	2	3
G	1	2	2
H	1	1	2
I	1	1	2
J	1	1	2
K	2	2	3
L	2	2	4
M	1	1	2
N	1	1	2
O	1	2	2
P	1	2	2
Q	1	2	2
R	1	2	2
S	1	2	2
T	2	2	4
U	1	1	2
V	2	2	4
W	2	2	4
X	2	2	3
Y	2	2	4
Z	2	2	3

b) Numeral to numeral code number

Preceding Numeral	Following number: 1, 5	Following number: 2, 3, 6, 8, 9, 0	Following number: 4, 7
	Code number		
1	1	1	2
2	1	2	2
3	1	2	2
4	2	2	4
5	1	2	2
6	1	2	2
7	2	2	4
8	1	2	2
9	1	2	2
0	1	2	2

c) Space between characters

Code No.	Character height (mm) 200	300	400
	Space (mm)		
1	48	71	96
2	38	57	76
3	25	38	50
4	13	19	26

d) Width of letter

Letter	Letter height (mm) 200	300	400
	Width (mm)		
A	170	255	340
B	137	205	274
C	137	205	274
D	137	205	274
E	124	186	248
F	124	186	248
G	137	205	274
H	137	205	274
I	32	48	64
J	127	190	254
K	140	210	280
L	124	186	248
M	157	236	314
N	137	205	274
O	143	214	286
P	137	205	274
Q	143	214	286
R	137	205	274
S	137	205	274
T	124	186	248
U	137	205	274
V	152	229	304
W	178	267	356
X	137	205	274
Y	171	257	342
Z	137	205	274

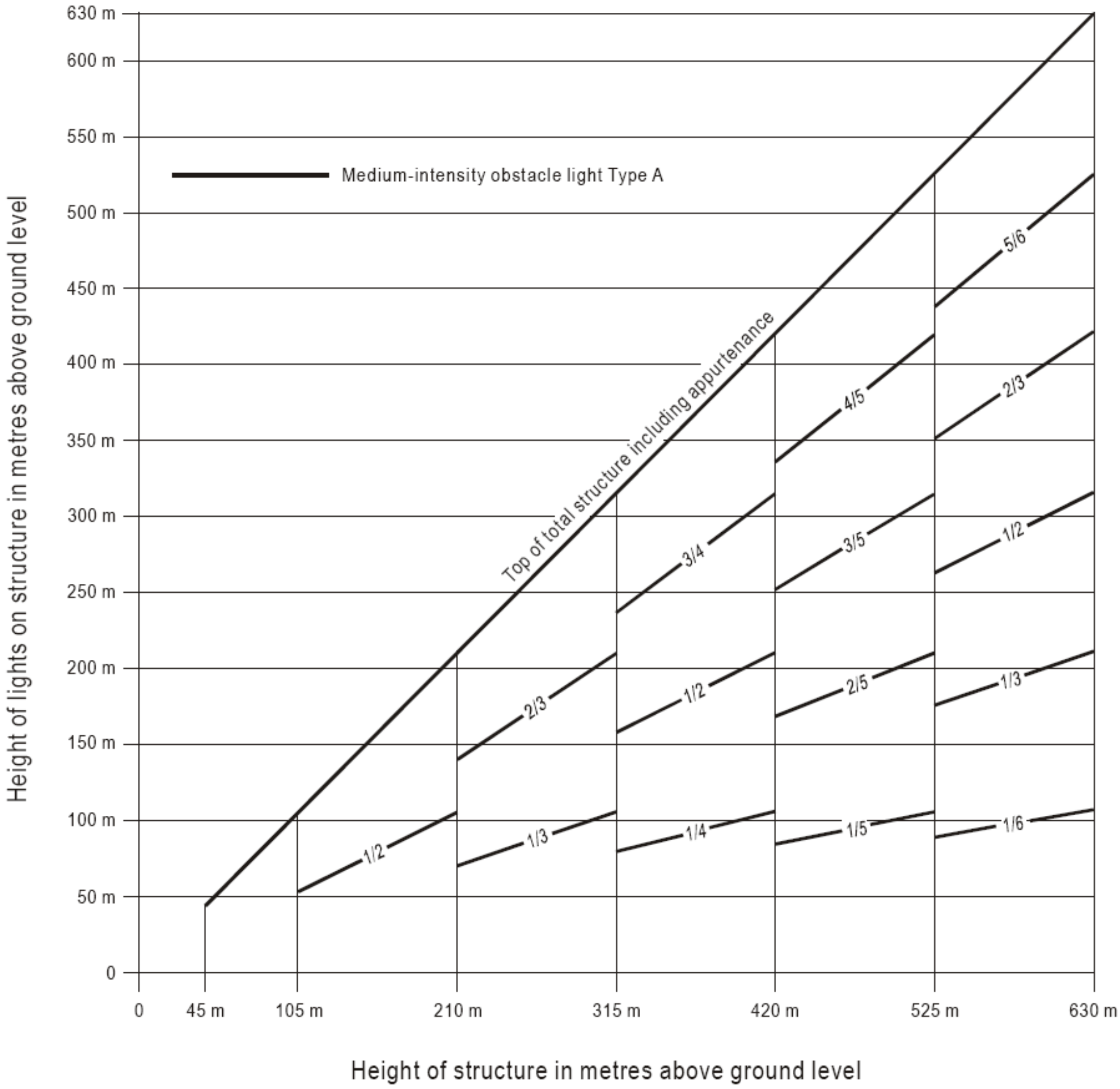
e) Width of numeral

Numeral	Numeral height (mm) 200	300	400
	Width (mm)		
1	50	74	98
2	137	205	274
3	137	205	274
4	149	224	298
5	137	205	274
6	137	205	274
7	137	205	274
8	137	205	274
9	137	205	274
0	143	214	286

INSTRUCTIONS

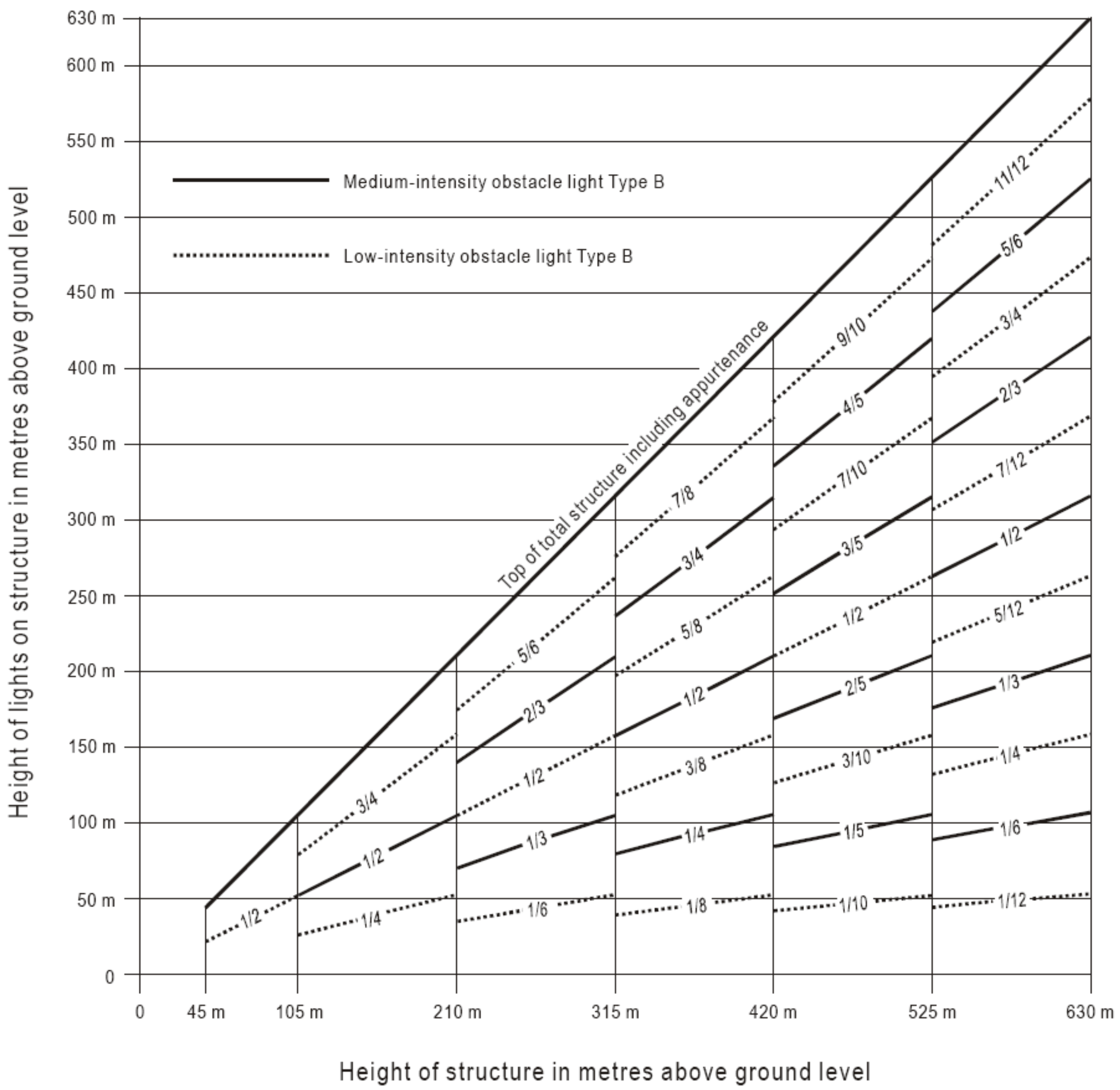
1. To determine the proper SPACE between letters or numerals, obtain the code number from table a) or b) and enter table c) for that code number to the desired letter or numeral height.
2. The space between words or groups of characters forming an abbreviation or symbol should be equal to 0.5 to 0.75 of the height of the characters used except that where an arrow is located with a single character such as 'A →', the space may be reduced to not less than one quarter of the height of the character in order to provide a good visual balance.
3. Where the numeral follows a letter or vice versa use Code 1.
4. Where a hyphen, dot, or diagonal stroke follows a character or vice versa use Code 1.
5. For the intersection take-off sign, the height of the lower case "m" is 0.75 of the height of the preceding "0" (zero) and spaced from the preceding "0" at code 1 for the character height of the numerals.

Appendix 5. Location of lights on obstacles



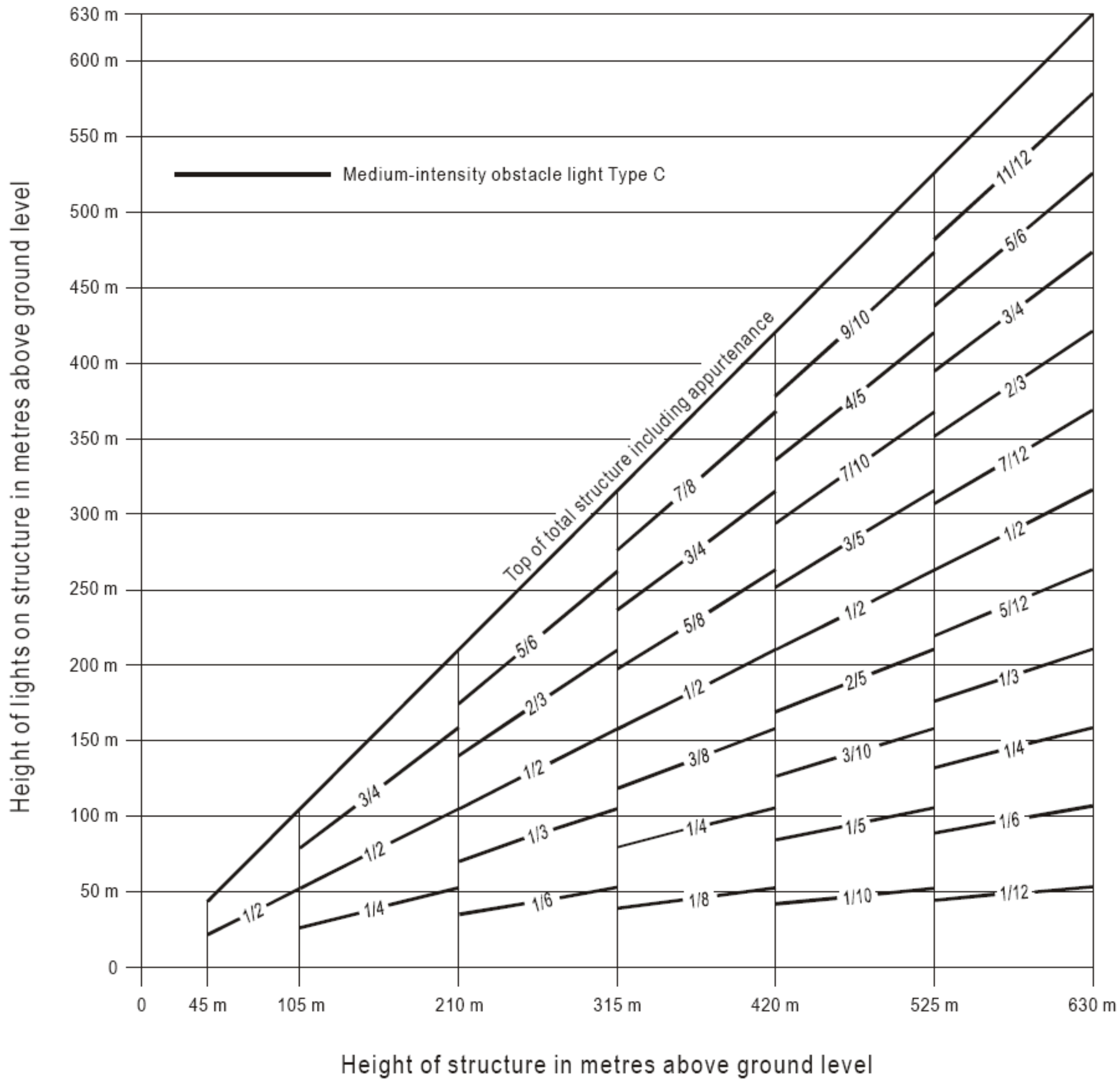
Note: High-intensity obstacle lighting is recommended on structures with a height of more than 150 m above ground level. If medium-intensity lighting is used, marking will also be required.

Figure A5-1. Medium-intensity flashing-white obstacle lighting system, Type A



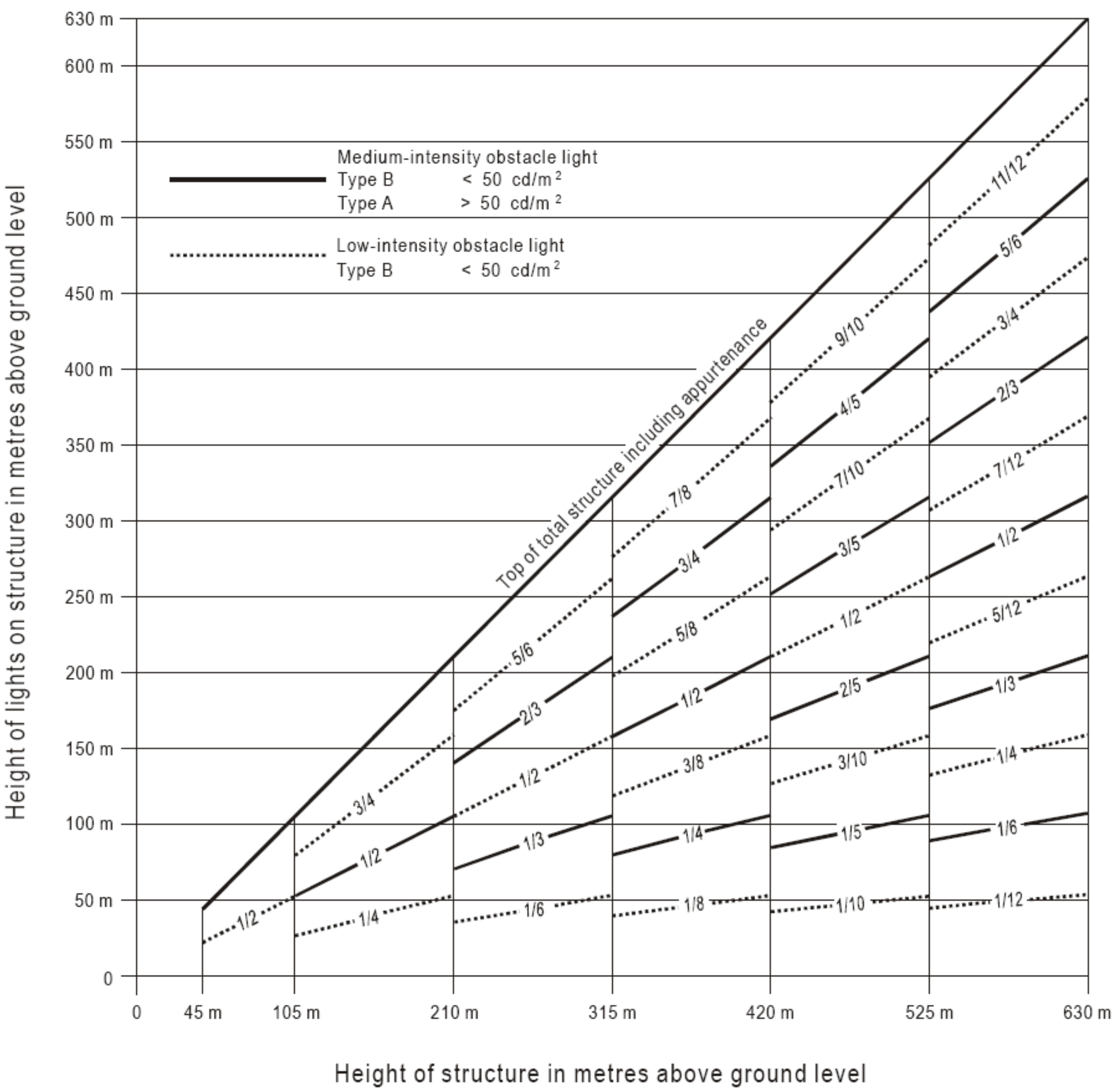
Note: For night-time use only.

Figure A5-2. Medium-intensity flashing-red obstacle lighting system, Type B



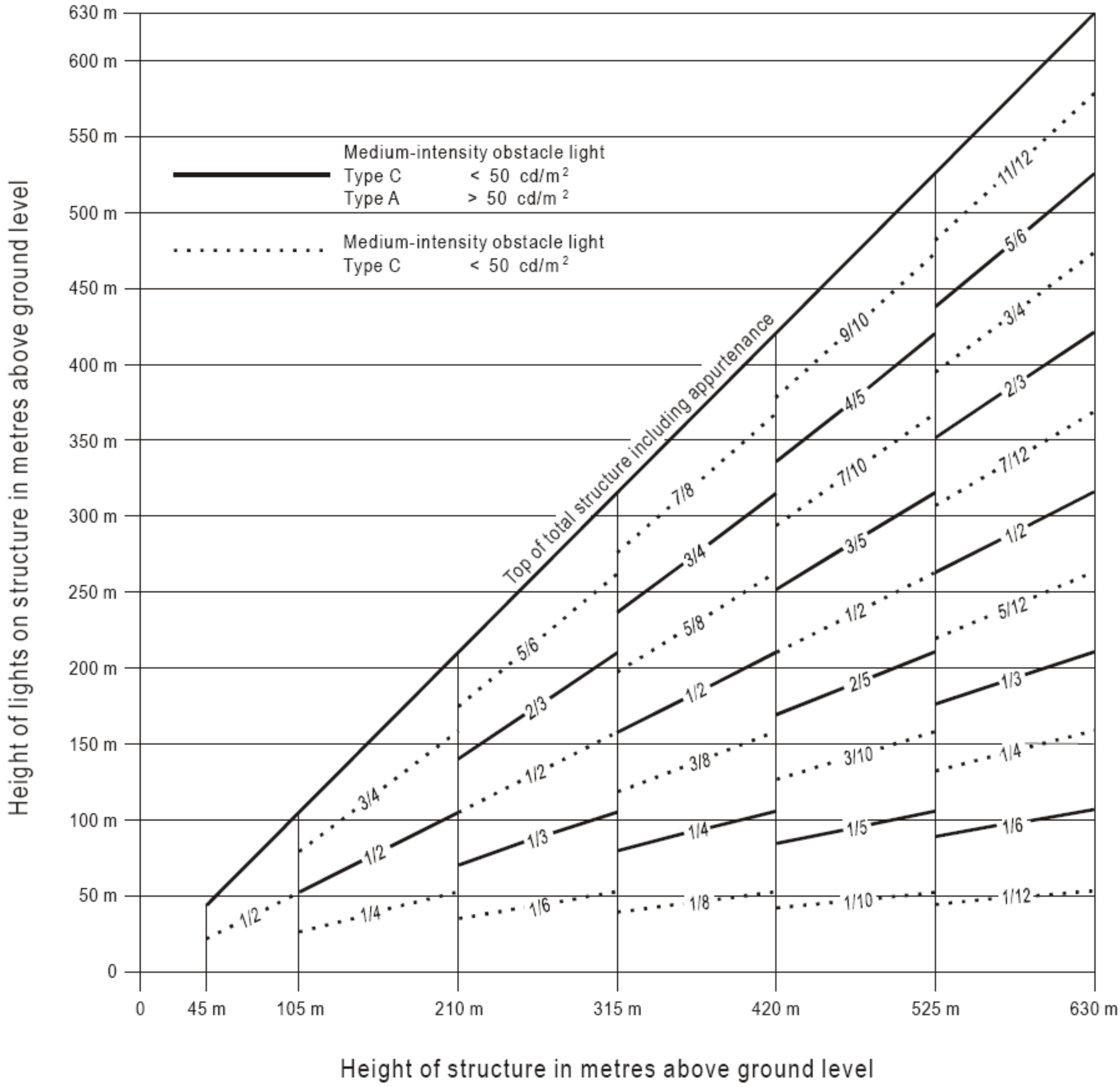
Note: For night-time use only.

Figure A5-3. Medium-intensity fixed-red obstacle lighting system, Type C



Note: High-intensity obstacle lighting is recommended on structures with a height of more than 150 m above ground level. If medium-intensity lighting is used, marking will also be required.

Figure A5-4. Medium-intensity dual obstacle lighting system, Type A/Type B



Note: High-intensity obstacle lighting is recommended on structures with a height of more than 150 m above ground level. If medium-intensity lighting is used, marking will also be required.

Figure A5-5. Medium-intensity dual obstacle lighting system, Type A/Type C

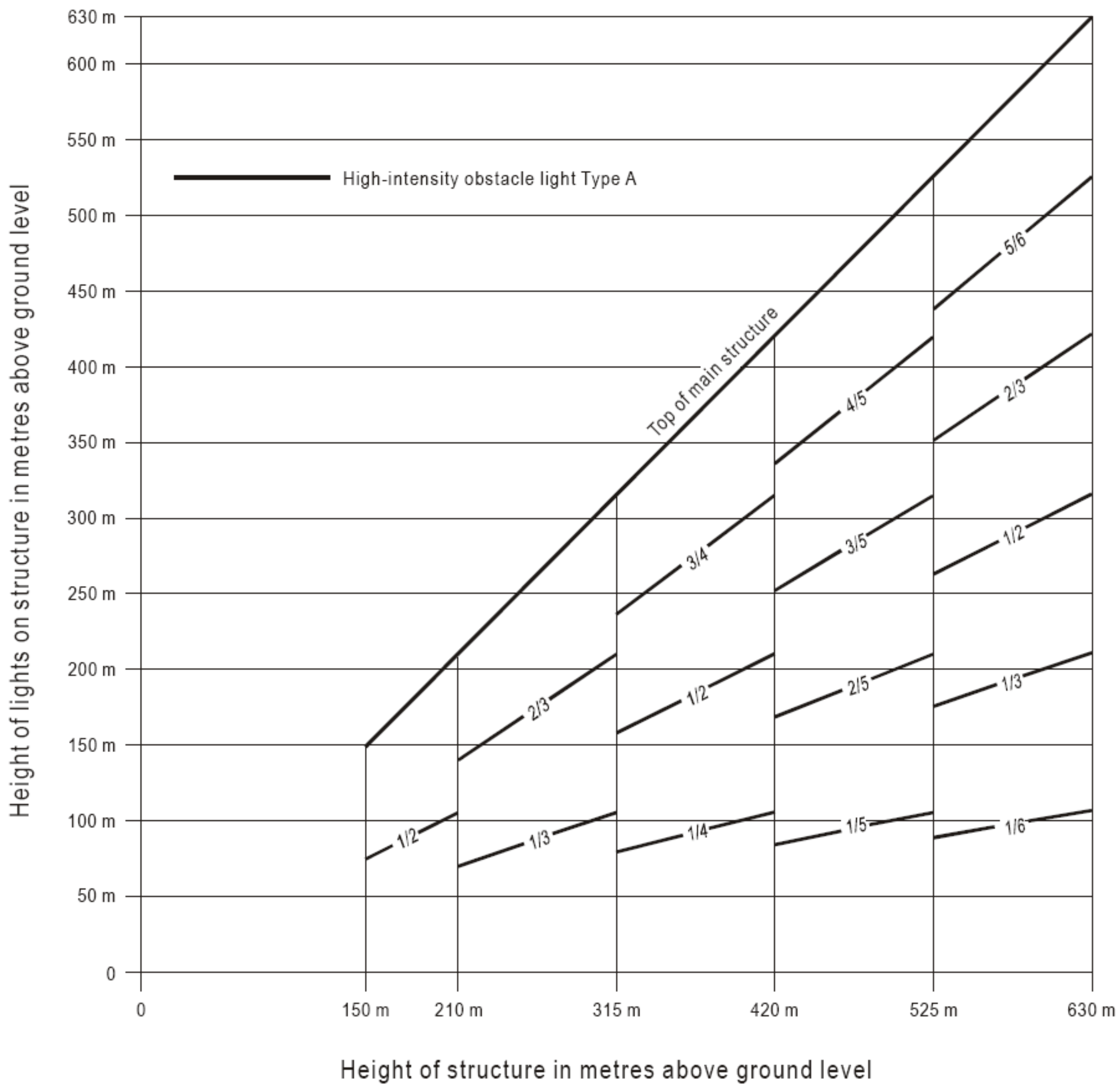


Figure A5-6. High-intensity flashing-white obstacle lighting system, Type A

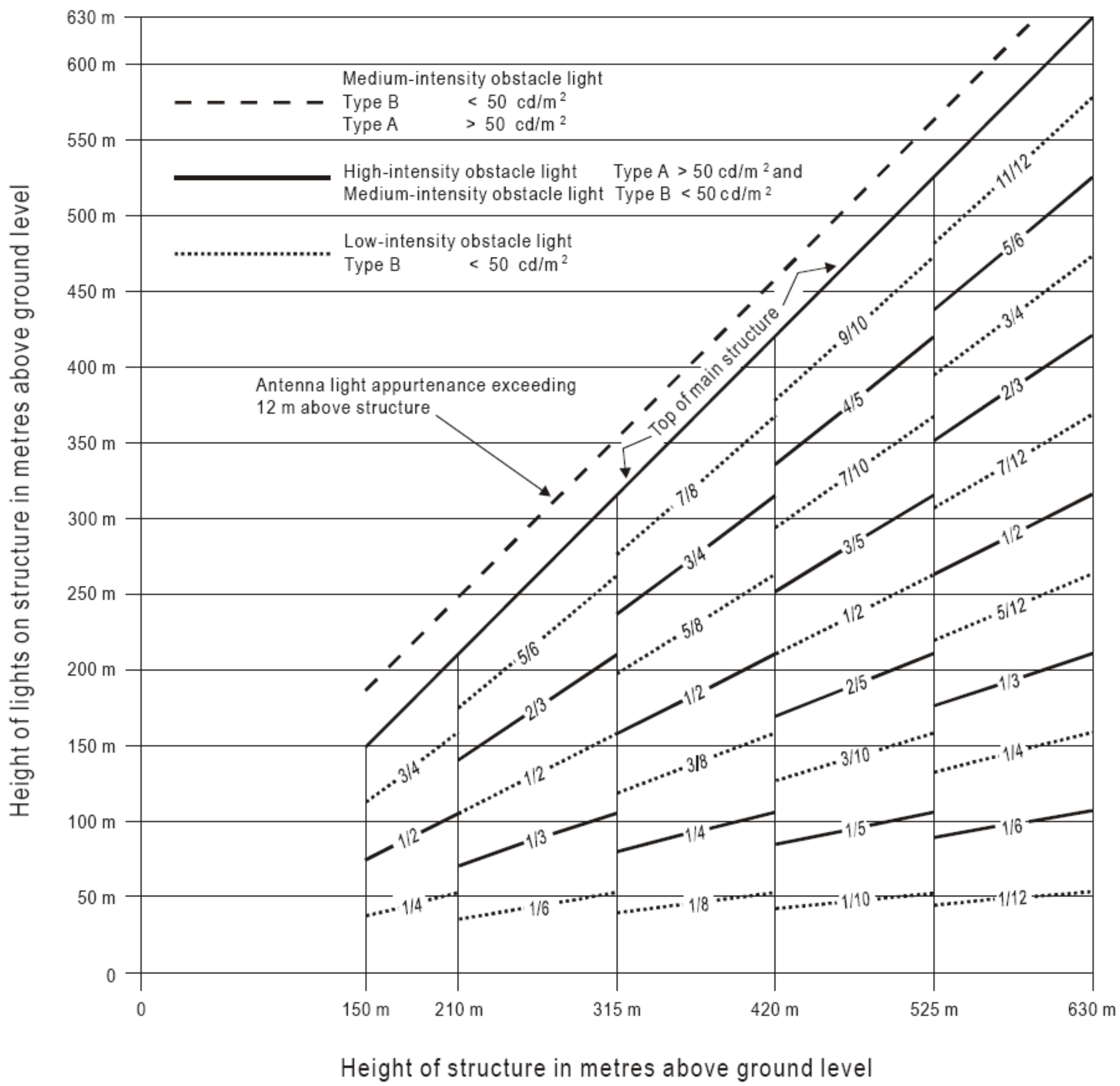


Figure A5-7. High-/medium-intensity dual obstacle lighting system, Type A/Type B

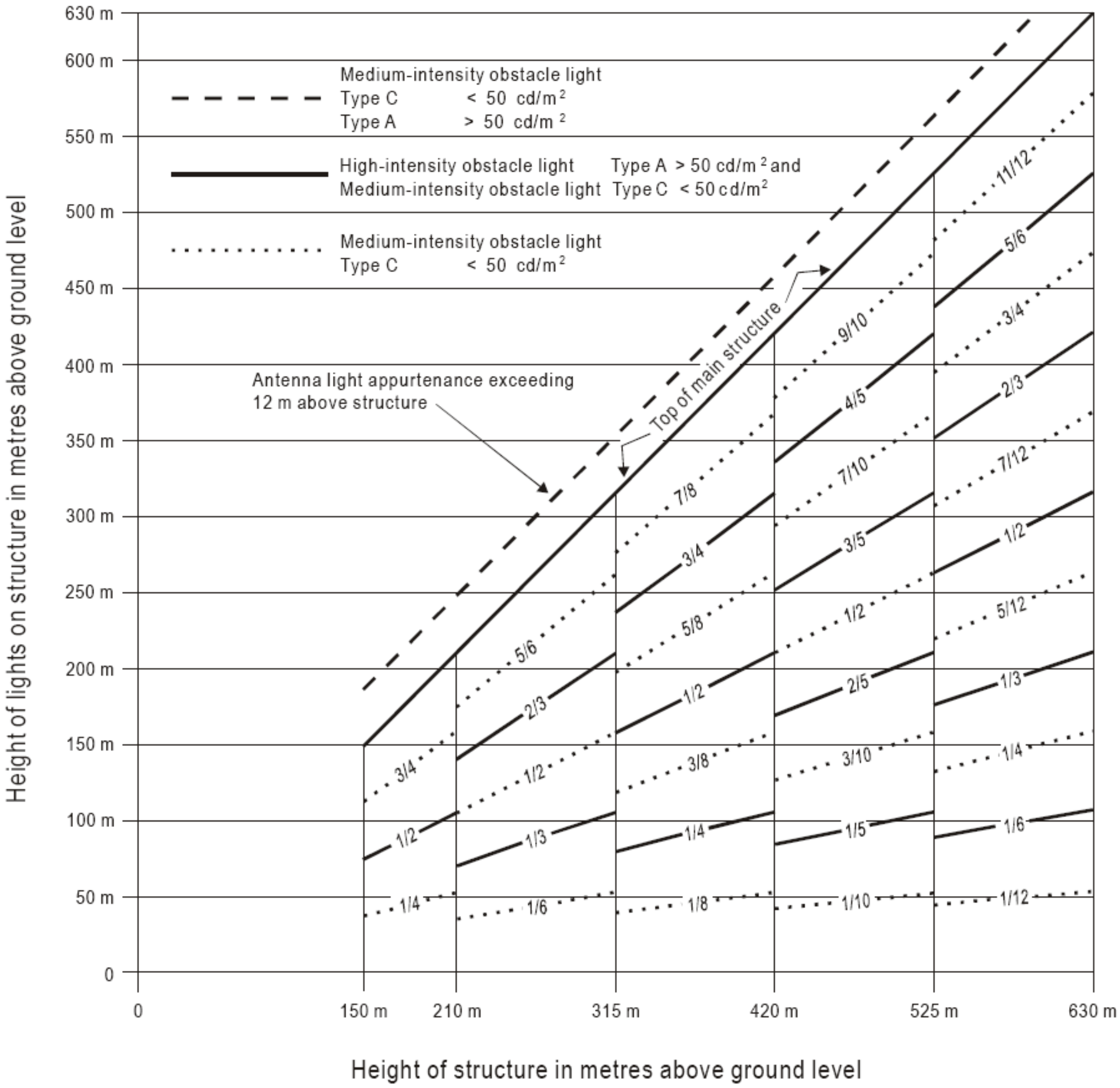


Figure A5-8. High-/medium-intensity dual obstacle lighting system, Type A/Type C

Attachment

Obstacle limitation surfaces

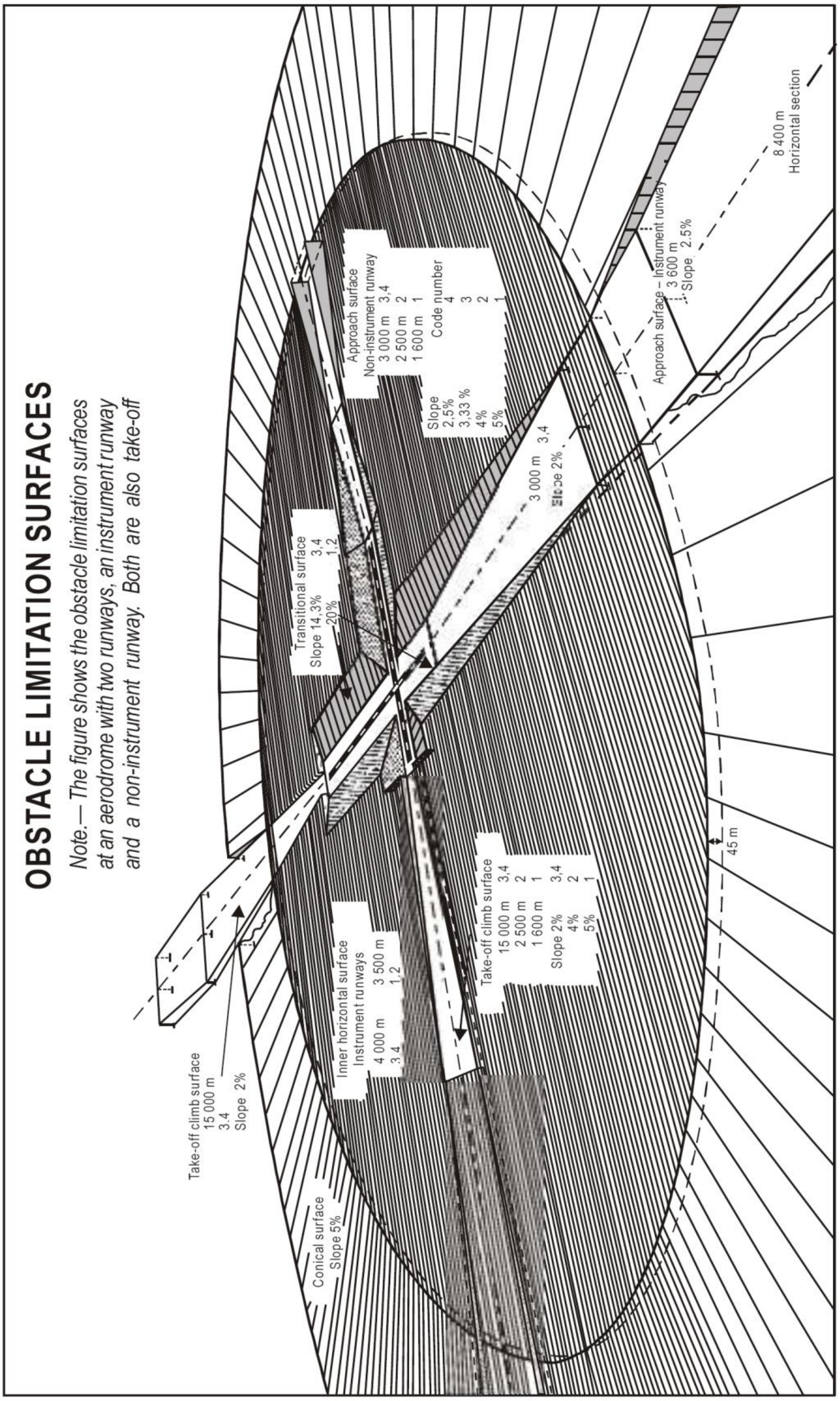


Figure B-1