MANUAL OF STANDARDS—AERODROMES

RCAA-MAN-AGA001A

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FOREWORD

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

This Manual of Standards is issued in pursuant to Article 29 of the LAW N°20/2018 of 29/04/2018, which empowers the Rwanda Civil Aviation Authority (hereafter referred to as the Authority) to establish minimum safety standards for certification of aerodromes. The standards contained in this Manual are applicable to all aerodromes intended for use for international air transport operations or for public use.

This Manual complements the Civil Aviation (Aerodromes) Regulations. It sets out standards for physical characteristics, obstacle limitation surfaces, visual aids and technical services the aerodrome operator at a certified aerodrome must comply with to support aircraft operations. These standards form part of the overall safety specifications to satisfy the requirements of aerodrome certification.

This manual serves as the authoritative document for Rwanda Civil Aviation(aerodromes) Technical Standards prescribed by the Authority. Appendices, tables or figures, which are used to amplify or illustrate standards are considered to form part of the main document and therefore have the same status as the primary text. Notes and attachments comprise material supplementary to the standards or are included as a guide to their application.

Some standards in this Manual incorporate, by reference, other standards contained in other documents. In such cases, the text of these references becomes part of this Manual.

In addition to this Manual, standards and procedures which do not reach the regulatory level and information of an educational or advisory nature, may be issued in the form of Advisory Circulars.

In some circumstances, the uniform application of a particular standard or procedure may not be possible or necessary. Such a standard or procedure will be phrased such as “if practicable”, “where physically practicable”, “where determined necessary” or similar words. Whilst such phrases may imply compliance is not mandatory, aerodrome operators need to provide justification for non-compliance and the final authority as to the applicability of the standard to a particular aerodrome facility or procedure rests with the Authority.

Aerodrome standards will change from time to time to meet identified safety needs, technological changes and changes in international standards and practices. Amendments to this Manual is a responsibility of the Authority. Readers should forward advice of errors, inconsistencies or suggestions for improvement to the Authority.

This Manual supersedes the *Aerodrome Manual of Standards (RCAA-MAN-AGA001A) of June 2017.*

RWANDA CIVIL AVIATION AUTHORITY

Director General
Rwanda Civil Aviation Authority

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CHAPTER 1: INTRODUCTION

Section 1.1: General

1.1.1 Background and scope

1.1.1.1 An aerodrome is a defined area on land or water intended to be used either for the arrival, departure and surface movement of aircraft. This document is the *Manual of Standards (MOS)* (the ***MOS***) made under Article 37 of the Civil Aviation Law No. 75/2013 (the **Law**). Together with RCARs (Aerodromes), it sets out certain standards for certified aerodromes, registered aerodromes, and other aircraft landing areas where aircraft arrive, depart or move that are not certified or registered. Aerodrome safety is a vital link in aviation safety and the applicable provisions of this MOS must be complied with to ensure aviation safety.

1.1.1.2 Except where otherwise stated, the standards set out in this MOS are for certified aerodromes.

1.1.1.3 Appendices and tables form part of this MOS. Where this MOS incorporates by reference standards from other documents, the incorporated standards become part of this MOS.

1.1.1.4 Standards in this MOS to prevent animals and people from inadvertently entering a movement area are for aviation safety purposes only.

1.1.1.5 This MOS does not deal with aviation security (that is, protection from acts of unlawful interference).

1.1.1.6 Notes in the MOS may provide information, explanations or references. A Note is not part of the standard.

1.1.2 Document Set

1.1.2.1 The document hierarchy consists of:

(a) the *Civil Aviation Law No. 75/2013* (the Law);

(b) relevant Civil Aviation Regulations (RCARs);

(c) the Manual of Standards (MOS); and

(d) Advisory Circulars (ACs).

1.1.2.2 The Law (s) establishes the Rwanda Civil Aviation Authority (RCAA) with functions relating to civil aviation, in particular the safety of civil aviation and for related purposes.

1.1.2.3 **RCARs** establish the regulatory framework (*Regulations*) within which all service providers must operate.

1.1.2.4 The **MOS** comprises specifications (S*tandards*) prescribed by RCAA, of uniform application, determined to be necessary for the safety of air navigation. In those parts of the MOS where it is necessary to establish the context of standards to assist in their comprehension, the sense of parent regulations has been reiterated.

1.1.2.5 Readers should understand that in the circumstance of any perceived disparity of meaning between MOS and RCARs, primacy of intent rests with the regulations.

1.1.2.6 Service providers must document internal actions (*Rules)* in their own operational manuals, to ensure the maintenance of and compliance with standards.

1.1.2.7 **ACs** are intended to provide recommendations and guidance to illustrate a means, but not necessarily the only means of complying with the Regulations. ACs may explain certain regulatory requirements by providing interpretive and explanatory materials. It is expected that service providers will document internal actions in their own operational manuals, to put into effect those, or similarly adequate, practices.

1.1.3 Differences Between ICAO Standards and those in MOS

1.1.3.1 Notwithstanding the above, where there is a difference between a standard prescribed in the ICAO standards and one in the MOS, the MOS standard shall prevail.

1.1.4 Differences published in AIP

1.1.4.1 Differences from ICAO Standards, Recommended Practices and Procedures are published in AIP Gen 1.7.

1.1.5 MOS Documentation Change Management

1.1.5.1 Responsibility for the technical content in the MOS resides with the relevant technical area within the Flight Safety Services Unit of RCAA.

1.1.5.2 This MOS is issued and amended under the authority of the Director General.

1.1.5.3 Suggested changes to this MOS must be directed to Flight Safety Services Unit of RCAA.

1.1.5.4 Requests for any change to the content of the MOS may be intimated from:

(a) technical areas within RCAA;

(b) aviation industry service providers or operators;

(c) individuals and authorisation holders.

1.1.5.5 The need to change standards in the MOS may be generated by a number of causes. These may be to:

(a) ensure safety;

(b) ensure standardisation;

(c) respond to changed RCAA standards;

(d) respond to ICAO prescription;

(e) accommodate new initiatives or technologies.

1.1.6 Related Documents

1.1.6.1 These standards should be read in conjunction with:

(a) ICAO Annex 4: Aeronautical Charts

(b) ICAO Annex 14: Aerodromes (Vol 1)

(c) ICAO Doc 9157/AN901: Aerodrome Design Manuals (all parts)

Section 1.2: Definitions

1.2.1 Unless the contrary intention appears, the following definitions apply for this MOS:

Definition	Meaning
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 elevation	The elevation of the highest point of the landing area.
Aerodrome facility	Any of the following at an aerodrome, or in or on something at an aerodrome, for which standards are provided by the MOS: surfaces, infrastructure; structures; buildings; installations; stations; systems; equipment; earthing points; cables; lighting; signage; markings.
Aerodrome reference point	The designated geographical location of an aerodrome.
Aerodrome reference temperature	The monthly mean of the maximum daily temperature for the hottest month of the year (the hottest month being that which has the highest monthly mean temperature.)
Aerodrome traffic density	See Paragraph 9.1.1.2(b).
Aerodrome works	Construction or maintenance works carried out at an aerodrome, on or adjacent to the movement area, that may create obstacles or restrict the normal take-off and landing of aircraft.
Aeronautical beacon	An aeronautical ground light visible at all azimuths, either continuously or intermittently, to designate a particular point on the surface of the earth.
Aeronautical ground light	Any light specially provided as an aid to air navigation, other than a light displayed on an aircraft.
Aeronautical study	An investigation of a problem concerned with some phase of flight, and aimed at identifying possible solutions and selecting the one most acceptable from the point of view of flight safety.
Aeroplane reference field length	The minimum field length required for take-off at maximum certificated take-off mass, sea level, standard atmospheric conditions, still air and zero runway slope, as shown in the appropriate aeroplane flight manual prescribed by the certificating authority or equivalent data from the aeroplane manufacturer. Field length means balanced field length for aeroplanes, if applicable, or take-off distance in other cases.

Definition	Meaning
Air side	The movement area of an aerodrome, adjacent terrain and buildings or portions thereof, access of which is controlled.
Aircraft classification number (ACN)	A number expressing the relative effect of an aircraft on a pavement for a specified standard subgrade category.
Aircraft parking position	A designated area on an apron intended to be used for parking an aircraft. Also known as an aircraft stand.
ALA	Aircraft landing area, being an area for the landing, movement and take-off of aircraft that is not a certified or registered aerodrome.
Apron	A defined area on a land aerodrome intended to accommodate aircraft for the purposes of loading or unloading passengers, mail or cargo, fuelling, parking, or maintenance.
Apron management service	A service provided to regulate the activities and the movement of aircraft and vehicles on the apron.
Apron taxiway	A portion of a taxiway system located on an apron and intended to provide a through taxi route for aircraft across the apron to another part of the taxiway system.
Balanced field length	A field length where the distance to accelerate and stop is equal to the take-off distance of an aeroplane experiencing an engine failure at the critical engine failure recognition speed (V1).
Barrette	Three or more aeronautical ground lights closely spaced in a transverse line so that from a distance they appear as a short bar of light.
Capacity discharge light	A lamp in which high-intensity flashes of extremely short duration are produced by the discharge of electricity at high voltage through a gas enclosed in a tube.
Clearway	A defined area at the end of the take-off run available on the ground or water under the control of the aerodrome operator, selected or prepared as a suitable area over which an aeroplane may make a portion of its initial climb to a specified height.
Critical obstacle	The obstacle within the take-off climb area and/or the approach area, which subtends the greatest vertical angle when measured from the inner edge of the take-off climb surface and/or the approach surface.
Cross-wind component	The surface wind component at right angles to the runway centre line.

Definition	Meaning
Declared distances	1. **Take-off run available (TORA).** The length of runway declared available and suitable for the ground run of an aeroplane taking off. 2. **Take-off distances available (TODA).**The length of the take-off run available plus the length of the clearway, if provided. 3. **Accelerate-stop distance available (ASDA).**The length of the take-off run available plus the length of the stopway, if provided. 4. **Landing distance available (LDA).**The length of runway which is declared available and suitable for the ground run of an aeroplane landing.
Dependent parallel approaches	Simultaneous approaches to parallel or near-parallel instrument runways where radar separation minima between aircraft on adjacent extended runway centre lines are prescribed.
Displaced threshold	A threshold not located at the extremity of a runway.
Effective intensity	The effective intensity of a flashing light is equal to the intensity of a fixed light of the same colour, which will produce the same visual range under identical conditions of observation.
Elevation	The vertical distance of a point or a level, on or affixed to the surface of the earth, measured from the mean sea level.
Exit taxiway	A taxiway connected to a runway to enable landing aeroplanes to turn off the runway.
Fixed light	A light having constant luminous intensity when observed from a fixed point.
Frangible object	An object of low mass designed to break, distort or yield on impact so as to present the minimum hazard to aircraft.
Hazard beacon	An aeronautical beacon used to designate a danger to air navigation.
Holding bay	A defined area where aircraft can be held, or bypassed, to facilitate efficient surface movement of aircraft.
Independent parallel approaches	Simultaneous approaches to parallel or near-parallel instrument runways where radar separation minima between aircraft on adjacent extended runway centre lines are not prescribed.
Independent parallel departures	Simultaneous departures from parallel or near-parallel instrument runways.

Definition	Meaning
Instrument approach procedures	The procedures to be followed by aircraft in letting down from cruising level and landing at an aerodrome. (A series of predetermined manoeuvres by reference to flight instruments for the orderly transfer of an aircraft from the beginning of the initial approach to a landing, or to a point from which a landing may be made.)
Instrument meteorological conditions (IMC)	Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling, less than the minimum specified for visual meteorological conditions.
Instrument runway	One of the following types of runway intended for the operation of aircraft using instrument approach procedures: (a) **Non-precision approach runway**. An instrument runway served by visual aids and a non-visual aid providing at least directional guidance adequate for a straight-in approach. (b) **Precision approach runway, Category (CAT) I**. An instrument runway served by ILS and visual aids intended for operations with a decision height (DH) not lower than 60 m (200 ft) and either a visibility not less than 800 m, or an RVR not less than 550 m. (c) **Precision approach runway, CAT II**. An instrument runway served by ILS and visual aids intended for operations with a decision height lower than 60 m (200 ft), but not lower than 30 m (100 ft), and an RVR not less than 300 m. (d) **Precision approach runway, CAT III**. An instrument runway served by ILS to and along the surface of the runway and: (i) for CAT IIIA — intended for operations with a decision height lower than 30 m (100 ft), or no decision height, and an RVR not less than 175 m; (ii) for CAT IIIB — intended for operations with a decision height lower than 15 m (50 ft), or no decision height, and an RVR less than 175 m but not less than 50 m; (iii) for CAT IIIC — intended for operations with no decision height and no RVR limitations.
Intermediate holding position	A designated holding position intended for traffic control at which taxiing aircraft and vehicles shall stop and hold until further clearance 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.

Definition	Meaning
Light failure	A light shall be deemed to be unserviceable when the main beam average intensity is less than 50% of the value specified in the appropriate figure showing the isocandella diagram. For light units where the designed main beam average intensity is above the value shown in the isocandella diagram, the 50% value shall be related to that design value. (When assessing the main beam, specified angles of beam elevation, toe-in and beam spread shall be taken into consideration).
Lighting system reliability	The probability that the complete installation operates within the specified tolerances and that the system is operationally usable.
Low visibility procedures	Procedures applied at an aerodrome for protecting aircraft operations during conditions of reduced visibility or low cloud.
Manoeuvring area	That part of the 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.
Mass	The terms mass and weight used in this MOS have the same meaning.
MAUM	Maximum all up mass.
Movement	Either a take-off or a landing by an aircraft.
Movement area	That part of the aerodrome to be used for the take-off, landing and taxiing of aircraft, consisting of the manoeuvring area and the apron(s).
MTOW	Maximum take-off weight.
Near parallel runways	Non-intersecting runways whose extended centre lines have an angle of convergence/divergence of 15 degrees or less.
Non-instrument runway	A runway intended for the operation of aircraft using visual approach procedures.
Non-precision approach runway	See Instrument runway.
Notices to airmen (NOTAMs)	A notice issued by the NOTAM office containing information or instruction concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to persons concerned with flight operations.

Definition	Meaning
Obstacle free zone (OFZ)	The airspace above the inner approach surface, inner transitional surfaces, balked landing surfaces, and that portion of the strip bounded by these surfaces, which is not penetrated by any fixed obstacle other than a low-mass and frangibly mounted one required for air navigation purposes.
Obstacle limitation surfaces (OLS)	A series of planes associated with each runway at an aerodrome that defines the desirable limits to which objects may project into the airspace around the aerodrome so that aircraft operations at the aerodrome may be conducted safely.
Obstacles	All fixed (whether temporary or permanent) and mobile objects, or parts thereof, that are located on an area intended for the surface movement of aircraft or that extend above a defined surface intended to protect aircraft in flight.
Pavement classification number (PCN)	A number expressing the bearing strength of a pavement for unrestricted operations by aircraft with ACN value less than or equal to the PCN.
Precision approach runway	See Instrument runway.
Primary runway(s)	Runway(s) used in preference to others whenever conditions permit.
Radio aids	Also known as non-visual aids. These aids may consist of NDB, VOR, VOR/DME or GPS.
Rapid exit taxiway	A taxiway connected to a runway at an acute angle, designed and intended to allow landing aeroplanes to turn off the runway at higher speeds than are achieved on exit taxiways, thereby minimizing runway occupancy times.
RESA	Runway end safety area.
Runway	A defined rectangular area on a land aerodrome prepared for the landing and take-off of aircraft.
Runway end safety area (RESA)	An area symmetrical about the extended runway centre line and adjacent to the end of the strip primarily intended to reduce the risk of damage to an aeroplane undershooting or overrunning the runway.
Runway guard light	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 authorised by the aerodrome control tower.

Definition	Meaning
Runway strip	A defined area including the runway and stopway, if provided, intended: 1. to reduce the risk of damage to aircraft running off a runway; and 2. to protect aircraft flying over it during take-off or landing operations.
Runway visibility (RV)	The distance along a runway over which a person can see and recognise a visibility marker or runway lights.
Runway visual range (RVR)	The range over which the pilot of an aircraft on the centreline of a runway can see the runway surface markings, or the lights delineating the runway or identifying its centreline.
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.
Shoulders	An area adjacent to the edge of a pavement so prepared as to provide a transition between the pavement and the adjacent surface.
Signal circle	An area on an aerodrome used for the display of ground signals.
Stopway	A defined rectangular area on the ground at the end of the 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% and recover to 50% during a power supply changeover, when the light is being operated at intensities of 25% or above.
Take-off runway	A runway intended for take-off only.
Taxi-holding position	See definition of runway holding position and intermediate holding position.
Taxilane	A portion of an apron that is not a taxiway and that is provided only for aircraft to access aircraft parking positions.
Taxiway	A defined path on an aerodrome on land, established for the taxiing of aircraft from one part of an aerodrome to another. A taxiway includes an apron taxiway and a rapid exit taxiway. **Note:** ***Apron taxiway***, ***exit taxiway***, ***rapid exit taxiway***, ***taxilane*** and ***taxiway system*** are also defined terms.
Taxiway intersection	A junction of two or more taxiways.

Definition	Meaning
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.
Taxiway system	A number of interconnecting taxiways.
Threshold	The beginning of that portion of the runway usable for landing.
Time limited works	Aerodrome works that may be carried out if normal aircraft operations are not disrupted and the movement area can be restored to normal safety standards in not more than 30 minutes.
Touchdown zone	The portion of a runway, beyond the threshold, where it is intended landing aeroplanes first contact the runway.
Upgrade (for an aerodrome facility)	1. Any change to, or improvement of, the facility that allows it to do 1 or more of the following: (a) accommodate the parking, holding, movement or operation of larger or heavier aircraft, or aircraft modified to carry more passengers or freight; (b) accommodate the parking, holding, movement or operation of more aircraft; (c) be used by aircraft flying under changed approach conditions, for example, a change: (i) from non-instrument to non-precision instrument; or (ii) from non-precision instrument to precision instrument; or (iii) from precision category I to category II or III; (d) accommodate aircraft take-offs and aerodrome surface movements in RVR conditions of less than 550 m. 2. The replacement of any aerodrome facility that does not comply with the standards for the facility in this MOS. **Note:** The upgrade of a particular non-compliant aerodrome facility is the trigger for that particular non-compliant facility to be brought into compliance with the relevant MOS standards. Since the timing and budgeting of an upgrade is usually under the aerodrome operator's control, so too is the timing of works necessary to bring the non-compliant facility into compliance with the MOS.

Definition	Meaning
Usability factor	The percentage of time during which the use of a runway or system of runways is not restricted because of cross-wind component.
Visibility (*V*)	Visibility for aeronautical purposes is the greater of: a. the greatest distance at which a black object of suitable dimensions, situated near the ground, can be seen and recognised when observed against a bright background; b. the greatest distance at which lights in the vicinity of 1 000 candelas can be seen and identified against an unlit background. ***Notes:*** 3. The 2 distances have different values in air of a given extinction coefficient, and the distance mentioned in paragraph (b) varies with the background illumination. The distance mentioned in paragraph (a) is represented by the meteorological optical range (***MOR***). 4. For international recognition and consistency, the definition of ***Visibility*** is taken from Chapter 1, Part 1, Annex 3, *Meteorological Service for International Air Navigation*, in the Convention on International Civil Aviation.
Visibility marker	A dark object of suitable dimensions for use as a reference in evaluating runway visibility.
Visual aids	May consist of T-VASIS, PAPI, runway markings and runway lights.
Visual meteorological conditions (VMC)	Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling, equal or better than specified minima.
Weight	The terms weight and mass used in this MOS have the same meaning.

CHAPTER 2: APPLICATION OF STANDARDS TO AERODROMES

Section 2.1: General

2.1.1 Legislative Background and Applicability

2.1.1.2 Article 37 of the Law empower the Authority to establish safety standards for certification of aerodrome intended for use for international air transport operations or for public use.

2.1.2 Standard Changes and Existing Aerodrome Facilities

2.1.2.2 An existing facility at an aerodrome, other than a certified aerodrome, that does not meet the standards set out in this MOS may continue to meet the Standards that applied to the facility when it was first introduced or last upgraded (as the case may be) until:

(a) the facility is replaced or again upgraded (as the case may be); or

(b) RCAA directs in writing that, in the interests of aviation safety, the facility must comply with the standards specified in this MOS.

> **Note:** See the definition of ***upgrade*** in subsection 1.2.1, Definitions. The reconfiguring of an existing facility (including, for example, an apron) to cater for more or larger aircraft constitutes an upgrade.

2.1.2.2A For paragraph 2.1.2.2, ***Standards*** means the standards set out in the MOS that applied to the facility when it was first introduced or last upgraded (as the case may be).

2.1.2.3 The operator of a certified aerodrome is not required to modify an existing aerodrome facility (a ***non-compliant facility***) so that it complies with this MOS until the facility is replaced or upgraded. However, until it is replaced or upgraded, details of the non-compliant facility must be recorded in the Aerodrome Manual, including:

(a) identification of the facility; and

(b) the date or period when the facility was first introduced or last upgraded (as the case may be); and

(c) a description of, or documented evidence of, the standard with which the facility complies, including a supporting reference to the version and date of the MOS embodying the standard with which the facility complies; and

(d) details of the plans and timescale for replacing or upgrading the facility so that it complies with this MOS.

> **Note:** As part of the audit of an aerodrome operator, RCAA may require the operator to supply evidence showing past and current bona fide efforts to implement the plan and timescale

2.1.2.4 A new facility that is brought into operation, and an existing facility that is replaced or upgraded, must comply with the standards in this MOS.

2.1.3 Exemptions to Standards

2.1.3.1 An exemption granted in relation to an existing facility continues to apply until its expiry date, unless sooner revoked by RCAA in the interests of aviation safety.

2.1.3.2 An application for an exemption from any standard in this MOS must include a clear indication of whether, and when, full compliance with the MOS would occur.

2.1.3.3 If a provision of this MOS imposes a standard subject to a qualifying phrase, such as “if practicable”, “where physically practicable”, or “where determined necessary”, the standard applies despite the qualifying phrase unless RCAA has granted an exemption from the standard.

> **Note:** The purpose of such qualifying phrases is to recognise that sometimes compliance with particular standards is not possible in some circumstances. The purpose of paragraph 2.1.3.3 is to ensure that it is RCAA, not an aerodrome operator, who decides whether the qualifying circumstances exist.

2.1.3.4 Exemptions to standards, granted to an aerodrome, must be recorded in the Aerodrome Manual. The Manual must contain details of the exemption, reason for the granting, any resultant limitations imposed, and similar relevant information.

2.1.4 Conflict with Other Standards

2.1.4.1 Compliance with the standards and procedures specified in this MOS does not absolve aerodrome operators from obligations in respect of standards prescribed by other government or statutory authorities. Where another statutory standard conflicts with this MOS, the matter must be referred to RCAA for resolution.

2.1.5 Using ICAO Aerodrome Reference Code to Specify Standards

2.1.5.1 Rwanda has adopted the International Civil Aviation Organisation (ICAO) methodology of using a code system, known as the Aerodrome Reference Code, to specify the standards for individual aerodrome facilities which are suitable for use by aeroplanes within a range of performances and sizes. The Code is composed of two elements: element 1 is a number related to the aeroplane reference field length; and element 2 is a letter related to the aeroplane wingspan and outer main gear wheel span. A particular specification is related to the more appropriate of the two elements of the Code or to an appropriate combination of the two Code elements. The Code letter or number within an element selected for design purposes is related to the characteristics of the aeroplane types for which the facility is intended.

2.1.5.2 The aerodrome reference code numbers and letters shall have the meanings assigned to them in Table 2.1-1. The Code number corresponding to the highest value of the aeroplane reference field lengths for which the runway is intended is to be selected.

> **Note:** The determination of the aeroplane reference field length is solely for the selection of a Code number and must not be confused with runway length requirements, which are influenced by other factors.

2.1.5.3 The code letter for element 2 shall be determined from Table 2.1-1 by selecting the code letter which corresponds to the greatest wingspan of the aeroplanes for which the facility is intended.

2.1.5.4 Information of the Aerodrome Reference Code number for each runway at the aerodrome shall be provided for publication in AIP. For certified aerodromes, information of the Aerodrome Reference Code letter for each runway and taxiway shall be set out in the Aerodrome Manual.

2.1.5.5 Unless otherwise agreed by RCAA, aerodrome operators must maintain the runways and taxiways in accordance with the applicable standards set out in this MOS for the notified aerodrome reference code for that runway or taxiway.

Table 2.1-1: Aerodrome Reference Code

Code element 1	
Code number	**Aeroplane reference field length**
1	Less than 800 m
2	800 m up to but not including 1 200 m
3	1 200 m up to but not including 1 800 m
4	1 800 m and over
Code element 2	
Code letter	**Wingspan**
A	Up to but not including 15 m
B	15 m up to but not including 24 m
C	24 m up to but not including 36 m
D	36 m up to but not including 52 m
E	52 m up to but not including 65 m
F	65 m up to but not including 80 m

2.1.6 Providing for Future Larger Aeroplanes

2.1.6.1 Nothing in this MOS is intended to inhibit the planning or provision of aerodrome facilities for larger aeroplanes that may be accommodated by the aerodrome at a later date. However, where movement area facilities are built for future larger aeroplanes, the aerodrome operator must liaise with the RCAA to determine interim notification of Reference Code and maintenance arrangements.

2.1.6.2 It is the prerogative of aerodrome operators to select the appropriate aeroplane and aeroplane characteristics for master planning of their aerodromes. This MOS has included ICAO Code F specifications for aerodrome facilities intended for aeroplanes larger than B 747 wide body jets.

2.1.9A Aerodrome with Terminal Instrument Flight Procedures

2.1.9A.1 Where an aerodrome with a terminal instrument flight procedure (***TIFP***) ceases (for whatever reason) to be a certified aerodrome, RCAA will take every reasonable step necessary to notify the certified or authorised designer of the TIFP of the cessation.

> **Note:** This procedure is to complement the obligations on the certified or authorised designer of a TIFP under ANS Manual of Standards (MOS) Part IV — Standards Applicable to the Provision of Instrument Flight Procedure Design. However, a failure to comply with subsection 2.1.9A does not affect any obligation under ANS Manual of Standards (MOS) Part IV.

2.1.10 Runways Used for Category (CAT I) Instrument Approach Operations

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

2.1.10.1 A runway is not suitable to be used for a Category I instrument approach operation unless all of the requirements in paragraphs 2.1.10.2 to 2.1.10.10 are met.

2.1.10.2 The aerodrome at which the runway is located must be a controlled aerodrome.

> **Note:** Aircraft operators will not be permitted to conduct Category I instrument approach operations unless aerodrome control is in operation.

2.1.10.3 Subject to paragraph 2.1.10.11, the runway must meet the standards in this MOS for a precision approach runway.

2.1.10.4 The runway must have electronic RVR equipment in the touchdown zone of the runway.

> **Note:** The runway may have electronic RVR equipment in the other zones of the runway.

2.1.10.5 The aerodrome operator must confirm with the ATS provider that the control tower has suitable RVR display equipment.

2.1.10.6 The runway must have a declared landing distance available of at least 1,524 m.

2.1.10.7 The runway must have, or be qualified for, a precision approach Category I ILS procedure.

2.1.10.8 An OFZ must be established for the runway.

2.1.10.9 In consultation with the ATS provider and the relevant aeronautical telecommunications service and radio navigation service provider, the relevant ILS equipment critical and sensitive areas must be determined, documented and associated protection requirements defined in the aerodrome's low visibility procedures.

2.1.10.10 The aerodrome operator must confirm with the relevant aeronautical telecommunications service and radio navigation service provider that the runway is equipped with a suitable precision approach aid.

2.1.10.11 Despite Chapter 9, a runway used for a Category I instrument approach operation is not required to have an approach lighting system extending over a distance of 900 m from the runway threshold.

Notes: 1: A runway with an existing Category II, Category III or Category II precision approach procedure is automatically eligible for Category I instrument approach operations.

2: Where possible, the runway should be equipped with an approach lighting system extending over a distance of at least 720 m from the runway threshold, which is either a precision approach Category I lighting system or a precision approach Category II and III lighting system.

3: The operating minima in each case are dictated by the available lighting facilities. Absence of an approach lighting system or a shorter approach lighting system will result in higher RVR minima. See the *ANS Manual of Standards (MOS) Part IV – Standards Applicable to the Provision of Instrument Flight Procedure Design* for specific details.

2.1.11 Runways Used for Category II Instrument Approach Operations

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

2.1.11.1 A runway is not suitable to be used for a Category II instrument approach operation unless all of the requirements in paragraphs 2.1.11.2 to 2.1.11.8 are met.

2.1.11.2 The aerodrome at which the runway is located must be a controlled aerodrome.

> **Note:** Aircraft operators will not be permitted to conduct Category II instrument approach operations unless aerodrome control is in operation.

2.1.11.3 Subject to paragraph 2.1.11.9, the runway must meet all of the standards in this MOS for a precision approach runway Category II.

2.1.11.4 The runway must have electronic RVR equipment in the touchdown zone and at least 1 other zone of the runway.

2.1.11.5 The aerodrome operator must confirm with the ATS provider that the control tower has suitable RVR display equipment.

2.1.11.6 The runway must have a declared landing distance available of at least 1,830 m.

2.1.11.7 In consultation with the ATS provider and the relevant aeronautical telecommunications service and radio navigation service provider, the relevant ILS equipment critical and sensitive areas must be determined, documented and associated protection requirements defined in the aerodrome's low visibility procedures.

2.1.11.8 The aerodrome operator must confirm with the relevant aeronautical telecommunications service and radio navigation service provider that the runway is equipped with a suitable precision approach aid.

2.1.11.9 Despite Chapter 9, a runway used for Category II instrument approach operation is not required to have a precision approach Category II and Category III lighting system extending over a distance of 900 m from the runway threshold, runway centreline lighting or touchdown zone lighting.

> **Notes:** 1: A runway with an existing Category II or Category III precision approach procedure is automatically eligible for Category II instrument approach operations.
>
> 2: Where possible, the runway should be equipped with an approach lighting system extending over a distance of at least 720 m from the runway threshold which is either a precision approach Category I lighting system or a precision approach Category II and III lighting system.
>
> 3: The operating minima in each case are dictated by the available lighting facilities. Absence of runway centreline lighting, touchdown zone lighting or an approach lighting system will result in higher RVR minima. Also, a shorter approach lighting system will result in higher operating minima. See the *ANS Manual of Standards (MOS) Part IV – Standards Applicable to the Provision of Instrument Flight Procedure Design* for specific details.

CHAPTER 3: APPLYING FOR AN AERODROME CERTIFICATE

Section 3.1: General

3.1.1 Introduction

3.1.1.1 Pursuant to Article 37 of the Law empower the Authority to establish safety standards for certification of aerodrome intended for use for international air transport operations or for public use.

3.1.1.2 The applicant shall be the owner of the aerodrome site, or have obtained permission from the owner to use the site as an aerodrome.

3.1.1.3 RCAA's aerodrome certification process only addresses the aviation safety aspect of the aerodrome. It is the responsibility of the applicant to ensure that use of the site as an aerodrome is in compliance with other national and local statutory requirements. The aerodrome certificate does not absolve the applicant from observing such requirements.

3.1.1.4 Before submitting an application, the applicant must prepare an Aerodrome Manual, in accordance with the requirements set out in RCARs. The standards to meet the requirements are set out in various chapters in this Manual of Standards (MOS). The initial application must be made on RCAA Form RCAA-Form-AGA001 (specimen at Section 3.2). The completed form shall be forwarded to the RCAA, together with a copy of the Aerodrome Manual.

3.1.2 Aerodrome Certificate Processing Fee

3.1.2.1 Where applicable, upon receipt of the application, the relevant RCAA Aerodrome Inspector will assess the likely effort involved in processing the application and provide the applicant with a quotation for the aerodrome certification processing fee.

3.1.2.2 The certificate application will only be processed upon payment of the certification processing fee.

3.1.3 Processing an Aerodrome Certificate Application

3.1.3.1 Applications shall be submitted in sufficient time to allow for detailed consideration and inspection of the aerodrome before the desired date of issue of the certificate.

3.1.3.2 Engineering and survey reports of the physical characteristics of the movement area, pavement strength and surface, obstacle limitation surfaces, etc., shall be provided by the applicant as required by RCAA.

3.1.3.3 As part of the certification process, RCAA Aerodrome Inspector may carry out inspection or testing of any aspect of the aerodrome or require substantiation of any information provided by the applicant. However, it should be clearly understood that the RCAA sample checking process does not absolve the applicant from the responsibility to provide accurate information.

3.1.3.4 Special assessments may be necessary if there are aerodrome facilities that are not in full compliance with the applicable standards. This may involve more time and resources and may result in restrictions being imposed on aircraft operations.

3.1.4 Granting of an Aerodrome Certificate

3.1.4.1 Before an aerodrome certificate is granted, RCAA needs to be satisfied that:

(a) the aerodrome physical characteristics and facilities are in compliance with relevant standards or are adequate for aeroplane safety;

(b) the aerodrome operating procedures proposed by the applicant and set out in the Aerodrome Manual are appropriate and adequate for the expected level of aircraft activities at the aerodrome;

(c) there are sufficient experienced trained or qualified personnel to conduct the safety functions of the aerodrome;

(d) the aerodrome operator is aware of the aerodrome safety functions and can be expected to properly operate the aerodrome.

3.1.4.2 Aerodrome certificates are granted on the condition that the aerodrome will, at all times, be in compliance with applicable regulations and standards. RCARs (Aerodromes) also empowers RCAA to attach additional conditions to a licence to take account of particular circumstances of the aerodrome.

3.1.4.3 Once granted an aerodrome certificate will remain in force for a period of one year, unless the certificate is suspended, cancelled or revoked in accordance with RCARs (Aerodromes).

3.1.5 Maintenance and Control of Aerodrome Manual

3.1.5.1 RCAA will retain one copy of the Aerodrome Manual. The aerodrome operator must keep his or her copy of the Aerodrome Manual at the aerodrome or at the operator’s principal place of business and make it available for RCAA audit purposes.

3.1.5.2 Additional copies of the Aerodrome Manual may be made available so that aerodrome staff and other organisations at the aerodrome may have access to a copy of the Manual.

3.1.5.3 When additional copies or sections of the Manual are required, the aerodrome manual controller is responsible for updates and distribution to those persons.

3.1.6 Initiating NOTAM to Promulgate a Certified Aerodrome

3.1.6.1 The RCAA Aerodrome Inspector responsible for the certification process will prepare and forward to the NOTAM Office a permanent NOTAM setting out all the aerodrome information which will be included in Rwanda AIP, including the effective date when the aerodrome is certified.

Section 3.2: Application for an Aerodrome Certificate

3.2.1 Sample Aerodrome Certificate Application

Rwanda Civil Aviation Authority	Form	RCAA-Form-AGA001 June 2015

1. Particulars of the Applicant

Full Name:
....

Address:
....
....

Position:
....

Phone: ....Fax: .... Email: …...........................

2. Particulars of Aerodrome Site

Aerodrome Name:
....

Real Property Description:
....
....

Geographical Coordinates of the Aerodrome Reference Point:

Latitude: ....Longitude: ………………………………….

(in degrees, minutes and tenths of minutes and in WGS-84 format)

3. Is the Applicant the Owner of the Aerodrome Site?

☐Yes ☐ No

If No, provide:

a) Details of rights held in relation to the site and

b) Name and address of the owner of the site and written evidence to show that permission has been obtained for the site to be used by the applicant as an aerodrome.

4. Indicate the Largest Type of Aircraft Expected to Use the Aerodrome

Intended commencement date of aerodrome operations:
……………………………………………………………………………………………

Other information:
……………………………………………………………………………………………
……………………………………………………………………………………………

5. Is the Aerodrome to Be Used for Air Transport Operations?

☐Yes ☐ No

6. Details to Be Shown on the Aerodrome Certificate

Aerodrome Name:
……………………………………………………………………………………………

Aerodrome Operator:
……………………………………………………………………………………………

Address:
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………

On behalf of the Aerodrome Operator shown above, I hereby apply for a certificate to operate the aerodrome. My authority to act on behalf of the applicant is: ………………………………………………………………………………………………… ………………………………………………………………………………… Signed: ……………………………………. Date: ………………………………….. Name of person making the declaration: ……………………………………………….

NOTES:

1. A copy of the Aerodrome Manual, prepared in accordance with the regulations and the standards in the Manual of Aerodrome Standards commensurate with the aircraft activities expected at the aerodrome, are required as part of this application.

2. Documentary evidence in support of all matters in this application may be provided if requested.

CHAPTER 4: APPLYING TO REGISTER AN AERODROME

Section 4.1: General

4.1.1 Introduction

4.1.1.1 Pursuant to RCARs (Aerodromes), operators of uncertified aerodromes may apply to have their aerodromes registered by RCAA. A registered aerodrome will have aerodrome information published in AIP, and changes to aerodrome information or conditions affecting aircraft operations can be notified through the NOTAM system.

> **Note:** RCAA will only approve instrument runways used for air transport operations at an aerodrome that is either certified or registered.

4.1.1.2 The applicant for registration must be the owner of the aerodrome site, or have obtained permission from the owner to use the site as an aerodrome.

4.1.1.3 RCAA's aerodrome registration process only addresses the aviation safety aspect of the aerodrome. It is the responsibility of the applicant to ensure that use of the site as an aerodrome is in compliance with other federal, state and local authority requirements. The aerodrome registration does not absolve the applicant from observing such requirements.

4.1.2 Aerodrome Registration Application and Processing Fee

4.1.2.1 Application for registration must be made on RCAA prescribed form, obtainable from the RCAA office. The completed form, together with aerodrome information for publication in AIP and confirmation from an applicant, that the aerodrome meets applicable safety standards, shall be forwarded to the RCAA office.

4.1.2.2 Upon receipt of the application, the RCAA Aerodrome Inspector will assess the likely effort involved in processing the registration application and provide the applicant with a quotation for the aerodrome registration processing fee.

4.1.2.3 The registration processing fee may include the RCAA Aerodrome Inspector making an inspection of the aerodrome. The inspection is normally only required if the information supplied is, in the opinion of the Aerodrome Inspector, inadequate or requires further clarification.

4.1.2.4 The application will only be processed upon payment of the registration processing fee.

4.1.2.5 Applications shall be submitted in sufficient time to allow for detailed consideration and inspection of the aerodrome, before the desired registration date.

4.1.3 Approving a Registration Application

4.1.3.1 Registration is approved on the condition that:

(a) the aerodrome meets appropriate standards;

(b) the aerodrome operator has the capacity to properly maintain the aerodrome; and

(c) the reporting officer has been trained to the standards detailed in Chapter 10.

4.1.3.2 When the application is approved, the responsible RCAA Aerodrome Inspector will prepare and forward to the NOTAM Office a permanent NOTAM setting out all the aerodrome information which will be included in AIP. The RCAA Aerodrome Inspector will also confirm, to the applicant, in writing, that the aerodrome is or will be registered, together with a copy of the NOTAM message.

4.1.4 Maintenance of Registration

4.1.4.1 Registered aerodromes will be included in the RCAA aerodrome surveillance program. A scheduled visit by an RCAA Aerodrome Inspector can be expected periodically. Appropriate notice of the scheduled visit will be given. Unscheduled visits may occur at any time, such as when prompted by reported safety concerns.

4.1.4.2 Registration will remain in force until it is suspended or cancelled.

4.1.4.3 Registration may be suspended if RCAA is not satisfied with:

(a) the accuracy of aerodrome information provided;

(b) the on-going maintenance of the aerodrome; or

(c) the ability of the reporting officer to conduct on-going aerodrome serviceability inspection and reporting functions.

> **Notes:** 1. Keeping records of aerodrome serviceability inspections, aerodrome works and NOTAMS issued will assist in demonstrating that the aerodrome has been operated properly.
>
> 2. Standards for ongoing operations and maintenance of a registered aerodrome are specified in Chapter 12.

4.1.4.4 Registration may be cancelled:

(a) on request of the aerodrome operator; or

(b) by RCAA after the aerodrome registration was suspended and the identified safety concerns are not corrected to the satisfaction of RCAA, within an acceptable period.

4.1.5 Aerodrome Safety Inspection Report

4.1.5.1 Operators of registered aerodromes are required to submit to RCAA an Aerodrome Safety Inspection Report. This must be done either annually, or at a longer interval as agreed by the relevant RCAA Aerodrome Inspector.

CHAPTER 5: AERODROME INFORMATION FOR AIP

Section 5.1: General

5.1.1 Introduction

5.1.1.1 RCARs (Aerodromes) require the applicant of an aerodrome certificate to provide information relating to the aerodrome for publication in Aeronautical Information Publication (AIP). This information must be included in the applicant's proposed Aerodrome Manual.

5.1.1.2 This Chapter sets out the aerodrome information which needs to be provided and the standards to which such aerodrome information must be gathered and presented.

5.1.1.3 The standards in this Chapter on gathering and presentation of aerodrome information are also applicable to aerodrome information provided to RCAA for aerodrome registration.

5.1.1.4 The importance of providing accurate aerodrome information for the safety of aircraft operations cannot be overemphasised. Accordingly, care and diligence must be exercised in obtaining the aerodrome information to be published. This will involve the use of appropriately qualified persons to measure, determine or calculate aerodrome operational information.

5.1.1.5 After the information is published, maintaining its accuracy is also of fundamental importance. Standards for maintaining accuracy of published aerodrome information in AIP, including NOTAMS, are set out in Chapter 10.

5.1.1.6 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.

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

5.1.1.8 Where made available in accordance with 5.1.1.7, the selection of the aerodrome mapping data features to be collected shall be made with consideration of the intended applications

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

5.1.2 Aerodrome Information to be Provided for a Certified Aerodrome

5.1.2.1 **Aerodrome diagram.** An aerodrome diagram must be provided to illustrate:

(a) layout of runways, taxiways and apron(s);

(b) nature of the runway surfaces;

(c) designations and length of runways;

(d) designations of the taxiways, where applicable;

(e) location of illuminated and non-illuminated wind direction indicators;

(f) location of the aerodrome reference point;

(g) the direction and distance to the nearest town;

(h) location of terminal buildings; and

(i) location of helipads.

5.1.2.2 **Aerodrome administration.** This must include:

(a) name, address, telephone and facsimile numbers of the aerodrome operator; including after-hours contacts;

(b) aerodrome usage, public or private;

(c) aerodrome charges, where notification is desired.

5.1.2.3 **Aerodrome location.** This information must include;

(a) name of aerodrome;

(b) Address of the Aerodrome;

(c) World Aeronautical Chart number, if known;

(d) latitude and longitude, based on the aerodrome reference point;

(e) magnetic variation;

(f) time conversion-universal time coordinated (UTC) plus local time difference;

(g) AVFAX and 'Y' location code indicator, if known;

(h) aerodrome elevation;

(i) currency of Type A charts, if provided.

5.1.2.4 **Movement area.** Must include for each runway designation;

(a) aerodrome reference code number;

(b) runway bearings-in degrees magnetic;

(c) runway length and surface type;

(d) runway pavement strength rating;

(e) runway and runway strip width;

(f) runway slope;

(g) runway declared distances, and STODA.

(h) elevation of the midpoint of runway threshold, for instrument runways.

5.1.2.5 **Approach and Runway Lighting.** For each runway, the following details of approach and runway lighting systems must be provided:

(a) type, length and intensity of approach lighting system;

(b) runway threshold lights, colour and wing bars;

(c) type of visual approach slope indicator system;

(d) length of runway touchdown zone lights;

(e) length, spacing, colour and intensity of runway centreline lights;

(f) length, spacing, colour and intensity of runway edge lights;

(g) colour of runway end lights and wing bars;

(h) length and colour of stopway lights.

5.1.2.5A **Other Lighting and Secondary Power Supply.** The following details of aerodrome lighting and secondary power supply systems must be provided:

(a) location, characteristics and hours of operation of aerodrome beacon (if any);

(b) lighting systems for taxiways;

(c) any other lighting systems;

(d) secondary power supply including switch-over time.

5.1.2.6 **Navigation aids.** Details of any navigation aid, which is provided by the aerodrome operator.

5.1.2.7 **Rescue and fire-fighting services.** The category of aerodrome-based rescue and fire-fighting services provided by the aerodrome operator.

5.1.2.8 **Ground services.** This information must include:

(a) fuel suppliers and their contact details, including after hours;

(b) automatic weather information broadcast if provided by aerodrome operator;

(c) ground to air communication systems such as Unicom, aerodrome frequency response unit (AFRU) or approved air ground operator service provided by the aerodrome operator, and

(d) any other services available to pilots.

5.1.2.9 **Special procedures.** Include any special procedures unique to the aerodrome, which pilots need to be advised; in cases where the flying procedure is generated by the aerodrome operator.

5.1.2.10 **Notices.** Include important cautionary or administrative information relating to the use of the aerodrome.

5.1.2.11 **Low Visibility Procedures**. If low visibility procedures are established at a controlled aerodrome, the information to be provided must include the following:

(a) the runways and associated equipment that are used under low visibility procedures;

(b) minimum take-off and landing visibility for which the aerodrome facilities are capable of providing appropriate support;

(c) defined meteorological conditions under which low visibility procedures are initiated, used and terminated;

(d) a description of ground marking and lighting for use under low visibility procedures.

5.1.3 Standards for Determining Aerodrome Information

5.1.3.1 **Nature of runway surface.** The runway surface type must be notified as either:

(a) bitumen seal;

(b) asphalt;

(c) concrete;

(d) gravel;

(e) grass; or

(f) natural surface.

Where only the central portion of runway is sealed, this must be advised accordingly.

5.1.3.2 **Runway bearing and designation.** The bearing of runways must be determined in degrees magnetic. Runways are normally numbered in relation to their magnetic direction, rounded off to the nearest 10 degrees.

5.1.3.3 **Runway length.** The aerodrome operator must provide the physical length of runways in whole numbers of metres and feet, with feet bracketed.

5.1.3.4 **Taxiway designation.** A single letter must be used without numbers to designate each main taxiway. Alpha-numeric designators may be used for short feeder taxiways. See also Chapter 8.

5.1.3.5 **Aerodrome reference point (ARP).** The geographic coordinates of the aerodrome reference point must be notified in degrees, minutes and tenths of a minute; based on the World Geodetic System-1984 (WGS-84). The ARP should be located at or near the centroid of the aerodrome.

5.1.3.6 **Aerodrome elevation.** Must be at the highest point of the landing area, above mean sea level.

5.1.3.7 **Runway reference code number.** For each runway provide the reference code number as defined in Chapter 2.

5.1.3.8 **Pavement strength.**

(a) Aircraft less than 5,700 kg maximum take-off mass.

The bearing strength of a pavement intended for aircraft of 5700 kg mass or less, must be made available by reporting the following information:

(i) maximum allowable aircraft mass; and

(ii) maximum allowable tyre pressure.

(b) Aircraft greater than 5,700 kg maximum take-off mass.

Report the bearing strength of pavements intended for aircraft greater than 5,700 kg mass, in accordance with the Aircraft Classification

Number/Pavement Classification Number (ACN/PCN) system; reporting all of the following information:

(i) the pavement classification number (PCN);

(ii) pavement type for ACN-PCN determination;

(iii) subgrade strength category;

(iv) maximum allowable tyre pressure category; and

(v) evaluation method.

> **Note:** The PCN reported will 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 tyre pressure, or aircraft all-up weight for specified aircraft type(s).

(c) Information on pavement type for ACN-PCN determination, subgrade strength category, maximum tyre pressure category and evaluation method must be reported using the following codes:

(i)

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

(ii)

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

(iii)

Maximum allowable tyre pressure category:	Code
High: no pressure limit	W
Medium: pressure limited to 1.50 MPa	X
Low: pressure limited to 1.00 MPa	Y1
Low: pressure limited to 0.80 MPa	Y2
Very low: pressure limited to 0.50 MPa	Z

(iv)

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

(v) **Examples of pavement strength reporting**

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

PCN 80/R/B/W/T

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

PCN 50/F/A/Y/U

Example 3: If the bearing strength of a flexible pavement, built on a medium strength subgrade, has been assessed by technical evaluation to be PCN 40 and the tyre pressure is to be limited to 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 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.

5.1.3.10 **Runway strip width.** For non-instrument runways, provide the full width of graded strip. For an instrument runway, provide the full width of runway strip which must include the graded portion and the flyover portion; in whole numbers of metres.

5.1.3.11 **Runway slope.** Determine the slope of runways, by taking the difference between the maximum and minimum elevation along the centreline and dividing the result by the runway length. Slope must be expressed as a percentage, to the nearest one tenth of a percent, indicating the direction of descent. Where there are significant multiple slope changes along the runway, slopes over individual segments must be provided over the length of the runway.

5.1.3.12 **Declared distances.**

(a) Declared distances are the available operational distances notified to a pilot for take-off, landing or safely aborting a take-off. These distances are used to determine whether the runway is adequate for the proposed landing or take-off or to determine the maximum payload permissible for a landing or take-off.

(b) The following distances in metres with feet equivalent shown in brackets, must be determined for each runway direction.

(i) take off run available (TORA);

(ii) take off distance available (TODA);

(iii) accelerate-stop distance available (ASDA);

(iv) landing distance available (LDA);

(c) **Calculation of declared distances.** The declared distances must be calculated in accordance with the following:

(i) **Take-off run available (TORA)** is defined as the length of runway available for the ground run of an aeroplane taking off. This is normally the full length of the runway; neither the SWY nor CWY are involved.

TORA = Length of RW

(ii) **Take-off distance available (TODA)** is defined as the distance available to an aeroplane for completion of its ground run, lift-off and initial climb to 35 ft. This will normally be the full length of the runway plus the length of any CWY. Where there is no designated CWY, the part of the runway strip between the end of the runway and the runway strip end is included as part of the TODA. Each TODA must be accompanied by an obstacle clear take-off gradient expressed as a percentage.

TODA =TORA + CWY

(iii) **Accelerate-stop distance available (ASDA)** is defined as the length of the take-off run available plus the length of any SWY. Any CWY is not involved.

ASDA = TORA + SWY

(iv) **Landing distance available (LDA)** is defined as the length of runway available for the ground run of a landing aeroplane. The LDA commences at the runway threshold. Neither SWY nor CWY are involved.

LDA = Length of RW (if threshold is not displaced.)

> **Note:** See Section 5.2 for illustrations of declared distances.

5.1.3.13 Determine and notify the gradient from the end of TODA to the top of the critical obstacle within the take-off climb area, expressed as a percent. Where there is no obstacle, a value of 1.2% must be notified.

5.1.3.14 **Fences or levee banks.** If a fence or levee bank is located so close to a runway strip end such that a take-off gradient is so large as to be meaningless; the take-off gradient can be based on the next obstacle within the take-off area. In this case, a note must be provided advising that the fence or levee bank has not been taken into account in the calculation of TODA and STODA gradients. The note must also advise the location and height of the fence or levee bank.

5.1.3.15 **Survey of take-off area.**

(a) The selection of the critical obstacle must be based on the survey of the full take-off area in accordance with the applicable take-off OLS standards specified in Chapter 7. If the survey is not in full compliance, or the runway may, on occasions, be used by a larger aircraft, for example a Code 2 runway being used by a Code 3 aircraft, then an appropriate note must be provided. For example, “TKOF area surveyed to 8500 m instead of 15000 m” or “TKOF area surveyed to Code 2 standards instead of Code 3”.

(b) Where the location of the critical obstacle is some distance from the take-off inner edge, and results in a take-off gradient that requires a curved departure, an additional lower take-off gradient may be declared based on a shorter length of TKOF area surveyed. Where this situation applies, aerodrome operators must consult with the appropriate RCAA office.

5.1.3.16 **Supplementary take-off distances available (STODA).** For TODA having an obstacle clear gradient of more than 1.6%, STODA must be provided, except if the STODA is less than 800 m. STODA must be provided for obstacle clear take-off gradients of 1.6%, 1.9%, 2.2%, 2.5%, 3.3% and 5%, up to the gradient associated with TODA. In calculating STODA, care must be taken to ensure that a shielded object does not become critical for the lesser take-off distances, and that the slope of the runway is taken into account. Examples showing how to calculate this will be provided in a subsequent Advisory Circular on the subject matter.

> **Note:** Section 5.3 contains an illustration of STODA and an example of a shielded object.

5.1.3.17 **Intersection departure take-off distances available**. At an aerodrome where air traffic procedures include regular taxiway intersection departures, the take-off distances available from each relevant taxiway intersection must be determined and declared. The method of determining the take-of distances available at an intersection is similar to that used at a runway end. This is to ensure that the same performance parameters (for example, line-up allowance) may be consistently applied for the line-up manoeuvre, whether entering the runway at the runway end or from some other intersection. Declared distances for an intersection must be measured from a perpendicular line commencing at the taxiway edge that is farther from the direction of take-off. Where take-offs may be conducted in either direction, the starting point of the declared distances for each direction will be the perpendicular line commencing from the respective edges of the taxiway farther from the direction of take-off. This is illustrated in Section 5.2. The format for notifying intersection departure information is as follows:

— RWY 16 – TKOF from TWY E; RWY remaining 2345 (7694) reduce all DIST by 1312 (4305).

5.1.3.18 **Threshold elevation.** For instrument runways, provide the elevation of the mid-point of each runway threshold.

5.1.3.19 **Aerodrome Obstruction Charts - Type A.** Where a Type A Chart is prepared, currency information of the Chart in the form of date of preparation or edition/issue number must be provided.

5.1.3.20 **One direction runways.** Where a runway direction cannot be used for take-off or landing, or both, the appropriate declared distance(s) must be shown as 'nil', along with an appropriate note, for example; 'TKOF 14 and LAND 32 not AVBL due surrounding terrain.'

5.1.3.21 **Lighting systems.** Provide information of aerodrome lighting systems by using the following abbreviations:

> **Note:** Runway lights include runway edge, threshold and runway end lights, and, where stopways are provided, stopway lights.

Abbreviation	Meaning
SDBY PWR AVBL	Standby power available.
PTBL	Portable or temporary lights (flares or battery).
LIRL	Low intensity runway lights (omnidirectional, single stage of intensity).
MIRL	Medium intensity runway lights (omnidirectional, three stages of intensity).
HIRL	High intensity runway lights (unidirectional, five or six stages of intensity; lower intensity stages may be omnidirectional).
RTIL	Runway threshold identification lights (flashing white).
RCLL	Runway centre line lights.

Abbreviation	Meaning
RTZL	Runway touchdown zone lights.
AL	Approach lights (other than high intensity).
HIAL-CAT 1	High intensity approach lights-CAT I.
HIAL-CAT 11 or 111	High intensity approach lights-CAT II or III.
SFL	Sequenced flashing lights.
T-VASIS	T-pattern visual approach slope indicator system.
AT-VASIS	Abbreviated (single side) T-pattern visual slope approach slope indicator system.
PAPI	PAPI visual approach slope indicator system.
PAPI#	PAPI commissioned by ground survey (not available to RPT jets).
HSL	Hold short lights (used in conjunction with land and hold short operations).
PAL (frequency)	Pilot activated aerodrome lighting (with dedicated frequency).
AFRU+PAL(frequency)	Aerodrome Frequency response Unit plus PAL.
ABN	Aerodrome beacon with colour and flashing rate.
HIOL	High intensity obstacle lights (flashing white).
MIOL	Medium intensity obstacle lights (flashing red).
LIOL	Low intensity obstacle lights (steady red).
Taxiways	Centreline lights are green and edge lights are blue.

5.1.3.22 **Navigation aids**. Where the aerodrome operator provides a navigation aid, the location coordinates and operating frequency must be provided. The location co-ordinates must be notified in degrees, minutes and tenths of a minute, based on the World Geodetic System – 1984 (WGS-84).

5.1.3.23 **Aerodrome obstacles**. Local data may include obstacles in the circuit area.

5.1.3.24 **Additional Information.** Significant local data may include the following:

(a) animal or bird hazard;

(b) aircraft parking restriction;

(c) aircraft to avoid overflying certain areas such as mine blasting areas;

(d) other aviation activities such as ultralight or glider operations in the vicinity.

5.1.4 Obstacle Data

5.1.4.1 Standards for obstacle identification, restriction and limitation are detailed in Chapter 7. Chapter 7 also provides details of and responsibilities for Aerodrome Obstacle Charts applicable to the aerodrome.

Section 5.2: Illustration of Declared Distances

5.2.1 Introduction

5.2.1.1 Declared distances are the available operational distances notified to a pilot for take-off, landing or safely aborting a take-off. These distances are used to determine whether the runway is adequate for the proposed landing or take-off or to determine the maximum payload permissible for a landing or take-off.

5.2.1.2 Declared distances are a combination of the runway (i.e. full strength pavement), any stopway (SW) and clearway (CW) provided.

5.2.2 Calculation of Declared Distances

5.2.2.1 The declared distances to be calculated for each runway direction are:

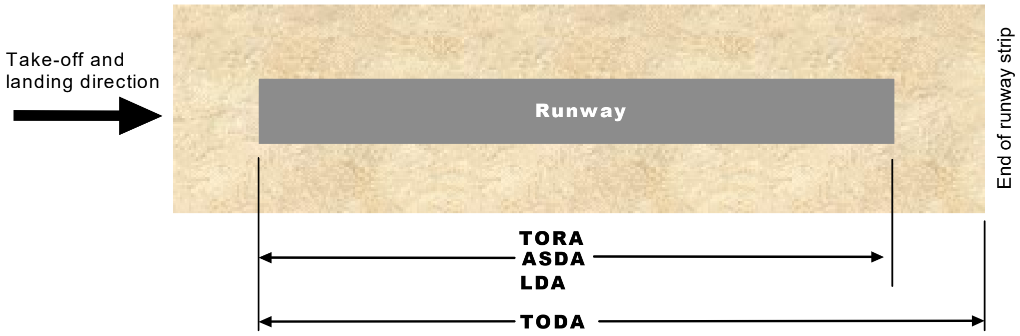
(a) **Take-off run available (TORA)** defined as the length of runway available for the ground run of an aeroplane taking off. It will normally be the full length of the runway. Neither stopway nor clearway are involved.

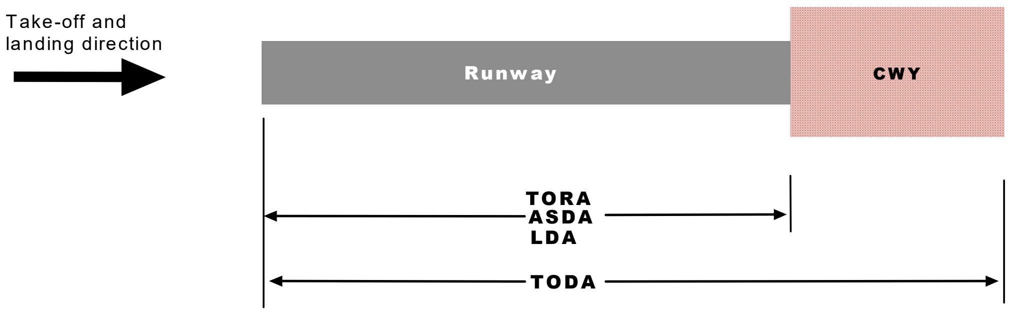
(b) **Take-off distance available (TODA)** defined as the distance available to an aeroplane for completion of its ground run, lift-off and initial climb to 35 ft. It will normally be the full length of the runway plus the length of any clearway.

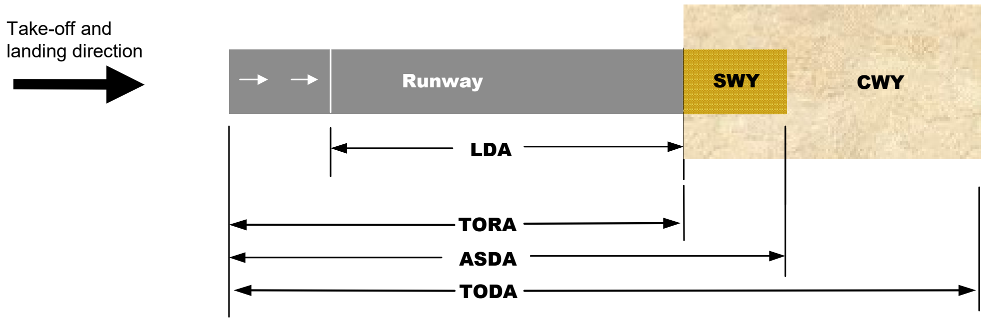
(c) **Accelerate-stop distance available (ASDA)** defined as the length of the take-off run available plus the length of any stopway. Any clearway is not involved.

(d) **Landing distance available (LDA)** defined as the length of runway available for the ground run of a landing aeroplane. The LDA commences at the runway threshold. Neither stopway nor clearway are involved.

5.2.2.2 The above definitions of the declared distances are illustrated in the diagrams below:







5.2.3 Obstacle-free Take-off Gradient

5.2.3.1 TODA is only usable where the minimum obstacle-free gradient from the end of the clearway is equal to or less than the climb performance of the aeroplane.

5.2.3.2 When calculating TODA it is necessary to also calculate the minimum obstacle-free take-off gradient. This is the gradient associated with the critical obstacle.

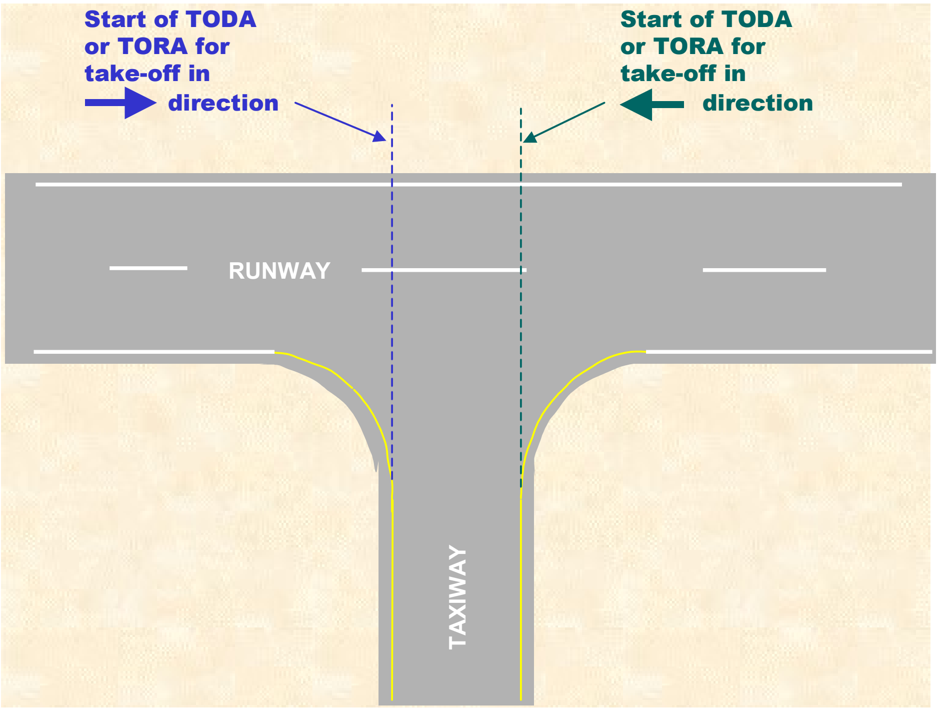
5.2.4 Critical Obstacle

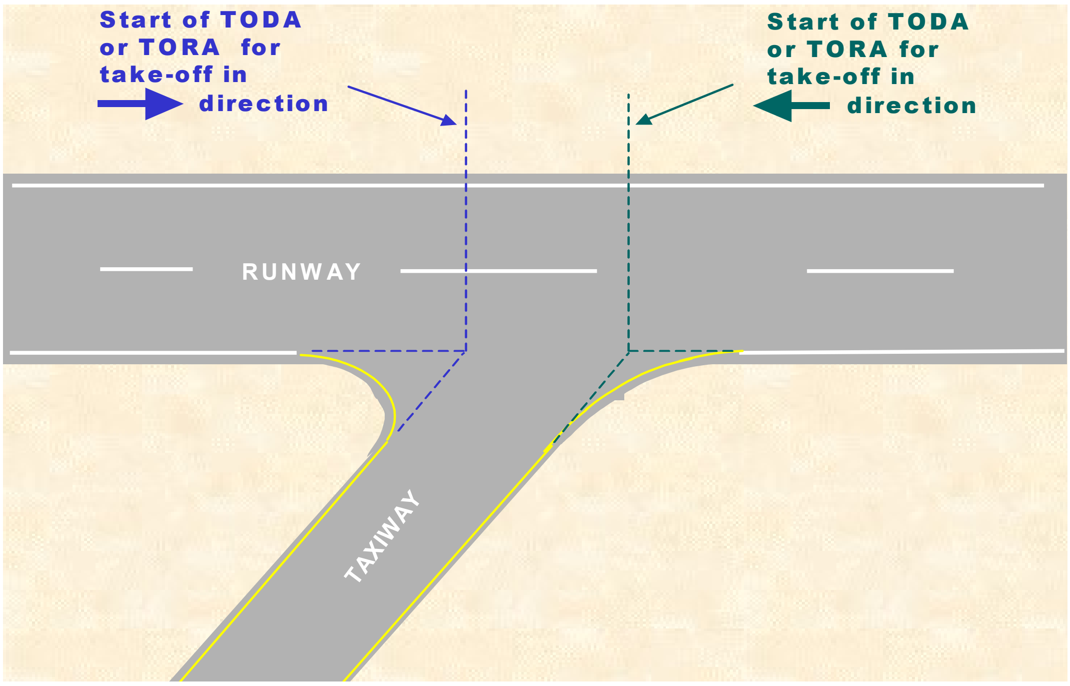
5.2.4.1 The critical obstacle is the obstacle within the take-off climb area which subtends the greatest vertical angle with the horizontal, at the highest point on the clearway, when measured from the inner edge of the take-off climb surface.

5.2.4.2 In assessing the critical obstacle, close in objects such as fences, transient objects on roads and railways, and navigational installations should also be considered. Standards relating to obstacle restrictions and limitations are included in Chapter 7.

5.2.5 Declared Distances for Intersection Departures

5.2.5.1 The following diagrams illustrate the method of calculating the take-off distance available or take-off run available where departures are allowed from taxiway intersections.

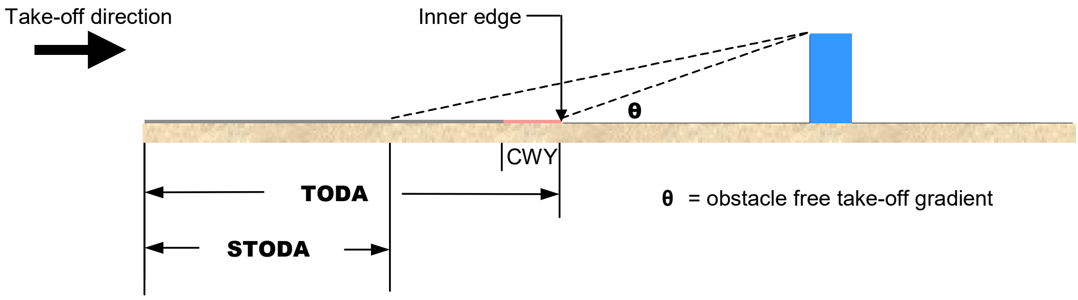




Section 5.3: Illustration of Supplementary Take-Off Distances Available and Shielding

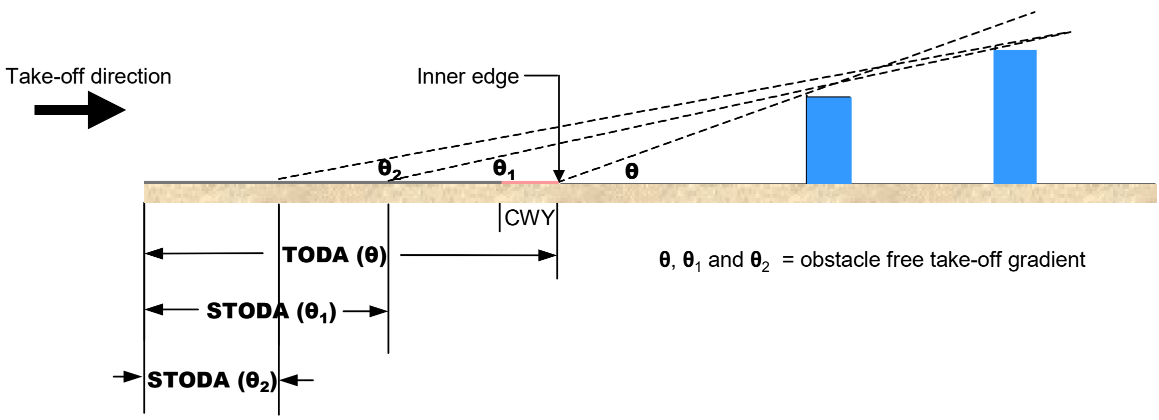
5.3.1 Introduction

5.3.1.1 For TODA having an obstacle-free gradient of more than 1.6%, supplementary take-off distances available (STODA) are to be provided for the following gradients, where applicable: 1.6%, 1.9%, 2.2%, 2.5%, 3.3% and 5%. STODA of less than 800 m are not shown.



5.3.1.2 The specifications for take-off climb surfaces are given in Chapter 6. Aerodrome operators should note in particular the standard for the elevation of the inner edge of the take-off climb surface.

5.3.1.3 In calculating supplementary take-off distances care should be taken to ensure that a shielded object does not become critical for the lesser take-off distances. This is most likely with a close-in critical obstacle.



One way to overcome an object protruding through the approach surface is to displace the threshold and this reduces the LDA. Instances where the threshold needs to be displaced more than 300 m from the end of the runway should be referred to the RCAA area office for consideration.

CHAPTER 6: PHYSICAL CHARACTERISTICS

Section 6.1: General

6.1.1 Introduction

6.1.1.1 The standards for the physical characteristics are the statutory requirements which apply to the planning, design and construction for the movement area facilities at certified and registered aerodromes, and at non-certified and non-registered aerodromes used by aircraft conducting air transport operations.

> **Note:** The standards in this Chapter are intended for the planning and construction of new aerodrome facilities rather than to limit the operations of aeroplanes.

6.1.1.2 The standards set out in this Chapter govern characteristics such as the dimensions and shape of runways, taxiways, aprons and related facilities provided for the safe movement of aircraft.

6.1.1.3 Aerodrome siting, including runway useability and number and orientation of runways, aerodrome master planning and matters relating to economics, efficiency and the environment at an aerodrome are not within the scope of these standards.

6.1.1.4 The aerodrome standards for glider facilities set out in Section 6.7 are applicable to glider facilities provided at a certified aerodrome or registered aerodrome.

Section 6.2: Runways

6.2.1 Location of Runway Threshold

6.2.1.1 The threshold of a runway must be located:

(a) if the runway's code number is 1 — not less than 30 metres after; or

(b) in any other case — not less than 60 metres after;

the point at which the approach surface for aircraft using the runway meets the extended runway centre line.

> **Note:** If obstacles infringe the approach surface, operational assessment may require the threshold to be displaced. The obstacle free approach surface to the threshold is not to be steeper than 3.3% where the runway code number is 4 or steeper than 5% where the code number is 3.

6.2.2 Length of Runway

6.2.2.1 The length of a runway must be adequate to meet the operational requirements of the aeroplanes for which the runway is intended.

6.2.3 Runway Width

6.2.3.1 Subject to Paragraph 6.2.3.2, the width of a runway must not be less than that determined using Table 6.2-1.

Table 6.2-1: Minimum runway width

Code number	Code letter					
	A	**B**	**C**	**D**	**E**	**F**
1	18 m	18 m	23 m	–	–	–
2	23 m	23 m	30 m	–	–	–
3	30 m	30 m	30 m	45 m	–	–
4	–	–	45 m	45 m	45 m	60 m

6.2.3.1B Subject to meeting the additional requirements for runway shoulders mentioned in paragraph 6.2.14.3, code letter E runways may be used for A380 operations.

6.2.3.1C Paragraph 6.2.3.1B does not allow code letter E runways to be used for A380 operations:

(a) if their construction begins after the commencement of paragraph 6.2.3.1B; or

(b) if they are subjected to a major redevelopment, such as a runway extension, that begins after the commencement of that paragraph.

6.2.3.2 If a precision approach runway's code number is 1 or 2, the runway's width must not be less than 30 m.

6.2.4 Runway Turning Area

6.2.4.1 If a turning area for aircraft is provided at any point on a runway, the width of the turning area must be such that the clearance between the outer main gear wheels of the aircraft using the runway and the edge of the turning area, at that point, is not less than the distance determined using Table 6.2-2.

Table 6.2-2: Minimum clearance between outer main gear wheels and edge of turning area on runway

Code letter	Minimum clearance
A	1.5 m
B	2.25 m
C	4.5* m
D, E or F	4.5 m
* If the turning area or curve is only intended to serve aircraft with a wheelbase of less than 18 m, the minimum clearance is 3.0 m.	
Note: The turning node should normally be located on the left hand side of the runway except where a runway is used by aircraft operating in right hand circuits.	

6.2.5 Parallel Runways

6.2.5.1 Where parallel runways are to be provided, the aerodrome operator should consult with RCAA on airspace and air traffic control procedures associated with the operation of the multiple runways. Where parallel, non-instrument runways are provided for simultaneous use, the minimum separation distance between the runway centrelines must not be less than:

(a) where the higher code number of the two runways is 3 or 4 — 210 m;

(b) where the higher code number of the two runways is 2 — 150 m;

(c) where the code number of the two runways is 1 — 120 m.

6.2.5.2 Where parallel instrument runways are intended for simultaneous use, the minimum distance between the runway centrelines must not be less than:

(a) for independent parallel approaches — 1,035 m;

(b) for dependent parallel approaches — 915 m;

(c) for independent parallel departures — 760 m; and

(d) for segregated parallel operations — 760 m.

6.2.6 Runway Longitudinal Slope

6.2.6.1 The overall runway slope, defined by dividing the difference between the maximum and minimum elevation along the runway centreline by the runway length, must not be more than:

(a) if the runway's code number is 3 or 4 — 1%; or

(b) if the runway's code number is 1 or 2 — 2%.

6.2.6.2 Subject to Paragraphs 6.2.6.3 and 6.2.6.4, the longitudinal slope along any part of a runway must not be more than:

(a) if the runway's code number is 4 — 1.25%; or

(b) if the runway's code number is 3 — 1.5%; or

(c) if the runway's code number is 1 or 2 — 2%.

> **Note:** A uniform slope for at least 300 m should be provided at each end of the runway, and at airports where large jet aeroplanes operate this distance should be increased to at least 600 m.

6.2.6.3 If the runway's code number is 4, the longitudinal slope along the first and last quarters of the runway must not be more than 0.8%.

6.2.6.4 If the runway's code number is 3 and it is a precision approach category II or category III runway, the longitudinal slope along the first and last quarters of the runway must not be more than 0.8%.

6.2.6.5 If slope changes cannot be avoided, the change in longitudinal slope between any two adjoining parts of a runway must not be more than:

(a) if the runway's code number is 3 or 4 — 1.5%; or

(b) if the runway's code number is 1 or 2 — 2%.

6.2.6.6 The transition from one longitudinal slope to another must be accomplished by a vertical curve, with a rate of change not more than:

(a) if the runway's code number is 4 — 0.1% for every 30 m (minimum radius of curvature of 30,000 m); or

(b) if the runway's code number is 3 — 0.2% for every 30 m (minimum radius of curvature of 15,000 m); or

(c) if the runway's code number is 1 or 2 — 0.4% for every 30 m (minimum radius of curvature of 7,500 m).

> **Note:** The rate of change of longitudinal slope may be relaxed outside the central one-third of the runway at intersections, either to facilitate drainage or to accommodate any conflicting slope requirements.

6.2.6.7 The distance between the points of intersection of two successive longitudinal slope changes must not be less than the greater of the following:

(a) 45 m; or

(b) the distance in metres worked out using the formula:

$D = k (|S1 - S2| + |S2 - S3|)/100$,

where 'k' is:

(i) if the runway's code number is 4 — 30,000 m; or

(ii) if the runway's code number is 3 — 15,000 m; or

(iii) if the runway's code number is 1 or 2 — 5,000 m; and

'S1', 'S2' and 'S3' are the three successive slopes expressed as percentage values.

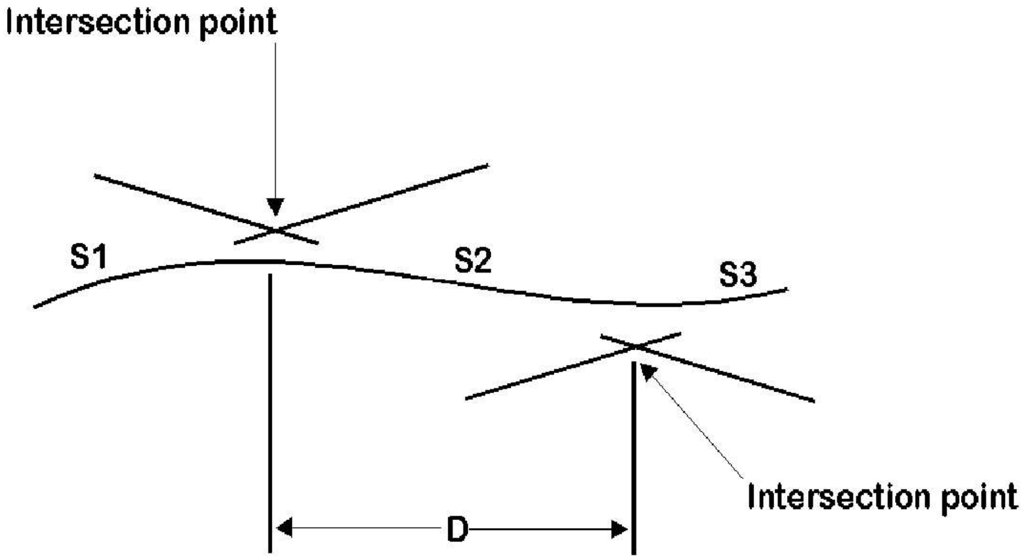


Figure 6.2-1

> **Example:** In Figure 6.2-1 above, if the runway's code number is 3, and the slopes are S1 (+1%), S2 (-1.5%) and S3 (+1.5%), then the distance in metres between the two points of intersection must not be less than 15,000 x (2.5 + 3)/100, that is to say 825 m.

6.2.7 Runway Sight Distance

6.2.7.1 The unobstructed line of sight along the surface of a runway, from a point above the runway, must not be less than the distance determined using Table 6.2-3.

Table 6.2-3: Runway line of sight

Code letter	Minimum unobstructed line of sight
A	From a point 1.5 m above the runway to any other point 1.5 m above the runway for half the length of the runway.
B	From a point 2 m above the runway to any other point 2 m above the runway for half the length of the runway.
C, D, E or F	From a point 3 m above the runway to any other point 3 m above the runway for half the length of the runway.

6.2.7.2 If runway lighting is provided, the unobstructed line of sight from 3 m above any point on the runway surface to any other point on the runway surface must not be less than 600 m.

6.2.8 Transverse Slopes on Runways

6.2.8.1 The transverse slope on any part of a runway must be adequate to prevent the accumulation of water and must be in accordance with Table 6.2-4.

Table 6.2-4: Runway transverse slope

	Code letter	
	A or B	**C, D, E or F**
Maximum slope	2.5%	2.0%
Preferred slope	2.0%	1.5%
Minimum slope	1.5%	1.0%
Note: The standard may not apply at intersections where design may dictate a variation to the standards.		

6.2.9 Runway Surface

6.2.9.1 The surface of a bitumen seal, asphalt or concrete runway must not have irregularities that would result in the loss of frictional characteristics or otherwise adversely affect the take-off or landing of an aircraft.

> **Note:** The finish of the surface of a runway should be such that, when tested with a 3m straight-edge placed anywhere on the surface, there is no deviation greater than 3mm between the bottom of the straight-edge and the surface of the runway pavement anywhere along the straight-edge.

7.2.9.1A The surface of a bitumen seal, asphalt or concrete runway must have an average surface texture depth of not less than 1mm over the full runway width and runway length.

> **Note:** A runway surface meeting the ICAO minimum design objective for new surfaces specified in Annex 14, Volume 1, derived using a continuous friction-measuring device, is acceptable.

6.2.9.2 If a runway surface cannot meet the standards of Paragraph 6.2.9.1, a surface treatment must be provided. Acceptable surface treatments include; grooving, porous friction course and bituminous seals.

6.2.9.3 The runway surface standards for grass, gravel or natural runways are as set out in Table 6.2-4A. However, the runway surface must not have irregularities which would adversely affect the take-off or landing of an aircraft.

Table 6.2-4A

Surface	Runway	Runway strip
Sealed surface	After compaction, the surface is to be swept clean of loose stones	N/A
Maximum height of grass:		
Sparse	450 mm	600 mm
Medium	300 mm	450 mm
Dense	150 mm	300 mm
Maximum size of loose stones:		
Isolated stones on natural surface	25 mm	50 mm
Constructed gravel surface	25 mm	75 mm
Maximum size of surface cracks	40 mm	75 mm
Note: An empirical test for runway riding quality is to drive a stiffly sprung vehicle such as a medium size utility or unladen truck along the runway at not less than 65 kph. If the ride is uncomfortable, then the surface needs to be graded and levelled.		

6.2.10 Runway Bearing Strength

6.2.10.1 The pavement strength rating for a runway must be determined using the ACN - PCN pavement rating system described in Chapter 5.

6.2.10.2 RCAA does not specify a standard for runway bearing strength, however, the bearing strength must be such that it will not cause any safety problems to aircraft. The published PCN value should be suitable for the aircraft that regularly use the runway.

6.2.11 Runway Shoulders

6.2.11.1 If a runway's code letter is F, shoulders must be provided and the total width of the runway and shoulders must not be less than 75 m.

6.2.11.2 If a runway's code letter is D or E, shoulders must be provided and the total width of the runway and shoulders must not be less than 60 m.

6.2.12 Characteristics of Runway Shoulders

6.2.12.1 Runway shoulders must:

(a) be of equal width on both sides;

(b) slope downwards and away from the runway surface;

(c) be resistant to aeroplane engine blast erosion;

(d) be constructed so as to be capable of supporting an aeroplane, running off the runway, without causing structural damage to the aeroplane; and

(e) be flush with the runway surface except during runway overlay works where a step down not exceeding 25 mm is permitted.

6.2.13 Transverse Slope on Runway Shoulder

6.2.13.1 The transverse slope of a runway shoulder must not be more than 2.5%.

6.2.14 Surface of Runway Shoulder

6.2.14.1 The shoulders of a runway intended to serve jet-propelled aeroplanes with engines which may overhang the edge of the runway must be surfaced with a bituminous seal, asphalt or concrete.

6.2.14.2 At a runway intended to serve a wide body jet aeroplane such as a Boeing 747 or any other aeroplane with engines, which may overhang the shoulders, a further width of 7 m outside each shoulder must be prepared to resist engine blast erosion.

6.2.14.3 Code letter E runways used for A380 operations must be provided with shoulders that consist of:

(a) inner shoulders 7.5 metres in width on either side that are able to support unintended aircraft runoff; and

(b) outer shoulders 7.5 metres in width on either side that are resistant to engine blast erosion, prevent engine ingestion and are able to support emergency and service vehicles.

6.2.15 Provision of Runway Strip

6.2.15.1 A runway and any associated stopways must be centrally located within a runway strip.

6.2.16 Composition of Runway Strip

6.2.16.1 A runway strip, in addition to the runway and stopway, must include:

(a) if the runway is a non-instrument runway — a graded area around the runway and stopway; or

(b) if the runway is an instrument runway — a graded area around the runway and stopway and an area, known as the fly-over area, outside the graded area.

Runway strip consisting of fully graded area only – non-instrument runways

Runway strip consisting of both graded and flyover area - instrument runways

Figure 6.2-2: Composition of Runway Strip

6.2.17 Runway Strip Length

6.2.17.1 The graded area of a runway strip must extend beyond the end of the runway or any associated stopway for at least:

(a) if the runway's code number is 1 and it is a non-instrument runway — 30 m; or

(b) in any other case — 60 m.

6.2.18 Runway Strip Width

6.2.18.1 The width of the graded area of a runway strip must be not less than that given in Table 6.2-5.

Table 6.2-5: Graded runway strip width

Aerodrome reference code	Runway strip width
1[b]	60 m
2 [c]	80 m
3 (where the runway width is 30 m)	90 m
3, 4 (where the runway width is 45 m or more)	150 m

[b] Runways used at night are required to have a minimum 80 m runway strip width.

[c] Aeroplanes not exceeding 5,700 kg by day, the runway strip width may be 60 m.

6.2.18.2 In the case of a non-precision approach runway, the width of the runway strip, including the fly-over area, must not be less than that given in Table 6.2-6.

Table 6.2-6: Runway strip width for non-precision approach runways

Aerodrome reference code	Overall runway strip width
1 or 2	90 m
3 (where the runway width is 30 m)	150 m
3 or 4 (where the runway width is 45 m or more)	300 m

6.2.18.3 In the case of a precision approach runway, the width of the runway strip, including the fly-over area, must not be less than that given in Table 6.2-7.

Table 6.2-7: Runway strip width for precision approach runways

Aerodrome reference code	Overall runway strip width
1 or 2	150 m
3 or 4	300 m

Notes:

2. For precision approach runways code 3 and 4, an additional width of graded runway strip shall be provided. In this case, the graded width extends to a distance of 105 m from the runway centreline, except that the width is gradually reduced (over a distance of 150 m) to 75 m from the runway centreline at both ends of the strip, for a length of 150 m from the runway ends as shown in Figure 6.2-3.

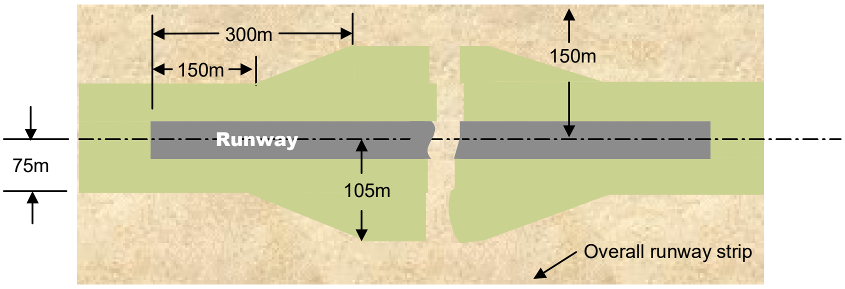


Figure 6.2-3: Runway Strip for Precision Approach Runways

6.2.18.4 If an aerodrome operator wishes to provide a lesser runway strip width to that specified in the standards, the aerodrome operator must provide RCAA with a safety case justifying why it is impracticable to meet the standard. The safety case must include documentary evidence that all relevant stakeholders have been consulted.

6.2.19 Longitudinal Slope on Graded Area of Runway Strip

6.2.19.1 As far as practicable the longitudinal slope along the graded area of the runway strip must not be more than:

(a) if the runway code number is 4 —1.5%;

(b) if the runway code number is 3 — 1.75%;

(c) if the runway's code number is 1 or 2 — 2.0%.

6.2.20 Longitudinal Slope Changes on Graded Area of Runway Strip

6.2.20.1 Slope changes must be as gradual as practicable and abrupt changes or sudden reversal of slopes avoided, and must not exceed 2%.

6.2.21 Runway Strip Longitudinal Slope Changes at Runway Ends (Radio Altimeter Operating Area)

6.2.21.1 For precision approach Category I, Category II, Category II and Category III runways, slope changes within an area 60 m wide and 300 m long, symmetrical about the centre line, before the threshold, must be avoided.

Note: This is because aeroplanes making Category I, Category II, Category II and Category III approaches are equipped with radio altimeters for final height guidance in accordance with the terrain immediately prior to the threshold and excessive slope changes can cause errors in data.

6.2.21.2 If a slope change cannot be avoided on a radio altimeter operating area, the rate of change between two consecutive slopes must not be more than 2% per 30 metres (minimum radius of curvature of 1,500 metres).

6.2.22 Runway Strip Transverse Slope

6.2.22.1 The transverse slope of the graded area of the runway strip must not be more than:

(a) if the runway's code number is 3 or 4 — 2.5%; and

(b) if the runway's code number is 1 or 2 — 3%.

6.2.22.2 The transverse slope of the graded runway strip adjacent to the runway shoulder, for the first 3 m outwards, must be negative and may be as great as 5%.

6.2.22.3 No part of a fly-over area, or any object on it, must project through a plane:

(a) that starts along each outer side of the graded area; and

(b) has an upward slope away from the graded area of more than 5%.

6.2.23 Surface of Graded Area of Runway Strip

6.2.23.1 Any step down to the abutting surface of a runway strip from a runway, runway shoulder or stopway must not be more than 25 mm.

6.2.23.2 Effective drainage in the graded area must be provided to avoid water ponding and thus attracting birds. Open drains must not be constructed in the graded portion of a runway strip.

6.2.23.3 The portion of a strip at the end of a runway must be prepared to resist blast erosion, in order to protect a landing aeroplane from the danger of an exposed edge.

6.2.23.4 Runway strip surface standards are the same as those set out in Table 6.2-4A.

6.2.24 Objects on Runway Strips

6.2.24.1 A runway strip must be free of fixed objects, other than visual aids for the guidance of aircraft or vehicles:

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

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

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

6.2.24.2 All fixed objects permitted on the runway strip must be of low mass and frangibly mounted.

6.2.24.3 When a runway is in use for an aircraft to land or take off, no mobile object may be on a part of the strip mentioned in paragraph 6.2.24.1.

> **Note:** See subsection 11.1.4A for information regarding siting of equipment and installations on runway strips.

6.2.25 Runway End Safety Area (RESA)

6.2.25.1 A RESA must be provided at the end of a runway strip, to protect the aeroplane in the event of undershooting or overrunning the runway, unless the runway's code number is 1 or 2 and it is not an instrument runway.

> **Notes:** The RESA standards in this Section are in compliance with the current ICAO standards, including measuring RESA from the end of the runway strip.

6.2.25.2 The new RESA standard shall apply to all new runways and existing runways when it is lengthened. Operators of existing code 4 runways used by air transport jet aeroplanes conducting international operations must make provision to comply with the RESA standards within five years of the promulgation of RCARs (Aerodromes).

> **Note:** Where it is not practicable to provide the full length of RESA, the provision may include an engineering solution to achieve the objective of RESA, which is to enhance aeroplane deceleration. In the latter case, aerodrome operators will need to liaise with RCAA.

6.2.26 Dimensions of RESA

6.2.26.1 The minimum length of the RESA must be 90 m where the associated runway is suitable for aircraft with a code number 3 or 4 and is used by air transport jet aeroplanes. In other cases, the minimum RESA length must be 60 m.

> **Note:** Additional length of RESA should be provided especially at international aerodromes, in accordance with the following ICAO recommendations:
>
> 1. if the runway's code number is 3 or 4 — 240 m; or
> 2. if the runway's code number is 1 or 2 — 120 m.

6.2.26.2 The width of a RESA must not be less than twice the width of the associated runway.

6.2.27 Slopes on RESA

6.2.27.1 The downward longitudinal slope of a RESA must not be more than 5%.

6.2.27.2 The transverse slope of a RESA must not be more than 5% upwards or downwards.

6.2.27.3 Transition between different slopes is to be as gradual as practicable.

6.2.27.4 No part of the RESA must project above the runway's approach or take-off climb surfaces.

6.2.28 Objects on RESA

6.2.28.1 A RESA must be free of fixed objects, other than visual or navigational aids for the guidance of aircraft or vehicles.

> **Note:** See subsection 11.1.4A for information regarding siting of equipment and installations on a RESA.

6.2.28.2 All fixed objects permitted on a RESA must be of low mass and frangibly mounted.

6.2.28.3 A RESA must be free of mobile objects that may endanger aircraft when the runway is being used for landing or taking off.

6.2.29 Bearing Strength of RESA

6.2.29.1 As far as practicable, a RESA must be prepared or constructed so as to reduce the risk of damage to an aeroplane, enhance aeroplane deceleration and facilitate the movement of rescue and fire fighting vehicles.

> **Note:** To reduce the risk of damage to an aeroplane undershooting the runway and to prevent jet blast erosion from jet aircraft turning and taking off at the end of the runway, it is recommended that areas abutting the runway should be provided with a compacted gravel pavement with a depth at the runway end equal to half the depth of the runway pavement, tapering to natural surface, the length of the taper being adjusted according to the bearing capacity of the natural surface. For areas beyond the gravel surface and outside the runway strip, graded but non-compacted natural surface with a grass cover is preferred. Hard pans should be broken up.

6.2.30 Clearways

6.2.30.1 A clearway, consisting of an obstruction-free rectangular plane, must be provided at the end of a runway so that an aeroplane taking off may make a portion of its initial climb to 35 ft (10.7 m) above the ground at the end of the clearway.

6.2.31 Location of Clearways

6.2.31.1 A clearway must start at the end of the take-off run available on the runway.

6.2.32 Dimensions of Clearways

6.2.32.1 The length of a clearway must not be more than half the length of the take-off run available on the runway.

6.2.32.2 The width of a clearway must not be less than:

(a) If the runway's code number is 3 or 4 — 150 m;

(b) If the runway's code number is 2 — 80 m; and

(c) If the runway's code number is 1 — 60 m.

> **Note**: For code 3 or 4 runways used by aeroplanes having a maximum take-off mass less than 22,700 kg and operating in VMC by day, the width of the clearway may be reduced to 90 m.

6.2.33 Slopes on Clearways

6.2.33.1 The surface below a clearway must not project above a plane with an upward slope of 1.25%, the lower limit of which is a horizontal line that:

(a) is perpendicular to the vertical plane containing the runway centreline; and

(b) passes through a point located on the runway centreline at the end of the take-off run available.

6.2.34 Objects on Clearways

6.2.34.1 A clearway must be free of fixed or mobile objects other than visual or navigational aids for the guidance of aeroplanes or vehicles.

> **Note**: See subsection 11.1.4A for information regarding siting of equipment and installations on a clearway.

6.2.34.2 All fixed objects permitted on the clearway must be of low mass and frangibly mounted.

6.2.35 Stopways

6.2.35.1 A stopway may be provided at the end of a runway on which an aeroplane may be stopped in the case of an aborted take-off.

6.2.36 Dimensions of Stopways

6.2.36.1 If provided the length of stopway is an economic decision for the aerodrome operator but must be such that it finishes at least 60 m before the end of the runway strip.

6.2.36.2 The width of a stopway must be as wide as the associated runway.

6.2.37 Surface of Stopway

6.2.37.1 A stopway with a bituminous seal or asphalt surface must have frictional characteristics at least as good as those of the associated runway.

6.2.38 Stopway Slopes and Slope Changes

6.2.38.1 Where practicable, slope and slope changes on a stopway must be the same as those for the associated runway, except that:

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

(b) at the junction of the stopway and runway and along the stopway the maximum rate of slope change may be increased to 0.3% per 30 m (minimum radius of curvature of 10,000 m).

6.2.39 Bearing Strength of Stopway

6.2.39.1 The bearing strength of a stopway must be able to support at least one single pass of the aircraft that the facility is intended to serve, without causing structural damage to the aircraft.

> **Note:** A stopway should be constructed to the full runway pavement depth where it abuts the runway, tapering to one half of the runway pavement depth over the first 15 m and continued at half the runway pavement depth thereafter, in order to affect a gradual transition in all weather conditions.

6.2.39.2 If the stopway does not meet the strength criteria defined in Paragraph 6.2.39.1, then:

(a) for aircraft having a maximum take-off mass in excess of 68,000 kg, any unsealed stopway must not be included in the calculation of the accelerate stop distance available;

(b) for aircraft having a maximum take-off mass between 36,300 kg and 68,000 kg, a maximum length of 60 m must be included in the calculation of the accelerate stop distance available; and

(c) for aircraft having a maximum take-off mass not exceeding 36,300 kg, a length of stopway not exceeding 13% of the runway length may be included in the calculation of the accelerate stop distance available.

Section 6.3: Taxiways

6.3.1 Taxiway Width

6.3.1.1 Subject to this subsection, the width of a straight section of a taxiway must not be less than the width determined using Table 6.3-1.

Table 6.3-1: Minimum width for straight section of taxiway

Code letter	Minimum taxiway width (straight sections)
A	7.5 m
B	10.5 m
C	18 m
D	23 m
E	23 m
F	25 m
Note: Minimum widths are subject to exceptions, see paragraph 6.3.1.1A	

6.3.1.1A The minimum taxiway widths in Table 6.3-1 are subject to the following exceptions:

(a) in the case of a code letter C taxiway that is only intended to serve aircraft with a wheelbase of less than 18 metres, the width may be reduced to 15 metres;

(b) in the case of a code letter D taxiway that is only intended to serve aircraft with an outer main gear span of less than 9 metres, the width may be reduced to 18 metres;

(c) subject to meeting the additional requirements for taxiway shoulders mentioned in paragraph 6.3.9.1A, code letter E taxiways may be used for A380 operations.

6.3.1.1B Subparagraph 6.3.1.1A (c) does not allow code letter E taxiways to be used for A380 operations:

(d) if their construction begins after the commencement of paragraph 6.3.1.1A; or

(e) if they are subjected to a major redevelopment, such as a taxiway extension, that begins after the commencement of that paragraph.

6.3.2 Taxiway Edge Clearance

6.3.2.1 Subject to paragraph 6.3.2.1A, the width of any section of a taxiway must be such that, with the nose wheel of the aircraft remaining on the taxiway, the clearance between the outer main gear wheels and the edge of the taxiway, at any point, must not be less than the distance determined using Table 6.3-2.

Table 6.3-2: Minimum clearance between outer main gear wheels of aircraft and edge of taxiway

Code letter	Minimum clearance
A	1.5 m
B	2.25 m
C	4.5 m*
D, E or F	4.5 m
* If the turning area or curve is only intended to serve aircraft with a wheelbase of less than 18 m, the minimum clearance is 3.0 m.	

6.3.2.1A For A380 aircraft using a code letter E taxiway, the minimum clearance between the outer main gear wheels and the edge of the taxiway at any point must not be less than 4.3 metres.

6.3.3 Taxiway Curves

6.3.3.1 Any change in the direction of a taxiway must be accomplished by a curve whose minimum radius, determined by the taxiway design speed, must not be less than that determined using Table 6.3-3.

Table 6.3-3: Radii for taxiway curves

Taxiway Design Speed	Radius of Curve
20 km/h	24 m
30 km/h	54 m
40 km/h	96 m
50 km/h	150 m
60 km/h	216 m
70 km/h	294 m
80 km/h	384 m
90 km/h	486 m
100 km/h	600 m

Note: The provision of rapid exit taxiways is a financial decision for the aerodrome operator. The aerodrome operator should seek specialist advice on the geometric design of rapid exit taxiways.

6.3.4 Taxiway Longitudinal Slope

6.3.4.1 The longitudinal slope along any part of a taxiway must not be more than:

(a) if the taxiway's code letter is C, D, E or F — 1.5%; and

(b) if the taxiway's code letter is A or B — 3.0%.

6.3.4.2 If slope changes cannot be avoided, the transition from one longitudinal slope to another must be accomplished by a vertical curve, with a rate of change not more than:

(a) if the taxiway's code letter is C, D, E or F — 1.0% per 30 m (minimum radius of curvature of 3,000 m); and

(b) if the taxiway's code letter is A or B — 1.0% per 25 m (minimum radius of curvature of 2,500 m).

6.3.5 Taxiway Transverse Slope

6.3.5.1 The transverse slope on any part of a taxiway must be adequate to prevent the accumulation of water and must not be less than 1.0% and not more than:

(a) if the taxiway's code letter is C, D, E or F — 1.5%; and

(b) if the taxiway's code letter is A or B — 2.0%.

6.3.6 Taxiway Sight Distance

6.3.6.1 The unobstructed line of sight along the surface of a taxiway, from a point above the taxiway, must not be less than the distance determined using Table 6.3-4.

Table 6.3-4: Standard for taxiway line of sight

Code letter	Minimum line of sight
A	150 m from 1.5 m above taxiway
B	200 m from 2 m above taxiway
C, D, E or F	300 m from 3 m above taxiway

6.3.7 Taxiway Bearing Strength

6.3.7.1 RCAA does not specify a standard for taxiway bearing strength, however the bearing strength must be such that it does not cause any safety problems to the operating aircraft.

6.3.8 Taxiway Shoulders

6.3.8.1 If the taxiway's code letter is C, D, E or F and is used by jet propelled aeroplanes it must be provided with shoulders.

6.3.9 Width of Taxiway Shoulders

6.3.9.1 The width of shoulders on each side of the taxiway must not be less than:

(a) if the taxiway's code letter is F — 17.5 m; or

(b) if the taxiway's code letter is E — 10.5 m; or

(c) if the taxiway's code letter is D — 7.5 m; or

(d) if the taxiway's code letter is C — 3.5 m.

6.3.9.1A The width of the shoulders on each side of a code letter E taxiway used for A380 operations must not be less than 18.5 metres.

6.3.9.2 On curved sections of taxiway, and at junctions or intersections with runways or other taxiways, where the width of the surface of the taxiway is increased, the width of the shoulders must not be reduced from their width along the adjacent straight sections of the taxiway.

6.3.10 Surface of Taxiway Shoulders

6.3.10.1 The taxiway shoulders must be:

(a) if the taxiway is used by jet-propelled aircraft — resistant to engine blast erosion and prevent engine ingestion; and

(b) if the taxiway is intended to serve a wide body jet, such as a Boeing 747 aeroplane or Airbus 380 aircraft, being an aircraft whose engines overhang the shoulders — sealed to a width of at least 3 metres on both sides of the taxiway.

6.3.11 Taxiway Strips

6.3.11.1 A taxiway must be located in a taxiway strip, the inner part of which is a graded area.

6.3.12 Width of Taxiway Strip

6.3.12.1 The width of the taxiway strip along the length of the taxiway on each side of the centre line of the taxiway must not be less than:

(a) if the taxiway's code letter is F — 57.5 m; or

(b) if the taxiway's code letter is E — 47.5 m; or

(c) if the taxiway's code letter is D — 40.5 m; or

(d) if the taxiway's code letter is C — 26 m; or

(e) if the taxiway's code letter is B — 21.5 m; or

(f) if the taxiway's code letter is A — 16.25 m.

6.3.13 Width of Graded Area of Taxiway Strip

6.3.13.1 The width of the graded area of a taxiway strip on each side of the centre line of the taxiway must not be less than:

(a) if the taxiway's code letter is F — 30 m; or

(b) if the taxiway's code letter is E — 22 m; or

(c) if the taxiway's code letter is D — 19 m; or

(d) if the taxiway's code letter is C or B — 12.5 m; or

(e) if the taxiway's code letter is A — 11 m.

6.3.14 Slope of Taxiway Strip

6.3.14.1 The graded area of a taxiway strip must not have an upward transverse slope that is more than:

(a) if the taxiway's code letter is C, D, E or F — 2.5%; or

(b) if the taxiway's code letter is A or B — 3%;

measured relative to the transverse slope of the adjacent taxiway surface.

6.3.14.2 The downward transverse slope of the graded area of a taxiway strip must not exceed 5.0%, measured relative to the horizontal.

6.3.14.3 No portion of the taxiway strip beyond the graded portion, nor objects thereon, must project upwards through a plane surface, originating from the outer edge of the graded taxiway strip, sloping upwards and outwards at a slope of 5% measured with reference to the horizontal.

> **Note:** The presence of drains and ditches in this part of the taxiway strip is acceptable.

6.3.15 Objects on Taxiway Strip

6.3.15.1 A taxiway strip must be free of fixed objects other than visual or navigational aids used for the guidance of aircraft or vehicles.

> **Note:** See subsection 11.1.4A for information regarding siting of equipment and installations on a taxiway strip.

6.3.15.2 Visual aids located within a taxiway strip must be sited at such a height that they cannot be struck by propellers, engine pods and wings of aircraft using the taxiway.

6.3.16 Taxiways on Bridges

6.3.16.1 Subject to Paragraph 6.3.16.2, the minimum width of the part of a taxiway bridge that is capable of supporting the traffic of aircraft that use the bridge must, when measured perpendicular to the taxiway centre line, not be less than the total width of the taxiway and the graded areas specified in Paragraph 6.3.13.1.

6.3.16.2 The minimum width of the part of the taxiway bridge referred to in Paragraph 6.3.16.1 may be reduced to a width not less than the width of the associated taxiway, if an adequate method of lateral restraint is provided at the edges of that part, to prevent aircraft leaving that part.

6.3.17 Taxiway Minimum Separation Distances

6.3.17.1 The separation distance between the centre line of a taxiway, including an apron taxiway, and:

(a) the centre line of a parallel runway; or

(b) the centre line of a parallel taxiway; or

(c) a building, structure, vehicle, wall, plant, equipment, parked aeroplane or road;

must not be less than the distances determined using Table 6.3-5.

Table 6.3-5: Taxiway minimum separation distance

To precision approach runway centre line	**Code letter**					
Runway code number	**A**	**B**	**C**	**D**	**E**	**F**
1	82.5 m	87 m	93 m	-	-	-
2	82.5 m	87 m	93 m	-	-	-
3	157.5 m	162 m	168 m	176 m	-	-
4	-	-	168 m	176 m	182.5 m	190 m
To non-precision approach runway centre line	**Code letter**					
Runway code number	**A**	**B**	**C**	**D**	**E**	**F**
1	52.5 m	57 m	63 m	-	-	-
2	52.5 m	57 m	63 m	-	-	-
3	82.5 m	87 m	93 m	176 m	-	-
4	-	-	93 m	176 m	182.5 m	190 m
To non-instrument runway centre line	**Code letter**					
Runway code number	**A**	**B**	**C**	**D**	**E**	**F**
1	37.5 m	42 m	48 m	-	-	-
2	47.5 m	52 m	58 m	-	-	-
3	52.5 m	57 m	63 m	101 m	-	-
4	-	-	93 m	101 m	107.5 m	115 m
To another taxiway centre line	**Code letter**					
	A	**B**	**C**	**D**	**E**	**F**
	23.75 m	33.5 m	44 m	66.5 m	80 m	97.5 m
To Paragraph 6.3.17.1(c) object	**Code letter**					
	A	**B**	**C**	**D**	**E**	**F**
	16.25 m	21.5 m	26 m	40.5 m	47.5 m	57.5 m

Note: 1. The separation distances are based on the concept of the wing of the aeroplane, centred on the parallel taxiway, remaining clear of the runway strip of standard width.

2. The taxiway centreline to runway centreline separation distances have been determined using the maximum runway strip width required for the particular category and code of runway.
3. ILS installations may also influence the location of taxiways due to interferences to ILS signals by a taxiing or stopped aircraft. Information on critical and sensitive areas surrounding ILS installations is contained in Annex 10, Volume I, Attachment C.

Section 6.4: Holding Bays, Runway-Holding Positions, Intermediate Holding Positions and Road-Holding Positions

6.4.1 Introduction

6.4.1.1 For the purpose of this Section:

(a) a holding bay is defined as an area offset from the taxiway where aircraft can be held;

(b) a runway-holding position is a designated position on a taxiway entering a runway;

(c) an intermediate holding position is a designated position on a taxiway other than at a taxiway entering a runway; and

(d) a road-holding position is a designated position at which vehicles may be required to hold before crossing a runway.

6.4.2 Provision of a Holding Bay, Runway-holding Position, Intermediate Holding Position and Road-holding Position

6.4.2.1 The provision of a holding bay is the prerogative of the aerodrome operator, however if it is provided, it must be located such that any aeroplane on it will not infringe the inner transitional surface.

6.4.2.2 A runway-holding position or positions must be established:

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

(b) at an intersection of a runway with another runway where the aircraft is required to be held.

6.4.2.3 Except for an exit taxiway, an intermediate holding position or positions must be established on a taxiway if the air traffic control requires the aeroplane to hold at that position.

6.4.2.4 A road-holding position must be established at an intersection of a road with a runway. See also Paragraph 8.6.11 for signage and marking of a road-holding position.

6.4.3 Location of Holding Bay, Runway-holding Position, Intermediate Holding Position or Road-holding Position

6.4.3.1 A holding bay, runway-holding position, intermediate holding position or road-holding position must not be placed where an aircraft or vehicle using it:

(a) infringes the inner transitional surface of a precision approach runway or, in other cases, the graded area of the runway strip; or

(b) interferes with the operation of radio navigation aids.

6.4.4 Distance from Runway-holding Position, Intermediate Holding Position or Road-holding Position to Runway Centreline

6.4.4.1 A runway-holding position, intermediate holding position, or a road-holding position must not be located closer to the centreline of the runway than the distance determined using Table 6.4-1.

Table 6.4-1: Minimum distance from runway-holding position, intermediate holding position or road-holding position to associated runway centre line

Code number	Type of runway				
	Non-instrument	**Non-precision approach**	**Precision Category I**	**Precision Category II or III**	**Take-off**
1	30m	40m	60 m[e, f]		30m
2	40m	40m	60 m[e, f]		40m
3	75m[a]	75m[a]	90 m[b, e, f]	105 m[c, e, f]	75m[a]
4	75m	75m	90 m[d, e, f]	105 m[c, d, e, f]	75m

[a] If the runway's code is 3A, 3B or 3C, the minimum distance is 45m.

[b] If the runway's code is 3A, 3B or 3C, the minimum distance is 75m.

[c] May be reduced to 90m up to 300m from the runway end.

[d] If the runway's code is F, this distance should be 107.5m.

[e] This distance may be decreased 5 m for every 1 m the bay or holding position is lower than the threshold, provided that the inner transitional surface is not infringed.

[f] This distance may be increased to avoid interference with radio navigation aids, particularly the glide path and localizer facilities. Advice on ILS critical and sensitive areas should be obtained from the relevant aeronautical telecommunications service and radio navigation service provider.

Section 6.5: Aprons

6.5.1 Location of Apron

6.5.1.1 An apron must be located so that aeroplanes parked on it do not infringe an obstacle limitation surface, and in particular, the transitional surface.

6.5.2 Separation Distances on Aprons

6.5.2.1 An aircraft parking position taxilane must be separated from any object by a distance not less than that determined using Table 6.5-1.

Table 6.5-1: Aircraft parking positions – Minimum separation distance

Code letter for aircraft	From centre line of aircraft parking position taxilane to object	From wing tip of aircraft on aircraft parking position to object
A	12.0 m	3.0 m
B	16.5 m	3.0 m
C	24.5 m	4.5 m
D	36.0 m	7.5 m
E	42.5 m	7.5 m*
F	50.5 m	7.5 m*
* The minimum separation distance is 10 metres if free moving parking is used.		

6.5.2.2 Subject to Paragraph 6.5.2.3, an aircraft on an aircraft parking position must be separated from any object, other than an aerobridge, by a distance not less than that determined using Table 6.5-1.

6.5.2.3 Paragraph 6.5.2.2 does not apply to a Code D, E or F aircraft if a visual docking guidance system allows a reduced separation distance.

6.5.2A Alternative aircraft parking position separation

6.5.2A.1 If:

(a) physical constraints prevent proposed aircraft parking positions (the ***positions***) from complying with the separation distances set out in subsection 6.5.2; and

(b) the aerodrome operator:

(i) designs the positions in accordance with Part 2 of the ICAO Aerodrome Design Manual; and

(ii) submits the design to RCAA with a safety case and an application for approval of the design and the safety case; and

(c) RCAA in writing, with or without conditions, approves the design and the safety case;

then:

(d) the standards in subsection 6.5.2 that are specified in the RCAA approval are taken not to apply to the operator; and

(e) the approved design and safety case, and the conditions of the approval (if any), are taken to be the applicable standards for the positions.

6.5.3 Slopes on Aprons

6.5.3.1 The slope on an aircraft parking position must not be more than 1%.

6.5.3.2 The slope on any other part of an apron must be as level as practicable without causing water to accumulate on the surface of the apron, but must not be more than 2%.

6.5.3.3 Subject to Paragraph 6.5.3.4 the grading of an apron must be such that it does not slope down towards the terminal building.

6.5.3.4 Where a slope down towards the terminal building cannot be avoided, apron drainage must be provided to direct spilled fuel away from buildings and other structures adjoining the apron.

6.5.3.5 Where stormwater drains could also serve to collect spilt fuel from the apron area, flame traps or interceptor pits must be provided to isolate and prevent the spread of fuel into other areas.

6.5.4 Apron Bearing Strength

6.5.4.1 RCAA does not specify a standard for apron bearing strength, however the bearing strength must be such that it does not cause any safety problems to the operating aircraft.

6.5.5 Apron Road

6.5.5.1 On an apron where a marked roadway is to be provided for surface vehicles, the location of the apron road must be such that, where practicable, vehicles travelling on it will be at least 3 m from any aircraft parked at the aircraft parking position.

Section 6.6: Jet Blast

6.6.1 General

6.6.1.1 The aerodrome operator must protect people and property from the dangerous effects of jet blast. Information on specific jet engine blast velocities, including lateral and vertical contours, for a given aircraft model is given in the Aircraft Characteristics - Airport Planning document, prepared for most aircraft models by the aircraft manufacturer.

6.6.2 Jet Blast and Propeller Wash Hazards

6.6.2.1 The recommended maximum wind velocities which people, objects and buildings in the vicinity of an aeroplane may be subjected to should not be more than:

(a) passengers and main public areas, where passengers have to walk and people are expected to congregate — 60 km/h;

(b) minor public areas, where people are not expected to congregate — 80 km/h;

(c) public roads — 50 km/h where the vehicular speed may be 80 km/h or more, and — 60 km/h where the vehicular speed is expected to be below 80 km/h.

(d) personnel working near an aeroplane — 80 km/h;

(e) apron equipment — generally not in excess of 80 km/h;

(f) light aeroplane parking areas — desirably 60 km/h and not greater than 80 km/h;

(g) buildings and other structures — not exceeding 100 km/h.

> **Note:** To offer protection from jet blast velocities the aerodrome operator may consider the provision of jet blast fences or the use of appropriate building material.

CHAPTER 7: OBSTACLE RESTRICTION AND LIMITATION

Section 7.1: General

7.1.1 Introduction

7.1.1.1 The scope of this Chapter is to define the standards that control airspace around an aerodrome.

7.1.1.2 An obstacle is defined as:

(a) any object that stands on, or stands above, the specified surface of an obstacle restriction area which comprises the runway strips, runway end safety areas, clearways and taxiway strips; and

(b) any object that penetrates the obstacle limitation surfaces (OLS), a series of surfaces that set the height limits of objects, around an aerodrome.

7.1.1.3 Obstacle data requirements for the design of instrument procedures need to be determined in liaison with flight procedure designers.

7.1.1.4 Non-compliance with standards may result in RCAA issuing hazard notification notices as prescribed in RCARs (aerodromes).

7.1.2 Obstacle Restriction

7.1.2.1 Objects, except for approved visual and navigational aids, must not be located within the obstacle restriction area of the aerodrome without the specific approval of RCAA.

7.1.2.2 Equipment and installations required for air navigation purposes are to be of minimum practicable mass and height, frangibly designed and mounted, and sited in such a manner as to reduce the hazard to aircraft to a minimum.

7.1.2.3 Obstacles on the obstacle restriction area must be taken into account when determining the obstacle clear approach or take-off surfaces.

7.1.3 Obstacle Limitation

7.1.3.1 An aerodrome operator must establish the OLS applicable to the aerodrome.

> **Note:** A description and illustration of the obstacle limitation surfaces is provided in Section 7.3.

7.1.3.2 The following OLS must be established for a non-instrument runway and a non-precision instrument runway:

(a) conical surface;

(b) inner horizontal surface;

(c) approach surface;

(d) transitional surface; and

(e) take-off climb surface.

7.1.3.3 The following OLS must be established for a precision approach runway:

(a) outer horizontal surface;

(b) conical surface;

(c) inner horizontal surface;

(d) approach surface;

(e) inner approach surface;

(f) transitional surface;

(g) inner transitional surface;

(h) baulked landing surface; and

(i) take-off climb surface.

> **Note:** See subsection 11.1.4A for information regarding siting of equipment and installations on operational areas.

7.1.3.4 The physical dimensions of the OLS surfaces, for approach runways, must be determined using Table 7.1-1.

Table 7.1-1: Approach Runways

OLS & Dimensions (in metres and percentages)	Runway Classification									
	Non-instrument				Instrument					
					Non-precision			Precision		
	Code No				Code No			I Code No		II & III Code No
	1*	2	3	4	1, 2	3	4	1, 2	3, 4	3, 4
OUTER HORIZONTAL										
Height (m)									150	150
Radius (m)									15000	15000
CONICAL										
Slope	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Height (m)	35	55	75	100	60	75	100	60	100	100
INNER HORIZONTAL										
Height (m)	45	45	45	45	45	45	45	45	45	45
Radius (m)	2000	2500	4000	4000	3500	4000	4000	3500	4000	4000
APPROACH										
Length of inner edge (m)	60	80	150[a]	150	90	150	300[b]	150	300	300
Distance from threshold (m)	30	60	60	60	60	60	60	60	60	60
Divergence each side	10%	10%	10%	10%	15%	15%	15%	15%	15%	15%
First section length (m)	1600	2500	3000	3000	2500	3000	3000	3000	3000	3000
Slope	5%	4%	3.33%	2.5%	3.33%	3.33%	2%	2.5%	2%	2%
Second section length (m)	-	-	-	-	-	3600[c]	3600	12000	3600	3600
Slope	-	-	-	-	-	2.5%[c]	2.5%	3%	2.5%	2.5%
Horizontal section length (m)	-	-	-	-	-	8400[c]	8400	-	8400	8400
Total length (m)	1600	2500	3000	3000	2500	15000[d]	15000	15000	15000	15000
INNER APPROACH										
Width (m)								90	120	120
Distance from threshold (m)								60	60	60
Length (m)								900	900	900
Slope								2.5%	2%	2%
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%
BAULKED LANDING										
Length of inner edge (m)								90	120	120
Distance from threshold (m)								[e]	1800[f]	1800
Divergence each side								10%	10%	10%
Slope								4%	3.3%	3.3%

All distances are measured horizontally unless otherwise specified.

* Runways used for RPT operations at night by aircraft with maximum take-off mass not exceeding 5,700 kg are required to meet code 2 standards.

[a] 90 m where width of runway is 30 m.

[b] 150 m if only used by aeroplanes requiring 30 m wide runway.

[c] No actual ground survey required unless specifically required by procedure designer. Procedure designer will use topographical maps and tall structure databank to determine minimum altitudes.

[d] Approach area up to this distance needs to be monitored for new obstacles. Refer to procedure designer's advice on significant high ground or tall structure that needs monitoring.

[e] Distance to end of runway strip.

[f] Or to the end of the runway strip, whichever is less.

7.1.3.5 The physical dimensions of the OLS surfaces, for take-off runways, must be determined using Table 7.1-2.

Table 7.1-2: Take-off runways

Take-off climb surface – Dimensions (in metres and percentages)	**Take-off Runways Code number**		
	1*	**2**	**3 or 4**
Length of inner edge	60	80	180 [a]
Minimum distance of inner edge from runway end [b]	30	60	60
Rate of divergence (each side)	10%	10%	12.5%
Final width	380	580	1800 [c]
Overall length	1600	2500	15000
Slope	5%	4%	2%[d]

All dimensions are measured horizontally unless otherwise specified.

* Runways used for RPT operations at night by aircraft with maximum take-off mass not exceeding 5,700 kg are required to meet code 2 standards.

[a] The length of the inner edge may be reduced to 90 m if the runway is intended to be used by aeroplanes having a mass less than 22,700 kg and operating in VMC by day. In this case the final width may be 600 m, unless the flight path may involve a change of heading in excess of 15°.

[b] The take-off climb starts from the end of clearway if a clearway is provided.

[c] The final width may be reduced to 1200 m if the runway is used only by aircraft with take-off procedure which does not include changes of heading greater than 15° for operations conducted in IMC or at night.

[d] The operational characteristics of aircraft for which the runway is intended should be examined to see if it is desirable to reduce the slope to cater for critical operating conditions. If the specified slope is reduced, corresponding adjustment in length for take-off climb is to be made so as to provide protection to a height of 300 m. If no object reaches the 2% take-off climb surface, new objects should be limited to preserve the existing obstacle free surface or a surface down to a slope of 1.6%.

7.1.3.6 Where two OLS surfaces overlap, the lower surface must be used as the controlling OLS.

7.1.4 Procedures for Aerodrome Operators to Deal with Obstacles

7.1.4.1 The aerodrome operator must monitor the OLS applicable to the aerodrome and report to RCAA any infringement or potential infringement of the OLS.

> **Note:** Aerodrome operators need to liaise with appropriate planning authorities and companies that erect tall structures, to determine potential infringements. Every effort should be made to implement the OLS standards and limit the introduction of new obstacles.

7.1.4.2 When a new obstacle is detected, the aerodrome operator must ensure that the information is passed on to pilots, through NOTAM, in accordance with the standards for aerodrome reporting procedures set out in Chapter 10.

7.1.4.3 Information on any new obstacle must include:

(a) the nature of the obstacle — for instance structure or machinery;

(b) distance and bearing of the obstacle from the start of the take-off end of the runway, if the obstacle is within the take-off area, or the ARP;

(c) height of the obstacle in relation to the aerodrome elevation; and

(d) if it is a temporary obstacle — the time it is an obstacle.

7.1.5 Objects Outside the OLS

7.1.5.1 Under RCARs (Aerodromes) any object which extends to a height of 110 m or more above local ground level must be notified to RCAA.

> **Note:** For instrument runways, obstacle monitoring includes the PANS-OPS surface which extends beyond the OLS of the aerodrome. See paragraph 7.1.1.

7.1.5.2 Any object that extends to a height of 150 m or more above local ground level must be regarded as an obstacle unless it is assessed by RCAA to be otherwise.

7.1.6 Objects That Could Become Obstacles

7.1.6.1 If a proposed object or structure is determined to be an obstacle, details of the proposal must be referred to RCAA the Authority to determine whether it will be a hazard to aircraft operations.

7.1.6.2 **Shielded Obstacle.** A new obstacle that is shielded by an existing obstacle may be assessed as not imposing additional restrictions to aircraft operations.

> **Note:** Information on the principle of shielding is provided in Section 7.4.

7.1.6.3 **Marking and lighting of obstacles**

(a) RCAA may direct that obstacles be marked and or lit and may impose operational restrictions on the aerodrome as a result of an obstacle.

(b) If directed by RCAA, lighting and/or marking of obstacles, including terrain, must be carried out in accordance with the standards set out in Chapter 8 and Chapter 9.

7.1.6.4 **Temporary and transient obstacles.** Temporary obstacles and transient (mobile) obstacles, such as road vehicles, rail carriages or ships, in close proximity to the aerodrome and which penetrate the OLS for a short duration, must be referred to RCAA to determine whether they will be a hazard to aircraft operations.

7.1.6.5 **Fences or levee banks.** A fence or levee bank that penetrates the OLS must be treated as an obstacle.

> **Note:** See Chapter 5 in regard to reporting of fences and levee banks.

7.1.6.6 **Hazardous objects below the OLS.** Where RCAA has identified an object, which does not penetrate the OLS to be a hazard to aircraft operations, RCAA may require the object to be either:

(a) removed, if appropriate; or

(b) marked and/or lit.

> **Note:** For example inconspicuous overhead wires or isolated objects in the vicinity of the aerodrome.

7.1.7 Monitoring of Obstacles Associated with Instrument Runways

7.1.7.1 For a precision approach runway, the aerodrome operator must monitor any object that may penetrate the applicable OLS.

7.1.7.2 For a non-precision approach runway, besides monitoring the applicable OLS, obstacle monitoring includes areas outside the OLS, also known as PANS-OPS surfaces, used in the design of the Non-Precision Approach (NPA) procedures. To make it easier for aerodrome operators to carry out this task, procedure designers will be asked to provide aerodrome operators with a drawing or drawings of the area around the aerodrome, showing the designed approach paths, the circling areas and locations of critical obstacles taken into account in the design. In the case of a terrain obstacle, such as a hill, allowance provided for vegetation should also be provided, if appropriate.

7.1.7.3 Aerodrome operators must establish procedures to monitor the OLS and the critical obstacles associated with the NPA procedures and have them included in the Aerodrome Manual. The procedure designer must be advised of any changes of the status of the existing critical obstacles and any proposed development that is likely to be higher than the critical obstacles within the area depicted by the procedure designer.

7.1.8 Additional Obstacle Assessment for an Existing Non-instrument Runway to be Upgraded to a Non-precision Instrument Runway

> **Note:** The following procedures are established to minimise the costs associated with the introduction of NPA procedures at country aerodromes without compromising aerodrome safety.

7.1.8.1 For code 1 and 2 runways, there is a slight increase in the area of coverage for both the inner horizontal and conical obstacle limitation surfaces, as specified in Table 7.1-1.

> **Note**: The required survey may be held over until the next OLS survey is due.

7.1.8.2 For code 1, 2 and 3 runways, an additional survey of the approach obstacle limitation surface may be limited to the first section of the approach OLS (i.e. to a distance of 2500m for code 1 and 2 runways and 3000m for code 3 runways). The purpose of this survey is to identify any obstacle that may affect the location of the threshold, or needs to be provided with obstacle marking or lighting.

7.1.8.3 For the approach area beyond the first section, existing topographical maps and the Tall Structure Data Bank, under the custodian of the RAAF, should provide general obstacle data for determining minimum altitude purposes. Accordingly, unless specifically requested by the procedure designer, no actual ground survey of obstacles within the area is necessary.

7.1.8.4 To allow for possibility of missing obstacle information, an NPA procedure will be checked by flight validation. On-going monitoring of obstacles within the second and horizontal sections of the approach area should be included in the drawing(s) provided by the procedure designer.

7.1.8.5 Any new object which may penetrate the inner horizontal, conical and the first section of the approach surfaces of the applicable NPA standard, as specified in Table 7.1-1, must be identified and, if its presence cannot be avoided, the details of the obstacles must be forwarded to the RCAA for assessment of marking and lighting requirements.

7.1.9 Obstacle Protection for Curved Take-Off

7.1.9.1 At present RCAA does not promulgate a general standard for obstacle limitation surfaces in respect of curved take-off climb surface. Request for approval for curved take-off procedures may originate from aircraft operators or the aerodrome operators, and RCAA will deal with such requests on a case-by-case basis.

Section 7.2: Aerodrome Obstacle Charts

7.2.1 Type A Charts

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

7.2.1.2 A Type A chart must be prepared for each runway that is used in international operations.

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

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

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

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

7.2.1.6 Where a Type A chart has been prepared, or updated, a copy of the chart must be given to RCAA.

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

> **Notes:** 1: Changes to the Type A chart information but not to OLS take-off climb surface does not require NOTAM action.
>
> 2: Where the change to Type A chart information is also the subject of NOTAM action, additional separate advice to Type A chart holders is not necessary.

7.2.1.8 A distribution list of current Type A chart holders must be maintained.

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

7.2.2 Type B Charts

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

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

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

7.2.2.3 The decision to prepare a Type B chart must be made in consultation with RCAA.

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

7.2.3 Type C Charts

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

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

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

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

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

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

7.2.4 Precision Approach Terrain Charts – ICAO

7.2.4.1 A Precision Approach Terrain Chart – ICAO provides detailed terrain profile information within a defined portion of the final approach to enable aircraft operators to assess the effect of the terrain on decision height determination by the use of radio altimeters.

7.2.4.2 Unless the same relevant information is provided in the Aerodrome Terrain and Obstacle Chart — ICAO (Electronic) in accordance with ICAO Annex 4, a Precision Approach Terrain Chart — ICAO must be made available for each precision approach runway:

(a) Category II and Category III; or

(b) that has, or is intended to have, a Category I or a Category II procedure.

7.2.4.3 A Precision Approach Terrain Chart – ICAO must be revised as soon as practicable after any significant change occurs to the relevant terrain profile.

7.2.4.4 A Precision Approach Terrain Chart – ICAO must conform to the standards and procedures set out in ICAO Annex 4.

Section 7.3: Obstacle Limitation Surfaces

7.3.1 General

7.3.1.1 The Obstacle Limitation Surfaces (OLS) are conceptual (imaginary) surfaces associated with a runway, which identify the lower limits of the aerodrome airspace above which objects become obstacles to aircraft operations, and must be reported to RCAA.

> **Note:** The term OLS is used to refer to each of the imaginary surfaces which together define the lower boundary of aerodrome airspace, as well as to refer to the complex imaginary surface formed by combining all the individual surfaces.

7.3.1.2 The OLS comprises the following:

(a) outer horizontal surface;

(b) conical surface;

(c) inner horizontal surface;

(d) approach surface;

(e) inner approach surface;

(f) transitional surface;

(g) inner transitional surface;

(h) baulked landing surface; and

(i) take-off climb surface.

7.3.2 Description of OLS

7.3.2.1 **Reference Elevation Datum.** A reference elevation datum is to be established as a benchmark for the horizontal and conical surfaces. The reference elevation datum is to be:

(a) the same as the elevation of the ARP (rounded off to the next half-metre below), provided this elevation is within three metres of the average elevations of all existing and proposed runway ends; otherwise

(b) the average elevation (rounded off to the next half-metre below) of existing and proposed runway ends.

> **Note:** The reference elevation datum is not to be confused with the aerodrome elevation published in AIP. Aerodrome elevation is, by definition, the highest point on the landing area.

7.3.2.2 **Outer Horizontal Surface.** The outer horizontal surface is a plane located 150 m above the reference elevation datum and extending from the upper edge of the extended conical surface for a distance of 15,000 m (radius) from the aerodrome reference point (ARP).

7.3.2.3 **Conical Surface.**

(a) The conical surface comprises both straight and curved elements, which slope upwards and outwards from the edge of the inner horizontal surface to a specified height above the inner horizontal surface.

(b) The slope of the conical surface is to be measured in a vertical plane perpendicular to the periphery of the inner horizontal surface.

7.3.2.4 **Inner Horizontal Surface.** The inner horizontal surface is a horizontal plane at a specified height above the reference elevation datum extending to an outer boundary comprising:

(a) in the case of an aerodrome with a single runway, semi-circular curves of a specified radius centred on the middle of each of the runway strip ends and joined tangentially by straight lines on each side of the runway, parallel to the runway centreline;

(b) in the case of an aerodrome with multiple runways, curves of a specified radius centred on the middle of each of the runway strip ends and the curves are joined by a tangential line as two curves intersect.

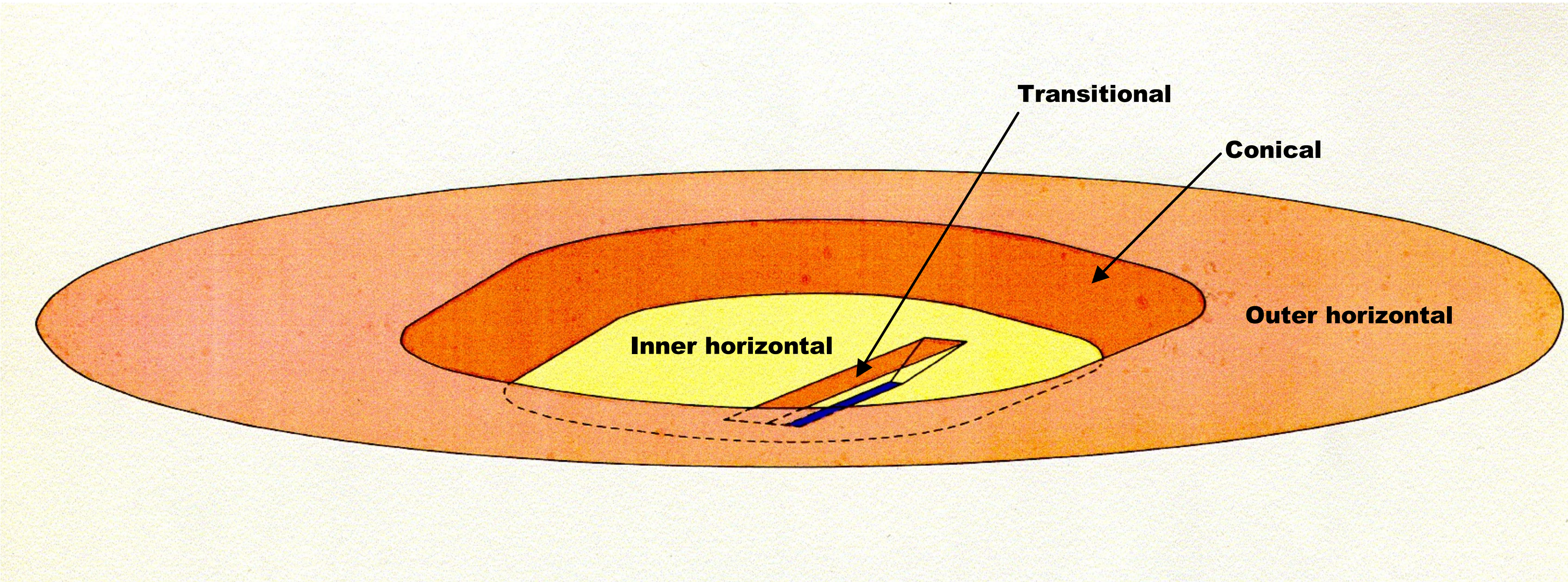


Figure 7.3-1: Relationship of outer horizontal, conical, inner horizontal and transitional surfaces

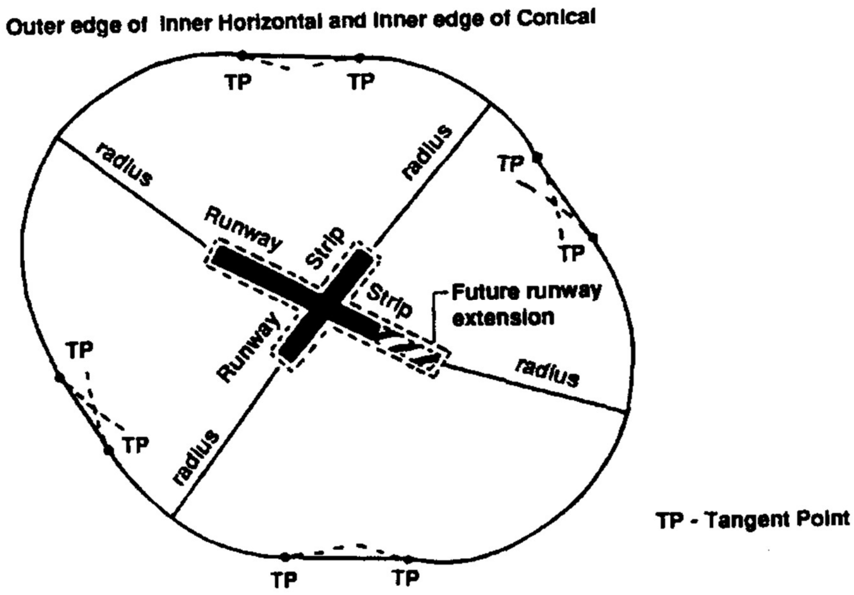


Figure 7.3-2: Boundary of inner horizontal surface

7.3.2.5 Approach Surface

(a) The approach surface is an inclined plane or combination of planes which originate from the inner edge associated with each runway threshold, with two sides originating at the ends of the inner edge.

(b) The inner edge associated with each runway threshold has a specified length, and is located horizontally and perpendicularly to the runway centreline, at a specified distance before the threshold.

(c) The two sides diverge uniformly at a specified rate from the extended centreline of the runway.

(d) The approach surface may be divided into three sections and ends at an outer edge that is located at a specified overall distance from the inner edge and parallel to the inner edge.

(e) The elevation of the midpoint of the threshold is to be the elevation of the inner edge.

(f) The slope of each section of the approach surface is at a specified rate and is to be measured in the vertical plane containing the centreline of the runway.

(g) The above surfaces are to be varied when lateral offset, offset or curved approaches are utilised, specifically, two sides originating at the ends of the inner edge and diverging uniformly at a specified rate from the extended centreline of the lateral offset, offset or curved ground track.

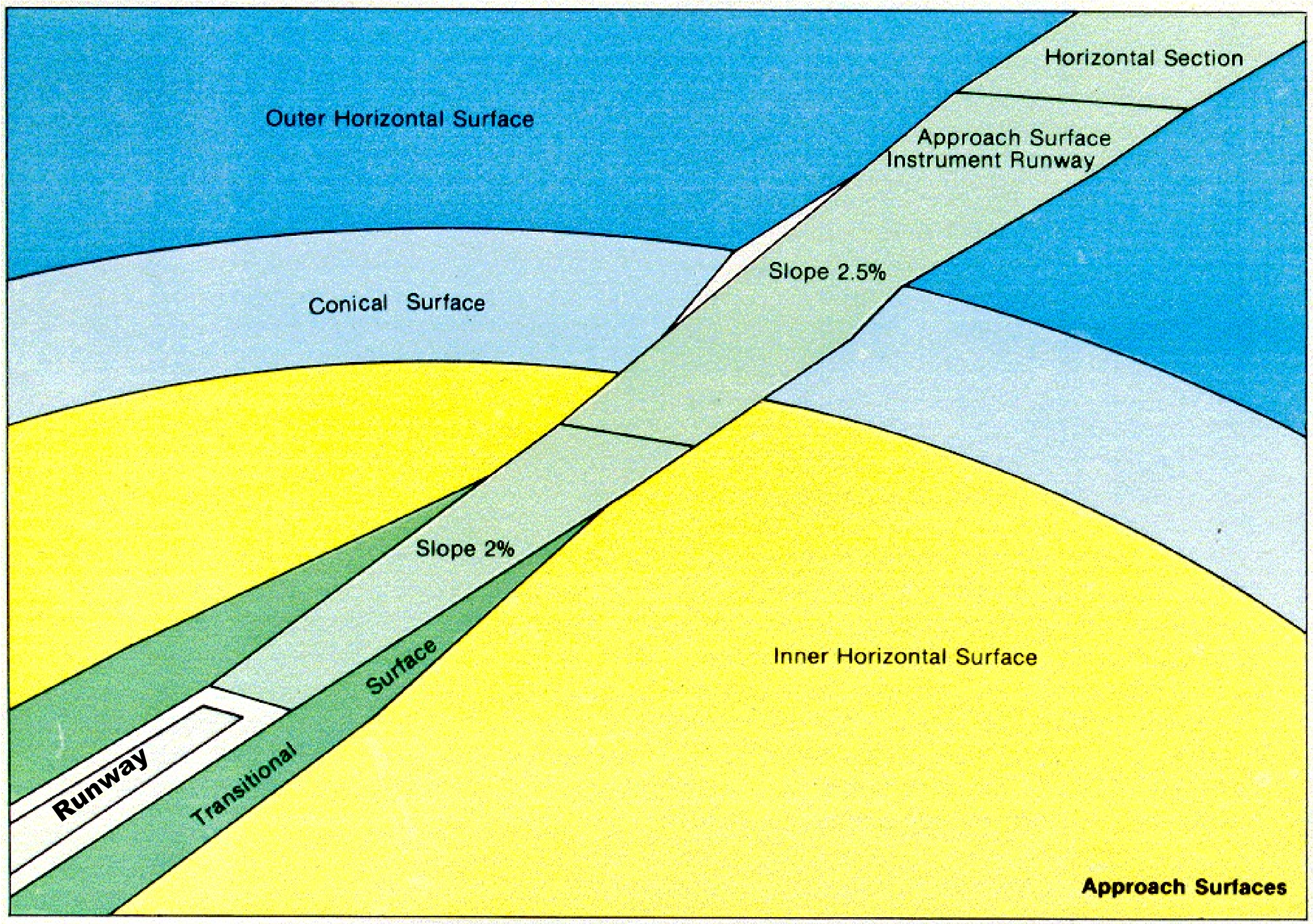


Figure 7.3-3: Approach surface for an instrument approach runway

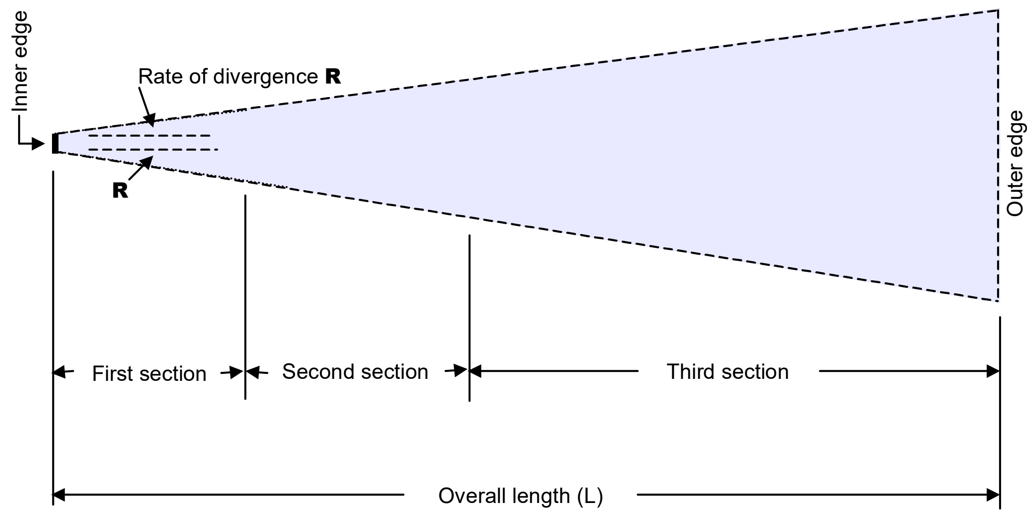


Figure 7.3-4: Plan view of approach surface

7.3.2.6 Transitional Surface

(a) The transitional surface comprises inclined planes that originate at the lower edge from the side of the runway strip (the overall strip), and the side of the approach surface that is below the inner horizontal surface, and finishes where the upper edge is located in the plane of the inner horizontal surface.

(b) The transitional surface slopes upwards and outward at a specified rate and is to be measured in a vertical plane at right angles to the centreline of the runway.

(c) The elevation of a point on the lower edge of the transition surface is to be:

  (i) along the side of the approach surface, equal to the elevation of the approach surface at that point; and

  (ii) along the side of the runway strip, equal to the nearest point on the centreline of the runway or stopway.

> **Note:** For the purpose of drawing the transitional surface, the lower edge of the transitional surface along the runway strip may be drawn as a straight line joining the corresponding ends of the approach surfaces at each end of the runway strip. However when assessing whether an object may penetrate the transitional surface, the standard of the transitional surface applies.

7.3.2.7 **Obstacle-Free Zone.** The inner approach, inner transitional and baulked landing surfaces together define a volume of airspace in the immediate vicinity of a precision approach runway, which is known as the obstacle-free zone. This zone must be kept free from fixed objects, other than lightweight frangibly mounted aids to air navigation which must be near the runway to perform their function, and from transient objects such as aircraft and vehicles when the runway is being used for precision approaches.

7.3.2.8 **Inner Approach Surface**

(a) The inner approach surface is a rectangular portion of the approach surface immediately preceding the threshold.

(b) The inner approach surface originates from an inner edge of a specified length, at the same location as the inner edge for the approach surface, and extends on two sides parallel to the vertical plane containing the runway centreline, to an outer edge which is located at a specified distance to the inner edge and parallel to the inner edge.

7.3.2.9 **Inner Transitional Surface**

(a) The inner transitional surface is similar to the transitional surface but closer to the runway. The lower edge of this surface originates from the end of the inner approach surface, extending down the side of the inner approach surface to the inner edge of that surface, thence along the runway strip to the inner edge of the baulked landing surface and from there up the side of the baulked landing surface to the point where the side intersects the inner horizontal surface.

(b) The elevation of a point on the lower edge is to be:

(i) along the side of the inner approach and baulked landing surface, equal to the elevation of the particular surface at that point;

(ii) along the runway strip, equal to the elevation of the nearest point on the centreline of the runway or stopway.

(c) The inner transitional surface slopes upwards and outwards at a specified rate and is to be measured in a vertical plane at right angles to the centreline of the runway.

(d) The upper edge of the inner transitional surface is located in the plane of the inner horizontal surface.

(e) The inner transitional surface should be used as the controlling surface for navigational aids, aircraft and vehicle holding positions which have to be located near the runway. The transitional surface should be used for building height control.

7.3.2.10 **Baulked Landing Surface**

(a) The baulked landing surface is an inclined plane originating at a specified distance after the threshold and extending between the inner transitional surfaces.

(b) The baulked landing surface originates from an inner edge of a specified length, located horizontally and perpendicularly to the centreline of the runway, with two sides from the ends of the inner edge diverging uniformly at a specified rate from the vertical plane containing the centreline of the runway, ending at an outer edge located in the plane of the inner horizontal surface.

(c) The elevation of the inner edge is to be equal to the elevation of the runway centreline at the location of the inner edge.

(d) The specified slope of the baulked landing surface is to be measured in the vertical plane containing the centreline of the runway.

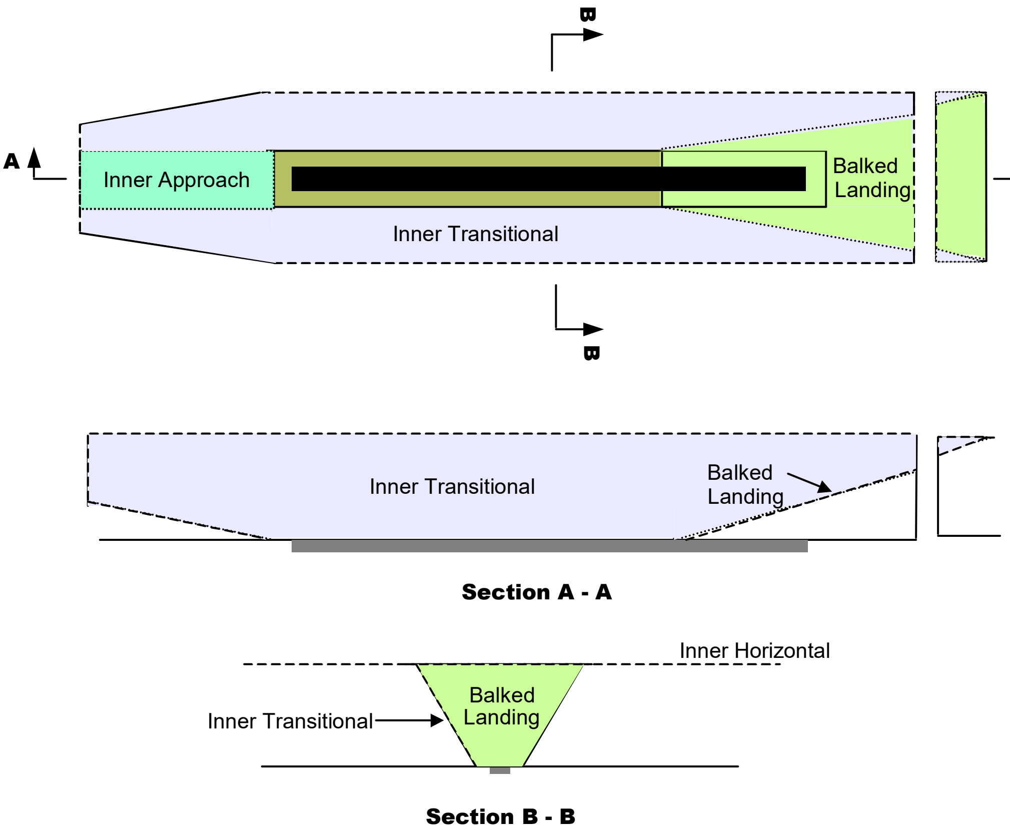


Figure 7.3-5: Inner approach, inner transitional and baulked landing obstacle limitation surfaces

7.3.2.11 Take-Off Climb Surface

(a) The take-off climb surface is an inclined plane (or other shape in the case of curved take-off) located beyond the end of the runway or clearway.

(b) The origin of the take-off climb surface is the inner edge of a specified length, located at a specified distance from the end of the runway or the clearway. The plane from the inner edge slopes upward at a specified rate, with the two sides of the plane originating from the ends of the inner edge concurrently diverging uniformly outwards at a specified rate, to a specified final width, and continuing thereafter at that width for the remainder of the specified overall length of the take-off climb surface until it reaches the outer edge which is horizontal and perpendicular to the take-off track.

(c) The elevation of the inner edge is to be equal to the highest point on the extended runway centreline between the end of the runway and the inner edge, except that when a clearway is provided the elevation is to be equal to the highest point on the ground on the centreline on the clearway.

(d) The slope of the take-off climb surface is to be measured in the vertical plane containing the centreline of the runway.

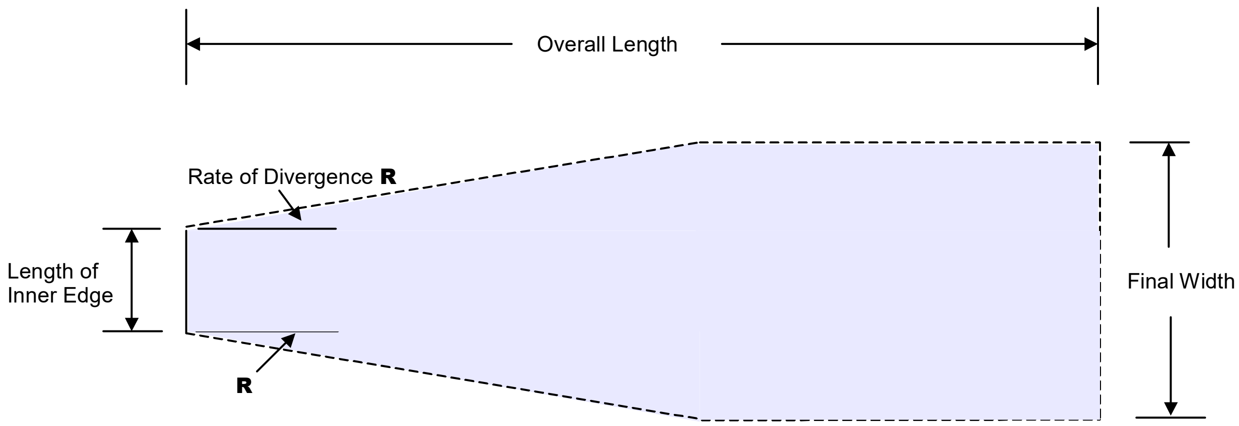


Figure 7.3-6: Plan view of take-off climb surface

Section 7.4: Principles of Shielding

7.4.1 General

7.4.1.1 A new obstacle located in the vicinity of an existing obstacle and assessed as not being a hazard to aircraft is deemed to be shielded.

7.4.1.2 Unless specifically directed by the Authority, a shielded obstacle does not require removal, lowering, marking or lighting and should not impose any additional restrictions to aircraft operations.

7.4.1.3 The Authority shall assess and determine whether an obstacle is shielded. The aerodrome operator is to notify the Authority of the presence of all obstacles.

7.4.1.4 Only existing permanent obstacles may be considered in assessing shielding of new obstacles.

7.4.2 Shielding Principles

7.4.2.1 In assessing whether an existing obstacle shields an obstacle, RCAA will be guided by the principles of shielding detailed below.

7.4.2.2 **Obstacles penetrating the approach and take-off climb surfaces**

(a) An existing obstacle within the approach and take-off climb area is called the critical obstacle. Where a number of obstacles exist closely together, the critical obstacle is the one which subtends the greatest vertical angle measured from the appropriate inner edge.

(b) As illustrated below, a new obstacle may be assessed as not imposing additional restrictions if:

(i) when located between the inner edge end and the critical obstacle, the new obstacle is below a plane sloping downwards at 10% from the top of the critical obstacle toward the inner edge;

(ii) when located beyond the critical obstacle from the inner edge end, the new obstacle is not higher than the height of the permanent obstacle;

(iii) where there is more than one critical obstacle within the approach and take-off climb area, and the new obstacle is located between two critical obstacles, the height of the new obstacle is not above a plane sloping downwards at 10% from the top of the next critical obstacle.

7.4.2.3 **Obstacles penetrating the inner and outer horizontal and conical surfaces.** The new obstacle may be accepted if it is in the vicinity of an existing obstacle, and does not penetrate a 10% downward sloping conical shaped surface from the top of the existing obstacle, i.e. the new obstacle is shielded radially by the existing obstacle.

7.4.2.4 **Obstacles Penetrating the Transitional Surfaces.** A new obstacle may be assessed as not imposing additional restrictions if it does not exceed the height of an existing obstacle which is closer to the runway strip and the new obstacle is located perpendicularly behind the existing obstacle relative to the runway centre line.

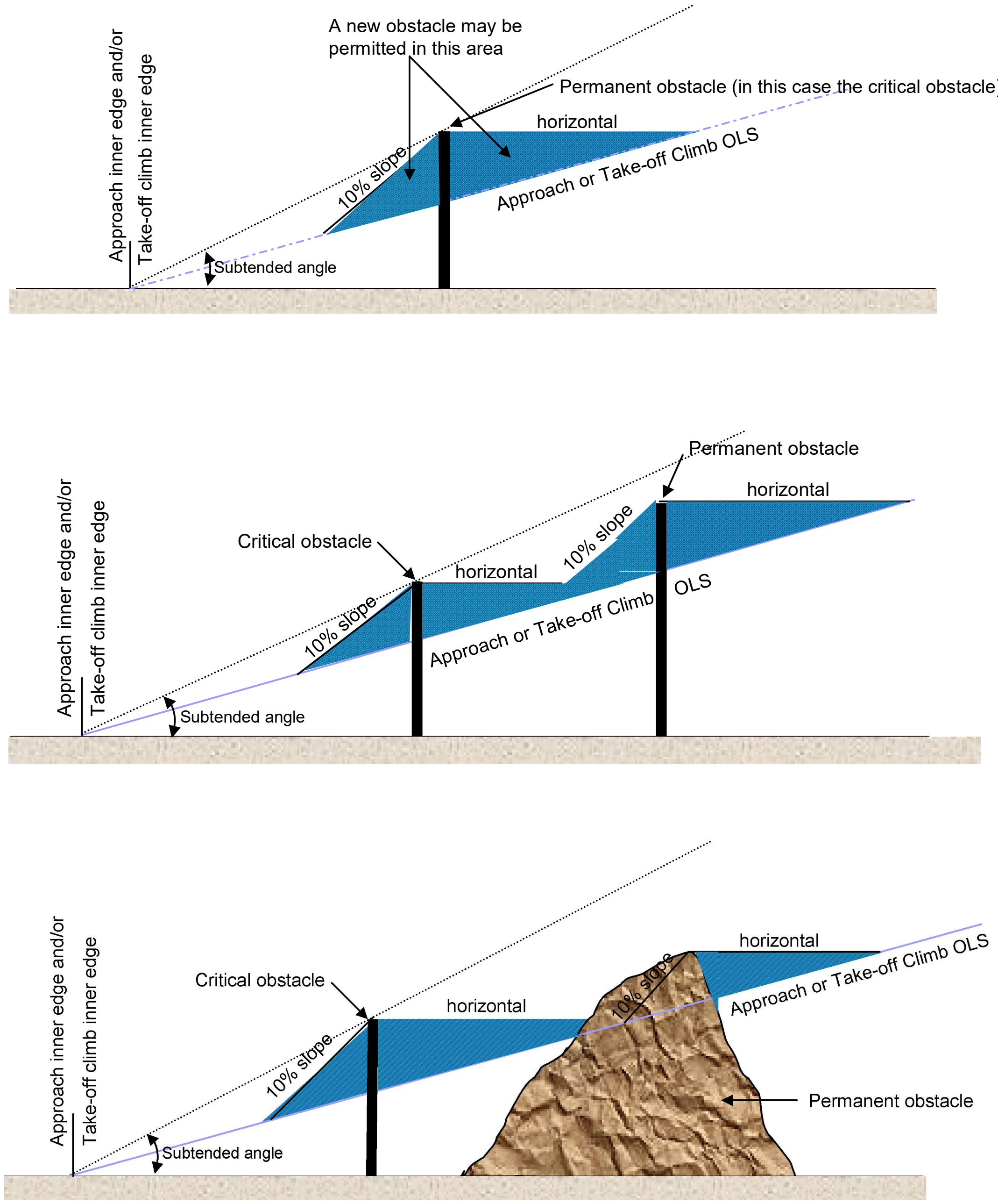


Figure 7.4-1: Shielding of obstacles penetrating the approach and take-off climb surfaces

CHAPTER 8: VISUAL AIDS PROVIDED BY AERODROME MARKINGS, MARKERS, SIGNALS AND SIGNS

Section 8.1: General

8.1.1 Introduction

8.1.1.1 This Chapter specifies the standards for Markers, Markings, Signals and Signs. Visual aids not conforming to these standards must not be used unless approved by RCAA, in writing.

8.1.1.2 Although the specifications given here are in metric measurements, existing visual aids, which were made to Imperial measurements, may continue to be used until replacement is required for other reasons. However, new visual aids must be made and located in accordance with the metric measurements.

8.1.2 Closed Aerodrome

8.1.2.1 All Markers, Markings and Signs on a closed aerodrome or closed part of an aerodrome, must be obscured or removed, except for unserviceability Markers or Markings, where required.

> **Note:** A ***closed aerodrome or aerodrome facility*** means one which has been withdrawn or decommissioned, not one which is temporarily unserviceable.

8.1.3 Colours

8.1.3.1 Colours used, must conform to the following:

Table 8.1-1: Standard colours

Colour	AS Colour Code	AS Colour Name
Blue	B41	Blue Bell
Green	G35	Lime Green
Orange	X15	Orange
Red	R13	Signal Red
Yellow	Y14	Golden Yellow
White	N14	White
Black	N61	Black

8.1.4 Visibility

8.1.4.1 Markings must be clearly visible against the background upon which they are placed. Where required, on a surface of light colour, a contrasting black surround must be provided: on a black surface, a contrasting white surround must be provided.

8.1.4.2 Where provided, the width of surround colour must ensure an adequate visibility contrast. In the case of line markings, the width of surround on either side of the marking must not to be less than the line width.

Section 8.2: Markers

8.2.1 Introduction

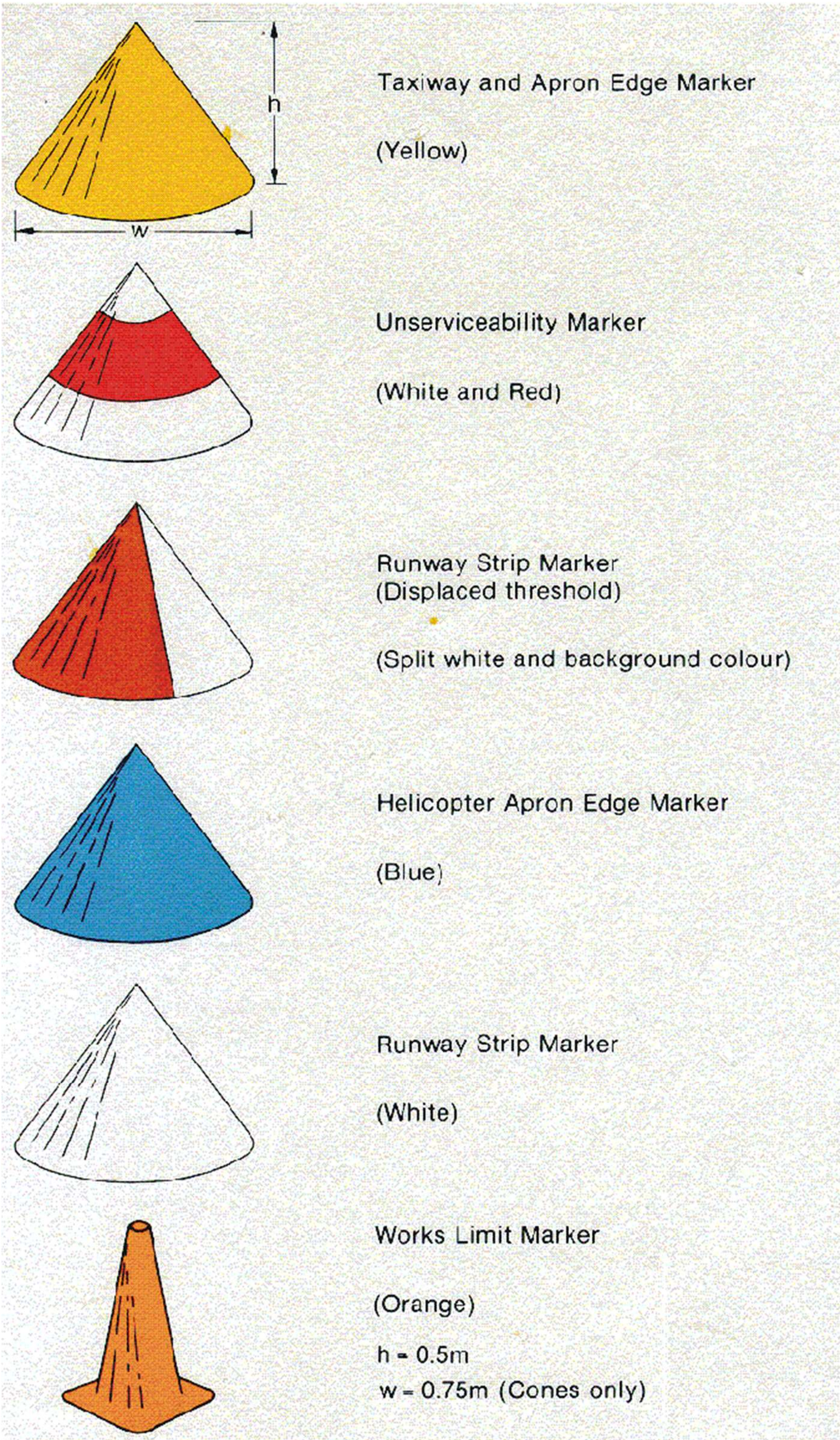
8.2.1.1 Markers must be lightweight and frangible; either cones or gables. Other forms of markers to identify extensive work areas may be used, subject to RCAA agreement. When displayed, they must be secured against prop wash and jet blast, in a manner that does not cause damage to an aircraft.

8.2.1.2 Cones used as runway markers must have a height of 0.3 m and a base diameter of 0.4 m. All other cones must be 0.5 m in height, with a base diameter of 0.75 m. Cones must be painted in the following colours:

Marker	**Colour**
Runway marker	white
Taxiway marker	yellow
Apron edge marker	yellow
Runway strip marker	white
Helicopter apron edge marker	blue
Unserviceability marker	white, with central 25 cm red band
Runway strip marker (displaced threshold.)	split white and suitable background colour

8.2.1.3 Gables must be 3 m long, 0.9 m wide, and 0.5 m high; painted white.

8.2.1.4 Fluorescent orange PVC cones or ‘witches’ hats’ approximately 0.5 m high, may be used to convey visual information about aerodrome works to the works organisation. Witches hats must not be used to convey information to pilots about changes to the movement area. For this purpose, standard cones must be used.



For cones used as runway edge markers h = 0.3m, w = 0.4m

Figure 8.2-1: Cone markers

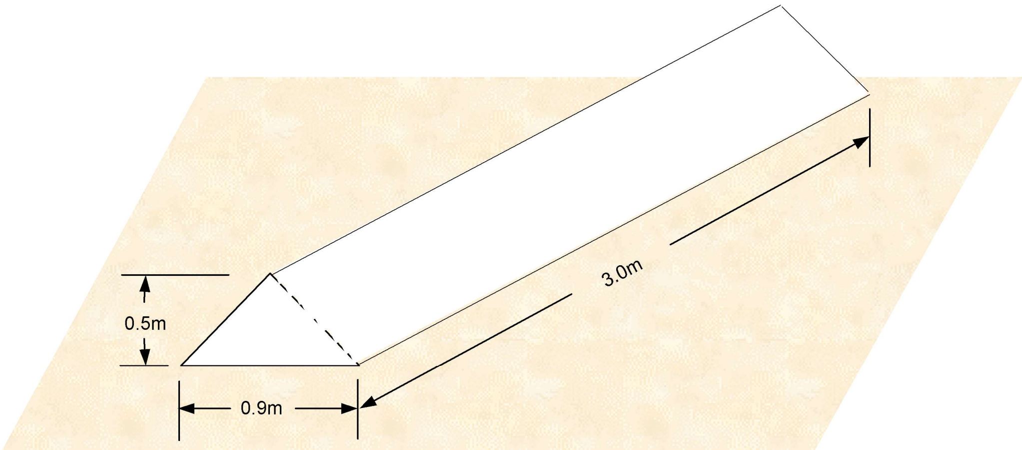
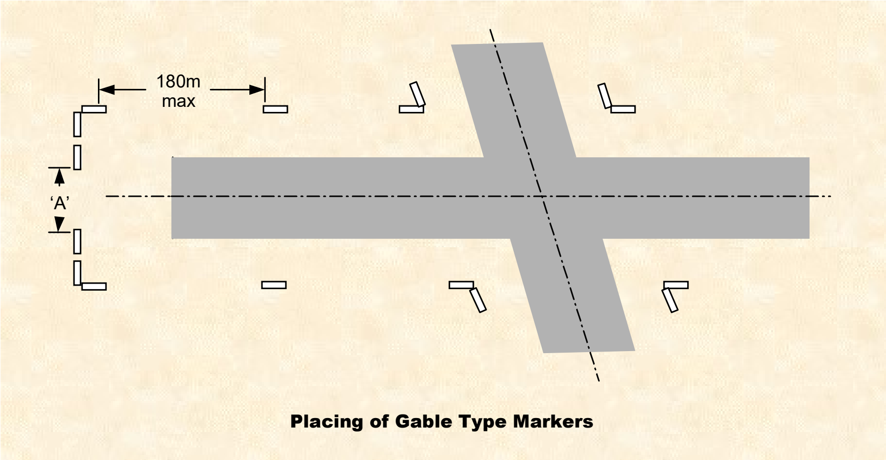


Figure 8.2-2: Gable marker

8.2.2 The Use of Markers on a Runway Strip

8.2.2.1 Where the limits of the graded portion of a runway strip need to be defined, runway strip markers must be placed along the edges of the graded portion of the runway strip.

8.2.2.2 Runway strip markers must be white, and may be gable, cone or flush. Gable markers are preferred, and flush markers must only be used where runway strips overlap. The spacing of gable or cone side strip markers must not exceed 180 m or 90 m respectively, as shown below.



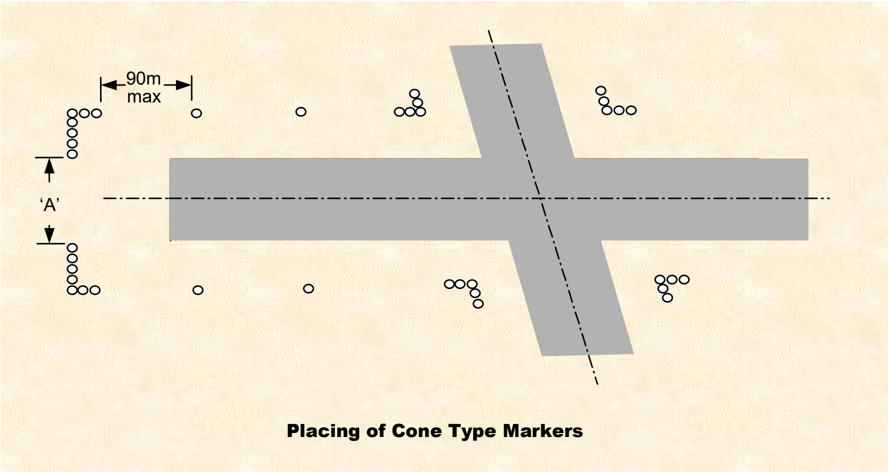


Figure 8.2-3: Runway strip markers

Width of graded strip	Dimension 'A'
30 m	10 m minimum
45 m	20 m minimum
60 m	20 m minimum
90 m	30 m minimum
150 m	60 m minimum

8.2.2.3 Where agreed by RCAA, 200 litre (44 gallon) steel drums or tyres may be used as runway strip markers at aerodromes used by aeroplanes of not more than 9 passenger seats. Steel drums must be cut in half along their length, placed on the ground open side down. Drums and tyres must be painted white. At a certificated aerodrome, use of these markers must be noted in the Aerodrome Manual.

8.2.3 The Use of Markers on an Unsealed Runway

8.2.3.1 On unsealed runways, runway markers must be provided along both sides of the runway where there is a lack of contrast between the runway and runway strip, and the whole of the runway strip is not maintained to normal runway grading standards. The longitudinal spacing of runway markers must not exceed 90 m.

8.2.3.2 Runway markers may be replaced by runway strip markers if the whole of the runway strip is maintained to normal runway grading standard. The thresholds must be marked either by normal threshold markings or runway cone markers in a pattern similar to that prescribed for runway strip ends.

8.2.3.3 Where an unsealed runway has a permanently displaced threshold at one end, two sets of strip markers must be provided at that end. Each set must be bi-coloured. The set associated with the permanently displaced threshold is to be painted so that the half facing the direction of approach (the first direction) appears white. The other half must be painted to match the background, and be inconspicuous to a pilot operating in the other direction (the second direction). Markers associated with the runway strip end are to appear white in the second direction and inconspicuous in the first direction.

8.2.3.4 The bi-coloured end markers associated with the displaced threshold must be cones; those associated with the runway strip end may be cones or gables.

8.2.4 The Use of Markers on an Unsealed Taxiway

8.2.4.1 Where the edges of unsealed taxiways or graded taxiway strips might not be visually clear, taxiway edge markers must be provided to show pilots the edge of trafficable taxiways.

8.2.4.2 Where provided, the taxiway markers must be yellow cones and must be spaced to enable pilots to clearly delineate the edge of the unsealed taxiway.

8.2.5 The Use of Markers on an Unsealed Apron

8.2.5.1 Where the edges of unpaved aprons might not be visually clear to pilots, apron edge markers must be provided.

8.2.5.2 Where provided, the apron edge markers must be yellow cones and must be spaced to enable pilots to clearly delineate the edge of the unsealed apron area.

Section 8.3: Runway Markings

8.3.1 General

8.3.1.1 Runway markings must be white on all concrete, asphalt or sealed runway surfaces. Pre-runway-end markings must be yellow.

8.3.1.2 At runway intersections, markings of the more important runway must take precedence over, or interrupt the markings of the other runway. At an intersection with a taxiway, the runway markings, except for runway side strip markings, must interrupt the taxiway markings.

8.3.1.3 To reduce the risk of uneven braking action, care must be taken that markings produce a non-skid surface of similar coefficient of friction to the surrounding surface.

8.3.2 Pre-runway-end Markings

8.3.2.1 Pre-runway-end markings are used where an area exceeding 60 m in length before the runway end, has a sealed, concrete or asphalt surface, which is not suitable for normal aircraft usage.

8.3.2.2 Marking must consist of yellow chevrons, spaced 30 m apart, comprising lines 0.9 m wide and angled 45 degrees to the runway centreline. The markings must terminate at the runway end marking.

8.3.2.3 This area will not normally be used for landing or take-off. If declared as a stopway, an aircraft in an abandoned take-off from the other direction may only use the area.

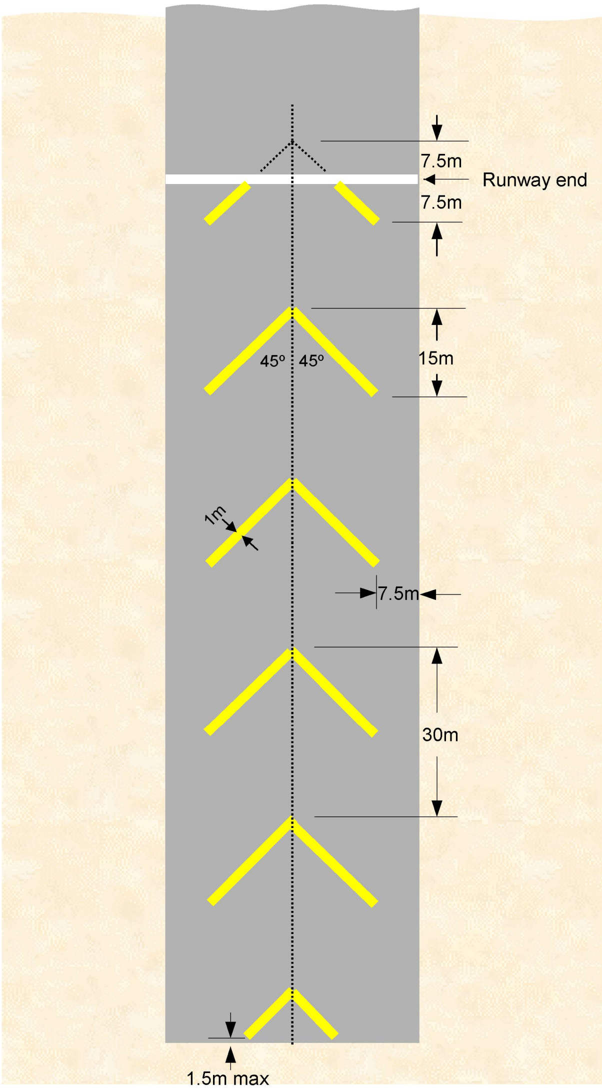


Figure 8.3-1: Pre-runway-end markings

8.3.3 Runway Centreline Markings

8.3.3.1 Runway centreline markings must be provided on all sealed, concrete or asphalt runways, to provide directional guidance during landing or take-off. Runway centreline marking may be omitted in the case of 18 m wide runways where side stripe markings are provided.

8.3.3.2 Runway centreline marking must consist of a line of uniformly spaced gaps and white stripes as shown in Figure 8.3-2 below. The combined length of a stripe and a gap (G) must be not less than 50 m and not more than 75 m. The length of each stripe must be at least equal to the length of each gap, or 30 m, whichever is greater. The first stripe is to commence 12 m from the runway designation number as shown below.

8.3.3.3 The width (W) of the runway centreline marking must be:

(a) 0.3 m on all non-instrument runways, and instrument non-precision approach runways where the code number is 1 or 2;

(b) 0.45 m on instrument non-precision approach runways where the code number is 3 or 4; and Category I precision approach runways; and

(c) 0.9 m on Category II and Category III precision approach runways.

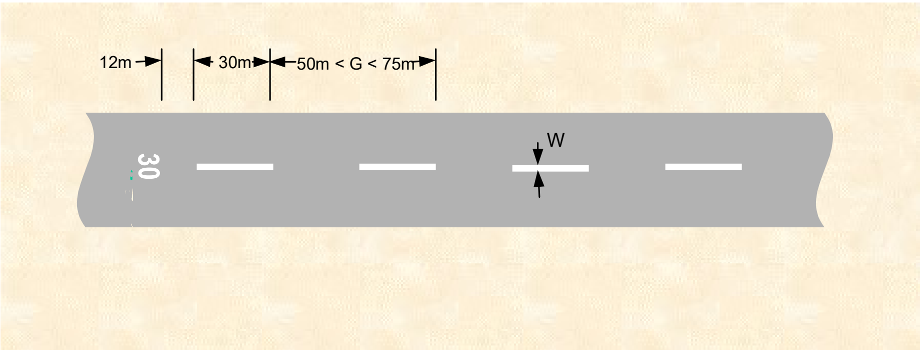


Figure 8.3-2: Runway centreline markings

8.3.4 Runway Designation Markings

8.3.4.1 Runway designation markings must be provided at the thresholds of all sealed, concrete or asphalt runways, and as far as practicable, at the thresholds of an unpaved runway.

8.3.4.2 Runway designation marking must consist of a two-digit number. The number is derived from the magnetic bearing of the runway centreline, when viewed from the direction of approach, rounded to the nearest 10 degrees.

8.3.4.3 If a bearing becomes a single digit number, a ‘0’ is to be placed before it. If a bearing becomes a three-digit number, the last ‘0’ digit is to be omitted. For parallel runways, appropriate letters L (left), C (centre) or R (right) must be added to the two-digit number.

8.3.4.4 The number selected for a runway designation marking must be acceptable to RCAA. When two or more runway ends have designations which may be confusing, either on the same or a nearby aerodrome, RCAA will determine the designations to be used.

8.3.4.5 The shape and dimensions of the numbers and letters to be used as runway designation markings are shown in Figure 8.3-3. The location of the marking on the runway is also shown.

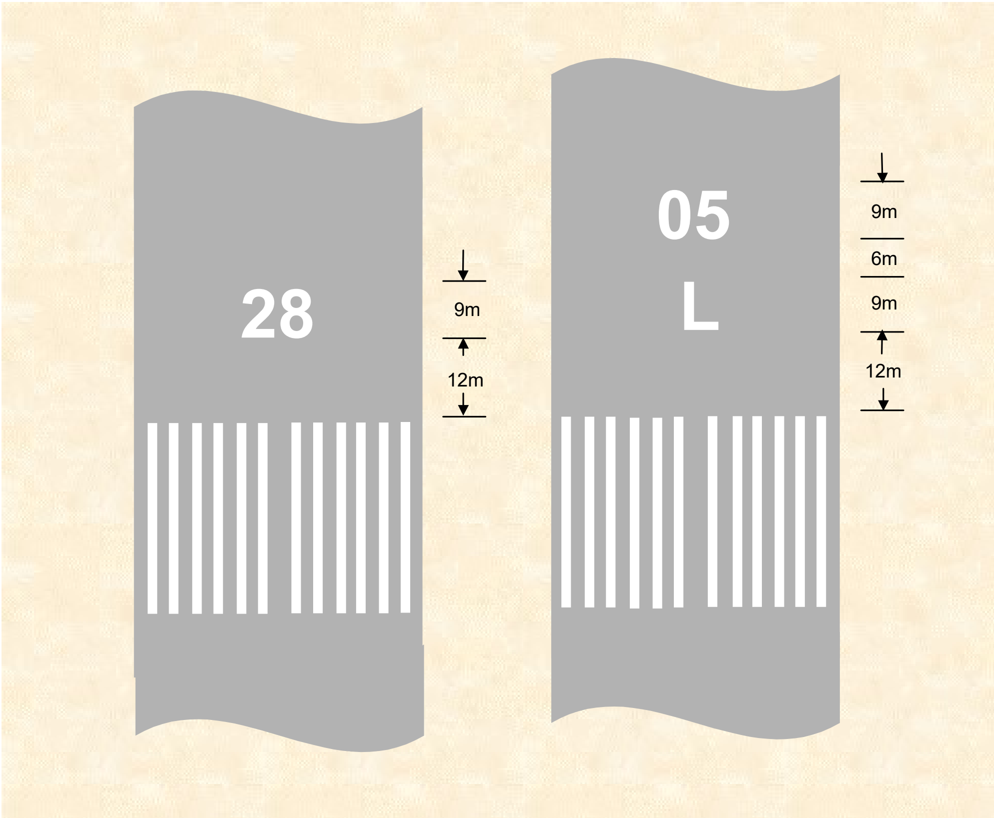


Figure 8.3-3: Runway designation markings

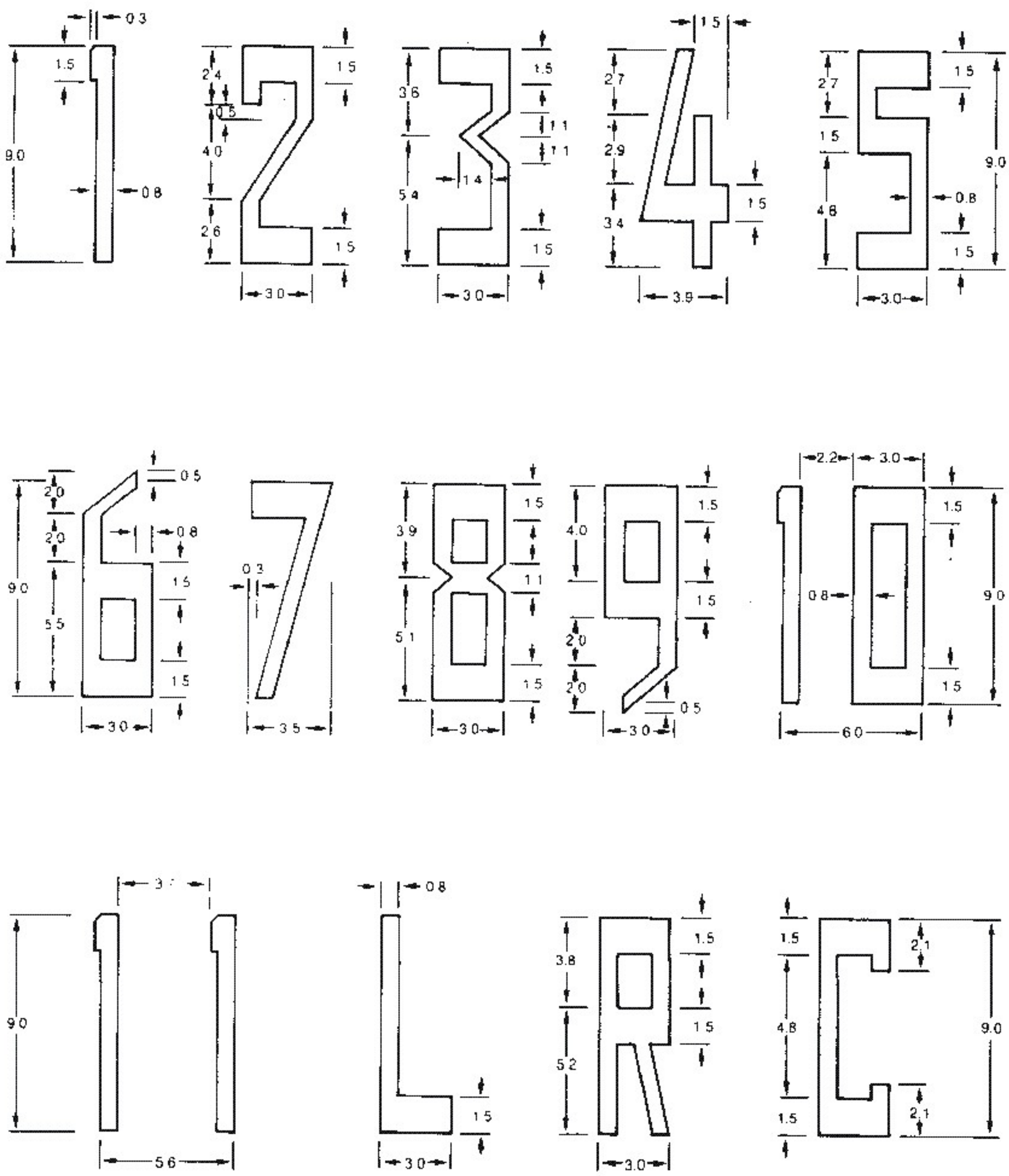


Figure 8.3-4: Shape and dimensions of runway numbers and letters

8.3.5 Runway End Markings

8.3.5.1 Runway end markings must be provided on all sealed, concrete or asphalt runways as shown below. The marking is a white line, 1.2 m wide, extending the full width of the runway. Where the threshold is located at the end of the runway, the runway end marking will coincide with the corresponding part of the threshold marking.

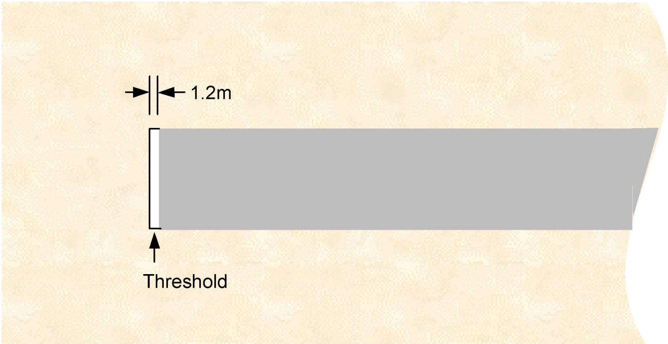


Figure 8.3-5: Runway end marking

8.3.6 Runway Side-stripe Markings

8.3.6.1 Runway side-stripe markings must be provided at the edge of all sealed, concrete or asphalt runways to delineate the width of the runway. Except where broken for taxiways and other runways; runway side-stripe markings must consist of one continuous white line, the same width as the runway centreline marking.

8.3.6.2 In the case of 18 m wide runways with no runway centreline marking, the width of the side-stripe marking must be 0.3 m.

8.3.6.3 The distance between outer edges of the stripes must be equal to the width of the runway. The stripes must be parallel to the runway centreline, and extend the full length of the runway, between the runway end markings.

8.3.6.4 Side-stripe markings must not extend across intersecting runways or taxiways.

8.3.6.5 For a runway with no sealed shoulders, the side-stripe markings may be omitted, if there is distinct contrast between the runway edges and the surrounding terrain.

8.3.6.6 This marking may also be used to mark the edges of a runway turning node.

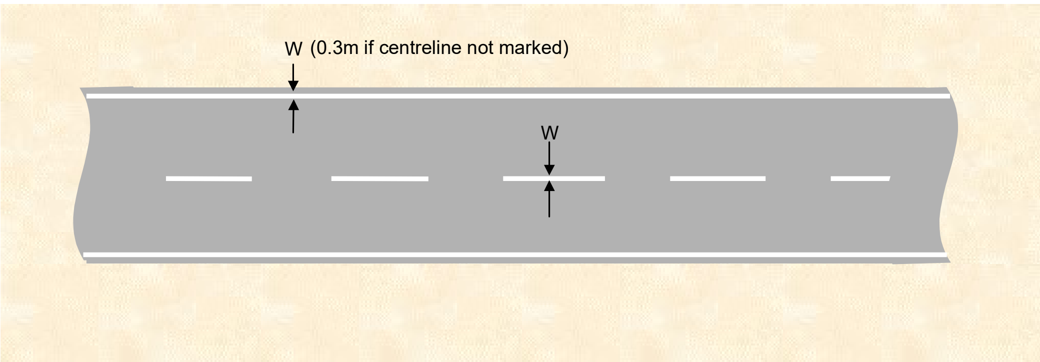


Figure 8.3-6: Runway side stripe markings

8.3.7 Aiming Point Markings

> **Note:** Aiming Point Markings were previously known as Runway Fixed Distance Markings.

8.3.7.1 An aiming point marking must be provided at each approach end of each sealed, concrete or asphalt runway that is 30 m or more wide and 1500 m or more long.

> **Note:** An aiming point marking should be provided at each approach end of each sealed, concrete or asphalt instrument runway that is less than 1500 m long.

8.3.7.2 An aerodrome operator may elect to retain a fixed distance marking that was:

(a) provided under subsection 8.3.7 before 2 June 2011; and

(b) in use immediately before 2 June 2011;

until not later than:

(c) for international aerodromes — 30 May 2013; or

(d) for other aerodromes — 29 May 2014.

> **Note:** When an aerodrome operator elects to implement an aiming point marking by providing an appropriate marking, the operator should raise a NOTAM for a period of 2 months after so providing or determining, to inform pilots about the presence of the marking.

8.3.7.3 For a precision approach runway with an available landing distance mentioned in a column of Table 8.3-1 (the ***Table***), the aiming point marking must:

(a) commence no closer to the threshold than the distance indicated in the same column, except that, on a runway with a visual approach slope indicator system (VASIS), the beginning of the marking must coincide with the origin of the visual approach slope; and

(b) consist of 2 conspicuous stripes whose dimensions, and lateral spacing between inner sides, must accord with the measurements set out in the same column.

> **Note:** For a precision approach runway, it is recommended that implementation of aiming point marking should also be accompanied by implementation of the ICAO 'A' – basic pattern touchdown zone marking. **See Figure 8.3-7A.1.**

Table 8.3-1: Location and dimensions of aiming point marking

Landing distance available				
Location and dimensions	**Less than 800 m**	**800 m up to, but not including, 1200 m**	**1200 m up to, but not including, 2400 m**	**2400 m and above**
Distance from threshold to beginning of marking	150 m	250 m	300 m	400 m
Length of stripe[a]	30-45 m	30-45 m	45-60 m	45-60 m
Width of stripe	4 m	6 m	9 m	9 m
Lateral spacing between inner sides of stripes	6 m[b]	9 m[b]	18-23 m[c]	18-23 m

a The greater dimensions of the specified ranges are intended to be used where increased conspicuity is required.

b These figures were deduced by reference to the outer main gear wheel span which is element 2 of the aerodrome reference code at Chapter 2, Table 2.1-1: Aerodrome Reference Code.

c The lateral spacing may be varied within these limits to minimize the contamination of the marking by rubber deposits.

8.3.7.4 For a non-precision approach runway, or a non-instrument runway, the aiming point marking must comply with:

(a) the following:

(i) the marking must consist of 2 conspicuous stripes, each 45 m in length, each having a width (***W***), and each with inside edges separated by a distance (***D***);

(ii) the ends of the stripes nearest the threshold must be located at 300 m from the line of the runway threshold;

(iii) for sub-subparagraph (i), W and D must be in accordance with the following table:

Runway width	**W**	**D**
30 m	6 m	17 m
45 m or more	9 m	23 m

or

(b) the relevant precision approach runway standard.

8.3.7A Touchdown Zone Marking

8.3.7A.1 A touchdown zone marking must be provided at each end of a sealed, concrete or asphalt runway 30 m wide or greater and 1500 m long or greater.

> **Note:** A touchdown zone marking may be provided at both ends of other sealed, concrete or asphalt runways.

8.3.7A.2 A touchdown zone marking must conform to the following pattern:

(c) on a precision approach runway — the ***ICAO 'A' – basic*** pattern, as described in this section (the ***ICAO 'A' – basic pattern***); or

(d) on other runways — the ICAO 'A' – basic pattern, or the ***simple pattern*** as described in this section

8.3.7A.3 An aerodrome operator may retain a simple pattern touchdown zone marking on a precision runway until not later than:

(a) for international aerodromes — 30 May 2013; or

(b) for other aerodromes — 29 May 2014.

\

> **Notes:**
>
> 1. When an aerodrome operator implements the ICAO 'A' – basic pattern touchdown zone marking, the operator should raise a NOTAM for a period of 2 months after the implementation to inform pilots about the revised marking.
> 2. For a precision approach runway, it is recommended that implementation of the ICAO 'A' – basic pattern touchdown zone marking should be accompanied by implementation of aiming point marking.

8.3.7A.4 The ICAO 'A' – basic pattern touchdown zone marking consists of pairs of rectangular markings symmetrically disposed about the runway centreline as shown in Figure 8.3-7A.2. Subject to paragraph 8.3.7A.5, the numbers and locations of such pairs are to be in accordance with Table 8.3-2.

Table 8.3-2: Pairs of rectangular markings for ICAO 'A' – basic pattern touchdown zone marking

Item	Landing distance available, or the distance between thresholds (where the touchdown zone marking is displayed at both of the approach directions)	Pair(s) of touchdown zone markings	Location of each pair of touchdown zone markings (distance in metres from threshold)

1	less than 900 m	1	300
2	900 m up to, but not including, 1200 m	2	150 and 450
3	1200 m up to, but not including, 1500 m	3[a]	150, 300, 450 and 600
4	1500 m up to, but not including, 2400 m	4[a]	150, 300, 450, 600 and 750
5	2400 m or more	5[a]	150, 300, 450, 600, 750 and 900
[a] The touchdown zone marking within 50 m of the aiming point marking must be omitted – see paragraph 8.3.7A.5.			

8.3.7A.5 For a landing distance available, or distance between thresholds, mentioned in item 3, 4 or 5 of Table 8.3-2, a touchdown zone marking that would be within 50 m of the aiming point marking must be omitted.

8.3.7A.6 Each ICAO 'A' – basic pattern touchdown zone marking must:

(a) be not less than 22.5 m long and 3 m wide; and

(b) have a lateral spacing between the inner sides of the rectangles equal to that of the aiming point marking.

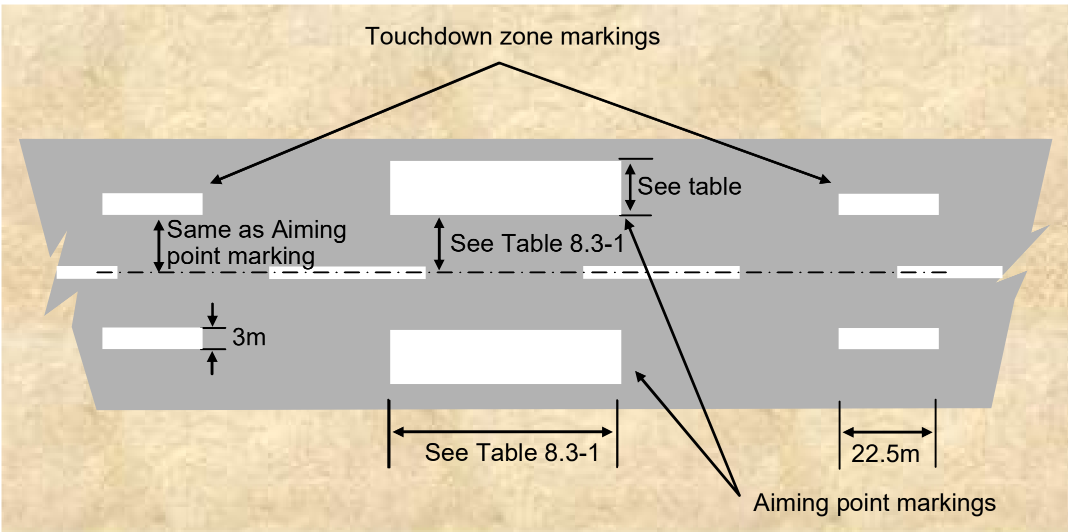


Figure 8.3-7A.1: Aiming point and ICAO 'A' – basic pattern touchdown zone markings — dimensions

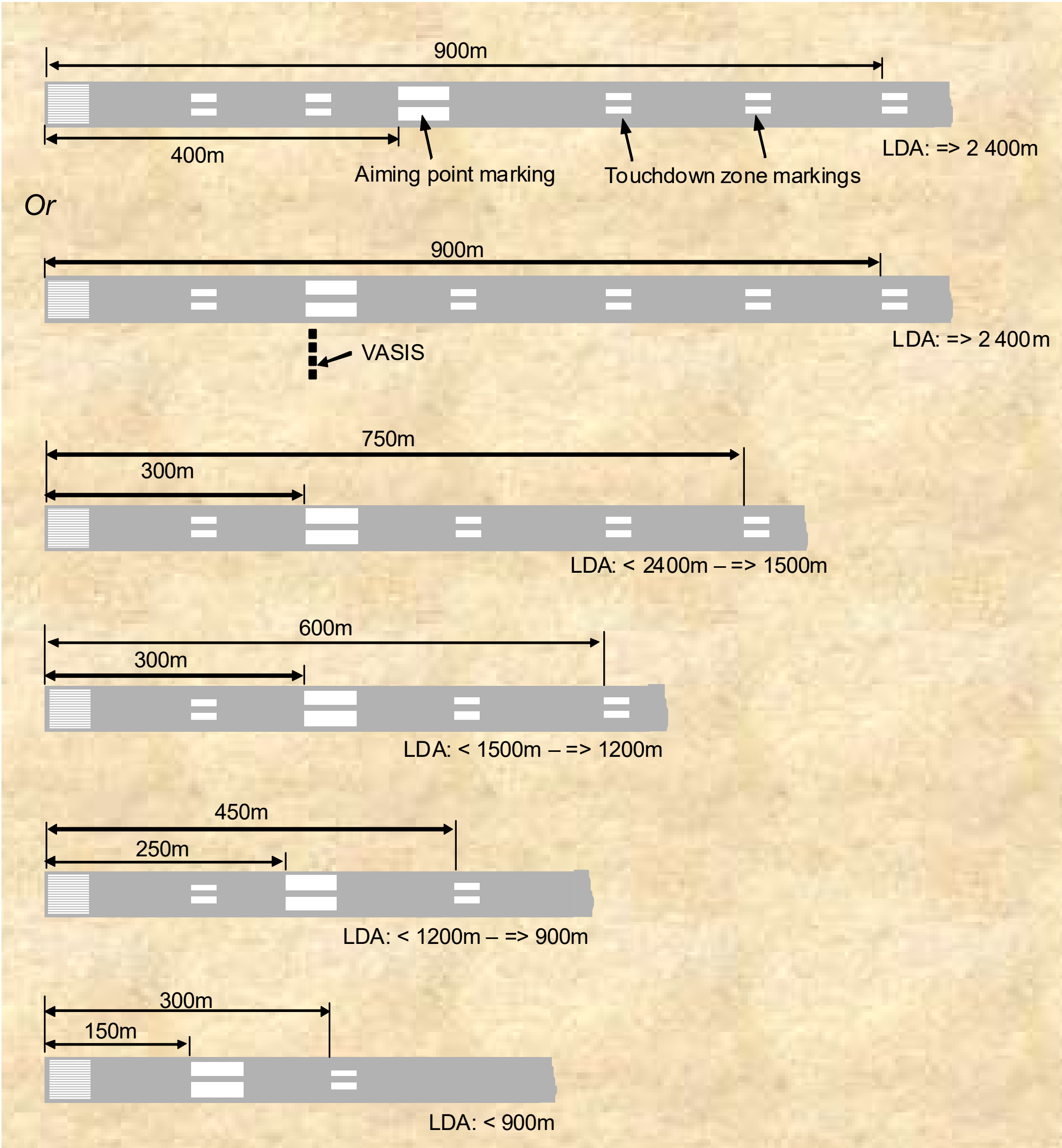


Figure 8.3-7A.2: Aiming point and ICAO 'A' – basic pattern touchdown zone markings – Examples

8.3.7A.7 A simple touchdown zone marking is as shown in Figure 8.3-7A.3 and must comprise 4 white stripes each not less than 22.5 m long and 3 m wide, located in pairs such that the ends nearest the threshold of each pair of stripes are 150 m and 450 m respectively from the line of the runway threshold. The lateral spacing between their inner sides must be equal to that of the aiming point marking.

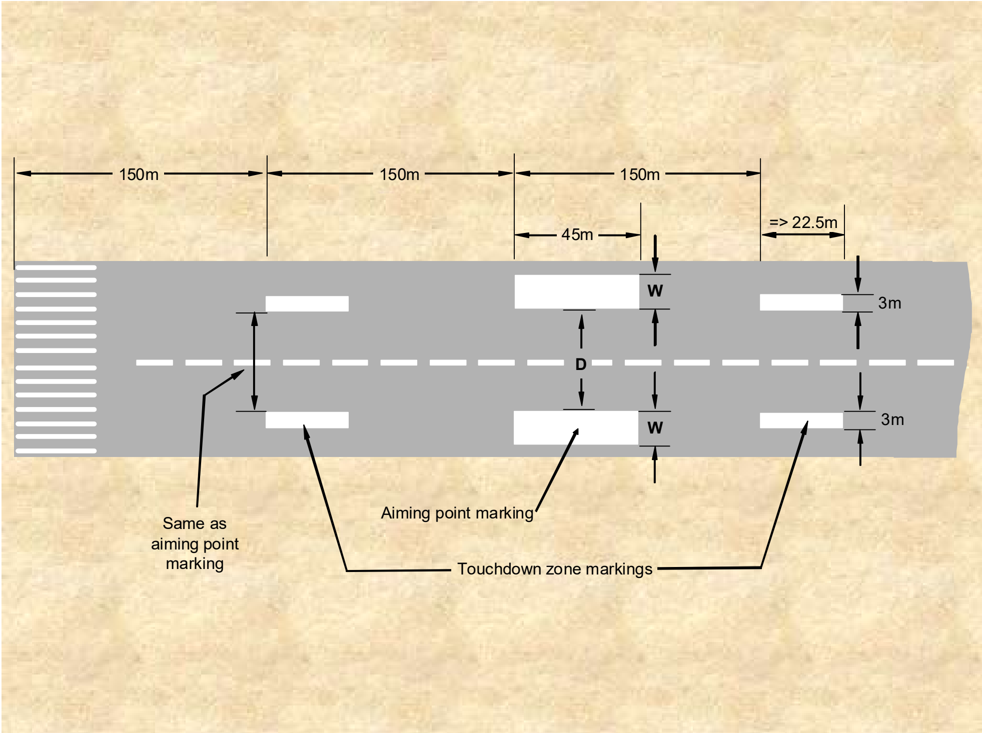


Figure 8.3-7A.3: Aiming point and simple touchdown zone markings

8.3.7A.8 If simple runway touchdown zone markings are provided on runways less than 1500 m in length, the markings at 450 m from the end of the runway threshold may be omitted.

8.3.8 Runway Threshold Markings

8.3.8.1 The permanent, or permanently displaced threshold must be indicated by a white transverse line, 1.2 m wide extending the full width of the runway at the location of the threshold, and white 'piano key' markings, consisting of adjacent, uniformly spaced, 30 m long stripes of specified width as shown in Figure 8.3-8.

8.3.8.2 Where practicable, this marking must also be used to indicate permanent or permanently displaced thresholds at gravel and natural surface runways.

8.3.8.3 Where the normal threshold marking is not practicable; runway markers may be used to delineate the ends of an unsealed runway.

8.3.8.4 Information on the location of thresholds is provided in Chapter 6 of this Manual.

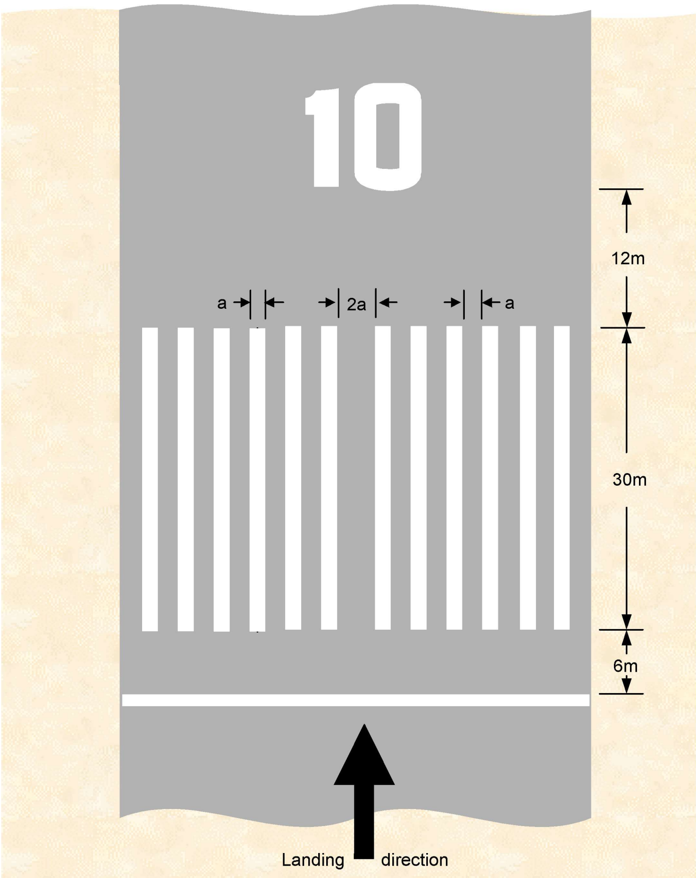


Figure 8.3-7: Runway threshold markings

Runway width (metres)	Number of Stripes	Width of Stripe Space (a) (metres)
15,18	4	1.5
23	6	1.5
30	8	1.5
45	12	1.7
60	16	1.7

8.3.9 Temporarily Displaced Threshold Markings

8.3.9.1 Whenever a permanent threshold is temporarily displaced, a new system of visual cues must be provided, which may include provision of new markings, obscuring and alteration of existing markings, and the use of RCAA approved Runway Threshold Identification Lights (RTILs).

8.3.9.2 Where a threshold is temporarily displaced less than 300 m from the end of the runway, there is no additional survey requirement for obstacles. However where this distance is exceeded, the aerodrome operator must refer the matter to RCAA.

8.3.9.3 Where a permanent threshold on any runway serving international air transport operations is displaced; the location of the new threshold must be identified by the system of temporary markings specified below, and RTILs.

8.3.9.4 Where practicable, RTILs should also be used for displaced thresholds on runways not serving international air transport aircraft. When used, unless otherwise directed by the Authority, the requirements to use Vee bar markers are waived.

8.3.9.5 Where the permanent threshold is to be displaced for more than 30 days, the temporary threshold must comprise a white line, 1.2 m wide, across the full width of the runway at the line of the threshold, together with adjacent 10 m long arrowheads, comprising white lines 1 m wide. The number of 10m long arrowhead markings used should be commensurate with the width of the runway. The existing centreline markings between the two thresholds must be converted to arrows as shown below; the permanent threshold marking and associated runway designation number must be obscured and a temporary runway designation number provided 12 m beyond the new threshold.

> **Note:** Where the runway fixed distance and touch down zone markings can cause confusion with the new threshold location those markings may also be obscured.

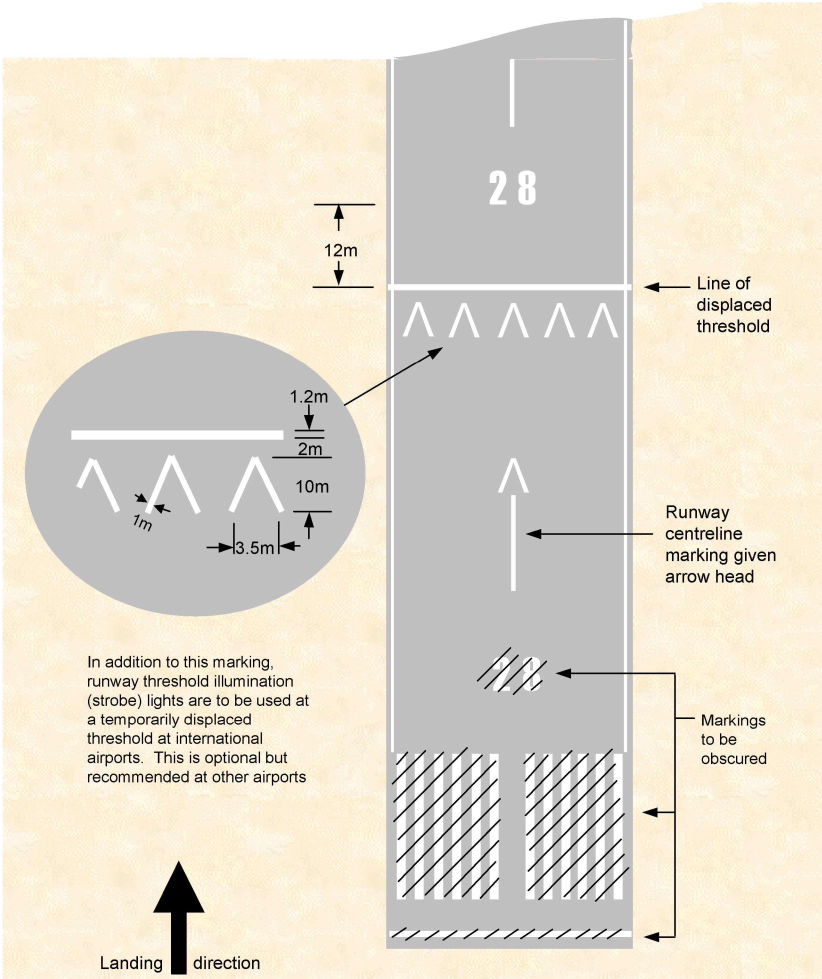


Figure 8.3-8: Temporarily displaced threshold markings (more than 30 days)

8.3.9.6 Where the permanent threshold is to be displaced for more than 5 days, but not more than 30 days, or by more than 450 m, the new location must be indicated by 'Vee-bar' markers comprising gable markers painted white and positioned on each side of the runway, together with flush, white, arrow markings, as shown. The existing threshold markings must be obscured. For runways more than 18 m wide, or accommodating air transport aircraft, 2 gables and 2 arrows must be provided on each side of the runway; in other cases, a single gable and arrow on each side of the runway is acceptable.

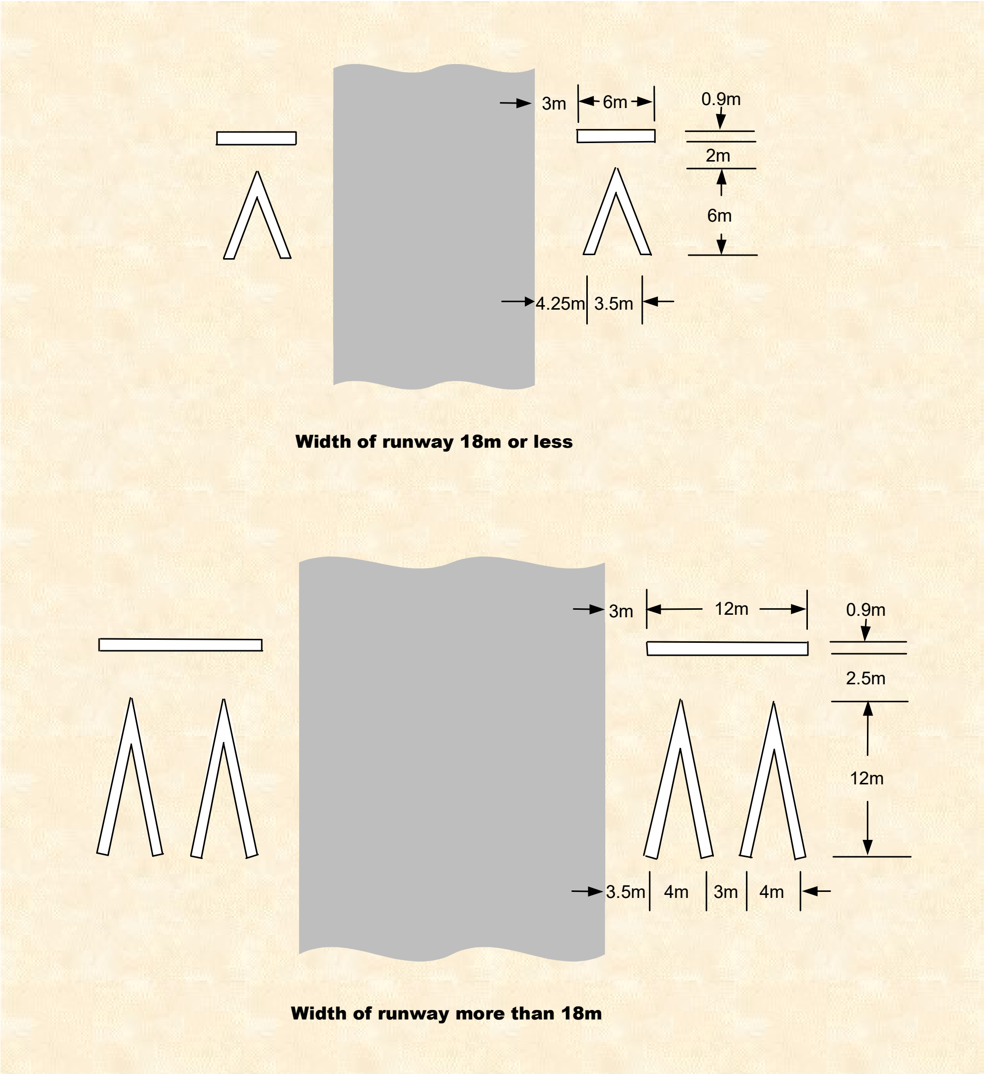


Figure 8.3-9: Temporarily displaced threshold markings (less than 30 days)

8.3.9.7 Where a threshold is to be temporarily displaced for 5 days or less, and the displacement is less than 450 m, the new threshold location must be indicated by the same 'Vee-bar' markers but the permanent threshold markings may be retained.

8.3.9.8 Where a threshold at an air traffic controlled aerodrome is to be temporarily displaced for 5 days or less, and the displacement is more than 450 m, the new threshold location is to be indicated by the above markings but the permanent threshold markings may be retained.

8.3.9.9 Markings of typical threshold and displaced thresholds are illustrated in the following six figures.

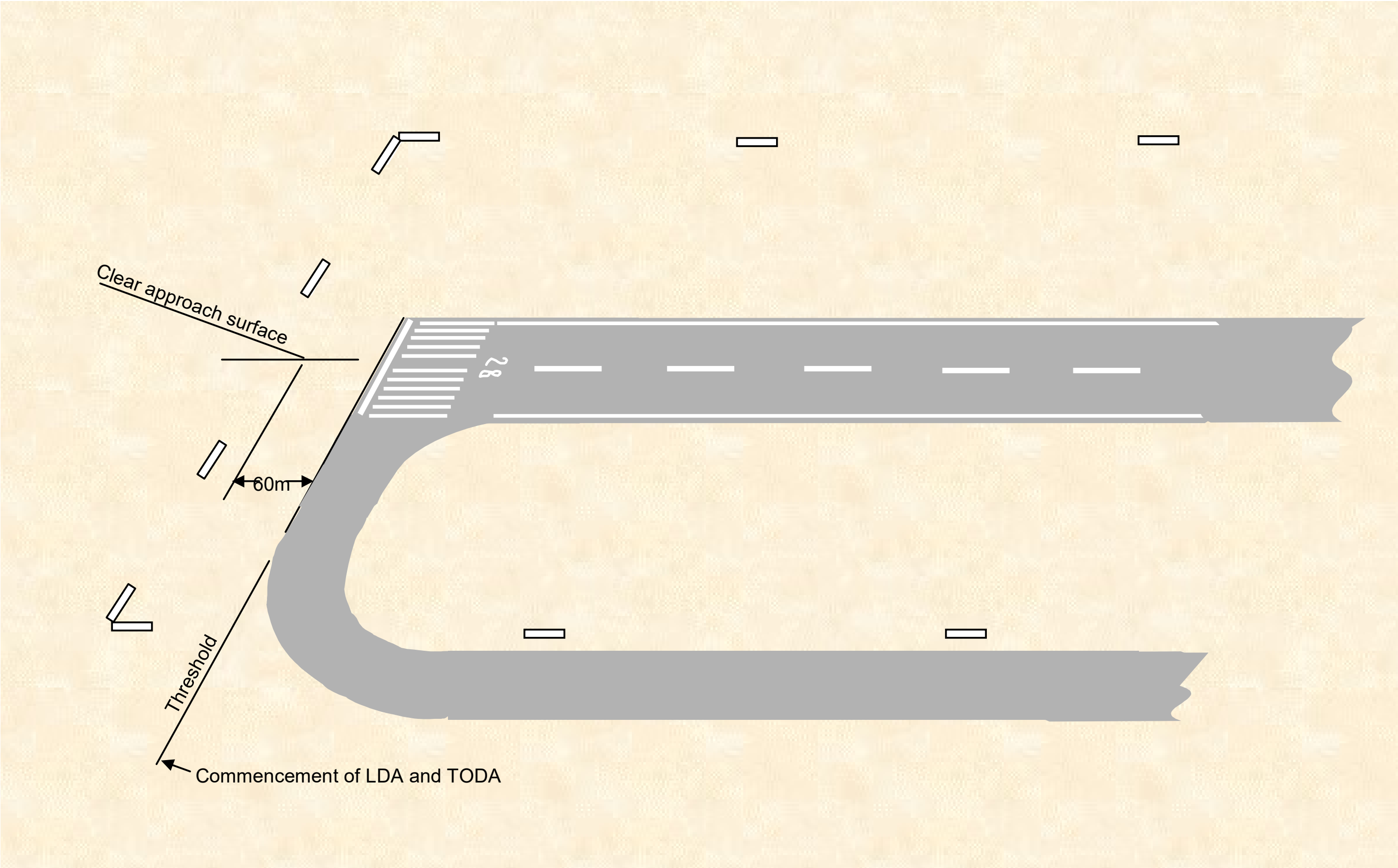


Figure 8.3-10: Markings for a typical runway with the threshold at the runway end

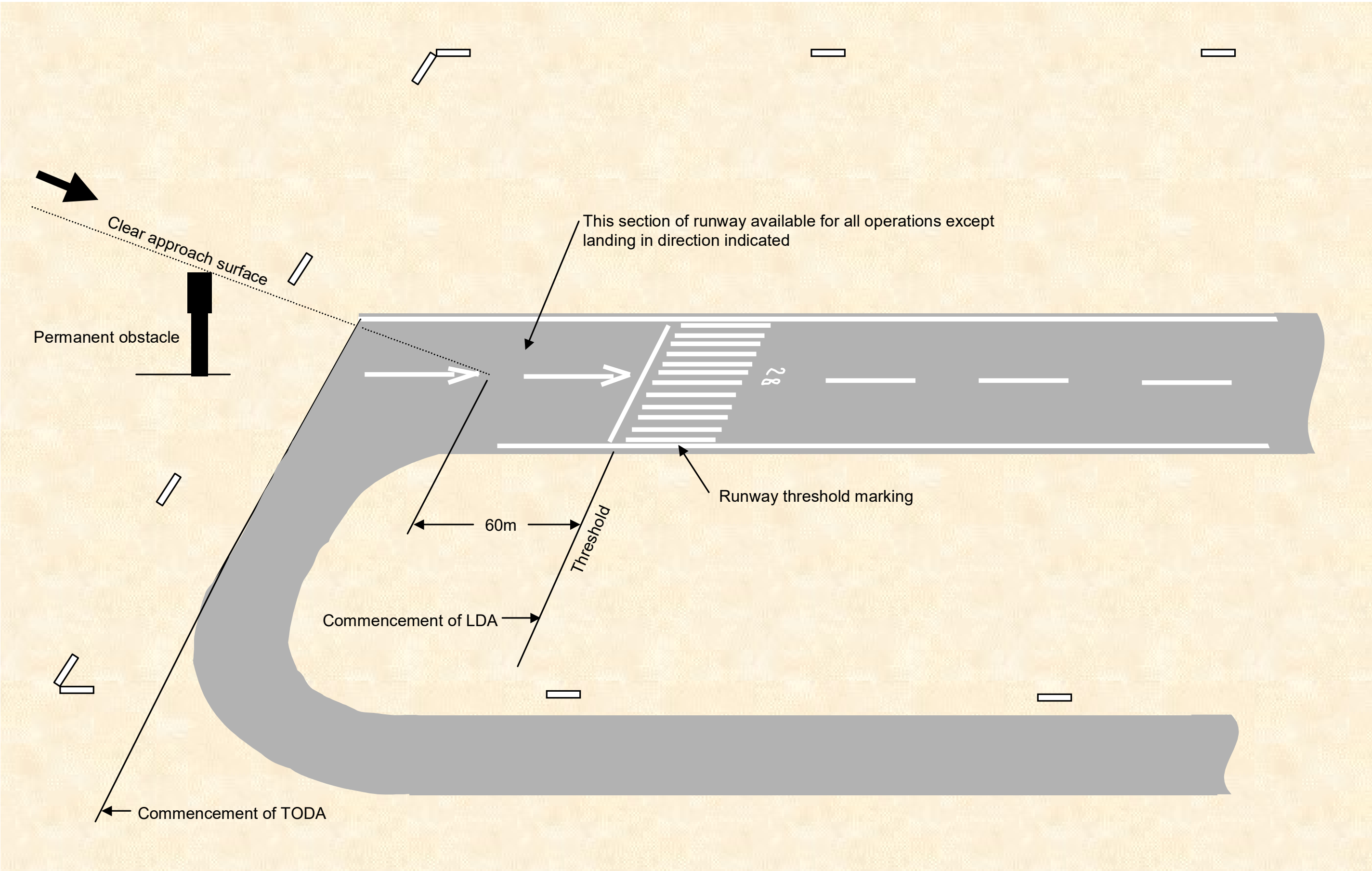


Figure 8.3-11: Markings for a typical runway with a permanently displaced threshold

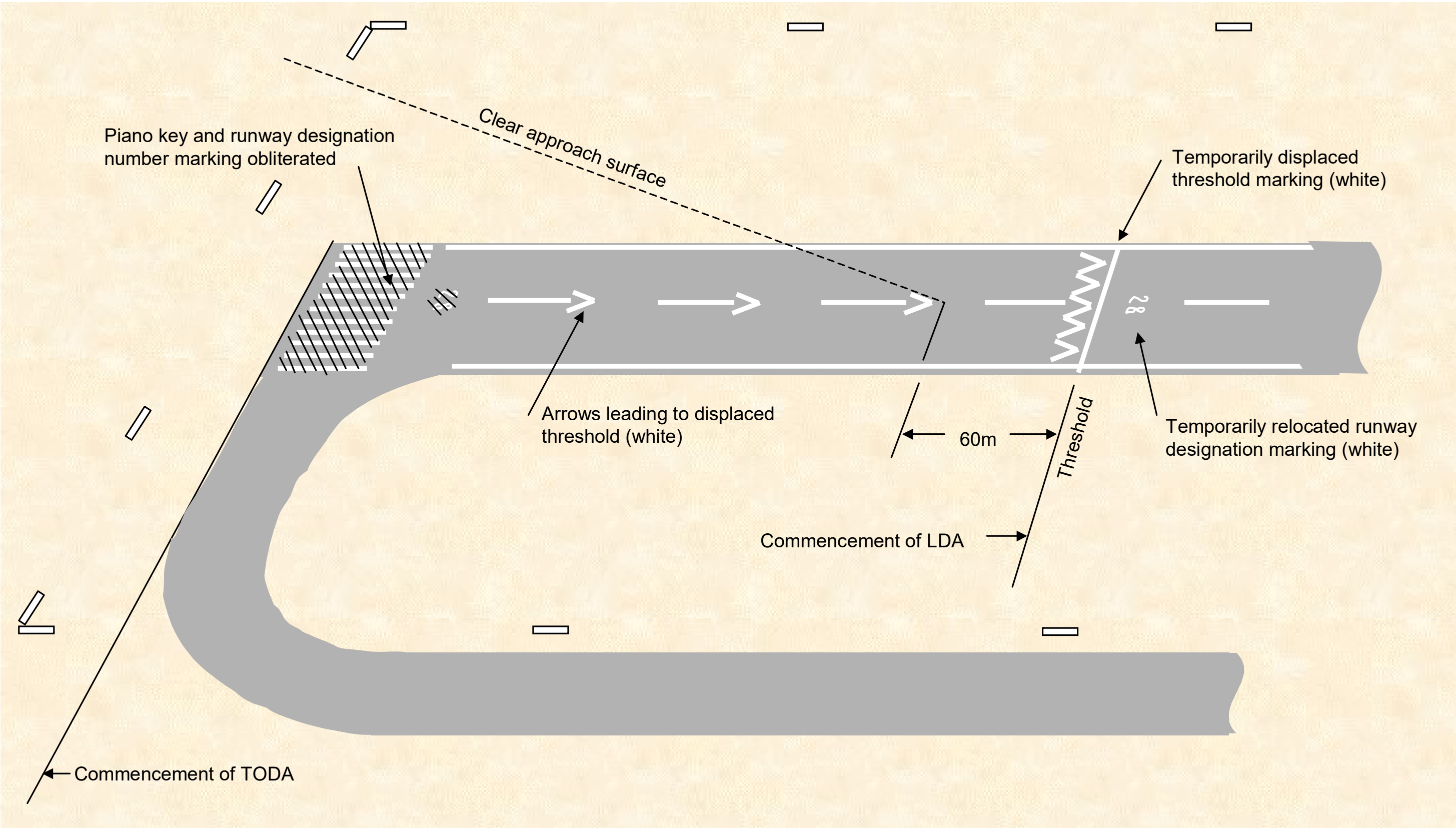


Figure 8.3-12: Markings for a temporarily displaced threshold due to obstacle infringement of the approach surface for a period in excess of 30 days

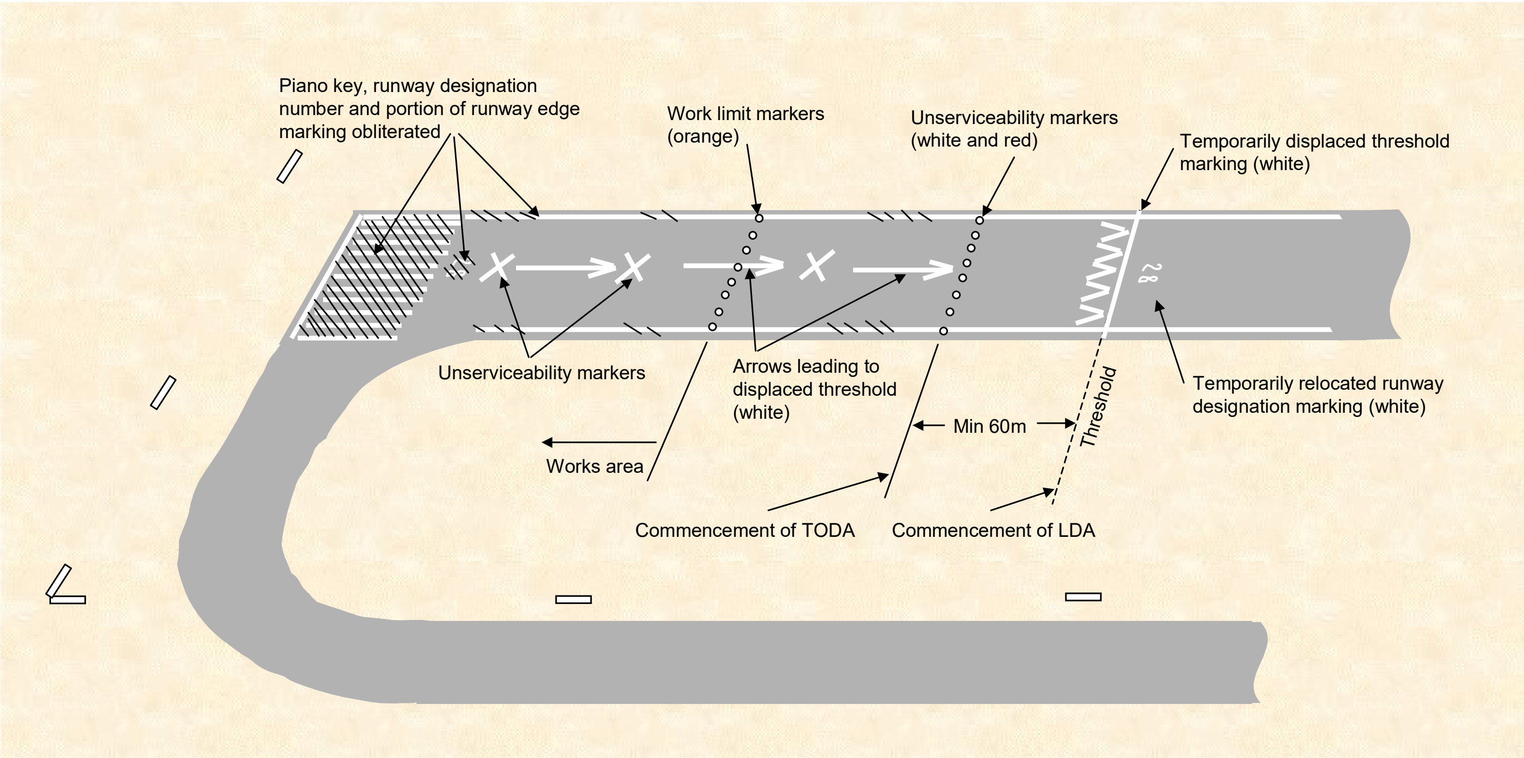


Figure 8.3-13: Markings for a temporarily displaced threshold due to works on the runway for a period in excess of 30 days

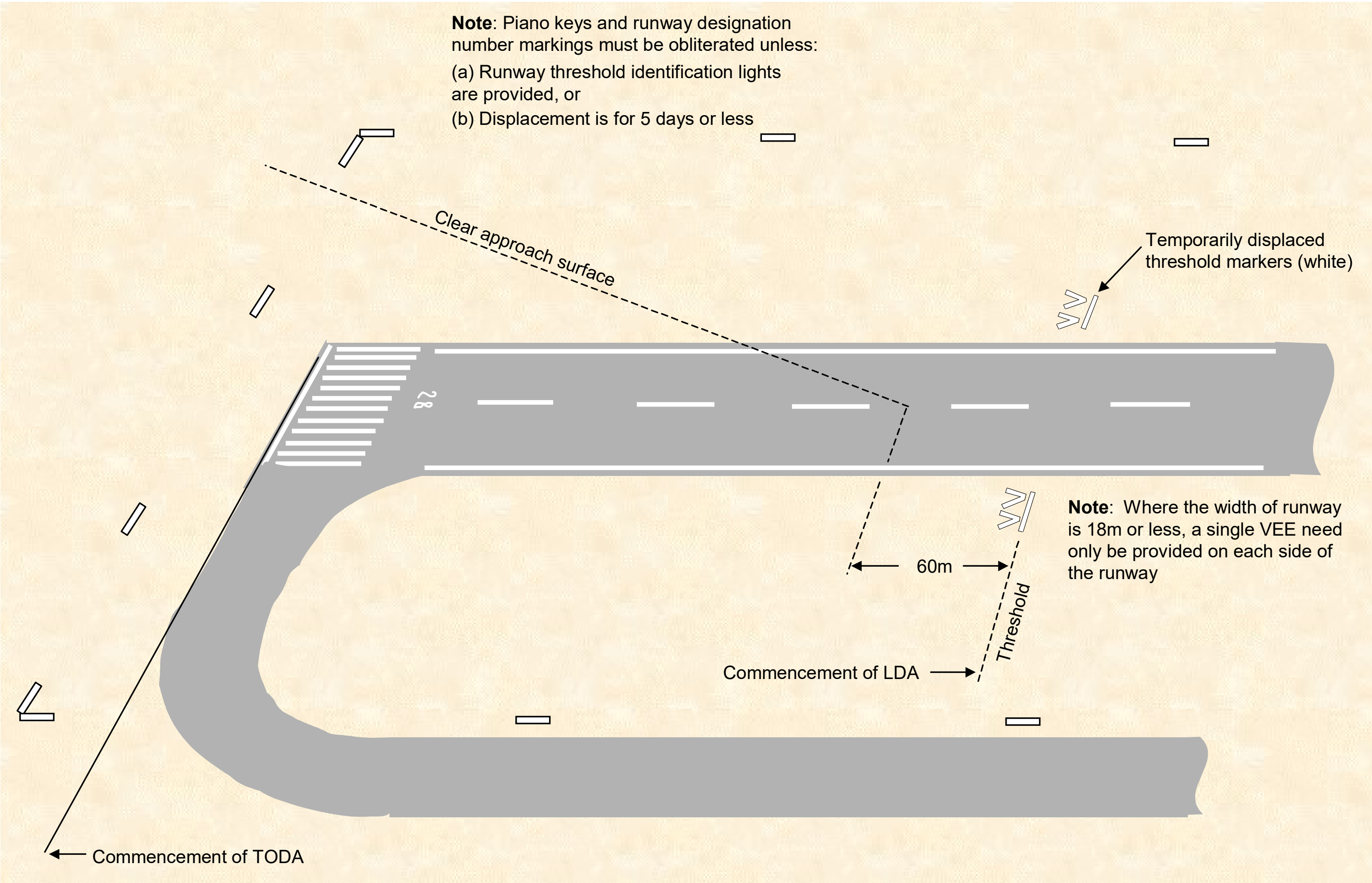


Figure 8.3-14: Markings for a temporarily displaced threshold due to obstacle infringement of approach surface for a period of 5 days or less and a displacement of less than 450 m

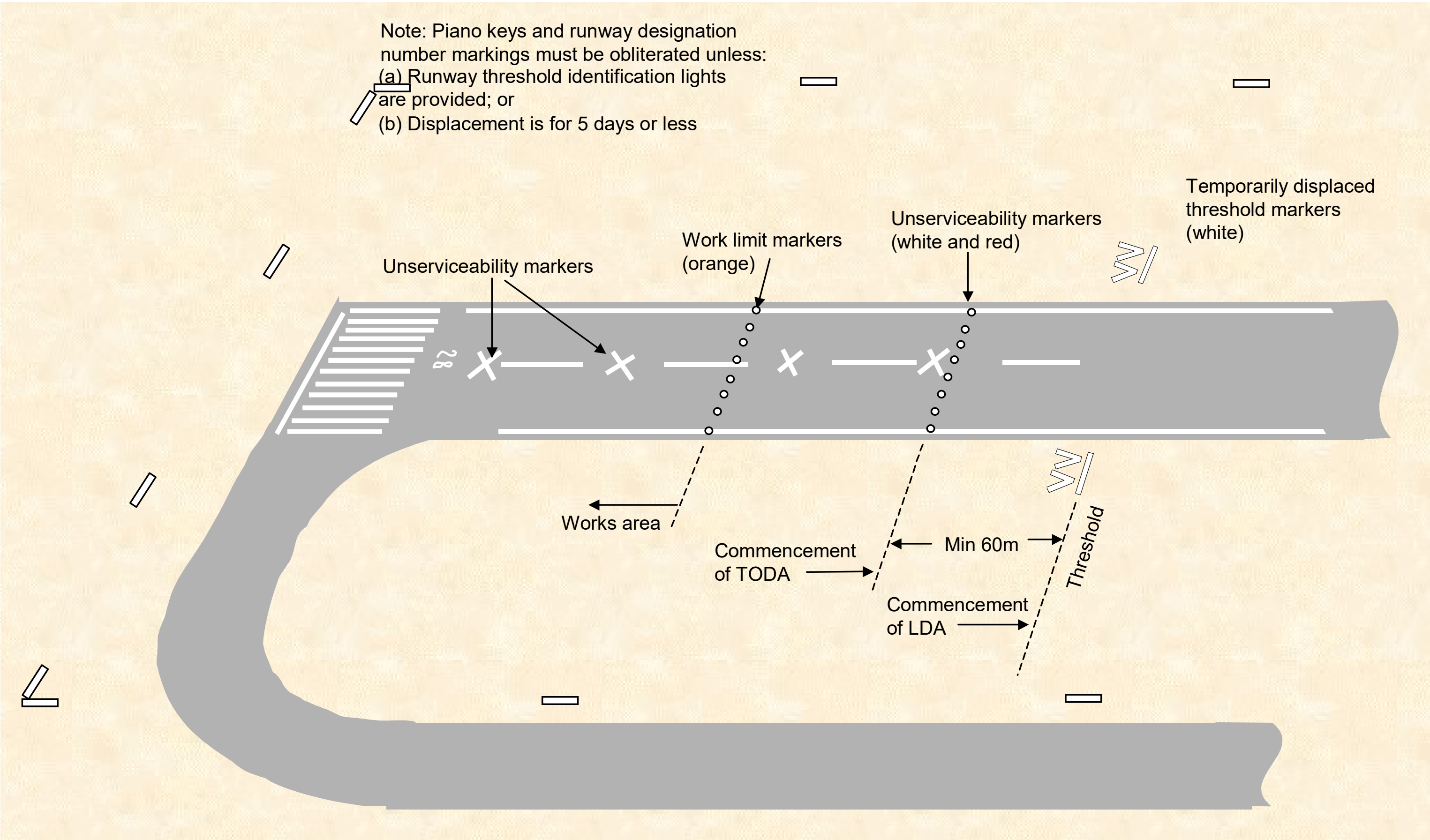


Figure 8.3-15: Markings for a temporarily displaced threshold due to works in progress on runway for a period of 5 days or less and a displacement of less than 450 m

8.3.10 Runway Land and Hold Short Position Markings

8.3.10.1 At an aerodrome where land and hold short operations are conducted, a runway land and hold short position marking must be provided at the intersection of two paved runways. The marking must be located and painted in accordance with the runway holding position marking specified in Paragraph 8.4.3.

Section 8.4: Taxiway Markings

8.4.1 Introduction

8.4.1.1 Taxiway markings must be provided on all asphalt, sealed or concrete taxiways, as specified below. Taxiway markings must be painted yellow.

8.4.2 Taxi Guideline Markings

8.4.2.1 Taxi guideline markings must be provided on all asphalt, sealed or concrete taxiway surfaces, in the form of a continuous yellow line 0.15 m wide. On straight sections, the guideline must be located in the centre of the taxiway. On curved taxiways, the guideline must be located parallel to the outer edge of the pavement and at a distance of half of the taxiway width from it; i.e. the effect of any fillet widening at the inner edge of a curve is ignored. Where a taxi guideline marking is interrupted by another marking such as a taxi-holding position marking, a gap of 0.9 m must be provided between the taxi guideline marking and any other marking.

8.4.2.2 The same form of taxi guideline marking must be used on aprons as detailed below, under ‘Apron Markings’.

8.4.2.3 Taxi guidelines on runways must not merge with the runway centreline, but run parallel to the runway centreline for a distance (D), not less than 60 m beyond the point of tangency where the runway code number is 3 or 4 and 30 m where the code number is 1 or 2. The taxi guideline marking must be offset from the runway centreline marking on the taxiway side, and be 0.9 m from the runway centrelines of the respective markings.

> **Note:** Markings with non-compliant separations do not have to be brought into compliance until the next remarking of the pavement.

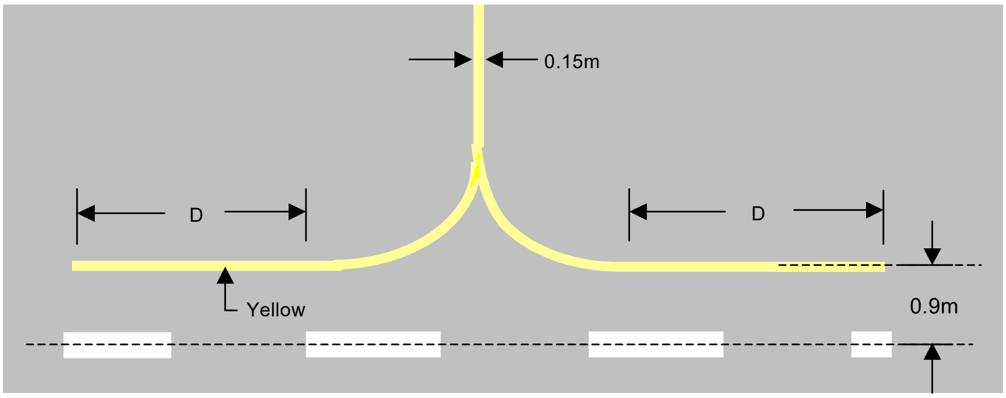


Figure 8.4-1: Taxi guideline markings meeting runway centreline markings

8.4.3 Runway Holding Position Markings

8.4.3.1 Runway holding position markings must be provided on all asphalt, sealed or concrete taxiways wherever these join or intersect with a runway. Standards for the location of runway holding positions are specified in Chapter 6.

8.4.3.2 Runway holding positions must be marked using the Pattern A or Pattern B runway holding position markings, shown in Figure 8.4-2, as appropriate.

8.4.3.3 Pattern A marking must be used at an intersection of a taxiway and a non-instrument, non-precision approach or precision approach Category I runway, and precision approach Category II or III runway where only one runway holding position is marked. Pattern A must also be used to mark a runway/runway intersection, where one of the runways is used as part of a standard taxi route.

8.4.3.4 Pattern B marking must be used where two or three runway holding positions are provided at an intersection of a taxiway with a precision approach runway. The marking closest to the runway must be the Pattern A marking; the marking(s) further from the runway must be Pattern B.

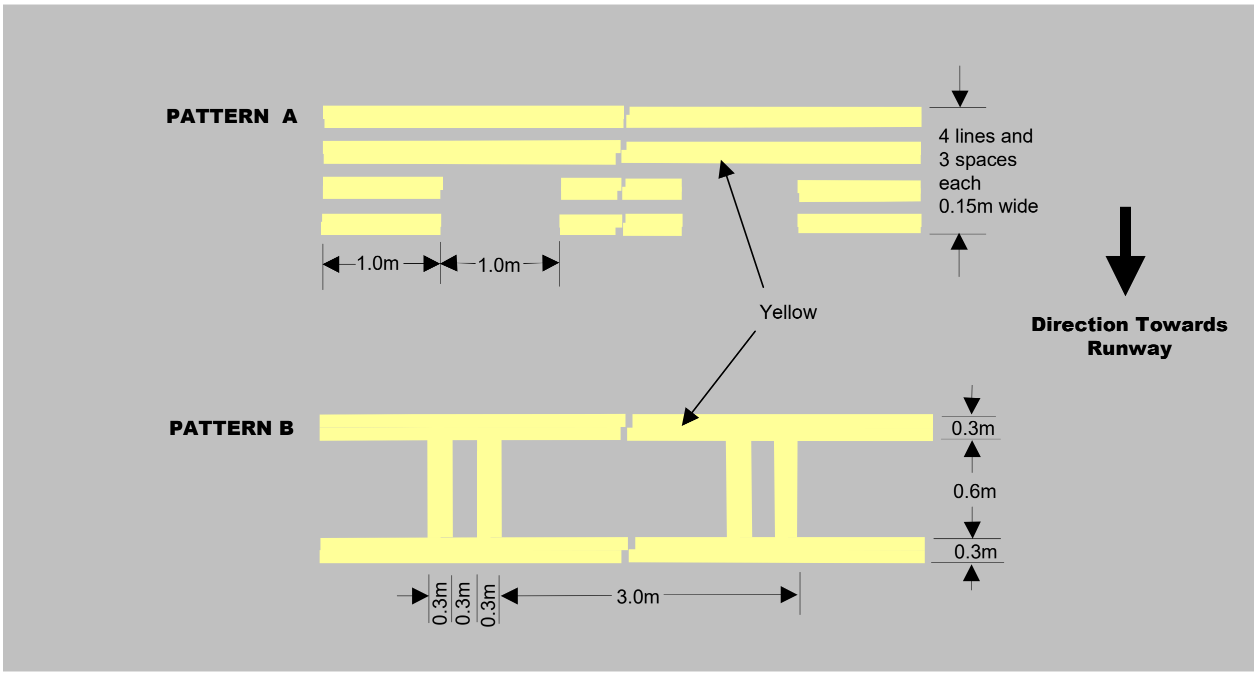


Figure 8.4-2: Pattern A and Pattern B runway-holding position markings

8.4.3.5 Where increased conspicuity of the Pattern A and Pattern B runway-holding position markings is required, the runway-holding position markings must be increased in size as indicated in Figure 8.4-3.

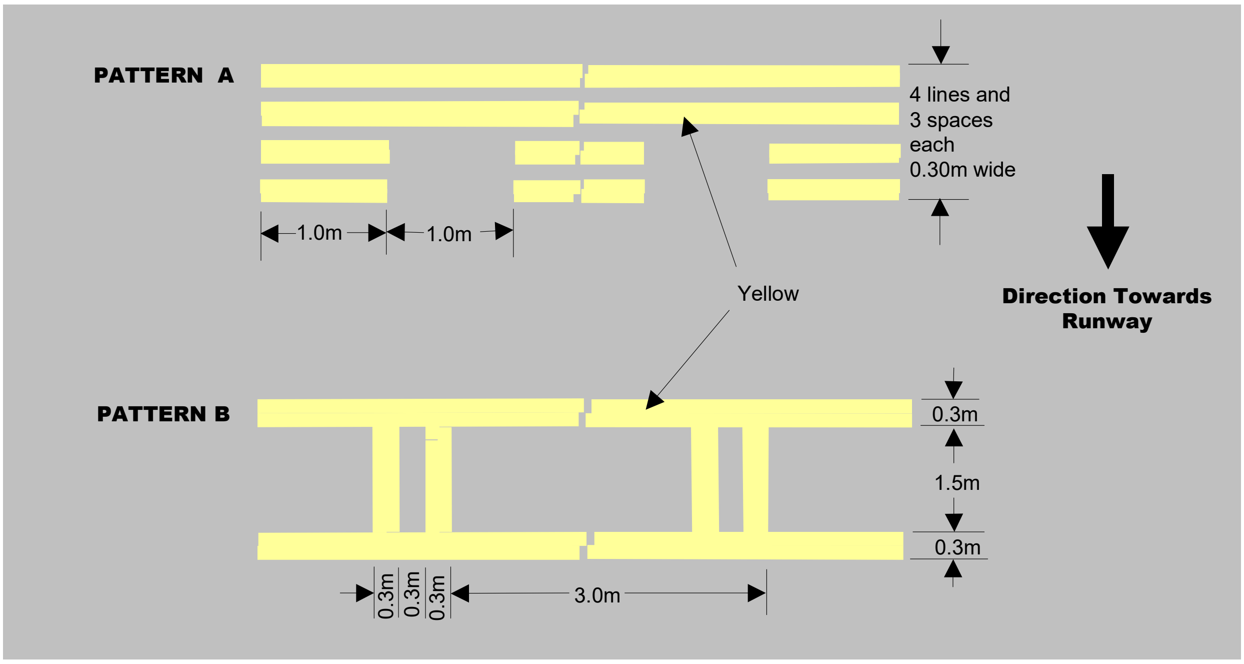


Figure 8.4-3: Pattern A and Pattern B runway-holding position markings — increased conspicuity

8.4.4 Intermediate Holding Position Markings

8.4.4.1 Intermediate holding position markings must be provided on all asphalt, sealed or concrete taxiway intersections or on any location of a taxiway where air traffic control requires the aircraft to hold. The intermediate holding position marking must be located in accordance with the standards specified in Chapter 6.

8.4.4.2 Intermediate holding position marking must consist of a single yellow broken line, 0.15 m wide, extending across the full width of the taxiway at right angles to the taxi guideline. Lines and gaps must each be 1.0 m long, as shown below:

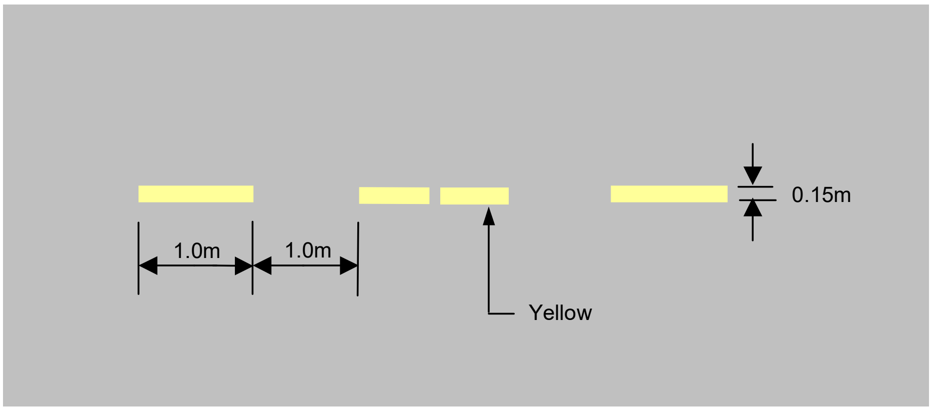


Figure 8.4-4: Intermediate holding position markings

8.4.5 Taxiway Edge Markings

8.4.5.1 Taxiway edge markings must be provided for paved taxiways where the edges of full strength pavement are not otherwise visually clear. Markings must consist of two continuous 0.15 m wide yellow lines, spaced 0.15 m apart and located at the taxiway edge, as shown below.

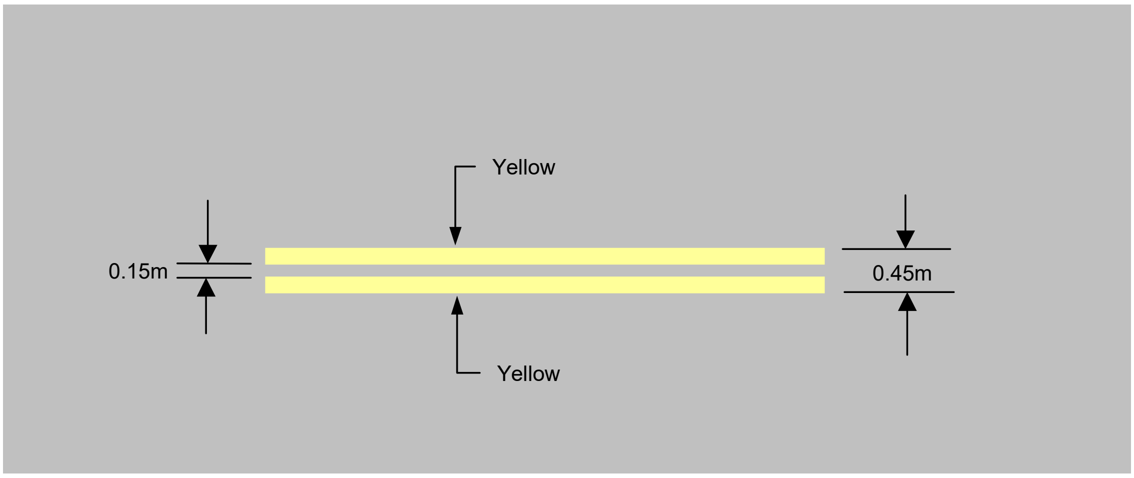


Figure 8.4-5: Taxiway edge markings

> **Note:** Whilst not mandatory, the additional provision of transverse or herringbone stripes on the sub strength surface has been found to be of assistance in avoiding the possibility for confusion on which side of the edge marking the sub strength pavement is located. This additional marking is an acceptable means of compliance with these standards.

8.4.6 Holding Bay Markings

8.4.6.1 Holding bay markings must be provided on all sealed, asphalt or concrete holding bays. Holding bay markings must comprise taxi guideline markings and intermediate holding position markings as shown in Figure 8.4-6. Markings must be located so that aircraft using the holding bay are cleared by aircraft on the associated taxiway by at least the distance specified in Chapter 6. The holding position marking must be painted in accordance with the intermediate holding position marking, unless that is also a runway holding position, in which case the Pattern A runway holding position marking applies.

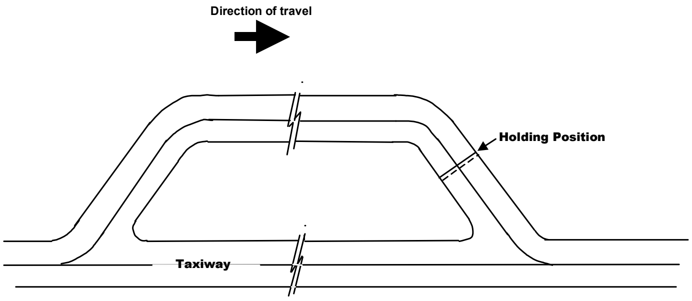


Figure 8.4-6: Holding bay markings

8.4.7 Taxiway Pavement Strength Limit Markings

8.4.7.1 These markings are used at the entrance of a taxiway of low strength pavement where the aerodrome operator decides to impose a weight limitation, for example, 'Max 5,700 kg'.

8.4.7.2 Where the taxiway pavement strength limit marking is provided, as shown in Figure 8.4-7, the letters and numbers must be painted yellow, must be 2.0 m in height, 0.75 m in width, with 0.15 m line width and at 0.5 m spaces. The marking must be readable from aircraft on the full strength pavement.

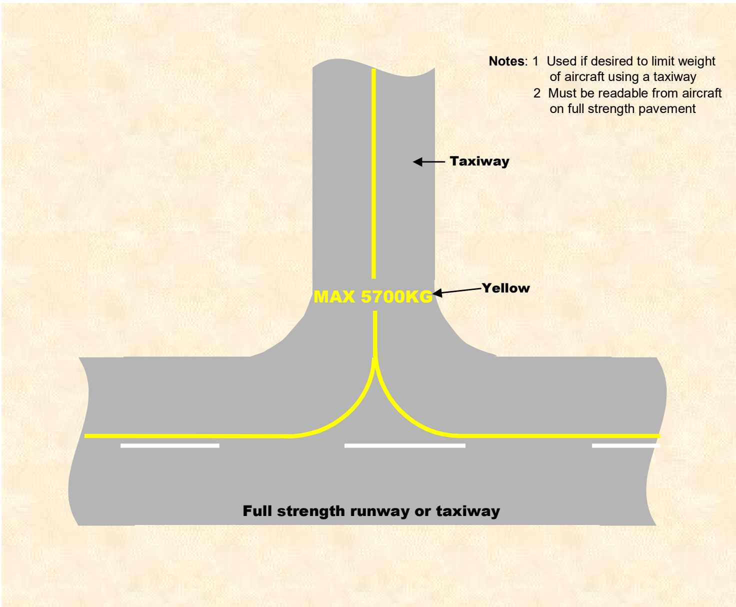


Figure 8.4-7: Taxiway pavement-strength limit markings

8.4.7.3 Edge markings of the associated main taxiway or apron, or the side stripe markings of the runway, must be interrupted across the width of the low strength taxiway entrance.

Section 8.5: Apron Markings

8.5.1 Introduction

8.5.1.1 Aprons accommodating aircraft of 5,700 kg Maximum All Up Mass (MAUM) and above, must be provided with taxi guidelines and primary aircraft parking position markings. Where the apron may be occupied by these and lighter aircraft at the same time, the aerodrome operator must also provide secondary aircraft parking position markings on the apron for the lighter aircraft.

8.5.1.2 Where aprons accommodate only aircraft of less than 5,700 kg MAUM, there is no mandatory requirement for taxi guidelines nor for marked aircraft parking positions. In these cases, the aerodrome operator may decide whether to provide markings, or to allow random parking.

8.5.1.3 The design of apron markings must ensure that all relevant clearance standards are met, so that safe manoeuvring and the precise positioning of aircraft is achieved. Care must be taken, to avoid overlapping markings.

8.5.2 Apron Taxi Guideline Markings

8.5.2.1 Apron taxi guideline markings must be of the same form as those used on the taxiway. The design of taxi guidelines on aprons is dependent on whether the aircraft is being directed by a marshaller or the pilot.

8.5.2.2 Where aircraft are to be directed by a marshaller, the ‘nose wheel position principle’ shall apply; that is, the taxi guideline is designed so that when the aircraft nose wheel follows the taxi guideline, all the required clearances are met.

8.5.2.3 Where aircraft are to be guided by the pilot, the ‘cockpit position principle’ shall apply; that is the taxi guideline is designed so that when a point on the centreline of the aircraft midway between the pilot and the co-pilot seats (or in the case of a single pilot aircraft, in the centre of the pilot seat) follows the taxi guideline, all the required clearances are met.

8.5.2.4 Where there is a change in aircraft position control between the pilot and the marshaller, the taxi guideline must convert from one principle to the other. At aerobridges, the taxi guideline must be designed using the cockpit position principle.

8.5.2.5 Where an aircraft designator marking is required to cover a multiple number of aircraft types, and there is insufficient space for the marking, an abbreviated version of the designator may be used e.g. an A330-200 may be abbreviated to A332, a BAe 146-200 to B462 and a B737-800 to B738.

8.5.3 Apron Edge Markings

8.5.3.1 Must be provided where the limit of high strength pavement cannot be distinguished from the surrounding area, and aircraft parking is not restricted to fixed parking positions. Where marking is required, the apron edge must be identified by 2 continuous yellow lines 0.15 m wide, spaced 0.15 m apart.

8.5.3.2 The edge of gravel, grass or other natural surface aprons must be identified by cones, spaced at a maximum distance of 60 m and painted yellow; except for dedicated helicopter aprons which must be light blue.

8.5.4 Parking Clearance Line

8.5.4.1 Parking clearance lines may be provided at an aircraft parking position to depict the area that must remain free of personnel, vehicles and equipment when an aircraft is taxiing (or being towed) into position or has started engines in preparation for departure.

8.5.4.2 Parking clearance lines may also be provided on light aircraft aprons with random parking, where it is desired to limit the parking to particular areas.

8.5.4.3 The parking clearance line must comprise a continuous red line 0.10 m or, if desired, 0.20 m wide. Where required, a continuous yellow or white line 0.10 m wide on either side can enhance the parking clearance line. The words 'PARKING CLEARANCE' must be painted in yellow on the side where the light aircraft are parked, and readable from that side. These words must be repeated at intervals not exceeding 50 m, using letters 0.3 m high, located 0.15 m from the line, as shown below.

Figure 8.5-1: Parking clearance line

8.5.5 Aircraft Type Limit Line

8.5.5.1 Where adjoining portions of pavement cannot accommodate the same aircraft type, information to this effect must be provided, marking the boundary of the restricted pavement. The marking must consist of a broken yellow line, comprising strips 3 m long and 0.3 m wide, separated by 1 m spaces. The designator must be 0.15 m above the line, in letters and numbers 0.5 m high. The marking is to be repeated at intervals not exceeding 50 m.

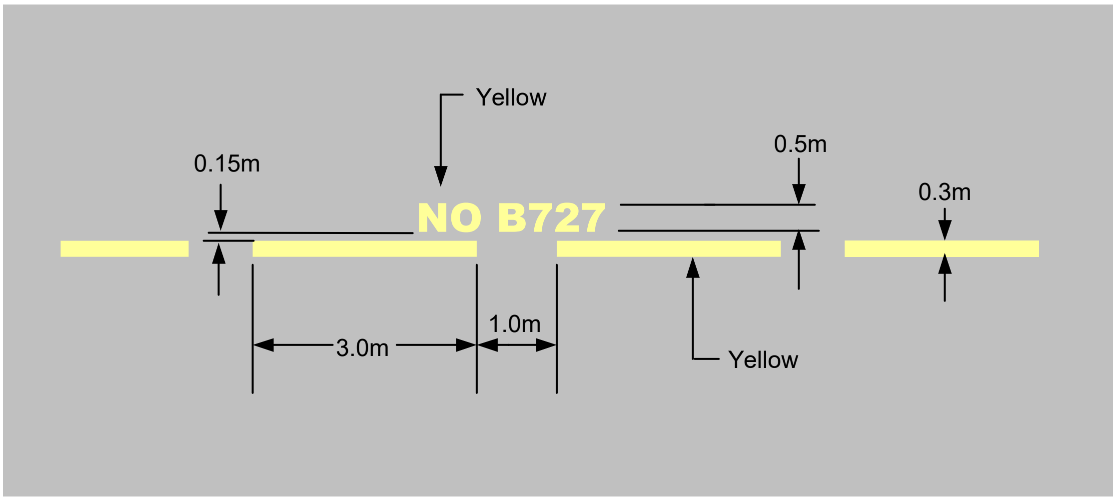


Figure 8.5-2: Aircraft type limit line

8.5.6 Parking Weight Limit Line

8.5.6.1 Where adjoining portions of pavement cannot accommodate the same aircraft weight, this must be signified by marking an aircraft weight limitation on the weaker pavement. The marking must consist of a broken yellow line, comprising strips 3 m long and 0.3 m wide, separated by 1 m spaces. The designator must be 0.15 m above the line, in letters and numbers 0.5 m high. The marking is to be repeated at intervals not exceeding 50 m.

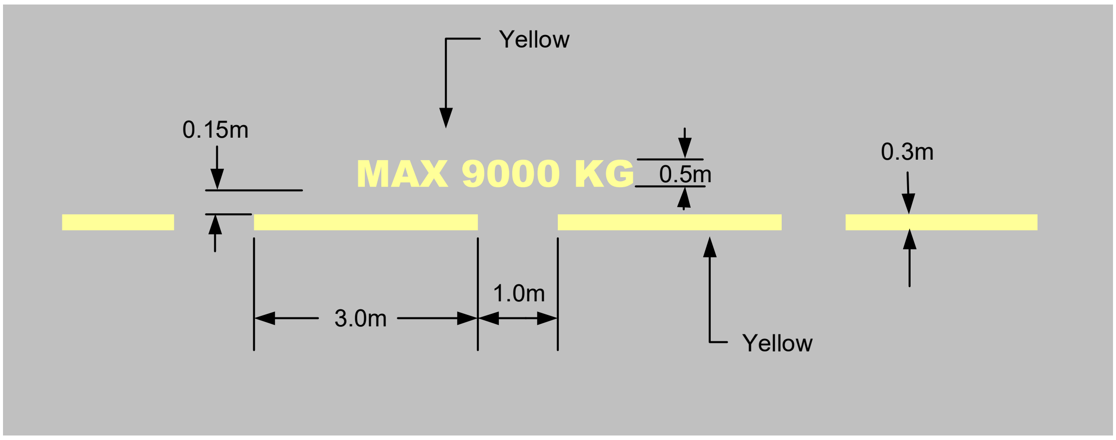


Figure 8.5-3: Parking weight limit line

8.5.7 Leased Area Line

8.5.7.1 Where the aerodrome operator wishes to identify leased areas on a sealed, concrete or asphalt apron, the marking must consist of a 0.15 m solid line, painted lime green.

8.5.8 Equipment Clearance Line

8.5.8.1 Equipment clearance lines must be used on congested aprons to assist service vehicles keep clear of manoeuvring aircraft. This marking must consist of red stripes, 1 m long and 0.15 m wide, separated by 1 m gaps. The designation 'EQUIPMENT CLEARANCE' must be painted on the side of the line occupied by the equipment and readable from that side. The designation must be repeated along the line at intervals of not more than 30 m. Letters must be 0.3 m high, 0.15 m from the line, painted red.

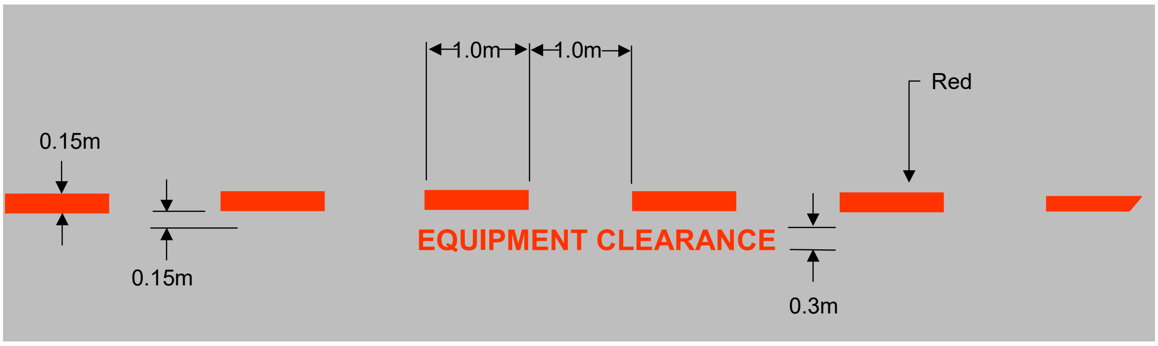


Figure 8.5-4: Equipment clearance line

8.5.9 Equipment Storage Markings

8.5.9.1 Equipment storage markings must consist of a continuous red painted line, 0.1 m wide.

8.5.9.2 The words 'EQUIPMENT STORAGE' must be painted in red on the side where equipment is stored, and readable from that side. Letters must be 0.3 m high and 0.15 m from the line, as shown below. This marking must be repeated at intervals not exceeding 50 m along the boundary.

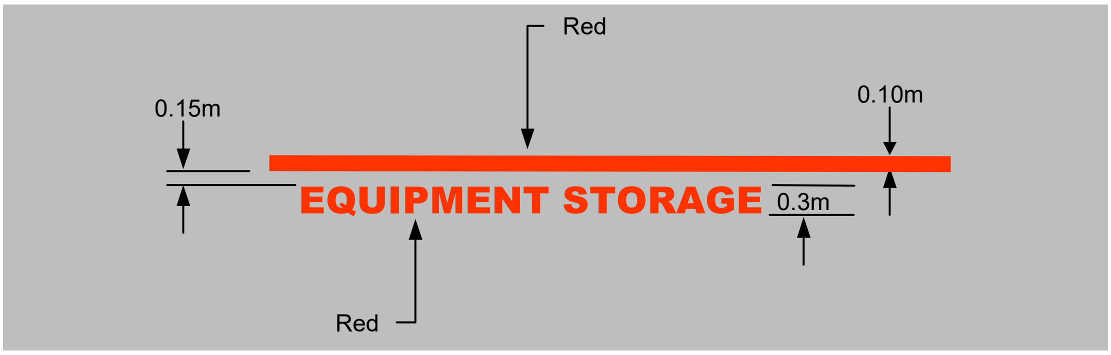


Figure 8.5-5: Equipment storage and apron road marking

8.5.10 Apron Service Road Markings

8.5.10.1 Roads on apron areas must be marked to keep vehicle traffic clear of aircraft and taxiways, and to minimise the risk of vehicle-to-vehicle accidents.

8.5.10.2 Each lane of an apron service road must be of a minimum width to accommodate the widest vehicle in use at that location, e.g. emergency vehicles or ground support equipment.

8.5.10.3 The apron service road marking must consist of a continuous white painted line, 0.1 m wide.

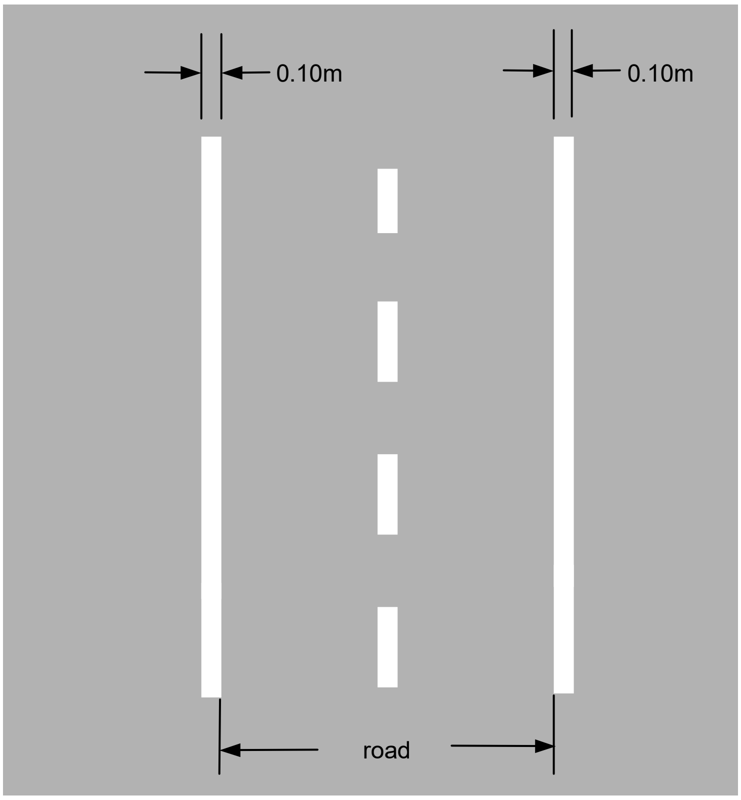


Figure 8.5-6: Apron service road

8.5.10.4 Where a service road is located adjacent to taxiing aircraft the side marking must be shown with a continuous double white line. This indicates DO NOT CROSS. Each continuous white line must be 0.1 m wide. The separation between the two continuous white lines must not be less than 0.05 m.

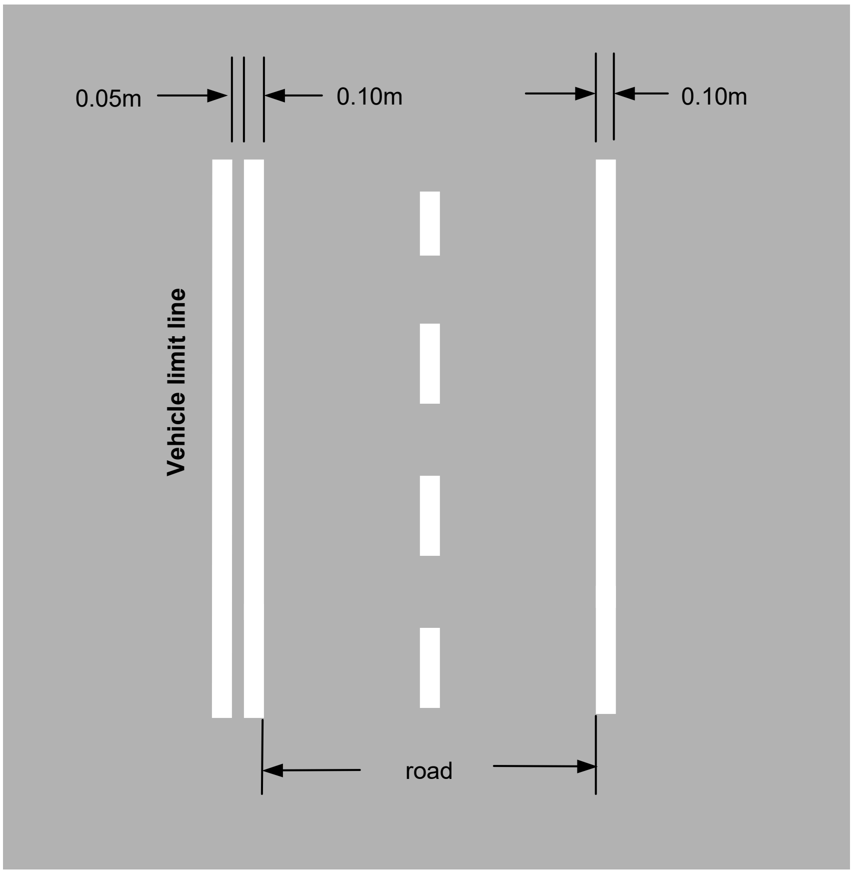


Figure 8.5-7: Apron service road alongside a vehicle limit line

8.5.10.5 Where a service road crosses a taxiway or apron taxilane, the service road marking may be presented in a zipper pattern. Each segment of the zipper is not to be more than 50 cm in length. This type of edge marking makes the road more conspicuous to the pilots of aircraft operating on the taxiway or taxilane.

8.5.11 Aircraft Parking Position Markings

8.5.11.1 The aerodrome operator must mark all aircraft parking positions for use by aircraft of 5,700 kg MAUM and above, on concrete, sealed or asphalt apron surfaces.

8.5.11.2 Aircraft parking positions are classified as primary or secondary positions. Primary positions are designed for normal apron demand, whereas secondary positions either provide alternative positions for use during abnormal circumstances, or allow a larger number of smaller aircraft to be parked.

8.5.11.3 Aircraft parking position markings comprise lead-in lines, primary parking position markings, secondary parking position markings, lead-out lines and designation markings.

8.5.12 Lead-in Line

8.5.12.1 Lead-in lines must be provided to each aircraft parking position on all sealed, concrete and asphalt aprons with aircraft parking position markings.

8.5.12.2 Lead-in lines to primary aircraft parking positions must be continuous, 0.15 m wide and painted yellow; they have the same characteristics as a taxi guideline.

8.5.12.3 At a secondary parking position, the lead-in line must be marked by a series of solid yellow circles 0.15 m in diameter, spaced at 1 m intervals. Where an abrupt change in direction occurs the line must be solid for a distance of 2 m before and after the turn.

8.5.13 Taxi Lead-in Line Designation

8.5.13.1 Designation must be provided where an apron has more than one marked aircraft parking position. Taxi lead-in line designation markings must be located at the beginning of each diverging taxi guideline or lead-in line; aligned so that they can be seen by the pilot of an approaching taxiing aircraft. There are three types of taxi lead-in line designations:

(a) parking position number designation;

(b) aircraft type limit designation; and

(c) aircraft weight limit designation.

8.5.13.2 The parking position number designation indicates the aircraft parking position to which the line leads. Where a lead-in line leads to several positions, the designation must include the first and last numbers of the positions served. For instance, a guideline leading to the six positions numbers 1 to 6, is shown as 1–6. The designations must comprise characters 2 m high, painted yellow, as shown in Figure 8.5-8.

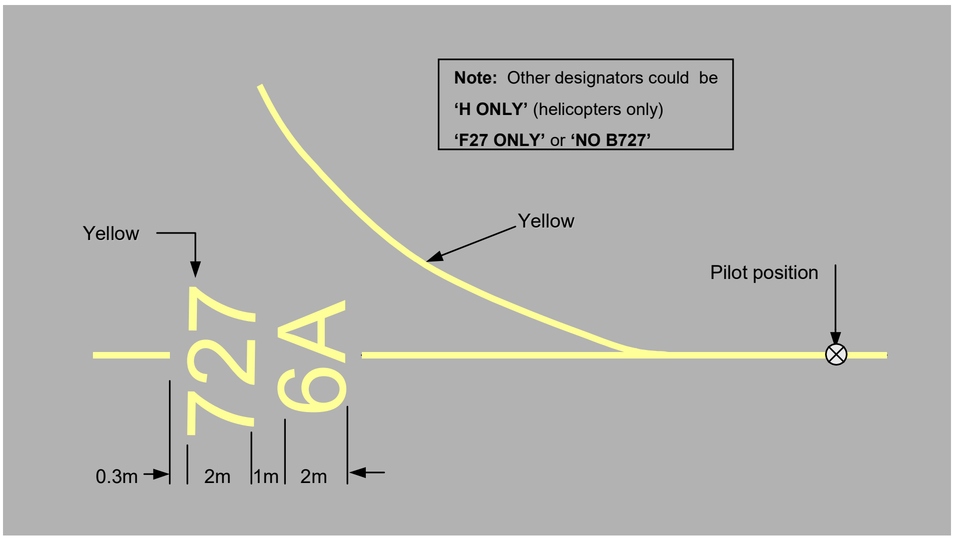


Figure 8.5-8: Parking position number designation

8.5.13.3 The aircraft type limit designations indicate which parking positions are capable of accommodating particular aircraft types. The designation must be painted in yellow characters 2 m high, with 0.3 m spacing from the lead-in line, as shown in Figure 8.5-9. Appropriate aircraft type limit designations must be provided at the lead-in line for each position to which restrictions apply. Where a diverging lead-in line leads to an apron parking position suitable only for helicopters; the designation 'H ONLY' must be provided.

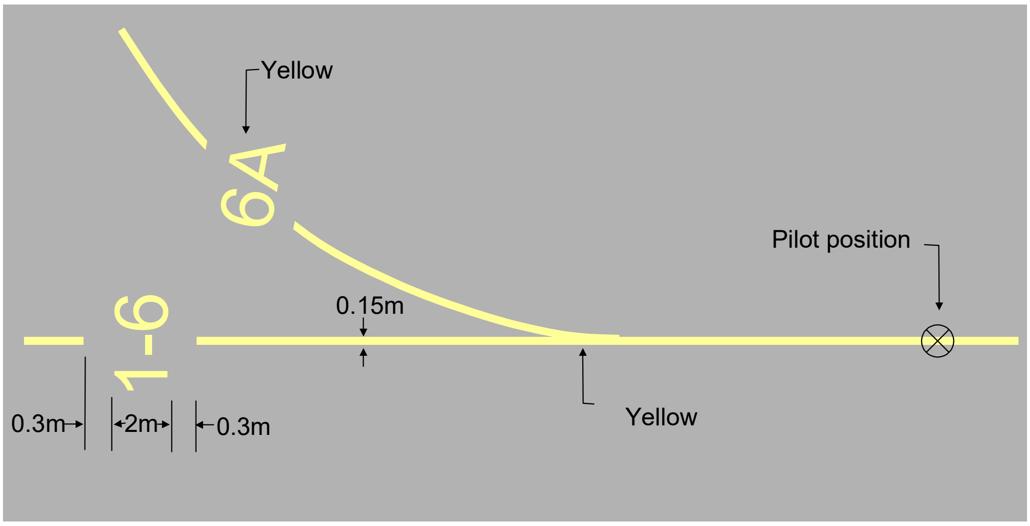


Figure 8.5-9: Aircraft type limit designation

8.5.13.4 The aircraft weight limit designations inform pilots of a weight limitation to a parking position. They specify the maximum weight allowable in the form, '9,000 kg'. The designation must be painted in yellow characters 2 m high, separated by 0.3 m spaces from the lead-in line, as shown in Figure 8.5-10.

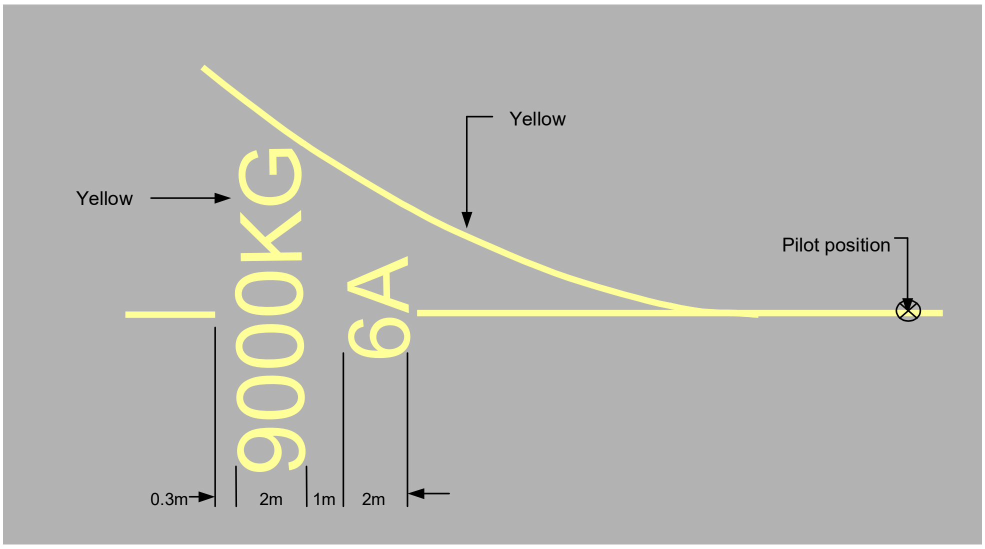


Figure 8.5-10: Aircraft upper weight limit designation

8.5.14 Pilot Turn Line

8.5.14.1 Where required, a pilot turn line must be placed at right angles to the lead-in line, located on the left side as viewed by the pilot, and must be 6 m long, 0.3 m wide and painted yellow. The aircraft type designation must be painted in yellow letters, 1 m high and spaced 0.15 m below the bar, facing the direction of incoming aircraft. The designation must be offset from the lead-in line as follows:

Table 8.5-1

Aircraft code letter	Offset
C	5 m
D	10 m
E	10 m

8.5.15 Primary Aircraft Parking Position Markings

8.5.15.1 Primary aircraft parking position markings comprise two straight yellow lines; the alignment line must be 0.15 m wide, and shows the required orientation of the parked aircraft. The stop line must be 0.3 m wide, and shows the pilot or marshaller the point at which the aircraft is to be stopped. The position of the stop line depends on whether the aircraft is under the control of the apron marshaller or the pilot.

8.5.16 Marshaller Stop Line

8.5.16.1 The stop line must be located where the aircraft nose wheel is to stop; and on the right hand side of, and at right angles to, the alignment line, as seen by the marshaller facing the incoming aircraft.

8.5.16.2 The aircraft type designation must be yellow, in letters 0.3 m high, and spaced 0.15 m below the stop line. The lettering must be legible to the marshaller facing the incoming aircraft, as shown below.

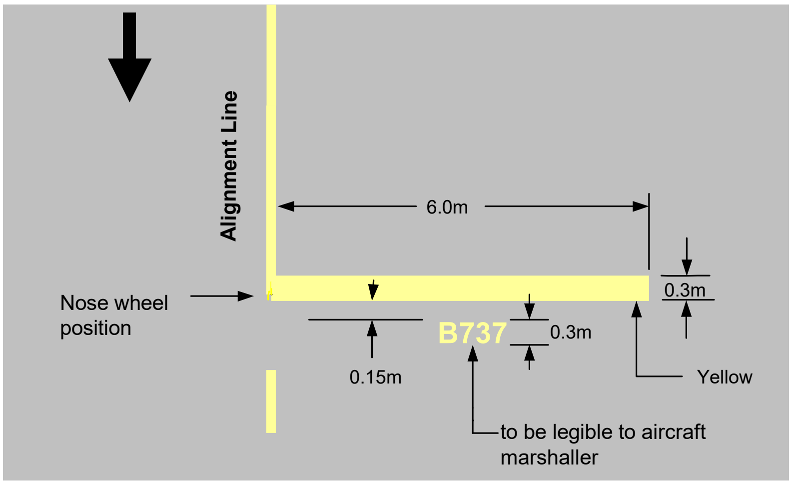


Figure 8.5-11: Marshaller stop line

8.5.17 Pilot Stop Line

8.5.17.1 The pilot stop line must be located so that when the aircraft is stopped, the line is immediately to the left of the pilot. The pilot stop line must be 6 m long and offset from the alignment line as follows:

Table 8.5-2

Reference Code Letter	Offset X
C	5 m
D	10 m
E	10 m

8.5.17.2 Where aircraft of all codes are to be accommodated at the one parking position, the offset for code letter C must be used and the marking extended in length to 11 m.

8.5.17.3 The aircraft type designation must be written in yellow letters 1 m high and spaced 0.15 m below the pilot stop line, as shown below.

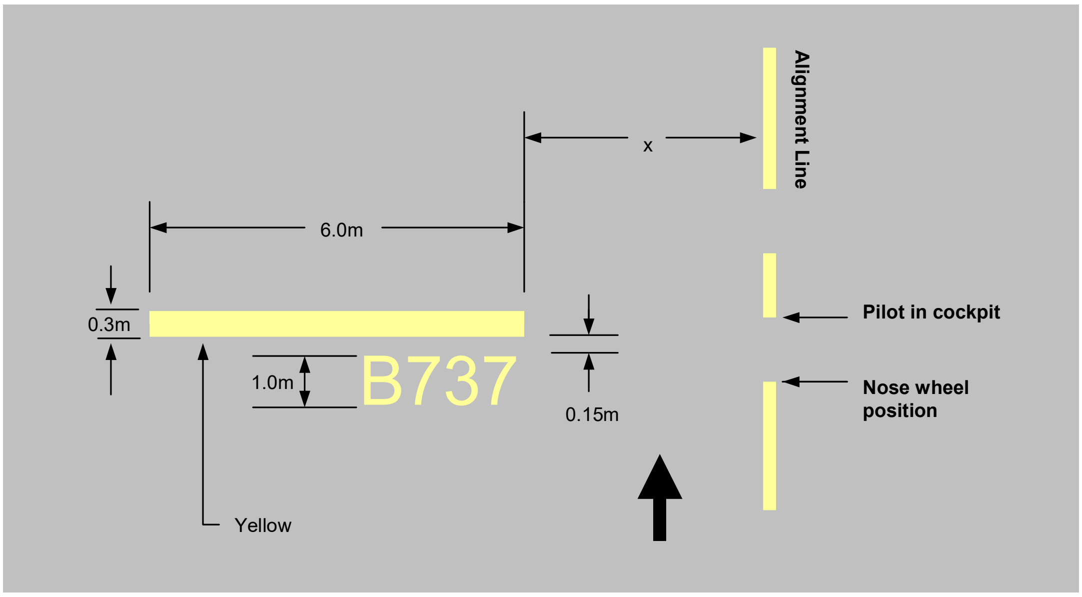


Figure 8.5-12: Pilot stop line (no marshaller)

8.5.18 Alignment Line

8.5.18.1 The alignment line must extend from the location of the nose wheel in the parked position, backwards under the body of the aircraft for a distance 'X' in Table 8.5-3. The line must also extend forward, commencing at a point 3 m past the most forward nose wheel position and extending for a distance 'Y', in the table. A 1 m long section of the alignment line must be placed in the centre of the 3 m gap, as shown in Figure 8.5-13.

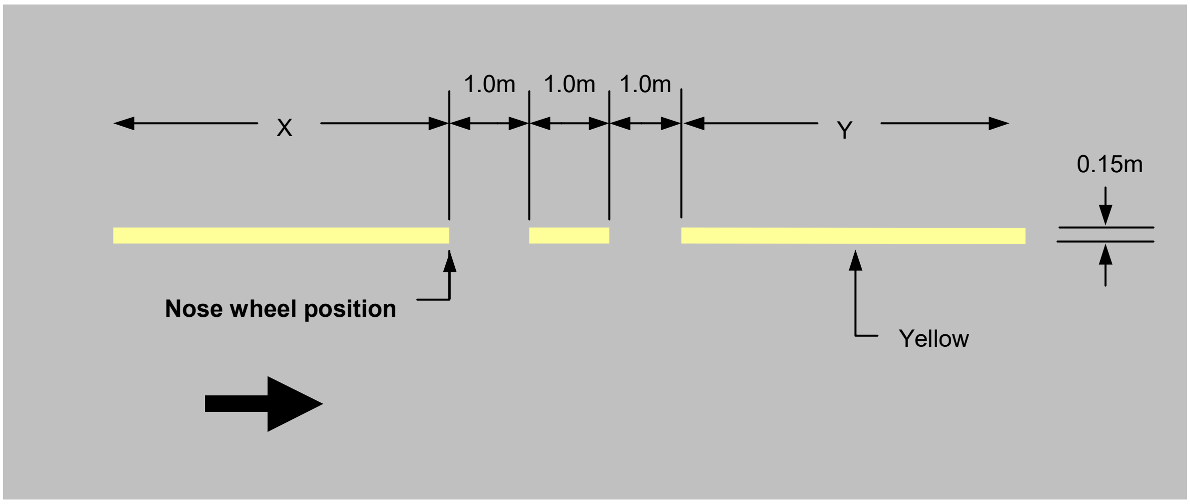


Figure 8.5-13: Alignment line

Table 8.5-3

Reference Code Letter	Distance Y	Distance X
A & B	9 m	5 m
C, D & E	18 m	10 m

8.5.19 Secondary Aircraft Parking Position Markings

8.5.19.1 These alternative markings are used during abnormal circumstances, or to allow a larger number of smaller aircraft to use the same apron area as a smaller number of larger aircraft using the primary positions. Secondary markings may be either keyhole markings or triangle markings, painted yellow, except where the secondary position markings overlap the primary position markings. In the latter case, the markings must be painted white.

8.5.20 Keyhole Marking

8.5.20.1 Where the secondary position is designed for aircraft with wingspan 15 m or greater, it must be identified with a keyhole marking, comprising an alignment line oriented in the desired alignment, and a terminating ring; with a parking position designator, as shown in Figure 8.5-14.

> **Note:** For aircraft having a wingspan of 15 m or greater:
>
> (a) Nose wheel position is centre of the circle.
>
> (b) Use white paint if likely to be confused with primary position markings.

8.5.20.2 The marking must be located so that the centre of the ring is at the final nose wheel position. Where required, any aircraft type or weight limit designation must be located at the commencement of the associated dotted lead-in line.

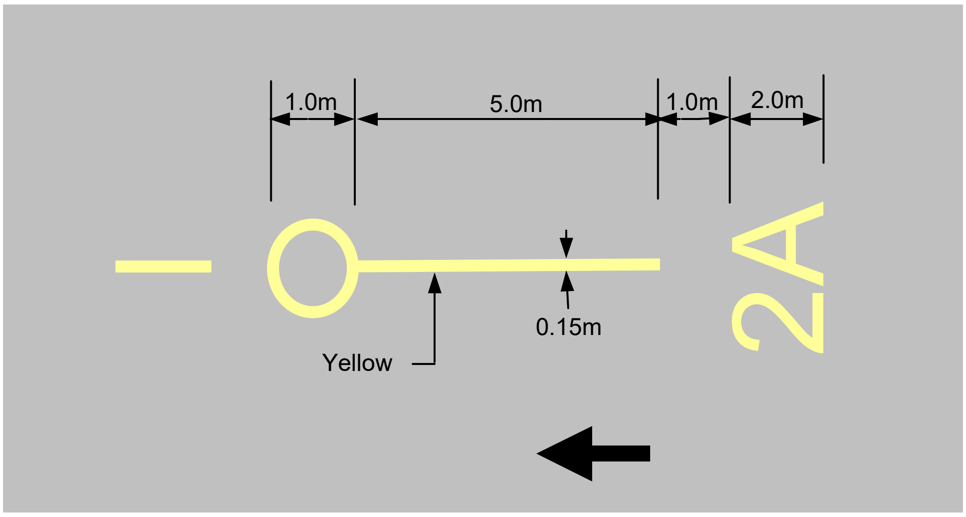


Figure 8.5-14: Keyhole marking

8.5.21 Triangle Marking

8.5.21.1 Where the secondary position is designed for aircraft with a wingspan of less than 15 m, it must be identified with a triangle marking comprising an alignment line, and a triangle, as shown in Figure 8.5-15. The triangle must be so located that its centre is the final nose wheel position.

> **Note:** For aircraft having a wingspan less than 15 m:
>
> (a) Nose wheel position is centre of triangle.
>
> (b) Use white paint if necessary to avoid confusion with primary marking.

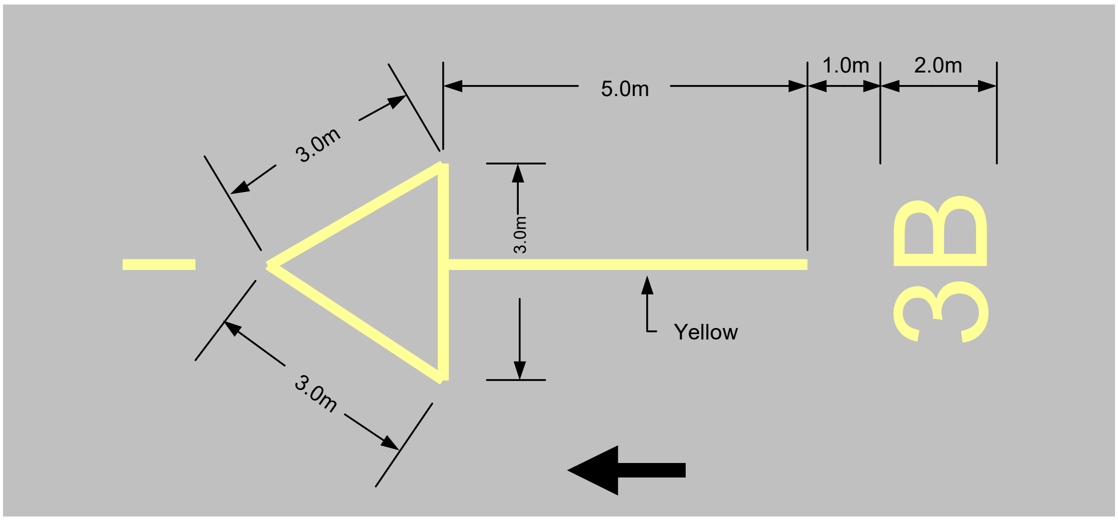


Figure 8.5-15: Triangle marking

8.5.22 Lead-out Line

8.5.22.1 Must comprise a broken line, painted yellow; stripes 1 m long and 0.15 m wide, spaced at 1 m intervals. The lead-out line must commence from the alignment line at least 3 m from the nose wheel position, as shown in Figure 8.5-16.

8.5.22.2 The lead-out line must extend to a point from where the pilot can clearly see the taxi guideline. If arrow indicators are inserted, the first arrow must be at least 15 m from the alignment line, with subsequent arrows at 30 m spacing.

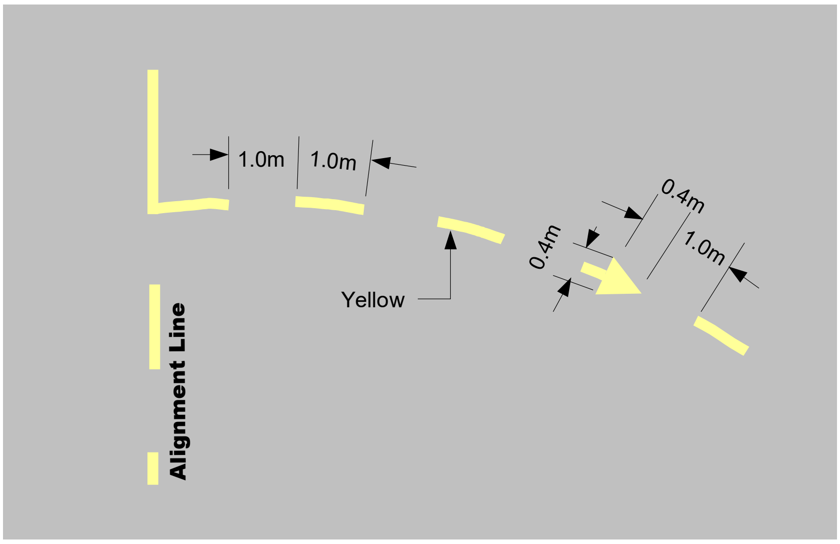


Figure 8.5-16: Lead-out line

8.5.23 Designation Markings

8.5.23.1 Designation markings are used to provide supplementary information, on all asphalt, sealed and concrete aprons where there is more than one aircraft parking position. Primary parking positions must be numbered sequentially with no omissions. Secondary positions must be identified with the same numbers as the associated primary position, together with an alphabetical suffix.

8.5.24 Aircraft Parking Position Designation

8.5.24.1 The parking position designation must be located adjacent to the parking position, either on the ground or on the aerobridge, and be visible to the pilot.

8.5.24.2 For fixed wing aircraft, the position designation, marked on the ground, must be placed 4 m forward of the nose wheel position and 5 m to the left, as viewed by the pilot. The designation must be yellow, and consist of characters 1 m high in a 2 m inside diameter ring of 0.15 m line thickness, as shown in Figure 8.5-17.

8.5.24.3 At aerobridge positions, the aerobridge designation must be the same as the associated parking position designation. The size of the position designation must not be less than the legend and face size specified in Table 8.6-1.

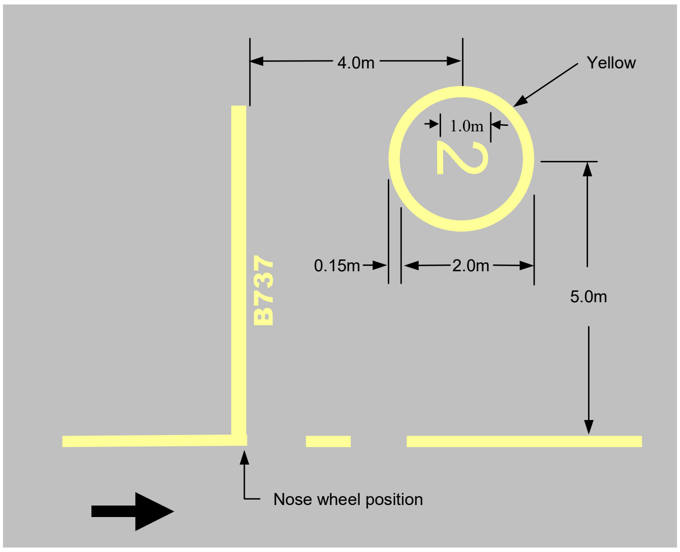


Figure 8.5-17: Aircraft parking position designation

8.5.24.4 An illustration showing a combination of all the aircraft parking position markings at an aircraft parking position is shown in Figure 8.5-18.

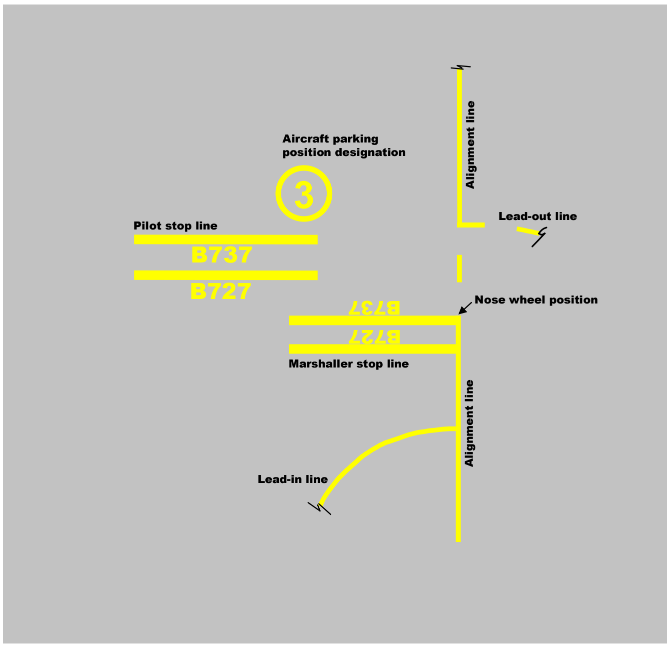


Figure 8.5-18: Aircraft parking position markings

8.5.25 Designation Characters for Taxi and Apron Markings

8.5.25.1 All letters and numbers used in designations for taxi and apron markings must conform in style and proportion to the following illustrations. Actual dimensions must be determined in proportion to the overall height standard for each specific designator. The grid spacing used in the following illustrations is 0.20 m.

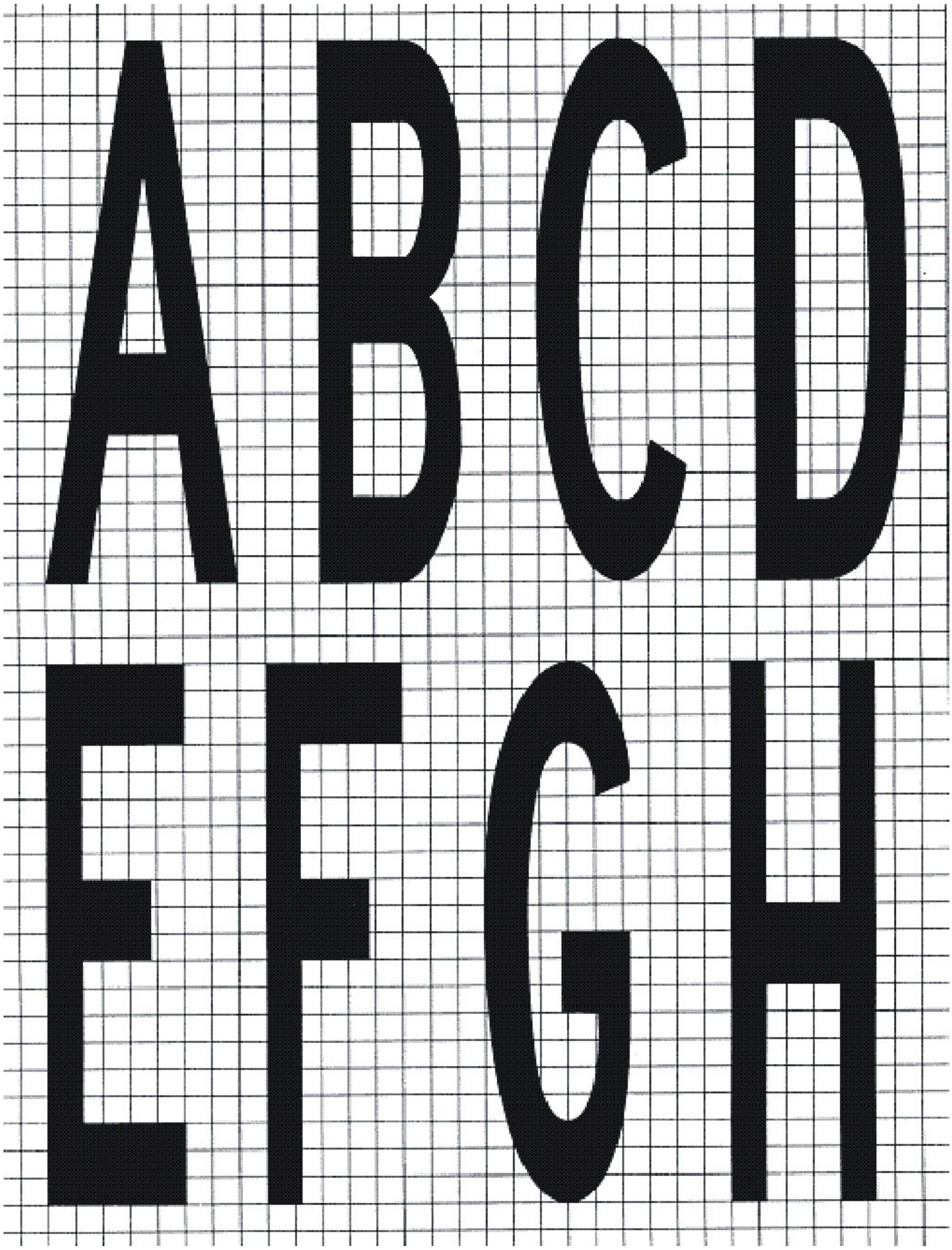


Figure 8.5-19: Letters and numbers used in designations for taxiway and apron markings

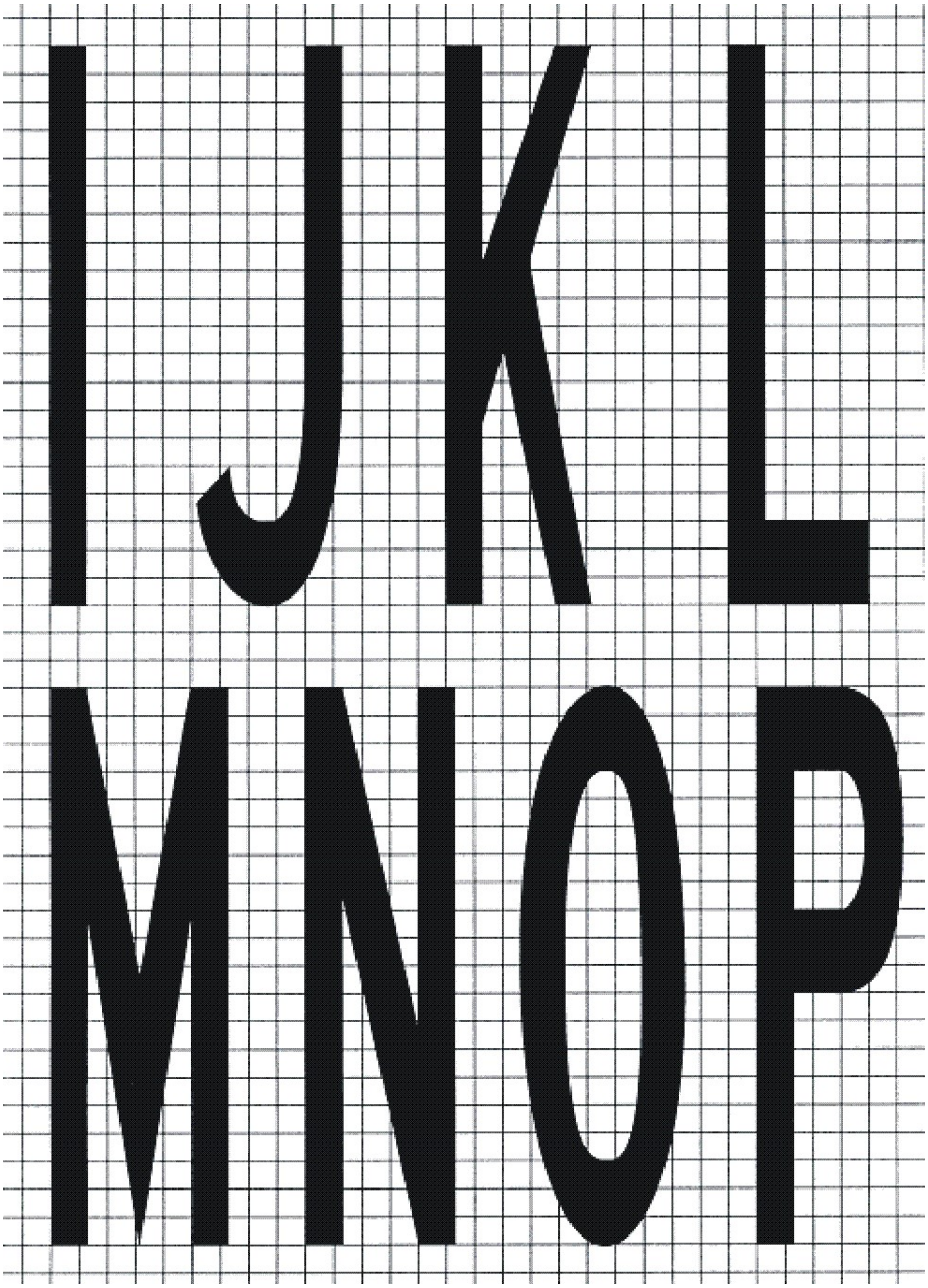


Figure 8.5-20: Letters and numbers used in designations for taxiway and apron markings

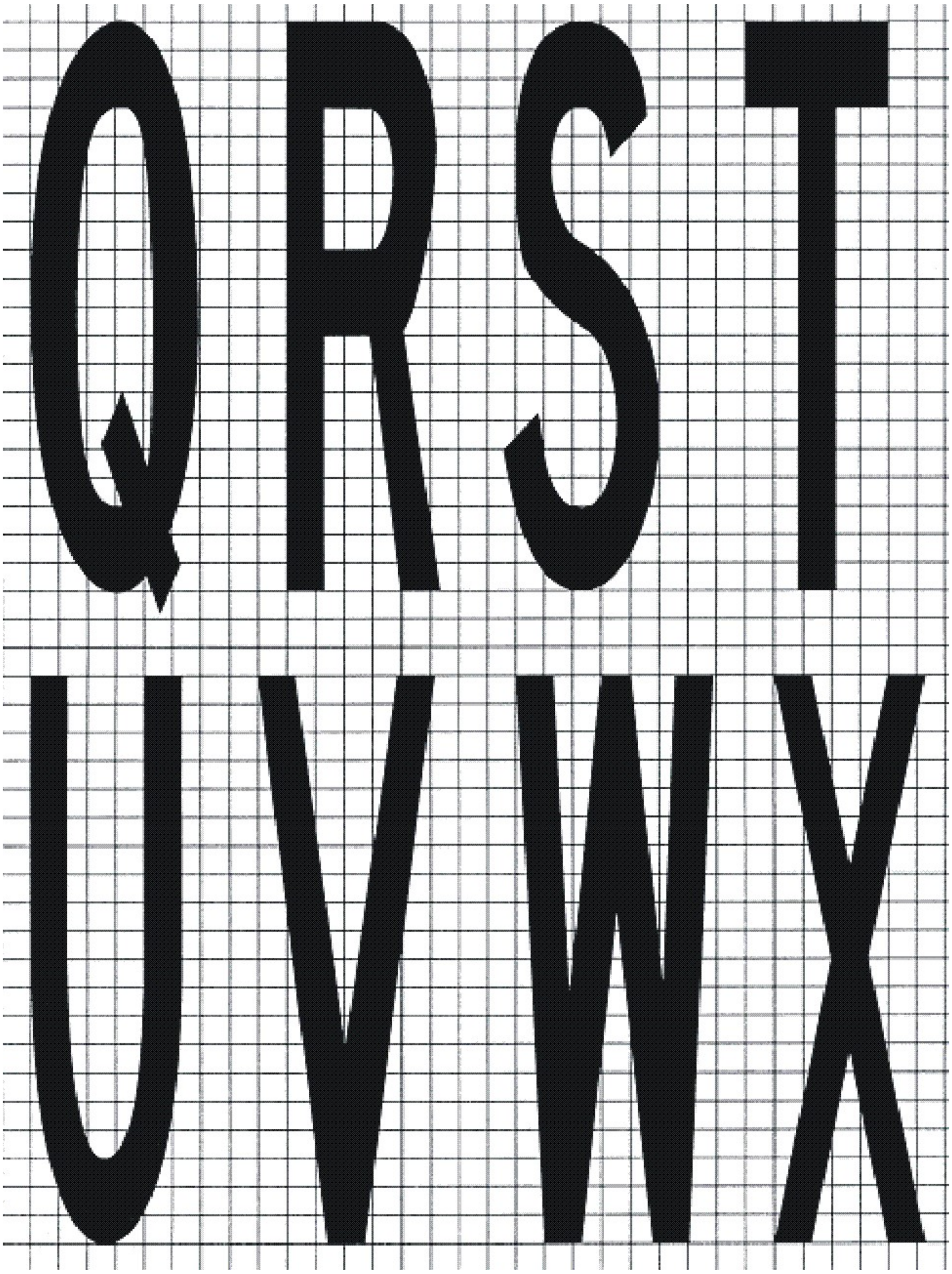


Figure 8.5-21: Letters and numbers used in designations for taxiway and apron markings

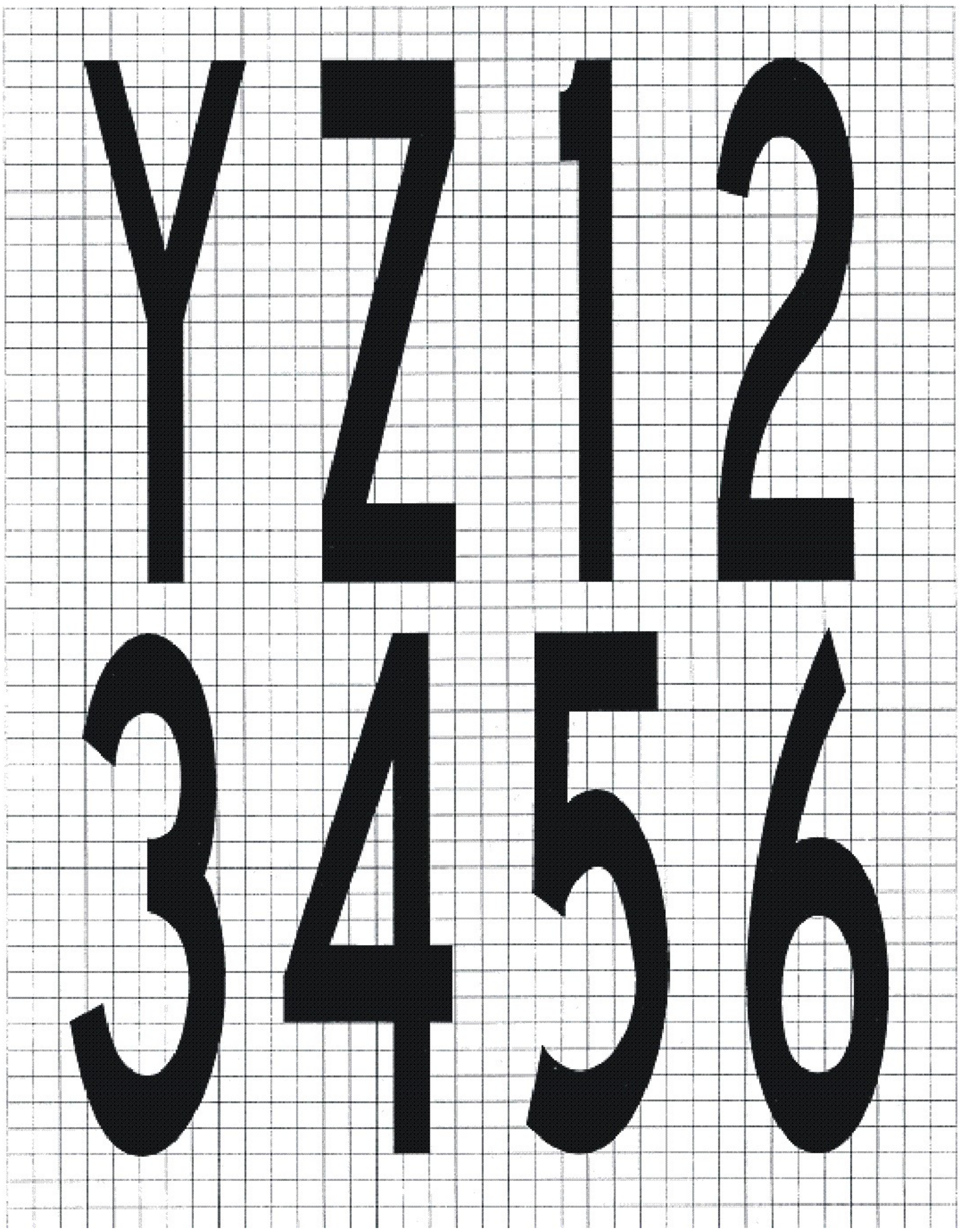


Figure 8.5-22: Letters and numbers used in designations for taxiway and apron markings

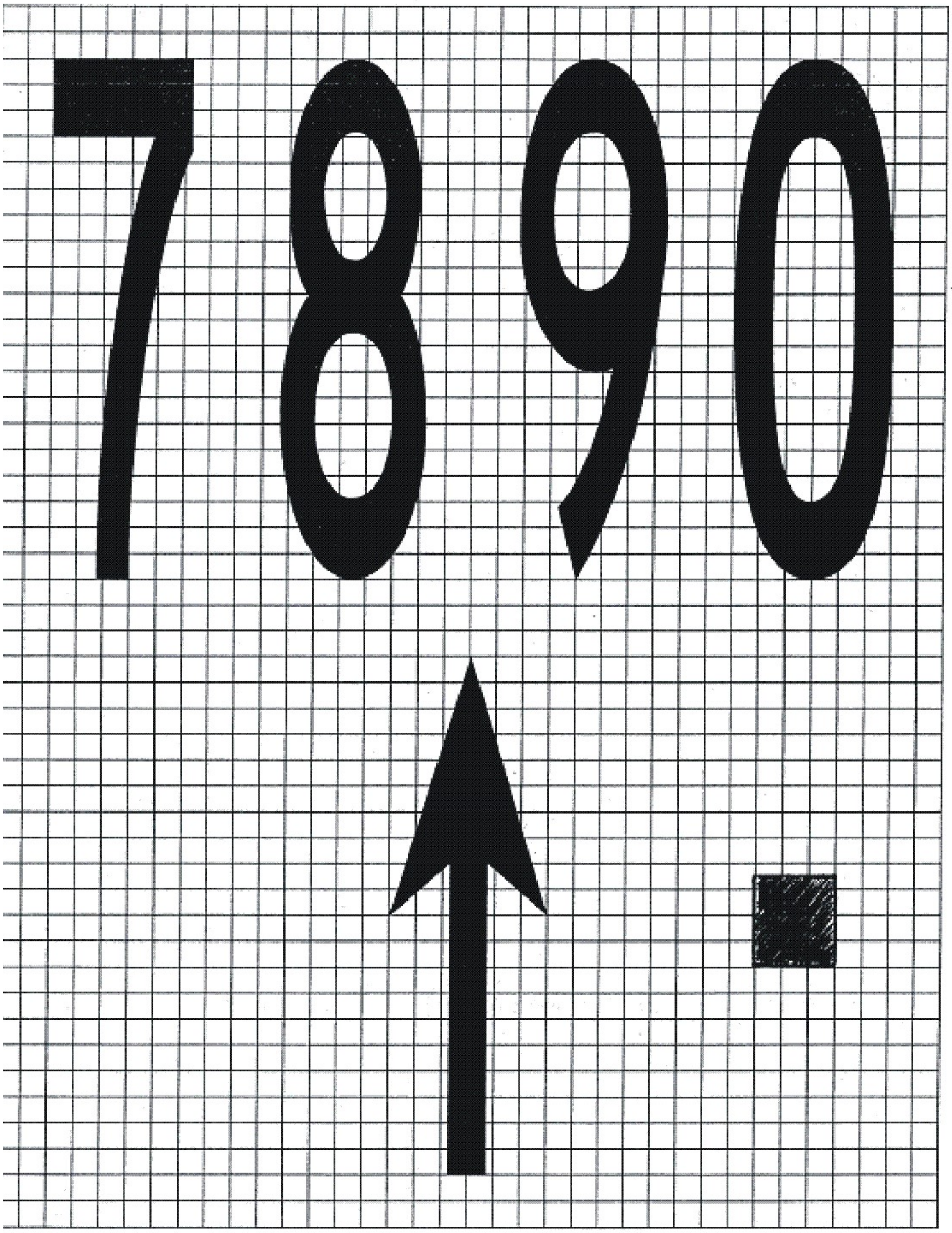


Figure 8.5-23: Letters and numbers used in designations for taxiway and apron markings

8.5.26 Tug operator Guidance Marking

8.5.26.1 Tug operator guidance marking must be provided on aprons where aircraft are being pushed back by tugs.

8.5.27 Aircraft Push-back Lines

8.5.27.1 The push-back line must be a broken line, painted white, comprising stripes 1 m long and 0.15 m wide, spaced at 1 m intervals. The line must be based on the required path of the nose wheel of the design aircraft. Where the line is used for tug operations with aircraft of reference code letter C, D and E, the 10 m before the tow bar disconnect point must be straight.

8.5.28 Tug Parking Position Lines

8.5.28.1 The tug parking position line marking must be provided at aerobridges and other power-in/push-out aircraft parking positions, to ensure parked tugs are clear of incoming aircraft. The marking must consist of a red line 0.10 m wide in the shape of a U, 3.5 m by 1.0 m commencing 3 m from the nose of the aircraft that the facility is intended to serve, as illustrated, below.

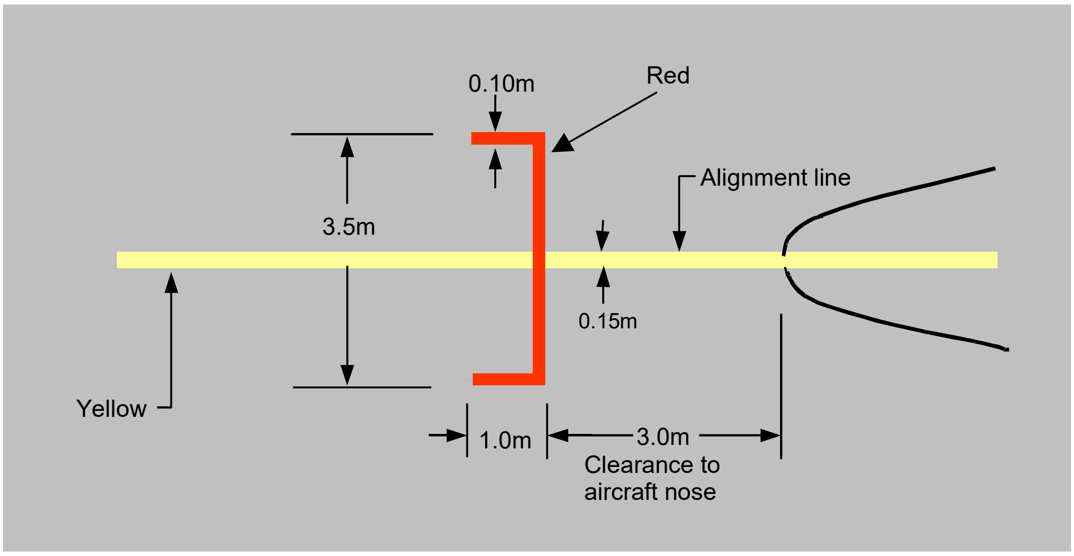


Figure 8.5-24: Tug parking position line

8.5.29 Towbar Disconnect Markings

8.5.29.1 The towbar disconnect point shown in Figure 8.5-25 must be located at the point of disconnection and must consist of a white line, 1.5 m long and 0.15 m wide, located on the left side of the taxi guideline or push-back line, as viewed from the tug; touching the guideline and at right angles to it.

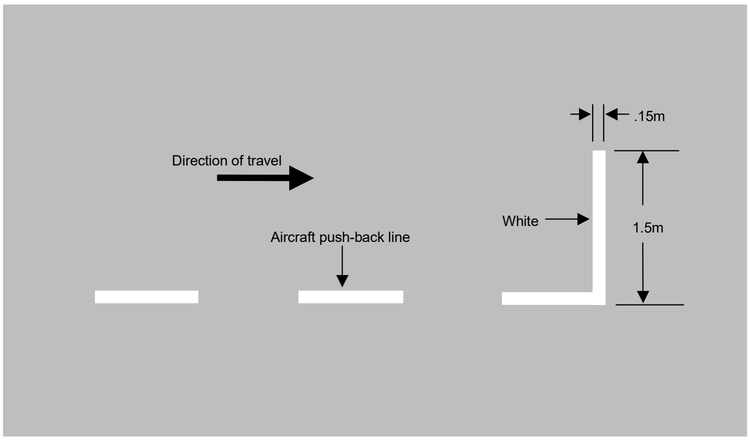


Figure 8.5-25: Towbar disconnect marking

8.5.30 Push-back Limit Markings

8.5.30.1 Push-back limit markings must comprise two parallel white lines at right angles to and symmetrical about the push back line. The marking must be 1 m long, 0.15 m wide and lines 0.15 m apart, as shown below.

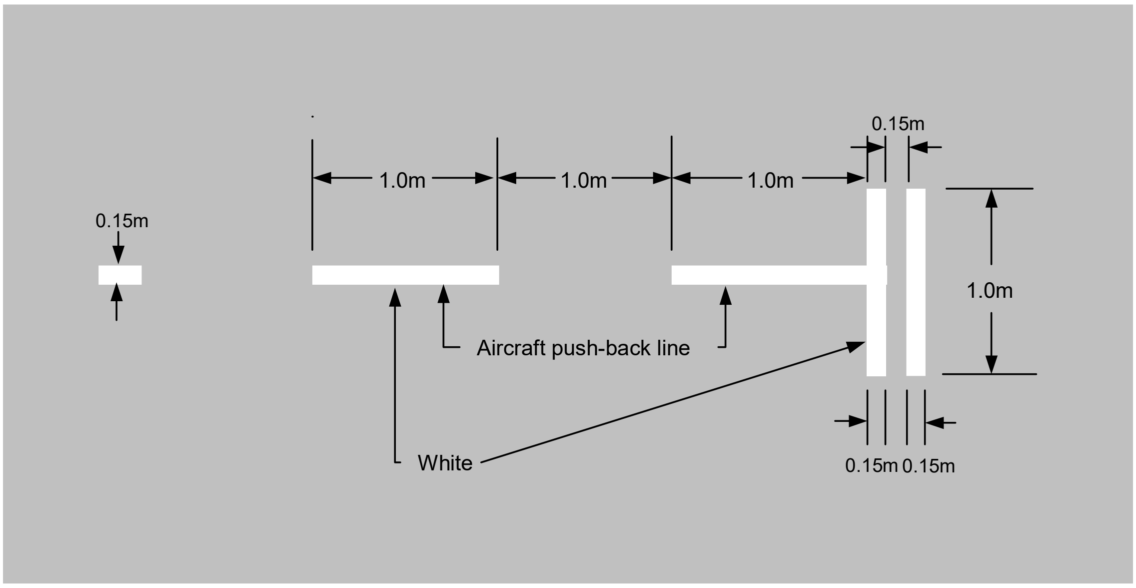


Figure 8.5-26: Push-back limit marking

8.5.31 Push-back Alignment Bars

8.5.31.1 Push-back alignment bars are provided to assist tug operators to align an aircraft correctly at the end of the push-back manoeuvre. The marking must be a broken white line, comprising stripes 1 m long and 0.15 m wide, spaced at 1 m intervals, for a length of 30 metres, aligned in the desired direction. The marking must commence 3 m past the tow disconnect marking, as shown below.

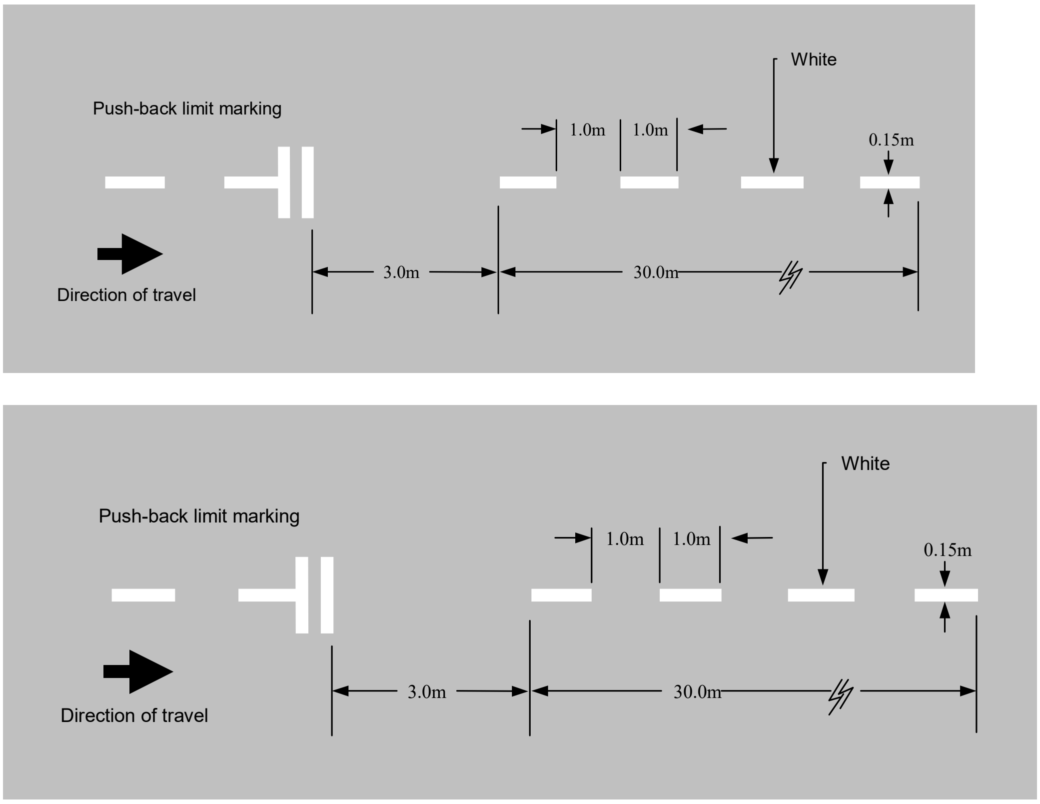


Figure 8.5-27: Push-back alignment line

8.5.32 Passenger Path Markings

8.5.32.1 Where provided, passenger path markings are provided to assist the orderly movement of passengers embarking or disembarking. Passenger path markings must be provided in accordance with the pattern and colour of the relevant State Road Authority pedestrian crossing marking standards. The width of the passenger pathway is to be commensurate with the expected pedestrian traffic.

8.5.32.2 The following diagram illustrates a typical layout for a pedestrian crossing.

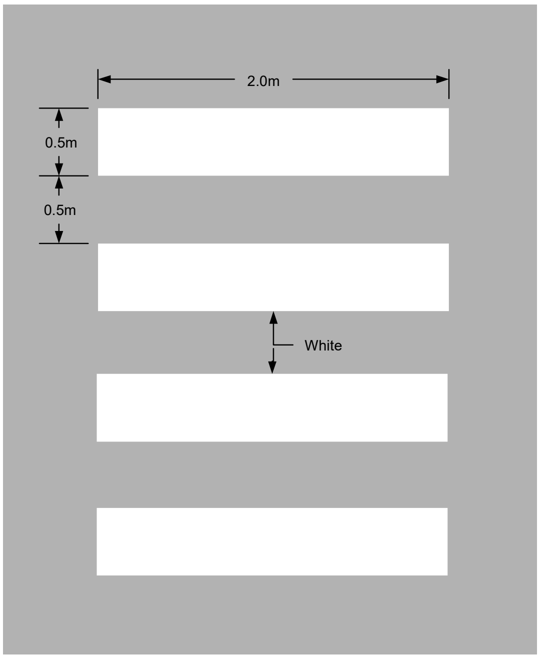


Figure 8.5-28: Pedestrian crossing

8.5.33 Typical Apron Markings

8.5.33.1 The following Figure 8.5-29 illustrates an apron with typical apron markings.

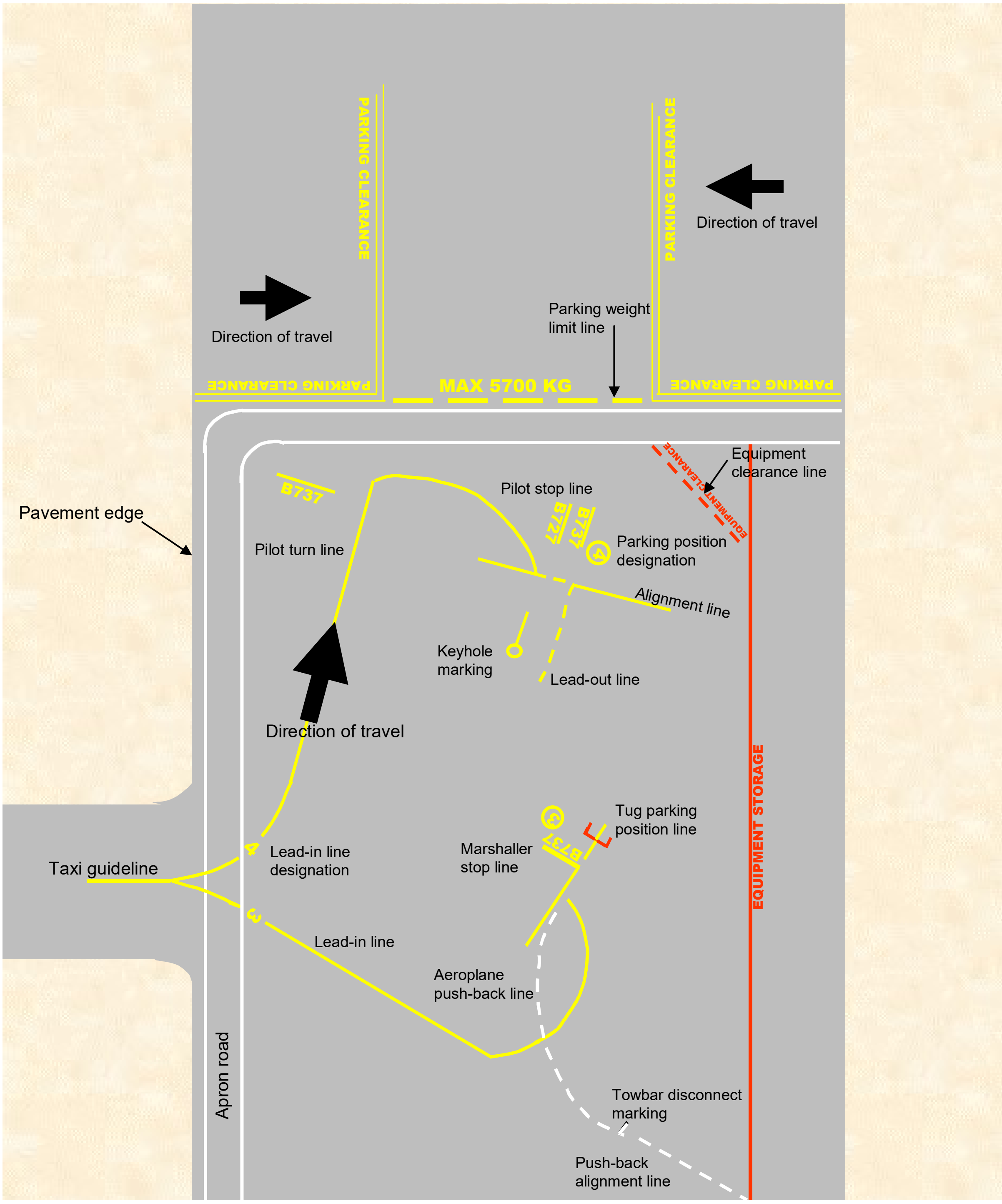


Figure 8.5-29: Typical apron markings

Section 8.6: Movement Area Guidance Signs (MAGS)

8.6.1 Introduction

8.6.1.1 Signs that convey messages that must be obeyed by pilots are known as mandatory instruction signs. These signs must have white lettering on a red background.

8.6.1.2 Signs that convey messages of information are known as information signs. These signs must have either black lettering on a yellow background, or yellow lettering on a black background.

8.6.1.3 Mandatory signs must be provided at major international aerodromes, and at other aerodromes that have air traffic control and for which RCAA determines these are required for safety reasons.

8.6.1.4 Aerodrome operators will consult with airlines and with Air Traffic Control, on the need for MAGS with information. Notwithstanding this, MAGS with information must be provided at aerodromes where taxiway intersection departures are promulgated in the AIP.

8.6.2 Naming of taxiways

8.6.2.1 The following convention must be used in the naming of taxiway location signs:

(a) a single letter must be used, without numbers, to designate each main taxiway;

(b) the same letter must be used throughout the length of taxiway, except where a turn of 90 degrees or more is made to join a runway, a different letter may be assigned to that portion of taxiway after the turn;

(c) for each intersecting taxiway, a different single letter must be used;

(d) to avoid confusion, letters I, O and X must not be used, letter Q should only be used where unavoidable;

(e) at aerodromes where the number of taxiways are or will be large, alphanumeric designators may be used for short intersecting taxiways. Successive intersecting taxiways must use the same letter, with sequential numbers. If sequential numbers are not practicable, due to geometry of the taxiway system; all pilot-used taxiway plans (aerodrome charts) must include advice as to the missing designators;

(f) the use of letters and numbers must be easily comprehensible. Should it ever be necessary to use double-digit alphanumeric designators, care must be taken to ensure the numbers used in the taxiway designation cannot in any way be confused with the runway designations.

8.6.3 Dimensions, Location and Lettering

8.6.3.1 Signs must be located to provide adequate clearance to passing aircraft. The depth and width of the signboard is dependent on the location of the sign, the size of the characters and the length of message conveyed.

8.6.3.2 Where MAGS are provided only on one side of the taxiway, they must be located on the pilots' left side unless this is impracticable. Where MAGS are to be read from both directions, they must be oriented so as to be at right angles to the taxi guideline. Where MAGS are to be read in one direction only, they must be oriented so as to be at 75 degrees to the taxi guideline.

8.6.4 Sign Size and Location Distances, Including Runway Exit Signs

8.6.4.1 Sign size and location distances must be in accordance with Table 8.6-1.

Table 8.6-1

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	**Type**	**Legend**	**Face (min)**	**Installed (max)**		
1 or 2[a]	I	200	400	700	5-11 m	3-10 m
1 or 2	M	300	600	900	5-11 m	3-10 m
3 or 4[a]	I	300	600	900	11-21 m	8-15 m
3 or 4	M	400	800	1100	11-21 m	8-15 m

[a] For runway exit signs, use the mandatory size.
I Information signs.
M Mandatory instruction signs.

8.6.4.2 The stroke width of letters and arrows must be:

Legend height	Stroke width
200 mm	32 mm
300 mm	48 mm
400 mm	64 mm

8.6.4.3 The form and proportion of the letters, numbers and symbols used on movement area guidance signs must be in accordance with Figure 8.6-1 to Figure 8.6-7. The grid spacing used in the following illustrations is 0.20 m.

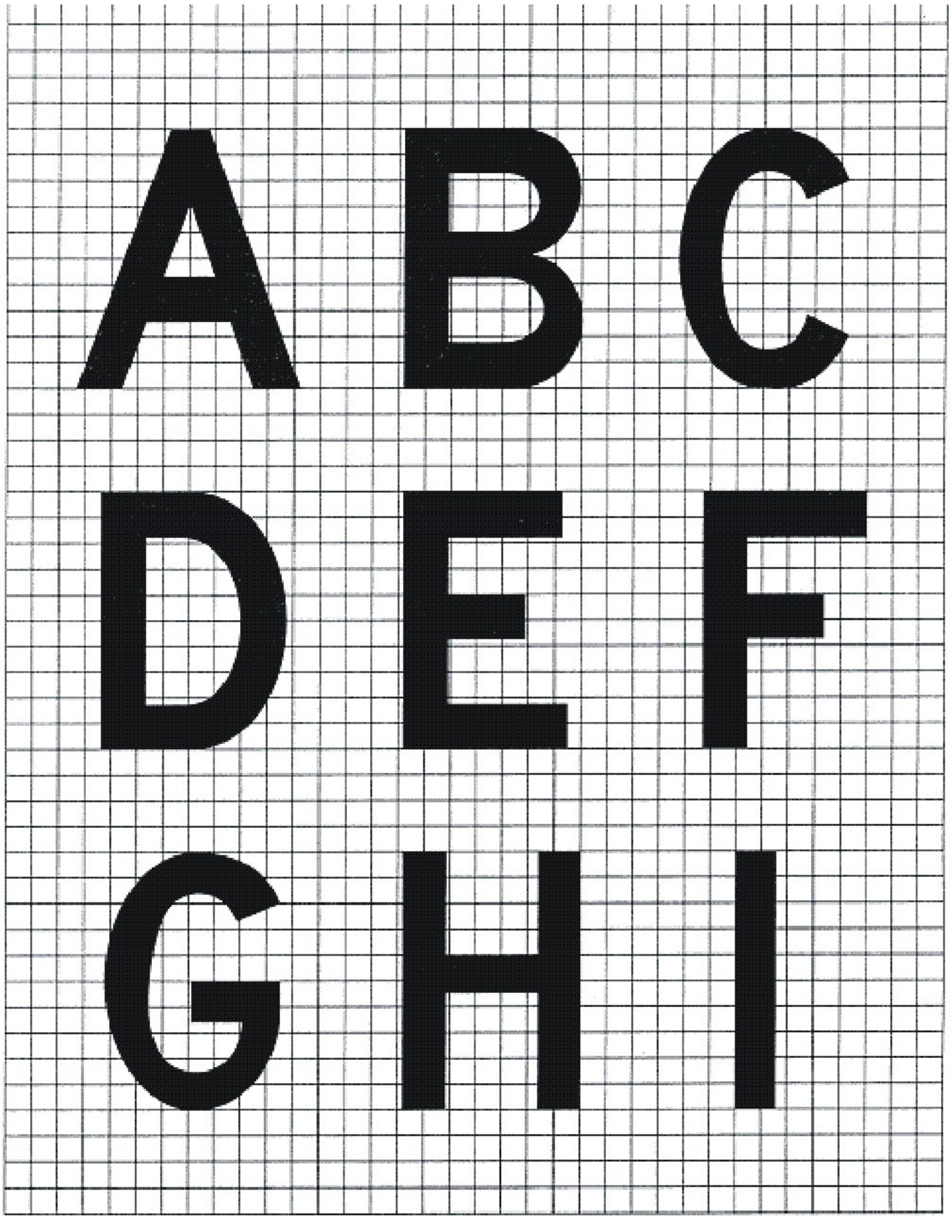


Figure 8.6-1: Form and proportion of letters, numbers and symbols used on Movement Area Guidance Signs

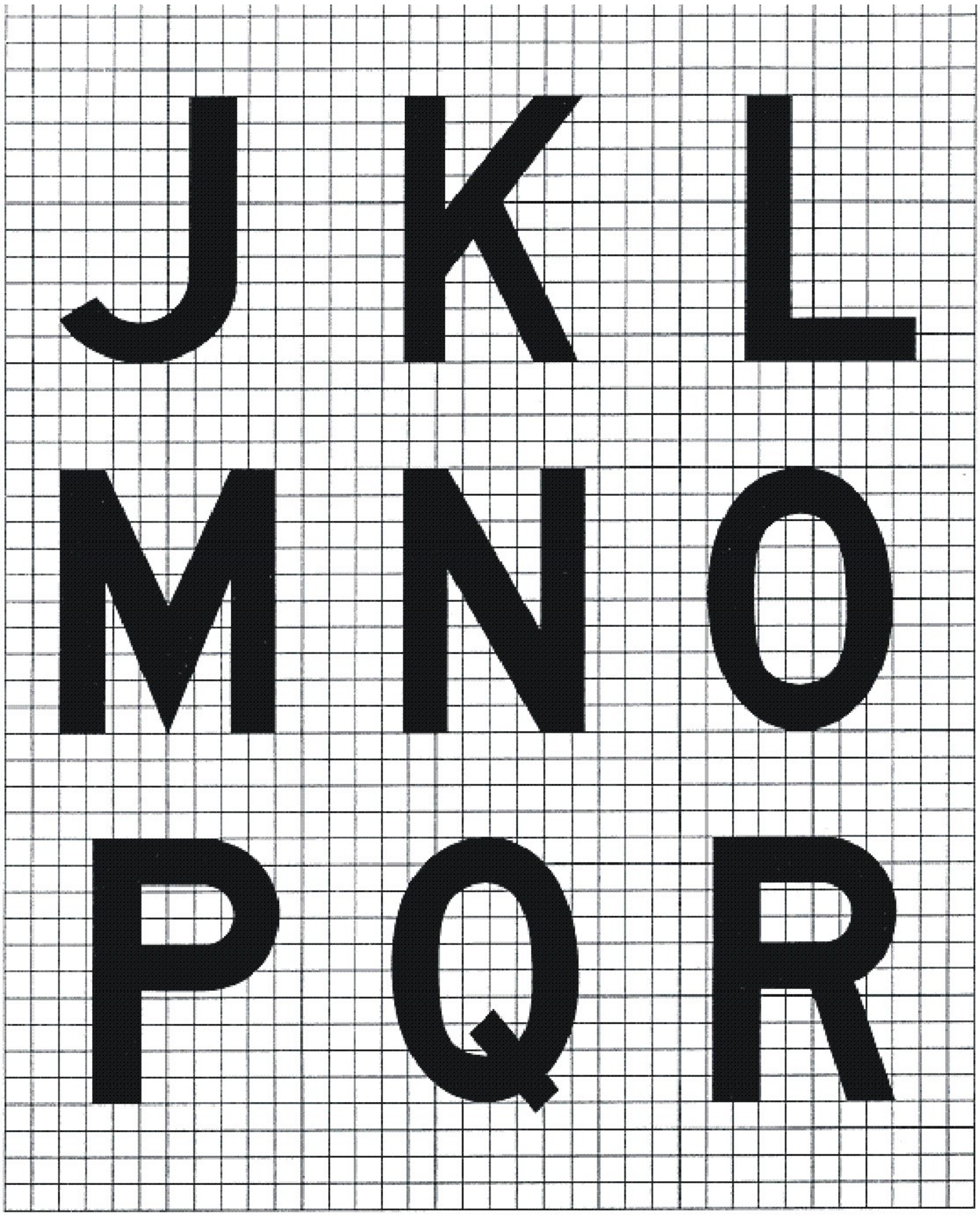


Figure 8.6-2: Form and proportion of letters, numbers and symbols used on Movement Area Guidance Signs

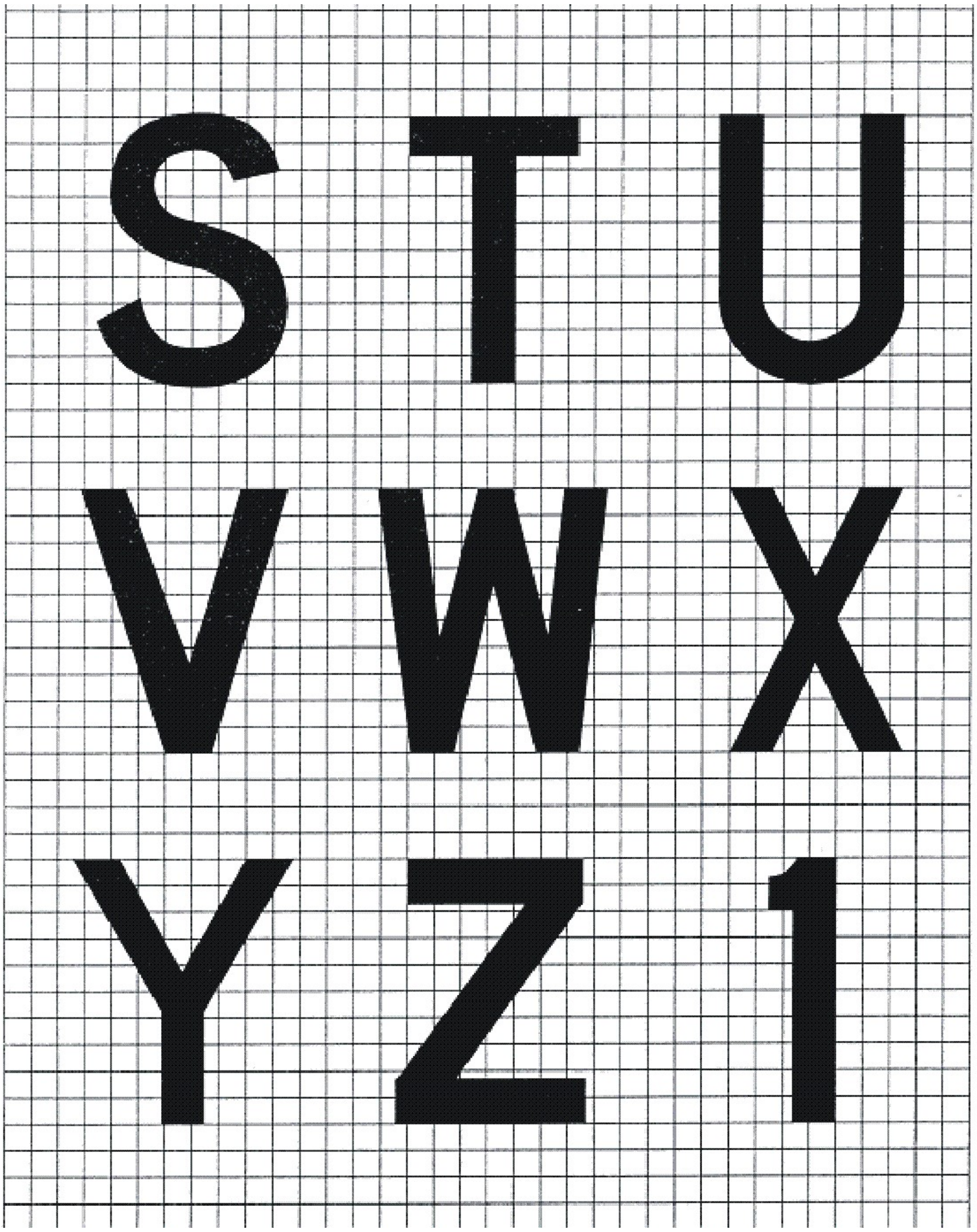


Figure 8.6-3: Form and proportion of letters, numbers and symbols used on Movement Area Guidance Signs

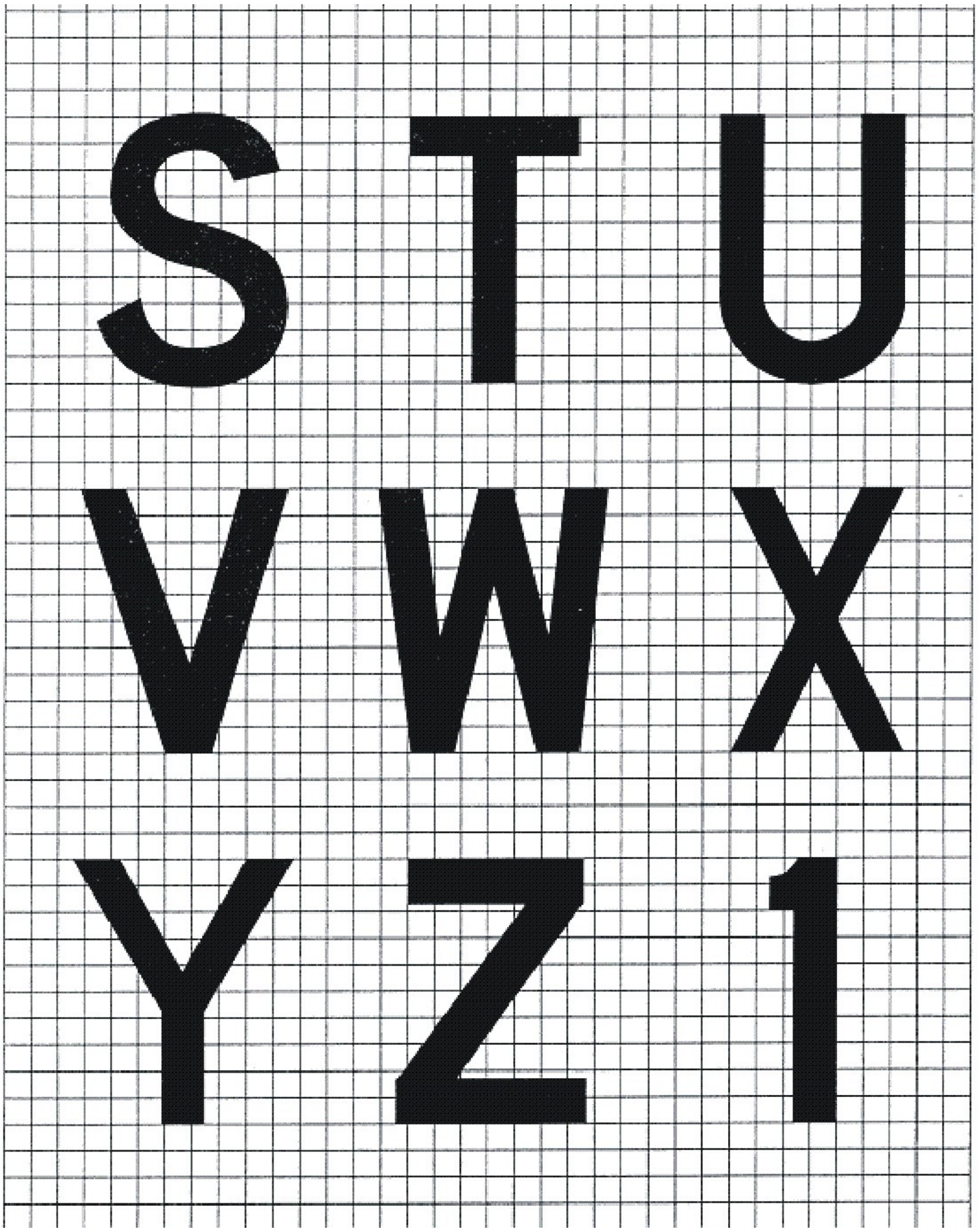


Figure 8.6-4: Form and proportion of letters, numbers and symbols used on Movement Area Guidance Signs

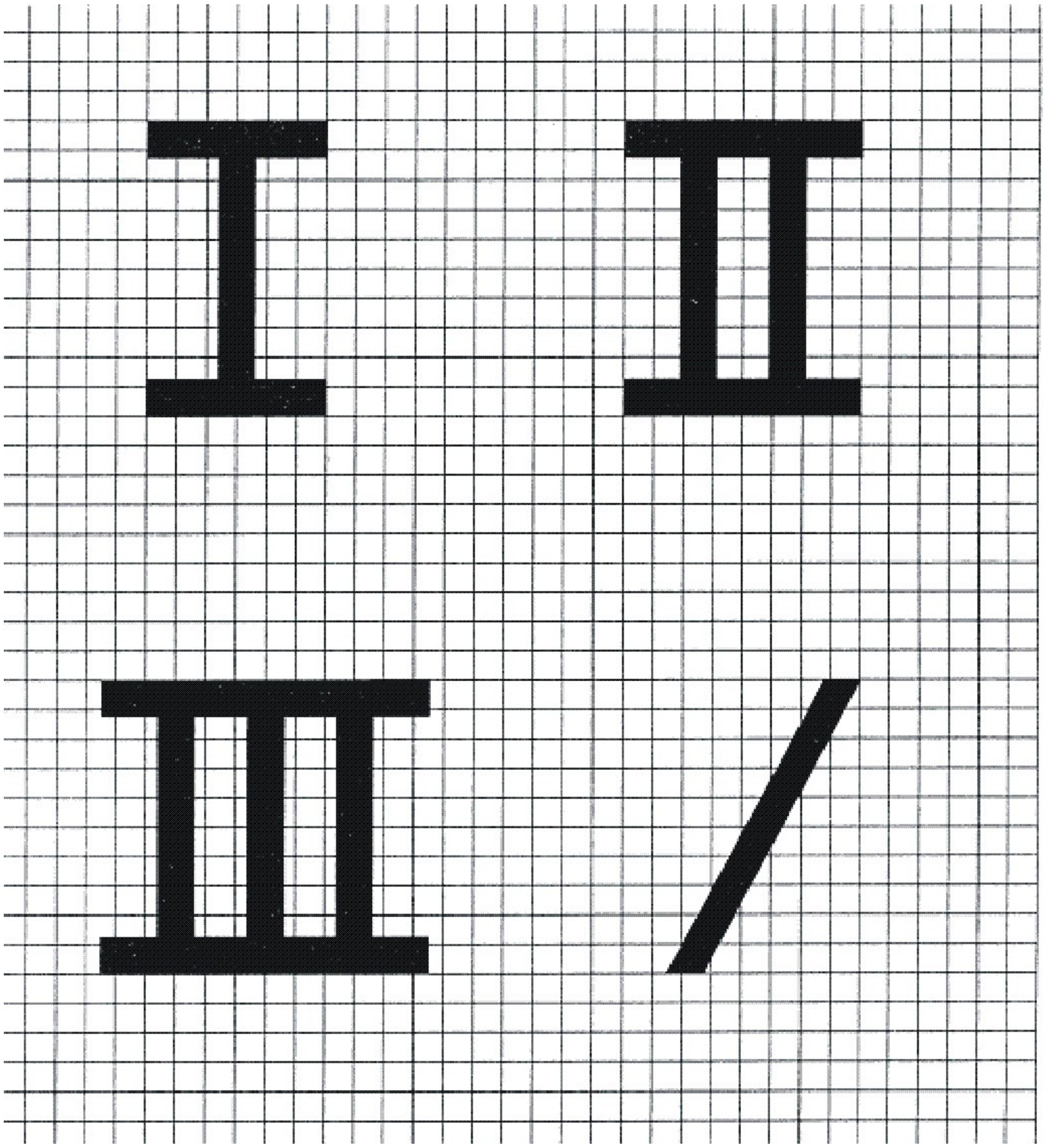
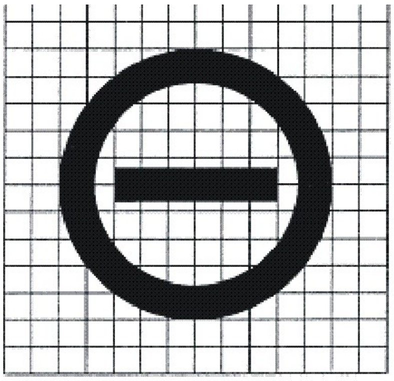
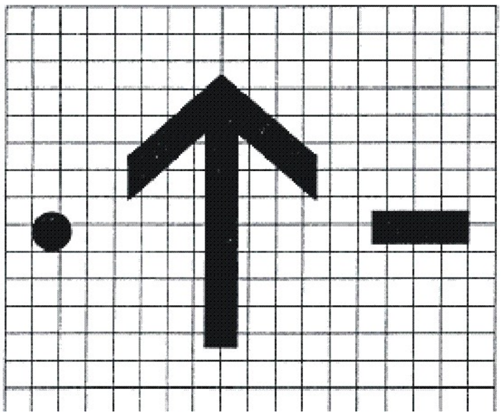


Figure 8.6-5: Form and proportion of letters, numbers and symbols used on Movement Area Guidance Signs



NO ENTRY sign



Note 1.— The arrow stroke width, diameter of the dot, and both width and length of the dash shall be proportioned to the character stroke widths.

Note 2.— The dimensions of the arrow shall remain constant for a particular sign size, regardless of orientation.

Figure 8.6-6: Form and proportion of letters, numbers and symbols used on Movement Area Guidance Signs

a) Letter to letter code number

Preceding Letter	Following Letter		
	B, D, E, F, H, I, K, L, M, N, P, R, U	C, G, O, Q, S, X, Z	A, J, T, V, W, Y
	Code number		
A	2	2	4
B	1	2	2
C	2	2	3
D	1	2	2
E	2	2	3
F	2	2	3
G	1	2	2
H	1	1	2
I	1	1	2
J	1	1	2
K	2	2	3
L	2	2	4
M	1	1	2
N	1	1	2
O	1	2	2
P	1	2	2
Q	1	2	2
R	1	2	2
S	1	2	2
T	2	2	4
U	1	1	2
V	2	2	4
W	2	2	4
X	2	2	3
Y	2	2	4
Z	2	2	3

b) Numeral to numeral code number

Preceding Numeral	Following number		
	1, 5	2, 3, 6, 8, 9, 0	4, 7
	Code number		
1	1	1	2
2	1	2	2
3	1	2	2
4	2	2	4
5	1	2	2
6	1	2	2
7	2	2	4
8	1	2	2
9	1	2	2
0	1	2	2

c) Space between characters

Code No.	Letter 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

Letter	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 character of the height in order to provide a good visual balance.
3. Where the numeral follows a letter or vice versa use Code 1.
4. Where a hyphen, dot, or diagonal stroke follows a character or vice versa use Code 1.

Figure 8.6-7: Form and proportion of letters, numbers and symbols used on Movement Area Guidance Signs

8.6.4.4 The face width of a sign must provide on either side of the legend a minimum width equal to half the height of the legend. In the case of a single letter sign, this width must be increased to the height of the legend. In all cases, the face width of a mandatory instruction sign provided on one side of a taxiway only, must 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 1or 2.

8.6.5 Structural

8.6.5.1 MAGS must be lightweight and frangibly mounted. They must be constructed so as to withstand a wind velocity of up to 60 m/sec without sustaining damage. Mountings must be constructed so as to fail, for frangibility requirements, under a static load not exceeding 8 kPa distributed over the sign face.

8.6.6 Illumination

8.6.6.1 All MAGS, except those where internal illumination is provided, must be made of retro-reflective class one material. Illumination must be provided to all mandatory instruction signs and information signs meant for use by code 4 aircraft. Illumination is optional for information signs intended to serve Code 1, 2 or 3 aircraft; however, if the location of a sign is such that the retro-reflectiveness is ineffective, illumination must be provided. Both external or internal illumination is acceptable, but care must be taken, to prevent dazzle.

8.6.6.2 The average sign luminance must be as follows:

(a) where operations are conducted in runway visual range of less than 800 m, the average sign luminance must be at least:

Red	30 cd/m^2
Yellow	150 cd/m^2
White	300 cd/m^2

(b) where operations are conducted at night, in runway visual range of 800 m or greater, average sign luminance must be at least:

Red	10 cd/m^2
Yellow	50 cd/m^2
White	100 cd/m^2

8.6.6.3 The luminous ratio between red and white elements of a mandatory sign must not be less than 1:5 and not greater than 1:10.

8.6.6.4 The average luminance of the sign must be calculated in accordance with ICAO Annex 14, Volume 1, Appendix 4, Figure 4.1.

8.6.6.5 In order to achieve uniformity of signal, luminance values must not exceed a ratio of 1.5:1 between adjacent grid points. Where the grid spacing is 7.5 cm, the ratio between luminance values of adjacent grid points must not exceed a ratio of 1.25:1. The ratio between the maximum and minimum luminance value over the whole sign face must not exceed 5:1.

8.6.6.6 At an aerodrome where land and hold short operations (LAHSO) are conducted, the signs specifically provided for LAHSO such as runway/runway intersection signs and distance-to-go signs must be electrically connected such that they will be illuminated when the lighting of the runway on which LAHSO are conducted is switched on.

8.6.6.7 Runway exit signs that are required for LAHSO must be illuminated where LAHSO are conducted at night.

8.6.6.8 Signs must have colours red, white, yellow and black, that comply with the relevant recommendations in ICAO Annex 14, Volume 1, Appendix 1, for externally illuminated signs, retro-reflective signs and transilluminated signs, as appropriate.

8.6.7 MAGS with Mandatory Instructions

8.6.7.1 MAGS with mandatory instructions include runway designation signs, category I, II or III holding position signs, runway-holding position signs, Aircraft NO ENTRY signs, vehicular STOP signs and runway/runway intersection signs.

8.6.8 Runway Designation Signs

8.6.8.1 A runway designation sign, as illustrated in Figure 8.6-8, must be provided at a runway/taxiway intersection, where a pattern 'A' runway holding position marking is provided. Only the designation for one end of the runway must be shown where the taxiway intersection is located at or near that end of the runway. Designations for both ends of the runway, properly orientated with respect to the viewing position of the sign, must be shown where the taxiway is located elsewhere.

8.6.8.2 A taxiway location sign must be provided alongside the runway designation sign, in the outboard (farthest from the taxiway) position.

8.6.8.3 A runway designation sign must be provided at least on the left side of a taxiway facing the direction of approach to the runway. Where practicable, a runway designation sign is to be provided on each side of the taxiway.

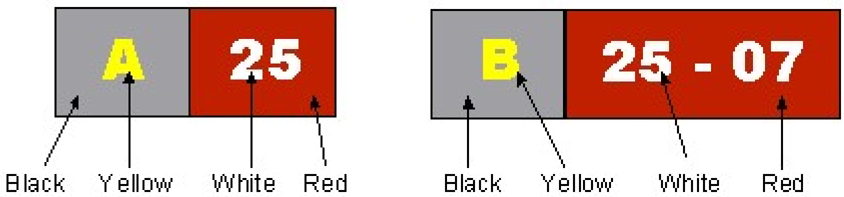


Figure 8.6-8: Runway designation signs with taxiway location sign

8.6.9 Category I, II or III Runway Designation Signs

8.6.9.1 Where a pattern 'B' taxi-holding position marking is provided, the sign, as shown below, must be provided on each side of the taxiway.

Figure 8.6-9: Category I runway-holding position sign

8.6.10 Runway Holding Position Sign

8.6.10.1 Runway-holding position signs must be provided at a taxiway location other than an intersection where the air traffic control has a requirement for aircraft to stop, such as entry to an ILS sensitive area. The sign is a taxiway designation sign, but with white lettering on a red background.

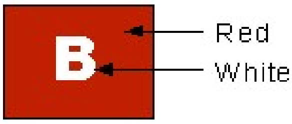


Figure 8.6-10: Mandatory runway-holding position sign

8.6.11 Aircraft NO ENTRY Sign

8.6.11.1 A NO ENTRY sign, consisting of a white circle with a horizontal bar in the middle, on a red background, must be provided at the entrance of an area to which entry is prohibited. Where practicable, a NO ENTRY sign must be located on each side of the taxiway.

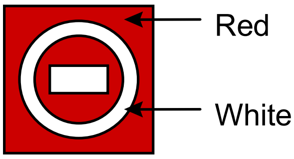


Figure 8.6-11: Aircraft NO ENTRY sign

8.6.12 Vehicular STOP Signs

8.6.12.1 Where required, vehicular 'STOP' signs can be provided at road/taxiway intersections, road holding positions, or entrance to ILS sensitive areas. This sign should be the same as a local road traffic sign. In addition, the vehicular holding position should be marked in accordance with local traffic pavement marking. See also Section 6.4 for provision and location of a road-holding position.

8.6.13 Runway/Runway Intersection Signs

8.6.13.1 These are runway designation signs, which must be provided on each side of the runway used in LAHSO, to identify the intersecting runway ahead. The sign must show the designation of the intersecting runway, oriented with respect to the viewing position of the sign, and separated by a dash. For example, '15-33' indicates the runway threshold '15' is to the left, and '33' is to the right. Signs are to be located at the Hold Short Line which must be at least 75 m from the centreline of the intersecting runway.

8.6.13.2 The overall height of the sign above the ground, and offset from the edge of the runway pavement, must be such as to provide at least 300 mm clearance between the top of the sign and any part of any aircraft using the runway when the outer edge of the wheel of the aircraft is at the runway pavement edge.

8.6.14 MAGS with Information

8.6.14.1 MAGS with information include taxiway location signs, direction signs, destination signs, take-off run available signs, runway exit signs, distance to go signs, and, where required, LAHSO distance to go signs.

8.6.15 Taxiway Location Signs

8.6.15.1 A location sign is normally provided in conjunction with a direction sign or a runway designation sign.

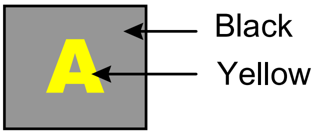


Figure 8.6-12: Taxiway location sign

8.6.16 Direction Signs

8.6.16.1 Each taxiway direction must be indicated by an arrow, as shown below. The sign must have black letters with yellow background. A direction sign must be complemented by a location sign, except where the taxiway designation is adequately displayed by previous location signs along the taxiway.

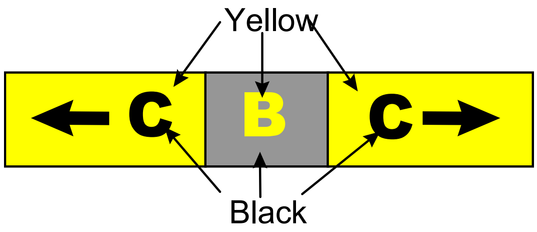


Figure 8.6-13: Direction/location/direction sign

8.6.16.2 At a taxiway/taxiway intersection, information signs must be located prior to the intersection and in line with the taxiway intersection marking.

8.6.17 Destination Signs

8.6.17.1 Destination signs must have black letters on yellow background, as shown below. They advise pilots of facilities on, or near, the movement area. This sign must not be co-located with a location or direction sign.

Figure 8.6-14: Destination sign

8.6.17.2 Examples of common sign text used for destination signs are set out below:

Sign text	Meaning
RAMP or APRON	General parking, servicing and loading area.
PARK or PARKING	Aircraft parking area
CIVIL	Civilian areas of joint-use aerodromes
MIL	Military area of a joint-use aerodrome.
CARGO	Freight or cargo handling area.
INTL	International areas
DOM	Domestic areas
RUNUP	Run-up areas
AC	Altimeter check point
VOR	VOR check point
FUEL	Fuel or service area
HGR	Hangar or hangar area

8.6.18 Take-off Run Available Sign

8.6.18.1 The take-off run available sign indicates to pilots the length of take-off run available from a particular taxiway, where intersection departures are available. This sign is provided to allow pilots to have final reassurance that they are at the correct take-off location:

(a) where the take-off point is close to the start of a runway, the sign is to show the designation of the take-off runway, and the take-off run available in metres, as shown in Figure 8.6-15.

(b) where the take-off point is not close to the start of the runway, the sign is to show the take-off run available in metres, plus an arrow, appropriately located and orientated, indicating the direction in which that take-off run is available, as shown in Figure 8.6-16.

(c) where intersection departures are available in both directions from the position, two signs, one for each direction of take-off, are required.

(d) the take-off run available signs are to be located abeam the runway-holding position on the entry taxiway. Where one take-off run available sign is provided, it is to be located on the left hand side of the taxiway. Where take-off is available in both directions, the two signs are to be located one on each side of the taxiway, corresponding to the direction of take-off. Take-off run available signs must not obscure a pilot's view of any mandatory instruction signs.

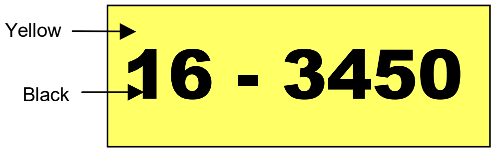


Figure 8.6-15: Take off run available sign

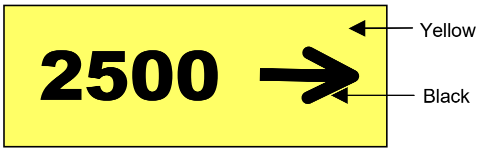


Figure 8.6-16 Take-off run available sign

8.6.19 Runway Exit Signs

8.6.19.1 Runway exit signs, as shown below, advise pilots of the designation and direction of a taxiway from which they can exit. Must be provided for a runway used in LAHSO, except when used only by Performance Category A aircraft, as defined in the AIP. For this purpose, Non-jet aircraft below 5,700 kg may be regarded as Category A aircraft.

8.6.19.2 The sign must consist of black lettering on a yellow background, with a black arrow outboard of the taxiway designator, or to the right of the designator for exits to the right, and to the left for exits to the left.

8.6.19.3 The runway exit sign must be located on the same side of the exit taxiway, 60 m prior to the exit junction where the runway code number is 3 or 4 and 30 m where the runway code number is 1 or 2.

Figure 8.6-17: Runway exit sign

8.6.20 LAHSO Distance To Go Signs

8.6.20.1 LAHSO distance to go signs may be required at a runway where a pilot engaged in LAHSO cannot readily see the hold short line due to runway geometry. Where needed, the distance to go signs must be provided on the left-hand side of the runway as seen by the landing pilot, in increments of 300 m from the hold short line. Three signs with inscriptions of 300, 600 and 900 must be provided. Below the numerals, the designation of the intersecting runway must be displayed in smaller characters, as shown below.

8.6.20.2 The sign must consist of black letters and numbers, on a yellow background. The height of the distance inscription must be 600 mm and the runway designation 200 mm.

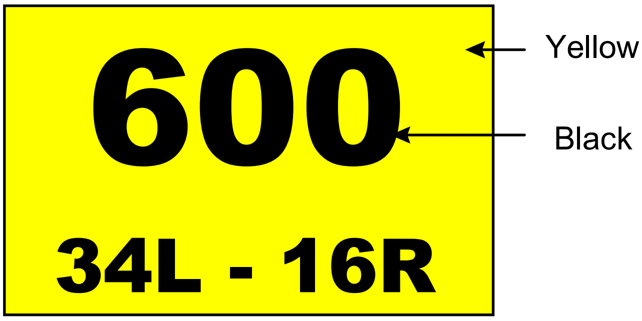


Figure 8.6-18: Distance-to-go sign

Section 8.7: Wind Direction Indicators

8.7.1 Requirements

8.7.1.1 RCARs (Aerodromes) requires the aerodrome operator to install and maintain at least one wind direction indicator at the aerodrome. RCAA may issue directions requiring additional wind direction indicators to be provided.

8.7.1.2 RCARs (Aerodromes) also requires that non-precision approach runways be provided with a wind direction indicator at the threshold of the runway. However, subject to paragraph 8.7.1.3, for runways 1200m or less in length one centrally located wind direction indicator visible from both approaches and the aircraft parking area is acceptable.

8.7.1.3 Paragraph 8.7.1.2 does not apply to a runway if surface wind information is passed to the pilots of aircraft approaching the runway through:

(a) an automatic weather observing system that:

(i) is compatible with the Bureau of Meteorology weather observing system, and

(ii) provides surface wind information through an aerodrome weather information broadcast, or

(b) an approved observer having a communication link with pilots through which timely information about surface wind may be clearly passed to them; or

(c) any other approved means of providing surface wind information.

8.7.1.4 A wind direction indicator must be located so as to be visible from aircraft that are in flight or aircraft that are on the movement area.

8.7.1.5 A wind direction indicator must be located so as to be free from the effects of air disturbance caused by buildings or other structures.

8.7.1.6 A wind direction indicator provided at the threshold of a runway must be located:

(a) except if it is not practicable to do so, on the left hand side of the runway as seen from a landing aircraft; and

(b) outside the runway strip; and

(c) clear of the transitional obstacle limitation surface.

8.7.1.7 If practicable to do so, a wind direction indicator provided at the threshold of a runway must be located 100 metres upwind of the threshold.

8.7.2 Standards

8.7.2.1 A wind direction indicator must consist of a tapering fabric sleeve attached to a pole at its wide end 6.5 m above the ground.

8.7.2.2 The sleeve must be 3.65 m long and taper from 900 millimetres in diameter to 250 millimetres in diameter.

8.7.2.3 The wide end must be mounted on a rigid frame to keep the end of the sleeve open and attached to the pole so as to allow it to move around freely.

8.7.2.4 The fabric of the primary wind direction indicator must be white and that of any additional wind direction indicator must be:

(a) yellow; if it is not intended to be illuminated at night; or

(b) if it is intended to be illuminated at night; either white, or another colour that is clearly visible when illuminated.

> **Note:** Natural or synthetic fibres having weight range of at least 270 to 275 g/m^2 have been used effectively as wind indicator sleeve material.

8.7.2.5 The primary wind direction indicator must be located in the centre of a circle 15 m in diameter, coloured black and bordered:

(a) by a white perimeter 1.2 m wide; or

(b) by a ring of 15 equally spaced white markers each with a base not less than 0.75 m in diameter.

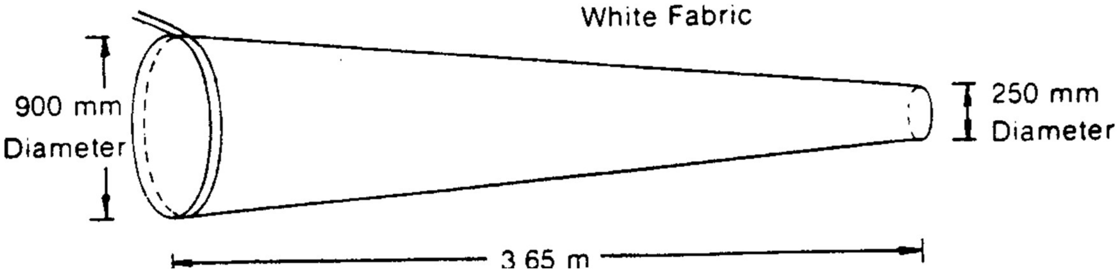


Figure 8.7-1: Wind Direction Indicator

8.7.2.6 For the illumination of wind direction indicators see Chapter 9.

Section 8.8: Ground Signals

8.8.1 Signal Areas

8.8.1.1 A signal area must be:

(a) 9 metres in diameter;

(b) black,

(c) bordered by:

(i) a white border 1 metre wide; or

(ii) 6 equally spaced white markers, each with a base not less than 0.75 m in diameter; and

(d) not more than 15 m from the wind direction indicator, or, if applicable, the primary wind direction indicator. The primary wind direction indicator is located closest to the apron of the aerodrome.

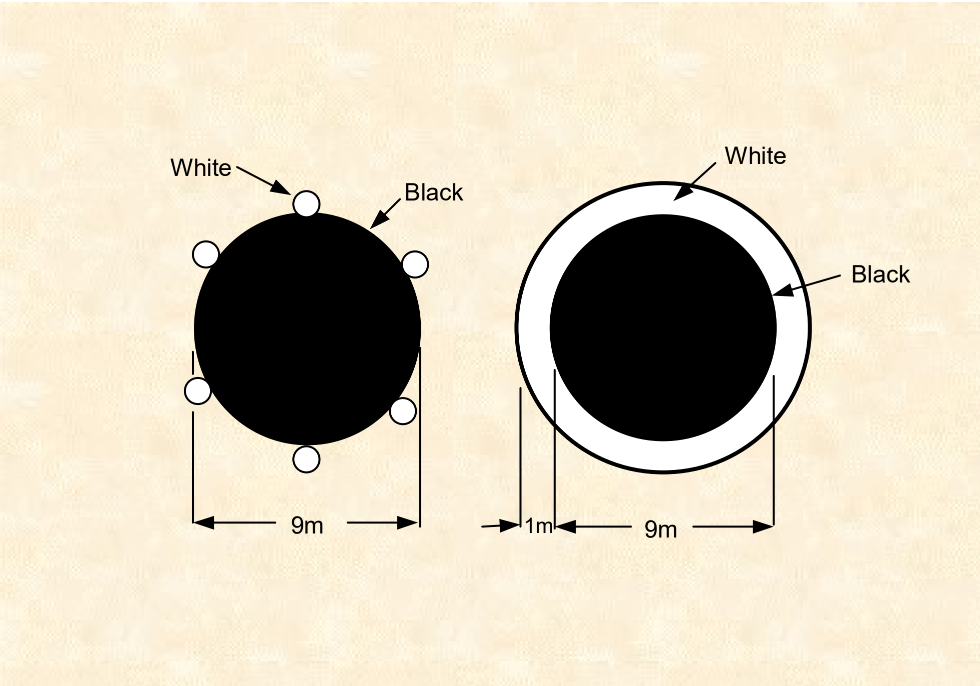


Figure 8.8-1: Signal Area

8.8.2 Ground Signals in Signal Area

8.8.2.1 A 'total unserviceability' signal must be displayed in a signal area when an aerodrome is closed to landing aircraft.

8.8.2.2 A 'total unserviceability' signal must consist of 2 white strips not less than 0.9 m wide and 6 m long, bisecting each other at right angles.

8.8.2.3 A 'restricted operations' signal must be displayed in the signal area at an aerodrome with more than one type of surface on its movement area, if aircraft are only to use:

(a) the sealed runways, taxiways and aprons; or

(b) the gravel runways; where there are no sealed runways, taxiways and aprons.

8.8.2.4 For the purposes of Paragraph 8.8.2.3:

(a) a sealed runway, taxiway or apron is one whose surface is wholly or mainly sealed; and

(b) a gravel runway, taxiway or apron is one whose surface is wholly or mainly gravel.

(c) the 'restricted operations' signal must consist of 2 white circles 1.5 m in diameter, connected by a white cross bar 1.5 m long and 0.4 m wide.

(d) a 'glider operations' signal, must consist of a white strip 5 m long and 0.4 m wide crossed at right angles by 2 strips 0.4 m wide and 2.5 m long, each being 1.05 m from the closest end of the horizontal strip, as shown below.

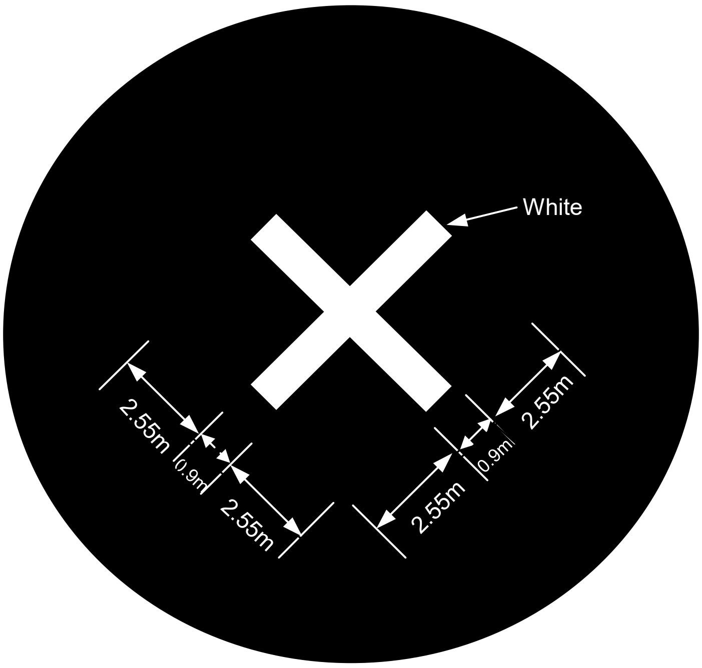


Figure 8.8-2: Total unserviceability signal

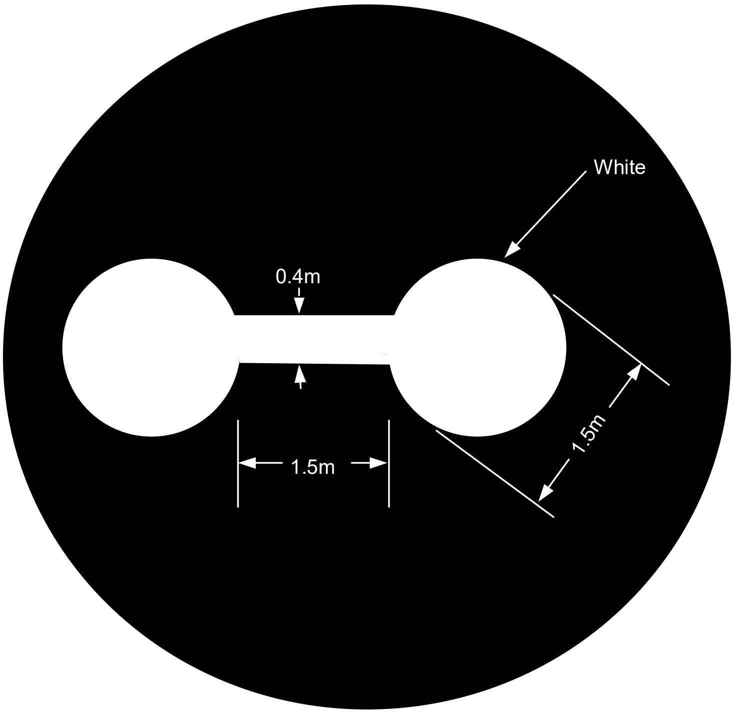


Figure 8.8-3: Restricted operations signal

Section 8.9: Marking of Unserviceable and Work Areas

8.9.1 Introduction

8.9.1.1 This section identifies the markings used on unserviceable areas of runways, taxiways, aprons and holding bays and markers used to mark the boundary of unserviceable areas and limit of work areas.

8.9.2 Marking of Unserviceable Areas on Runways, Taxiways and Aprons

8.9.2.1 An unserviceability marking or closed marking must be used to indicate any part of a runway, which is not to be used by aircraft. The marking must comprise a white cross placed on the unserviceable portion of the runway.

8.9.2.2 An unserviceability marking may also be used to indicate any part of a taxiway or apron, which is not to be used by aircraft. The preferred way of marking an unserviceable part of taxiway or apron, is by the placement of unserviceable markers at the entrance to that area or around the unserviceable area.

8.9.2.3 There are two types of unserviceability markings, shown in Figure 8.9-1 and Figure 8.9-2. Where feasible, the larger marking is the preferred marking for a runway.

8.9.2.4 Unserviceability marking is not required for time-limited works.

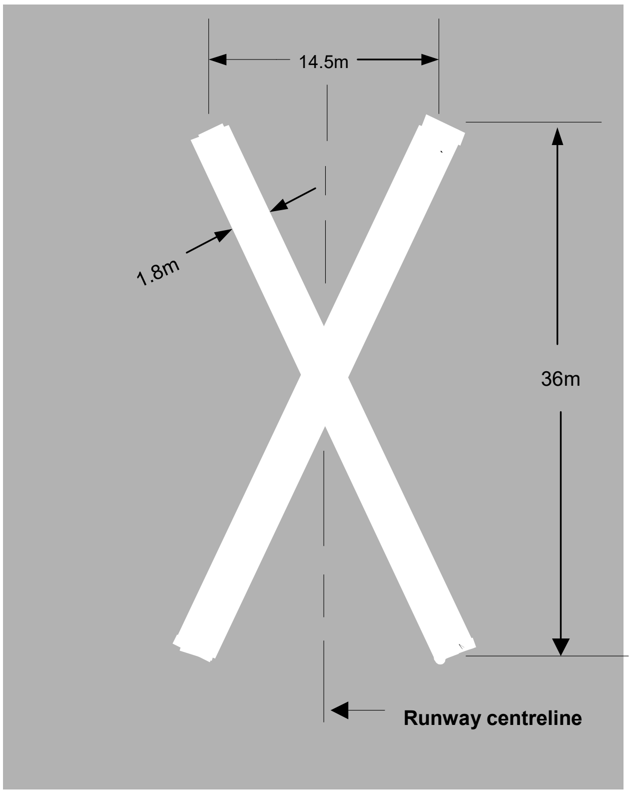


Figure 8.9-1: Unserviceability (closed runway) marking

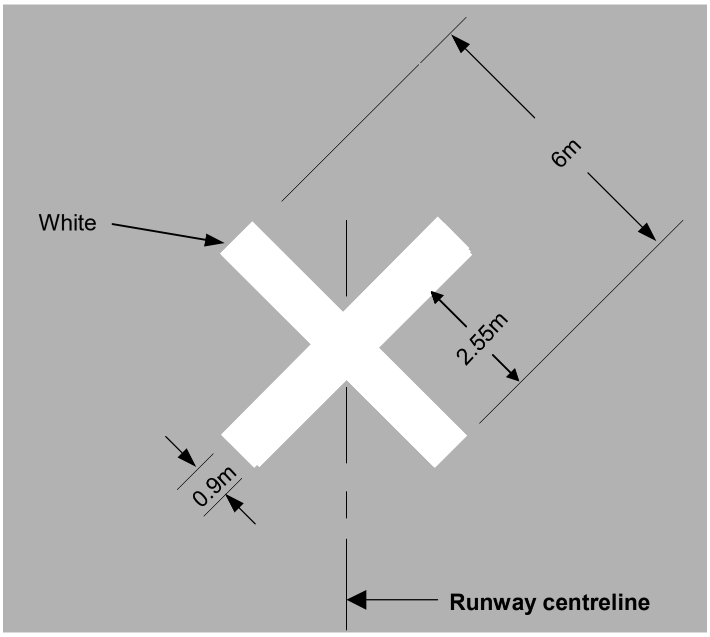


Figure 8.9-2: Unserviceability marking

8.9.2.5 The larger marking must be used on Code 4 runways when the whole or part of the runway is permanently closed or closed to aircraft operations, for more than 30 days. Markings must be displayed at each end of the unserviceable runway, and also in the intermediate area, at intervals of not more than 300 m.

8.9.2.6 The larger making should be used at an aerodrome with multiple and parallel Code 3 runways, when one or more runways, or part of a runway is closed for more than 30 days. Where provided, the markings must be displayed in accordance with Paragraph 8.9.2.5.

8.9.2.7 In other cases of runway unserviceability, if markings in accordance with the larger configuration are not used, then the smaller marking must be used. The smaller markings must be displayed at each end of the unserviceability and in the intermediate area at intervals of not more than 200 m.

8.9.3 Use of Unserviceability Markers

8.9.3.1 Unserviceability markers are shown in Figure 8.2-1. They must consist of a white standard cone with a horizontal red stripe, 25 cm wide around its centre, half way up the cone, so as to provide three bands of colour, white-red-white.

8.9.3.2 Unserviceability markers must be displayed wherever any portion of a taxiway, apron or holding bay is unfit for the movement of aircraft but is still possible for aircraft to bypass the area safely.

8.9.4 Works Limit Markers

8.9.4.1 Works limit markers, shown in Figure 8.2-1, where used, must be spaced at intervals marginally less than the smallest track of the plant or vehicles operating within the work area.

8.9.4.2 Other forms of work limit markers may be used for works on apron and other areas provided they are not a hazard to aircraft and other airside vehicles operating in the vicinity of the works area.

Section 8.10: Obstacle Markings

8.10.1 General

8.10.1.1 Fixed objects, temporary and permanent, which extend above the obstacle limitation surfaces but are permitted to remain; or objects which are present on the movement area, are regarded as obstacles, and must be marked. The aerodrome operator must submit details of such obstacles to RCAA, for hazard assessment and particular requirements for marking and lighting. This information must be included in the Aerodrome Manual.

8.10.1.2 RCAA may permit obstacles to remain unmarked;

(a) when obstacles are sufficiently conspicuous by their shape, size or colour;

(b) when obstacles are shielded by other obstacles already marked; or

(c) when obstacles are lighted by high intensity obstacle lights by day.

8.10.2 Marking of Obstacles

8.10.2.1 A structure must be marked when more than 150 m higher than the surrounding terrain. Surrounding terrain means the area within 400 m of the structure. Structures above 90 m may need to be marked, and inconspicuous structures 75 m above ground level should also be marked. Fixed objects on the aerodrome movement area, such as ILS buildings, must be marked as obstacles.

8.10.2.2 Obstacles other than wires and cables, must be painted in a pattern of contrasting colours which also contrast with the background, as agreed and set out in the Aerodrome Manual. Orange and white or red and white are normally used.

8.10.2.3 Obstacles with unbroken surfaces more than 4.5 m by 4.5 m size, must be painted in a chequered pattern of lighter and darker squares or rectangles, with sides no less than 1.5 m and no more than 3 m long, as shown in Figure 8.10-1. The corners of the obstacle must be painted in the darker colour.

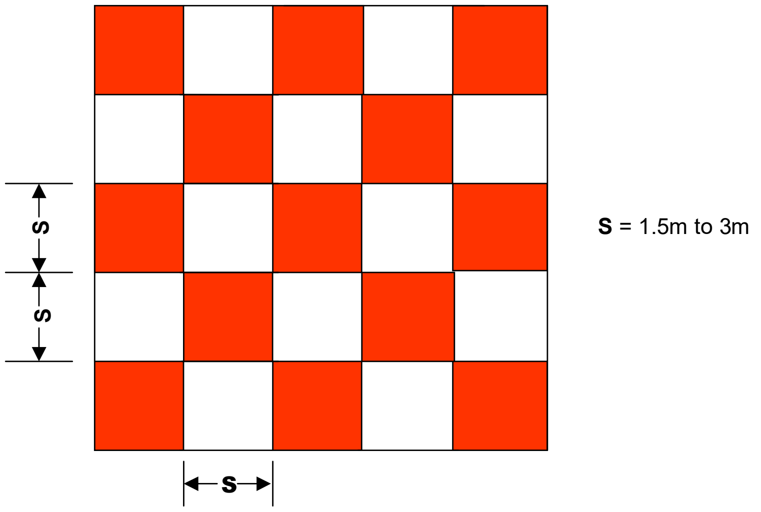


Figure 8.10-1: Marking of square face obstacle

8.10.2.4 Obstacles more than 1.5 m size in one direction and less than 4.5 m in the other, or any lattice obstacle greater than 1.5 m in size in both directions, must be marked with alternating contrasting bands of colour, with the ends painted in the darker colour, as shown in Figure 8.10-2. The bands must be perpendicular to the longest dimension and have a width approximately 1/7 of the longest dimension or 30 m, whichever is less.

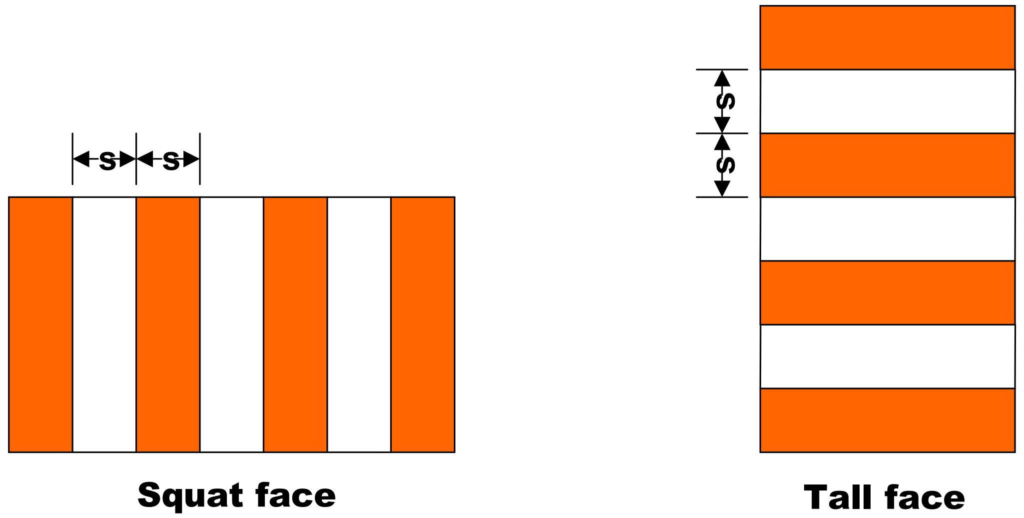


Figure 8.10-2: Marking of squat or tall face objects

8.10.2.5 Obstacles with any dimension less than 1.5 m, except for masts, poles and towers described in Paragraph 8.10.2.6, must be painted in a solid contrasting colour.

8.10.2.6 Masts, poles and towers must be marked in contrasting bands with the darker colour at the top, as shown in Figure 8.10-3. The bands must be perpendicular to the longest dimension and have a width approximately 1/7 of the longest dimension or 30 m, whichever is less.

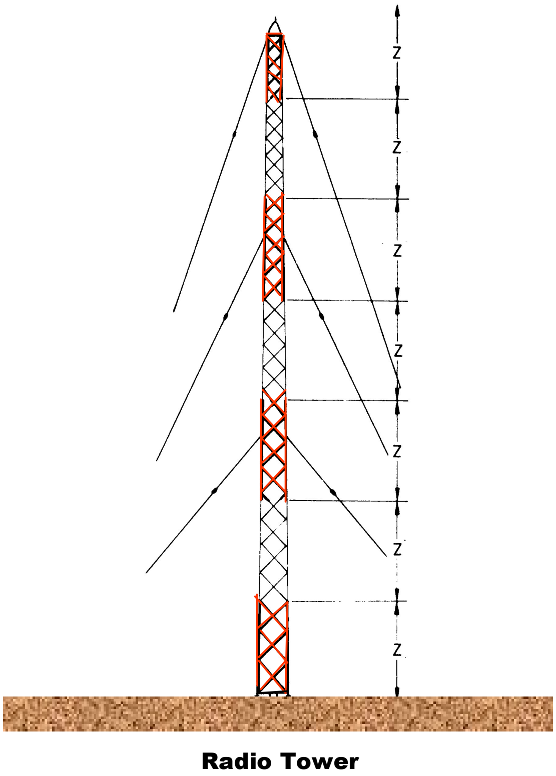


Figure 8.10-3: Marking of mast, pole and tower

8.10.2.7 Fence posts which are determined to be obstacles, must be painted in a single conspicuous colour, normally white.

8.10.2.8 Wires or cable obstacles must be marked using three-dimensional coloured objects such as spheres and pyramids, etc; of a size equivalent to a cube with 600 mm sides, spaced 30 m apart.

8.10.3 Marking of Temporary and Transient Obstacles

8.10.3.1 Temporary and transient obstacles may be required by RCAA to be marked. Fixed temporary obstacles should be marked as described above for permanent obstacles. Where this is not practicable, RCAA accepts the use of unserviceability cone markers and/or flags to delineate the shape and size of the obstacle so that it is clearly visible from any line of approach likely to be used by an aircraft.

8.10.3.2 Flags used for marking fixed temporary obstacles must be not less than 0.6 m square. They must be either orange or orange and white, split diagonally. Where orange merges with the background, another conspicuous colour must be used.

8.10.4 Marking of Vehicles

8.10.4.1 A vehicle used regularly on the manoeuvring area by day should be painted a single conspicuous colour, preferably yellow or orange. Where so painted, it does not require additional marking.

8.10.4.2 Vehicles not painted yellow or orange must be marked, by using either:

(a) flags; or

(b) vehicle warning lights, in accordance with paragraph 9.19.1.

8.10.4.3 Flags must be not less than 0.9 m square and consist of an orange and white chequered pattern, each square of which must have sides not less than 0.3 m. Where orange merges with the background, another colour that contrasts with the background must be used.

8.10.4.4 For marking of rescue and firefighting service vehicles, see MOS 139, Subpart H, Chapter 4.

Section 8.11: Helicopter Areas on Aerodromes

8.11.1 Introduction

8.11.1.1 At aerodromes used by both helicopters and fixed wing aircraft, specific markings must be provided on facilities for the exclusive use of helicopters.

8.11.2 Helicopter Landing and Lift-off Area Markings

8.11.2.1 Where a specific area other than the runway, is provided for the landing and lift-off of helicopters, the area must be marked by a circle, painted white, with an inside radius of 6 m and a line width of 1 m. A white 'H' marking must be provided, located centrally within the circle, aligned with the orientation of the helicopter landing direction. The dimensions of the H marking must be 6 m high and 3 m wide, with a line width of 1 m.

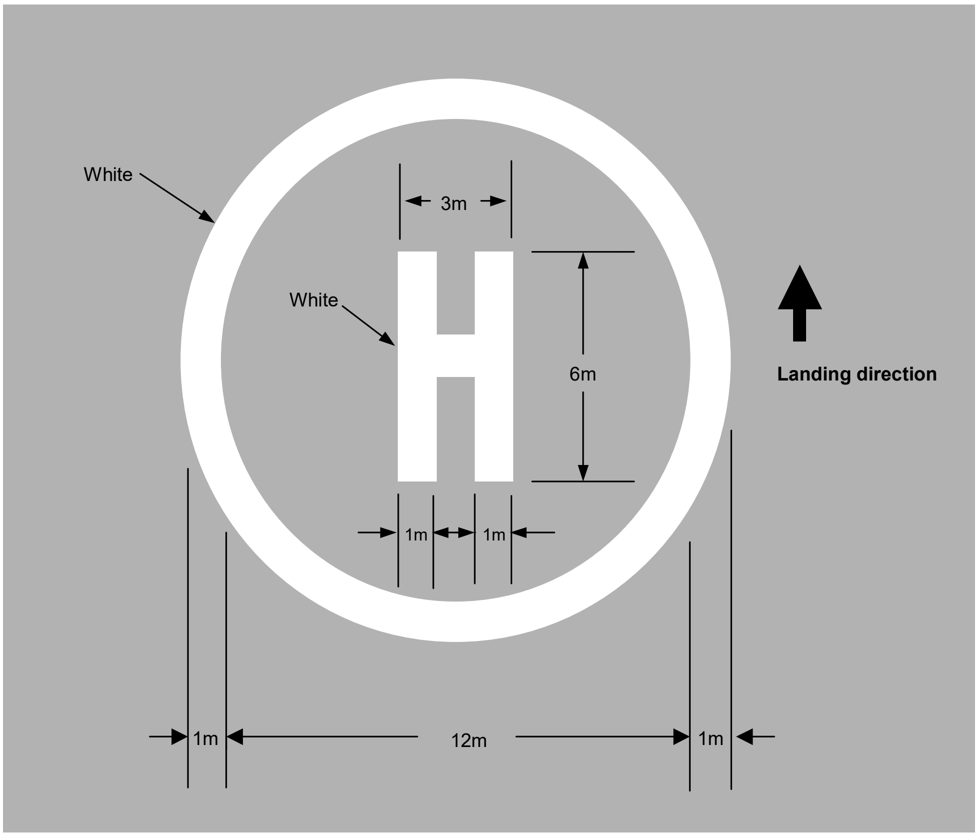


Figure 8.11-1: Helicopter landing and lift-off marking

8.11.3 Helicopter Apron Markings

8.11.3.1 Helicopter apron markings comprise taxi guidelines, lead-in lines and helicopter parking position markings. Markings for taxi guidelines and lead-in lines to dedicated helicopter parking positions must be the same as for fixed wing aircraft.

8.11.4 Helicopter Parking Position Markings

8.11.4.1 Where a dedicated helicopter parking position is provided on a sealed, concrete or asphalt apron, it must be marked with the letter 'H', painted yellow, 4 m high, 2 m wide with line width 0.7 m. The marking must conform to the shape and proportions shown in Figure 8.11-2.

8.11.4.2 The letter H must be located centrally in the parking position and aligned with the desired orientation of the helicopter when parked. This marking also serves as the parking position designator.

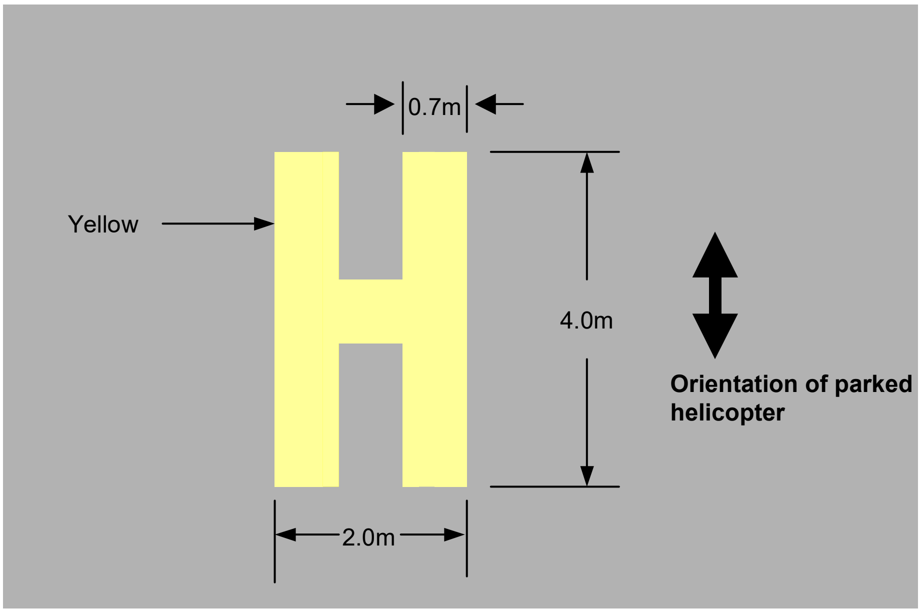


Figure 8.11-2: Helicopter parking position marking

8.11.5 Helicopter Taxi Guideline Designation

8.11.5.1 Designation must be provided where a taxi guideline leads to a parking position which is restricted to helicopters only. Where an apron contains both fixed wing and dedicated helicopter parking positions, taxi guidelines leading to dedicated helicopter parking positions must be marked with a 2 m high, yellow designator 'H', at their divergence from the aircraft taxi guideline, as shown in Figure 8.11-3.

8.11.5.2 These designations must be located and oriented in such a way that they can be seen by the pilot of an aircraft 15 m away on the taxi guideline.

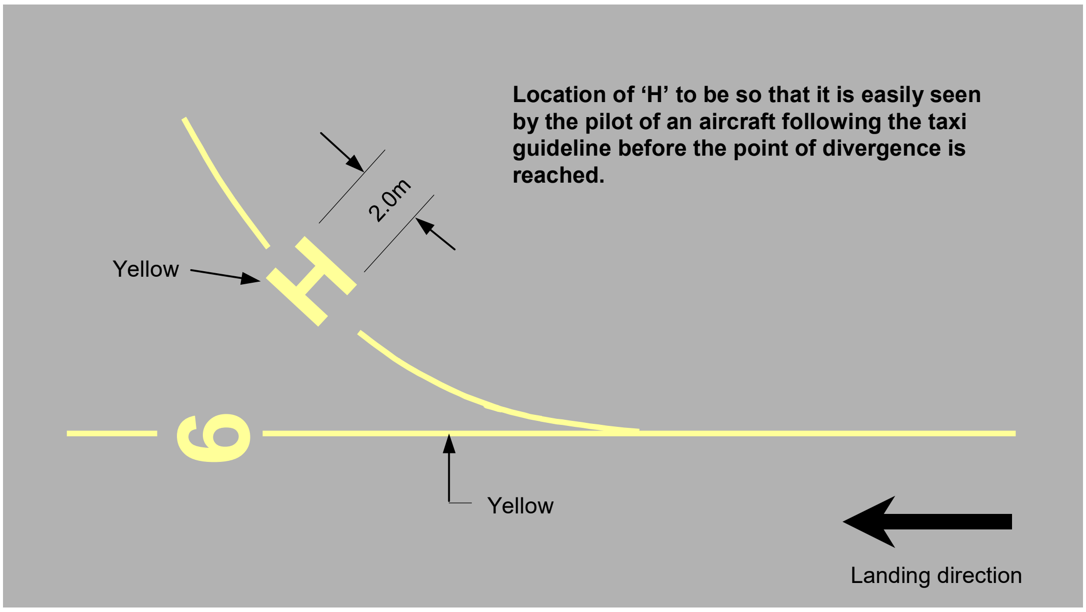


Figure 8.11-3: Helicopter taxi guideline designator

8.11.6 Helicopter Parking Position Numbers

8.11.6.1 Parking position numbers must be provided when there is more than one helicopter parking position on an apron. All parking positions must be numbered above, and below the helicopter parking position marking. Numbers must be 2 m high, painted yellow, as illustrated in Figure 8.11-4.

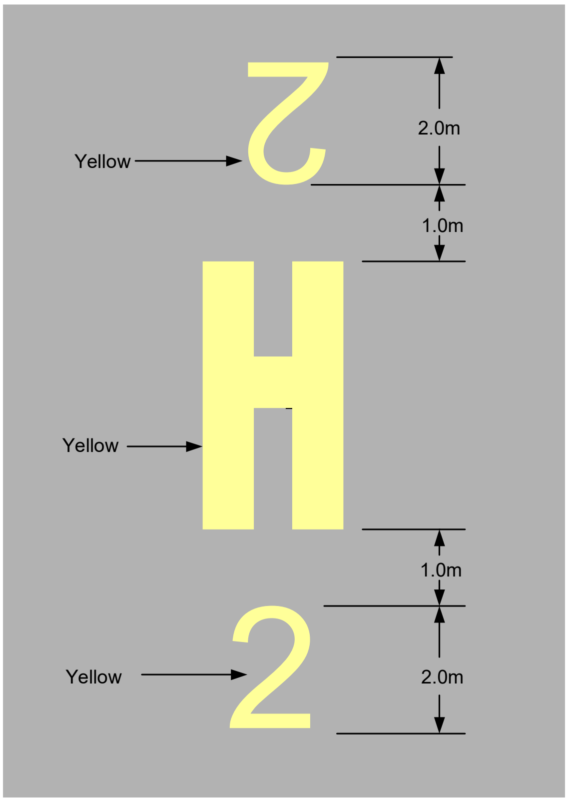


Figure 8.11-4: Helicopter parking position number

8.11.7 Helicopter Apron Edge Markings

8.11.7.1 Apron edge markings must be provided when it is necessary to clearly define areas allocated specifically for helicopter parking.

8.11.7.2 On sealed, concrete or asphalt aprons, the edge marking must consist of two continuous lines 0.15 m wide, 0.15 m apart, painted light blue. Additionally, the words 'HELICOPTER ONLY' must be painted in yellow, along the edge marking, outside the helicopter apron, and legible to pilots of approaching aircraft. The letters must be 0.5 m high, located 0.15 m from the helicopter apron edge marking. These words must be spaced at intervals not exceeding 50 m, along the helicopter apron edge marking, as shown below.

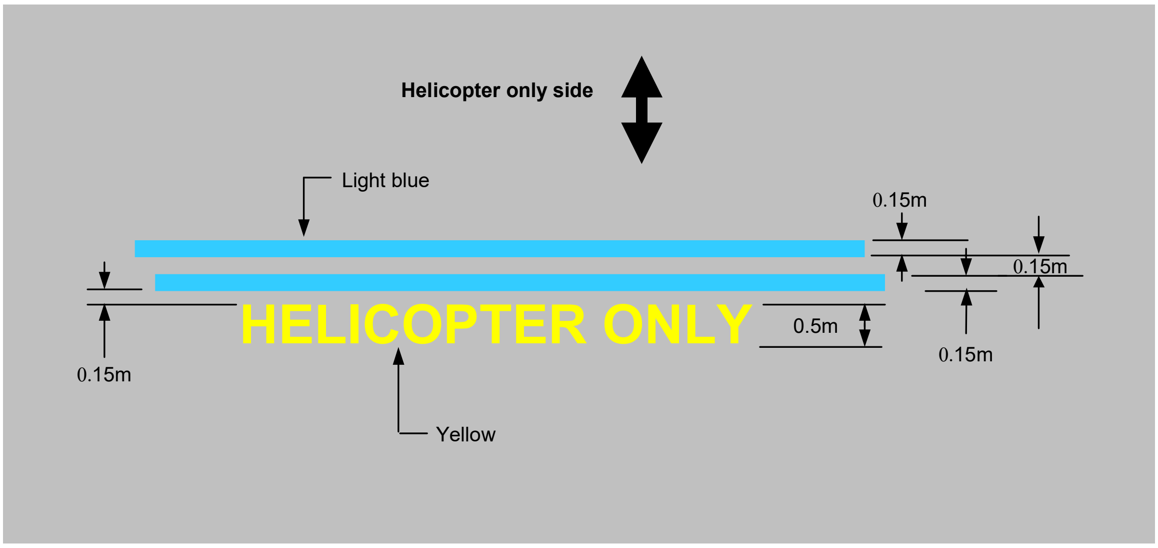


Figure 8.11-5: Helicopter apron edge markings

8.11.7.3 On gravel or natural surfaces, the apron must be marked using light blue cones; spaced at a minimum of 30 m, and a maximum of 60 m apart.

CHAPTER 9: VISUAL AIDS PROVIDED BY AERODROME LIGHTING

Section 9.1: General

9.1.1 Application and Definitions

9.1.1.1 Existing installed lighting systems must be operated and maintained in accordance with existing procedures. The standards in this Chapter do not apply to an existing lighting facility until:

(a) the light fittings of a lighting system are being replaced with fittings of a different type. A lighting system in this case has the following meaning: lights on a section of taxiway (not all taxiways), lights on a threshold (not all thresholds) etc.

(b) the facility is upgraded;

(c) there is a change in the category of either:

(i) aerodrome layout; or

(ii) aerodrome traffic density; or

(d) for operations of the kind mentioned in sub-subparagraph (i) or (ii) — 29 May 2014, or an earlier date if an aerodrome operator so elects and tells RCAA in writing of the election, being aerodrome operations supporting:

(i) approaches in which the meteorological minima are as follows:

(A) decision height or minimum descent height less than 200 ft;

(B) visibility or runway visual range less than 550 m; or

(ii) take-offs in visibility of less than 550 m; or

(e) in exceptional circumstances, RCAA determines that in the interests of safety a lighting facility must meet the standards of this Chapter.

9.1.1.2 For aerodrome lighting purposes, words used in this Chapter have the following meaning:

(a) **Aerodrome layout.** This means the number of runways, taxiways and aprons at an aerodrome provided with lighting, and is divided into the following categories:

(i) **Basic** – an aerodrome with one runway, with one taxiway to one apron area;

(ii) **Simple** – an aerodrome with one runway, having more than one taxiway to one or more apron areas;

(iii) **Complex** – an aerodrome with more than one runway, having many taxiways to one or more apron areas.

(b) **Aerodrome traffic density.** This means the number of aircraft movements in the mean busy hour, and is divided into the following categories:

(i) **Light** – not greater than 15 movements per runway or typically less than 20 total aerodrome movements;

(ii) **Medium** – 16 to 25 movements per runway or typically between 20 to 35 total aerodrome movements;

(iii) **Heavy** – 26 or more movements per runway or typically more than 35 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.
>
> 2: Either a take-off or a landing constitutes a movement.

(c) **Upgrade of a facility** has the same meaning as **Upgrade (for an aerodrome facility)** in Section 1.2.

> **Notes:**
>
> 1. The upgrade of a facility, including an aerodrome lighting system, is the trigger for a non-compliant system to be brought into compliance with the relevant MOS standards. Since the timing and budgeting of an upgrade is usually under the aerodrome operator's control, so too is the timing of works necessary to bring the non-compliant system into compliance with the MOS.
>
> 2. The following are examples of how RCAA interprets this standard:
>
> (a) if an approach lighting system requires new light fittings to be installed, for example because the existing fittings can no longer be maintained due to unavailability of spare parts, all aspects of the approach lighting system must be brought into compliance with the MOS, including, for example the photometric characteristics of the new approach lights and the frangibility standards;

> (b) if a runway (A) at an aerodrome is lengthened to accommodate larger or heavier aircraft, the runway lights must be extended and threshold and runway end lights relocated. If the existing runway lights, threshold lights or end lights do not comply with the MOS, lengthening runway A is a trigger for bringing all of the lighting on the runway into compliance with the MOS. However, this would not, of itself, trigger the requirement for all of the lighting on runway B at the aerodrome to be brought into compliance with the MOS;
>
> (c) if an apron (A) at an aerodrome is extended to accommodate more or larger aircraft, the changed apron and resultant apron floodlighting must comply with the MOS. However, all of floodlighting on apron A must also comply with the MOS. It would not, of itself, trigger the requirement for non-compliant floodlighting on apron B at the aerodrome to be brought into compliance with the MOS;
>
> (d) routine maintenance pavement overlays would not, of itself, trigger the replacement of associated non-compliant visual aids.

(d) **Practicable.** This term is used to allow RCAA acceptance of variation to a standard due to insurmountable difficulties in the way of full compliance. If an aerodrome operator believes that compliance with a standard is impracticable, the onus rests with that operator to demonstrate the impracticability to the satisfaction of RCAA.

9.1.2 Standardisation of Aerodrome Lighting

9.1.2.1 It is important for pilot recognition and interpretation of aerodrome lighting systems, that standard configurations and colours be used. The pilot always views the aerodrome lighting systems in perspective, never in plan, and has to interpret the guidance provided, while travelling at high speed, often with only a limited segment of the lighting visible. As time will be limited to see and react to visual aids, particularly in the lower visibilities, simplicity of pattern, in addition to standardisation, is extremely important.

9.1.2.2 Pilot visual workload is best moderated by standardisation, balance and integrity of elements. A ragged system with many missing lights can break the pattern from the pilot's eye position, restricted as that position is by cockpit cut-off angles and possibly by patchy fog or other conditions.

9.1.2.2A As far as practicable, light fittings with different photometric characteristics must not be mixed in a lighting system.

> **Note:** It is necessary to ensure, as far as practicable, uniformity in the visual appearance of light in a light system. See also paragraph 9.1.12.6.

9.1.2.3 For some aerodrome lighting systems, historic usage in various countries has resulted in more than one system being endorsed by ICAO.

9.1.2.4 Those systems not included in the MOS are not endorsed by RCAA for use in Rwanda. It is important that aerodrome owners do not introduce non-endorsed or non-standard aerodrome lighting systems.

9.1.2.5 If the aerodrome owner has any doubts about a new system for their aerodrome, they are to check with RCAA before proceeding.

9.1.3 Lighting in the Vicinity of an Aerodrome

9.1.3.1 An existing or proposed non-aeronautical ground light in the vicinity of an aerodrome, which, by reason of its intensity, configuration or colour, might endanger the safety of aircraft, must be notified to the relevant RCAA office for a safety assessment. In general, vicinity of the aerodrome can be taken as within a 6 km radius of the aerodrome. Within this 6 km area, the following specific areas are the most likely to cause problems to aircraft operations:

(a) for a code 4 instrument runway – within a rectangular area the length of which extends at least 4500 m before each threshold and the width of which is at least 750 m either side of the extended runway centreline;

(b) for a code 2 or 3 instrument runway, within an area with the same width as (a) with the length extending to at least 3000 m from the threshold;

(c) for other cases, within the approach area.

> **Note:** 1: Aerodrome operators should liaise with local electricity and planning authorities, so that they can be alerted of lighting proposals in the vicinity of their aerodromes.
>
> 2: Section 9.21 provides advice to lighting designers when planning lighting installations in the vicinity of an aerodrome.

9.1.4 Minimum Lighting System Requirements

9.1.4.1 At an aerodrome opened for night operations, at least the following facilities must be provided with appropriate lighting:

(a) runways, taxiways and aprons intended for night use;

(ab) for taxiways used only by aeroplanes of code A or B — at least 1 such code A or B taxiway between the runway and the apron, with retroreflective markers permitted on the other code A or B taxiways;

(b) at least one wind direction indicator;

(c) if an obstacle within the applicable OLS area of the aerodrome is determined by RCAA as requiring obstacle lighting, the obstacle lighting.

9.1.4.2 Where any approach end of a runway is intended to serve jet-propelled aeroplanes engaged in air transport operations, that approach end must be provided with an approved visual approach slope indicator system, in accordance with Paragraph 9.9.1. Additionally, RCAA may direct a runway to be provided with a visual approach slope indicator system if the circumstances surrounding the aerodrome require such an aid for aircraft safety purposes.

9.1.4.3 To avoid confusion at an aerodrome with more than one visual approach slope indicator system, the same type of approach slope indicator system must be used, in accordance with Paragraph 9.9.1.7.

9.1.4.4 A runway intended to serve Category I, II or III precision approach operations must be provided with an approach lighting system, where physically practicable, in accordance with the standards set out in this Chapter.

9.1.4.5 Movement area guidance signs intended for use at night must be illuminated in accordance with the standards set out in Chapter 8.

9.1.4.6 In certain circumstances additional lighting systems may be required at some aerodromes. For example, aerodrome beacons, visual docking guidance systems and runway threshold identification lights. Where provided, they shall be in compliance with the standards set out in this Chapter.

9.1.5 Primary Source of Electricity Supply

9.1.5.1 Unless it is impracticable to do so, except for Paragraph 9.1.5.3 below, an aerodrome lighting system must be an electrically connected installation, with the primary source of electric power supplied by the local electricity supply authority.

9.1.5.2 Where the power supply of an aerodrome lighting system has to be derived from a source other than the normal reticulated electricity supply, a note to that effect shall be included in AIP.

9.1.5.3 If, at an aerodrome intended for use by aircraft with less than 10 passenger seats engaged in air transport operations, power supply cannot be supplied by normal reticulated electricity, the supply may be derived from stand-alone generators or solar charged batteries.

> **Note:** This type of lighting installation is not considered by RCAA to be portable lighting. It is considered to be a permanent installation. The lighting system must, therefore, satisfy all of the permanent aerodrome lighting standards, for example light intensity, light colour, frangibility etc.

9.1.6 Electrical Circuitry

9.1.6.1 Where they are electrically connected, aerodrome ground lighting, which includes runway, taxiway, approach and visual approach slope indicator and MAGS lighting circuits, must be by means of the series current system.

> **Note: 1.** Inter-leaf circuitry is recommended for aerodromes intended for precision approach operations. Guidance on this may be found in ICAO Aerodrome Design Manual Part 5.
>
> **2:** Some operational credit is available to runways with interleaf circuits. For more information see Aeronautical Information Publication (AIP) Rwanda, Part 2 – En Route, ENR 1.1, paragraph "Partial Runway Lighting Failure".

9.1.6.2 Feeder cables and series isolating transformers must be installed below ground, being:

(a) directly buried; or

(b) in pits, ducts or similar receptacles.

> **Note:** Section 9.22 provides information on the use of unarmoured cables on an aerodrome.

9.1.6.3 Other electrical equipment and wiring, except for a light or light fitting, must not be installed above ground level in the manoeuvring area.

9.1.7 Secondary Power Supply

9.1.7.1 Secondary power supply means electricity power supply which is connected to the load automatically on the failure of the primary power source. This may be derived by either of the following:

(a) 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

(b) generators, batteries etc. from which electric power can be obtained.

9.1.7.2 Secondary power must be provided to at least one runway at an aerodrome intended for Cat I precision approach operations, which would allow the operation of the following lighting systems:

(a) approach lighting;

(b) visual approach slope indicator;

(c) runway edge;

(d) runway threshold;

(e) runway end;

(f) essential taxiway and runway guard lights;

(g) apron; and

(h) obstacles, if any, lighting of which has been determined by RCAA as essential for the safety of aircraft operations.

> **Note:** Not applicable in general to off-aerodrome obstacle lighting, the status of lighting availability of which is subject to aerodrome operator monitor.

9.1.7.3 In addition to Paragraph 9.1.7.2 above, for an aerodrome intended for Cat II and III precision approach operations, the secondary power must be adequate for the lighting of the following:

(a) runway centreline lights;

(b) touchdown zone lights; and

(c) all stop bars.

9.1.7.4 Secondary power must be provided to allow the operation of the following lighting systems at every runway from which aircraft are intended to take off in RVR conditions less than a value of 800 m:

(a) runway edge lights;

(b) runway end lights;

(c) runway centreline lights, where provided;

(d) all stop bars, when they are being used;

(e) runway guard lights, when stop bars are not being used;

(f) essential taxiway lights;

(g) essential obstacle lights.

> **Note:** For subparagraph (f), RCAA considers taxiway lights essential when their operation is essential to the safety of aircraft operations.

9.1.8 Switch-over Time

9.1.8.1 The time interval between failure of the normal source of power and the complete restoration of the service following switch-over to secondary power is not to exceed, for:

(a) Precision Approach Cat I visual aids – 15 seconds.

(b) Precision Approach Cat II and III visual aids;

(i) essential obstacle lights - 15 seconds.

(ii) essential taxiway lights - 15 seconds.

(iii) all other visual aids - 1 second.

(c) Runways meant for take-off in RVR conditions less than a value of 800 m;

(i) essential obstacle lights - 15 seconds.

(ii) essential taxiway lights - 15 seconds.

(iii) runway edge lights, where runway centre line lights are provided - 15 seconds.

(iv) runway edge lights, where runway centre line lights are not provided - 1 second.

(v) runway end lights - 1 second.

(vi) runway centre line lights - 1 second.

(vii) all stop bars - 1 second.

9.1.8.2 For paragraph 9.1.8.1, alerting of the generators is an acceptable method of achieving the very short switch-over times. For this method, before commencement of low visibility, or when weather conditions indicate that the main electricity may be susceptible to interruption, the generator(s) are started, and when they come up to speed, the electrical load is connected to them. In the unlikely event that a generator fails, the electrical system must automatically reconnect the load to the main power.

9.1.8.3 Where alerting of the generators is the method adopted for meeting the switch-over times to support Precision Approach Cat II and III approaches, and take offs in RVR conditions less than a value of 800 m, real time information on the operating status of the generator set(s) and the main supply au power must be provided to ATC.

9.1.9 Standby Power Supply

Note: Operational credit is given to a runway lighting system notified in AIP as provided with standby power or portable lighting. This is because when a flight is planned to land at night at an aerodrome with electric runway lighting, provision must be made for flight to an alternate aerodrome unless the destination aerodrome has standby power, or portable runway lights are available and arrangements have been made for a responsible person to be in attendance.

9.1.9.1 For lighting to be notified in AIP as provided with standby power, the standby power supply may be either secondary power or standby generators which are manually activated.

9.1.9.2 Where the activation of the standby power is not automatic, procedures must be established to facilitate the introduction of standby power as soon as possible when the need arises.

Note:
1. For non-automatic activation the actual time required for activation of standby power should be notated in AIP.
2. The procedures should allow standby power to be provided within 15 minutes of demand. Aircraft fuel management is the pilot’s responsibility. For aircraft operating at night with no alternate aerodrome, the recommended fuel reserves are; 45 minutes for propeller driven aeroplanes and 30 minutes for jet aeroplanes.

9.1.10 Portable Lighting

9.1.10.1 Portable lights are only for temporary emergency use, and primarily for VFR operations.

> **Note:** For example, portable lights may be used at an aerodrome for landings and take-offs as follows:
>
> (a) if the aerodrome is intended for regular night operations and, therefore, has a permanent lighting system installed — to replace unserviceable lights until the permanent lights are urgently repaired;
>
> (b) if the aerodrome is not intended for regular night operations and, therefore, does not have a permanent lighting system installed — for temporary emergencies such as medical emergencies or emergency landings.

9.1.10.2 Portable lights:

(a) may comprise liquid fuel-burning flares or lamps, battery-powered electric lights or other similar devices; and

(b) must have a substantially Omni-directional light output.

> **Notes:**
>
> 1. Because of the variable technology permitted, no light intensity is specified. However, as an indication of adequate light intensity under the weather conditions prevailing at the time of their use, portable runway lights should be visible from a distance of not less than 3 km.
> 2. The colour of the portable lights should conform to the colour for permanent lights, except that, where the provision of coloured lights at the threshold and the runway end is not practicable, all runway lights may be variable white or as close to variable white as practicable.

9.1.10.3 If an aerodrome is notified in AIP as having portable lighting, the following requirements apply:

(a) the portable lights must always be in a serviceable condition and a state of readiness, including clean glasses and either fuel tanks filled or fresh batteries available;

(b) appropriate persons must be trained to deploy the lights and put them into operation without delay when the need arises.

> **Note:** Due to the time required to deploy portable lights, the AIP entry should include a notation that prior notice of operations is required.

9.1.10.4 The portable lights must be:

(a) at the same spacing as permanently installed lights; and

(b) level so that the vertical axis is true; and

(c) deployed in such a way that an aircraft can land into the wind.

> **Note:** To allow speedy deployment, the locations of the portable lights should be clearly marked, and the surface appropriately treated and maintained.

9.1.10.5 For an aircraft arrival, the portable lights must be lit or switched on at least 30 minutes before the estimated time of arrival.

9.1.10.6 For an aircraft departure, the portable lights must be:

(a) lit or switched on at least 10 minutes before the time of departure; and

(b) retained after take-off:

(i) for at least 30 minutes; or

(ii) if no air-ground communication exists with the aircraft — for at least 1 hour.

> **Note:** Retention of the portable lights is required for the contingency that an aircraft may need to return to the aerodrome.

9.1.11 Light Fixtures and Supporting Structures

9.1.11.1 All aerodrome light fixtures and supporting structures must be of minimum weight while being fit for the function, and frangible.

> **Notes:**
>
> 1. For guidance on frangibility, see:
>
>   (a) ICAO Aerodrome Design Manual Part 4 – Visual Aids, Chapter 15, Frangibility of Visual Aids; and
>
>   (b) ICAO Aerodrome Design Manual Part 6 – Frangibility.
>
> 2. See subsection 11.1.4A for information regarding siting of equipment and installations on operational areas.

9.1.11.2 Supporting structures for approach lights also need to be of minimum weight and frangible, except that, in that portion of the approach lighting system beyond 300 m from the runway threshold:

(a) where the height of a supporting structure exceeds 12 m, the frangibility requirement need 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 need be frangible.

9.1.11.3 Where an approach light fixture or supporting structure is not in itself sufficiently conspicuous, it is to be suitably marked.

9.1.12 Elevated and Inset Lights

9.1.12.1 Elevated lights must be frangible and sufficiently low to preserve clearance for propellers and the engine pods of jet aircraft. In general, they should not be more than 360 mm above the ground.

9.1.12.2 Elevated lights, in general, are preferable to inset lights, because they provide a larger aperture from which light signals can be seen. Elevated lights must be used in all cases except:

(a) where the use of inset lights is specified in this Chapter, or

(b) where it is not practicable to use elevated lights.

> **Note**: Elevated lights are not practicable on pavements where aircraft or vehicles travel or in areas subject to significant jet blast.

9.1.12.3 Inset lights, also known as in-pavement lights, must not:

(a) be constructed with sharp edges;

(b) project more than 25 mm above the surrounding surface at locations where the lights will not normally come into contact with aircraft wheels, such as threshold lights, runway end lights and runway edge lights;

(c) project more than 13 mm above the surrounding surface at locations which will normally come into contact with aircraft wheels, such as runway centreline lights, touch down zone lights and taxiway centreline lights.

9.1.12.4 The maximum surface temperature attained by an inset light must not exceed 160°C over a period of 10 minutes, if operating at maximum intensity while covered by an aircraft wheel.

9.1.12.5 The standard colour of the casings of elevated light units is yellow.

9.1.12.6 If some inset lights are included in a system of elevated lights, the photometric characteristics of the inset lights must be as close as practicable to those of the elevated lights.

> **Note:** The standard in this provision is set in terms of "practicability". RCAA accepts that some difference in photometric characteristics may be unavoidable as a matter of practicability. In such a case, the resultant non-uniformity of visual appearance of the lighting system would be acceptable to RCAA for paragraph 9.1.2.2A.

9.1.13 Colour of Light Shown

9.1.13.1 The colour of the light shown must be in accordance with the applicable standard specified in Section 9.2.

9.1.13.2 To ensure uniformity of visual appearance, light fittings using different filter technology must not be mixed (e.g. dichroic filters, other absorption filters, light emitting diode (LED), etc.) in such a way as to create inconsistency in either light colour or intensity when viewed by pilots from a moving aircraft on a runway or taxiway.

9.1.14 Light intensity and Control

9.1.14.1 At an aerodrome with an air traffic service (ATS), the following lighting systems, if provided, must be equipped with an intensity control so that the ATS can select light output to suit ambient conditions and avoid dazzling pilots:

(a) approach lighting system;

(b) approach slope guidance system;

(c) runway edge, threshold and end lights;

(d) runway centreline lights;

(e) runway touchdown zone lights;

(f) taxiway lights.

9.1.14.2 At an aerodrome with a Certified Air-Ground Radio Operator (CAGRO), a Unicom operator, or similar responsible person with 2-way radio communications with aircraft, the aerodrome may choose to provide aerodrome lighting intensity control for use by that person.

9.1.14.3 Intensity must be capable of being varied in 5 or 6 stages, for the following systems:

(a) approach lighting systems

(b) visual approach slope indicator systems;

(c) high intensity runway edge, threshold and end lights;

(d) runway centreline lights;

(e) runway touchdown zone lights.

9.1.14.4 Intensity must be capable of being varied in at least 3 stages, for medium intensity runway edge, threshold and end lights.

9.1.14.5 If a runway is equipped with both high and medium intensity runway edge lighting, the 3 lowest intensity stages shall be provided by the medium intensity system.

9.1.14.6 For taxiway lights:

(a) Taxiway centreline lights with a main beam average intensity of the order of 50 cd or less, 3 stages of intensity control will normally be sufficient.

(b) Taxiway centreline lights with main beam average intensity of the order of 100 cd or greater will normally require more than 3 stages of intensity control, or alternatively to have the maximum light output permanently reduced by fixing the maximum intensity stage at less than 100% of the rated output of the light.

(c) Taxiway edge lights do not normally require separate intensity control. It is common for taxiway edge lights to be installed on the same electrical circuit as the low or medium intensity runway edge lights, and to be controlled by the runway light control.

9.1.14.7 Intensity must be reduced from each successive stage to an order of 25-33%. This is based on the fact that a change of that magnitude is required for the human eye to detect that a change has occurred. For 6 stages of intensities, they should be of the order of: 100%, 30%, 10%, 3%, 1% and 0.3%.

9.1.14.8 At an aerodrome where the lighting is provided with intensity settings but the ATS, CARGO, Unicom operator, or similar responsible person, does not provide 24 hours' coverage and:

(a) the operator leaves the lights turned on all night; or

(b) the lights are controlled by a PAL out of hours;

the recommended stage of intensity, which provides adequate illumination but will not dazzle pilots is stage 2.

> **Note:** Guidance on selecting series currents for various intensity stages for some airport lighting systems is given in the Table 9.1-1 below. The guidance is only applicable to systems installed to the industry standard of 6.6 amps series current giving 100% intensity, except where noted otherwise in the Table.

9.1.14.9 If a lighting system is operated by an ATS provider or a similar responsible person (the ***lighting system operator***):

(a) an automatic monitoring system must provide the lighting system operator with the following information:

(i) an indication of each lighting system that is on;

(ii) the intensity of each lighting system that is on;

(iii) any fault in a lighting system used to control aircraft movement; and

(b) the information must be automatically relayed to the lighting system operator position of the operator responsible for the lighting system.

9.1.14.9A For subparagraph 9.1.14.9 (b), the information must be automatically relayed within the following time frames:

(a) for a stop bar at a runway-holding position — 2 seconds;

(b) for all other types of visual aids — 5 seconds.

> **Note:** A runway meant for use in visibility conditions of less than 550 m should have a suitable monitoring system for informing ATC and the operator's maintenance crew when the serviceability level of any of the following lighting systems falls below the minimum level for the system:
>
> (a) approach lighting;
>
> (b) runway centreline;
>
> (c) runway threshold;
>
> (d) runway edge;
>
> (e) touchdown zone;
>
> (f) runway end;
>
> (g) stop bars;
>
> (h) essential taxiways.

9.1.14.10 At an aerodrome with Low Intensity Runway Edge Lighting Systems, in accordance with Paragraph 9.10.1.1(a), the light fittings used must be in compliance with Paragraph 9.10.6. However, it is permissible with these systems, at commissioning, to adjust and then set the system current to a value other than the rated current value. This is to enable the actual light output of the light units to be set to a suitable light level to match the specific conditions of the particular aerodrome, to harmonise with the intensity of visual approach slope indicators if present, and minimise the likelihood of dazzling pilots. Where the system current is set to a value other than the rated current, the actual value of current set must be recorded in the Aerodrome Manual.

Table 9.1-1: Guidance on selecting series line currents for various intensity stages

Lighting System	Nominal minimum intensity at rated output	Stage 6	Stage 5	Stage 4	Stage 3	Stage 2	Stage 1
Runway Edge Lights, Low Intensity	100 cd						100% 6.6 A
Runway Edge Lights, Medium Intensity	300 cd typical				100% 6.6 A	30% 5.4 A	10% 4.5 A
Runway Edge Lights, High Intensity	10,000 cd	100% 6.6 A	30% 5.4 A	10% 4.5 A			
Approach Lights * 12.5A/6.6A series isolating transformer * 6.6A/6.6A series isolating transformer	20,000 cd	100% 12.5 A 6.6 A	25% 9.5 A 5.3 A	6.5% 7.5 A 4.3 A	2% 6.2 A 3.6 A	0.5% 5.0 A 3.2 A	0.12% 4.0 A 3.0 A
Runway Centreline lights	5,000 cd	100% 6.6 A	25% 5.2 A	8% 4.4 A	2.5% 3.8 A	0.8% 3.3 A	0.25% 3.0 A
Runway Touchdown Zone lights	5,000 cd	100% 6.6 A	25% 5.2 A	8% 4.4 A	2.5% 3.8 A	0.8% 3.3 A	0.25% 3.0 A
Taxiway Centreline lights	50 cd				100% 6.6 A	40% 5.5 A	16% 4.8 A
PAPI	15,000 cd red light	100% 6.6 A	30% 5.5 A	10% 4.8 A	3% 3.85 A	1% 3.4 A	0.3% 3.0 A
T-VASIS	See Section 9.9 Paragraph 9.9.3.11.						

Notes:

1. All values are for the Industry Standard system of 6.6A series current for full rated light output, (except Approach Lights using 12.5 A/6.6 A series isolating transformers), and would not be relevant for lighting systems installed to other electrical parameters.
2. The current values are true root mean square (RMS) amperes.
3. The intensity percentages are approximate only. At the higher Stages (5 and 6) it is more important to maintain the intensity ratio to runway edge lights as given in paragraphs 9.8.1.2 and 9.11.1.4. At the lower intensity stages, as used during good visibility conditions, maintaining those intensity ratios tends to result in glare for pilots, and so lower ratios are suggested.

9.1.15 Commissioning of Lighting Systems

9.1.15.1 Commissioning means the formal process by which the performance of the lighting system is confirmed by RCAA, or a qualified person, as meeting the specifications. Qualified person in this case means:

(a) **For ground check of compliance with electrical specifications and RCAA standards** — an electrical engineer or licensed electrician with such aerodrome lighting knowledge and experience of aerodrome lighting as equips him or her to competently perform the compliance checks.

(b) **For flight checking of compliance with operational specifications** — pilot approved by RCAA as having the competency to conduct flight check.

9.1.15.2 All aerodrome lighting systems must be commissioned by ground check before they are brought into use.

9.1.15.2A For commissioning, evidence that light fitting types, models and versions comply with the standards for photometric and other characteristics as specified in this Chapter must be in the form of test reports from a laboratory that is accredited by appropriate authorities.

9.1.15.3 The ground check of a visual approach slope indicator system must include verification of vertical and horizontal angles of light signal changes by a person having civil engineering or surveying qualification and experience.

9.1.15.4 The commissioning of the following lighting systems, in addition to the ground check, must include flight checks of:

(a) approach lighting system;

(b) runway lighting system for instrument runways;

(c) visual approach slope indicator system

(i) used by jet propelled aeroplanes engaged in air transport operations; or

(ii) installed on RCAA direction, in accordance with Paragraph 9.9.1.1(b);

(d) pilot-activated lighting system (PAL).

9.1.15.5 For a visual approach slope indicator system specified in Paragraph 9.1.15.4, that is provided for temporary use only, for example due to a temporary displaced threshold, or during works in progress, the requirement for a flight check is waived.

9.1.15.6 For those systems specified in Paragraph 9.1.15.4, the aerodrome operator shall forward duly certified ground check and flight check reports to the relevant RCAA office. If RCAA is satisfied with the reports, RCAA will approve the issue of a permanent NOTAM. Information to be supplied by aerodrome operator for inclusion in the permanent NOTAM includes:

(a) For visual approach slope indicator system;

(i) runway designation;

(ii) type of system, and for AT-VASIS and PAPI systems, the side of runway, as seen by approaching pilot, that the aid is installed;

(iii) where the axis of the system is not parallel to the runway centreline, the angle of displacement and the direction of displacement, i.e. left or right;

(iv) approach slope; and

(v) minimum eye height over threshold, for the on-slope signal.

(b) For a PAL;

(i) the PAL frequency; and

(ii) any notes explaining PAL operation, for example where the PAL only controls certain visual aids at the aerodrome.

9.1.15.7 For those systems not specified in Paragraph 9.1.15.4, the aerodrome operator must use the duly certified ground check as sufficient evidence of compliance with standards to initiate a permanent NOTAM.

9.1.15.8 At any time after commissioning, RCAA may direct the ground checking and/or the flight checking of a lighting system specified in Paragraph 9.1.15.4, following substantial changes to the system, or on receipt of adverse reports on the performance of the system from pilots or aircraft operators. Examples of substantial changes to the system include:

(a) removal and replacement of 50% or more of the light fittings, at the same time, of an approach or runway lighting system;

(b) removal and replacement of one or more light units of a PAPI system;

(c) removal and replacement of two or more light units, at the same time, of an AT-VASIS system; and

(d) removal and replacement of the receiver unit from a PAL.

9.1.15.9 Before a runway is opened for night use, the aerodrome operator must assess obstacles within the obstacle limitation surface area of the aerodrome for obstacle lighting purposes, particularly if the obstacles are within 3 km of the aerodrome.

9.1.15.10 Copies of all ground check reports, flight check reports, and light fitting laboratory test reports used to support the commissioning of lighting systems must be:

(a) filed in the aerodrome operator’s Aerodrome Manual; and

(b) kept in the custody, or under the control, of the aerodrome operator for as long as the relevant lighting system remains in service.

Section 9.2: Colours for Aeronautical Ground Lights

9.2.1 General

9.2.1.1 The following specifications define the chromaticity limits of colours to be used for aerodrome lighting.

9.2.1.2 The chromaticities are expressed in terms of the standard observer and co-ordination system adopted by the International Commission on Illumination (CIE).

9.2.2 Chromaticities

9.2.2.1 The chromaticities of aerodrome lights must be within the following boundaries:

CIE Equation (see Figure 9.2-1)

(a) Red

Purple boundary $y = 0.980 - x$

Yellow boundary $y = 0.335$

(b) Yellow

Red boundary $y = 0.382$

White boundary $y = 0.790 - 0.667x$

Green boundary $y = x - 0.120$

(c) Green

Yellow boundary $y = 0.726 - 0.726x$

White boundary $x = 0.650y$

(except for visual docking guidance systems)

White boundary $x = 0.625y - 0.041$

(for visual docking guidance systems)

Blue boundary $y = 0.390 - 0.171x$

(d) Blue

Green boundary $y = 0.805x + 0.065$

White boundary $y = 0.400 - x$

Purple boundary $x = 0.600y + 0.133$

(e) White

Yellow boundary $x = 0.500$

Blue boundary $x = 0.285$

Green boundary $y = 0.440$ and $y = 0.150 + 0.640x$

Purple boundary $y = 0.050 + 0.750x$ and $y = 0.382$

(f) Variable White

Yellow boundary	$x = 0.255 + 0.750y$ and $x = 1.185 - 1.500y$
Blue boundary	$x = 0.285$
Green boundary	$y = 0.440$ and $y = 0.150 + 0.640x$
Purple boundary	$y = 0.050 + 0.750x$ and $y = 0.382$

9.2.3 Discrimination Between Coloured Lights

9.2.3.1 If there is a requirement to discriminate yellow and white from each other, they must be displayed in close proximity of time or space as, for example, by being flashed successively from the same beacon.

9.2.3.2 If there is a requirement to discriminate yellow from green or white, as for example with exit taxiway centreline lights, the 'y' co-ordinate of the yellow light must not exceed a value of 0.40.

> **Note**: The limits of white have been based on the assumption that they will be used in situations in which the characteristics (colour, temperature) of the light source will be substantially constant.

9.2.3.3 The colour variable white is intended to be used only for lights that are to be varied in intensity, e.g. to avoid dazzling. If these lights are to be discriminated from yellow lights, the lights must be designed and operated so that:

(a) the 'x' co-ordinate of the yellow is at least 0.050 greater than the 'x' co-ordinate of the white; and

(b) the disposition of the lights is such that the yellow lights are displayed simultaneously and in close proximity to the white lights.

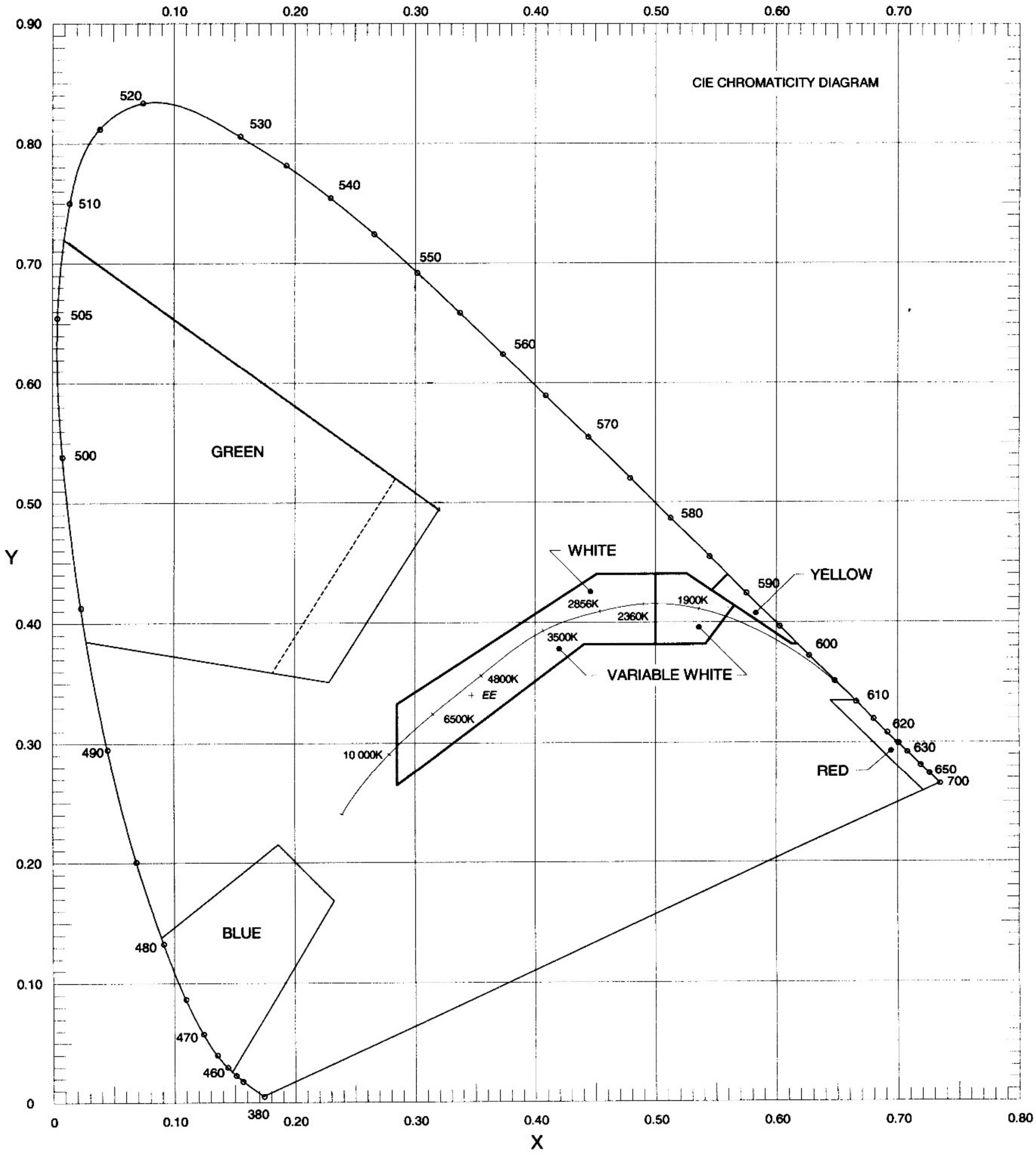


Figure 9.2-1: Colours for aeronautical ground lights

Section 9.3: Pilot Activated Lighting Systems

9.3.1 General

> **Note:** See subsection 14.3.6 for "AFRU with PAL Features".

9.3.1.1 If a pilot activated lighting (PAL) system is used to activate aerodrome lighting, the PAL is to turn ON all the lighting facilities which are required to be illuminated for night operations, unless the illumination of a required facility is achieved by other means, e.g. obstacle lights activated by photo-electric switches.

9.3.1.2 Where PAL is used to activate visual approach slope guidance systems (T-VASIS or PAPI):

(a) activation of the PAL during daytime is to turn the visual approach slope guidance system ON to Day intensity, and leave all other aerodrome lighting extinguished;

(b) activation of the PAL during twilight is to turn the visual approach slope guidance system ON to Twilight intensity, and turn all other aerodrome lighting on to the only intensity available, or to Night intensity if multiple intensities are available;

> **Note:** The night intensity will avoid the effect of glare and is normally adequate for operations during twilight hours. However, if an aerodrome, due to local conditions, requires the aerodrome lights to be set at a higher intensity than night intensity, it is permissible to provide Twilight intensity provided it does not produce glare.

(c) activation of the PAL during night-time is to turn the visual approach slope guidance system ON to Night intensity, and turn all other aerodrome lighting on to the only intensity available, or to Night intensity if multiple intensities are available;

(d) once the lighting has been activated by the PAL, appropriate changes from Day to Twilight to Night intensities must take place automatically;

(e) the appropriate changes from Day to Twilight to Night operation shall take place under the control of a light sensitive switch or similar device;

(f) intensity must be the following percentage of full intensity:

(i) Day intensity — nominally 100%;

(ii) Twilight intensity — nominally 10%;

(iii) Night intensity — nominally 1%.

> **Note:** For guidance in setting up the light sensitive switch, the following values of background luminance are suggested, though other values may be used if they provide a better match to local visibility conditions:
>
> (a) Day — background luminance above 500 cd/m^2;
>
> (b) Twilight — between 50 and 500 cd/m^2;
>
> (c) Night — below 50 cd/m^2.

9.3.1.3 The PAL must activate an aerodrome lighting system on detection of a coded carrier frequency signal from an aircraft air/ground VHF transmitter.

9.3.1.4 On receipt of the coded signal, the PAL control unit must go into the operate mode for a pre-set period. The minimum period that the lights remain ON shall be 30 minutes.

> **Note:** The length of the period should be adjustable as local aerodrome operating conditions may require the lights to remain ON for a longer period.

9.3.1.5 Ten minutes before the aerodrome lighting system is due to turn OFF, the PAL must cause the lights of at least the primary Illuminated Wind Direction Indicator (IWDI), in accordance with Paragraph 9.6.1.10, to commence to flash at approximately 50 cycles per minute (approximately 0.6 seconds ON and 0.6 seconds OFF), and continue to flash until either:

(a) the PAL system switches OFF, and all aerodrome lighting, including the IWDI lights, is extinguished; or

(b) the PAL system has been reset for another ON period.

9.3.1.6 When in operate mode (including the last 10 minutes) the receipt of another correctly coded signal must reset the PAL system to the beginning of the pre-set period.

9.3.2 VHF Carrier Activation Code

9.3.2.1 The code required to activate the PAL system must be generated when the microphone button of the aircraft radio air/ground VHF transmitter is depressed and a radio frequency carrier signal is produced.

9.3.2.2 The correct code is to consist of three bursts of carrier signal each anywhere between 1 and 5 seconds long, with the last two code bursts completed within 24 seconds of the end of the first burst.

9.3.2.3 The gap between code bursts that the detector can tolerate shall be 0.1 seconds. (This is less than the time it takes to release and depress the aircraft microphone button.)

> **Note:** Pilots are advised that the code they should send is three bursts of approximately 3 seconds, with at least 1 second between bursts, and the three bursts must be transmitted within 25 seconds.

9.3.3 VHF Carrier Detector Technical Requirements

9.3.3.1 The VHF carrier detector must accept a carrier signal over the frequency range of 118 MHz to 136 MHz.

9.3.3.2 The receiver must be crystal controlled at a single frequency within the frequency range, with a channel separation of 25 kHz.

9.3.3.3 Only allocated frequencies must be used, to maintain order in the air/ground VHF band, and prevent interference to other facilities or users in the vicinity.

9.3.3.4 The frequency stability must be within ±0.0010% over the temperature range of -10°C to +70°C.

9.3.3.5 The minimum detectable input signal of the VHF carrier detector must be adjustable over a range to suit the operational requirements.

9.3.3.6 Under normal circumstances, to ensure activation of the PAL system by aircraft at approximately 15 NM from the aerodrome, the receiver sensitivity must be set at not less than 15 μV.

> **Note:**
> 1. The suitability of the receiver sensitivity from different azimuth of the aerodrome will be flight tested.
> 2. The upper range of the receiver sensitivity may be of the order of 50 to 65 mV, but may be adjusted downward depending on whether nuisance operation is experienced from aircraft using the same PAL frequency at other locations.

9.3.3.7 The VHF carrier detector bandwidth is to have the following characteristics:

±7.5 kHz within 3 dB of nominal

±16 kHz greater than 60 dB below nominal;

the spurious response is to be no less than 80 dB below nominal.

9.3.4 Inputs to the PAL

9.3.4.1 The PAL must be capable of having the following inputs:

(a) radio frequency activation signal, as described above;

(b) manual activation of the PAL. An ON/OFF switch must be provided for manual activation. When the switch is selected to ON the lighting system will be activated and remain on. When the switch is selected to OFF the PAL system must go into operate mode for the full timing cycle, including the ten-minute turn-off warning. This is intended for use by authorised ground personnel, departing pilots, and maintenance technicians;

(c) remote control override of the PAL. If a PAL is provided at a controlled aerodrome, the circuitry of the PAL system must be such that when the controller is on duty, the PAL will be overridden by the controller.

9.3.5 Fail-safe Arrangements with PAL system

9.3.5.1 The circuitry of the PAL system must be so designed that if the PAL fails for whatever reason, the aerodrome lighting can still be provided. This can be achieved by either:

(a) the lighting facilities being automatically turned ON if the PAL fails; or

(b) the provision of a by-pass switch to allow manual activation of the lights.

9.3.5.2 The mains supply to the equipment may be subject to electrical transients, typical of rural electrical distribution systems. The PAL system must be so designed that the electrical transients have no effect on the PAL system.

9.3.5.3 Following a PAL failure, on restitution of power the PAL must automatically commence a complete ‘Light ON’ cycle.

9.3.6 Access to Manual Switches

9.3.6.1 If the manual switches provided for PAL are either key operated switches, or enclosed in an area that requires key access, sufficient numbers of keys must be provided to persons who may have reason to gain access to the manual switches in the event of the PAL failing to respond to aerial VHF signal from incoming aircraft.

> **Note**: The aerodrome operator is responsible for the allocation of access keys.

9.3.6.2 The following persons are likely to be called upon to manually activate the aerodrome lighting:

(a) the agents of the airlines using the aerodrome;

(b) a representative from local operators of flying schools, fuelling agents, or aircraft maintenance organisations;

(c) representatives from the local hospital and/or emergency services;

(d) local police;

(e) where available, responsible person or persons living close to the aerodrome.

9.3.7 Receiving Antenna

9.3.7.1 The PAL receiving antenna must be so located such that it will receive activating signals from aircraft both in the air and on the aerodrome movement area.

9.3.7.2 The PAL must be so designed that it will operate satisfactorily when connected to an antenna with the following specifications:

(a) unity gain with respect to a dipole;

(b) vertical polarisation;

(c) omnidirectional radiation pattern in the horizontal plane;

(d) voltage standing wave ratio when matched to the PAL antenna input of not greater than 1.5:1, over the frequency range of 118 to 136 MHz;

(e) height of the mounting above local ground level not less than 4.5 m.

9.3.8 PAL with Audio Acknowledgment

9.3.8.1 Aerodrome operators are encouraged to use a PAL with message acknowledgment capability, which can provide positive response on receipt of pilot transmission and caution if the lighting cycle is within the 10 minute switch off phase.

> **Note**: Such a PAL will require a radio transmitter licence.

9.3.8.2 Where provided, the broadcast message must be brief, to minimise congestion on the frequency.

> **Note**: Typical broadcast message should be of the form: "*Name of aerodrome* PAL ACTIVATED".

Section 9.4: Obstacle Lighting

9.4.1 General

9.4.1.1 Under the Civil Aviation Regulations, RCAA may determine that an object or a proposed object which intrudes into navigable airspace requires, or will be required to be provided with, obstacle lighting. Responsibility for the provision and maintenance of obstacle lighting on a building or structure rests with the owner of the building or structure. Within the limits of the obstacle limitation surfaces of an aerodrome, responsibility for the provision and maintenance of obstacle lighting on natural terrain or vegetation, where determined necessary for aircraft operations at the aerodrome, rests with the aerodrome operator.

9.4.1.2 In general, an object in the following situations would require to be provided with obstacle lighting unless RCAA, in an aeronautical study, assesses it as being shielded by another lit object or that it is of no operational significance:

(a) for a runway intended to be used at night:

(i) if the object extends above the take-off climb surface within 3000 m of the inner edge of the take-off climb surface;

(ii) if the object extends above the approach or transitional surface within 3000 m of the inner edge of the approach surface;

(iii) if the object extends above the applicable inner, conical or outer horizontal surfaces;

(iv) if the object extends above the obstacle protection surface of the T-VASIS or PAPI installed at the aerodrome;

(v) a vehicle or other mobile objects, excluding aircraft, on the movement area, except aircraft service equipment and vehicles used only on aprons;

(vi) obstacles in the vicinity of taxiways, apron taxiways or taxilanes, except that obstacle lights are not to be installed on elevated ground lights or signs in the movement area.

(b) outside the obstacle limitation surfaces of an aerodrome, if the object is or will be more than 110 m above ground level.

9.4.1.3 Owners of tall buildings or structures below the obstacle limitation surfaces, or less than 110 m above ground level, may, of their own volition, provide obstacle lighting to indicate the presence of such buildings or structures at night. To ensure consistency and avoid any confusion to pilots, the obstacle lighting provided needs to conform with the standards specified in this Chapter.

9.4.1.4 In circumstances where the provision of obstacle marking is impracticable, obstacle lighting may be used during the day in lieu of obstacle marking.

9.4.2 Types of Obstacle Lighting and Their Use

9.4.2.1 Three types of lights are used for lighting obstacles. These are low intensity, medium intensity and high intensity lights, or a combination of such lights.

9.4.2.2 Low intensity obstacle lights are steady red lights and are to be used on non-extensive objects whose height above the surrounding ground is less than 45 m.

> **Note**: A group of trees or buildings is regarded as an extensive object.

9.4.2.3 Medium intensity obstacle lights are to be used either alone or in combination with low intensity lights, where:

(a) the object is an extensive one;

(b) the top of the object is 45 m or more above the surrounding ground; or

(c) RCAA determines that early warning to pilots of the presence of the object is desirable.

9.4.2.4 There are three types of medium intensity obstacle lights:

(a) Flashing white light. Likely to be unsuitable for use in environmentally sensitive locations, and near built-up areas. May be used in lieu of obstacle markings during the day to indicate temporary obstacles in the vicinity of an aerodrome, for example construction cranes, etc. and are not to be used in other applications without specific RCAA agreement.

(b) Flashing red light, also known as a hazard beacon. Is suitable for all applications, and is extensively used to mark terrain obstacles such as high ground.

(c) Steady red light. May be used where there is opposition to the use of a flashing red light, for example in environmentally sensitive locations.

9.4.2.5 High intensity obstacle lights are flashing white lights used on obstacles that are in excess of 150 m in height. As high intensity obstacle lights have a significant environmental impact on people and animals, it is necessary to consult with interested parties about their use. High intensity obstacle lights may also be used during the day, in lieu of obstacle markings, on obstacles that are in excess of 150 m in height, or are difficult to be seen from the air because of their skeletal nature, such as towers with overhead wires and cables spanning across roads, valleys or waterways.

9.4.3 Location of Obstacle Lights

9.4.3.1 One or more obstacle lights are to be located as close as practicable to the top of the object. The top lights are to be arranged so as to at least indicate the points or edges of the object highest above the obstacle limitation surface.

9.4.3.2 In the case of a chimney or other structure of like function, the top lights are to be placed sufficiently below the top (nominally 1.5 m to 3 m) so as to minimise contamination by smoke, etc.

9.4.3.3 In the case of a tower or antenna structure to be provided with high intensity obstacle lights, and the structure has an appurtenance such as a rod or antenna extending greater than 12 m above the structure, and it is not practicable to locate the high intensity obstacle light on top of the appurtenance, the high intensity obstacle light is to be located at the highest practicable point and, if practicable, have a medium intensity obstacle light (flashing white) mounted on the top.

9.4.3.4 In the case of an extensive object or a group of closely spaced objects, top lights are to be displayed at least on the points or edges highest in relation to the obstacle limitation surfaces, so as to indicate the general definition and extent of the objects. If two or more edges are at the same height, the edge nearest the runway threshold is to be lit. Where low intensity lights are used, they are to be spaced at longitudinal intervals not exceeding 45 m. Where medium intensity lights are used, they are to be spaced at longitudinal intervals not exceeding 900 m, and at least three are to be displayed on one side of the extensive obstacle to indicate a line of lights.

9.4.3.4A In the case of a wind farm whose wind turbines must have obstacle lighting, medium intensity lights are to be installed as follows:

(a) if any part of the wind turbine, including the rotating blades, penetrates the obstacle limitation surface (OLS) of an aerodrome, top lights must mark the highest point reached by the rotating blades;

> **Note:** Because it is not practicable to install obstacle lights at the tip of the blades, these lights may be located on a separate structure, adjacent to the wind turbine, at a height that corresponds to the highest point of the rotating blade of the turbine.

(b) if the rotating blades do not penetrate the OLS, the top lights must be placed on top of the generator housing;

(c) obstacle lights must be provided on a sufficient number of individual wind turbines to indicate the general definition and extent of the wind farm, with intervals between lit turbines not exceeding 900 m;

(d) all of the obstacle lights on a wind farm must be synchronised to flash simultaneously;

(e) the downward component of obstacle lighting may be shielded to the extent mentioned in either or both of the following sub-subparagraphs:

(i) so that no more than 5% of the nominal light intensity is emitted at or below 5^{o} below horizontal;

(ii) so that no light is emitted at or below 10^{o} below horizontal;

(f) to prevent obstacle light shielding by the rotating blades, 2 lights must be provided on top of the generator housing in a way that allows at least 1 of the lights to be seen from every angle in azimuth.

9.4.3.5 When the obstacle limitation surface concerned is sloping and the highest point above the obstacle limitation surface is not the highest point of the object, additional obstacle lights are to be placed on the highest part of the object.

9.4.3.6 When the top of the obstacle is more than 45 m above the level of the surrounding ground or the elevation of the tops of nearby buildings (when the obstacle is surrounded by buildings), the top lights are to be medium intensity lights. Additional low intensity lights are to be provided at lower levels to indicate the full height of the structure. These additional lights are to be spaced as equally as possible, between the top lights and ground level or the level of tops of nearby buildings, as appropriate. The spacing between the lights is not to exceed 45 m.

9.4.3.7 Where high intensity obstacle lights are used on an object other than a tower supporting overhead wires or cables, the spacing between the lights is not to exceed 105 m. Where the high intensity obstacle lights are used on a tower supporting wires or cables, they are to be located on three levels:

(a) at the top of the tower;

(b) at the lowest level of the catenary of the wires or cables; and

(c) at approximately midway between the two levels.

> **Note**: In some cases this may require the bottom and middle lights to be located off the tower.

9.4.3.8 The number and arrangement of lights at each level to be marked is to be such that the obstacle is indicated from every angle of azimuth. Where a light is shielded in any direction by an adjacent object, the light so shielded may be omitted but additional lights may be required in such a way so as to retain the general definition of the obstacle.

9.4.3.9 Illustrations of typical lighting of obstacles are shown below.

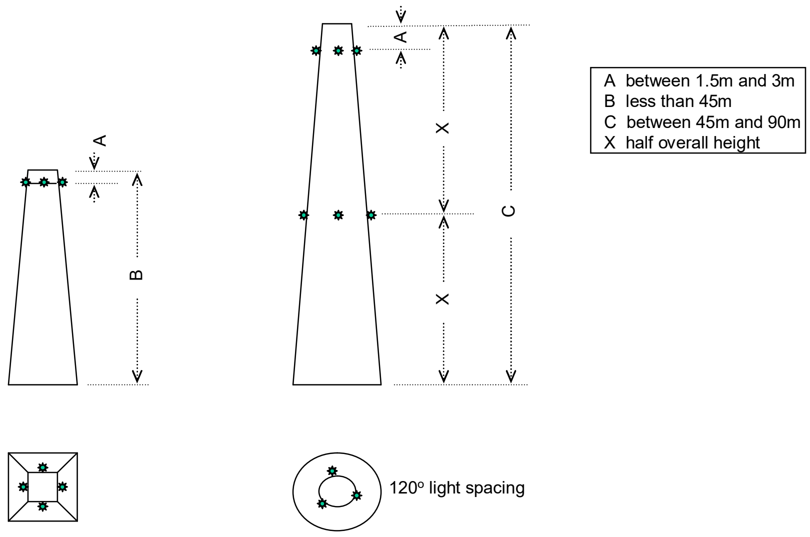


Figure 9.4-1: Typical lighting of tall obstructions

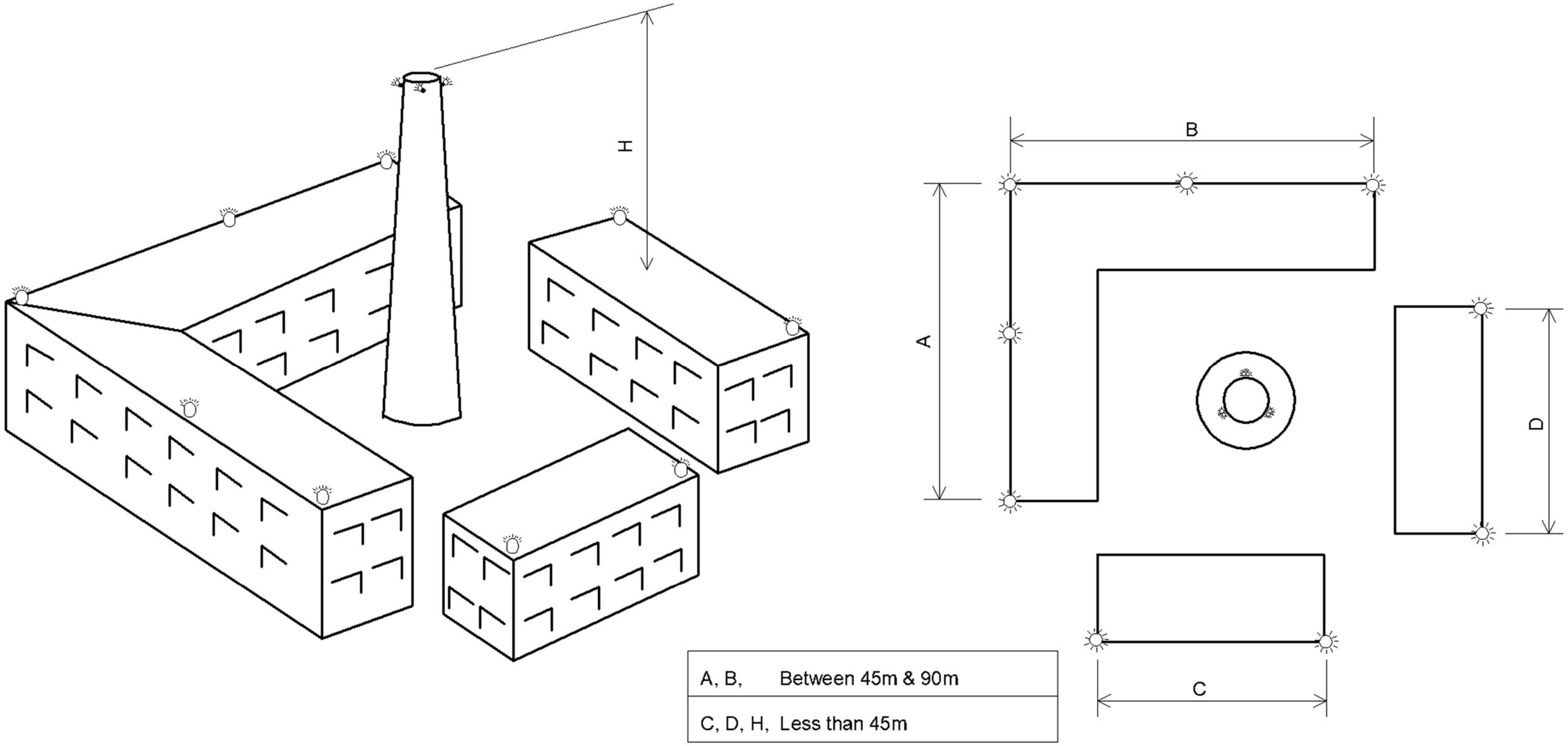


Figure 9.4-2: Typical lighting of a group of obstructions

A	90m or less
B	Between 25m and 45m
C	25m or less

Note: If A is more than 90m or B more than 45m intermediate lights shall be provided.

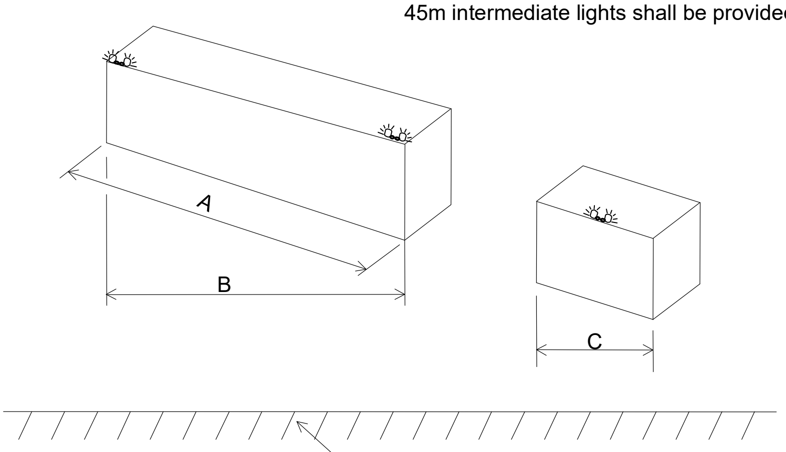
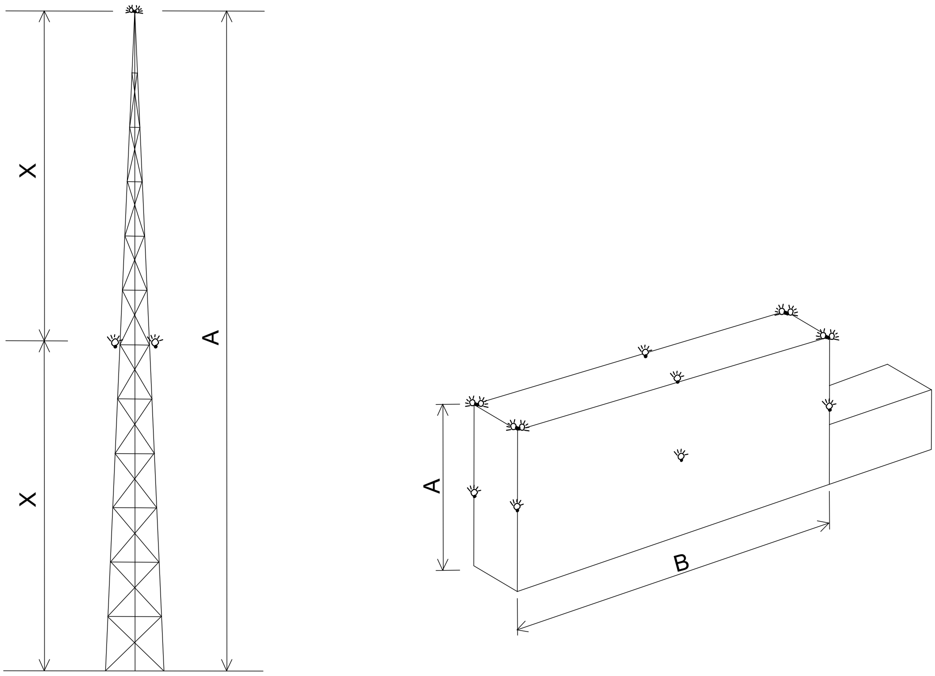


Figure 9.4-3: Typical lighting of horizontally extended obstructions



A, B	Between 45m and 90m
X	Equal spaces (maximum 45m)

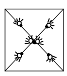


Figure 9.4-4: Typical lighting of towers and large obstructions

9.4.4 Natural Obstacles

9.4.4.1 Natural obstacles such as terrain and vegetation are normally extensive and the need for obstacle lighting will be assessed by RCAA on an individual case basis. Where required, obstacle lights are to be provided as follows:

(a) if the obstacle is located within the approach area, the portion of the obstacle which is within the approach area is to be treated in the same manner as man-made obstacles for the provision of obstacle lights;

(b) if the obstacle is located outside the approach area, it is to be marked by sufficient number of lights on the highest and most prominent features, so placed that the obstacle can be readily identified.

9.4.5 Temporary Obstacles

9.4.5.1 At night and in poor visibility conditions, temporary obstacles in the approach area or on the movement area are to be marked with permanent or temporary red obstacle lights. The lights are to be so arranged that they clearly mark the height, limits and extent of the obstacle.

9.4.6 Characteristics of Low Intensity Obstacle Lights

9.4.6.1 Low intensity obstacle lights, for general applications, are to have the following characteristics:

(a) fixed lights showing red;

(b) a horizontal beam spread that results in 360° coverage around obstacle;

(c) a peak intensity of 100 cd minimum;

(d) a vertical beam spread (to 50% of peak intensity) of 10°;

(e) a vertical distribution with 100 cd minimum at +6° and +10° above the horizontal; and

(f) not less than 10 cd at all elevation angles between –3° and +90° above the horizontal.

9.4.6.2 Low intensity obstacle lights, used to indicate taxiway obstacles or unserviceable areas of the movement area, are to have a peak intensity of 10 cd minimum.

9.4.7 Characteristics of Medium Intensity Obstacle Lights

9.4.7.1 Medium intensity obstacle lights are to be flashing or steady red lights or flashing white lights, visible in all directions in azimuth.

9.4.7.2 The frequency of flashes is to be between 20 and 60 flashes per minute.

9.4.7.3 The peak effective intensity is to be 2,000 ± 25% cd with a vertical distribution as follows:

(a) vertical beam spread is to be 3° minimum (beam spread is defined as the angle between two directions in a plane for which the intensity is equal to 50% of the lower tolerance value of the peak intensity);

(b) at -1° elevation, the intensity is to be 50% minimum and 75% maximum of lower tolerance value of the peak intensity; and

(c) at 0° elevation, the intensity is to be 100% minimum of the lower tolerance value of the peak intensity.

9.4.7.4 Where the flashing white light is used in lieu of obstacle marking during the day to indicate temporary obstacles in the vicinity of an aerodrome, in accordance with Paragraph 9.4.2.4(a), the peak effective intensity is to be increased to 20,000 ± 25% cd when the background luminance is 50 cd/m² or greater.

9.4.8 Characteristics of High Intensity Obstacle Lights

9.4.8.1 High intensity obstacle lights are flashing white lights.

9.4.8.2 The effective intensity of a high intensity obstacle light located on an object other than a tower supporting overhead wires or cables is to vary depending on background luminance as follows:

(a) 200,000 ± 25% cd effective intensity at a background luminance of above 500 cd/m² (day);

(b) 20,000 ± 25% cd effective intensity at a background luminance of between 50-500 cd/m² (dusk or dawn);

(c) 2,000 ± 25% cd effective intensity at a background luminance of below 50 cd/m² (night).

9.4.8.3 The effective intensity of a high intensity obstacle light located on a tower supporting overhead wires or cables is to vary depending on background luminance as follows:

(a) 100,000 ± 25% cd effective intensity at a background luminance of above 500 cd/m² (day);

(b) 20,000 ± 25% cd effective intensity at a background luminance of between 50-500 cd/m² (dusk or dawn);

(c) 2,000 ± 25% cd effective intensity at a background luminance of below 50 cd/m² (night).

9.4.8.4 High intensity obstacle lights located on an object other than a tower supporting overhead wires or cables are to flash simultaneously at a rate between 40-60 flashes per minute.

9.4.8.5 High intensity obstacle lights located on a tower supporting overhead wires or cables are to flash sequentially; first the middle light, second the top light, and last the bottom light. Cycle frequency is to be 40 - 60 per minute and the intervals between flashes of lights are to approximate the following ratios:

Table 9.4-1

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

9.4.8.6 To minimise environmental impact, unless otherwise directed by RCAA, the installation setting angles for high intensity obstacle lights are to be:

Table 9.4-2

Height of light unit above terrain	**Angle of the peak of the beam above the horizontal**
greater than 151 m AGL	0°
122 m to 151 m AGL	1°
92 m to 122 m AGL	2°
less than 92 m AGL	3°

9.4.9 Floodlighting of Obstacles

9.4.9.1 Where the installation of normal obstacle lights is deemed impracticable or undesirable for aesthetic or other reasons, floodlighting of obstacles may be an acceptable alternative. However, floodlighting is not to be used unless with the concurrence of the relevant RCAA office.

9.4.9.2 In general, floodlighting is not suitable if:

(a) the structure is skeletal as a substantially solid surface or cladding with satisfactory reflectance properties are required; or

(b) there is high background lighting level.

9.4.9.3 The floodlighting colour is to be white. Illumination of the obstacle is to cover all directions of azimuth over the full height portion of the obstacle which needs to be illuminated and is to be uniform around the circumferences of the obstacle.

9.4.9.4 The minimum level of luminance is to be 5 cd/m² at all points.

> **Note:** Based on a reflectance factor of 50% for white paint, this would require illuminance of at least 10 lux. For concrete with typical reflectance factor of 40%, the required illuminance would be at least 12.5 lux. Materials with reflectance factors less than 30% are unlikely to be suitable for floodlighting.

9.4.9.5 The light fittings are to be spaced evenly around the structure, at not more than 120° with at least two fittings at each location. At each location the fittings are to be on separate circuits and separately fused.

9.4.10 Ongoing Availability of Obstacle Lights

9.4.10.1 It is important that obstacle lights provided are in working condition when they are required to be on. The owners of obstacle lights need to establish a pro-active maintenance program to minimise light outage.

9.4.10.2 For obstacle lights located within the obstacle limitation surface area of the aerodrome, the aerodrome operator is to establish a monitoring program, which is to include:

(a) visual observation of the obstacles lights at least once every 24 hours (see note); and

(b) where a medium or high intensity obstacle light is located such that it is not readily observable visually:

(i) establish a procedure whereby such a light would be visually monitored within every 24-hour period; or

(ii) install an automatic visual or audio alarm indicator at an aerodrome location generally occupied by aerodrome personnel.

> **Note**: At smaller aerodromes with a low level of night aircraft operations, this period may be extended with the agreement of the relevant RCAA office.

9.4.10.3 For an obstacle located within the OLS area of the aerodrome, the following requirements apply:

(a) if there is an obstacle light outage, the aerodrome operator must:

(i) immediately request the AIS Office to advise pilots of the details of the outage; and

(ii) as soon as practicable liaise with the owner of the obstacle light so that the outage is repaired as quickly as practicable;

(b) if the aerodrome has been notified by RCAA that it must close upon the failure of a specified obstacle light considered by RCAA to be essential for safety, the aerodrome operator must immediately notify RCAA of the failure.

> **Note:** Information on requesting NOTAM action is in Chapter 10, Section 10.3.

9.4.10.3A The aerodrome operator's Aerodrome Manual must include:

(a) the procedures to be followed when an obstacle light outage occurs; and

(b) details of any RCAA notification that the aerodrome must close upon the failure of a specified obstacle light considered by RCAA to be essential for safety.

9.4.10.4 For obstacles located outside the obstacle limitation surface area of an aerodrome, the owners of the lights need to establish a program to monitor the lights and report light failures. The reporting point for obstacle light failure is normally the RCAA. When an obstacle light is unserviceable, the matter needs to be reported immediately to the relevant RCAA office so that a NOTAM warning pilots of the light outage can be initiated.

Section 9.5: Aerodrome Beacons

9.5.1 General

9.5.1.1 An aerodrome beacon is to be provided if it is determined by RCAA that such a visual cue is operationally necessary.

9.5.1.2 The following factors will be used in determining operational necessity:

(a) whether the aerodrome is intended to be used at night by aircraft navigating predominantly by visual means;

(b) the type and quantity of air traffic;

(c) the presence of other visual or radio aids;

(d) whether the location is subject to frequent periods of reduced visibility;

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

9.5.1.3 Where provided, the aerodrome beacon is to be located on or adjacent to the aerodrome in an area of low ambient background lighting. In addition, the aerodrome beacon is to be sited so that it is neither shielded by obstacles nor dazzling to a pilot making an approach to land.

9.5.1.4 At international aerodromes or aerodromes in built-up areas, the aerodrome beacon is to show two flashes, one white and the other coloured, so that they produce alternate white and colour flashes. For land aerodromes, the colour is to be green, for water aerodromes, the colour is to be yellow.

9.5.1.5 At other locations, white flashes only is satisfactory.

9.5.1.6 The frequency of total flashes must be from 20 to 30 per minute.

> **Note**: Older beacons with a frequency of flashes in the range of 12 to 20 per minute are acceptable, until the next replacement or upgrade of the beacon.

9.5.1.7 The light from the beacon is to be visible from all angles of azimuth.

9.5.1.8 The light intensity distribution of the aerodrome beacon must be in accordance with Table 9.5-1:

Table 9.5-1: Aerodrome beacon light intensity distribution

Elevation angle (in degrees)	Minimum effective intensity of white flashes (in candelas)
1 to 2	25 000
2 to 8	50 000
8 to 10	25 000
10 to 15	5 000
15 to 20	1 000

9.5.1.9 The effective intensity of colour flashes is to be not less than 0.15 times the intensity of the white flashes at the corresponding angle of elevation.

9.5.1.10 Where provided, information on the colour coding, flash rate and location (if not in the immediate vicinity of the aerodrome) of the aerodrome beacon is to be published in the aerodrome AIP entry.

Section 9.6: Illuminated Wind Direction Indicator

9.6.1 General

9.6.1.1 At an aerodrome intended for night use, at least one wind direction indicator is to be lit.

> **Note:** Wind direction indicators must be provided in accordance with Section 8.7.

9.6.1.2 If a WDI is provided in the vicinity of a runway threshold to provide surface wind information for pilots engaged in instrument straight-in approach and landing operations, and such operations are to be conducted at night, then the wind direction indicator is to be lit.

9.6.1.3 An illuminated wind direction indicator (IWDI) must be illuminated by floodlighting from above.

9.6.1.3A An IWDI installed on or after 1 July 2011 must be illuminated by at least 4 lamp units which together provide between 100 and 600 lux illumination on any point of the horizontal plane passing through the top of the IWDI sleeve at the supporting pole end for the 360° area swept by the fully extended sleeve.

> **Note:** An acceptable method of testing for illumination compliance is to measure illumination levels on the horizontal plane passing through the top of the sleeve at the pole end. Measurements should be taken at 1 m intervals starting at the pole and working outwards on a radial to the pole to a range equal to the length of the fully extended sleeve. The outermost interval on each radial may be less than 1 m to correspond with the actual length of the sleeve. The radials should be at 30° intervals. Each reading should be in the range 100 to 600 lux.

9.6.1.3B The lighting must have:

(a) accurate colour rendering; and

(b) no perceptible warm-up or restrike delay.

9.6.1.3C An IWDI installed before 1 July 2011 must be illuminated:

(a) in accordance with paragraphs 9.6.1.3A and 9.6.1.3B; or

(b) as follows:

(i) four 200W 240V tungsten filament general purpose lamps in either vertical elliptical industry reflectors, or round deep bowl reflectors, between 1.8 m and 2.2 m above the mid-height of the sleeve mounting, and between 1.7 m and 1.9 m radial distance from the axis of rotation of the wind sleeve; or

(ii) eight 120W 240V PAR 38 flood lamps in reflectorless fittings, between 1.8 m and 2.2 m above the mid-height of the wind sleeve mounting, and between 1.7 m and 1.9 m radial distance from the axis of the rotation of the wind sleeve; or

(iii) some other method of floodlighting which:

(A) produces lighting equivalent to that provided under sub subparagraph 9.6.1.3C (b) (i) or (ii); and

(B) has accurate colour rendering; and

(C) has no perceptible warm-up or restrike delay.

9.6.1.4 The floodlighting is to be aimed and shielded to ensure that it causes neither glare nor distraction to pilots.

> **Note**: An acceptable method of testing for compliance is as follows: from an observer's standing position on ground that is level with the base of the pole there should be no glare at a range of 25 m or more. The assessment need only be made from those directions likely to be viewed from landing, taking-off or taxiing aircraft.

9.6.1.5 If only one wind direction indicator is lit at an aerodrome and there are two or more lit runways, control of the lighting of the wind direction indicator is to be incorporated in the runway lighting control for each runway, so that energising any runway lighting system will automatically energise the lighting of the wind direction indicator.

9.6.1.6 Where more than one wind direction indicator can be lit, control of the lighting of each wind direction indicator is to be incorporated in the runway lighting control for the operationally related runway.

9.6.1.7 If the electricity supply to a wind direction indicator is provided from a runway lighting circuit for which intensity control is provided, a uniform intensity is required for the wind direction indicator irrespective of the intensity setting of the runway lighting.

9.6.1.8 Where a PAL is installed the wind direction indicator lighting is to be programmed in such a way that 10 minutes before the end of the aerodrome lighting 'ON' period, the lights of the wind direction indicator will commence to flash, at approximately 50 cycles per minute, and continue to flash until either:

(a) the PAL system switches off, and all aerodrome lighting, including the wind direction indicators, is extinguished; or

(b) the PAL system has been reset for another 'ON' period.

9.6.1.9 If the PAL system is reset for another 'ON' period, the lights of the wind direction indicator are to return to steady lighting.

Section 9.7: Approach Lighting Systems

9.7.1 Simple Approach Lighting System

9.7.1.1 A simple approach lighting system is a lighting system intended for a non-instrument or a non-precision approach runway. Standards for this system are not included in this Chapter as there is no operational credit for such systems.

> **Note**: Standard runway edge and threshold lights, supplemented by a visual approach slope indicator system have been found adequate for non-instrument and non-precision approach runways.

9.7.2 Precision Approach Category I Lighting System

9.7.2.1 A precision approach Category I lighting system must be provided to serve a precision approach runway Category I, as far as physically practicable.

Location

9.7.2.2 A precision approach Category I lighting system must consist of a row of lights on the extended centreline of the runway extending, wherever possible, over a distance of 900 m from the runway threshold, with a row of lights forming a crossbar 30 m in length at a distance of 300 m from the runway threshold.

> **Note:** The installation of an approach lighting system of less than 900 m in length may result in operational limitations on the use of the runway.

9.7.2.3 The lights forming the crossbar must be:

(a) as nearly as practicable in a horizontal straight line at right angles to, and bisected by, the line of the centreline lights; and

(b) spaced so as to produce a linear effect, except that gaps may be left on each side of the centreline provided:

   (i) the spacing of gaps is kept to a minimum to meet local requirements; and

   (ii) no gap exceeds 6 m.

Notes:

1. Spacings for the crossbar lights between 1 m and 4 m are in use. Gaps on each side of the centreline may improve directional guidance when approaches are made with a lateral error, and facilitate the movement of rescue and firefighting vehicles.
2. See ICAO Annex 14, Attachment A, Section 11 for guidance on installation tolerances.

9.7.2.4 The lights forming the centreline must be placed at longitudinal intervals of 30 m with the innermost light located 30 m from the threshold.

9.7.2.5 The lighting system must lie as nearly as practicable in the horizontal plane passing through the threshold, and be such that:

(a) no object, other than an ILS azimuth antenna, protrudes through the plane of the approach lights within a distance of 60 m from the centreline of the system; and

(b) no light, other than a light located within the central part of a crossbar or a centreline barrette (not their extremities), is screened from an approaching aircraft.

Antenna protrusions

9.7.2.6 An ILS azimuth antenna protruding through the plane of the lights must be treated as an obstacle and marked and lighted accordingly.

Characteristics

9.7.2.7 The centreline and crossbar lights of a precision approach Category I lighting system must:

(a) be fixed lights showing variable white; and

(b) for each centreline light position — consist of:

(i) 1 light source in the innermost 300 m of the centreline, 2 light sources in the central 300 m of the centreline and 3 light sources in the outer 300 m of the centreline, to provide distance information; or

(ii) a barrette.

9.7.2.8 A barrette must be:

(a) at least 4 m in length; and

(b) if composed of lights approximating to point sources — composed of such lights uniformly spaced at intervals of not more than 1.5 m.

9.7.2.9 If the centreline consists of barrettes in accordance with sub-subparagraph 9.7.2.7 (b) (ii), each barrette that is at least 300 m from the threshold must be supplemented by a capacitor discharge light which must:

(a) be flashed twice a second in sequence, beginning with the outermost light and progressing toward the threshold to the innermost light of the system; and

(b) be of such electrical circuit design that it can be operated independently of the other lights of the approach lighting system.

9.7.2.10 If the centreline consists of lights as described in sub-subparagraph 9.7.2.7 (b) (i):

(a) crossbars of lights (additional to the crossbar of lights at 300 m from the threshold) must be provided at 150 m, 450 m, 600 m and 750 m from the threshold; and

(b) the lights forming each crossbar must be:

(i) as nearly as practicable in a horizontal straight line at right angles to, and bisected by, the line of the centreline lights; and

(ii) spaced so as to produce a linear effect, except that gaps may be left on each side of the centreline provided:

(A) the number of gaps is kept to a minimum to meet local requirements; and

(B) no gap exceeds 6 m.

9.7.2.11 Where the additional crossbars described in 9.7.2.10 are incorporated in the system, the outer ends of the crossbars must lie on two straight lines that converge to meet the runway centreline 300 m from threshold.

9.7.2.12 Figure 9.7-1 below illustrates both kinds of precision approach Category I lighting configurations mentioned in this section.

9.7.2.13 The lights must be in accordance with the specifications of Section 9.8, Figure 9.8-1.

> **Note:** ICAO Annex 14, Attachment A, Section 11 provides information on the flight path envelopes used in the design of these lights.

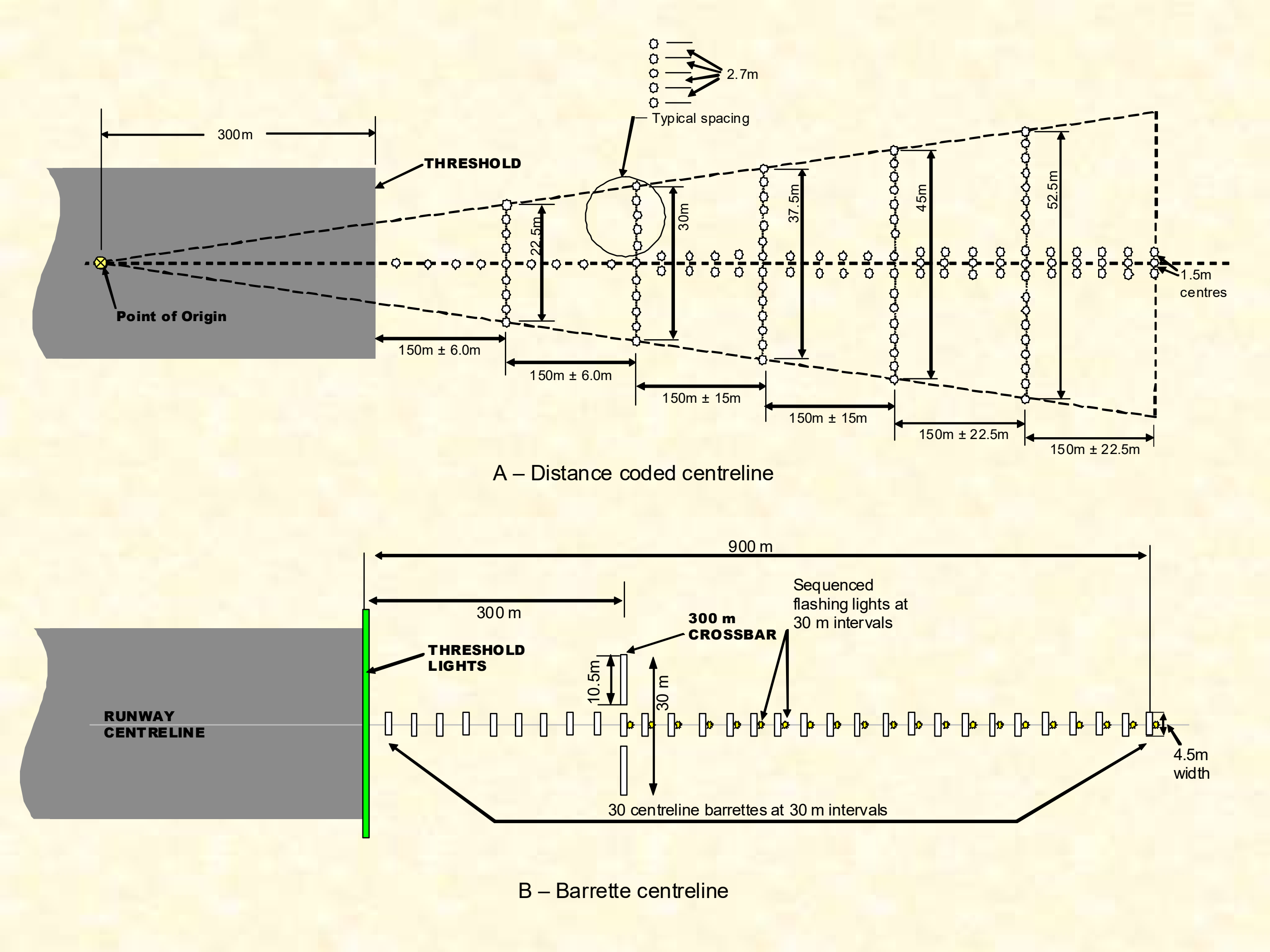


Figure 9.7-1: Precision approach Category I lighting systems

9.7.3 Precision Approach Categories II and III Lighting System

9.7.3.1 A precision approach Category II and Category III lighting system must be provided to serve a precision approach runway Category II or III.

> **Note:** Where a precision approach Category II and Category III lighting system is provided, touchdown zone lights must also be provided.

Location

9.7.3.2 The approach lighting system must consist of a row of lights on the extended centreline of the runway, extending, wherever possible, over a distance of 900 m from the runway threshold, with:

(a) 2 side rows of lights, extending 270 m from the threshold; and

(b) 2 crossbars, 1 at 150 m and 1 at 300 m from the threshold, as shown in Figure 9.7.2.

> **Note:** The length of 900 m is based on providing guidance for operations under Categories I, II and III conditions. Reduced lengths may support Categories II and III operations but may impose limitations on Category I operations.

9.7.3.3 The centreline lights must be at longitudinal intervals of 30 m, with the innermost lights located 30 m from the threshold.

9.7.3.4 The side row lights must be placed:

(a) on each side of the centreline; and

(b) at a longitudinal spacing equal to that of the centreline lights; and

(c) with the first light located 30 m from the threshold; and

(d) so that the lateral spacing (or gauge) between the innermost lights of the side rows is not less than 18 m nor more than 22.5 m, but in any event equal to that of the touchdown zone lights.

9.7.3.5 The crossbar provided at 150 m from the threshold must fill in the gaps between the centreline and side row lights.

9.7.3.6 The crossbar provided at 300 m from the threshold must extend on both sides of the centreline lights to a distance of 15 m from the centreline.

9.7.3.7 If the centreline beyond a distance of 300 m from the threshold consists of lights as described in subparagraph 9.7.3.12 (b), additional crossbars of lights must be provided at 450 m, 600 m and 750 m from the threshold.

9.7.3.8 Where the additional crossbars described in 9.7.3.7 are incorporated in the system, the outer ends of these crossbars must lie on two straight lines that converge to meet the runway centreline 300 m from the threshold.

9.7.3.9 The lighting system must lie as nearly as practicable in the horizontal plane passing through the threshold, and be such that:

(a) no object, other than an ILS azimuth antenna, may protrude through the plane of the approach lights within a distance of 60 m from the centreline of the system; and

(b) no light, other than a light located within the central part of a crossbar or a centreline barrette (not their extremities), may be screened from an approaching aircraft.

Antenna protrusions

9.7.3.10 An ILS azimuth antenna protruding through the plane of the lights must be treated as an obstacle and marked and lighted accordingly.

Characteristics

9.7.3.11 The centreline of a precision approach Categories II and III lighting system for the first 300 m from the threshold must consist of barrettes showing variable white, except that, where the threshold is displaced 300 m or more, the centreline may consist of single light sources showing variable white.

9.7.3.12 Beyond 300 m from the threshold, each centreline light position must consist of 1 of the following which all must show variable white:

(a) 1 barrette as used on the inner 300 m;

(b) 2 light sources in the central 300 m of the centreline, and 3 light sources in the outer 300 m of the centreline.

9.7.3.13 A barrette must be:

(a) at least 4 m in length; and

(b) if composed of lights approximating to point sources — composed of such lights uniformly spaced at intervals of not more than 1.5 m.

9.7.3.14 If the centreline beyond a distance of 300 m from the threshold consists of barrettes as described in subparagraph 9.7.3.12 (a), each barrette must be supplemented by a capacitor discharge light which must:

(a) be flashed twice a second in sequence, beginning with the outermost light and progressing toward the threshold to the innermost light of the system; and

(b) be of such electrical circuit design that it can be operated independently of the other lights of the approach lighting system.

9.7.3.15 Each side row of lights must consist of a barrette:

(a) whose lights show red; and

(b) whose length and light spacing must be equal to the length and light spacing of the barrettes in the touchdown zone.

9.7.3.16 The lights forming the crossbars must be:

(a) fixed lights showing variable white; and

(b) uniformly spaced at intervals of not more than 2.7 m.

9.7.3.17 The intensity of the red lights must be compatible with the intensity of the white lights.

9.7.3.18 The lights must be in accordance with the specifications of Section 9.8, Figure 9.8-1 and Figure 9.8-2.

> **Note:** ICAO Annex 14, Attachment A, Section 11 provides information on the flight path envelopes used in the design of these lights.

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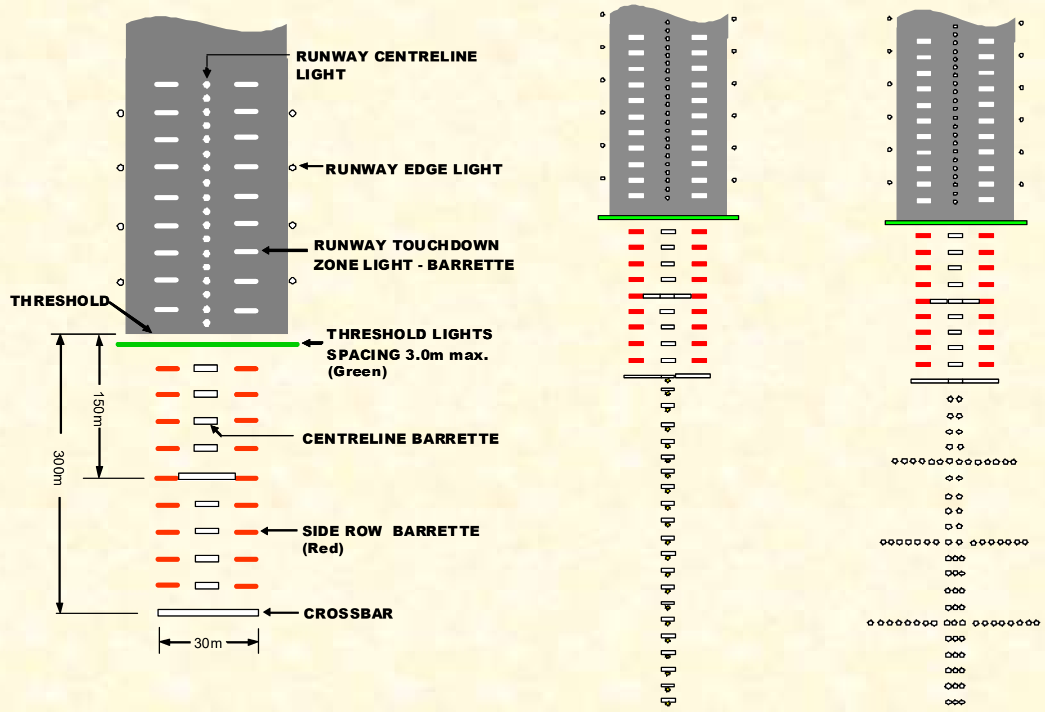


Inner 300 m approach and runway lighting for precision approach runways, categories II and III

Typical full length configurations for approach lighting systems, categories II and III

Figure 9.7-2: Precision approach lighting system, Categories II and III

Section 9.8: Isocandela Diagrams of Approach Lighting

9.8.1 Collective Notes

9.8.1.1 Except for Paragraph 9.11.1.4, the collective notes for Section 9.11 apply to this Section.

9.8.1.2 **Average intensity ratio.** The ratio between the average intensity within the ellipse defining the main beam of a typical new light and the average intensity of the main beam of a new runway edge light is to be as follows:

(a) Figure 9.8-1 Approach centreline and crossbars — 1.5 to 2.0 (white light)

(b) Figure 9.8-2 Approach side row — 0.5 to 1.0 (red light)

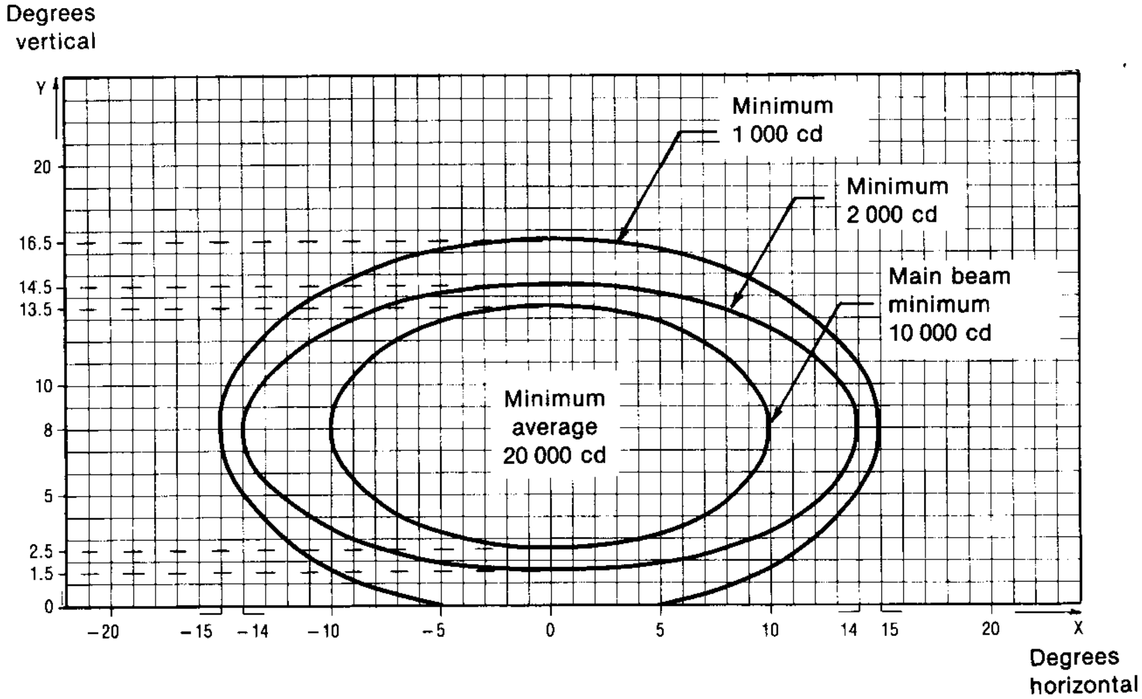


Figure 9.8-1: Isocandela diagram for approach centreline light and cross bars (white light)

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 must 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	0º – 11º
316 m to 475 m	0.5º – 11.5º
476 m to 640 m	1.5º – 12.5º
641 m and beyond	2.5º – 13.5º (as illustrated above)

3. Lights in crossbars beyond 22.5 m from the centre line must be toed-in 2 degrees. All other lights must be aligned parallel to the centre line of the runway.
4. See collective notes at Paragraph 9.8.1.

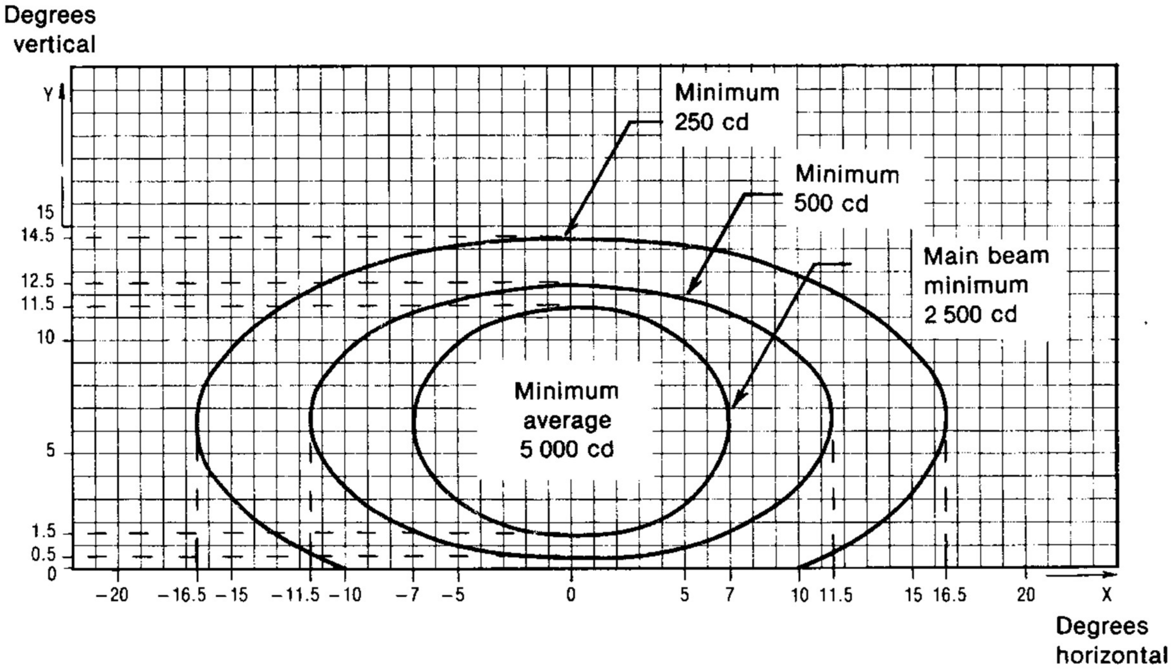


Figure 9.8-2: Isocandela Diagram for approach side row light (red light)

Notes: 1. Curves calculated on formula $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$

a	7.0	11.5	16.5
b	5.0	6.0	8.0

2. Toe-in 2 degrees
3. Vertical setting angles of the lights must 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	0.5º – 10.5º
116 m to 215 m	1.0º – 11º
216 m and beyond	1.5º – 11.5º (as illustrated above)

4. See collective notes at Paragraph 9.8.1.

Section 9.9: Visual Approach Slope Indicator Systems

9.9.1 General

9.9.1.1 A visual approach slope indicator system shall be provided to serve the approach to a runway, whether or not the runway is served by electronic approach slope guidance, where one of the following applies:

(a) The runway is regularly used by jet-propelled aeroplanes engaged in air transport operations.

(b) RCAA directs that visual approach slope guidance be provided, because it has determined that such a visual aid is required for the safe operation of aircraft.

9.9.1.2 In making a determination that visual approach slope guidance is required, RCAA will take into account the following:

(a) The runway is frequently used by other jet-propelled aeroplanes, or other aeroplanes with similar approach guidance requirements.

(b) The pilot of any type of aeroplane may have difficulty in judging the approach due to:

(i) 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;

(ii) misleading approach information such as that produced by deceptive surrounding terrain, runway slope, or unusual combinations of runway width, length and light spacing;

(iii) a displaced threshold.

(c) The presence of objects in the approach area may involve serious hazard if an aeroplane descends below the normal approach path, particularly if there are no non-visual or other visual aids to give warning of such objects.

(d) Physical conditions at either end of the runway present a serious hazard in the event of an aeroplane undershooting or overrunning the runway.

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

9.9.1.3 RCAA may direct that a visual approach slope indicator system be provided for temporary use only, for example due to a temporary displaced threshold, or during works in progress.

9.9.1.4 The following visual approach slope indicator systems are approved for use in Rwandan civil aerodromes:

(a) T-VASIS;

(b) AT-VASIS;

(c) Double-sided PAPI; and

(d) PAPI.

9.9.1.5 The standard installations must be:

(a) At international aerodromes, T-VASIS, or double-sided PAPI. Where this is impracticable, an AT-VASIS or PAPI is acceptable.

(b) At aerodromes other than international aerodromes, AT-VASIS or PAPI, except where (c) below applies.

(c) At aerodromes where RCAA has determined that additional roll guidance is required, and/or high system integrity is necessary, T-VASIS or double-sided PAPI.

(d) AT-VASIS and PAPI must be installed on the left side of the runway, unless this is impracticable.

9.9.1.6 Where a T-VASIS is to be replaced by a PAPI, a double-sided PAPI must be provided.

9.9.1.7 Where more than one visual approach slope indicator system is provided at an aerodrome, to avoid confusion, the same type of approach slope indicator system must be used at each end of a runway. If there is more than one runway, the same type of approach slope indicator system must be used on all runways of similar reference code number.

9.9.1.8 Where a visual approach slope indicator system is provided for temporary use only, in accordance with 9.9.1.3, then 9.9.1.7 need not apply.

9.9.1.9 The choice of T-VASIS or PAPI is a matter between the aerodrome operator and airline operators using the runway. For capital city runways used by a range of medium and large jet aeroplanes, T-VASIS would be a better visual aid.

9.9.2 Obstacle Assessment Surface

9.9.2.1 An obstacle assessment surface (OAS) must be surveyed and assessed for obstacles for each end of the runway where a T-VASIS, AT-VASIS, double-sided PAPI or PAPI is to be provided. Standards of OAS are as follows and an OAS is illustrated below:

(a) Baseline: Width 150 m, coincident with the existing baseline for the approach surface;

(b) Slope: 1.9º;

(c) Splay: 7.5º outwards, commencing from the ends of the baseline;

(d) Length: 9 km from the baseline.

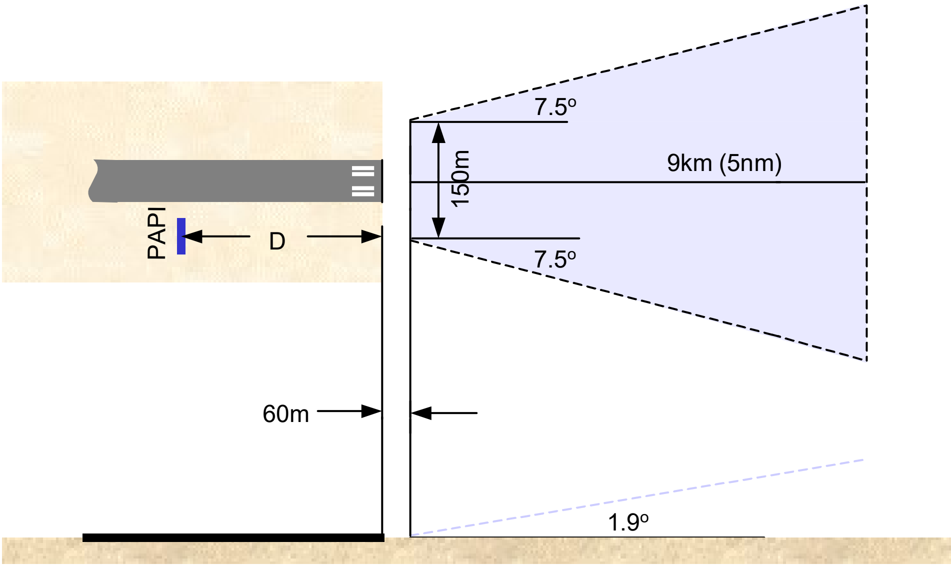


Figure 9.9-1: Illustration of an Obstacle Assessment Surface for 3° approach slope

9.9.2.2 The aerodrome operator must check any penetration by, or proximity to, objects such as radio masts, buildings etc. and terrain, of the Obstacle Assessment Surface as specified in Paragraph 9.9.2.1. Where one or more obstacles are found, or where high ground lies close to the approach path, the relevant RCAA Office must be requested to conduct an aeronautical study to determine whether the obstacle(s) or terrain could adversely affect the safety of aircraft operations.

9.9.2.3 Where practicable, objects above the assessment surface must be removed, except where RCAA determines that the object would not adversely affect the safety of operations.

9.9.2.4 If the study determines that safety could be adversely affected, and it is not practicable to remove the object, then one or more of the following measures should be undertaken:

(a) suitably raise the approach slope of the system – to a maximum of 3.3° where the runway is used by jet propelled aeroplanes, or 4° for other aeroplanes: the OAS slope can then be raised by the same amount, e.g. for a 3.3° slope the OAS can become 2.2° instead of 1.9°;

(b) reduce the azimuth spread so that the obstacle is outside the confines of the beam;

(c) displace the axis of the system and its associated OAS by up to 5°;

(d) suitably displace the threshold; and

(e) if (d) is impracticable, suitably displace the system upwind of the threshold to provide an increase in threshold crossing height equal to the height of the obstacle penetration.

9.9.3 T-VASIS and AT-VASIS

9.9.3.1 A T-Visual Approach Slope Indicator System (T-VASIS) is a set of lights so arranged that the pattern seen by the pilot varies according to his position (up or down, left or right) relative to the desired approach path. Where installed in the runway strip, it provides the pilot with visual cues about his or her actual descent path relative to the desired descent path.

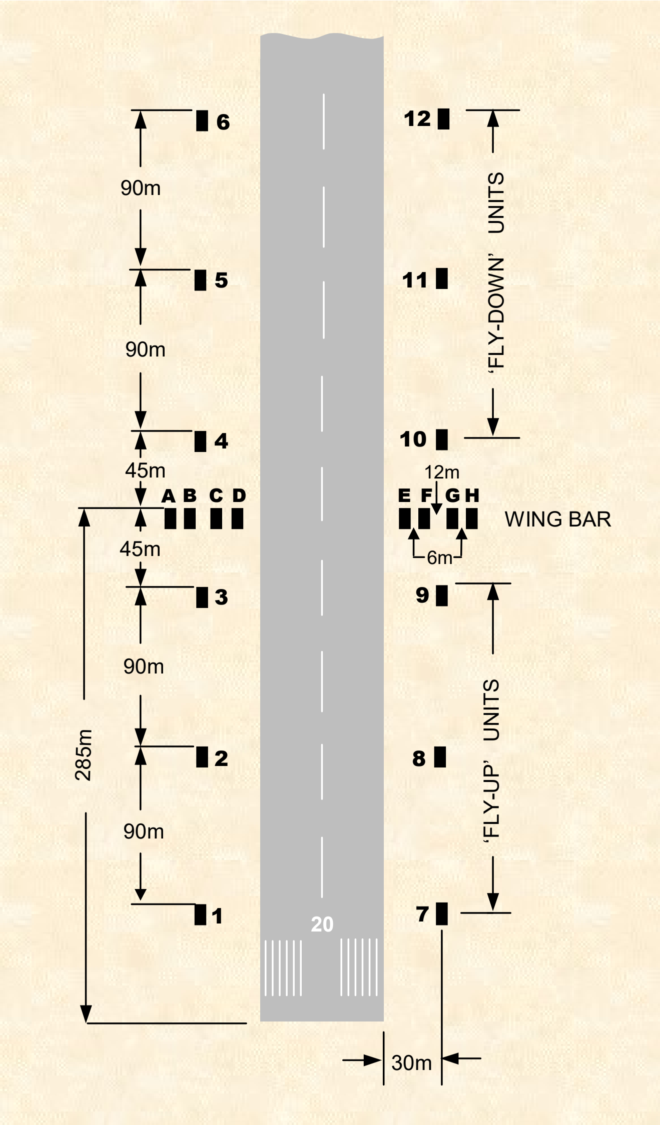


Figure 9.9-2: T-VASIS Layout

9.9.3.2 A T-VASIS must consist of twenty light units symmetrically disposed about the runway centreline in the form of two wing bars of four light units each, with bisecting longitudinal lines of six lights, and laid out as shown in Figure 9.9-2.

9.9.3.3 An AT-VASIS must 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.

9.9.3.4 The light units must be constructed and arranged in such a manner that the pilot of an aeroplane during an approach will:

(a) When above the correct approach slope, see an inverted white 'T' pattern comprising the white wing bar(s) lights, and one, two or three white 'fly-down' lights, the more fly-down lights being visible, the higher the pilot is above the correct approach slope.

(b) When on the correct approach slope, see a line of white wing bar(s) lights.

(c) When below the correct approach slope, see a white 'T' pattern comprising the white wing bar(s) lights and one, two or three white 'fly-up' lights, the more fly-up lights being visible the lower the pilot is below the correct approach slope; and when well below the correct approach slope, see a red 'T' pattern with the wing bar(s) and the three fly-up lights showing red.

9.9.3.5 **Siting a T-VASIS or AT-VASIS.** The siting of a T-VASIS or AT-VASIS must be such that:

(a) The light units must be located as shown in Figure 9.9-2, subject to the tolerances given in Table 9.9-1.

(b) The light units forming the wing bars, or the light units forming a fly-down or a fly-up matched pair, must be mounted so as to appear to the pilot of an approaching aeroplane to be substantially in a horizontal line. The light units must be mounted as low as possible and must be frangible.

9.9.3.6 **Characteristics of the T-VASIS light units.** The characteristics of the T-VASIS light units must be such that:

(a) The system must be suitable for both day and night operations.

(b) A suitable intensity control must be provided to allow adjustments to meet the prevailing conditions and to avoid dazzling the pilot during approach and landing.

(c) The light distribution of the beam of each light unit must 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 must produce a beam of white light extending from an elevation of 6° down to approximately the approach slope, where it must have a sharp cut-off. The fly-up light units must produce a beam of white light from approximately the approach slope down to 1° 54' vertical angle and a beam of red light below 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 provide obstacle clearance.

(d) The colour transition from white to red must be so 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’. Immediately below this transition sector the intensity of the completely red beam must not be less than 15% of the intensity of the completely white beam immediately above the transition sector.

(e) The beam of light produced by the light units must show through an angle of at least 1° 30’ above and below the approach slope both by day and by night and in azimuth through not less than 10° by day and not less than 15° by night. The effective visual range of the light units in clear weather must be at least 7.4 km over the above angles.

(f) The light units must be so designed that deposits of condensation, dirt, etc. on optically transmitting or reflecting surfaces must interfere to the least possible extent with the light signals and must in no way affect the elevation of the beams or the contrast between the red and white signals. The construction of the light units must be such as to minimise the probability of the slots being wholly or partially blocked by snow or ice where these conditions are likely to be encountered.

9.9.3.7 **Approach slope and elevation settings of light beams.** The approach slope and elevation settings of light beams must be such that:

(a) An approach slope that is operationally satisfactory is to be selected for each runway. The standard approach slope is 3º (1:19 nominal), and with an eye height over threshold of 15 m.

(b) When the runway on which a T-VASIS is provided is equipped with an ILS, the siting and elevation of the light units must be such that the T-VASIS approach slope is compatible with the ILS glide path. A T-VASIS eye-height over the threshold 1 m higher than the ILS glide path has been found to satisfy most aeroplanes.

(c) The light beams from the corresponding light units on opposite sides of the runway must have the same recognition angle. The fly-up and fly-down light units of the ‘T’ must appear with uniform steps as the approach slope changes.

(d) The elevation of the beams of the wing bar light units on both sides of the runway must be the same. The elevation of the top of the beam of the fly-up light unit nearest to each wing bar, and the bottom of the beam of the fly-down light unit nearest to each wing bar, must be equal and must correspond to the approach slope. The cut-off angle of the top of the beams of successive fly-up units shall decrease by 5’(±½’) 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 must increase by 7’(±½’) of arc at each successive unit away from the wing bar.

(e) The elevation setting of the top of the red light beams of the wing bar and fly-up light units must be such that, during an approach, the pilot of an aeroplane, to whom the wing bar and three fly-up units are visible, would clear all objects in the approach area by a safe margin, if any such light did not appear red.

9.9.3.8 **Clearance from movement areas.** Light unit must not be sited closer than 15 m from the edge of the runway. Light units should be sited at least 15 m from the edge of a taxiway but should circumstances require units to be closer than this distance the particular case should be referred to RCAA.

9.9.3.9 **System dimensions.** Tabulated below are system dimensions, with allowable tolerances. These values apply to design, installation and subsequent maintenance:

Table 9.9-1

Item	Standard	Allowable Tolerance
Eye height over threshold	15 m [1,2]	+1 m –3 m
Approach slope [3]	3° (1: 19 nominal)	
Distance of longitudinal line of light units from runway edge [4]	30 m	±3 m
Leg light unit spacing	45 m 90 m	±4.5 m ±9 m
Clearance from pavements	15 m [5]	
Alignment of each light unit	Parallel to runway centreline	±1°
Light units in a wing bar Fronts of light units Height of light units	 Aligned Aligned	 ±25 mm ±25 mm
Levelling of light units	Level	To the accuracy of the precision engineers level. [6]

[1] When the runway on which a T-VASIS is provided is equipped with an ILS, the siting and elevations of the T-VASIS shall be such that the visual approach slope conforms as closely as possible to the Glide Path of the ILS.

[2] A T-VASIS eye height over threshold 1 m higher than the ILS Glide Path satisfies most aircraft.

[3] The use of a different approach slope requires prior approval from RCAA.

[4] The edge of the runway is defined as the distance from the runway centreline, which is half the nominal width of the runway and ignores sealed shoulders.

[5] A minimum clearance between any part of a T-VASIS light unit (but not the foundation slab) and an adjacent runway or taxiway pavement.

[6] This includes end-for-ending the level to ensure no inaccuracy of the instrument.

9.9.3.10 The aerodrome operator must ensure that the immediate surround of each unit is kept free of grass. Tall grass immediately in front of the light unit could provide conflicting light signals. Grass growing near to the box on any side could result in the fine settings being disturbed during power mowing operations.

9.9.3.11 **Current settings.** The following information is provided for guidance only of aerodrome operators. For existing installations, the recommended lamp current, the approximate series current and approximate light intensities are shown in Table 9.9-2 and Table 9.9-3.

Table 9.9-2: Using 021027.8 (V1/418) Day Lamps and 020946-1 (V1/312) Night Lamps

Intensity stage	Lamp Current	Series Circuit Current	Light Unit Intensity
6	6.2 amps	6.2 amps	80,000 cd
5	5.0 amps	5.0 amps	20,000 cd
4	4.0 amps	4.0 amps	5,000 cd
3	2.4 amps	6.1 amps	450 cd
2	2.05 amps	5.2 amps	140 cd
1	1.65 amps	4.2 amps	50 cd
Note: For intensity stage 6, experiments have shown that lamp current down to 6.05 amps did not adversely affect visual acquisition from the 4 NM range in bright sunlight conditions. Hence if preservation of lamp life is desired, reduction of lamp current for stage 6 down to 6.05 amps is acceptable.			

Table 9.9-3: Using 020975.2 (V1/353) Day Lamps (with 074315.4 (Y9/1846) transformer) and 020946-1 (V1/312) Night Lamps

Intensity stage	Lamp Current	Series Circuit Current	Light Unit Intensity
6	6.85 amps	5.4 amps	80,000 cd
5	5.65 amps	4.5 amps	20,000 cd
4	4.8 amps	3.8 amps	5,000 cd
3	2.4 amps	6.1 amps	450 cd
2	2.05 amps	5.2 amps	140 cd
1	1.65 amps	4.2 amps	50 cd
Note: For intensity stage 6, experiments have shown that lamp current down to 6.35 amps did not adversely affect visual acquisition from the 4 NM range in bright sunlight conditions. Hence if preservation of lamp life is desired, reduction of lamp current for stage 6 down to 6.35 amps is acceptable.			

9.9.4 Precision Approach Path Indicator (PAPI) system

9.9.4.1 The PAPI system must consist of a row, also termed 'wing bar', of 4 equally spaced sharp transition multi-lamp (or paired single lamp) units. The system must be located on the left side of the runway, as viewed by an aircraft approaching to land, unless it is impracticable to do so.

9.9.4.2 The PAPI system must be sited and adjusted so 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;

(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.

9.9.4.3 Where it is impracticable to install the PAPI on the left side of the runway, and it has been installed on the right, the usual order of the light units must be reversed, so that the on-slope indication is still given by the two units nearest the runway showing red.

9.9.4.4 A double-sided PAPI system must consist of eight light units symmetrically disposed about the runway centre line in the form of two wing bars of four light units each. The indications seen by the pilot must be symmetrical, so that when on or close to the approach slope, the two light units nearest the runway, in both wing bars, show red.

9.9.4.5 **Siting a PAPI or a Double-sided PAPI.** The following requirements are applicable to the siting of a PAPI or a Double-sided PAPI:

(a) The light units must be located as in the basic configuration illustrated in Figure 9.9-3, subject to the installation tolerances given therein.

(b) The light units forming a wing bar must be mounted so as to appear to a pilot of an approaching aeroplane to be substantially in a horizontal line. The light units must be mounted as low as possible and must be frangible.

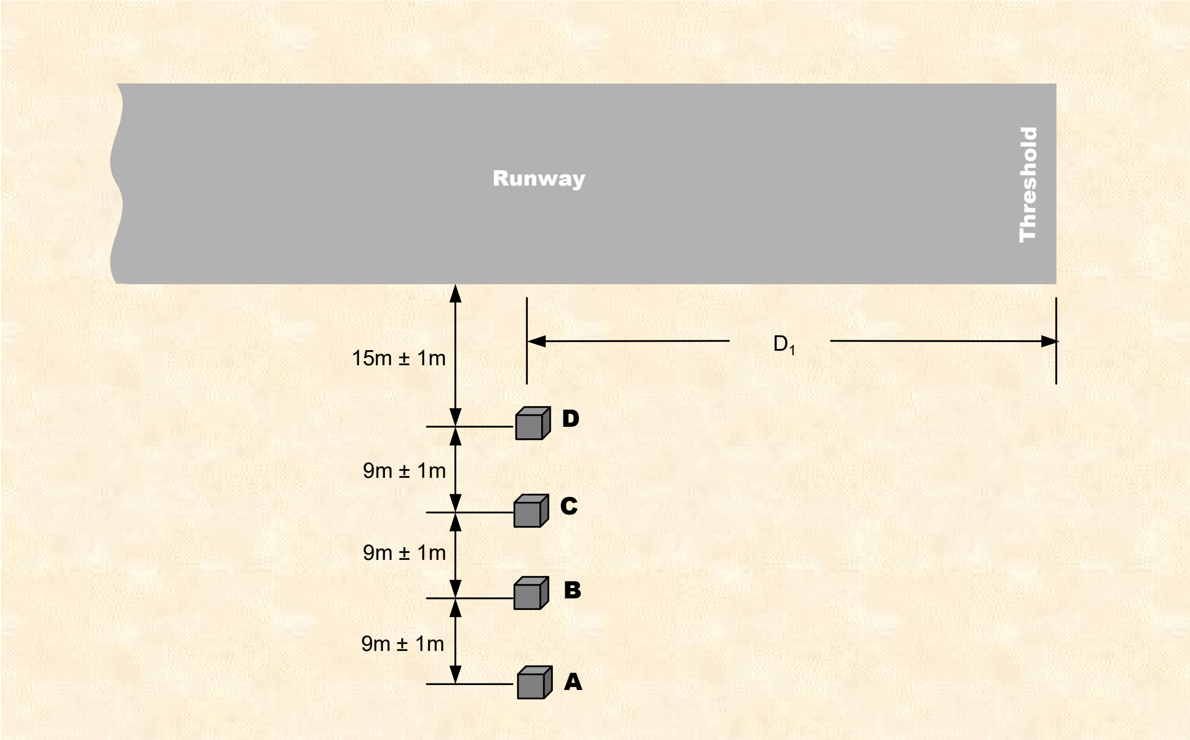


Figure 9.9-3: Siting of PAPI Light Units

> **Notes:** 1. The edge of the runway is defined as the distance from the runway centreline, which is half the nominal width of the runway and ignores sealed shoulders.
>
> 2. In the case of runways where the row of edge lights is located beyond the standard 3 m specified in 9.10.5.1, for example those runways in accordance with the Note following 9.10.5.1, or those in accordance with 9.10.5.2, the PAPI should be located with the inner light unit 13 ±1 m from the line of the edge lights, rather than 15±1 m from the runway edge. (The reason for this is because reducing the spacing between PAPI light units results in a reduction in usable range of the system.) In the case of the Note following 9.10.5.1, when the runway edge lights are relocated to the standard location, the PAPI should also be relocated to the standard location.

9.9.4.6 **Characteristics of the PAPI light units.** The characteristics of the PAPI light units must be such that:

(a) The system must be suitable for both day and night operations.

(b) The colour transition from red to white in the vertical plane must be such that as to appear to an observer, at a distance of not less than 300 m, to occur within a vertical angle of not more than 3'.

(c) At full intensity the red light must have a Y co-ordinate not exceeding 0.320.

(d) The light intensity distribution of the light units must be as shown in Figure 9.9-4.

(e) Suitable intensity control must be provided to allow adjustment to meet the prevailing conditions and to avoid dazzling the pilot during approach and landing.

(f) Each light unit must 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.

(g) The light units must be so designed that deposits of condensation, snow, ice, dirt, etc., on optical transmitting or reflecting surfaces must interfere to the least possible extent with the light signals and must not affect the contrast between the red and white signals and the elevation of the transition sector.

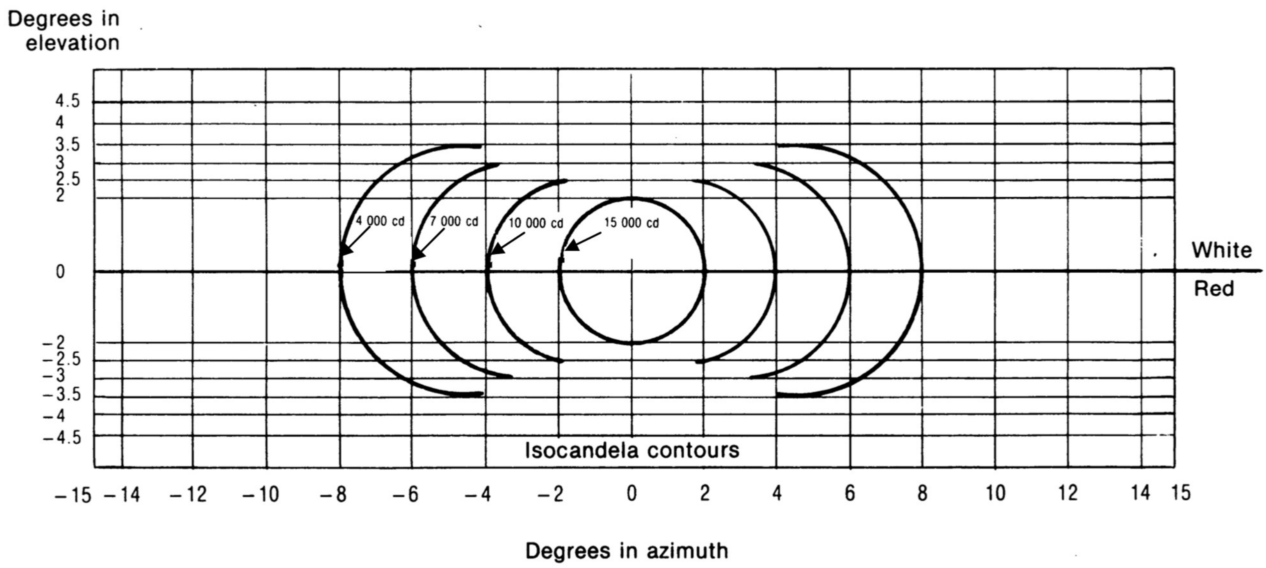


Figure 9.9-4: Light intensity distribution of PAPI

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.

9.9.4.7 **Approach slope and elevation setting of light units.** The requirements for the approach slope and elevation setting of light units are:

(a) The approach slope, as defined in Figure 9.9-5, must be appropriate for use by the aeroplanes using the approach. The standard approach slope is 3°.

(b) When the runway on which a PAPI is provided is equipped with an ILS, the siting and elevation of the light units must be such that the PAPI approach slope conforms as closely as possible with the ILS glide path.

(c) The angle of elevation settings of the light units in a PAPI wing bar must be such that, during an approach, the pilot of an aeroplane observing a signal of one white and three reds will clear all objects in the approach area by a safe margin. See 9.9.2.4(a) concerning the raising of the approach slope.

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

(e) Where a double-sided PAPI is provided, corresponding units must be seen at the same angle so that the signals of each wing bar change symmetrically at the same time.

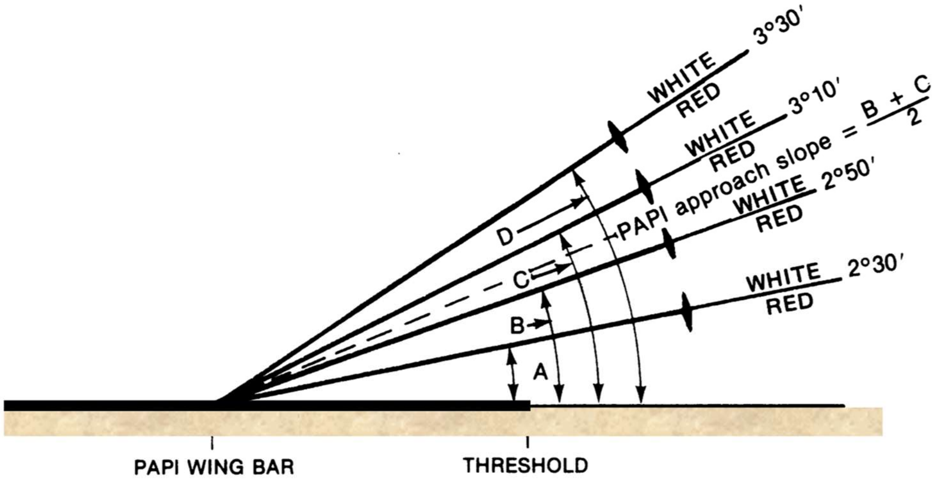


Figure 9.9-5: Light beams and angle of elevation setting for PAPI 3° approach slope

9.9.4.8 Determining PAPI wing bar distance from threshold

(a) The optimum distance of PAPI wing bar from the runway threshold is determined by:

(i) the requirement to provide adequate wheel clearance over the threshold for all types of aircraft landing on the runway;

(ii) the operational desirability that PAPI is compatible with any non-visual glide path down to the minimum possible range and height; and

(iii) any difference in elevation between the PAPI units and the runway threshold.

(b) The distance of the PAPI units from the threshold may have to be modified from the optimum after consideration of:

   (i) the remaining length of runway available for stopping the aircraft; and

   (ii) obstacle clearance.

(c) Table 9.9-4 specifies the standard wheel clearance over the threshold for the most demanding amongst the aircraft regularly using the runway, for four aircraft eye-to-wheel height groups. Where practicable, the standard wheel clearance shown in column (2) must be provided.

(d) Where the landing run may be limited, especially at smaller aerodromes, a reduction in wheel clearance over the threshold may be more acceptable than a loss of landing distance. The special minimum wheel clearance shown in column (3) may be used in such a situation, if an aeronautical study indicates such reduced clearances to be acceptable. As guidance, these wheel clearances are unlikely to be acceptable where there are objects under the approach near the threshold, such as approach light supporting structures, boundary fences, roads, etc.

(e) The final location of the units is determined by the relationship between the approach angle, the difference in levels between threshold and the units, and the minimum eye height over the threshold (MEHT). The angle M used to establish the MEHT is 2' of arc less than the setting angle of the unit which defines the lower boundary of the on-slope indication, i.e. unit B, the third unit from the runway. See Figure 9.9-6.

(f) Where a PAPI is installed on a runway not equipped with an ILS, the distance D_1 shall be calculated to ensure that the lowest height at which a pilot will see a correct approach path indication provides the wheel clearance over the threshold specified in Table 9.9-4 for the most demanding amongst aeroplanes regularly using the runway.

(g) Where a PAPI is installed on a runway equipped with an ILS, 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.

(h) If a wheel clearance greater than that that specified in 9.9.4.8(f) is required for specific aircraft, this can be achieved by increasing D_1.

(i) Distance D_1 shall be adjusted to compensate for differences in elevation between the lens centres of the light units and the threshold.

(j) PAPI units must be the minimum practicable height above ground, and not normally more than 0.9 m. All units of a wing bar should ideally lie in the same horizontal plane; however, to allow for any transverse slope, small height differences of no more than 50 mm between light units are acceptable. A lateral gradient not greater than 1.25% can be accepted provided it is uniformly applied across the units.

Table 9.9-4: Wheel clearance over threshold for PAPI

Eye-to-wheel height of aeroplane in the approach configuration [a]	**Standard wheel clearance (metres)**[b]	**Special minimum wheel clearance (metres)**[c, d]
(1)	(2)	(3)
Up to but not including 3 m	6	3
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 standard wheel clearance shown in column (2) shall be provided.

[c] The wheel clearance may be reduced to not less than those in column (3) with specific agreement of RCAA, where an aeronautical study indicates that such reduced wheel clearances are acceptable.

[d] Where the Special Minimum wheel clearance is provided at a displaced threshold it shall be ensured that the corresponding Standard 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.

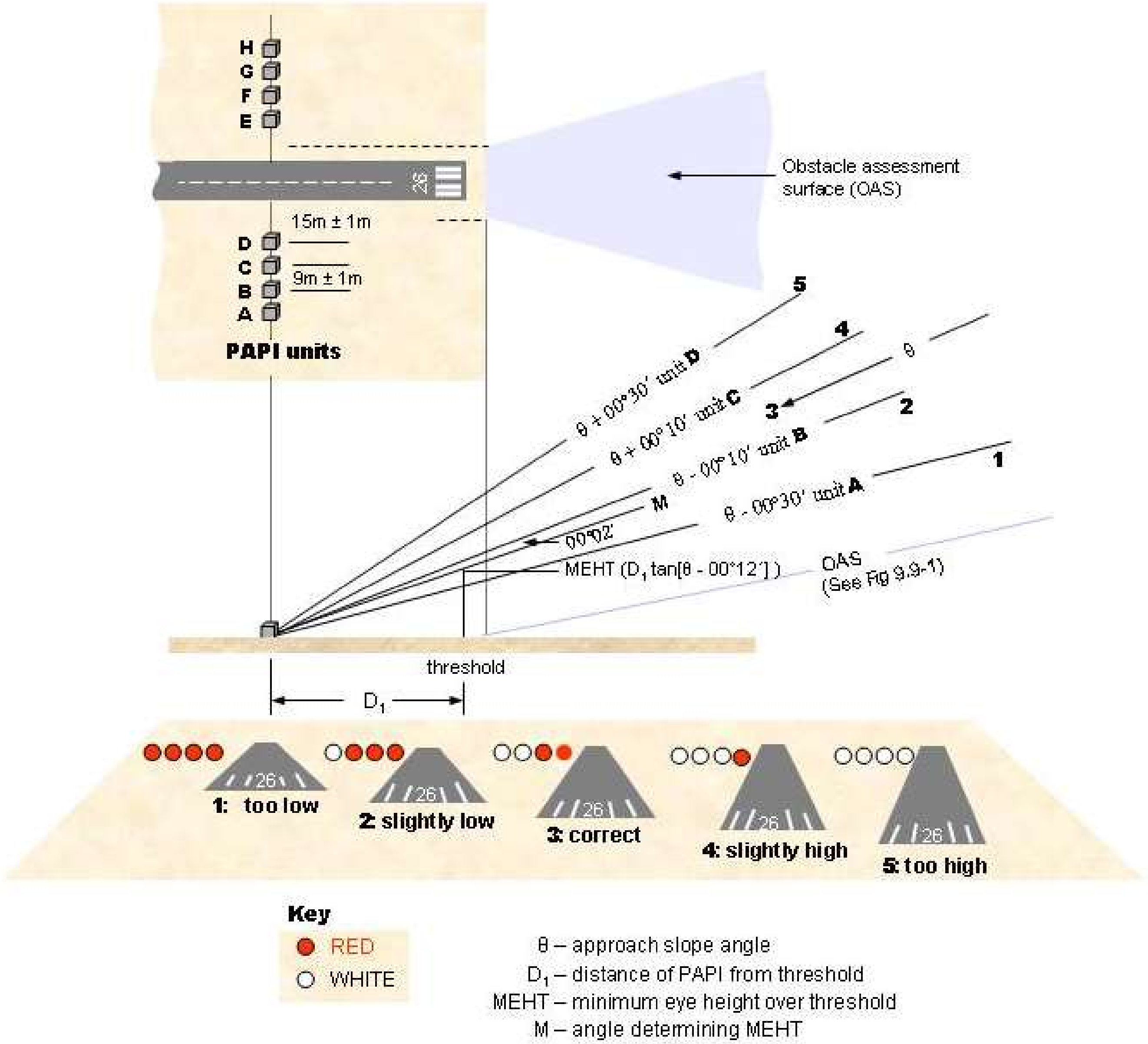


Figure 9.9-6: The arrangement of a PAPI system and the resulting display

9.9.4.9 Procedure for Establishing the Distance of the PAPI Wing Bar from the Runway Threshold

(a) Decide on the required approach slope. The standard approach slope is 3°.

(b) On runways where no ILS is installed, refer to Table 9.9-4 to determine the aeroplane eye-to-wheel group and the wheel clearance to be provided at the threshold. The MEHT, which provides the appropriate wheel clearance over the threshold, is established by adding the approach configuration eye-to-wheel height of the most demanding amongst the aircraft regularly using the runway to the required threshold wheel clearance.

(c) The calculation of the nominal position of the PAPI is made on the assumption that the PAPI units are at the same level as the runway centreline adjacent to them, and this level, in turn, is the same as that of the runway threshold. The nominal distance of the PAPI is derived by multiplying the required MEHT by the cotangent of the angle M in Figure 9.9-6.

(d) Where there is a difference in excess of 0.3 m between the elevation of the runway threshold and the elevation of unit B at the nominal distance from the threshold, it will be necessary to displace the PAPI from its nominal position. The distance will be increased if the proposed site is lower than the threshold and will be decreased if it is higher. The required displacement is determined by multiplying the difference in level by the cotangent of the angle M.

(e) Where a PAPI is installed on a runway equipped with an ILS, the distance D_1 must be equal to that between the threshold and the effective origin of the ILS glide path, 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. The PAPI is then aimed at the same angle as the ILS glide slope. Harmonization of the PAPI signal and the ILS glide path to a point closer to the threshold may be achieved by increasing the width of the PAPI on-course sector from 20' to 30'. However, the distance D_1 must be such that in no case will the wheel clearance over the threshold be lower than specified in column (3) of Table 9.9-4.

Section 9.10: Runway Lighting

9.10.1 Types of Runway Edge Lighting Systems

9.10.1.1 A runway edge lighting system may be of the following type:

(a) low intensity – a single intensity lighting system suitable for a non-instrument runway or a non-precision approach runway. This is provided at an aerodrome where there is no appropriate person, such as an air traffic controller, certified air/ground radio operator, or similar, to adjust the intensity settings of the lights;

(b) medium intensity – a 3-stage intensity lighting system suitable for a non-instrument runway or a non-precision approach runway. This is provided to enhance the lighting system particularly in marginal weather conditions. This system cannot be used at an aerodrome that does not have air traffic services or similar personnel.

> **Note:** This requirement is for controlling light intensity during the landing phase. This section is not to be confused with lighting systems controlled by a photo-electric cell which can provide Day, Twilight and Night intensity settings based on ambient conditions.

(c) high intensity – a 5 or 6 stage intensity lighting system which is suitable for precision approach runways. This system cannot be used at an aerodrome that does not have air traffic services or similar personnel.

9.10.2 Runway Edge Lights

9.10.2.1 Runway edge lights must be provided for a runway intended for use at night or for a precision approach runway intended for use by day or night.

9.10.2.2 Runway edge lighting must meet the following operational requirements:

(a) for every runway intended for use at night, omnidirectional lights meeting the characteristics requirements of 9.10.6 shall be provided to cater for both visual circling after an instrument approach to circling minima, and circuits in VMC;

(b) for a precision approach runway, in addition to (a) above, unidirectional lights meeting the characteristics requirements of 9.10.7, and 9.10.8, if applicable, shall also be provided.

> **Note**: Successful past practice has been for separate light fittings, one to satisfy the omnidirectional characteristic, and another to satisfy the unidirectional characteristic, to be provided.

9.10.3 Location of Runway Edge Lights

9.10.3.1 Runway edge lights must be placed along both sides of the runway, in two parallel straight rows equidistant from the centreline of the runway, commencing one-light spacing from the threshold and continuing to one-light spacing from the runway end.

9.10.4 Longitudinal Spacing of Runway Edge Lights

9.10.4.1 The longitudinal spacing of runway edge lights must be uniform and be:

(a) for an instrument runway, 60 m +0 / -5 m;

(b) for a non-instrument runway, 90 m ± 10 m, or 60 m +0 / -5 m if there is an intention to upgrade the runway to an instrument runway at some time in the future.

(c) for non-precision instrument runways intended to be used in visibility conditions of 1.5 km or greater, where existing edge lights are spaced at 90 m ±10 m, it is acceptable to retain this spacing until the next replacement or improvement of the edge lighting system. (This situation typically arises from an existing non-instrument runway being upgraded to a non-precision instrument runway, but without re-installing the runway edge lights to the 60 m +0 / -5 m standard.)

Notes: 1. With GPS technology, virtually any runway can become an instrument runway. Accordingly, it is recommended that any new runway edge lights should be spaced in accordance with Paragraph 9.10.4.1(a).

2. Existing lights spaced in accordance with previous standards of 200 ft or 300 ft imperial measurements may exceed 60 m or 100 m respectively. They are deemed to comply with the standards of this Paragraph, until the next replacement or upgrade of the edge lighting system.

9.10.4.2 Where the runway is a non-instrument or a non-precision instrument runway, and it is intersected by other runways or taxiways:

(a) within 600 m of the threshold, lights may be spaced irregularly, but not omitted, and

(b) more than 600 m from the threshold, lights may be spaced irregularly or omitted, but no two consecutive lights may be omitted;

provided that such irregular spacing or omission does not significantly alter the visual guidance available to a pilot using the runway.

9.10.4.3 Runway edge lights must not to be omitted on a precision approach runway.

9.10.4.4 Where a runway edge light cannot be omitted, inset runway edge lights must be provided in place of elevated lights.

9.10.4.5 Unless a light is omitted or displaced in accordance with Paragraph 9.10.4.2, a runway edge light must be aligned with a light on the opposite side of the runway.

9.10.5 Lateral Spacing of Runway Edge Lights

9.10.5.1 Subject to Paragraph 9.10.5.2, runway edge lights must 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.

> **Note:** Existing edge lights located beyond 3 m from the edge of runway as a result of a reduction in the declared runway width do not need to be relocated until they are being replaced.

9.10.5.2 If the width of a runway is less than 30 m in width, the runway edge lights must be placed as if the runway is 30 m in width, and in accordance with Paragraph 9.10.5.1.

9.10.5.3 If a runway is provided with both low or medium intensity and high intensity runway light units, the row of high intensity light units shall be placed closer to the runway centreline. The two rows of light units are to be parallel, separated by a distance of at least 0.5 m.

9.10.6 Characteristics of Low and Medium Intensity Runway Edge Lights

9.10.6.1 Low intensity and medium intensity runway edge lights must be fixed omnidirectional lights that show variable white. Elevated omnidirectional lights must have light distribution that is uniform for the full 360° horizontal coverage. Where elevated lights are impracticable and inset lights are used, the photometric characteristics of the inset lights are to be as close as practicable to those of the elevated lights.

9.10.6.2 The minimum light intensity for low intensity runway edge lights is to be in accordance with Section 9.11, Figure 9.11-1. The main beam, between 0° and 7° above the horizontal, is to have a minimum average intensity of not less than 100 cd, and a maximum average intensity of not more than 200 cd.

9.10.6.3 Low intensity runway edge lights are to have a single intensity for all lights in the same runway lighting system.

9.10.6.4 The minimum light intensity for medium intensity runway edge lights is to be in accordance with Section 9.11, Figure 9.11-2. The main beam, between 0° and 7° above the horizontal, is to have a minimum average intensity of not less than 200 cd, and a maximum average intensity of not more than 600 cd.

9.10.7 Characteristics of High Intensity Runway Edge Lights

9.10.7.1 High intensity runway edge lights must be fixed unidirectional lights with the main beam directed towards the threshold.

9.10.7.2 High intensity runway edge light beam coverage shall be toed in towards the runway as follows:

(a) 3.5° in the case of a 30-45 m wide runway;

(b) 4.5° in the case of a 60 m wide runway.

9.10.7.3 High intensity runway edge lights must show variable white except for those located within 600 m from the runway end which must show yellow.

9.10.7.4 The minimum light intensity for high intensity runway edge lights that show variable white is to be in accordance with Section 9.11

(a) Figure 9.11-3 for 30 m to 45 m wide runways; and

(b) Figure 9.11-4 for 60 m wide runways.

9.10.7.5 The minimum light intensity for high intensity runway edge lights that show yellow is the standard set out in Figure 9.11-3 or Figure 9.11-4, whichever is applicable, multiplied by 0.4.

9.10.8 Use of Bidirectional or Back-to-back Light Fittings

9.10.8.1 On a runway where high intensity edge lights are intended to be used from either direction, separate high intensity runway edge light fittings may be provided back-to-back, or bidirectional light fittings with the correct toe-in angle built in, may be used.

9.10.9 Runway Threshold Lights

9.10.9.1 Runway threshold lights must be provided on a runway that is equipped with runway edge lights.

9.10.10 Location of Runway Threshold Lights

9.10.10.1 Runway threshold lights must be located in a straight line at right angles to the centreline of the runway and:

(a) when the threshold is at the extremity of a runway – as near to the extremity as possible and not more than 3 m outside, or 1 m inside of the extremity; or

(b) when the threshold is a displaced threshold – at the displaced threshold with a tolerance of ± 1 m.

9.10.11 Pattern of Low Intensity and Medium Intensity Runway Threshold Lights

9.10.11.1 Low and medium intensity runway threshold lights are to consist of:

(a) 2 omnidirectional lights, one at each end of the threshold and in line with the runway edge lights; and

(b) 6 unidirectional lights at equal intervals between the 2 omnidirectional lights.

9.10.11.2 The 6 unidirectional lights are to be inset lights if:

(a) the threshold is a permanently displaced threshold; or

(b) the threshold is also equipped with high intensity threshold lights; or

(c) it is impractical for elevated lights to be installed.

9.10.11.3 Subject to paragraph 9.10.11.6, only an aerodrome used predominantly for training and general aviation may use the alternative pattern of low intensity or medium intensity runway threshold lights as described in paragraph 9.10.11.5.

9.10.11.4 The alternative pattern is not suitable for aerodromes used predominantly by aircraft having a take-off weight greater than 5,700 kg, nor is it suitable for aerodromes where commercial air transport jet propelled aeroplanes operate.

9.10.11.5 The alternative pattern consists of:

(a) 6 elevated lights arranged in 2 groups of 3 equally spaced lights, with the distance between the 2 groups equal to half the lateral distance between the 2 rows of runway edge lights; and

(b) The outer lights on either side shall be omnidirectional green lights, and the inner 4 lights shall be unidirectional green lights (or bidirectional green/red lights when the same light fittings are used for runway end lights).

9.10.11.6 On and after 1 June 2010, an aerodrome may use the alternative pattern of low intensity or medium intensity runway threshold lights in paragraph 9.10.11.5 only if:

(a) the aerodrome was using, and was entitled to use, the alternative pattern immediately before 1 June 2010; and

(b) the aerodrome operator continues to comply with the alternative pattern on and after that date.

9.10.12 Pattern of High Intensity Runway Threshold Lights

9.10.12.1 High intensity runway threshold lights must consist of:

(a) 2 unidirectional lights, one at each end of the threshold and in line with the row of runway edge lights; and

(b) unidirectional lights uniformly spaced between the 2 outer lights, at intervals of not more than 3 m. These lights must be inset lights.

9.10.13 Characteristics of Low Intensity and Medium Intensity Runway Threshold Lights

9.10.13.1 Low intensity and medium intensity runway threshold lights must have the following characteristics:

(a) the outermost light on each side must be a fixed omnidirectional light showing green;

(b) the inner lights must be fixed unidirectional lights showing green in the direction of approach over not less than 38° or more than 180° of azimuth;

(c) the light distribution in the direction of approach must be as close as practicable to that of the runway edge lights;

(d) the intensity of the green lights must be in the range of 1 to 1.5 times the intensity of the runway edge lights.

> **Note:** Older installations with the intensity of green light in the range of 0.5 to 1 times the intensity of the runway edge lights are acceptable, until the next replacement or upgrade of the runway and/or threshold lighting system.

9.10.14 Characteristics of High Intensity Runway Threshold Lights

9.10.14.1 High intensity runway threshold lights must be fixed lights showing green in the direction of approach with a minimum light intensity in accordance with Section 9.11, Figure 9.11-5.

9.10.15 Additional Lighting to Enhance Threshold Location

9.10.15.1 Threshold Wing Bars:

(a) On a precision approach runway, if it is operationally required that an increase in the conspicuity of the threshold at night be provided, the threshold may be provided with threshold wing bars.

(b) Where provided, threshold wing bars must be symmetrically disposed on either side of the threshold:

- (i) each wing bar is to consist of 5 lights at 2.5 m apart;
- (ii) at right angles to the runway centreline; and
- (iii) with the inner most light of each wing bar aligned with the row of runway edge lights on that side of the threshold.

9.10.15.2 Characteristics of Threshold Wing Bars:

(a) Threshold wing bars must have the following characteristics:

- (i) be fixed unidirectional lights showing green in the direction of approach; and
- (ii) the minimum light intensity is to be in accordance with Section 9.11, Figure 9.11-6.

(b) If it is impracticable to use elevated lights, inset lights may be used, however, inset and elevated lights must not be used in the same threshold wing bar.

9.10.15.3 Runway Threshold Identification Lights:

(a) At an aerodrome where it is difficult to locate a runway threshold from the air during the day such as in the case of a displaced threshold or an aerodrome with complex runway/taxiway layout in the vicinity of the threshold, runway threshold identification lights may be required.

> **Note:** Runway threshold identification lights may also assist pilot acquisition of a threshold during twilight hours and at night. During these periods the lights need to be controlled such that an approaching pilot will not be dazzled by the flashing lights.

(b) Runway threshold identification lights must be provided, during the day, to mark a temporarily displaced threshold of a runway serving international jet propelled aeroplanes conducting air transport operations.

> **Note:** Runway threshold identification lights may also be used to mark the temporarily displaced thresholds of other runways. When used, the need for temporarily displaced threshold V-bar markings is normally waived.

9.10.15.4 **Location of runway threshold identification lights**. Because of their nature and use, runway threshold identification lights can have more flexibility in their installation location than other visual aids. Advantage can be taken of this particularly when they are provided on temporary displaced thresholds, to site them clear of existing facilities, and works areas.

9.10.15.5 Where provided, one light unit shall be on each side of the runway, equidistant from the runway centreline, on a line perpendicular to the runway centreline. The optimum location of the light units shall be 12 to 15 m outside each line of runway edge lights, and in line with the threshold. The light units may be located laterally up to 20 m from the line of runway edge lights and longitudinally up to 12 m prior to the threshold. Each light unit shall be a minimum of 12 m from the edge of taxiways and runways. The elevation of both light units shall be within 1 m of a horizontal plane through the runway centreline, with the maximum height above ground not exceeding 1 m.

9.10.15.6 **Characteristics of runway threshold identification lights.** Runway threshold identification lights must have the following characteristics:

(a) be flashing lights;

(b) the light flashes are synchronised with a normal flash rate of 100-120 per minute;

(c) the colour of the lights is white;

(d) a minimum range in bright sunlight of approximately 7 km; and

(e) the beam axis of each light unit shall be aimed 15° outward from a line parallel to the runway centreline and inclined at an angle of 10° above the horizontal.

> **Note:** L-849 A and E light units specified in FAA AC 150/5345-51 '*Specification for Discharged -Type of Flashing Light Equipment*' are xenon strobe type of lights suitable for use as runway threshold identification lights.

9.10.15.7 **Temporarily displaced threshold lights for use at night.** Temporarily displaced threshold lights must be provided at night to identify the new threshold location when the threshold of a runway is temporarily displaced.

9.10.15.8 **Location of temporarily displaced threshold lights.** Temporarily displaced threshold lights must be provided on each side of the runway:

(a) in line with the displaced threshold:

(b) at right angles to the runway centreline; and

(c) with the innermost light on each side aligned with the row of runway edge lights on that side of the threshold.

9.10.15.9 **Characteristics of temporarily displaced threshold lights.** Temporarily displaced threshold lights must have the following characteristics:

(a) each side must consist of 5 lights except that 3 lights per side is sufficient if the runway width is 30 m or less;

(b) the lights must be spaced at 2.5 m apart;

(c) the innermost light of each side must be a fixed omnidirectional light showing green in all angles of azimuth;

(d) the outer 4 or 2 lights, as appropriate, of each side must be fixed unidirectional lights showing green in the direction of approach, over not less than 38° or more than 180° of azimuth;

(e) the light distribution in the direction of approach must be as close as practicable to that of the runway edge lights;

(f) the light intensity must be as close as practicable to 1.5 times, and not less than, that of the runway edge lights.

Note: Temporary displaced threshold lights are associated only with low intensity or medium intensity runway lighting systems. They are not associated with high intensity runway lighting systems. If a precision approach runway has the threshold temporarily displaced, it renders ILS unavailable for precision approaches, which changes the runway to a non-precision or non-instrument runway.

9.10.15.10 Runway lighting before a displaced threshold

(a) If the part of runway located before a displaced threshold is available for aircraft use, i.e. for take-offs, and landings from the opposite direction, runway edge lights in this part of runway must:

(i) show red in the direction of approach to the displaced threshold; and

(ii) show white in the opposite direction, or yellow as appropriate for a precision approach runway.

(b) The intensity of the red runway edge lights required under Paragraph 9.10.15.10(a) must not be less than one-quarter, and not more than one-half, that of the white runway edge lights.

(c) Runway edge lights may be bidirectional light fittings or separate light fittings installed back to back.

(d) If the portion of runway before a displaced threshold is closed to aircraft operations, all the runway lights thereon must be extinguished.

9.10.16 Runway End Lights

9.10.16.1 Runway end lights must be provided on a runway equipped with runway edge lights.

9.10.17 Location of Runway End Lights

9.10.17.1 Runway end lights must be located in a straight line at right angles to the runway centreline, and:

(a) when the runway end is at the extremity of the runway – as near to the extremity as possible and not more than 3 m outside, or 1 m inside the extremity;

(b) when the runway end is not at the extremity of the runway – at the runway end, with a tolerance of ± 1 m.

(c) for the following areas:

(i) a taxiway for exiting a runway;

(ii) a runway turning area;

(iii) other similar areas;

the runway end lights must be located in such a way that an aircraft using the area will not be required to cross the row of red lights comprising the runway end lights.

> **Note:** The universally accepted convention in aerodrome lighting is that a pilot is never required to cross a row of red lights.

9.10.18 Pattern of Runway End Lights

9.10.18.1 The pattern of runway end lights must consist of:

(a) at least 6 lights spaced at equal intervals between the rows of runway edge lights; or

(b) if the runway is provided with the alternative threshold light pattern, the threshold pattern.

9.10.18.2 For a precision approach runway Category III, the spacing between runway end lights must not exceed 6 m.

9.10.19 Characteristics of Low and Medium Intensity Runway End Lights

9.10.19.1 Low intensity and medium intensity runway end lights must have the following characteristics:

(a) the lights must be fixed unidirectional showing red in the direction of the runway over not less than 38° or more than 180° of azimuth;

(b) the intensity of the red light must not be less than one-quarter, and not more than one-half, that of the runway edge lights;

(c) the light distribution in the direction of the runway must be as close as practicable to that of the runway edge lights.

9.10.19.2 Low intensity and medium intensity runway end lights must be inset lights if:

(a) the runway is also equipped with high intensity runway end lights; or

(b) it is impracticable for elevated lights to be installed.

9.10.19.3 If the runway end coincides with the runway threshold, bidirectional light fittings may be used or separate light fittings installed back to back.

9.10.20 Characteristics of High Intensity Runway End Lights

9.10.20.1 High intensity runway end lights must have the following characteristics:

(a) the lights must be inset, fixed unidirectional showing red in the direction of the runway; and

(b) the minimum light intensity must be in accordance with Section 9.11, Figure 9.11-7.

9.10.21 Runway Turning Area Edge Lights

9.10.21.1 Where an aircraft turning area is provided on a runway, the edge of the turning area must be provided with blue edge lights if the runway is provided with edge lights.

9.10.21.2 Runway turning area edge lights must be located not less than 0.6 m, and not more than 1.8 m, outside the edge of the turning area.

9.10.21.3 If the beginning of the splay into a runway turning area is more than 10 m from the previous runway edge light, a blue edge light must be located where the turning area commences.

9.10.21.4 Turning area edge lights must be provided to mark any change of direction along the side of the turning area.

9.10.21.5 Where a side of the turning area is longer than 30 m, equally spaced blue edge lights must be provided along that side, with spacing not exceeding 30 m.

9.10.21.6 Runway turning area edge lights must have the same characteristics as taxiway edge lights, in accordance with Paragraph 9.13.15.

9.10.22 Stopway Lights

9.10.22.1 Stopway lights must be provided on a stopway which is longer than 180 m and is intended for night use.

9.10.22.2 Stopway lights must be located along both sides of the stopway in line with the runway edge lights and up to the stopway end.

9.10.22.3 The spacing of stopway lights must be uniform and not more than that of the runway edge lights, with the last pair of lights located at the stopway end.

9.10.22.4 The stopway end must be further indicated by at least 2 stopway lights at equal intervals across the stopway end between the last pair of stopway lights.

9.10.22.5 Stopway lights must have the following characteristics:

(a) the lights must be fixed and unidirectional showing red in the direction of the runway, and not visible to a pilot approaching to land over the stopway;

(b) the light distribution in the direction of the runway must be as close as possible to that of the runway edge lights; and

(c) the intensity of the red light must not be less than one quarter, and not more than one half, that of the white runway edge lights.

9.10.23 Hold Short Lights

9.10.23.1 Hold short lights must be provided on a runway which is intended to accommodate land and hold short operations (LAHSO).

9.10.23.2 Hold short lights must be at least 6 inset lights located across the runway as near to the hold short line as possible, and in any case not beyond, and not more than 3 m before the hold short line, which is at least 75 m from the centreline of the intersecting runway.

9.10.23.3 The hold short lights must be at right angles to the runway, and located symmetrically about the runway centreline, with the closest lights at 1.5 m from the centreline, and subsequent lights 3 m apart.

9.10.23.4 The hold short lights must be unidirectional, showing white in the direction of approach to the hold short position, and have photometric characteristics in accordance with Section 9.11, Figure 9.11-8.

9.10.23.5 The lights must occult, in unison, at between 25 and 35 cycles per minute. The illumination period shall be approximately 2/3, and the light suppression period shall be approximately 1/3, of the total period of each cycle.

> **Note:** The illumination and suppression period will be affected by varying the light intensity. The FAA AC 150/5345-54 specified L-884 Power and Control Unit (PCU) is typically used to power LAHSO systems. The PCU pulses the lights by varying the voltage on the primary side of the series circuit. The light fixtures need to be isolated from the series circuit via 6.6/6.6 ampere isolating transformers. Typically, the PCU continuously switches the output current with an 'on' cycle duration of 1.35 ± 0.1 seconds, and an 'off' cycle duration of 0.8 ± 0.1 seconds.

9.10.23.6 Each bar of hold short lights must be individually controlled, provided with variable intensity setting, and technically monitored for serviceability, at the operator position of the ATC operator controlling the LAHSO operation.

9.10.23.7 Where secondary power is available, hold short lights must be connected to that power system, with changeover times not greater than for the runway lighting on the same runway.

9.10.24 Runway Centreline Lights

9.10.24.1 Runway centreline lights must be provided on the following:

(a) a Cat II or III precision approach runway;

(b) a runway intended for take-offs with an operating minimum below an RVR of 350 m.

> **Note:** Runway centreline lights are also recommended for the following runways if the distance between the runway edge lights is greater than 50 m:
>
> (a) Cat I precision approach runways;
>
> (b) runways intended for take-offs with an operating minimum equal to or above an RVR of 350 m.

9.10.24.2 Runway centreline lights must be located from the threshold to the end at longitudinal spacing of approximately:

(a) 15 m on a runway intended for use in runway visual range conditions less than a value of 350 m; and

(b) 30 m on a runway intended for use in runway visual range conditions of 350 m or greater.

9.10.24.3 The runway centreline lights may be offset by not more than 0.6 m from the true runway centreline, for maintenance of runway marking purposes.

9.10.24.4 The offset shall be on the left hand side of the landing aircraft, where practicable. Where the runway is used in both directions, the direction from which the majority of landings will take place shall prevail.

9.10.24.5 Runway centreline lights must be inset, fixed lights showing white from the threshold to a point 900 m from the runway end. From 900 m to 300 m from the runway end, the light pattern is to be two red lights followed by two white lights. For the last 300 m before the runway end, the lights must show red.

> **Note:** The double red and white alternating light arrangement is for interleaving circuitry, to ensure that failure of part of the electrical system does not result in a false indication of the runway distance remaining.

9.10.24.6 The light intensity and distribution of runway centreline lights must be in accordance with:

(a) Section 9.11, Figure 9.11-8 — for 30 m spacing;

(b) Section 9.11, Figure 9.11-9 — for 15 m spacing.

9.10.25 Runway Touchdown Zone Lights

9.10.25.1 Runway touchdown zone lights must be provided for a runway intended for precision approach Category II or III operations.

> **Note:** Where a precision approach Category II or Category III lighting system is provided, touchdown zone lights must also be provided.

9.10.25.3 Runway touchdown zone lights must extend from the threshold for a distance of 900 m. The lighting is to consist of a series of transverse rows of lights, or barrettes, symmetrically located on each side of the runway centreline.

9.10.25.4 Each barrette must consist of three light units at 1.5 m apart. The innermost light of each barrette must be at 9 m from the true runway centreline.

9.10.25.5 The first pair of barrettes must be located at 60 m from the threshold. Subsequent barrettes must be spaced longitudinally at 60 m apart.

9.10.25.6 Runway touchdown zone lights must be inset, fixed unidirectional lights showing variable white.

9.10.25.7 Runway touchdown zone lights must be in accordance with Section 9.11, Figure 9.11-10.

9.10.26 Photometric Characteristics of Runway Lights

9.10.26.1 Section 9.11, Figure 9.11-11 shows the method of establishing the grid points for calculating the average intensity of low and medium intensity runway lights for non-instrument and instrument non-precision approach runways.

9.10.26.2 Section 9.11, Figure 9.11-12 shows the method of establishing grid points for calculating the average intensity of high intensity approach and runway lights for precision approach runways.

9.10.26.3 The average light intensity of the main beam of a light is calculated by:

(a) establishing grid points in accordance with the method shown in Section 9.11, Figure 9.11-11 or Figure 9.11-12, whichever is applicable.

(b) measuring the light intensity values at all grid points within and on the perimeter of the rectangle or ellipse representing the main beam;

(c) calculating the arithmetic average of the light intensity values as measured at those grid points.

9.10.26.4 The maximum light intensity value measured on or within the perimeter of the main beam must not to be more than three times the minimum light intensity value so measured.

9.10.27 Installation and Aiming of Light Fittings

9.10.27.1 The following points must be followed in the installation and aiming of light fittings:

(a) the lights are aimed so that there are no deviations in the main beam pattern, to within 1/2° from the applicable standard specified in this Chapter;

(b) horizontal angles are measured with respect to the vertical plane through the runway centreline;

(c) when measuring horizontal angles for lights other than runway centreline lights, the direction towards the runway centreline is to be taken to be positive;

(d) vertical angles specified are to be measured with respect to the horizontal plane.

9.10.28 Illustrations of Runway Lighting

9.10.28.1 Section 9.12 contains illustrations of runway lighting.

Section 9.11: Isocandela Diagrams of Runway Lighting

9.11.1 Collective Notes

9.11.1.1 The ellipses in each figure are symmetrical about the common vertical and horizontal axes.

9.11.1.2 Figure 9.11-1 to Figure 9.11-10 show the minimum allowable light intensities. The average intensity of the main beam is calculated by establishing the grid points as shown in Figure 9.11-11 or Figure 9.11-12, as appropriate, and using the intensity values measured at all grid points located within and on the perimeter of the ellipse representing the main beam. The average value is the arithmetic average of light intensities measured at all considered grid points.

9.11.1.3 No deviations are acceptable in the main beam pattern when the lighting fixture is properly aimed.

9.11.1.4 Average intensity ratio. The ratio between the average intensity within the ellipse defining the main beam of a typical new light and average light intensity of the main beam of a new runway edge light is to be as follows:

Figure 9.11-1	Low intensity runway edge lights	1.0 (white light)
Figure 9.11-2	Medium intensity runway edge lights	1.0 (white light)
Figure 9.11-3	High intensity runway edge lights (where the width of runway is 30-45 m)	1.0 (white light)
Figure 9.11-4	High intensity runway edge lights (where the width of runway is 60 m)	1.0 (white light)
Figure 9.11-5	High intensity threshold lights	1.0 to 1.5 (green light)
Figure 9.11-6	High intensity threshold wing bar lights	1.0 to 1.5 (green light)
Figure 9.11-7	High intensity runway end lights	0.25 to 0.5 (red light)
Figure 9.11-8	High intensity runway centreline lights (longitudinal spacing 30 m)	0.5 to 1.0 (white light)
Figure 9.11-9	High intensity runway centreline lights (longitudinal spacing 15 m)	0.5 to 1.0 for CAT III (white light) 0.25 to 0.5 for CAT I, II (white light)
Figure 9.11-10	Runway touchdown zone lights	0.5 to 1.0 (white light)

9.11.1.5 The beam coverages in the figures provide the necessary guidance for approaches down to an RVR of the order of 150 m and take-off to an RVR of the order of 100 m.

9.11.1.6 Horizontal angles are measured with respect to the vertical plane through the runway centreline. For lights other than centreline lights, the direction towards the runway centreline is considered positive. Vertical angles are measured with respect to the horizontal plane.

9.11.1.7 The light units are to be installed so that the main beam is aligned within one-half degree of the specified requirement.

9.11.1.8 On the perimeter of and within the ellipse defining the main beam, the maximum light intensity is not to be greater than three times the minimum light intensity value measured.

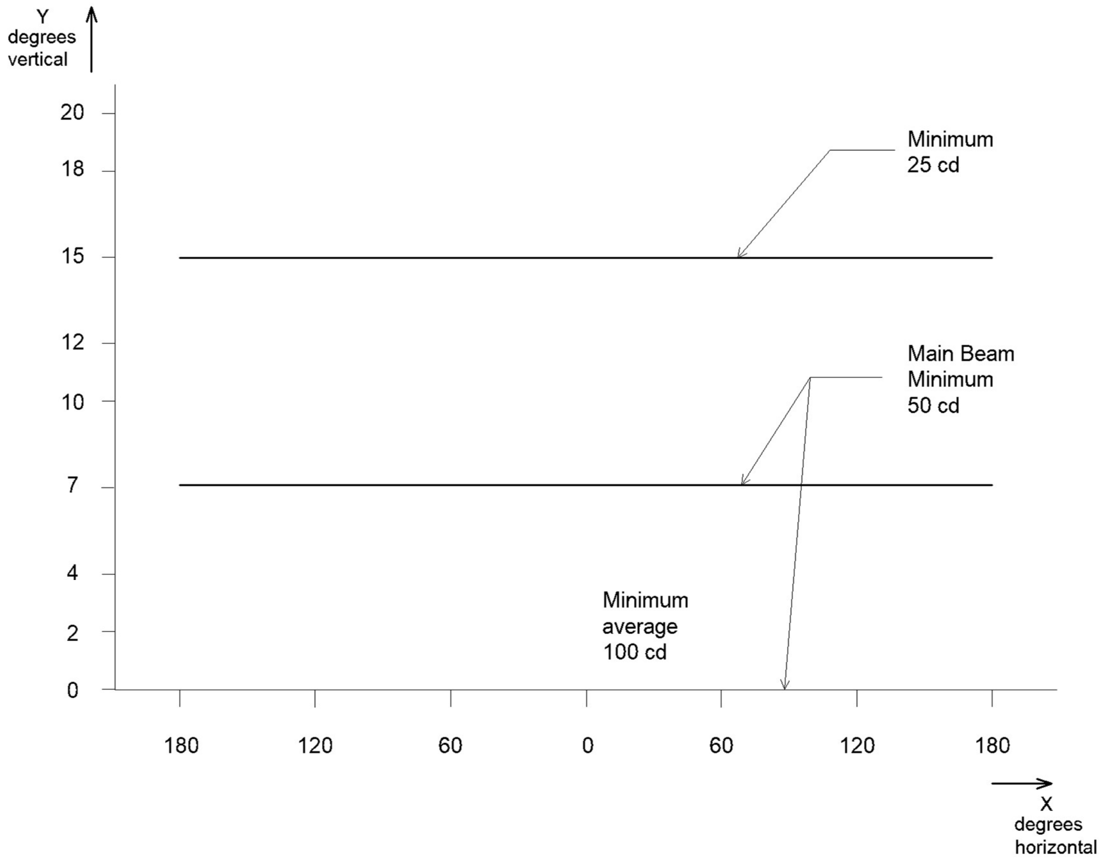


Figure 9.11-1: Isocandela Diagram for Omnidirectional Runway Edge Light - Low Intensity Runway Lighting System

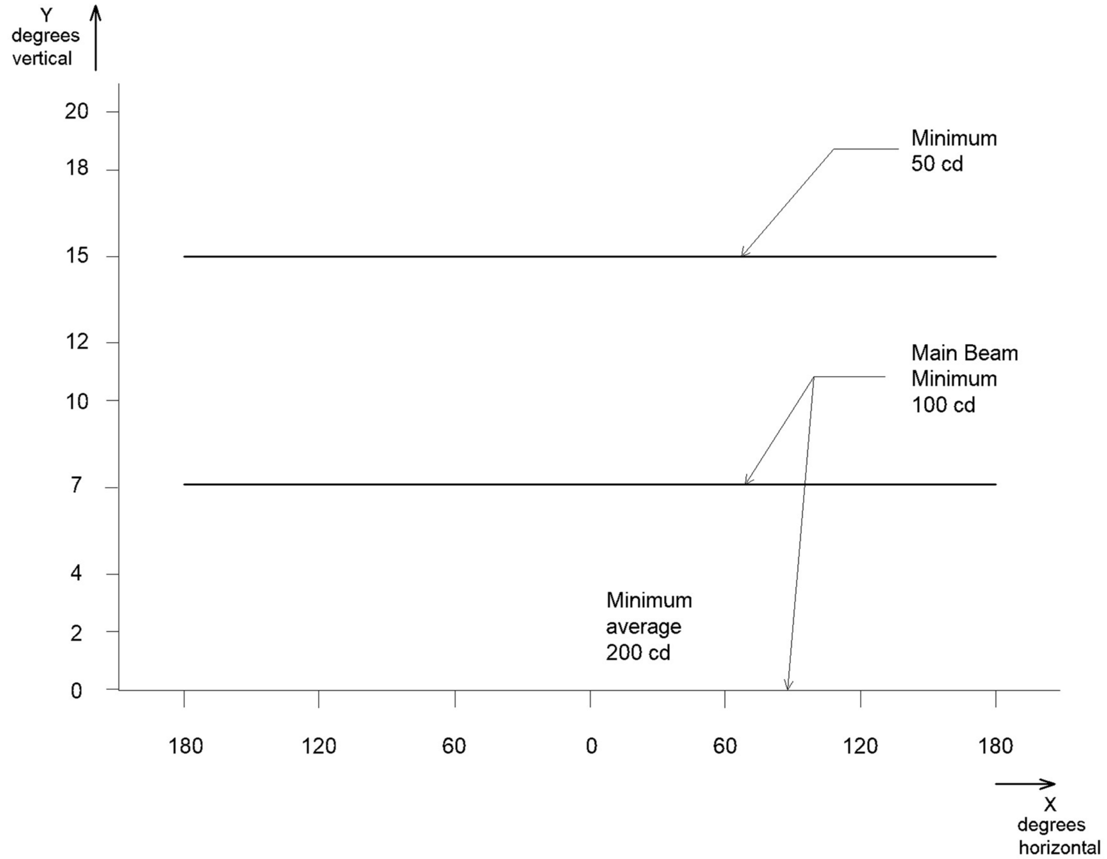


Figure 9.11-2: Isocandela Diagram for Omnidirectional Runway Edge Light - Medium Intensity Runway Lighting System

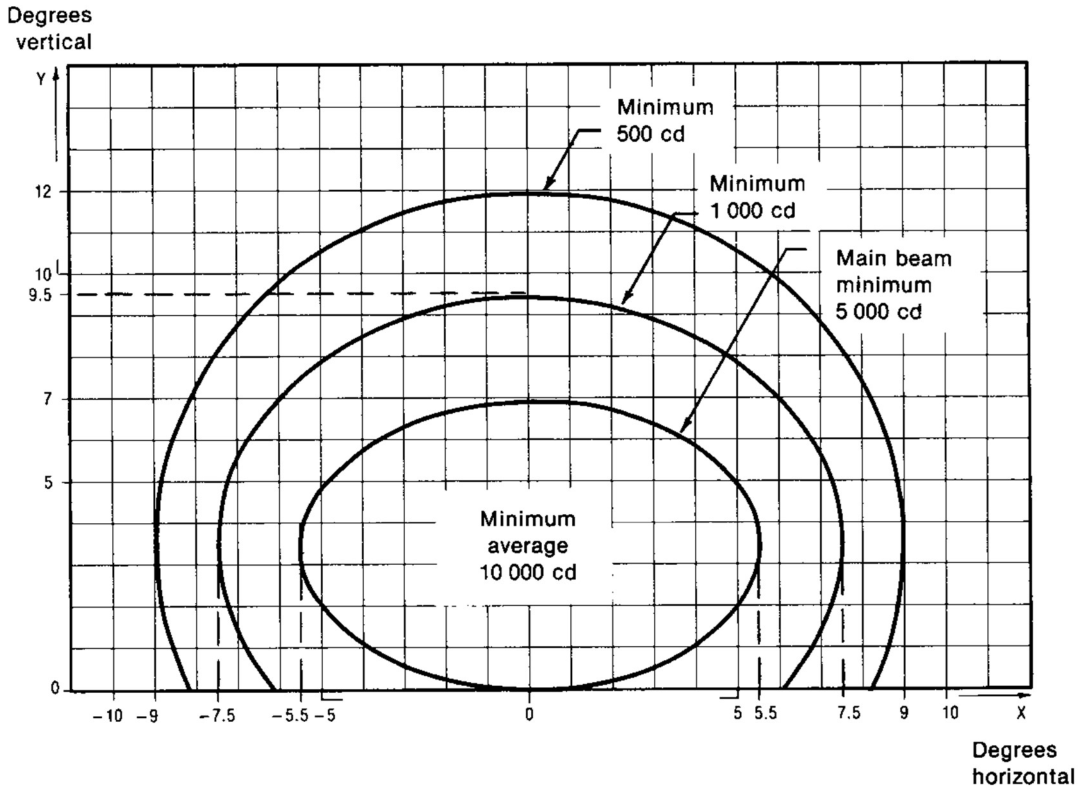


Figure 9.11-3: Isocandela Diagram for High Intensity Runway Edge Lights where the Width of the Runway is 30 to 45 metres (White Light)

Notes: 1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	5.5	7.5	9.0
b	3.5	6.0	8.5

2. Toe-in 3.5º
3. For yellow light multiply values by 0.4
4. See collective notes at Paragraph 9.11.1 for Figure 9.11-1 to Figure 9.11-10.

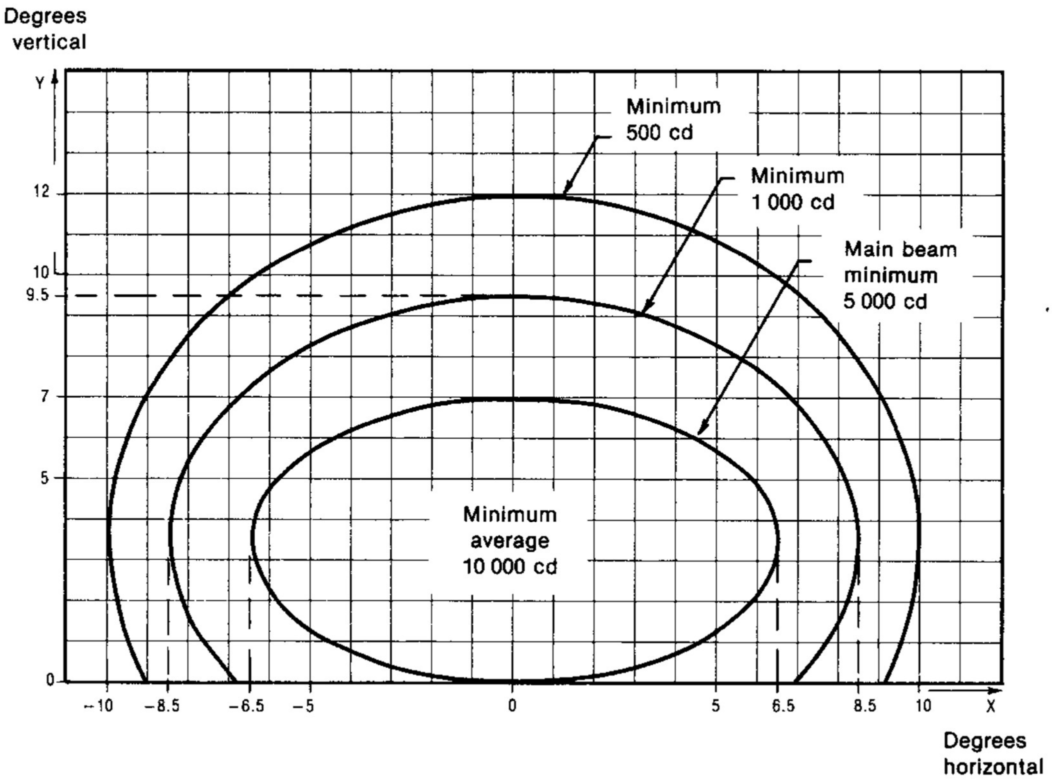


Figure 9.11-4: Isocandela Diagram for High Intensity Runway Edge Lights where the Width of the Runway is 60 m (White Light)

Notes: 1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	6.5	8.5	10.0
b	3.5	6.0	8.5

2. Toe-in 4.5º
3. For yellow light multiply values by 0.4
4. See collective notes at Paragraph 9.11.1 for Figure 9.11-1 to Figure 9.11-10.

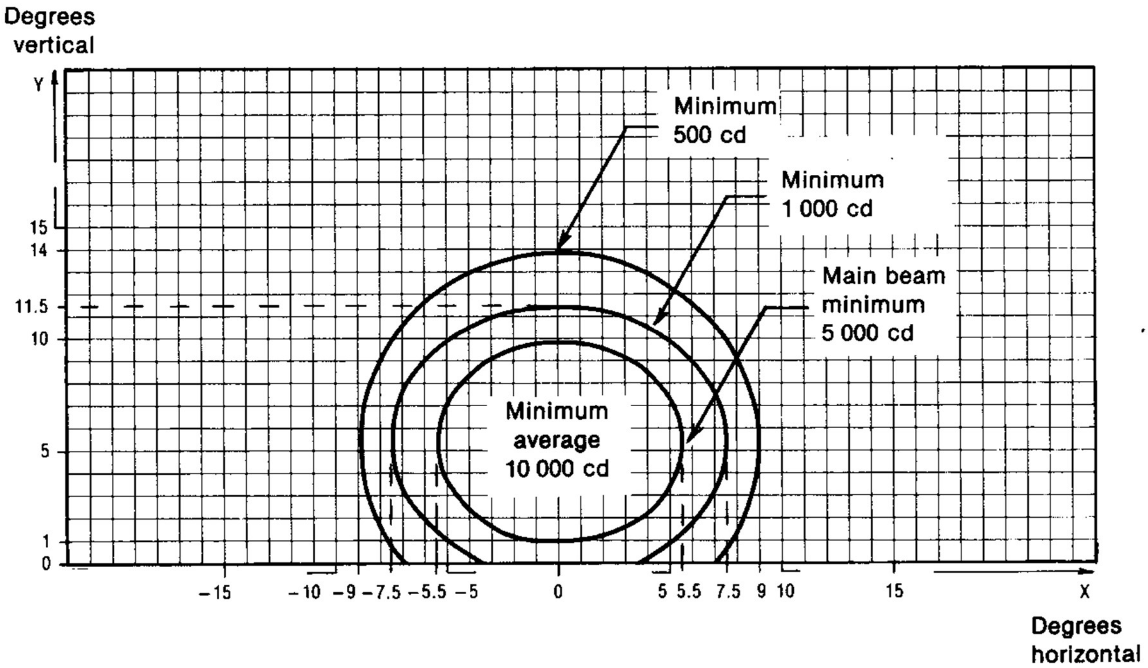


Figure 9.11-5: Isocandela Diagram for High Intensity Threshold Lights (Green Light)

Notes: 1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	5.5	7.5	9.0
b	4.5	6.0	8.5

2. Toe-in 3.5º

3. See collective notes at Paragraph 9.11.1 for Figure 9.11-1 to Figure 9.11-10.

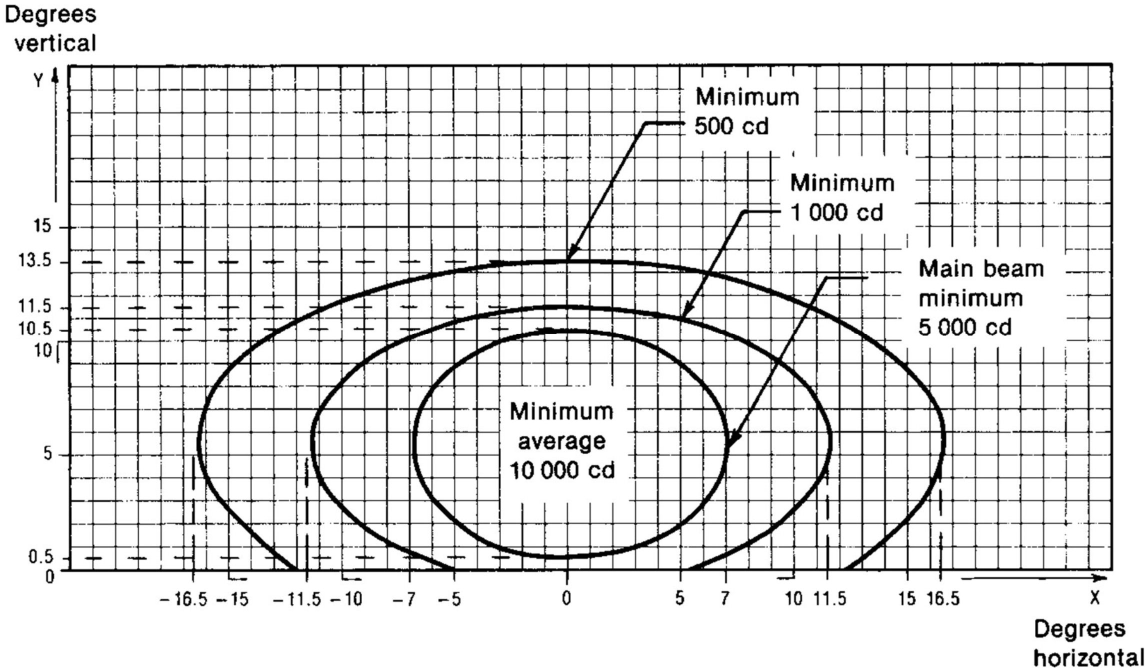


Figure 9.11-6: Isocandela Diagram for High Intensity Threshold Wing Bar Lights (Green Light)

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 2º
3. See collective notes at Paragraph 9.11.1 for Figure 9.11-1 to Figure 9.11-10.

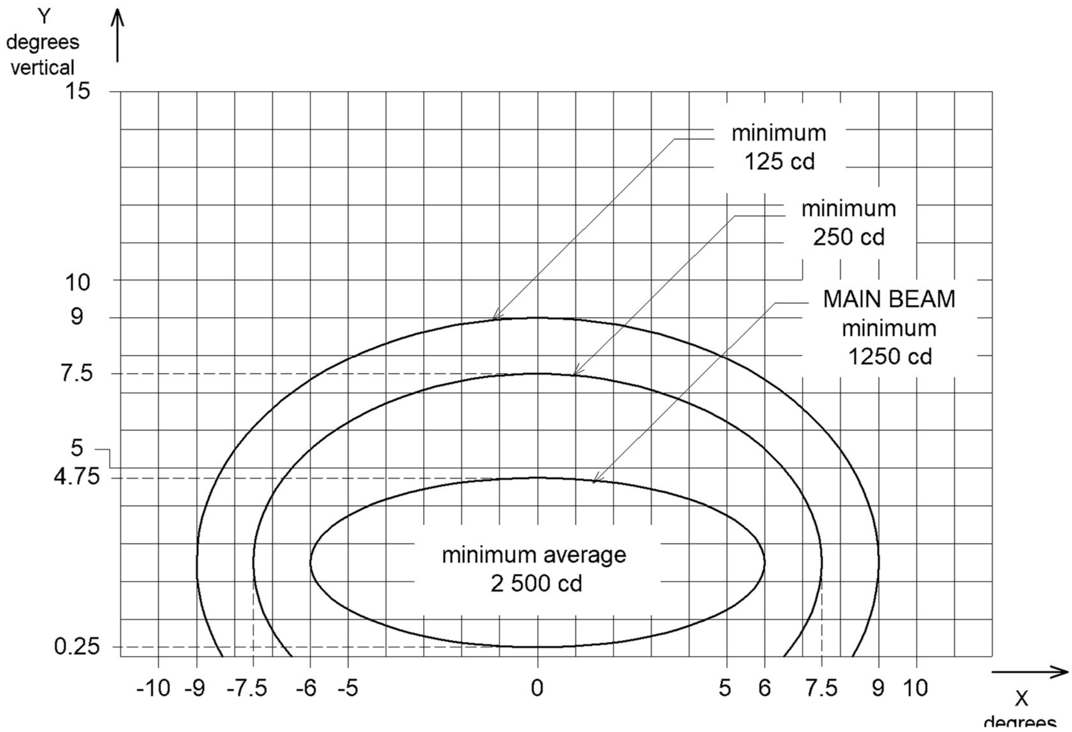


Figure 9.11-7: Isocandela Diagram for High Intensity Runway End Lights (Red Light)

Notes: 1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	6.0	7.5	9.0
b	2.25	5.0	6.5

2. See collective notes at Paragraph 9.11.1 for Figure 9.11-1 to Figure 9.11-10.

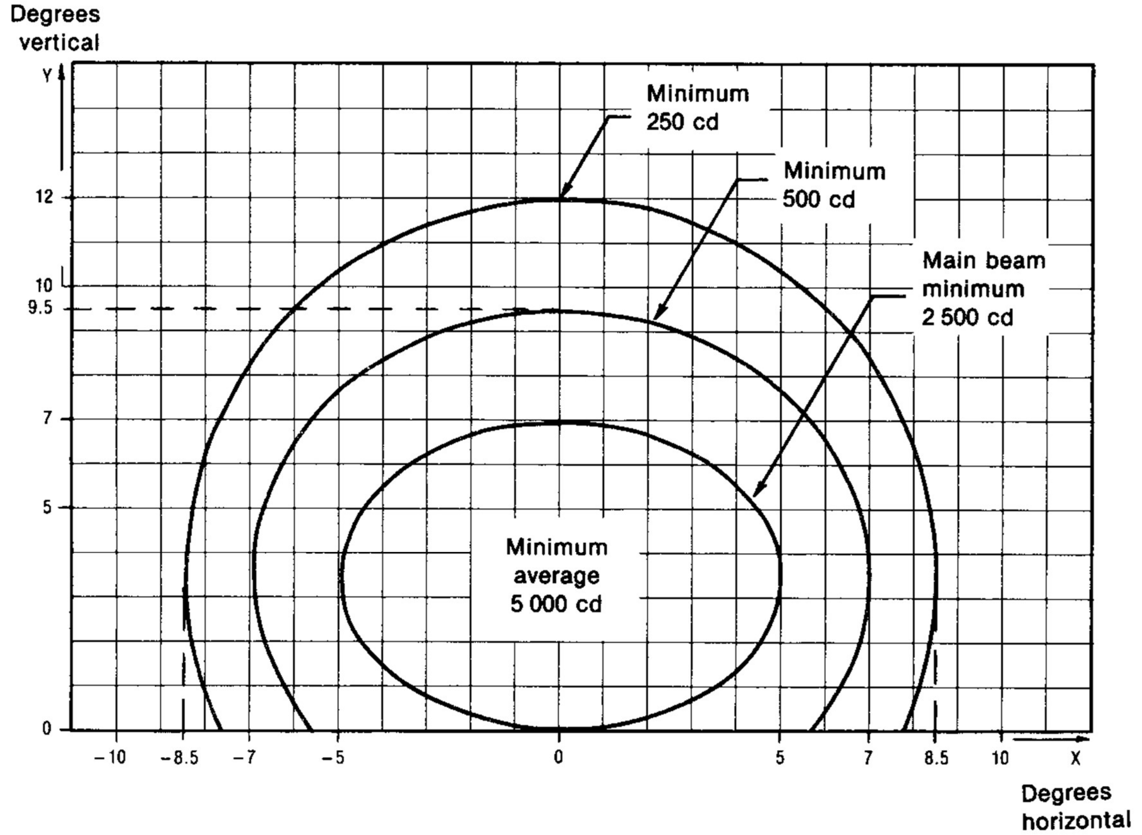


Figure 9.11-8: Isocandela Diagram for High Intensity Runway Centreline Lights with 30 m Longitudinal Spacing (White Light)

Notes: 1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	5.0	7.0	8.5
b	3.5	6.0	8.5

2. For red light multiply values by 0.15

3. See collective notes at Paragraph 9.11.1 for Figure 9.11-1 to Figure 9.11-10.

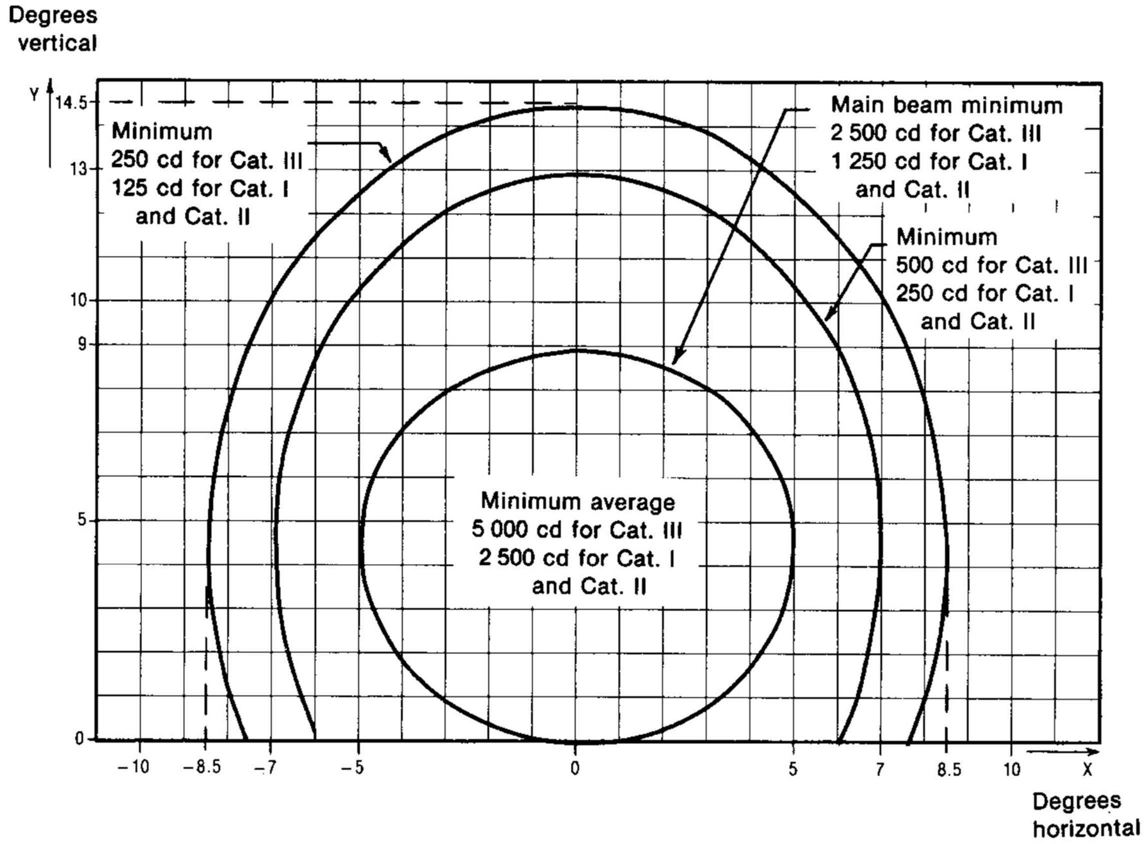


Figure 9.11-9: Isocandela Diagram for High Intensity Runway Centreline Lights with 15 m Longitudinal Spacing (White Light)

Notes: 1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	5.0	7.0	8.5
b	4.5	8.5	10

2. For red light multiply values by 0.15
3. See collective notes at Paragraph 9.11.1 for Figure 9.11-1 to Figure 9.11-10.

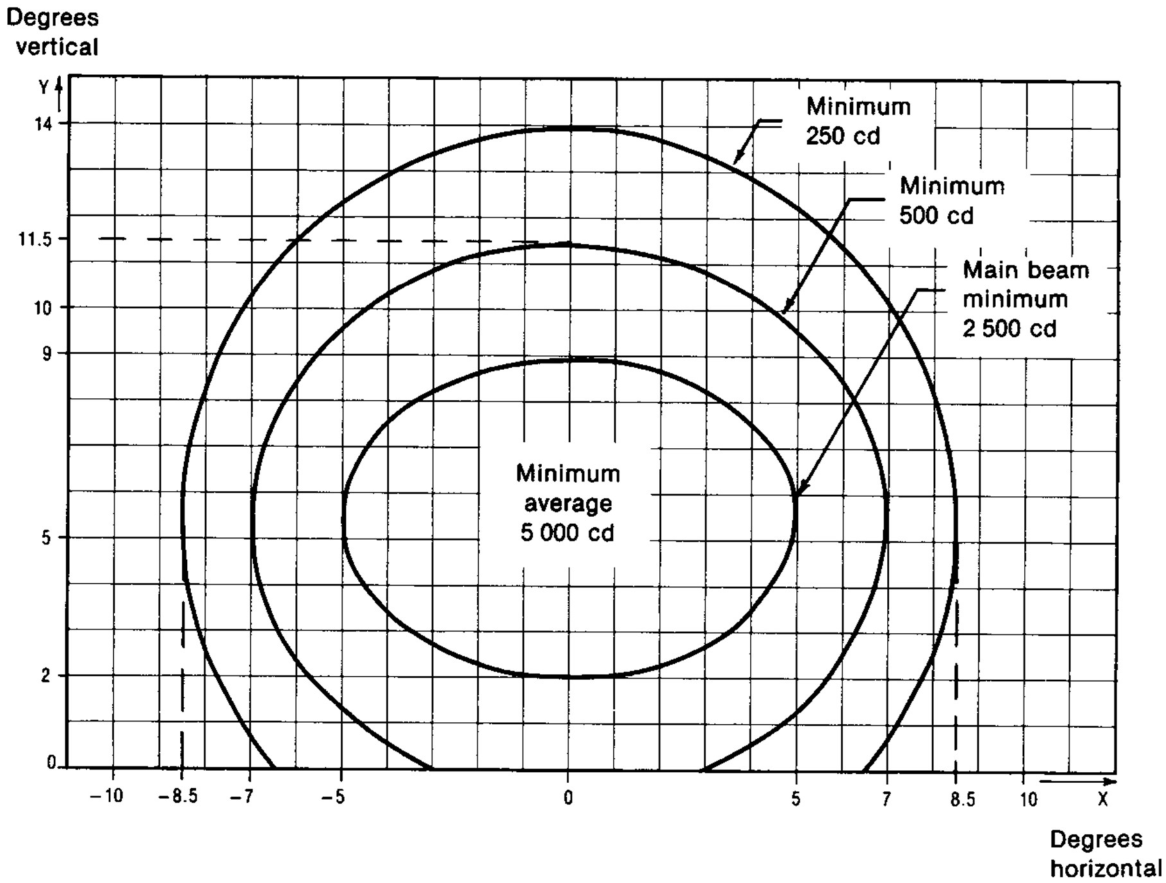


Figure 9.11-10: Isocandela Diagram for Runway Touchdown Zone Lights (White Light)

Notes: 1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	5.0	7.0	8.5
b	3.5	6.0	8.5

2. Toe-in 4º
3. See collective notes at Paragraph 9.11.1 for Figure 9.11-1 to Figure 9.11-10.

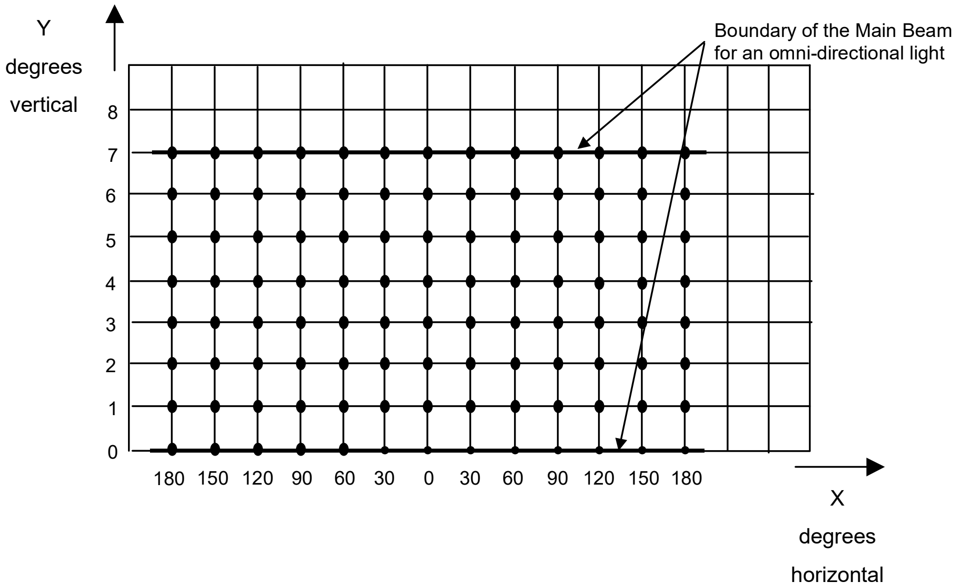


Figure 9.11-11: Method of Establishing Grid Points to be used for the Calculation of Average Intensity of Runway Lights specified by Figure 9.11-1 and Figure 9.11-2

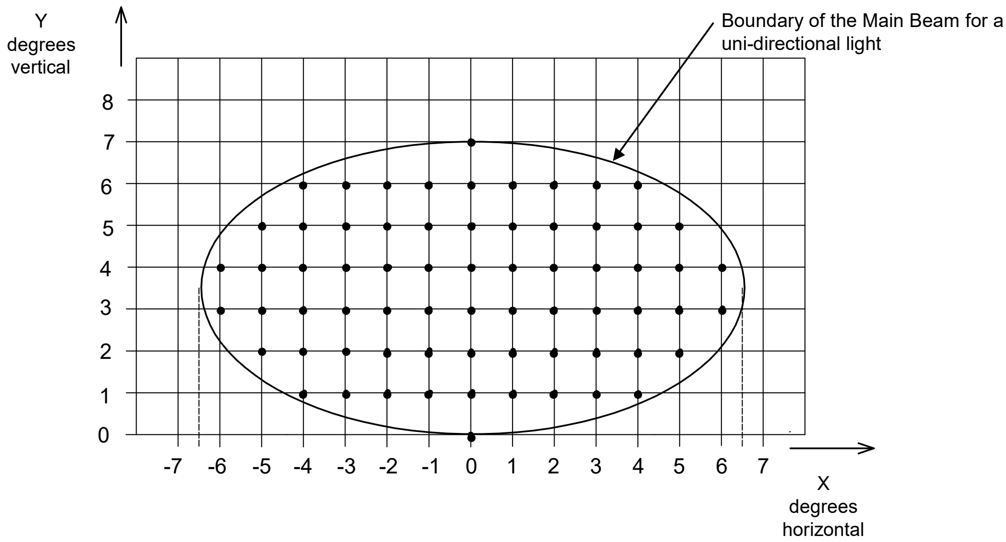


Figure 9.11-12: Method of Establishing Grid Points to be used for the Calculation of Average Intensity of Runway Lights specified by Figure 9.11-3 to Figure 9.11-10

Section 9.12: Illustrations of Runway Lighting

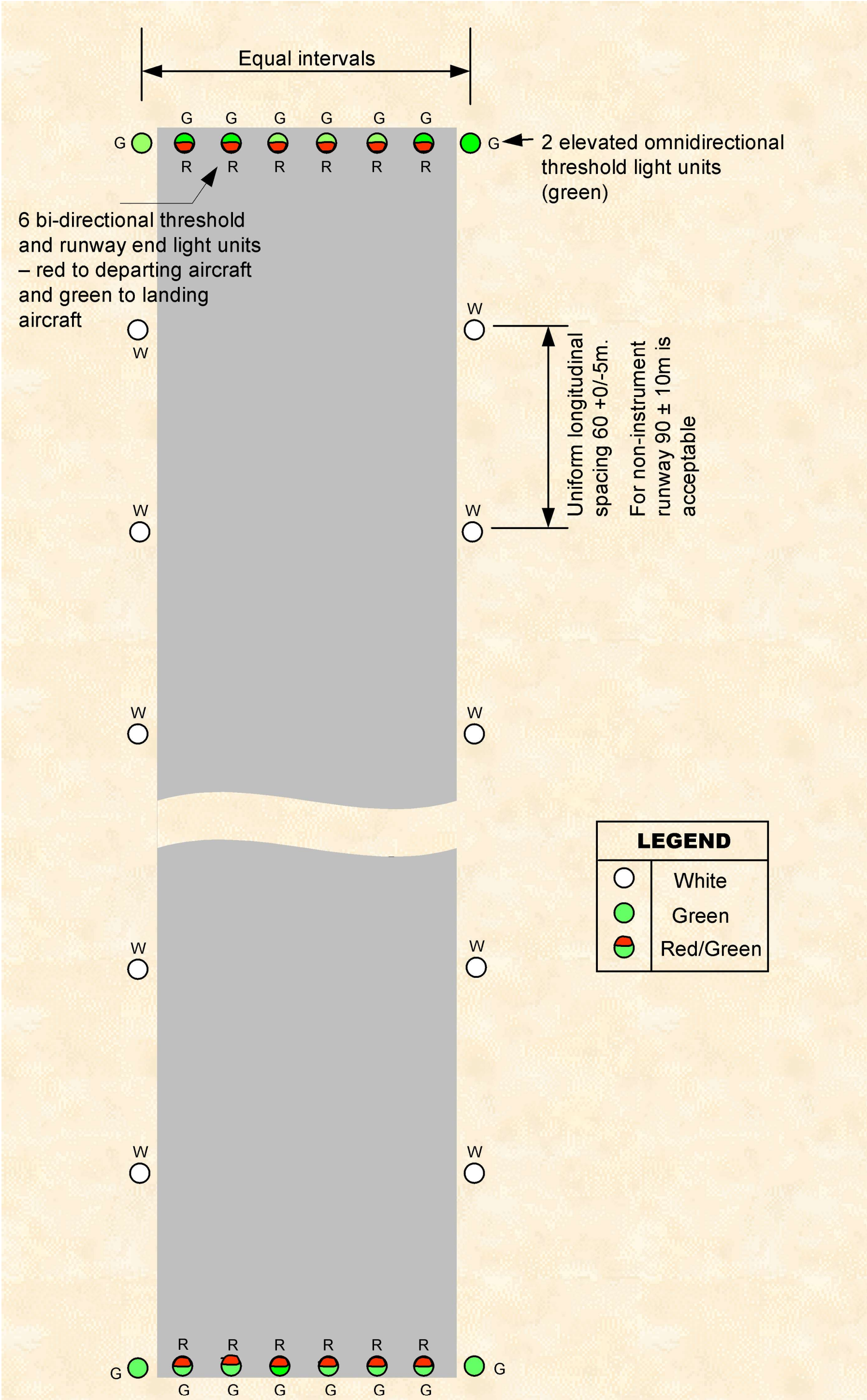


Figure 9.12-1: Runway Edge Lights, Threshold Lights and Runway End Lights Low and Medium Intensity for Non-Instrument and Non-Precision Approach Runways

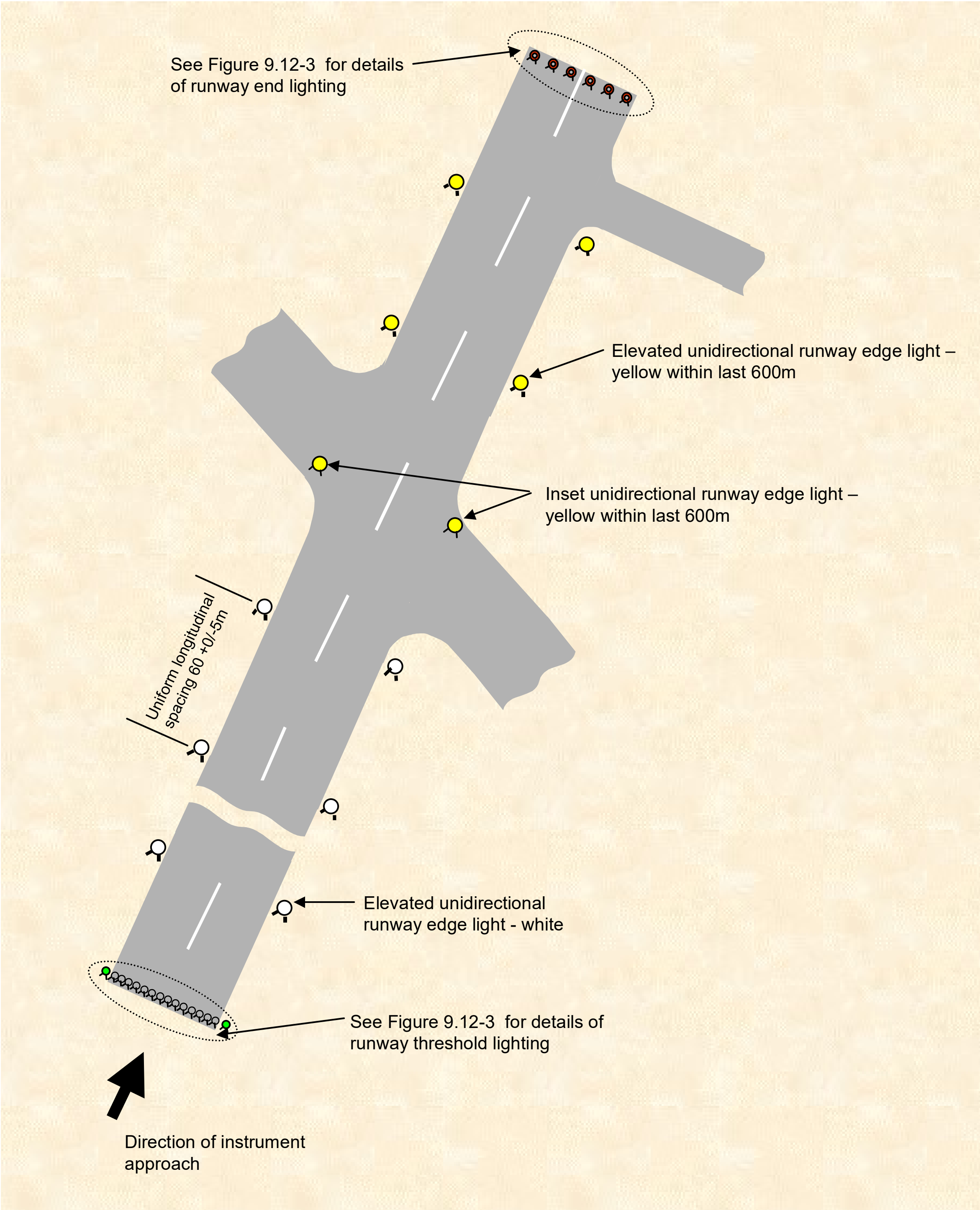


Figure 9.12-2: Runway Edge Lights High Intensity for Precision Approach Runways

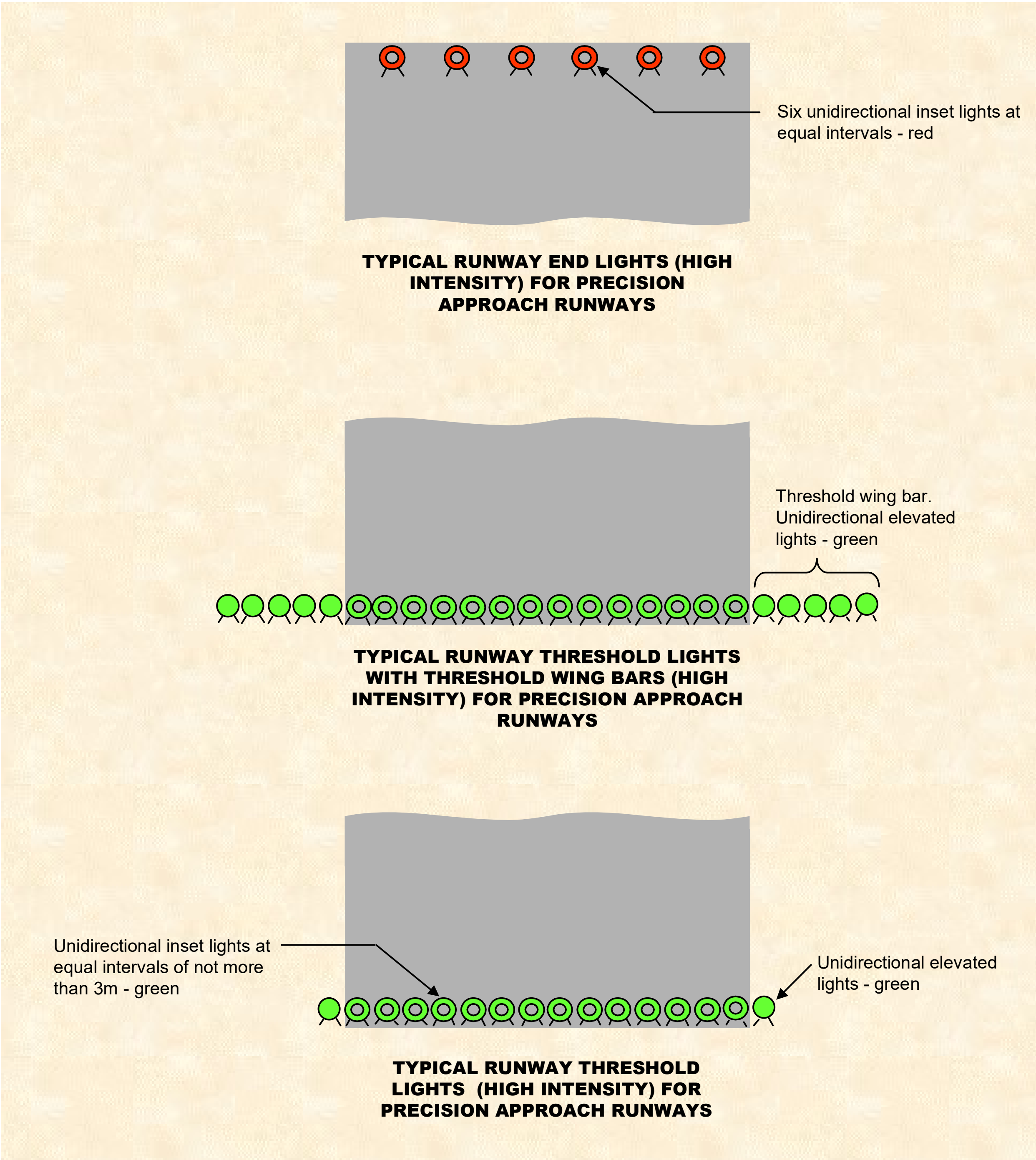


Figure 9.12-3: Typical Runway Threshold and Runway End Lights High Intensity for Precision Approach Runways

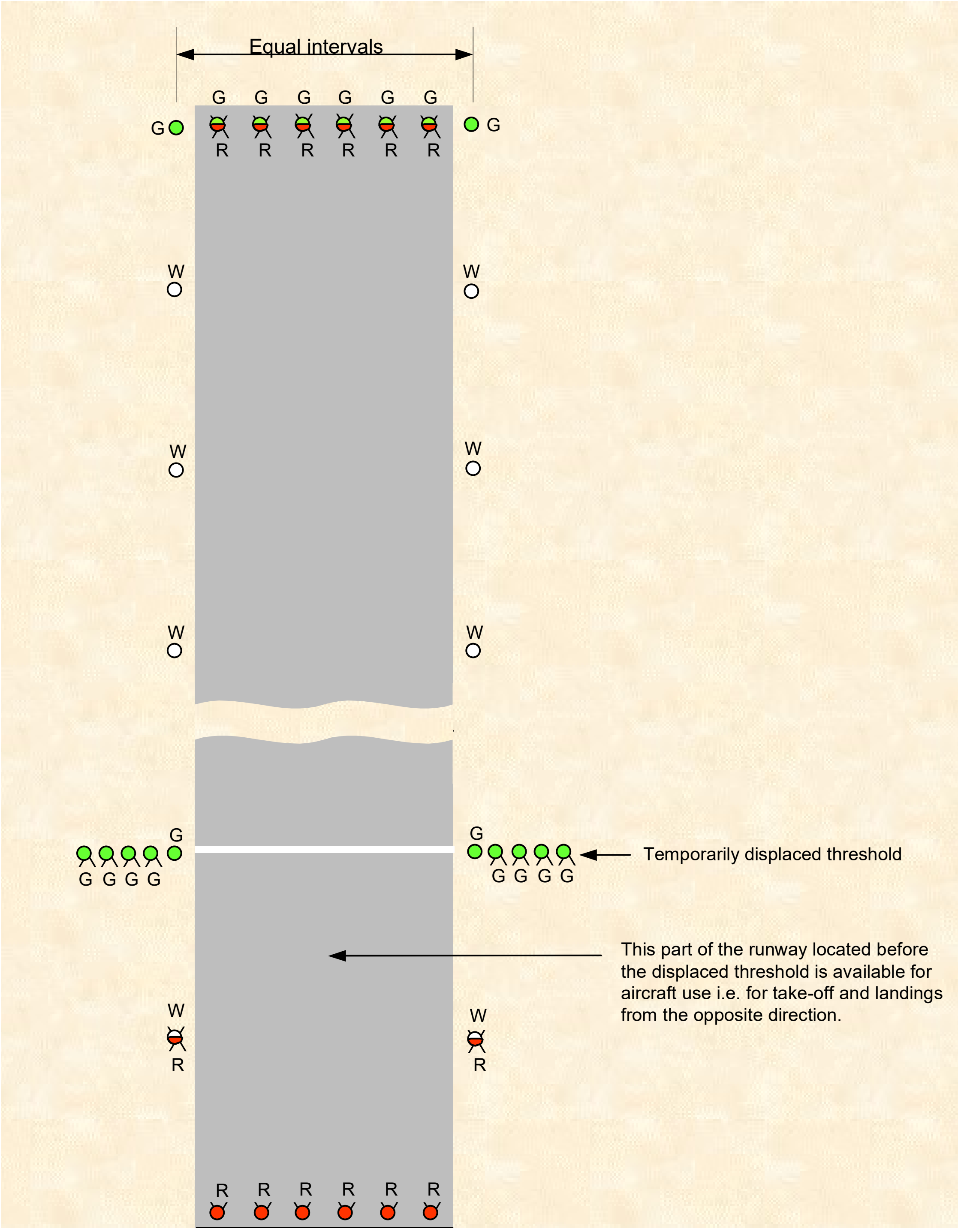


Figure 9.12-4: Typical Temporarily Displaced Threshold

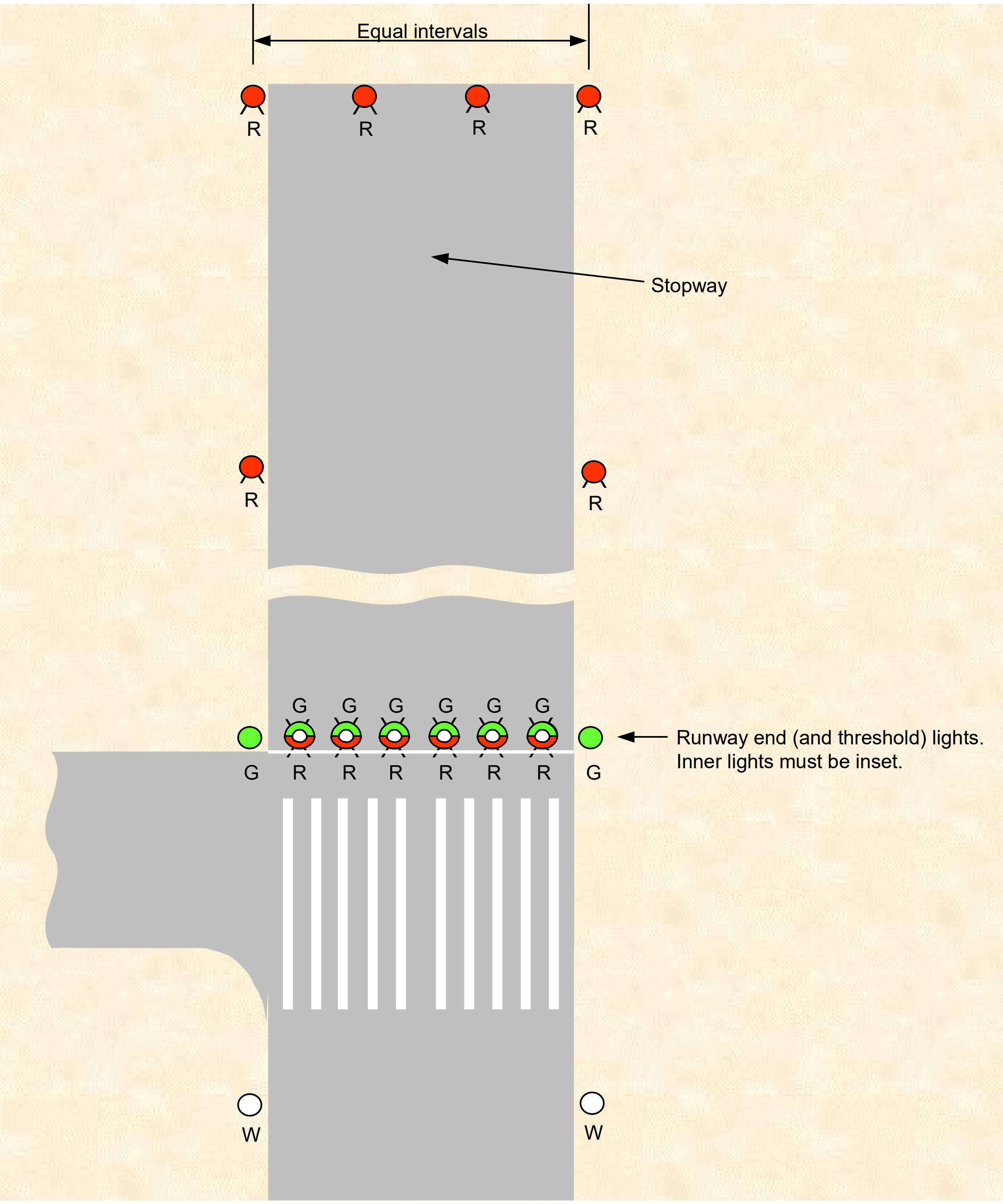
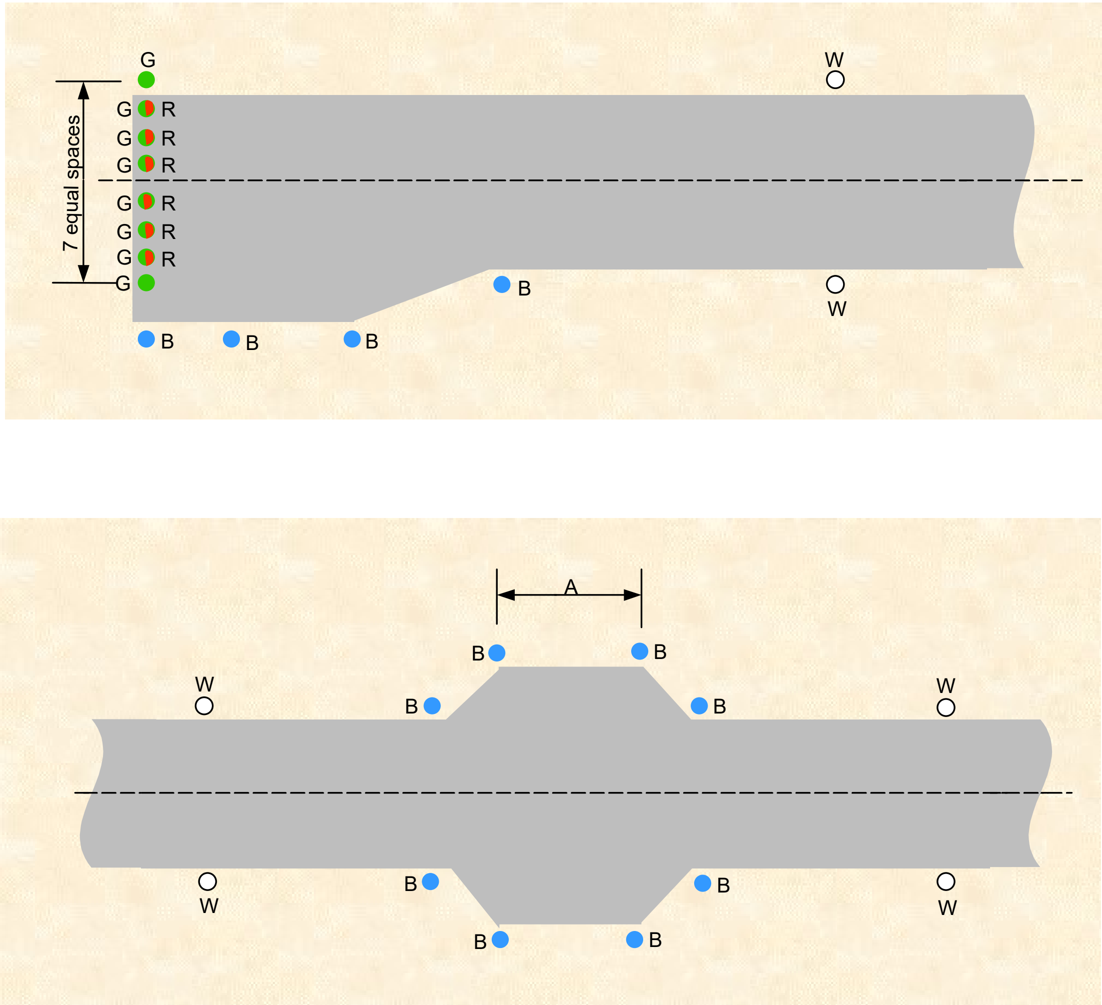


Figure 9.12-5: Typical Stopway Lights



Where distance 'A' is longer than 30m, equally spaced lights not exceeding 30m spacing are to be included

Blue edge lights at the start of the splay are to be omitted where runway edge lights are located within 10m of the start of the splay

Figure 9.12-6: Typical Turning Area Edge Lights

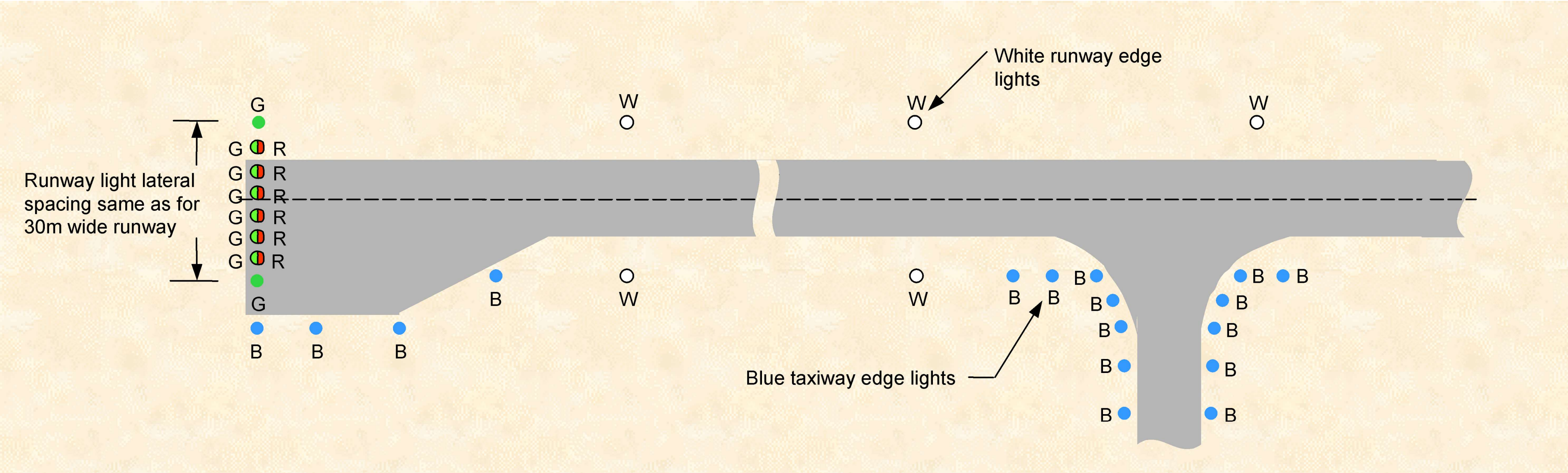


Figure 9.12-7: Typical Light Layout Where Runway Pavement is 23 m or 18 m wide

Section 9.13: Taxiway Lighting

9.13.1 Provision of Taxiway Centreline Lights

9.13.1.1 Unless the aerodrome has light traffic density, a taxiway intended for use in RVR conditions less than a value of 350 m must have centreline lights that provide continuous guidance between the runway centreline and the apron.

9.13.1.2 A taxiway intended for use at night in RVR conditions of between 350 m and 1 200 m must have centreline lights unless the aerodrome has:

(a) a simple layout; or

(b) light traffic density.

9.13.1.3 Taxiway centreline lights must be used on a rapid exit taxiway.

9.13.1.4 Taxiway centreline lights may be used in other cases, if the aerodrome chooses. At aerodromes where the layout is complex, the use of taxiway centreline lights would be beneficial for surface movement.

9.13.2 Provision of Taxiway Edge Lights

9.13.2.1 Except for Paragraphs 9.13.3.1 and 9.13.4.1, taxiway edge lights must be provided at the edges of a taxiway and holding bays, intended for use at night and not provided with centreline lights.

9.13.2.2 Where additional visual cues are required to delineate apron edges at night, taxiway edge lights may be used. Examples of where this requirement may occur include, but are not limited to:

(a) aprons where taxi guidelines and aircraft parking position marking are not provided;

(b) aprons where apron floodlighting provides inadequate illumination at the edge of the apron; and

(c) where the edge of the apron is difficult to distinguish from the surrounding area at night.

9.13.3 Taxiway Markers

9.13.3.1 For code letter A or B taxiways, retroreflective taxiway centreline or edge markers may be used instead of taxiway centreline or edge lights, provided at least 1 taxiway from the runway to the apron has taxiway centreline or edge lights.

9.13.3.2 If taxiway centreline lights are not provided, taxiway centreline markers may be used to improve guidance on the taxiway, or to supplement:

(a) taxiway centreline marking; or

(b) taxiway edge markers or taxiway edge lights.

> **Note:** Curves and intersections are examples of where improved guidance or supplementation may be given.

9.13.3.3 If taxiway edge lights are not provided, taxiway edge markers may be used to improve guidance on the taxiway, or to supplement:

(a) taxiway edge marking; or

(b) taxiway centreline markers or taxiway centreline lights.

> **Note:** Curves, intersections and apron edges are examples of where improved guidance or supplementation may be given.

9.13.4 Apron Taxiway Lighting

9.13.4.1 Taxiway lights are not required for an apron taxiway if the apron taxiway is illuminated by apron floodlighting meeting the standards specified in Section 9.16.

9.13.5 Use of Different Types of Taxiway Lights

9.13.5.1 As far as practicable, the provision of taxiway lights shall be such that taxying aircraft do not need to alternate between taxiway centreline and edge lights.

9.13.5.2 Where additional guidance is required to delineate taxiway edges, taxiway edge lights may be used to supplement taxiway centreline lights. When provided, taxiway edge lights must comply with Paragraphs 9.13.13 to 9.13.15. This may occur at, but is not limited to:

(a) rapid exit taxiways;

(b) taxiway curves;

(c) intersections;

(d) a narrower section of taxiway.

9.13.6 Control of Lights on Taxiways

9.13.6.1 At an aerodrome with Air Traffic Service, taxiway lights with an average intensity within the main beam of more than 20 candela must be provided with intensity control in accordance with Paragraph 9.1.14.6, to allow adjustment of the lighting to suit ambient conditions.

9.13.6.2 If it is desired to illuminate only standard taxi routes during certain period of operations, for example during low visibility operations, the taxiway lighting may be designed to allow taxiways in use to be lit and those not in use to be unlit.

9.13.6.3 Where a runway forming part of a standard taxi-route is provided with runway lighting and taxiway lighting, the lighting systems must be interlocked to preclude the possibility of simultaneous operation of both forms of lighting.

9.13.7 Location of Taxiway Centreline Lights

9.13.7.1 Taxiway centreline lights must be located on the centreline of the taxiway or uniformly offset from the taxiway centreline by not more than 0.3 m.

9.13.8 Spacing of Taxiway Centreline Lights

Notes: The longitudinal spacing of centreline lights that will provide satisfactory guidance to pilots on curved sections of taxiway, including exit taxiways and fillets at intersections, is influenced by the width of the light beam from the centreline light fittings.

9.13.8.1 Except for Paragraphs 9.13.8.2 and 9.13.9.1, the longitudinal spacing of taxiway centreline lights on a straight section of taxiway must be uniform and be not more than the values specified in Table 9.13-1 below:

Table 9.13-1 Maximum spacing on straight sections of taxiway

Type	General	Last 60 m before a runway or apron
Taxiways intended for use in RVR conditions of 550 m or greater	60 m	15 m
Taxiways intended for use in RVR conditions of less than a value of 550 m but not less than a value of 350 m	30 m	15 m
Taxiways intended for use in RVR conditions of less than a value of 350 m	15 m	7.5 m

9.13.8.2 For the purpose of taxiway centreline lighting, a straight section of taxiway that is less than 181 metres in length is considered a short straight taxiway. Taxiway centreline lights on a short straight section of taxiway must be spaced at uniform intervals of not more than 30 m.

9.13.8.3 For a taxiway entering a runway:

(a) the last taxiway centreline light must be not more than 1 m outside the line of runway edge lights; and

(b) if the taxiway centreline lights continue towards the runway centreline, they must end no closer than 1.2 m from the runway centreline.

9.13.8.4 When a taxiway changes from a straight to a curved section, the taxiway centreline lights must continue on from the preceding straight section at a uniform distance from the outside edge of the taxiway.

9.13.8.5 The longitudinal spacing of taxiway centreline lights on a curved section of taxiway must be uniform and be not more than the values specified in Table 9.13-2.

Table 9.13-2: Maximum spacing on curved sections of taxiway

Type	On curve with radius of 400 m or less	On curve with radius greater than 400 m	On straight section before and after the curve
Taxiways intended for use in RVR conditions of 350 m or greater	15 m See Note	30 m	No special requirement. Use same spacing as on the rest of the straight section.
Taxiways intended for use in RVR conditions of less than a value of 350 m	7.5 m	15 m	Same spacing as on the curve is to extend for 60 m before and after the curve
Note: At a busy or complex taxiway intersection where additional taxiing guidance is desirable, closer light spacing down to 7.5 m should be used.			

9.13.9 Location of Taxiway Centreline Lights on Exit Taxiways

9.13.9.1 Taxiway centreline lights on exit taxiways, other than rapid exit taxiways, must:

(a) start at the tangent point on the runway;

(b) have the first light offset 1.2 m from the runway centreline on the taxiway side; and

(c) be spaced at uniform longitudinal intervals of not more than 7.5 m.

9.13.10 Location of Taxiway Centreline Lights on Rapid Exit Taxiways

9.13.10.1 Taxiway centreline lights on a rapid exit taxiway must:

(a) start at least 60 m before the tangent point;

(b) on that part of taxiway parallel to the runway centreline, be offset 1.2 m from the runway centreline on the taxiway side; and

(c) continue at the same spacing to a point on the centreline of the taxiway at which an aeroplane can be expected to have decelerated to normal taxying speed.

9.13.10.2 Taxiway centreline lights on a rapid exit taxiway must be spaced at uniform longitudinal intervals of not more than 15 m.

9.13.11 Characteristics of Taxiway Centreline Lights

9.13.11.1 Taxiway centreline lights are to be inset, fixed lights showing green on:

(a) a taxiway other than an exit taxiway; and

(b) a runway forming part of a standard taxi-route.

9.13.11.2 Taxiway centreline lights on exit taxiways, including rapid exit taxiways, must be inset, fixed lights:

(a) showing green and yellow, alternately, from the point where they begin near the runway centreline, to whichever of the following is furthest from the runway:

(i) the perimeter of the ILS critical and sensitive area;

(ii) the lower edge of the inner transitional surface; and

(b) showing green from that point onwards.

9.13.11.3 When viewed from the runway, the exit taxiway light nearest the perimeter or the lower edge of the inner transitional surface, whichever is further, must show yellow.

9.13.11.4 Where the taxiway centreline lights are used for both runway exit and entry purposes, the colour of the lights viewed by a pilot of an aircraft entering the runway must be green. The colour of the lights viewed by a pilot of an aircraft exiting the runway is to be green and yellow alternately. See Figure 9.15-1.

9.13.11.5 Where the taxiway centreline lights cross a runway, the colour of the taxiway centreline lights viewed by a pilot of an aircraft entering the runway from the taxiway must be:

(a) green up to the runway centreline; and

(b) alternately green and yellow beyond the runway centreline while exiting on the other side of the runway.

9.13.12 Beam Dimensions and Light Distribution of Taxiway Centreline Lights

9.13.12.1 The beam dimensions and light distribution of taxiway centreline lights must be such that the lights are visible only to pilots of aircraft on, or in the vicinity of, the taxiway.

9.13.12.2 The light distribution of the green taxiway centreline lights in the vicinity of a threshold must be such as not to cause confusion with the runway threshold lights.

9.13.12.3 On a taxiway intended for use in RVR conditions of 350 m or greater, taxiway centreline lights must comply with the specifications set out in Section 9.14, Figure 9.14-1 or Figure 9.14-2, whichever is applicable.

9.13.12.4 On a taxiway intended for use in RVR conditions of less than a value of 350 m, the taxiway centreline lights must comply with the specifications set out in Section 9.14, Figure 9.14-3, Figure 9.14-4 or Figure 9.14-5, whichever is applicable.

> **Notes:** 1 Light units meeting the intensity standards of Figure 9.14-3, Figure 9.14-4 and Figure 9.14-5, are specifically designed for use in low visibility conditions.
>
> 2 Very high intensity taxiway light units are also available. These lights can have main beam intensities of the order of 1800 cd.

9.13.13 Location of Taxiway Edge Lights

9.13.13.1 Taxiway edge lights must be located along both sides of the taxiway, with edge lights along each edge located opposite the corresponding lights along the other edge, except as allowed for in Paragraph 9.13.13.2.

9.13.13.2 A taxiway light may be omitted if it would otherwise have to be located on an intersection with another taxiway or runway.

9.13.13.3 Taxiway edge lights must be located outside the edge of the taxiway, being:

(a) equidistance from the centreline except where asymmetric fillets are provided; and

(b) as close as practicable to 1.2 m from the taxiway edge, but no further than 1.8 m, or nearer than 0.6 m.

9.13.13.4 Where a taxiway intersects with a runway, the last taxiway edge lights should preferably line-up with the line of runway edge lights, and must not encroach beyond the line of runway edge lights into the area outlined by the runway edge lights.

9.13.14 Spacing of Taxiway Edge Lights

9.13.14.1 Spacing of taxiway edge lights must be in accordance with Figure 9.13-1 below:

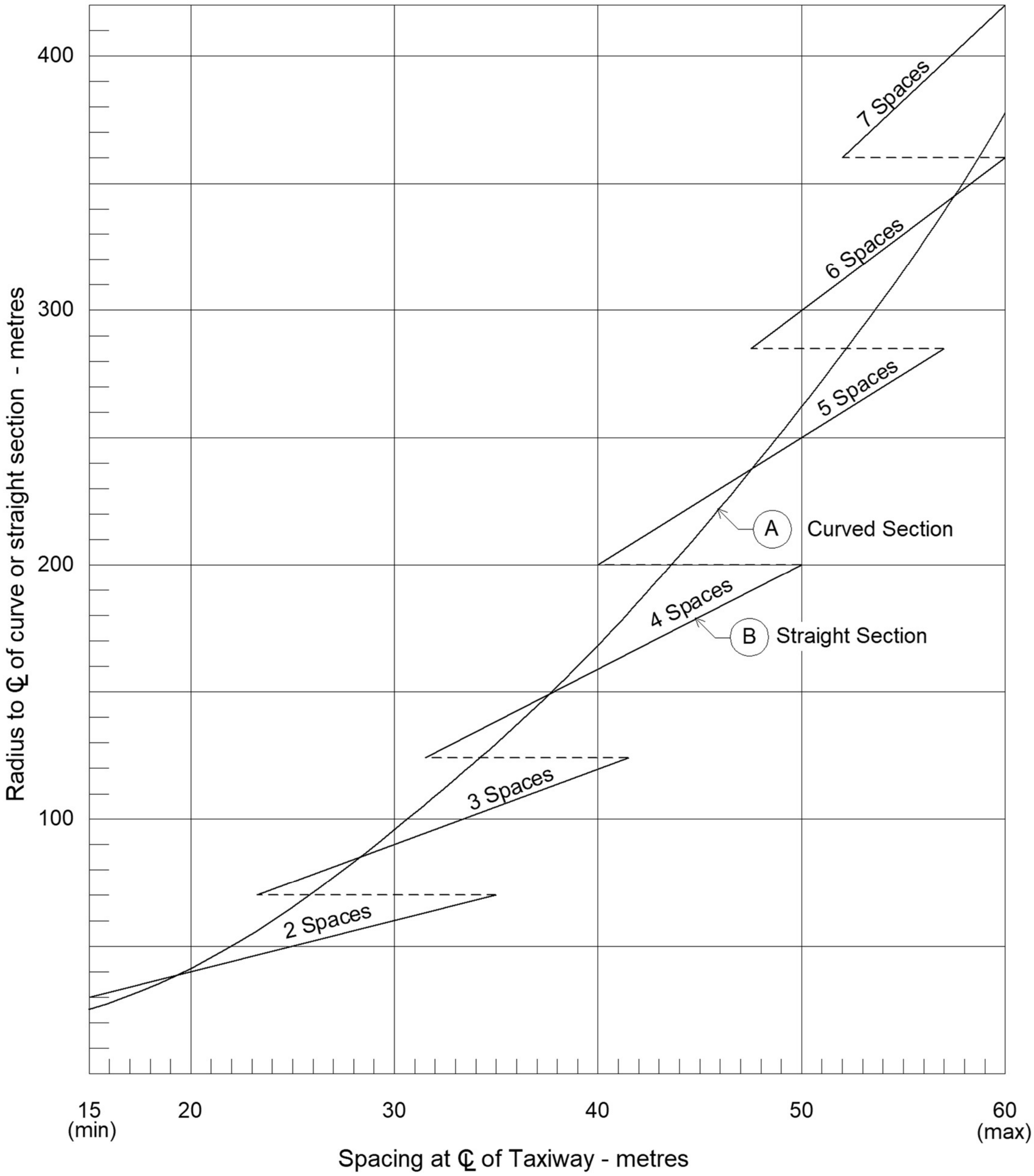


Figure 9.13-1: Longitudinal Spacing for Taxiway Edge Lights

9.13.14.2 On a curved section of taxiway, the edge lights must be spaced at uniform longitudinal intervals in accordance with Curve A in Figure 9.13-1 above.

9.13.14.3 On a straight section of taxiway, the edge lights must be spaced at uniform longitudinal intervals, not exceeding 60 m, in accordance with Curve B in Figure 9.13-1 above.

9.13.14.4 Where a straight section joins a curved section, the longitudinal spacing between taxiway edge lights must be progressively reduced, in accordance with Paragraphs 9.13.14.5 and 9.13.14.6, over not less than 3 spacings before the tangent point.

9.13.14.5 The last spacing between lights on a straight section must be the same as the spacing on the curved section.

9.13.14.6 If the last spacing on the straight section is less than 25 m, the second last spacing on the straight section must be no greater than 25 m.

9.13.14.7 If a straight section of taxiway enters an intersection with another taxiway, a runway or an apron, the longitudinal spacing of the taxiway edge lights must be progressively reduced over not less than 3 spacings, before the tangent point, so that the last and the second last spacings before the tangent point are not more than 15 m and 25 m respectively.

9.13.14.8 The taxiway edge lights must continue around the edge of the curve to the tangent point on the other taxiway, the runway or apron edge.

9.13.14.9 Taxiway edge lights on a holding bay or apron edge are to be spaced at uniform longitudinal intervals not exceeding 60 m, and in accordance with Curve B in Figure 9.13-1.

9.13.15 Characteristics of Taxiway Edge Lights

9.13.15.1 Taxiway edge lights must be fixed omnidirectional lights showing blue. The lights must be visible:

(a) up to at least 30° above the horizontal; and

(b) at all angles in azimuth necessary to provide guidance to the pilot of an aircraft on the taxiway.

9.13.15.2 At an intersection, exit or curve, the lights must be shielded, as far as is practicable, so they cannot be seen where they may be confused with other lights.

9.13.15.3 The peak intensity of the blue edge lights must not be less than 5 candela.

9.13.16 Provision of Runway Guard Lights

Notes:

1. Runway guard lights are sometimes colloquially referred to as “wig wags”.
2. The purpose of runway guard lights is to warn pilots and drivers of vehicles operating on taxiways that they are about to enter an active runway.

9.13.16.1 Runway guard lights must be provided at the intersection of a taxiway with a runway intended for use in:

(a) RVR conditions less than a value of 550 m where stop bars are not installed; or

(b) RVR conditions of values between 550 m and 1 200 m where the traffic density is heavy.

9.13.16.2 An aerodrome that is not required to provide runway guard lights may choose to do so as an aid to reducing runway incursions.

Note: Paragraph 9.13.16.3 would apply.

9.13.16.3 Subject to paragraph 9.13.16.5, if runway guard lights are introduced for a runway, they must:

(a) be introduced and used at all taxiways which allow access to the runway; and

(b) as far as practicable, be introduced at all taxiways at the same time; and

(c) if introduced in stages — be introduced in a way that removes any risk of confusion.

9.13.16.4 Runway guard lights are not required for a taxiway if:

(a) the taxiway is used only for exiting from the runway; and

(b) the taxiway cannot be used for entry to the runway.

9.13.16.5 Paragraph 9.13.16.3 does not apply if an aerodrome that is not required and has not chosen to be equipped with runway guard lights installs such lights only at an identified runway incursion hot spot.

9.13.17 Pattern and Location of Runway Guard Lights

9.13.17.1 There are two standard configurations of runway guard lights:

(a) Configuration A (or Elevated Runway Guard Lights) has lights on each side of the taxiway, and

(b) Configuration B (or In-pavement Runway Guard Lights) has lights across the taxiway.

9.13.17.2 Configuration A is the configuration to be installed in all cases; except that Configuration B, or both Configuration A and B, must be used where enhanced conspicuity of the taxiway/runway intersection is needed, for example;

(a) on complex taxiway intersections with a runway; or

(b) where holding position markings do not extend straight across the taxiway; or

(c) on a wide-throat taxiway where the Configuration A lights on both sides of the taxiway would not be within the normal field of view of a pilot approaching the runway guard lights.

9.13.17.3 Configuration A runway guard lights must be located on both sides of the taxiway, at the runway holding position closest to the runway, with the lighting on both sides:

(a) equidistant from the taxiway centreline; and

(b) not less than 3 m, and not more than 5 m, outside the edge of the taxiway.

9.13.17.4 Configuration B runway guard lights must be located across the entire taxiway, including fillets, holding bays, etc. at the runway holding position closest to the runway, with the lights spaced at uniform intervals of 3 m.

9.13.18 Characteristics of Runway Guard Lights

9.13.18.1 Configuration A runway guard lights must consist of two pairs of elevated lights showing yellow, one pair on each side of the taxiway.

> **Note:** To enhance visual acquisition:
>
> (a) the centreline of lights in each pair should be separated by a horizontal distance that is not less than 2.5 times, and not more than 4 times, the radius of the individual lantern lens;
>
> (b) each light should be provided with a visor to minimise extraneous reflection from the optical surfaces of the lanterns;
>
> (c) the visors and the face of the light fitting surrounding the lantern lens should be black to minimise reflection and provide enhanced contrast;
>
> (d) where additional isolation of the signal is required from the background, a black target board may be provided around the sides and top of the face of the light fitting.

9.13.18.2 Configuration B runway guard lights must consist of inset lights showing yellow.

9.13.18.3 The performance of Configuration A runway guard lights must comply with the following:

(a) the lights in each pair are to be illuminated alternately at between 30 and 60 cycles per minute;

(b) the light suppression and illumination periods of each light in a pair are to be of equal and opposite duration;

(c) the light beams are to be unidirectional and aimed so that the beam centres cross the taxiway centreline at a point 60 m prior to the runway holding position;

(d) the effective intensity of the yellow light and beam spread are to be in accordance with the specifications in Section 9.14, Figure 9.14-6.

9.13.18.4 The performance of Configuration B runway guard lights must comply with the following:

(a) adjacent lights are to be alternately illuminated and alternate lights are to illuminate in unison;

(b) the lights are to be illuminated between 30 and 60 cycles per minute and the light suppression and illumination periods are to be equal and opposite in each light;

(c) the light beam is to be unidirectional and aligned so as to be visible to the pilot of an aeroplane taxying to the holding position.

(d) the effective intensity of the yellow beam and beam spread are to be in accordance with the specifications in Section 9.14, Figure 9.14-3.

9.13.19 Control of Runway Guard Lights

9.13.19.1 Runway guard lights are to be electrically connected such that all runway guard lights protecting a runway can be turned on when the runway is active, day or night.

9.13.20 Provision of Intermediate Holding Position Lights

9.13.20.1 Intermediate holding position lights must be provided at the following locations:

(a) the runway holding position on a taxiway serving a runway equipped for night use when runway guard lights and/or stop bars are not provided;

(b) the holding position of a holding bay, where the holding bay is intended to be used at night;

(c) at taxiway/taxiway intersections where it is necessary to identify the aircraft holding position; and

(d) a designated intermediate holding position on a taxiway intended to be used at night.

> **Note:** Provision of intermediate holding position lights for (c) and (d) is based on local air traffic control procedures requirements.

9.13.21 Pattern and Location of Intermediate Holding Position Lights

9.13.21.1 On a taxiway equipped with centreline lights, the intermediate holding position lights must consist of at least 3 inset lights, spaced 1.5 m apart, disposed symmetrically about, and at right angles to, the taxiway centreline, located not more than 0.3 m before the intermediate holding position marking or the taxiway intersection marking, as appropriate.

9.13.21.2 On a taxiway equipped with edge lights, the intermediate holding position lights must consist of 1 elevated light on each side of the taxiway, located in line with the taxiway edge lights and the runway holding position marking, intermediate holding position marking or taxiway intersection marking, as appropriate.

9.13.22 Characteristics of Intermediate Holding Position Lights

9.13.22.1 Inset intermediate holding position lights must:

(a) be fixed, unidirectional lights showing yellow;

(b) be aligned so as to be visible to the pilot of an aircraft approaching the holding position;

(c) have light distribution as close as practicable to that of the taxiway centreline lights.

9.13.22.2 Elevated intermediate holding position lights must:

(a) be fixed, omnidirectional lights showing yellow;

(b) have light distribution as close as practicable to that of the taxiway edge lights.

9.13.23 Stop Bars

9.13.23.1 If a runway is intended to be used in RVR conditions less than a value of 550 m, a stop bar must be provided at each runway holding position serving the runway.

9.13.23.1A Paragraph 9.13.23.1 does not apply if:

(a) operational procedures ensure that in RVR conditions less than a value of 550 m:

(i) aircraft on the manoeuvring area are limited to 1 at a time; and

(ii) vehicles on the manoeuvring area are limited to the minimum essential for safe aerodrome operations; or

(b) appropriate aids and procedures designed to prevent the inadvertent incursion of aircraft or vehicles on to the runway are:

(i) proposed in writing by the aerodrome operator; and

(ii) approved in writing by RCAA; and

(iii) in force for the runway.

> **Note**: Stop bars require direct ATC control. Therefore, an aerodrome operator must consult with ATC before planning their introduction.

9.13.23.2 Where provided, the control mechanism for stop bars must meet the operational requirements of the Air Traffic Service at that aerodrome.

9.13.24 Location of Stop Bars

9.13.24.1 A stop bar must:

(a) be located across the taxiway on, or not more than 0.3 m before, the point at which it is intended that traffic approaching the runway stop;

(b) consist of inset lights spaced 3 m apart across the taxiway;

(c) be disposed symmetrically about, and at right angles to, the taxiway centreline.

9.13.24.2 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, a pair of elevated lights, with the same characteristics as the stop bar lights, must be provided abeam the stop bar, located at a distance of at least 3 m from the taxiway edge sufficient to overcome the visibility problem.

9.13.25 Characteristics of Stop Bars

9.13.25.1 A stop bar must be unidirectional and show red in the direction of approach to the stop bar.

9.13.25.2 The intensity and beam spread of the stop bar lights must be in accordance with the applicable specifications in Section 9.14, Figure 9.14-1 to Figure 9.14-5.

9.13.25.3 Selectively switchable stop bars must be installed in conjunction with at least three taxiway centreline lights (extending for a distance of at least 90 m from the stop bar) in the direction that it is intended for an aircraft to proceed from the stop bar.

9.13.25.4 The lighting circuit must be designed so that:

(a) stop bars located across entrance taxiways are selectively switchable;

(b) stop bars located across taxiways used as exit taxiways only are switchable selectively or in groups;

(c) when a stop bar is illuminated, any taxiway centreline lights immediately beyond the stop bar are to be extinguished for a distance of at least 90 m; and

(d) with control interlock and not manual control, when the centreline lights beyond the stop bar are illuminated the stop bar is extinguished and vice versa.

9.13.26 Taxiway Edge Markers

9.13.26.1 Where taxiway edge markers are used, they must be installed at least in the same locations as taxiway edge lights would have been installed had they been used.

> **Note:** Taxiway edge markers must be used in accordance with subsection 9.13.3.

9.13.27 Characteristics of Taxiway Edge Markers

9.13.27.1 Taxiway edge markers must be retroreflective blue.

9.13.27.2 The surface of a taxiway edge marker as viewed by the pilot must be a rectangle with a height to width ratio of approximately 3:1 and a minimum viewing area of 150 cm^2.

9.13.27.3 Taxiway edge markers must be lightweight, frangible and low enough to preserve adequate clearance for propellers and for the engine pods of jet aircraft.

9.13.28 Taxiway Centreline Markers

9.13.28.1 Where taxiway centreline markers are used, they must be installed at least in the same locations as taxiway centreline lights would have been installed had they been used.

> **Note:** Taxiway centreline markers must be used in accordance with subsection 9.13.3.

9.13.29 Characteristics of Taxiway Centreline Markers

9.13.29.1 Taxiway centreline markers must be retroreflective green.

9.13.29.2 The marker surface as viewed by the pilot must be a rectangle and must have a minimum viewing surface of 20 cm^2.

9.13.29.3 Taxiway centreline markers must be able to withstand being run over by the wheels of an aircraft without damage either to the aircraft or to the markers themselves.

9.13.30 Photometric Characteristics of Taxiway Lights

9.13.30.1 The average intensity of the main beam of a taxiway light is calculated by:

(a) establishing the grid points in accordance with the method shown in Section 9.14, Figure 9.14-7;

(b) measuring the light intensity values at all grid points located within and on the perimeter of the rectangle representing the main beam;

(c) calculating the arithmetic average of the light intensity values as measured at those grid points.

9.13.30.2 The maximum light intensity value measured on or within the perimeter of the main beam must not be more than three times the minimum light intensity values so measured.

9.13.31 Installation and Aiming of Light Fittings

9.13.31.1 The following points must be followed in the installation and aiming of light fittings:

(a) the lights are aimed so that there are no deviations in the main beam pattern, to within ½° from the applicable standard specified in this Chapter;

(b) horizontal angles are measured with respect to the vertical plane through the taxiway centreline;

(c) when measuring horizontal angles for lights other than taxiway centreline lights, the direction towards the taxiway centreline is to be taken to be positive;

(d) vertical angles specified are to be measured with respect to the horizontal plane.

(e) Illustrations of Taxiway Lighting

9.13.31.2 Section 9.15: contains illustrations of taxiway lighting.

Section 9.14: Isocandela Diagrams for Taxiway Lights

9.14.1 Collective Notes to Figures

9.14.1.1 Figure 9.14-1 to Figure 9.14-5 show candela values in green and yellow for taxiway centreline lights and red for stop bar lights.

9.14.1.2 Figure 9.14-1 to Figure 9.14-5 show the minimum allowable light intensities. The average intensity of the main beam is calculated by establishing grid points as shown in Figure 9.14-7, 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.

9.14.1.3 No deviations are acceptable in the main beam when the lighting fixture is properly aimed.

9.14.1.4 Horizontal angles are measured with respect to the vertical plane through the taxiway centreline except on curves where they are measured with respect to the tangent to the curve.

9.14.1.5 Vertical angles are measured from the longitudinal slope of the taxiway surface.

9.14.1.6 The light unit is to be installed so that the main beam is aligned within one-half degree of the specified requirement.

9.14.1.7 On the perimeter of and within the rectangle defining the main beam, the maximum light intensity value is not to be greater than three times the minimum light intensity measured.

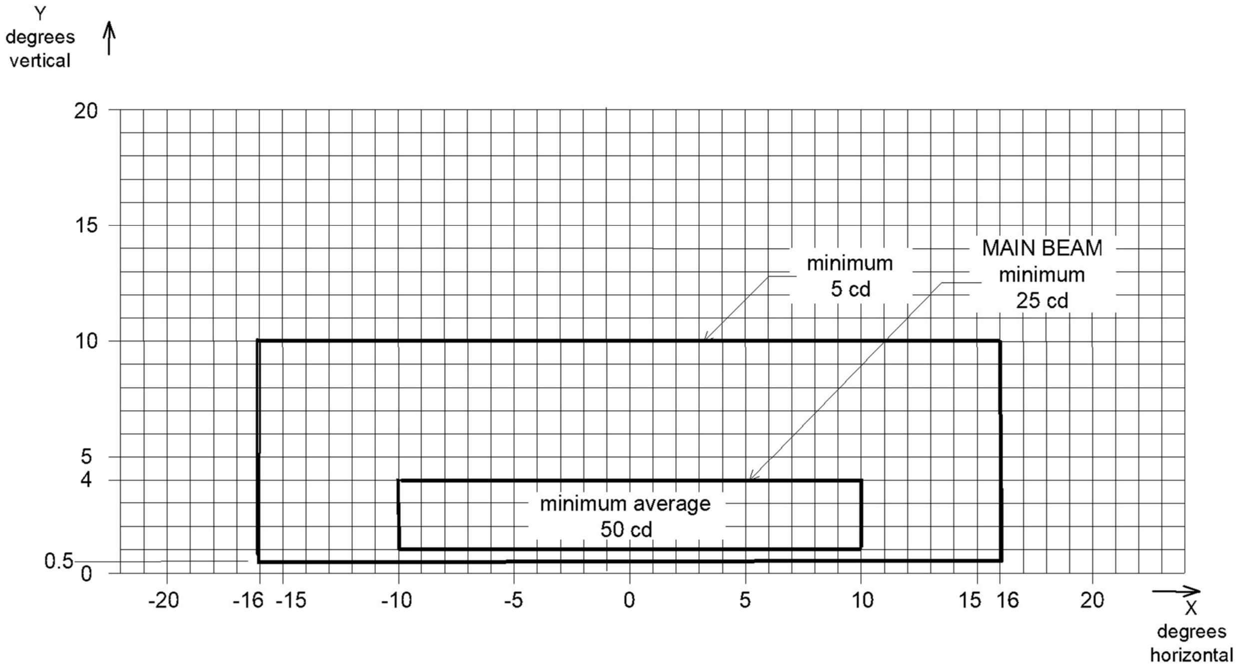


Figure 9.14-1: Isocandela Diagram for Taxiway Centreline Lights and Stop Bar Lights on Straight Sections of Taxiways intended for use in RVR conditions of 350 m or greater

Notes:
1. The intensity values have taken into account high background luminance, and possibility of deterioration of light output resulting from dust and local contamination.
2. Where omnidirectional lights are used they must comply with the vertical beam spread.
3. See the collective notes at Paragraph 9.14.1 for these Isocandela diagrams.

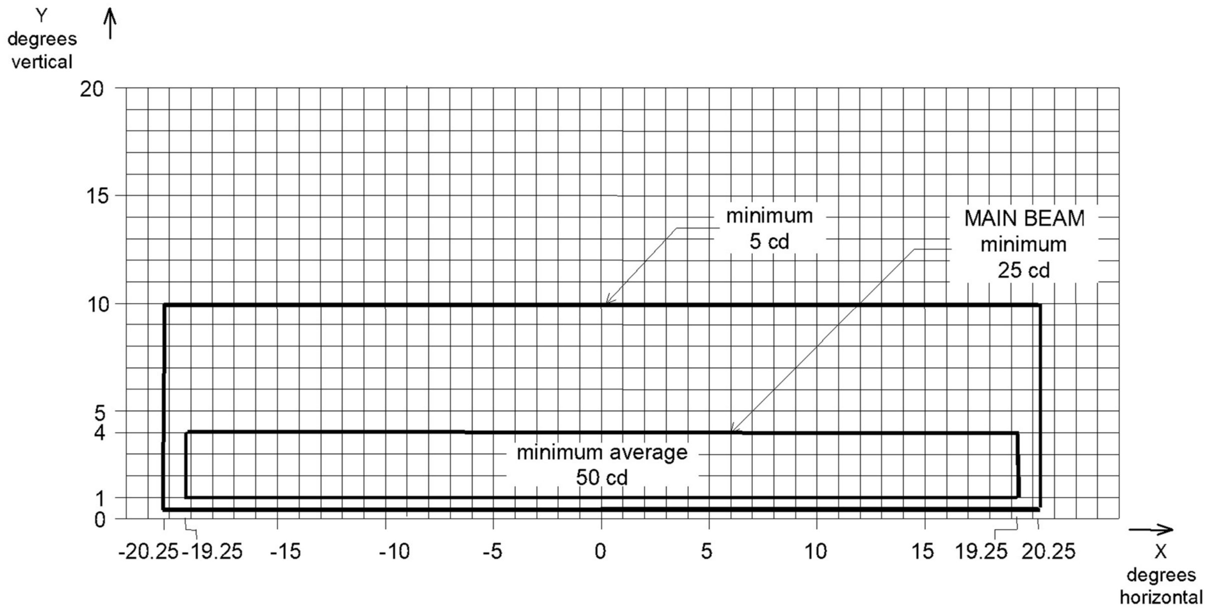


Figure 9.14-2: Isocandela Diagram for Taxiway Centreline Lights and Stop Bar Lights on Curved Sections of Taxiways intended for use in RVR conditions of 350 m or greater

Notes:

1. The intensity values have taken into account high background luminance, and possibility of deterioration of light output resulting from dust and local contamination.
2. Lights on curves to have light beam toed-in 15.75º with respect to the tangent of the curve.
3. These beam coverages allow for displacement of the cockpit from the centreline up to distance of the order of 12 m as could occur at the end of curves.
4. See collective notes at Paragraph 9.14.1 for these Isocandela diagrams.

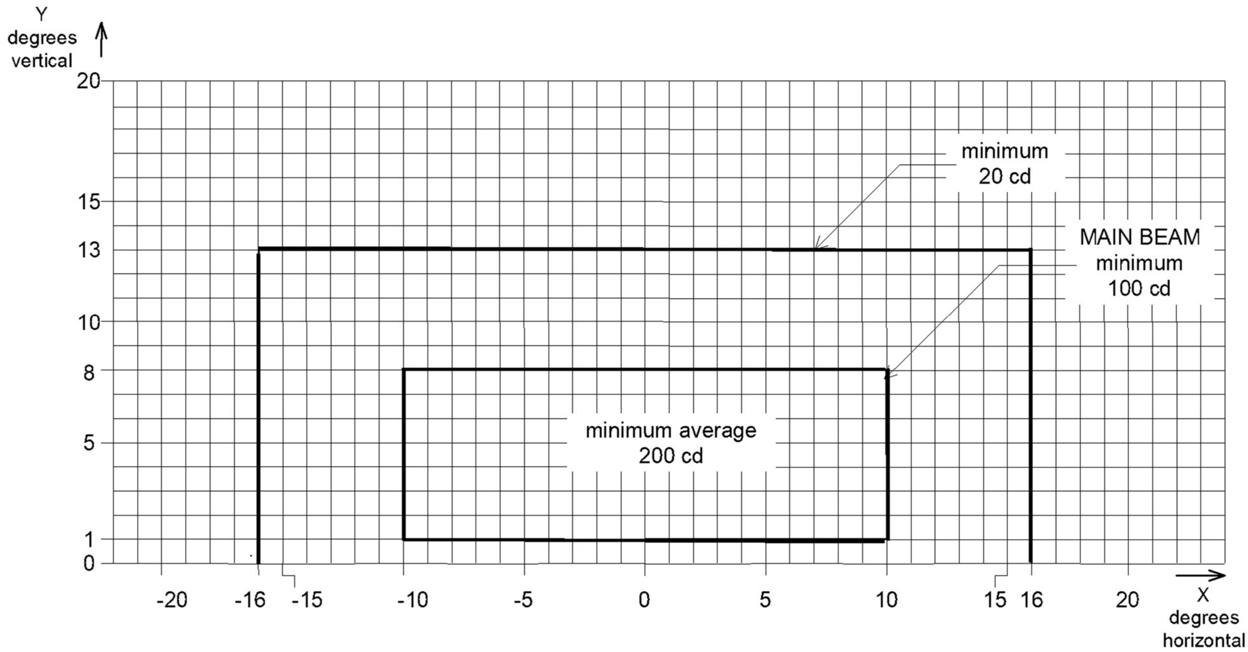


Figure 9.14-3: Isocandela Diagram for Taxiway Centreline Lights and Stop Bar Lights on Taxiways intended for use in RVR conditions of less than a value of 350 m — for use on straight sections of taxiway where large offsets can occur. Also for Runway Guard Lights Configuration B

Notes: 1. These beam coverages allow for displacement of the cockpit from the centreline of up to 12 m and are intended for use before and after curves.

2. See collective notes at Paragraph 9.14.1 for these Isocandela diagrams.

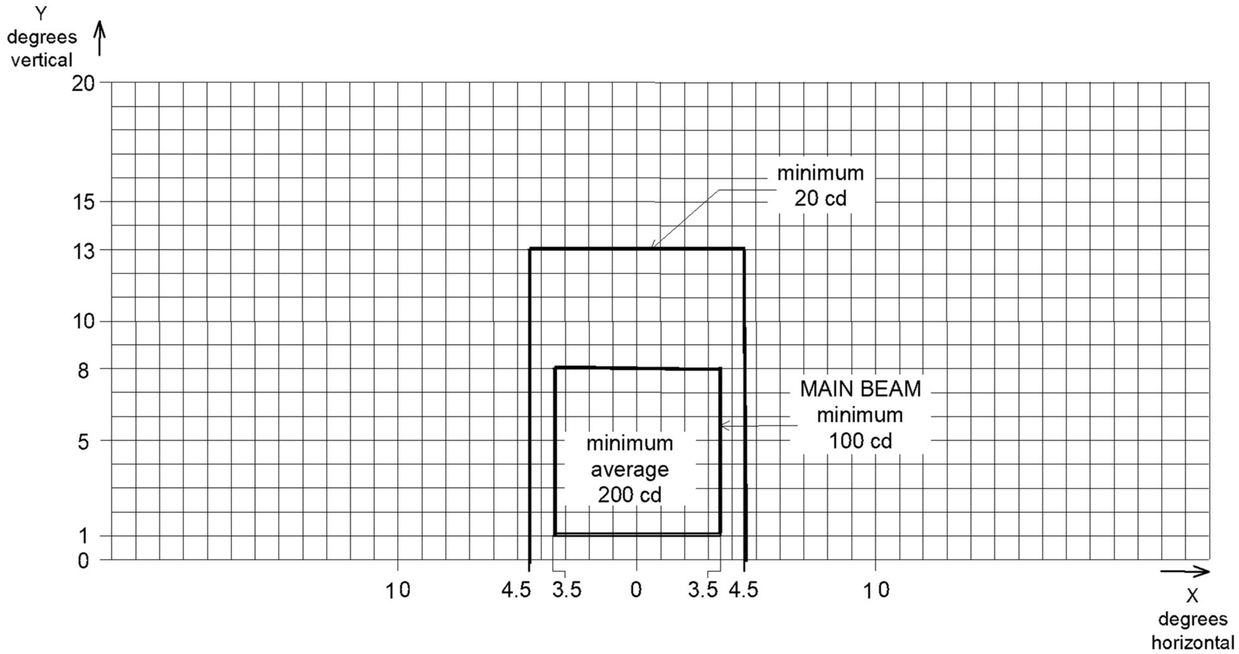


Figure 9.14-4: Isocandela Diagram for Taxiway Centreline Lights and Stop Bar Lights on Taxiways intended for use in RVR conditions of less than a value of 350 m — for use on straight sections of taxiway where large offsets do not occur

Notes: 1. These beam coverages are suitable for a normal displacement of the cockpit from the centreline of up to 3 m.

2. See collective notes at Paragraph 9.14.1 for these Isocandela diagrams.

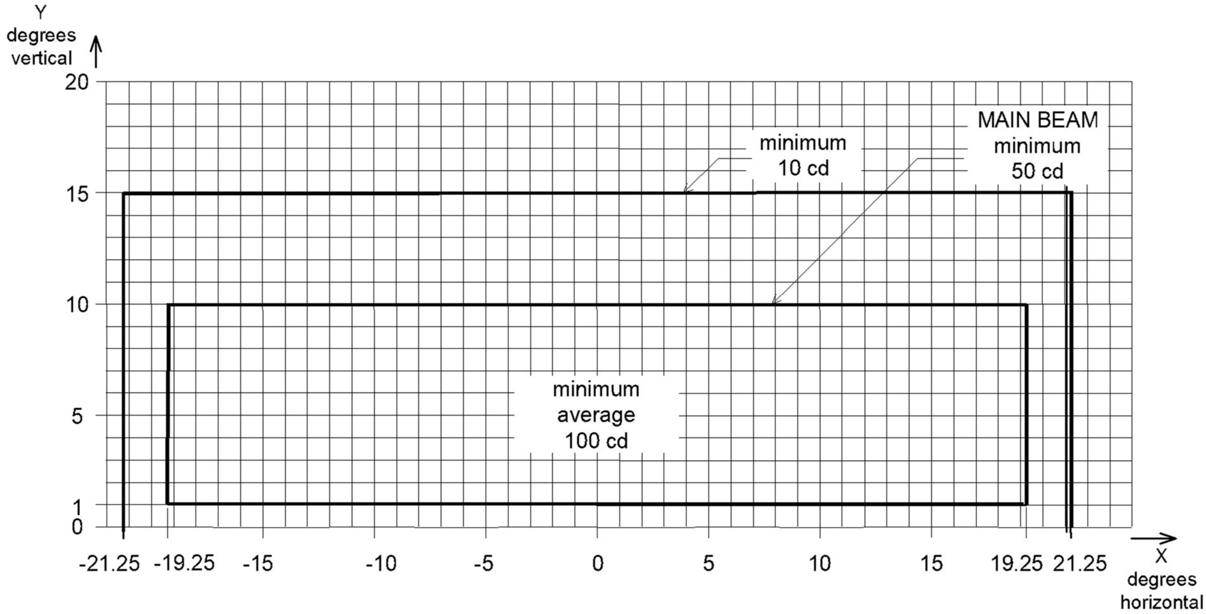


Figure 9.14-5: Isocandela Diagram for Taxiway Centreline Lights and Stop Bar Lights on Taxiways intended for use in RVR conditions of less than a value of 350 m — for use on curved sections of taxiway

Notes: 1. Lights on curves to have light beam toed-in 15.75º with respect to the tangent of the curve.

2. See collective notes at Paragraph 9.14.1 for these isocandella diagrams.

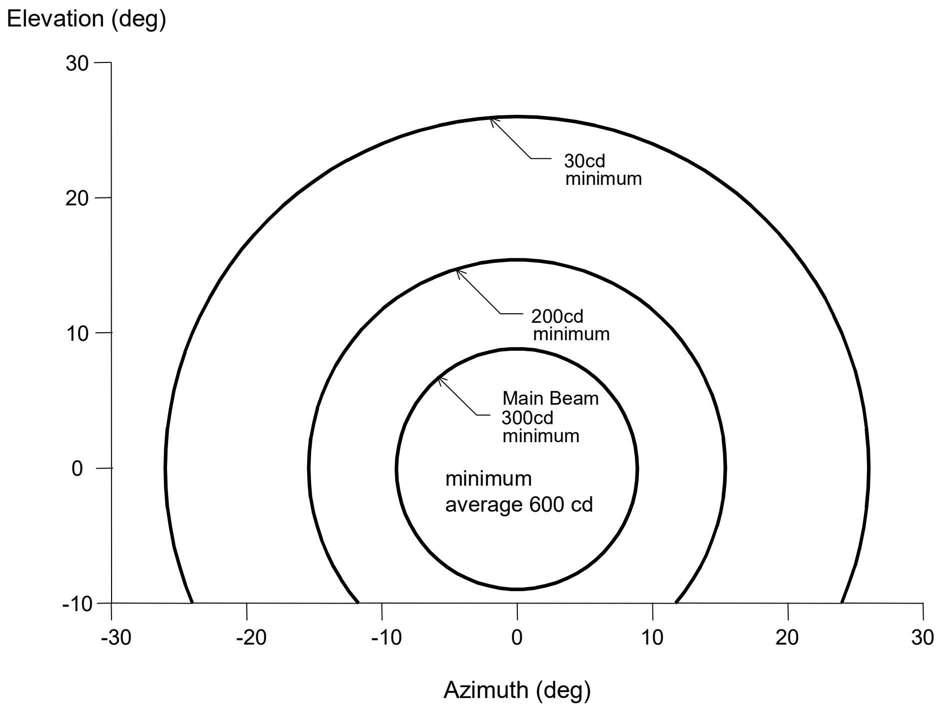


Figure 9.14-6: Isocandela Diagram for Each Light in Runway Guard Lights. Configuration A.

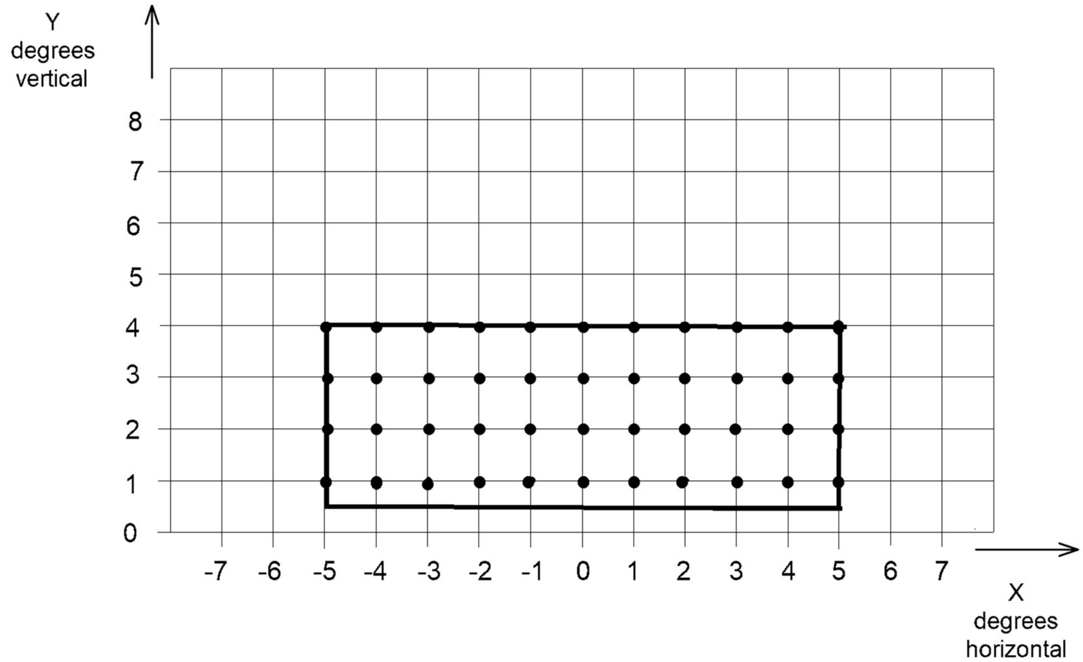


Figure 9.14-7: Method of Establishing Grid Points to be used for Calculation of Average Intensity of Taxiway Centreline Lights and Stop Bar Lights

Section 9.15: Illustrations of Taxiway Lighting

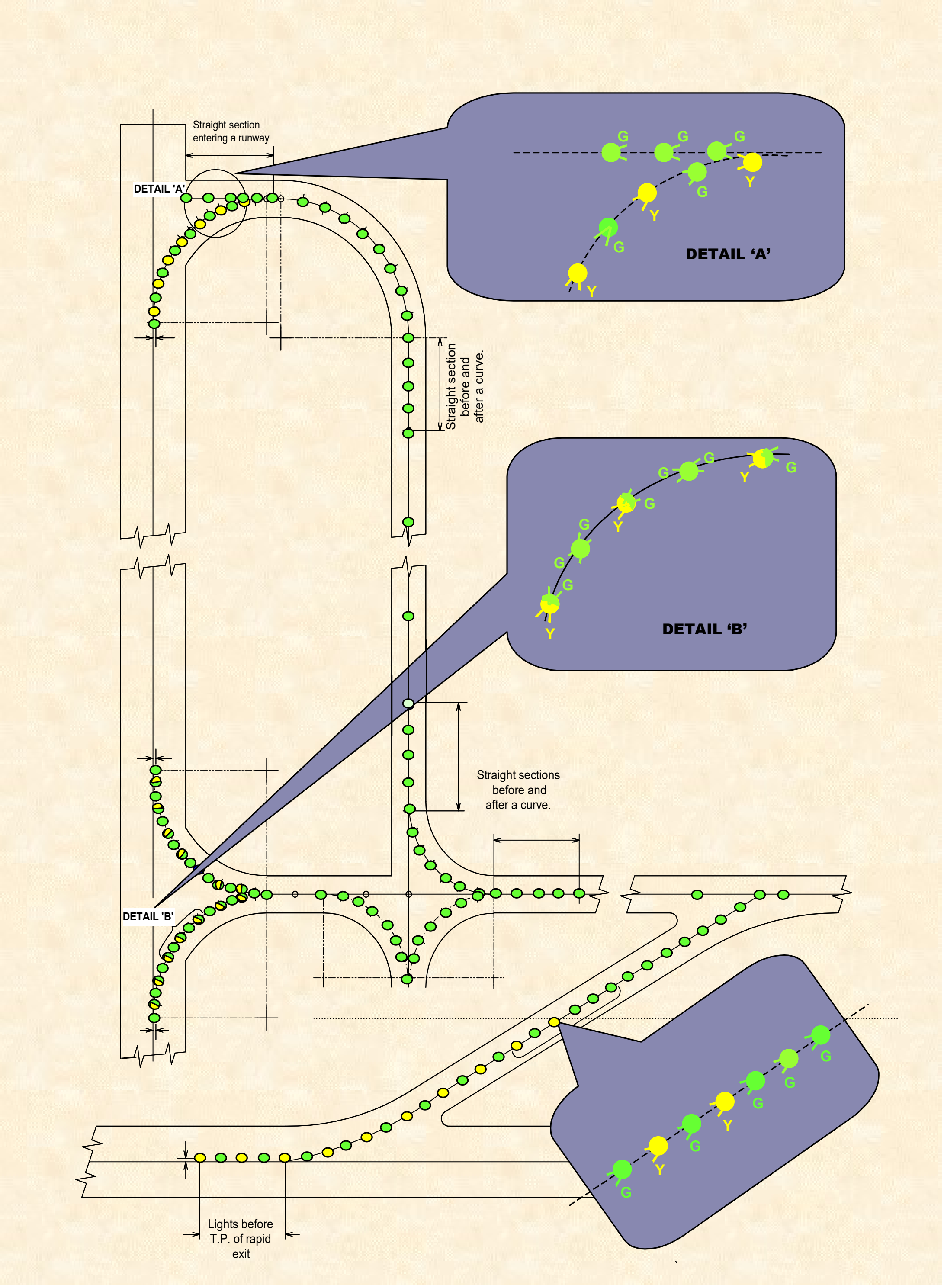


Figure 9.15-1 (a): Typical Taxiway Centreline Lights Layout

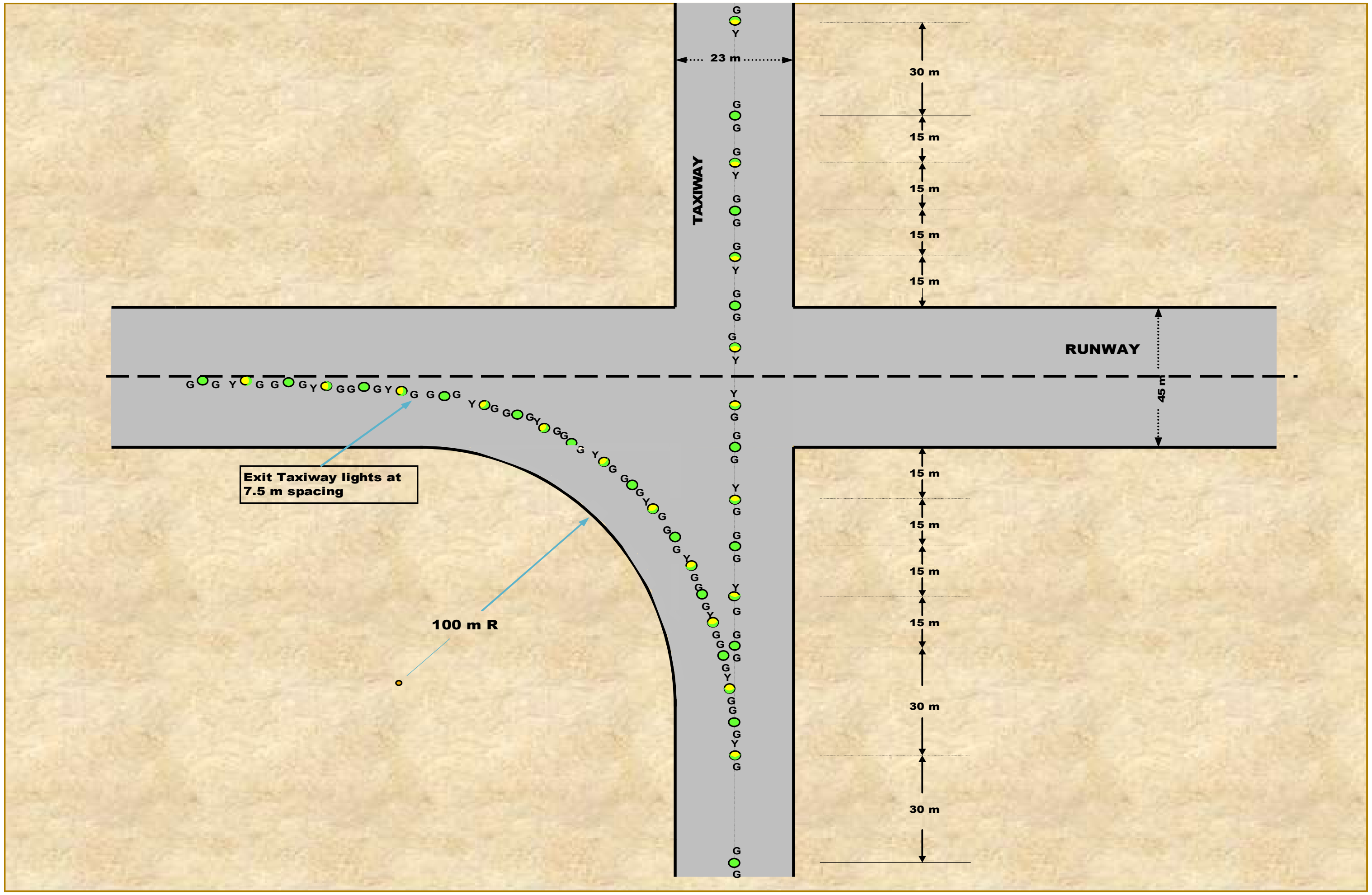


Figure 9.15-1 (b): Typical Taxiway Centreline Lights Layout

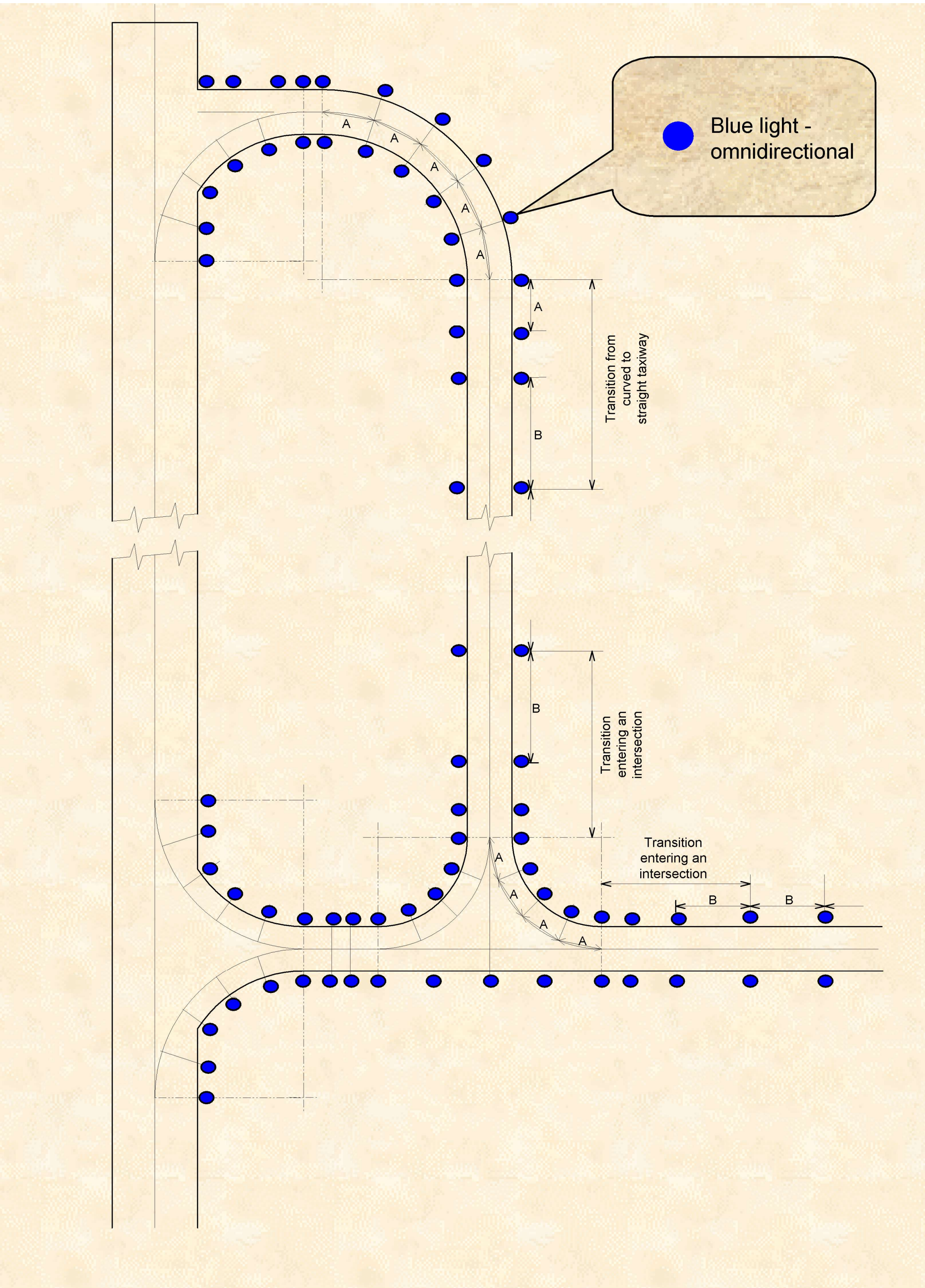


Figure 9.15-2: Typical Taxiway Edge Lights Layout

Section 9.16: Apron Floodlighting

9.16.1 Introduction

9.16.1.1 ICAO establishes only apron floodlighting standard.

9.16.1.2 Guidance on apron floodlighting is given in the Aerodrome Design Manual (Doc 9157), Part 4.

9.16.2 Provision of Apron Floodlighting

9.16.2.1 Apron floodlighting, in accordance with this Section, must be provided on an apron, or the part of an apron, and on a designated isolated aircraft parking position, intended for use at night.

9.16.3 Location of Apron Floodlighting

9.16.3.1 Apron floodlighting must be located so as to provide adequate illumination on all the apron service areas that are intended for use at night.

9.16.3.2 If an apron taxiway is not provided with taxiway lighting, then it must be illuminated by the apron floodlighting in accordance with either 9.16.4.3(b) or 9.16.4.4(b).

9.16.3.3 Apron floodlights must be located and shielded so that there is a minimum of direct or reflected glare to pilots of aircraft in flight and on the ground, air traffic controllers, and personnel on the apron.

> Note: See also Section 9.21 in regard to upward component of light.

9.16.3.4 An aircraft parking position must receive, as far as practicable, apron floodlighting from two or more directions to minimise shadows.

> **Note:** For apron floodlighting purpose, an aircraft parking position means a rectangular area subtended by the wing span and overall length of the largest aircraft that is intended to occupy that position.

9.16.3.5 Apron floodlighting poles or pylons must not penetrate the obstacle limitation surfaces.

9.16.4 Characteristics of Apron Floodlighting

9.16.4.1 To minimise the chance of an illuminated rotating object such as a propeller appearing stationary, at major aerodromes, the apron floodlighting is to be distributed across the phases of a three-phase power supply system to avoid a stroboscopic effect.

> **Note:** Aerodrome operators are strongly encouraged to apply Paragraph 9.16.4.1 to aprons at ALL aerodromes.

9.16.4.2 The spectral distribution of apron floodlights must be such that the colours used for aircraft marking connected with routine servicing, and for surface and obstacle marking, can be correctly identified. Monochromatic lights must not to be used.

9.16.4.3 The average illuminance of an apron intended for larger aeroplanes must be at least as follows:

(a) at an aircraft parking position:

(i) for horizontal illuminance – 20 lux with a uniformity ratio (average to minimum) of not more than 4 to 1; and

(ii) for vertical illuminance – 20 lux at a height of 2 m above the apron in the relevant parking direction, parallel to the aeroplane centreline;

(b) at other apron areas, horizontal illuminance at 50 per cent of the average illuminance on the aircraft parking position with a uniformity ratio (average to minimum) of not more than 4 to 1.

> **Note:** The uniformity ratio between the average of all values of illuminance, measured over a grid covering the relevant area, and the minimum illuminance within the area. A 4:1 ratio does not necessarily mean a minimum of 5 lux. If an average illuminance of say 24 lux is achieved, then the minimum should be not less than 24/4 = 6 lux.

9.16.4.4 The average illuminance of an apron intended to be used only by smaller aeroplanes must be at least as follows:

(a) at an aircraft parking position:

(i) for horizontal illuminance – 5 lux with a uniformity ratio (average to minimum) of not more than 4 to 1; and

(ii) for vertical illuminance – 5 lux at a height of 2 m above the apron in the relevant parking direction, parallel to the aeroplane centreline;

(b) at other apron areas, horizontal illuminance graded to a minimum of 1 lux at the apron extremities or 2 lux for apron edge taxiways which do not have taxiway lights.

9.16.4.5 A dimming control may be provided to allow the illuminance of an aircraft parking position on an active apron that is not required for aircraft use to be reduced to not less than 50 per cent of its normal values.

9.16.4.6 At an aerodrome where PAL activates the apron floodlighting, the apron floodlighting must achieve normal illuminance within 2 minutes of activation.

9.16.4.7 For aprons used by larger aeroplanes, the apron floodlighting must:

(a) be included in the aerodrome secondary power supply system; and

(b) be capable, following a power interruption of up to 30 seconds, of being re-lit and achieving not less than 50 per cent of normal illuminance within 60 seconds.

9.16.4.8 If existing or proposed floodlights cannot meet the requirement of Paragraph 9.16.4.7, auxiliary floodlighting must be provided that can immediately provide at least 2 lux of horizontal illuminance of aircraft parking positions. This auxiliary floodlighting must remain on until the main lighting has achieved 80 per cent of normal illuminance.

9.16.4.9 Each minimum illuminance value mentioned in this Section is maintained illuminance below which the actual value must not fall.

9.16.4.10 Each floodlight design must meet a target value which allows for a depreciation and maintenance factor that is appropriate for the particular floodlighting system.

> **Note:** The floodlight designer may choose the factor provided it is appropriate for the particular floodlighting system.

Section 9.17: Visual Docking Guidance Systems

9.17.1 Provision of Visual Docking Guidance Systems

9.17.1.1 A visual docking guidance system must be provided at an apron aircraft parking position equipped with a passenger loading bridge, where the characteristics of the passenger loading bridge require precise positioning of an aircraft.

9.17.1.2 The provisions of this Section do not, of themselves, require the replacement of existing installations. When existing installations are to be replaced due to obsolescence, facility upgrade, change of apron layout, change of passenger loading bridge, change of aircraft category, change of operational requirements, or similar reasons, all new and/or replacement visual docking guidance systems must comply with this Section.

9.17.2 Characteristics of Visual Docking Guidance Systems

9.17.2.1 The system must provide both azimuth and stopping guidance.

9.17.2.2 The azimuth guidance unit and the stopping position indicator must 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 must not dazzle the pilot.

> **Note:** Care is required in both the design and on-site installation of the system to ensure that reflection of sunlight, or other light in the vicinity, does not degrade the clarity and conspicuity of the visual cues provided by the system.

9.17.2.3 The azimuth guidance unit and the stopping position indicator must 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.

9.17.2.4 The azimuth guidance unit and the stopping position indicator must be located in such a way that there is continuity of guidance between the aircraft parking position markings, the aircraft stand manoeuvring guidance lights, if present, and the visual docking guidance system.

9.17.2.5 The accuracy of the system must be adequate for the type of loading bridge and fixed aircraft servicing installations with which it is to be used.

9.17.2.6 The system must be usable by all types of aircraft for which the aircraft parking position is intended, preferably without selective operation.

9.17.2.7 If selective operation is required to prepare the system for use by a particular type of aircraft, then the system must 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.

9.17.3 Azimuth Guidance Unit - Location

9.17.3.1 The azimuth guidance unit must be located on or close to the extension of the parking position centreline ahead of the aircraft so that its signals are visible from the cockpit of an aircraft throughout the docking manoeuvre and aligned for use at least by the pilot occupying the left seat.

9.17.3.2 Systems with azimuth guidance aligned for use by the pilots occupying both the left and right seats are acceptable.

9.17.4 Azimuth Guidance Unit - Characteristics

9.17.4.1 The azimuth guidance unit must provide unambiguous left/right guidance which enables the pilot to acquire and maintain the lead-in line without over controlling.

9.17.4.2 When azimuth guidance is indicated by colour change, green must be used to identify the centreline and red for deviations from the centreline.

9.17.5 Stopping Position Indicator - Location

9.17.5.1 The stopping position indicator must 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.

9.17.5.2 The stopping position indicator must be usable at least by the pilot occupying the left seat.

9.17.5.3 Systems with stopping position indicator usable by the pilots occupying both the left and right seats are acceptable.

9.17.6 Stopping Position Indicator - Characteristics

9.17.6.1 The stopping position information provided by the indicator for a particular aircraft type must account for the anticipated range of variations in pilot eye height and/or viewing angle.

9.17.6.2 The stopping position indicator must show the stopping position of the aircraft for which the guidance is being provided, and must provide closing rate information to enable the pilot to gradually decelerate the aircraft to a full stop at the intended stopping position.

9.17.6.3 The stopping position indicator must provide closing rate information over a distance of at least 10 m.

9.17.6.4 When stopping guidance is indicated by colour change, green must 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 stopping point a third colour may be used to warn that the stopping point is close.

9.17.7 Parking Position Identification Sign

9.17.7.1 A parking position identification sign must be provided at an aircraft parking position equipped with a visual docking guidance system.

9.17.7.2 A parking position identification sign must be located so as to be clearly visible from the cockpit of an aircraft prior to entering the parking position.

9.17.7.3 A parking position identification sign must consist of a numeric or alphanumeric inscription that is:

(a) in white on a black background; and

(b) illuminated at night by a continuous line of green light outlining the inscription.

> **Note:** Green neon tubing illumination is satisfactory.

9.17.8 Notification of Type of Aircraft Docking Guidance Systems

9.17.8.1 Due to the large variety of different type of visual docking guidance systems to be found in operation at aerodromes, information on particular types installed is published in aeronautical information publications, for use by pilots.

9.17.8.2 Aerodrome operators must notify the Procedure Design Air Navigation Services, the details of their aircraft docking guidance system intended for use for International operations.

9.17.8.3 The information to be provided is to include:

(a) type of visual docking guidance system;

(b) descriptive information, including illustrations where appropriate, for any type of system not currently described in Rwanda AIP*;* and

(c) parking positions at which the system is installed.

9.17.8.4 Initial and subsequent notification must be in accordance with Chapter 5, Aerodrome Information for AIP and Chapter 10, Operating Standards for Certified Aerodromes. The visual docking guidance system information must also be recorded in the Aerodrome Manual.

Section 9.18: Lighting Associated with Closed and Unserviceable Areas

9.18.1 Closed Runway or Taxiway

9.18.1.1 When a runway or taxiway, or portion thereof is closed, all aerodrome lighting thereon is to be extinguished. The lighting is to be electrically isolated or disabled, to prevent inadvertent activation of the lights.

> **Note:** 1. Restricted operation of the lights is permissible for maintenance or related purposes.
>
> 2. It is acceptable for short time periods, to cover lights with an opaque cover provided that:
>
> (a) the cover is firmly attached to the ground, so that it cannot be unintentionally dislodged, and
>
> (b) the cover, and its means of attachment to the ground, do not pose a hazard to aircraft, and do not constitute an object that is not lightweight and frangible.

9.18.1.2 Where a closed runway, taxiway, or portion thereof, is intercepted by a useable runway or taxiway which is used at night, unserviceability lights are to be placed across the entrance to the closed area at intervals not exceeding 3 m.

9.18.2 Unserviceable Areas

9.18.2.1 When any portion of a taxiway, apron, or holding bay is unfit for movement of aircraft, but it is still possible for aircraft to bypass the area safely, and the movement area is used at night, unserviceability lights are to be used.

9.18.2.2 The lights are to be placed at intervals sufficiently close so as to delineate the unserviceable area and, in any case, must not be more than 7.5 m apart.

9.18.3 Characteristics of Unserviceability Lights

9.18.3.1 Unserviceability lights are to be steady red lights.

9.18.3.2 The lights are to have an intensity sufficient to ensure conspicuity considering the intensity of the adjacent lights and the general level of illumination against which they would normally be viewed. In no case is the intensity to be less than 10 cd of red light.

Section 9.19: Other Lights on an Aerodrome

9.19.1 Vehicle Warning Lights

9.19.1.1 Vehicle warning lights, as required by subsection 10.9.2, must be provided to indicate to pilots and others the presence of vehicles or mobile plant on the movement area.

9.19.1.2 A vehicle warning light or lights must be mounted on the top of the vehicle, so as to provide 360° visibility.

9.19.1.3 The lights must be amber/yellow/orange, and be flashing or rotating of a standard type commercially available as an automobile accessory.

> **Note:** International experience has shown the following specification to be particularly suitable. Yellow light, with a flash rate of between 60 and 90 flashes per minute, with a peak intensity of between 40 cd and 400 cd, a vertical beam spread of 12°, and with the peak intensity located at approximately 2.5° vertical.

9.19.1.4 The lighting of rescue and fire fighting vehicles shall be as prescribed by the Authority.

9.19.1.5 For emergency or security vehicles not dedicated to aerodrome use, vehicle warning lights complying with the local traffic code are acceptable for on-aerodrome operation.

9.19.2 Works Limit Lights

9.19.2.1 Works limit lights are provided to indicate to persons associated with the works organisation the limit of the works area.

9.19.2.2 Works limit lights must be portable, amber/yellow/orange lights of a standard type commercially available as works warning lights. Alternatively they may be liquid fuel lanterns with amber/yellow/orange lenses.

9.19.3 Road and Car Park Lighting

9.19.3.1 RCAA does not regulate the lighting of roads and car parks, other than ensuring compliance with Paragraph 9.1.3.

9.19.3.2 Where road and car park lighting is required on an aerodrome, the aerodrome operator is advised to consult with the relevant local road authority.

9.19.4 Road-holding Position Light

9.19.4.1 A road-holding position light must be provided at each road-holding position serving a runway if it is intended that the runway will be used in RVR conditions of less than 350 m.

9.19.4.2 A road-holding position light must:

(a) conform to the standards specified in ICAO Annex 14; or

(b) be capable of demonstrating an outcome equivalent to that of light which does conform.

> **Note:** See subsection 11.1.4A for the mass and height limitations and frangibility requirements of navigation aids located on runway strips.

Section 9.20: Monitoring, Maintenance and Serviceability of Aerodrome Lighting

9.20.1 General

9.20.1.1 The aerodrome operator must monitor and maintain all lights and lighting systems associated with the aerodrome visual ground aids, both day and night, on a continuing basis for correctness and so that they are easily seen. Monitoring of lighting systems such as T-VASIS, PAPI and approach lighting must be carried out in accordance with the frequencies and procedures set out in the Aerodrome Manual. Other aerodrome lights must be monitored during the daily serviceability inspections and they must be switched on for this purpose.

9.20.1.2 Grass areas around lights must be maintained such that the lights are not in any way obscured. Lights must be kept free from dirt so as not to degrade their colour and conspicuousness. Damage to lights, including loss or degradation of light must be made good.

9.20.2 Reporting of Aerodrome Lighting Outage

9.20.2.1 Any aerodrome light outage detected must be fixed as soon as is practicable. The specifications listed below are intended to define the maintenance performance level objectives. They are not intended to define whether the lighting system is operationally out of service. Nor are they meant to condone outage, but are intended to indicate when lighting outage must be notified to the NOTAM office. The specifications must be used as triggers for NOTAM action, to advise pilots of actual outage, unless the outage can be rectified before the next period of use.

9.20.2.2 For details of the raising of NOTAMs refer to Section 10.3.

9.20.2.3 A light is deemed to be on outage when the main beam is out of its specified alignment or when the main beam average intensity is less than 50 per cent of the specified value. For light units where the designed main beam average intensity is above the specified value, the 50 per cent value shall be related to that design value.

> **Note:** For installations that were in existence prior to 2 May 2003, and where the design main beam average intensity values are unknown and/or unobtainable, the 50 per cent value shall be related to the specified value.

9.20.2.4 A flashing or occulting light is deemed to be on outage when:

(a) the light ceases to flash or occult; or

(b) the frequency and/or duration of flash is outside the specified range by a factor of 2 to 1 or greater; or

(c) within a 10-minute period, more than 20% of flashes fail to occur.

9.20.2.5 A lighting system is deemed to be on outage when:

(a) in the case of a lighting system comprising less than 4 lights (e.g. intermediate holding position lights or runway threshold identification lights), any of the lights are on outage;

(b) in the case of a lighting system comprising 4 or 5 lights (e.g. wind direction indicator lights or runway guard lights), more than 1 light is on outage;

(c) in the case of a lighting system comprising 6 to 13 lights (e.g. threshold lights or LAHSO lights), more than 2 lights are on outage, or 2 adjacent lights are on outage;

(d) for a precision approach runway Category II or III:

(i) more than 5% of the lights are on outage in any of the following elements:

(A) the inner 450 m of the approach lighting system;

(B) the runway centreline lights;

(C) the runway threshold lights; or

(D) the runway edge lights; or

(ii) more than 10% of the lights are on outage in the touchdown zone lights; or

(iii) more than 15% of the lights are on outage in the approach lighting system beyond 450 m; or

(iv) in any case other than a barrette or a crossbar — 2 or more adjacent lights are on outage; or

(v) for a barrette or a crossbar — 3 or more adjacent lights are on outage; and

(e) in the case of a runway meant for take-off in visibility conditions of less than 550 m:

(i) more than 5% of the lights are on outage in any of the following elements:

(A) runway centreline lights (where provided); and

(B) runway edge lights; or

(ii) 2 or more adjacent lights are on outage; and

(f) in the case of a taxiway intended for use in RVR conditions of less 350 m, 2 or more adjacent taxiway centreline lights are on outage; and

(g) in the case of any other lighting system with more than 13 lights:

(i) more than 15% of the lights are on outage; or

(ii) 2 or more adjacent lights are on outage.

> **Note:** For this subsection, a lighting system means lights used to illuminate a particular facility, for example:
>
> (a) all of the lights used to mark a threshold; or
>
> (b) all of the lights used to mark a runway end; or
>
> (c)all of the runway edge lights on a runway; or
>
> (d) all of the taxiway centreline lights on a length of taxiway between intersections.

9.20.2.6 For a T-VASIS, the outage standards take into account both the number of outage lamps within a light unit, and also the number of light units within the T-VASIS system. The standards are:

(a) A T-VASIS light unit is deemed on outage when 3 or more lamps in the electrical (day) circuit are on outage, or when any of the lamps in the electrical (night) circuit is on outage.

(b) A T-VASIS system is deemed on outage when:

(i) bar units — more than 2 light units or two adjacent light units are on outage;

(ii) fly-up units — more than 1 light unit are on outage;

(iii) fly-down units — more than 1 light unit are on outage.

(c) An AT-VASIS system is deemed on outage when:

(i) bar units — more than 1 light unit is on outage, or

(ii) fly-up units — any light unit is on outage, or

(iii) fly-down units — any light unit is on outage.

(d) Whenever a red filter has deteriorated such that it does not produce the correct colour light beam, is missing, or is damaged, all the lamps within the affected light unit must be extinguished until the red filter is rectified. The affected light unit is included as an outage light unit when applying (b) or (c) above.

9.20.2.7 For a PAPI, the outage standards take into account both the number of lamps on outage within a light unit and also the number of light units within the PAPI system. The standards are:

(a) a PAPI light unit is deemed on outage when more than one lamp in a 3 or more lamp light unit is on outage, or any lamp in a less-than-3-lamp light unit is on outage;

(b) whenever a red filter has deteriorated such that it does not produce the correct colour light beam, is missing, or is damaged, all the lamps associated with that filter must be extinguished until the red filter is rectified. The affected lamp/s are included as outage lamps when determining (a) above.

(c) a double-sided PAPI system (i.e. 8 light units) is:

(i) deemed to be on outage but useable when all light units in one wing bar are fully functioning, and any light units in the other wing bar are on outage. The system may remain in use but a NOTAM must be issued detailing the number of light units on outage, and on which side of the runway they are; and

(ii) deemed on outage when one or more light units in each wing bar is on outage. The double-sided PAPI system must be extinguished until the system is rectified;

(d) a single-sided PAPI system (i.e. 4 light units) is deemed to be on outage when any light unit is on outage. The PAPI system must be extinguished until the system is rectified.

9.20.2.8 At an aerodrome where the lighting system is provided with interleaf circuitry, the lighting system is deemed to be on outage when any one of the circuits fails.

9.20.2.9 For a movement area guidance sign:

(a) the sign must be legible at all times; and

(b) any lamp outage in a sign must be fixed as soon as practicable.

Notes: 1. No specific standard is specified for the critical number of lamps on outage in an illuminated movement area guidance sign. The key requirement is the legibility of the sign inscription at all times.

2. The failure of movement area guidance sign illumination is not subject to notification by NOTAM.

Section 9.21: Lighting in the Vicinity of Aerodromes

9.21.1 Reserved

9.21.1A Purpose of the Section

9.21.1A.1 This Section provides advice to those involved in the design or provision of lighting systems for use at or in the vicinity of an aerodrome. The intention is to minimise the potential hazard to aircraft operations from the lighting systems.

9.21.1A.2 If an aerodrome operator becomes aware that a lighting installation is proposed to be or is being installed in the vicinity of the aerodrome, it is in the aerodrome's interest to make sure that the person responsible for the lighting system is made aware of the contents of this Section.

9.21.2 Legislative Background

9.21.2.1 The RCAA has the power to require lights which may cause confusion, distraction or glare to pilots in the air, to be extinguished or modified. Ground lights may cause confusion or distraction by reason of their colour, position, pattern or intensity of light emission above the horizontal plane.

9.21.3 General Requirement

9.21.3.1 Advice for the guidance of designers and installation contractors is provided for situations where lights are to be installed within a 6 km radius of a known aerodrome. Within this large area there exists a primary area which is divided into four light control zones: A, B, C and D. These zones reflect the degree of interference ground lights can cause as a pilot approaches to land.

9.21.3.2 The primary area is shown in Figure 9.21-1. This drawing also nominates the intensity of light emission above which interference is likely.

9.21.3.3 The fact that a certain type of light fitting already exists in an area is not necessarily an indication that more lights of the same type can be added to the same area.

9.21.3.4 Even though a proposed installation is designed to comply with the zone intensities shown in Figure 9.21-1, designers are advised to consult with RCAA as there may be overriding factors which require more restrictive controls to avoid conflict.

9.21.4 Light Fittings

9.21.4.1 Light fittings chosen for an installation should have their Isocandela diagram examined to ensure the fitting will satisfy the zone requirements. In many cases the polar diagrams published by manufacturers do not show sufficient detail in the sector near the horizontal, and therefore careful reference should be made to the Isocandela diagram.

9.21.4.2 For installations where the light fittings are selected because their graded light emission above horizontal conform with the zone requirement, no further modification is required.

9.21.4.3 For installations where the light fitting does not meet the zone requirements, then a screen should be fitted to limit the light emission to zero above the horizontal. The use of a screen to limit the light to zero above the horizontal is necessary to overcome problems associated with movement of the fitting in the wind or misalignment during maintenance.

9.21.5 Coloured Lights

9.21.5.1 Coloured lights are likely to cause conflict irrespective of their intensity as coloured lights are used to identify different aerodrome facilities. Proposals for coloured lights should be referred to the Authority for detailed guidance.

9.21.6 Information and Correspondence

9.21.6.1 Check with the RCAA for likely effect on aircraft operations of proposed lighting in the vicinity of an aerodrome.

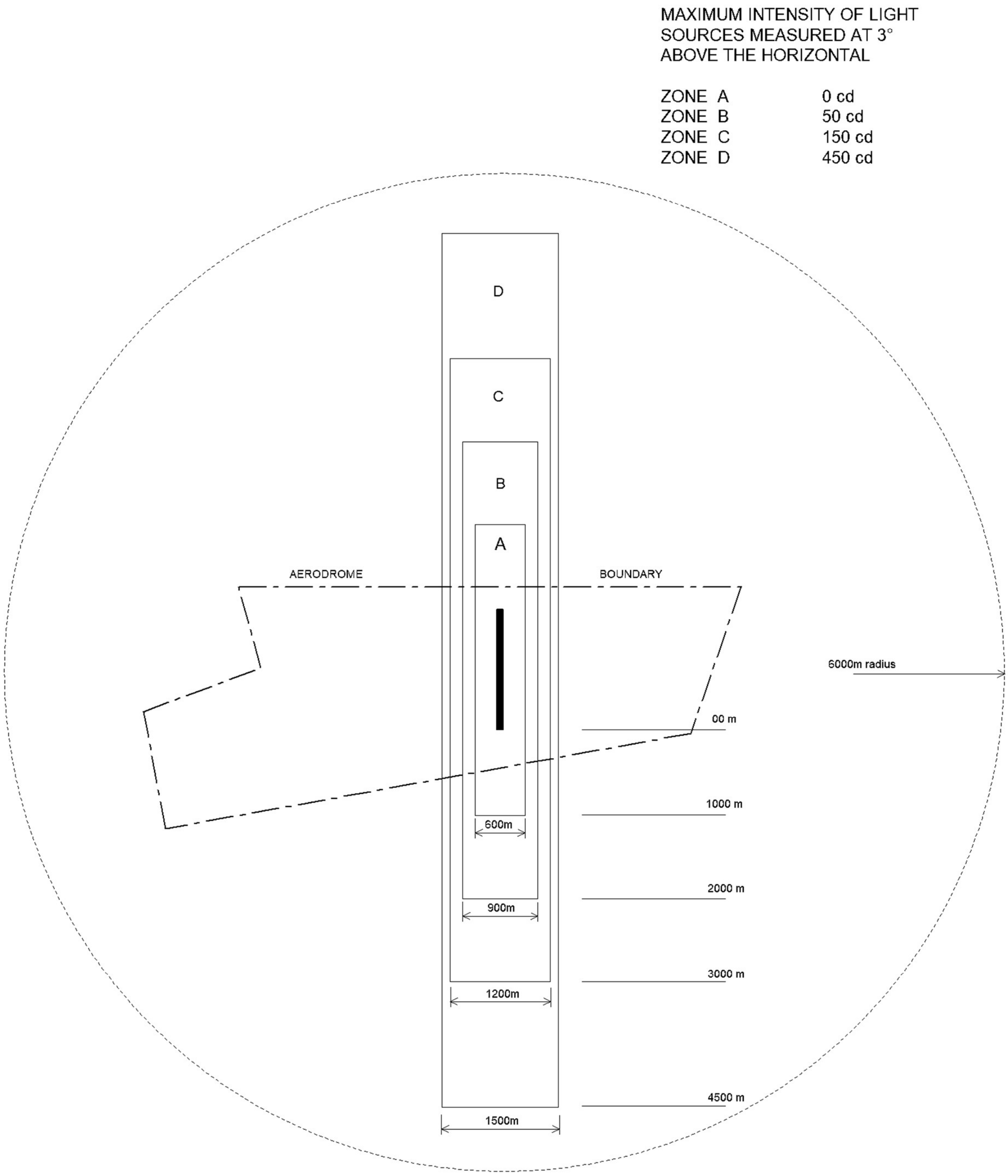


Figure 9.21-1: Maximum lighting intensities

CHAPTER 10: OPERATING STANDARDS FOR CERTIFIED AERODROMES

Section 10.1: General

10.1.1 Introduction

10.1.1.1 This Chapter sets out the standards to be incorporated in operating procedures at certified aerodromes, including those procedures to be documented in the aerodrome manual.

10.1.1.2 This Chapter also contains information on aerodrome Safety Management System (SMS). As prescribed in RCARs (Aerodromes), SMS will be applicable at certified aerodromes. All aerodrome operators are required to adopt SMS.

10.1.1.3 The standards are to be applied in a manner commensurate with the type and level of aircraft activities at the particular aerodrome. For example, Section 10.17 on low visibility operations, will not apply to all aerodromes.

10.1.2 Aerodrome Manual and Aerodrome Operating Procedures

10.1.2.1 As an integral part of the certification process, an aerodrome manual must be prepared setting out a range of information and operating procedures specified in RCARs (Aerodromes). Although the certification process does not involve a separate approval process for the aerodrome manual, the information contained in the manual must be acceptable to RCAA.

10.1.2.2 The aerodrome manual must be in a format that can be readily updated.

10.1.2.3 The contents of the aerodrome manual may be presented in a single bound document or in a number of separate documents. For example, at major aerodromes, the aerodrome emergency plan and the airside vehicle control handbook may each be a large stand-alone publication. Where this is the case, the aerodrome manual must effectively integrate the component publications by appropriate references.

10.1.2.4 An up-to-date copy of all components of the aerodrome manual must be kept at the business premises of the aerodrome operator and made available for RCAA audit purposes.

10.1.3 Training of Aerodrome Personnel Involved with Safety Functions

10.1.3.1 Persons engaged to perform the reporting officer functions, including aerodrome serviceability inspections; and works safety officer functions must be adequately trained for the job. In addition, Aerodrome Technical Inspections must be carried out by technically qualified and competent persons.

10.1.3.2 RCAA is primarily concerned with the competency of persons involved with aerodrome safety functions. Essential competencies will include:

(a) inspect and report on the physical characteristics and conditions of the aerodrome;

(b) inspect and report on aerodrome lighting systems;

(c) inspect and report on the OLS;

(d) initiating a NOTAM;

(e) use of radio, and

(f) supervise the safety of aerodrome works.

10.1.3.3 There are no mandatory provisions which regulate private training organisations or aerodrome operator training initiatives; but aerodrome operators must be able to demonstrate that persons carrying out aerodrome safety functions, have had the appropriate training and experience to undertake those functions

10.1.4 Aerodrome Safety Management System (SMS)

10.1.4.1 In line with international practice, SMS will be progressively introduced at Rwandan aerodromes, with particular emphasis initially on aerodromes used in international operations.

10.1.4.2 Safety culture and ongoing commitment of senior management are essential ingredients for a successful SMS, along with the setting of safety objectives, clear responsibilities, ongoing hazard identification and reporting, training and performance measurement.

10.1.4.3 The SMS does not necessarily generate a need for an additional set, or duplication of documents. The SMS requirements should complement the procedures set out in the aerodrome manual.

Section 10.2: Inspecting and Reporting Aerodrome Serviceability

10.2.1 General

10.2.1.1 Whilst aerodrome serviceability inspections are essentially visual checks, the process must include appropriate remedial actions where there is an immediate effect on the safety of aircraft operations. If the identified fault cannot be remedied before the next aircraft operations, then the matter must be reported to the NOTAM office. Examples of this type of remedial action include replacement of broken light lenses, lamp replacement or removal of debris from the movement area.

10.2.1.2 The operator of a certified aerodrome is required to arrange for aerodrome serviceability inspections to be carried out each day and after a severe wind or rain storm, or when requested by air traffic control or by RCAA.

10.2.1.3 Subject to RCAA agreement, the frequency of inspections may be reduced to not less than 2 per week, at aerodromes with low numbers of traffic movements.

10.2.1.4 Aerodrome reporting is the notification of changes to the published aerodrome information or any other occurrence or emergency affecting the availability of the aerodrome and safety of aircraft using the aerodrome. The occurrences may be known beforehand, as planned aerodrome works, or discovered during an inspection of the aerodrome or obstacle limitation surfaces.

10.2.1.5 Particulars of the procedures for carrying out serviceability inspections, including the use of a checklist, and for reporting any changes to aerodrome information or for requesting the issue of a NOTAM; are to be included in the aerodrome manual.

10.2.2 Significant Objects

10.2.2.1 Any significant object found in the course of the inspection, including aircraft parts which may have fallen from the aircraft, or the remains of birds which may have been struck by an aircraft, must be reported immediately to Air Traffic Control, where appropriate, and to the Aviation Accident and Incident Investigation Division (AAID), Ministry of Infrastructure.

> **Note**: Any bird strike incident is to be reported to AAID. Contact AAID for the format of reporting details.

10.2.3 Surface Conditions of the Movement Area, Including the Presence of Water

10.2.3.1 The inspection must check for the presence of:

(a) ponding;

(b) cracking or spalling;

(c) rubber build up;

(d) surface irregularities;

(e) damage caused by spillage of corrosive fluids;

(f) pipe drain faults particularly in fine grain non cohesive subgrades, in high rainfall areas;

(g) scour or erosion ditches;

(h) termite mounds or other ground obstacles obscured by long grass;

(i) soft ground, particularly in combination with surface roughness and slipperiness; and

(j) any other sign of pavement distress which has the potential to develop quickly into a hazardous situation.

10.2.4 Aerodrome Markings, Lightings, Wind Direction Indicators and Ground Signals

10.2.4.1 The inspection must check for:

(a) loss of visibility of markers and markings;

(b) use of incorrect markers and markings;

(c) any disturbance to level and alignment of lights;

(d) visual light intensity check; does a light stand out less bright than others in the same system?

(e) discoloured or dirty lenses;

(f) outage lamps, incorrect lamps fitted, or lamps fitted wrongly;

(g) the condition of the frangibility of light bases;

(h) exposed edges around footings and other aerodrome installations;

(i) damage to wind indicator assembly or mounting; and

(j) damage to wind indicator sleeve fabric, or loss of conspicuous colour.

10.2.5 Cleanliness of the Movement Area.

10.2.5.1 The inspection must check for:

(a) foreign objects, such as aircraft fastening devices and other parts,

(b) mechanics tools, small items of equipment and personal items;

(c) debris, such as sand, loose rocks, concrete, wood, plastic, pieces of tyre and mud; and

(d) with particular vigilance during and after construction activity, where vehicles and plant travel over unpaved areas under wet conditions.

10.2.6 Obstacles Infringing the Take-off, Approach and Transitional Surfaces

10.2.6.1 The aerodrome operator must have procedures and equipment in place to enable inspection personnel to identify objects protruding through the OLS. Equipment should include appropriate instrumentation, such as:

(a) a hand held clinometer;

(b) ‘sighting plane’ installations; or

(c) more formal survey equipment.

10.2.7 Birds or Animals on, or in the Vicinity of, the Movement Area

10.2.7.1 The inspection must include:

(a) the condition of aerodrome fencing, particularly in critical areas;

(b) climatic or seasonal considerations, such as the presence of birds at certain times of the year, or related to the depth of water in drainage ponding areas;

(c) possible shelter provided by aerodrome infrastructure such as buildings, equipment and gable markers;

(d) bird hazard mitigating procedures incorporated in the environmental management procedures for the aerodrome;

(e) off-airport attractors like animal sale yards, picnic areas, aeration facilities and waste disposal or landfill areas, and

(f) use of harassment procedures where appropriate.

10.2.8 Empirical Assessment of the Bearing Strength of Unrated Runway Pavements and Runway Strips

10.2.8.1 The bearing strength of a runway strip will only be required to be assessed where an unsealed runway is not marked and the whole of the runway strip is available for aircraft operations.

10.2.8.2 Whilst discretion and judgement together with local knowledge, will always form part of empirical assessment of bearing capacity, appropriate test procedures must be in place for the practical guidance of persons making the assessment. Simple test procedures can be devised such as those involving:

(a) use of a crowbar when a dry surface may conceal a soft unserviceable base;

(b) the back of a pick, in the hands of someone with practical pavement experience; or

(c) a suitably laden utility or truck to simulate the wheel loads of user aircraft.

10.2.9 Currency of NOTAMs

10.2.9.1 Daily serviceability inspection must include checking any outstanding NOTAM for the aerodrome. Check that the contents of the NOTAM, particularly the effective period(s) are still current.

10.2.10 Aerodrome Fencing

10.2.10.1 The inspection must check for damaged fences, open gates and signs of attempted entry by either animals or humans.

10.2.11 Aerodrome Frequency Response Unit

10.2.11.1 Where provided by the aerodrome operator, the inspection must check that the equipment is functional.

10.2.12 Inspection Logbooks

10.2.12.1 The aerodrome operator must maintain aerodrome inspection logbooks for recording the date and time of each aerodrome serviceability inspection, the results of each inspection and any action taken. Logbooks must be retained for at least 2 years.

Section 10.3: Initiating a NOTAM

10.3.1 Introduction

10.3.1.1 A NOTAM is used to inform pilots and aircraft operators of significant changes to the aerodrome that may impact on aircraft operations. This is one of the most important aerodrome safety functions, so the process and procedures for initiating NOTAMs must be clearly set out in the Aerodrome Manual and all the persons involved must be fully informed and trained. A NOTAM may be originated and cancelled by the nominated reporting officer or relevant Air Navigation Services provider or RCAA AIM officer.

10.3.1.2 For changes to navigation aids, MBZ/CTAF frequencies or special procedures, NOTAM may be originated by Air Navigation Services or a RCAA AIM officer. Where a navigation aid is owned and maintained by the aerodrome operator, a NOTAM to notify changes to its status may be originated by the nominated reporting officer.

10.3.2 Changes Reported to AIS Office

10.3.2.1 Where a change in the aerodrome condition requires a NOTAM to be issued, the nominated reporting officer must send the notification to the AIS Office by FAX or by telephone. Telephone advice must be confirmed in writing as soon as possible.

10.3.2.2 The following occurrences must be reported to the NOTAM Office:

(a) changes (temporary or permanent) in the published aerodrome information including additional changes to current permanent NOTAMs;

(b) aerodrome works affecting runways or the obstacle limitation surfaces, including time-limited works that require more than 10 minutes to re-instate to serviceable order;

(c) unserviceable portions of the runway or failure in aerodrome lighting or obstacle lighting;

(d) temporary obstacles to aircraft operations;

(e) a significant increase in, or concentration of birds or animals on or in the vicinity of the aerodrome;

(f) changes in excess of 0.05% of the published gradient data;

(g) emergence of new obstacles;

(h) when a radio navigation aid or landing aid owned by the aerodrome operator is unserviceable or returned to service;

(i) when an Aerodrome Frequency Response Unit owned by the aerodrome operator is unserviceable or returned to service; and

(j) any other significant event which affects the safety of aircraft using the aerodrome.

10.3.2.3 Reporting to AIS Office must be carried out as expeditiously as possible. If all the relevant information cannot be provided at once, the matter must still be reported, and subsequent details can be issued by further NOTAM. When in doubt, err on the side of safety.

> **Note:** To avoid overloading the NOTAM system, non-safety critical failures are not normally reported. For example, runway strip condition is not normally reported. Similarly, if a section of taxiway or apron is unserviceable, including some of the taxiway lighting or apron floodlighting being unserviceable, the area should be appropriately marked and lit, but the unserviceability does not normally need to be reported. If, however, the aerodrome only has one taxiway, and it is unserviceable, or only one apron, and the entire apron is unserviceable, it would be appropriate to notify these occurrences by NOTAM.

10.3.2.4 In reporting changes for NOTAM action, the aerodrome operator must submit a report which includes:

(a) aerodrome name;

(b) the aerodrome facility affected and details of unserviceability;

(c) reason for change;

(d) start time and expected end time of the unserviceability; and

(e) daily duration or time schedule of the unserviceability, where applicable.

> **Note:** Use of a form with standard headings will assist reporting. A sample aerodrome report form is shown in Section 10.4.

10.3.2.5 After making a request to the AIS Office for a NOTAM, the reporting officer must obtain a copy of the subsequent NOTAM, in order to check the accuracy and to keep a record of its issue.

> **Note:** To illustrate how changes to aerodrome information are communicated to pilots, some examples of NOTAMs are given in Section 10.5. This Section also provides a listing of general word abbreviations and phrase contractions to minimise the length of aerodrome NOTAMs.

10.3.3 Time-Limited NOTAM

10.3.3.1 A NOTAM which is not a Permanent NOTAM is ‘time limited’. A time-limited NOTAM will have an expected end time, and will lapse automatically.

10.3.4 Permanent NOTAM

10.3.4.1 A PERM NOTAM is originated in respect to permanent changes to aerodrome operational information published in AIP. This information is passed to the AIS Office which will issue the NOTAM and further pass the information on to AIS.

AIS will incorporate the changes in the following edition of AIP. The NOTAM is cancelled when the information is duly published in AIP.

10.3.5 Making Changes to Aerodrome Information Published in AIP

10.3.5.1 For changes to AIP information which does not have an immediate impact on aircraft operations, the changes are not to be notified to NOF. Instead the aerodrome operator must notify AIS directly in writing of such changes. Example: change of a fuel supplier.

10.3.6 Bird or Animal Hazard Warning

10.3.6.1 At aerodromes where a standing caution is included in AIP for a bird or animal hazard, NOTAM must only be initiated where there is a significant increase of birds or animals. The NOTAM must provide specific information on species, period of concentration, likely location and flight path.

10.3.7 New or Upgraded Visual Aids

10.3.7.1 Any AIP amendment which introduces a new visual aid, or the upgrading of an existing aid, must be referred to the appropriate RCAA Aerodrome Inspector for clearance purposes. Certain visual aids have to be commissioned or flight checked before being brought into operational use.

10.3.8 Changes to Type A Chart Information

10.3.8.1 Changes to Type A Chart information are not notified through NOTAM, however, AIP must refer to the latest edition of the Type A Chart. Aerodrome operators must provide an amendment service for the Type A Chart information directly to holders of the Charts.

10.3.9 Follow up Actions

10.3.9.1 Whenever a report of AIP changes is sent to the AIS Officeor to the AIS, a copy of the report must also be sent to the appropriate RCAA Aerodrome Inspector. The aerodrome operator must also ensure that the Aerodrome Manual is amended to reflect changes other than temporary changes.

10.3.10 Record Keeping

10.3.10.1 Aerodrome operators must maintain a logbook showing details of all reports; check subsequent NOTAM or changes to AIP for accuracy, and keep a copy of reports and NOTAM with the logbook.

Section 10.4: Reserved

Section 10.5: Examples of NOTAM and Listing of Abbreviations

10.5.1 Examples

10.5.1.1 To illustrate how changes to aerodrome information are communicated to pilots, some examples of NOTAM are given below.

10.5.1.2 **Time-limited Work**

C0174/91 NOTAMN

A) MARYBOROUGH 0174/91 (AD) 9106140900

B) 9106211000

C) 9106211600

E) RWY 17/35 WIP. MAE WILL CLR IF OPRT INDICATED.

10.5.1.3 **Explanations of NOTAM Format**

C0174/91 — the NOTAM number;

NOTAMN — a NOTAM containing new information;

A) Maryborough — name of aerodrome;

AD — information relating to aerodromes, or facilities thereon, including approach and landing aids, and the existence or removal of hazards or obstructions;

9106140900 — year/date/time of issue of NOTAM, in ten figures UTC, representing year, month, day, hour and minutes (Note, the year may be omitted);

B) 9106211000 — commencement of occurrence;

C) 9106211600 — cessation of occurrence and notification;

D) 1000/1600 — periods of activity within the period specified in Fields B and C;

E) The text of the NOTAM expressed as concisely as possible.

10.5.1.4 **Major works in accordance with Method of Working Plan (MOWP)** The MOWP will be faxed directly into the AVFAX electronic briefing system, with the pertinent stages of work activated by a trigger NOTAM quoting duration and AVFAX product code. Trigger NOTAM referring to specific stages of the MOWP will be issued as appropriate:

(a) C0943/91 NOTAMN

A) PERTH 0943/91 (AD) 9105200600

B) 9105222300

C) 9105270800 EST

E) RWY 06/24 NOT AVBL DUE WIP. REF MOWP 4/1987 ACT STAGE 1. AVFAX CODE XXXX.

(b) C0056/91 NOTAMN

A) COOLANGATTA 0056/91 (AD) 9106101002

B) 9106121100

C) 9106140600

E) RWY 14/32 NOT AVBL DUE WIP. REF MOWP QRO 86/7 ACT STAGE3. AVFAX CODE XXXX.

(c) C0934/95 NOTAMN

A) MACKAY C0934/95 (AD) 9505200600

B) 9506032200

C) 9506100600

D) 2200/0600 DAILY

E) RWY 06/24 WIP. REF MOWP 4/1993 AMENDMENT 3. 360M N END NOT AVBL.

(d) C0935/95 NOTAMN

A) MACKAY C0935/95 (AD) 9505200600

B) 9506032200

C) 9506040600

D) 2200/0600 DAILY

E) RWY 18/36 WIP. REF MOWP 4/1993 AMENDMENT 3. (followed by lengthy text of NOTAM).

10.5.1.5 **Unserviceable movement areas.**

(a) C0639/91 NOTAMN

A) KINGAROY 0639/91 (AD) 9107272100

B) 9107272100

C) 9108010600 EST

E) RWY 05/23 AND TWY PARL RWY 16/34. NOT AVBL DUE SOFT WET SFC. RWY 16/34 AVBL.

(b) C0021/91 NOTAMN

A) WONDAI 0021/91 (AD) 9103232200

B) 9103232200

C) 9103290600 EST

E) RWY 18/36 AMD. LEN. 140M S END NOT AVBL DUE ROUGH SFC. THR 36 DISP 200M. RWY 18 TORA 1264 (4146) TODA 1464 (4802) (2.3) ASDA 1264 (4146) LDA 1264 (4146) RWY 36 TORA 1264 (4146) TODA 1324 (4343) (1.6) ASDA 1264 (4146) LDA 1204 (3949) STODA RWY 18 1195 (3920) (1.6) 1339 (4392) (1.9) 1436 (4710) (2.2).

10.5.1.6 **Surface bearing capacity.** If the surface or part of the manoeuvring area is not serviceable for heavy aircraft a weight restriction may be imposed to allow light aircraft to operate.

C0281/91 NOTAMN

A) TARA 0281/91 (AD) 9108160400

B) 9108160400

C) 9108230600 EST

E) AD NOT AVBLTO ACFT ABV 1930 KG MTOW. DUE SOFT WET SFC.

10.5.1.7 **Apron areas.** These are not part of the manoeuvring area and therefore should not normally be the subject of NOTAM, but a NOTAM may be issued at minor aerodromes to indicate temporary parking arrangements.

C0256/91 NOTAMN

A) MERIMBULA 0256/91 (AD) 9108280500

B) 9108280500

C) 9108292600 EST

E) APRON CLOSED DUE WIP. LOAD UNLOAD ON RWY. RWY NOT AVBL WHEN ACFT STANDING THEREON. PILOTS SHOULD MAKE PROVISION FOR ALTN.

10.5.1.8 **Obstacle information**

(a) A permanent NOTAM to amend changes to declared distances owing to change in height of critical obstacle (trees).

C0166/95 NOTAMN

A) COOLANGATTA CO166/95 (AD) 9501210200

B) 9501210200

C) PERM

E) AMD RWY 14 GRADIENTS RWY 14 TORA 2042 (6698) TODA 2102 (6895) (2.82) ASDA 2042 (6698) LDA 2042 (6698) STODA RWY 14 1226 (4021) (2.2) 1716 (5628) (2.5) AMD AIP DATED 12 SEP 96.

(b) A temporary NOTAM to advise of a crane within the OLS area.

C0073/91 NOTAMN

A) COOLANGATTA 0073/91 (AD) 9104200700

B) 9104200700

C) 9106210600 EST

E) RWY 14/32 TEMPO TEMP OBST CRANE. 300FT AMSL BRG 076 MAG 2 NM FROM SE END OF RWY 14/32. INFRINGES HZS.

10.5.1.9 **Runway Lighting Out of Service**

C0091/91 NOTAMN

A) RICHMOND 0091/91 (AD) 9108510420

B) 9108162200

C) 9108192200

E) RWY LGT NOT AVBL.

10.5.1.10 **Temporary or Permanent Withdrawal of Aerodrome Licence**

(a) C0037/91 NOTAMN

A) MOROWA 0037/91 (AD) 9109251035

B) 9109251035

C) 9109260600

E) AD LICENCE SUSPENDED.

(b) C0048/91 NOTAMN

A) TURKEY CREEK 0048/91 (AD) 9103272218

B) 9103272220

C) PERM

E) AD DELICENSED.

10.5.2 General Word Abbreviations and Phrase Contractions to Minimise Message Length of Aerodrome NOTAMs

(Abbreviations shown in singular words are also applicable to the plural of those words)

Words and Phrases	Abbreviation
April	APR
Abbreviated ‘T’ Visual Approach Slope Indicator System	AT-VASIS
Abbreviated Visual Approach Slope Indicator System	A-VASIS
Abeam	ABM
About	ABT
Above Aerodrome level	AAL
Above ground level	AGL
Above mean sea level	AMSL
Accelerate-stop distance available	ASDA
Accept or accepted	ACPT
Active, activated, activity	ACT
Actual time of arrival	ATA
Actual time of departure	ATD
Addition or additional	ADDN

Words and Phrases	Abbreviation
Adjacent	ADJ
Advise	ADZ
Aerodrome	AD
Aerodrome Diagrams	ADDGM
Aerodrome beacon	ABN
Aerodrome control or aerodrome control tower	TWR
Aerodrome Frequency Response Unit	AFRU
Aerodrome obstruction chart	AOC
Aerodrome reference point	ARP
Aeronautical Information Circular	AIC
Aeronautical Information Publication	AIP
Aeronautical Information Service	AIS
After....(time or place)	AFT
Again	AGN
Air Traffic Control (in general)	ATC
Air traffic services	ATS
Aircraft	ACFT
Aircraft classification number	ACN
Airport	AP
Airway	AWY
All-up-weight	AUW
Alternate (Aerodrome)	ALTN
Alternate or alternating (light alternates in colour)	ALTN
Altimeter sub-scale setting to obtain elevation or altitude	QNH
Altitude	ALT
Amend(ed)	AMD
Amendment (AIP Amendment)	AMDT
Approach	APCH
Approach lighting system	ALS
Approximate(ly)	APRX
Arrange	ARNG
Arrive, or arrival	ARR

Words and Phrases	Abbreviation
As soon as possible	ASAP
Asphalt	ASPH
Associated with	ASSW
Attention	ATTN
Aircraft landing area (previously known as Authorised landing area)	ALA
Authorised or authorisation	AUTH
Automatic terminal information service	ATIS
Auxiliary	AUX
Available	AVBL
Average	AVG
Aviation gasoline	AVGAS
Azimuth	AZM
Beacon (aeronautical ground light)	BCN
Bearing	BRG
Becoming	BECMG
Before	BFR
Below	BLW
Between	BTN
Blue	B
Boundary	BDRY
Braking	BRKG
Broken	BKN
Building	BLDG
By way of..	VIA
Calibration	CLBG
Callsign (used to request a callsign)	CSGN
Category	CAT
Caution	CTN
Celsius (Centigrade)	C
Centreline	C/L
Centimetre	CM

Words and Phrases	Abbreviation
Centre (runway)	C
Change frequency to...	CF
Channel	CH
Check	CK
Civil	CIV
Clear, cleared to, clearance	CLR
Clearway	CWY
Close or closed or closing	CLSD
Code number (runway)	CN
Commissioned	CMSD
Common Traffic Advisory Frequency	CTAF
Communications	COM
Completion or completed or complete	CMPL
Concrete	CONC
Condition	COND
Confirm(ing) or I confirm	CFM
Conical surface	COS
Construction or constructed	CONST
Contact	CTC
Continue(s) or continued	CONT
Continuous day and night service	H24
Continuous(ly)	CONS
Co-ordinated Universal Time	UTC
Correction or correct or corrected	COR
Cover or covered or covering	COV
Cross	X
Crossbar (of approach lighting system)	XBAR
Crossing	XNG
Customs	CUST
Danger or dangerous	DNG
Decommissioned	DCMSD
Degrees	DEG

Words and Phrases	Abbreviation
Delay or delayed	DLA
Depart or departure	DEP
Departure and Approach procedures	DAP
Depth	DPT
Destination	DEST
Deteriorate, deteriorating	DTRT
Deviation or deviated	DEV
Direct	DCT
Displaced	DISP
Distance	DIST
Distance measuring equipment	DME
Divert or diverting or diversion	DIV
Docking	DOCK
Document	DOC
Domestic	DOM
Doppler VOR	DVOR
Duration	DUR
During	DRG
Dust	DU
Dust storm	DS
East north-east	ENE
East or east longitude	E
East south-east	ESE
Eastbound	EB
Effective operational length	EOL
Elevation	ELEV
Emergency	EMERG
En route	ENRT
Engine	ENG
Equipment	EQPT
Estimate or estimated	EST
Estimated/estimating time of arrival	ETA

Words and Phrases	Abbreviation
Estimated/estimating time of departure	ETD
Every	EV
Except	EXC
Exercises or exercising or to exercise	EXER
Expect(ed)(ing)	EXP
Expected approach time	EAT
Extend(ed)(ing)	EXTD
February	FEB
Facility, facilities	FAC
Facsimile transmission	FAX
Feet (dimensional unit)	FT
Field	FLD
First	FST
Flares	FLR
Flight	FLG
Flight information service	FIS
Flight service (in general)	FS
Flight service centre	FSC
Flight service unit	FSU
Flight plan (domestic)	PLN
Fluctuating, fluctuation, fluctuated	FLUC
Fly or flying	FLY
Fog	FG
Follow(s), following	FLW
Forecast	FCST
Frequency	FREQ
Frequent	FRQ
Friday	FRI
From	FM
General	GEN
General Aviation	AWK or PVT
General Aviation Aerodrome Procedures	GAAP

Words and Phrases	Abbreviation
Glide path	GP
Glider	GLD
Glider flying	GLY
Gradual(ly)	GRADU
Gravel	GRVL
Green	G
Ground	GND
Hazard beacon	HBN
Haze	HZ
Heading	HDG
Heavy	HVY
Height or height above	HGT
Helicopter	HEL
Helicopter Landing Site	HLS
Hertz (cycles per second)	HZ
High intensity approach lighting	HIAL
High intensity obstacle lights	HIOL
High intensity runway lighting	HIRL
Higher	HYR
Hold(ing)	HLDG
Homestead	HS
Horizontal surface	HZS
Hour	HR
ICAO standard atmosphere	ISA
Immediate(ly)	IMT
Immigration	IMM
Improve(ment), improving	IMPR
Inbound	INBD
Information	INFO
Inner marker	IM
Inoperative	INOP
Install or installed or installation	INSTL

Words and Phrases	Abbreviation
Instrument	INSTR
Instrument approach and landing charts	IAL
Instrument approach chart	IAC
Instrument flight rule	IFR
Instrument landing system	ILS
Instrument meteorological conditions	IMC
Intensify(ing)	INTSF
Intensity	INTST
Intermittent(ly)	INTER
International	INTL
International Civil Aviation Organisation	ICAO
Interrupt(ion)(ed)	INTRP
Intersection	INT
Isolated	ISOL
January	JANUARY
July	JULY
June	JUNE
Jet barrier	JBAR
Jet stream	JTST
Kilogram	KG
Kilometres	KM
Kilometres per hour	KMH
Kilopascals	KPA
Kilowatts	KW
Knots	KT
Landing	LDG
Landing direction indicator	LDI
Landing distance available	LDA
Latitude	LAT
Leave or leaving	LVE
Left (runway identification)	L
Length	LEN

Words and Phrases	Abbreviation
Level	LVL
Light or lighting	LGT
Lighted	LGTD
Limited	LTD
Local mean time	LMT
Local, locally, location, located	LOC
Localiser	LLZ
Low intensity obstacle lights	LIOL
Low intensity runway lights	LIRL
Longitude	LONG
Magnetic	MAG
Magnetic bearing	QDR
Magnetic orientation of runway	QFU
Magnetic variation	VAR
Maintain(ed)(ing)	MNTN
Maintenance	MAINT
Mandatory Broadcast Zone	MBZ
Manual	MAN
Marker radio beacon	MKR
Maximum	MAX
Maximum brakes release weight	MBRW
Maximum landing weight	MLW
Maximum take off weight	MTOW
Maximum tyre pressure	MTP
Mean sea level	MSL
Medical	MED
Medium intensity obstacle lights	MIOL
Medium intensity runway lights	MIRL
Megahertz	MHZ
Men and equipment	MAE
Message	MSG
Method of working plan	MOWP

Words and Phrases	Abbreviation
Metres (preceded by figures)	M
Metres per second	MPS
Microwave landing system	MLS
Mid-point (related to RVR)	MID
Middle marker	MM
Military	MIL
Minimum	MNM
Minimum eye height over threshold (VASI system)	MEHT
Minimum obstacle clearance (required)	MOC
Minus	MS
Minutes	MIN
Miscellaneous	MISC
Missed approach point	MAPT
Mist	BR
Moderate(ly)	MOD
Modification	CHG
Monitor(ed and ing)	MNT
Mountain	MT
Move(d)(ment), moving	MOV
Nautical mile	NM
Navigation	NAV
Near or over large town	CIT
Next	NXT
Night	NGT
Night visual flight rule	NV
Non-scheduled commercial transport	CHTR
No SAR action required	NOSAR
No change	NC
No or negative or permission not granted or that is not correct	NEG
No specific working hours	HX
Non-directional radio beacon	NDB
None or nothing	NIL

Words and Phrases	Abbreviation
North north-east	NNE
North north-west	NNW
North or north latitude	N
North-west	NW
Northbound	NB
NOTAM Office	NOF
Not before	NBFR
Notice to airmen	NOTAM
Number	NR
Open(ed)(ing)	OPN
Obscure	OBSC
Observe(d), observation	OBS
Obstacle	OBST
Obstacle clearance altitude/height	OCA/H
Obstacle clearance limit	OCL
Obstruction	OBSTR
Occasional(ly)	OCNL
Occulting (light)	OCC
On request	O/R
On top	OTP
Operate, operator, operative, operating, operational	OPR
Operation	OPRT
Operations	OPS
Outbound	OUBD
Outer marker	OM
Overhead	OHD
Parallel	PARL
Parking	PRKG
Passengers	PAX
Passing	PSG
Pavement classification number	PCN
Performance	PER

Words and Phrases	Abbreviation
Persons on board	POB
Pilot activated lighting	PAL
Plus	PS
Position	PSN
Power	PWR
Precision approach path indicator	PAPI
Prior notice required	PN
Probable, probability	PROB
Procedure	PROC
Procedures for air navigation services	PANS
Provisional	PROV
Public Holidays	PH
Quadrant(al)	QUAD
Radial	RDL
Radius	RAD
Ragged	RAG
Rain	RA
Rapid or rapidly	RAPID
Reach or reaching	RCH
Read back	RB
Recent (to qualify other abbreviations)	RE
Reference	REF
Reference datum height (for ILS)	RDH
Registration	REG
Remarks	RMK
Report(ed)(ing)(ing point)	REP
Requested	REQ
Require	RQ
Requirements	RQMNTS
Reroute	RERTE
Rescue and Fire Fighting Services	RFFS
Rescue Coordination Centre	RCC

Words and Phrases	Abbreviation
Rescue Sub Centre	RSC
Restriction	RESTR
Return to service	RTS
Return(ed)(ing)	RTN
Review	REV
Route	RTE
Runway	RWY
Runway centreline	RCL
Runway centreline light	RCLL
Runway edge light	REDL
Runway end light	RENL
Runway lead in lighting system	RLLS
Runway strip	RWS
Runway surface condition	RSCD
Runway threshold light	RTHL
Runway touchdown zone light	RTZL
Runway visual range	RVR
Rules of the air and air traffic services (associated with AIP)	RAC
Sand	SA
Sandstorm	SS
Scattered	SCT
Scheduled	SKED
Scheduled commercial air transport	S
Search and Rescue	SAR
Second(ary)	SRY
Secondary surveillance radar	SSR
Seconds	SEC
Sector	SECT
Service available during scheduled hours of operation	HS
Service available to meet operational requirements	HO
Service(ing), served	SER
Serviceable	SVCBL

Words and Phrases	Abbreviation
Severe	SEV
Short take-off and landing	STOL
Showers	SH
Simple approach lighting system	SALS
Simultaneous(ly)	SIMUL
Simultaneous Runway Operations	SIMOPS
Slow(ly)	SLW
Smoke	FU
Snow	SN
South or south latitude	S
South south-east	SSE
South south-west	SSW
South-east	SE
South-west	SW
Southbound	SB
Special series NOTAM (message type designator)	SNOWTAM
Sport aviation	SPA
Standard	STD
Standard instrument arrival	STAR
Standard instrument departure	SID
Standard departure clearance	SDC
Standby	SDBY
Start of TORA (take-off run available)	SOT
Start of climb	SOC
Station	STN
Stationary	STNR
Status	STS
Stop-end(related to RVR)	END
Stopway	SWY
Stopway light	STWL
Straight in approach	STA
Subject to	SUBJ

Words and Phrases	Abbreviation
Sunrise	SR
Sunrise to sunset	HJ
Sunset	SS
Sunset to sunrise	HN
Supplement (AIP Supplement)	SUP
Supplementary take-off distance	STODA
Surface	SFC
Surface movement control	SMC
Surface movement radar	SMR
‘T’ visual approach slope indicator system	T-VASIS
Take-off	TKOF
Take-off distance available	TODA
Take-off run available	TORA
Taxiing guidance system	TGS
Taxiing or taxi	TAX
Taxiway	TWY
Taxiway link	TWYL
Technical reason	TECR
Telephone	TEL
Temperature	T
Temporary	TEMPO
Terminal area surveillance radar	TAR
Terminal control area	TMA
Threshold	THR
Threshold crossing height	TCH
Through	THRU
Thunderstorm	TS
Thursday	THU
Time-limited WIP (work in progress)	TLW
Time search action required	SARTIME
To be advised	TBA
Tornado	TDO

Words and Phrases	**Abbreviation**
Touchdown zone	TDZ
Track	TR
Traffic	TFC
Transitional surface	TNS
Trend or tending to	TEND
Tropical cyclone	TC
True bearing	QTE
Turbulence	TURB
Type of aircraft	TYP
Typhoon	TYPH
UHF tactical air navigation aid	TACAN
Ultra high frequency (300-3000 MHz)	UHF
Unable	UNA
Unable to approve	UNAP
Unlimited	UNL
Unserviceable	U/S
Until	TIL
Until advised by	UAB
Until further notice	UFN
Upper limits	UL
VHF Omni-direction radio range	VOR
Variable	VRB
Vertical	VER
Vertical take-off and landing	VTOL
Very high frequency (30-300 MHz)	VHF
Very important person	VIP
Very low frequency (3-30 kHz)	VLF
Vicinity	VCY
Visibility	VIS
Visual approach slope indicator system	VASIS
Visual En-route chart	VEC
Visual flight rules	VFR

Words and Phrases	**Abbreviation**
Visual meteorological conditions	VMC
Visual terminal chart	VTC
Warning	WRNG
We agree or it is correct	OK
Weaken(ing)	WKN
Weather	WX
Weight	WT
West north-west	WNW
West or west longitude	W
West south-west	WSW
White	W
Widespread	WID
Wind direction indicator	WDI
Wind shear	WS
With effect from, or effective from	WEF
Within	WI
With immediate effect, or effective immediately	WIE
Without	WO
Work in progress	WIP
World Aeronautical Chart (1:1,000,000)	WAC
Yards	YD
Yellow caution zone (runway lighting)	YCZ
Yes, or affirm, or affirmative, or that is correct	AFM
Yours	YR

Section 10.6: Appointment of Reporting Officers

10.6.1 General

10.6.1.1 The aerodrome operator must appoint suitably trained person(s) as the nominated reporting officer(s). The nomination(s) must be notified in writing, to the AIS Office and the relevant RCAA Office which has surveillance responsibility for the aerodrome.

10.6.1.2 Persons other than employees of the aerodrome operator may, with appropriate training and experience, also be appointed as aerodrome reporting officers.

10.6.2 Reporting Officer Qualifications

10.6.2.1 Aerodrome operators must ensure that any person carrying out the reporting function has been suitably trained and has the following attributes:

(a) a sound knowledge of the physical characteristics of the aerodrome movement area, the aerodrome obstacle limitation surfaces, aerodrome markings, lighting and ground signals and essential aerodrome safety equipment;

(b) an understanding of the aerodrome information included in AIP;

(c) the ability to carry out a serviceability inspection of the aerodrome;

(d) a knowledge of the aerodrome emergency procedures; and

(e) a knowledge of the NOTAM system and the ability to carry out aerodrome reporting procedures.

10.6.3 What to Report

10.6.3.1 Aerodrome operators must advise the AIS Office of the following occurrences:

(a) changes (temporary or permanent) in the published runway information including further changes to information contained in current permanent NOTAMs;

(b) aerodrome works affecting runways or the obstacle limitation surfaces, including time-limited works that require more than 10 minutes to restore normal safety standards;

(c) outage of aerodrome lighting or obstacle lighting beyond specified limits;

(d) temporary obstacles to aircraft operations;

(e) a significant increase in, or concentration of birds or animals on or near the aerodrome which is a danger to aircraft;

(f) changes in excess of 0.05% of the published gradient data;

(g) emergence of new obstacles;

(h) when a radio navigation aid owned by the aerodrome operator, or landing aid is unserviceable or returned to service;

(i) when an Aerodrome Frequency Response Unit (AFRU) owned by the aerodrome operator is unserviceable or returned to service; or

(j) any other event which affects the safety of aircraft using the aerodrome.

10.6.3.2 Reporting must be carried out as soon as possible after a reportable occurrence is observed, giving as much detail as is available. Where necessary, subsequent additional detail can be reported as it becomes available for further NOTAM to be issued. Where applicable, ATC must be advised of the unserviceability and the intention to initiate a NOTAM.

10.6.3.3 Aerodrome operators must provide as much notice as possible of aerodrome works which will affect airline schedules.

10.6.4 Monitoring Activities Outside Aerodrome

10.6.4.1 The reporting function must also include monitoring activities outside but in the vicinity of the aerodrome which may result in hazards to aircraft operations. This includes:

(a) developments which may become obstacles;

(b) land planning and use which may attract birds; and

(c) installation of lighting systems which may create confusion to pilots at night.

Section 10.7: Aerodrome Emergency Planning

10.7.1 Introduction

10.7.1.1 The aerodrome operator must 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.

10.7.1.2 Currency and adequacy of the AEP must be reviewed at least once every twelve months.

10.7.1.3 Emergency exercises must be carried out at least once every two years, commensurate with the size and scale of operations at the airport, unless the emergency plan was activated in a real emergency within the two-year period.

10.7.1.4 AEP must include organisational and procedural arrangements for responding to at least the following emergencies:

(a) aircraft crash;

(b) local standby and full emergency;

(c) bomb scare;

(d) disabled aircraft;

(e) hazardous material incident;

(f) fire and natural disaster; or

(g) medical emergency.

10.7.1.5 The AEP must clearly define the activation sequence including call out arrangements for Local Standby and Full Emergency. For instance, Local Standby does not require a response from off-aerodrome agencies whereas a Full Emergency does. The activation plan will detail the Action Required for each type of emergency.

10.7.1.6 The aerodrome operator must produce a grid map (or maps) of the aerodrome and its immediate vicinity, to include detailed location of primary and secondary access gates; this information to be made available to all responding agencies.

10.7.1.7 RCAA does not regulate AEP responding agencies and how they conduct their functions. It is the responsibility of the AEC to ensure that the level and availability of emergency equipment and services are adequate for the aerodrome.

10.7.1.8 At those aerodromes located near water, the AEP must include as far as practicable, arrangements for water rescue.

> **Note:** See Section 10.8 for content guidelines for AEP.

10.7.2 Records

10.7.2.1 Records of reviews and exercises including real emergencies must be kept and retained for at least 3 years.

10.7.3 Disabled Aircraft Removal

10.7.3.1 The Disabled Aircraft Removal Plan (DARP) must include a list of equipment and personnel that would be available for timely aircraft recovery and removal.

10.7.3.2 The Plan must identify a coordinator designated to implement the DARP, when necessary.

10.7.3.3 The Plan must be based on the characteristics of the aircraft that may normally be expected to operate at the aerodrome.

Section 10.8: Guidelines for Aerodrome Emergency Plans

10.8.1 General

10.8.1.1 Aerodrome emergency planning is the process of preparing an aerodrome to cope with an emergency occurring at the aerodrome or in its vicinity. The objective of the planning is to ensure a timely and effective response to an emergency, particularly in respect of saving lives and maintaining aircraft operations.

10.8.1.2 Examples of aerodrome emergencies are: crash (aircraft accident), bomb scare, disabled aircraft, spillage of hazardous material, fire and natural disaster.

10.8.1.3 The aerodrome emergency plan should be commensurate with the scale and type of aircraft operations, the surrounding geography and other activities conducted at the aerodrome. With the assistance of the Aerodrome Emergency Committee, the aerodrome licence holder should plan for the worse type of emergency situations that might conceivably occur with respect to size, location, timing and weather.

10.8.1.4 Examples of agencies that could be of assistance in responding to aerodrome emergencies are:

(a) on-aerodrome agencies: air traffic services units, rescue and firefighting units, airport administration, aircraft operators, security services; and

(b) off-aerodrome agencies: fire brigades, police, medical and ambulance services, hospitals, defence forces, the Ministry Infrastructure’s Aviation Accident and Incident Investigation Division (AAID), State emergency services, transport authorities, volunteer rescue services, welfare agencies, Government authorities (Customs, Health, Immigration, etc.), maritime services and refuelling agents.

10.8.1.4A Where a rescue and firefighting service (RFFS) is established at an aerodrome, the aerodrome operator and the rescue and firefighting service provider must work together to ensure that they achieve the required outcome.

10.8.1.5 The off-aerodrome responding agencies will have been established to deal with most, if not all, emergency situations occurring in the community. Therefore the aerodrome emergency procedures should have the highest degree of similarity with the procedures used in the community generally.

10.8.1.6 The best understanding of the procedures is achieved through taking part in the planning process and the most workable procedures are the ones derived by those who have to carry them out. Therefore in the development of the procedures, licence holders should seek the maximum possible involvement of responding agencies and obtain their endorsement of the procedures so developed.

10.8.2 Medical Subcommittee

10.8.2.1 On larger aerodromes it is usual to delegate the preparation of the medical plan to a sub-committee. When established, the medical sub-committee should:

(a) plan the deployment of medical personnel called to an aircraft emergency;

(b) develop procedures for triage, emergency treatment and movement of casualties; and

(c) nominate a co-ordinator of crash site medical resources.

10.8.3 Testing Facilities and Reviewing Roles

10.8.3.1 Facilities used in the responses by the various agencies including communications systems should be tested at intervals not exceeding one year.

10.8.3.2 Individual participants in the aerodrome emergency plan should be encouraged to continuously review their roles (for example on a particular day each month) to ensure that they know their responsibilities and that all the information in the plan is current. It is important that all personnel who may be required to act in an emergency should develop the correct mental attitude to aerodrome emergency planning. To that end and in spite of their self-evident nature, it is worthwhile noting that the salient lessons to be gained from those who have experienced an airport emergency are that:

(a) people do best in an emergency what they have been trained to do;

(b) emergencies happen with little or no warning; and

(c) emergencies happen to anybody.

10.8.4 Aerodrome Emergency Exercises

10.8.4.1 The minimum frequency of full-scale aerodrome emergency exercises of two years has been set after considering international practice and the cost of mounting such exercises. However, such exercises should be held annually.

10.8.4.2 Speciality emergency exercises aimed at testing and reviewing the response of individual responding agencies, such as rescue and firefighting services, as well as parts of the emergency plan, such as the communications system, should be held at more frequent intervals than the full-scale exercise.

10.8.4.3 Aerodrome licence holders should conduct ‘table-top’ exercises involving the Aerodrome Emergency Committee annually or whenever there is a change of major participants, provided such exercises do not conflict with the full-scale or speciality exercises.

10.8.4.4 Experience to be gained from exercises should be shared by inviting other aerodrome licence holders to attend as observers. Operators of major aerodromes should notify the relevant pilot and cabin attendant staff associations of each planned emergency exercise to enable representatives of those organisations to observe the exercise and participate in the review should they so desire.

10.8.5 Emergency Operations Centre and Mobile Command Post

10.8.5.1 A fixed emergency operations centre and a forward mobile command post should be available for use in an emergency. The fixed emergency operations centre should be a part of the aerodrome facilities and be used to co-ordinate and direct the overall response to the emergency. The location of the emergency operations centre should be clearly identified in the plan. The forward mobile command post should be an easily recognisable structure capable of being moved rapidly to the scene of an emergency, when required, and should be used to control the on-scene agencies responding to the emergency.

10.8.5.2 The aerodrome emergency plan should clearly set out the discrete roles of the emergency operations centre and the forward command post, highlighting the physical location of the police co-ordinator.

10.8.6 Definitions of Command, Control, and Coordination

10.8.6.1 **Command.** ‘Command’ is the direction of members and resources of an organisation in the performance of the organisation’s role and tasks. Authority to command is established in legislation or by agreement with an organisation. Command relates to organisations and operates vertically within organisations.

10.8.6.2 **Control.** ‘Control’ is the overall direction of activities. Authority for control is established in legislation or in an emergency plan and carries with it the responsibility for tasking and co-ordinating other organisations in accordance with the needs of the situation. In this context, tasking means telling people what to do, but not how to do it. Control relates to situations and operates horizontally across organisations.

10.8.6.3 **Coordination.** ‘Coordination’ is the bringing together of organisations and elements to ensure effective counter-emergency responses, and is primarily concerned with the systematic acquisition and application of resources (organisation, manpower and equipment) in accordance with the requirements imposed by the threat or impact of an emergency. Co-ordination relates primarily to resources and operates:

(a) vertically within an organisation as a function of the authority to command; and

(b) horizontally across organisations as a function of the authority to control.

10.8.7 Role of the Police

10.8.7.1 The person who initially assumes co-ordination of the situation should hand over the role when police arrive.

10.8.7.2 The police represent the Coroner at a crash site and may be authorised to direct the custody, transport and storage of deceased persons. The Coroner is responsible for determining cause of death and in the case of aviation casualties draws on the specialised skills of the RCAA Flight Operations and Personnel Licensing Offices and the AAID.

10.8.7.3 The police are required to account for all people on board a crashed aircraft. In discharging this function it will normally be necessary to secure the crash site area and impose control over persons entering and leaving the site.

10.8.7.4 The police may also be given the responsibility of guarding any aircraft wreckage on behalf of AAID.

Section 10.9: Control of Airside Access Including Vehicle Control

10.9.1 Introduction

10.9.1.1 Particulars of the procedures for preventing unauthorised entry into the movement area, including the arrangements for controlling airside access, and airside vehicle control, are to be included in the aerodrome manual.

10.9.1.2 At aerodromes catering for air transport operations by aircraft of more than 30 passenger seats, a fence or other suitable barrier must be provided where practicable, around the movement area of the aerodrome.

10.9.2 Airside Vehicle Control

10.9.2.1 Vehicles and ground equipment operated airside must be maintained in a sound mechanical and roadworthy condition, so as to prevent avoidable breakdowns and spillage of fuels, lubricants and hydraulic fluids.

10.9.2.2 In the case of major capital city aerodromes, or aerodromes with significant levels of vehicular traffic, the aerodrome operator must introduce and maintain a permit system for airside operations approval.

10.9.2.3 In the case of major capital city aerodromes, or aerodromes with significant levels of vehicular traffic, the aerodrome operator must establish speed limits for vehicles on the movement area and a regime to enforce them.

10.9.2.4 Vehicles must not be driven under an aircraft or within 3 m of any part of an aircraft except when required for the servicing of aircraft.

10.9.2.5 Vehicles operating on the manoeuvring area by day must be marked in accordance with paragraph 8.10.4.

10.9.2.6 Vehicles operating on the movement area must:

(a) be lit with vehicle warning lights in accordance with paragraph 9.19.1, unless accompanied by a vehicle that is so equipped; and

(b) display dipped headlights at night or in conditions of poor visibility.

10.9.2.7 Aircraft servicing equipment used only on aprons need not comply with paragraph 10.9.2.6. In this case, equipment is deemed to be mobile objects that do not have their own motive power.

10.9.3 Airside drivers

10.9.3.1 Drivers operating vehicles on the airside must be trained and competent to do so.

10.9.3.2 Any person operating vehicles and ground equipment, must:

(a) hold an appropriate licence to operate,

(b) know the terminology used to describe, and be familiar with airside areas,

(c) understand the significance of aerodrome signs and markings, and

(d) where appropriate, be competent in the use of radio communications equipment, and understand radio instructions.

Section 10.10: Aerodrome Works Safety

10.10.1 Introduction

10.10.1.1 The operator of a certified aerodrome must arrange aerodrome works so as not to create any hazard to aircraft or confusion to pilots. The aerodrome manual must include particulars of the procedures for planning and safely carrying out aerodrome works.

10.10.1.2 Aerodrome works may be carried out without the closure of the aerodrome, provided safety precautions are adhered to.

10.10.1.3 Aerodrome works may be carried out in the following manner:

(a) where the works are of a nature that they will disrupt aircraft operations, they must be carried out under a proper plan called the method of working plan; and

(b) where works are of a maintenance nature they must be carried out as time-limited works.

10.10.1.4 Where a threshold is required to be temporarily displaced for more than 300 m, due to aerodrome works, the matter must be referred to the relevant RCAA office to assess the operational significance of that displacement.

10.10.2 Method of Working Plans

10.10.2.1 At an aerodrome used by aircraft of more than 5,700 kg maximum take-off weight, unless the aerodrome is closed during aerodrome works, or the work is of an emergency nature, the aerodrome operator must not carry out aerodrome works, other than time-limited works, without a Method of Working Plan (MOWP) prepared for those works.

10.10.2.2 The MOWP must set out the arrangements for carrying out those works.

10.10.2.3 An MOWP must be prepared in accordance with Section 10.11 to this Chapter.

10.10.2.4 When preparing a MOWP, an aerodrome operator must consult:

(a) commercial air transport operators using the aerodrome;

(b) Air Traffic Control; and

(c) if the MOWP may affect its operations, the Rescue and Fire Fighting Service unit at the aerodrome;

so as to ensure the safety of aircraft operations at the aerodrome.

10.10.2.5 The aerodrome operator must give a copy of the MOWP, and any alteration thereof, to the relevant RCAA aerodrome inspector, as soon as possible after the Plan is prepared or altered.

10.10.2.6 Aerodrome works, for which a MOWP is required, must be carried out in accordance with the arrangements set out in the MOWP and any subsequent alteration.

10.10.2.7 An MOWP is not required, if the aerodrome operator closes the aerodrome to aircraft operations while aerodrome works are being carried out. RCAA aerodrome inspectors, commercial air transport operators and all organisations and persons likely to be affected by the closure, must be given reasonable notice of intention to close the aerodrome.

10.10.2.8 The operator must not close the aerodrome to aircraft operations due to aerodrome works, unless a NOTAM giving notice of the closure has been issued not less than 14 days before closure takes place.

10.10.2.9 An MOWP is not required for emergency aerodrome works carried out to repair unforeseen damage to part of the manoeuvring area, or to remove an obstacle, or if the works do not require any restrictions to aircraft operations. Where practicable, a NOTAM, giving the time and date of the commencement of the works must be issued, as early as possible, but preferably not less than 48 hours before commencement of the works.

10.10.3 Time-Limited Works

10.10.3.1 Aerodrome works may be carried out as time-limited works if normal aircraft operations are not disrupted, the movement area can be restored to normal safety standards and any obstacle created by those works removed in not more than 30 minutes.

10.10.3.2 Time-limited works include the following works:

(a) maintenance of markings and lights;

(b) grass mowing;

(c) rolling surfaces;

(d) sweeping pavements;

(e) minor repairs to pavements; and

(f) surveys and inspections.

10.10.3.3 A person must not commence time-limited works that require more than 10 minutes to restore normal safety standards to the movement area and remove obstacles, unless a NOTAM has been issued not less than 24 hours before the commencement, giving the date and time of commencement and the time required to restore normal safety standards.

10.10.4 Restrictions on Carrying Out Time-Limited Works

10.10.4.1 Subject to paragraph 10.10.4.2 time-limited works must not be carried out at night or if visibility is less than 5 kilometres.

10.10.4.2 Paragraph 10.10.4.1 does not apply at a controlled aerodrome or in other cases if the area can be restored to the required safety standards so as to allow aircraft operations to take place without delay.

10.10.5 Restoration of Normal Safety Standards

10.10.5.1 Time-limited works must be stopped and normal safety standards restored, when required to allow an aircraft operation to take place.

10.10.5.2 All reasonable measures must be taken to complete the restoration of normal safety standards not less than 5 minutes before the scheduled or notified time of an aircraft operation.

10.10.6 Resumption of Aerodrome Works

10.10.6.1 At an uncontrolled aerodrome, works that have been stopped to allow the restoration of normal safety standards may be resumed:

(a) if stopped for an aircraft arrival, immediately after the arrival, if the safety of the aircraft is not endangered by the resumption; or

(b) if stopped for an aircraft departure, 15 minutes after the departure has taken place; or

(c) if stopped for an aircraft arrival that does not take place; 30 minutes after the time scheduled or notified for the arrival (when a new ETA is established).

10.10.6.2 At a controlled aerodrome, Air Traffic Control may, at the request of the aerodrome operator, vary the time limits set out in paragraph 10.10.6.1 for restoring normal safety standards or resuming aerodrome works. A variation under this paragraph is subject to such conditions as Air Traffic Control may impose.

10.10.7 Management and Control of Aerodrome Works

10.10.7.1 An aerodrome operator must ensure that aerodrome works are carried out in accordance with the standards in this Chapter.

10.10.7.2 An aerodrome operator must appoint a person in writing as a works safety officer for the purpose of ensuring the safe conduct of aerodrome works.

10.10.7.3 Before appointing a person as a works safety officer, the aerodrome operator must be satisfied that the person is able to perform the functions of a works safety officer set out in Section 10.12.

10.10.7.4 A works safety officer must be present at all times if aerodrome works are being carried out and the aerodrome is open to aircraft operations.

10.10.7.4A For time-limited works, a dedicated works safety officer is not required if one of the persons carrying out the time-limited work has been trained to perform the function of the works safety officer.

10.10.7.5 An aerodrome operator must take all reasonable measures to ensure that the works organisation carries out aerodrome works in a manner that will ensure the safety of aircraft operations.

10.10.7.6 Persons, vehicles, plant and equipment required for carrying out aerodrome works, must not be permitted to enter the movement area or remain on it, except for the purpose of carrying out those works.

10.10.7.7 Procedures for entering works areas must be stated in the MOWP.

10.10.7.8 The operator must allow access to works areas only along routes shown in the MOWP.

10.10.8 Markers, Markings and Lights

10.10.8.1 Aerodrome markers, markings and lights required for, or affected by, aerodrome works must be installed, altered or removed in accordance with the appropriate standards.

10.10.8.2 Parts of the movement area that are unserviceable as a result of aerodrome works being carried out must be marked and lit in accordance with the appropriate standards.

10.10.8.3 All obstacles created as a result of aerodrome works being carried out must be marked and lit in accordance the appropriate standards in Chapter 8.

10.10.8.4 Vehicles and plant used in carrying out aerodrome works must be marked in accordance with paragraph 8.10.4.

10.10.8.5 In addition to paragraph 10.10.8.4 requirements, vehicles and plant used in carrying out aerodrome works at night must be lit in accordance with paragraph 9.19.1.

10.10.9 Communication Equipment

10.10.9.1 At a controlled aerodrome, a vehicle used by a works safety officer while supervising aerodrome works must be equipped with a radio for two-way communication with Air Traffic Control.

10.10.9.2 For the purpose of communication with Air Traffic Control, each vehicle used by a works safety officer must be given a call sign.

10.10.9.3 Any vehicle or plant that is not:

(a) marked or lit in accordance with Paragraph 10.10.8; or

(b) if applicable, equipped with a two-way radio;

may only be used in carrying out aerodrome works if it is:

(i) used under the direct supervision of the works safety officer; or

(ii) used only within the limits of appropriately marked and lit works areas.

10.10.10 Completion

10.10.10.1 On the completion of aerodrome works and the restoration of normal safety standards to the movement area, the aerodrome operator must cancel any NOTAM issued to advise of those works.

10.10.11 Pavement Overlay Works

10.10.11.1 At the end of an overlay work session, when the runway is to be returned to an operational status, the new and old runway surfaces must not be left with an abrupt vertical surface of more than 25 mm. This will normally require the provision of a temporary ramp between the new and the old surfaces.

10.10.11.2 The longitudinal slope of the temporary ramp described in paragraph 10.10.11.1, measured with reference to the existing runway surface or previous overlay course, must 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.

10.10.11.3 Where practicable, the direction of pavement overlay must proceed from one end of the runway toward the other end so that based on runway utilisation most aircraft operations will experience a down ramp.

10.10.11.4 Where practicable, the entire width of the runway must be overlaid during each work session. Where the entire width of the runway cannot be overlaid during a work session, then at least the central two-third width of the runway is to be overlaid. In this case, a temporary transverse ramp of between 0.8 and 1.0 per cent must be provided between the edge of the new overlay surface and the existing runway surface or previous overlay course; when the difference in level exceeds 25 mm.

10.10.11.5 Before a runway being overlaid is returned to a temporary operational status, a runway centreline marking conforming to the specifications in Chapter 8, Section 8.3, Subsection 8.3.3 must be provided.

10.10.12 Works on Runway Strips

10.10.12.1 Works on runway strips must be carried out in the shortest possible time, and where undertaken within 23 m of the edge of the runway or runway shoulder:

(a) works must only be undertaken on one side of the runway at any one time;

(b) the works area at any one time must not exceed 9 square metres, except for machine cut trenches, not exceeding a width of 100 mm and length of 280 m;

(c) materials such as gravel, signs and lights, etc left within this part of the runway strip, must not exceed one metre in height above ground. Any material likely to be affected by propeller wash or jet blast, must be removed; and

(d) plant and vehicles must vacate this area when the runway is in use.

10.10.12.2 Where works are undertaken on a runway strip between 23 m from the edge of the runway or runway shoulder and the edge of the graded runway strip, similar restriction must be applied within this area of the runway strip, as for paragraph 10.10.12.1 above, except that the works area may extend up to an area of 18 square metres at any one time, and the height of materials may extend up to two metres.

10.10.12.3 Where works are to be undertaken in the vicinity of navigational or landing aids located within the runway strips, care must be taken to ensure that neither the works nor vehicles or plant associated with the works, may affect the performance of the aids.

Section 10.11: Method of Working Plans

10.11.1 Introduction

10.11.1.1 The MOWP must be presented in sections in the following sequence:

(a) title page

(b) works information

(c) restrictions to aircraft operations

(d) restrictions to works organisation

(e) administration

(f) authority

(g) drawings

(h) distribution list.

10.11.2 Title Page

10.11.2.1 Each MOWP must be given a reference number, consisting of the code used to identify the aerodrome in the AIP, the last two digits of the year and the number given to the MOWP by the aerodrome operator.

10.11.2.2 MOWPs issued in relation to the same aerodrome must be numbered consecutively in the order of their issue.

10.11.2.3 The MOWP number, the date of issue, and the date and number of any amendment are to be set out in the top right hand corner of the title page.

10.11.2.4 The title must indicate the location of the work and give a short description of the project, for instance "[name of aerodrome]: runway 07/25 repairs".

10.11.2.5 The date of approval of the MOWP, the date of commencement and the date of expiry of the MOWP, and the date of completion of the works are to be set out on the title page.

10.11.2.6 The title page must include a list of the sections of the MOWP.

10.11.3 Works Information

10.11.3.1 The MOWP must:

(a) include an outline of the full scope of the works and state which aerodrome facilities are affected.

(b) provide the planned date and time of commencement, the duration of each stage and the time of completion.

(c) contain the following sentence:

"The actual date and time of commencement will be advised by a NOTAM, to be issued not less than 48 hours before work commences".

10.11.4 Restrictions to Aircraft Operations and Issue of NOTAMs

10.11.4.1 This section of the MOWP must be in a form that allows its separate issue to aircraft operators and permits those operators to have easy reference to the information as it affects them.

10.11.4.2 This section of the MOWP must state each restriction and each aircraft type affected by that restriction.

10.11.5 Work Stages

10.11.5.1 Any restrictions to aircraft operations on the manoeuvring area, or in the approach and take-off areas must be listed and shown on drawings of each stage of the works.

10.11.5.2 When complex works are being undertaken, a table showing the restrictions applicable to each stage of the works and for each type of aircraft operation must be included.

10.11.5.3 The table must outline the various work stages with start and completion dates and have a remarks column to list details of special restrictions and the issue of NOTAMs for the information of a pilot before a flight.

10.11.6 Emergencies and Adverse Weather

10.11.6.1 The MOWP must outline details, if any, of special arrangements to be made during works if emergencies or adverse weather conditions occur.

10.11.7 NOTAMs

10.11.7.1 The full text of all planned NOTAMs associated with the aerodrome works must be included.

10.11.8 Restrictions to Works Organisations

10.11.8.1 The MOWP must provide any restrictions on the organisation carrying out of aerodrome works and requirements for the restoration of normal safety standards.

10.11.9 Personnel and Equipment

10.11.9.1 When personnel and equipment are required to vacate the movement area for certain operations, specific mention of this fact must be made, e.g. “All personnel and equipment will clear runway strip 11/29 for air transport operations”.

10.11.10 Access

10.11.10.1 The MOWP must identify the routes to and from the works area and the procedures for entering the works areas within the movement area.

10.11.10.2 Particulars of routes to and from the works area must be shown in drawings attached to the MOWP.

10.11.11 Aerodrome Markers, Markings and Lights

10.11.11.1 Details of arrangements for the installation, alteration and removal of aerodrome markers, markings and lights in the work areas and other areas affected by the aerodrome works must be shown in drawings attached to the MOWP.

10.11.12 Protection of Electrical Services

10.11.12.1 The MOWP must set out procedures for ensuring that electrical services and control cables are not damaged.

10.11.13 Special Requirements

10.11.13.1 The MOWP must provide details of any special requirements arising during or on completion of aerodrome works, for example, arrangements for leaving pavement surfaces swept and clean before evacuation of the works area.

10.11.14 Administration

10.11.14.1 The MOWP must provide the name of the project manager appointed by the aerodrome operator and the means of contact, including the means outside normal working hours.

10.11.14.2 The MOWP must provide the names of the works safety officer or officers appointed by the aerodrome operator and the means of contact, including the means outside normal working hours.

10.11.14.3 The MOWP must provide the name of the works organiser (where appropriate) and the means of contact, including the means outside working hours.

10.11.15 Authority

10.11.15.1 Each MOWP must contain the following statement: “All works will be carried out in accordance with the MOWP”.

10.11.15.2 Each MOWP must set out its expiry date, and any alteration of that date.

10.11.15.3 Each MOWP must be signed, immediately after paragraph 10.11.15 (this paragraph), by the aerodrome operator or the project manager.

10.11.16 Drawings

10.11.16.1 Drawings must be attached, which provide a visual reference for each stage of the works. The drawings must contain specific details such as works area, restrictions to aircraft, location of radio navigational aids, exact location of visual ground aids and markings, details of the height and location of critical obstacles, location of temporary taxiways, access routes, storage areas for material and equipment, and the location of electrical services and control cables which may be disturbed during the works.

10.11.17 Distribution List

10.11.17.1 The distribution list of the MOWP must include at least the following persons and organisations:

(a) the project manager,

(b) the works safety officer;

(c) the aerodrome security manager, if any;

(d) the works organiser;

(e) the RCAA aerodrome inspector;

(f) ATC and the Rescue and Fire Fighting Service Unit for the aerodrome;

(g) the air transport aircraft operators using the aerodrome at which the aerodrome works are to be carried out; and

(h) fixed-base operators using the aerodrome at which the aerodrome works are to be carried out.

Section 10.12: Functions of a Works Safety Officer

10.12.1 Works Safety Officer

10.12.1.1 The Works Safety Officer performs the following responsibilities.

(a) Ensure the safety of aircraft operations in accordance with the standards for aerodrome works and the applicable MOWP;

(b) Ensure that, where applicable, the aerodrome works are notified by issue of a NOTAM and that the text of each NOTAM is exactly as set out in the applicable MOWP;

(c) Supply the air-traffic controller, on a daily basis, with whatever information is necessary to ensure the safety of aircraft operations;

(d) Discuss with the works organisation, on a daily basis, any matters necessary to ensure the safety of aircraft operations;

(e) Ensure that unserviceable portions of the movement area, temporary obstructions, and the limits of the works area are correctly marked and lit in accordance with Paragraph 10.10.8, and the applicable MOWP;

(f) Ensure that the vehicles, plant and equipment carrying out aerodrome works are properly marked and lit or are under works safety officer supervision or within properly marked and lit works area;

(g) Ensure that all other requirements of the directions and MOWP relating to vehicles, plant, equipment and materials are complied with;

(h) Ensure that access routes to work areas are in accordance with the applicable MOWP and clearly identified and that access is restricted to these routes;

(i) Ensure that excavation is carried out in accordance with the MOWP and, in particular, so as to avoid damage or loss of calibration to any underground power or control cable associated with a precision approach and landing system or any other navigational aid;

(j) Report immediately to the air-traffic controller and the aerodrome operator any incident, or damage to facilities, likely to affect air-traffic control services or the safety of aircraft;

(k) Remain on duty at the works area while work is in progress and the aerodrome is open to aircraft operations;

(l) Ensure that the air-traffic controller is kept informed of the radio call signs of the vehicles used by the works safety officer;

(m) Require the immediate removal of vehicles, plant and personnel from the movement area where necessary to ensure the safety of aircraft operations;

(n) Ensure that the movement area is safe for normal aircraft operations following removal of vehicles, plant, equipment and personnel from the works area;

(o) In the case of time-limited works, ensure that the works area is restored to normal safety standards not less than 5 minutes before the time scheduled or notified for an aircraft movement; and

(p) Ensure that floodlighting or any other lighting required for carrying out aerodrome works is shielded so as not to represent a hazard to aircraft operations.

Section 10.13: Aircraft Parking

10.13.1 Introduction

10.13.1.1 This Section is applicable only at aerodromes where apron congestion is a problem.

10.13.1.2 The aerodrome operator must include in the aerodrome manual particulars of the procedures for aircraft parking control, on those aprons, to ensure the safety of aircraft during ground manoeuvring.

10.13.2 Apron Congestion

10.13.2.1 Appropriate apron safety procedures must be developed by the aerodrome operator in conjunction with relevant organisations such as the airlines, ground handlers and caterers; and monitored for compliance, on a regular basis. Written agreements and contracts are useful components of congestion mitigation measures.

10.13.3 Apron Safety Management

10.13.3.1 Aerodrome operators must ensure that, irrespective of who is responsible for aircraft parking, procedures are in place and documented for aircraft docking, ground servicing, engine start and push back operations.

10.13.3.2 Apron safety management procedures must:

(a) ensure that people involved are appropriately trained and experienced; and

(b) ensure that people engaged in these activities are provided with appropriate equipment such as communications, high visibility garments and fire extinguishing equipment suitable for at least initial intervention in the event of a fuel fire.

> **Note:** Advice is given in the USA National Fire Protection Association (NFPA) standards on the requirements for fire extinguishers at aircraft parking positions. The NFPA web page is: http://www.nfpa.org/catalog/home/index.asp.

10.13.3.3 If apron operational activities are undertaken by organisation(s) other than the aerodrome operator, then the aerodrome operator must ensure the apron safety management procedures are followed.

Section 10.14: Bird and Animal Hazard Management

10.14.1 Introduction

10.14.1.1 The aerodrome operator must monitor and record, on a regular basis, the presence of birds or animals on or in the vicinity of the aerodrome. Monitoring personnel must be suitably trained for this purpose.

10.14.1.2 Where regular monitoring confirms existence of a bird or animal hazard to aircraft operations, or when RCAA so directs, the aerodrome operator must produce a bird or animal hazard management plan, which would be included as part of the Aerodrome Manual.

10.14.1.3 The management plan must be prepared by a suitably qualified person such as an ornithologist or a biologist, etc.

10.14.1.4 The management plan must address:

(a) hazard assessment, including monitoring action and analysis;

(b) pilot notification;

(c) liaison and working relationships with land use planning authorities;

(d) on-airport bird and animal attractors which provide food, water or shelter;

(e) suitable harassment methods; and

(f) an ongoing strategy for bird and animal hazard reduction, including provision of appropriate fencing.

10.14.1.5 The bird and animal hazard management plan must be reviewed for effectiveness, on a regular basis, at least as part of each technical inspection.

10.14.1.6 Where the presence of birds or animals is assessed as constituting an ongoing hazard to aircraft, the aerodrome operator must notify the AIS in writing, to include an appropriate warning notice in the AIP.

10.14.1.7 Where a bird or animal hazard is assessed as acute, of short term or seasonal nature, additional warning must be given to pilots by NOTAM.

> **Note:** Aerodrome operators are encouraged to provide bird strike incident information to the AAID.

Section 10.15: Pavement Maintenance

10.15.1 Pavement Cleanliness

10.15.1.1 All paved runway, taxiway and apron surfaces must be kept clear of foreign objects or debris that may cause damage to aircraft.

10.15.1.2 All runways, taxiways and apron pavement used by air transport jet aircraft with reference code numbers 3 or 4, must be cleaned of foreign objects on a regular basis.

10.15.2 Runway Surface Friction

10.15.2.1 The aerodrome operator must maintain runways with sealed, asphalt or concrete surfaces, in accordance with the surface texture standards specified in Chapter 6.

10.15.2.2 The Aerodrome Technical Inspection of runway surfaces must confirm that the texture standard is being met.

> **Note:** RCAA may require testing of part or whole of the runway surface to validate the technical inspection report, including use of continuous friction measuring equipment.

10.15.2.3 From January 2006, designated international aerodromes with runways serving code 4 jet aeroplanes, conducting international air transport operations, will be required to use an ICAO accepted continuous friction measuring device with self-wetting features to measure the friction level of the runway.

10.15.2.4 Runways must be evaluated when first constructed or after resurfacing to determine the wet runway surface friction characteristics.

10.15.2.5 Friction measurements must be taken at intervals that will ensure identification of runways in need of maintenance or special surface treatment before the surface conditions deteriorate further. The time interval between measurements will depend on factors such as: aircraft type and frequency of usage, climatic conditions, pavement type, and maintenance requirements.

10.15.2.6 When conducting friction tests on wet runways there is a drop in friction with an increase in speed. However, as the speed increases, the rate at which the friction is reduced becomes less. The macro texture of the surface affects the relationship between friction and speed. Therefore a speed high enough to reveal these friction/speed variations should be used. It is desirable, but not mandatory, to test the friction characteristics of a paved runway at more than one speed.

10.15.2.7 The results of measurements will be used as follows:

(a) to verify the friction characteristics of new or resurfaced sealed, asphalt or concrete surfaced runways, using the *Design objective for new surface* values in Table 10.15-1.

(b) if the measured friction level falls below the relevant *Maintenance planning level* values in Table 10.15-1, the aerodrome operator must initiate appropriate corrective maintenance action to improve the friction.

(c) if the measured friction level falls below the relevant *Minimum friction level* values in Table 10.15-1, the aerodrome operator must promulgate by NOTAM, that the runway pavement falls below minimum friction level when wet. Additionally, corrective maintenance action must be taken without delay. This requirement applies when friction characteristics for either the entire runway or a portion thereof are below the minimum friction level.

Table 10.15-1: Friction Values for Continuous Friction Measuring Devices

Test Equipment	Test Tyre Tyre Pressure (kPa)	Test Speed (km/h)	Test Water Depth (mm)	Design Objective for New Surface	Maintenance Planning Level	Minimum Friction Level
Mu-meter trailer	A 70 A 70	65 95	1.0 1.0	0.72 0.66	0.52 0.38	0.42 0.26
Skiddometer trailer	B 210 B 210	65 95	1.0 1.0	0.82 0.74	0.60 0.47	0.50 0.34
Surface friction tester vehicle	B 210 B 210	65 95	1.0 1.0	0.82 0.74	0.60 0.47	0.50 0.34
Runway friction tester vehicle	B 210 B 210	65 95	1.0 1.0	0.82 0.74	0.60 0.54	0.50 0.41
TATRA friction tester vehicle	B 210 B 210	65 95	1.0 1.0	0.76 0.67	0.57 0.52	0.48 0.42
GRIPTESTER trailer	C 140 C 140	65 95	1.0 1.0	0.74 0.64	0.53 0.36	0.43 0.24

10.15.3 Deterioration of Runway Grooves

10.15.3.1 When a runway pavement surface has been grooved, the aerodrome operator should periodically check the condition of the runway grooves in accordance with the US Federal Aviation Administration (FAA) advice set out in the FAA Advisory Circular AC 150/5320-12C. The Advisory Circular states that when 40 per cent of the grooves in the runway are equal to or less than 3mm in depth and/or width for a distance of 457m, the effectiveness of the grooves for preventing hydroplaning will have been considerably reduced. The aerodrome operator should take immediate corrective action to reinstate the 6 mm groove depth and/or width.

10.15.4 Surface Irregularities

10.15.4.1 Aerodrome operators must maintain the surface of paved runways in a condition such as to preclude excessive bouncing, pitching, vibration or other difficulties with control of aircraft.

> **Note:** Reports of actual aircraft performance will be used to determine compliance.

10.15.4.2 Paved runway surfaces should be maintained so that standing water is neither formed nor retained. Birdbath depressions should be repaired at the earliest opportunity.

10.15.5 Standards for Natural and Gravel Surface Runways

10.15.5.1 Surface standards for natural and gravel surface runways and runway strips are the same as those set out in Table 6.2-4A. However, the runway surface must not have irregularities which would adversely affect the take-off or landing of an aircraft.

> **Note:** A rough surface, in combination with a soft, wet surface, is particularly hazardous for aircraft operations.

Section 10.16: Maintenance Around Navigational Aids

10.16.1 Introduction

10.16.1.1 Aerodrome operators must document procedures for the maintenance of the areas around navigation aids serving the aerodrome. This would include navigational aids located on or off the aerodrome, either owned by the aerodrome operator or by other service providers.

10.16.1.2 The arrangements for ground maintenance around these installations must include details of consultation with the telecommunication service provider to avoid interference with operation of the aid.

10.16.1.3 Ground maintenance carried out around navigational aids must be in accordance with the agreement with the telecommunications service provider.

10.16.1.4 If there is no agreed specification with the telecommunications service provider, ground maintenance around new facilities is to be in accordance with manufacturers instructions, and for pre-existing facilities where manufacturers instructions are not available, in accordance with the following:

(a) elimination of grass at the base of towers, fence lines and foundation of buildings, for a distance of 500 mm;

(b) fenced areas to be kept free of grass, shrubs or other growth exceeding 300 mm in height; and

(c) within fenced areas, or at unfenced sites within the aerodrome boundary:

(i) VOR installations, the height of grass within a radius of 150 m from the antenna is not to exceed 600 mm;

(ii) ILS localiser with a 7-element antenna, the height of grass in the area of 90 m radius behind the antenna and the area 180 m by 90 m wide in front of the antenna is not to exceed 150 mm;

(iii) ILS localiser with a 12-element antenna, the height of grass in the rectangular area extending to 90 m either side of the antenna and from 30 m behind to 300 m in front of the antenna (or to the runway end if closer) is not to exceed 150 mm;

(iv) NDB or DME installations, the height of grass over the area covering the tower(s), the earth mat, buildings, and access road, together with a 5 m margin, is not to exceed 150 mm;

(d) The maintained areas described above must not be otherwise used or treated, for example by ploughing or cropping.

10.16.1.5 Ground maintenance procedures around navigational aids must include the provision and enforcement of appropriate signage.

Section 10.17: Aerodrome Safety Procedures during Conditions of Reduced Visibility or Low Cloud

10.17.1 Introduction

10.17.1.1 The operator of a controlled aerodrome must establish low visibility procedures (***LVP***) in accordance with paragraph 10.17.2.1 to ensure the safety of aircraft operations in conditions of reduced visibility or low cloud.

> **Note:** Aircraft operations at aerodromes during reduced visibility or low cloud conditions present additional hazards to the aircraft and to other aerodrome users. As visibility reduces, the ability of air traffic service staff, pilots, vehicle drivers and other personnel to identify hazards and to take remedial action in a timely manner becomes limited. In conditions of low cloud, the time available for the pilot of an approaching aircraft to assess the aerodrome environment visually is reduced.

10.17.2 Development of Low Visibility Procedures

10.17.2.1 LVP must:

(a) be the subject of proper consultation with any party likely to be affected by them, including ATC and aerodrome service providers; and

(b) take into account local conditions; and

(c) as a minimum, address the following matters:

(i) the specific circumstances in which LVP measures are to be initiated, fully implemented and terminated;

(ii) aerodrome procedures and facilities for supporting the desired movement rate;

(iii) training and authorisation for drivers and other personnel to work airside during the operation of low visibility procedures;

(iv) control of airside operations by means of vehicles or personnel;

(v) withdrawal of non-essential vehicles and personnel;

(vi) suspension of routine maintenance on visual and non-visual aids;

(vii) securing access and preventing inappropriate or inadvertent entry;

(viii) adequate provision for alerting airlines and other affected organisations;

(ix) coordination of procedures and activities with air traffic services;

(x) physical checking of lighting installations and warning devices such as signage;

(xi) protection of ILS critical and sensitive areas;

(xii) emergency procedures.

> **Note:** Further guidance on low visibility procedures and surface movement control under varying conditions can be found in the ICAO *Manual of Surface Movement Guidance and Control Systems* (SMGCS) [Doc 9476-AN/927].

10.17.3 Implementation of Low Visibility Procedures

10.17.3.1 When meteorological conditions are such that all or part of the manoeuvring area cannot be visually monitored from the control tower, the aerodrome operator must co-operate with ATC to initiate measures in accordance with the aerodrome's LVP.

10.17.3.2 The aerodrome operator must co-operate with ATC to ensure that LVP are fully implemented before:

(a) for approach operations — the earlier of the following:

(i) the reported cloud ceiling falls below the precision approach Category I decision height published in the AIP for the runway to be used;

(ii) the visibility falls below the precision approach Category I RVR minimum published in the AIP for the runway to be used; and

(b) for take-off operations — the reported visibility or RVR on the runway to be used falls below 550 m.

> **Notes:**
>
> 1. The point at which restrictions on aerodrome operations should be progressively introduced as the weather deteriorates will vary from aerodrome to aerodrome depending on local conditions. The point should relate to a specific RVR or RV measurement in a worsening weather situation and should be based on the rate of weather deterioration and the amount of lead time necessary to implement extra measures.
> 2. In order to continue unrestricted operations for as long as possible whilst weather conditions deteriorate, LVP should be designed to implement most of the ground-based measures in good time, and in certain circumstances before they are absolutely necessary. The final measures should be implemented only when the weather conditions demand it. However, there is potential for misunderstandings to occur as to the status of LVP at the aerodrome. Procedures should ensure that the potential for such misunderstandings is minimised and that there is a single point from which definitive information about the current status of LVPs can be confirmed.
> 3. ATC will inform pilots that LVP are in force, but only after:
>   (a) ATC has verified that all LVP measures at the aerodrome are in place; and
>   (b) for an aerodrome conducting instrument approach operations with minima less than precision approach Category I or localiser-guided take-offs — procedures are in place to safeguard ILS critical and sensitive areas, or ILS localiser critical and sensitive areas.
> 4. ATC will normally inform the aerodrome operator when LVP measures must be implemented.

10.17.3.3 The aerodrome operator must advise ATC when all aerodrome operator preparations relevant to LVP are complete.

10.17.4 Review of Low Visibility Procedures

10.17.4.1 Each aerodrome operator, in consultation and co-operation with local ATC and other persons or organisations involved in relevant LVP operations must regularly review the LVP to ensure their relevance and effectiveness.

Section 10.18: Aerodrome Technical Inspections

10.18.1 Introduction

10.18.1.1 Aerodrome technical inspections must be carried out in accordance with the requirements of the regulations.

10.18.1.2 Aerodrome technical inspections must be carried out at intervals of not more than 12 months and when required as a result of the findings of the aerodrome serviceability inspections.

10.18.1.3 Parts of an aerodrome technical inspection may be carried out at different times from the other parts. Each part of the technical inspection must be carried out at intervals of not more than 12 months.

10.18.1.4 The technical inspection should identify any shortcomings, or areas for improvement.

10.18.1.5 The technical inspection must include a plan(s) for corrective action.

10.18.1.6 RCAA audit activity will include follow-up on the progress achieved on previous reports and plans for corrective action.

Section 10.19: Runway Visibility Assessments by Ground Personnel

10.19.1 Application

10.19.1.1 An aerodrome operator may appoint a person (the ***appointed RV assessor)*** to conduct runway visibility (***RV***) assessments at the aerodrome in accordance with this section.

10.19.1.2 Appointment of an RV assessor must be made in writing and the name of each assessor holding an appointment must be included in the aerodrome manual.

10.19.1.3 The appointed RV assessor must:

(a) before and after appointment — satisfy each of the requirements mentioned in subsection 10.19.3; and

(b) follow the procedures set out in subsection 10.19.4.

10.19.2 Facilities and Procedures

10.19.2.1 For runway visibility assessments, the aerodrome operator must:

(a) establish a system for using visibility markers or counting runway lights (or both) for assessing runway visibility; and

(b) establish and mark fixed locations from which assessments are to be conducted; and

Note:	These locations should be near the threshold or midpoint of the runway, such as the taxiway holding position for the taxiway adjoining the runway threshold, or at a point adjacent to the runway threshold, from which the distance to visibility markers is known.

(c) if runway markers are to be used:

(i) locate visibility markers to be representative of the runway conditions; and

(ii) locate visibility markers within 10 degrees of the runway centreline; and

(iii) provide visibility markers that:

(A) consist of dark objects of suitable dimension or lights of moderate intensity; and

(B) meet the standards of section 8.6.5 for structural strength and frangibility; and

(d) (d) produce a visibility markers chart that includes:

(i) the visibility markers used to assess runway visibility, showing their distances in metres and bearings from the point of observation; and

(ii) the identification of the day and night visibility markers in their proper positions by means of the designated symbols listed on the chart; and

(iii) the clear identification of the point of observation; and

(e) if assessments are made by counting runway lights, produce a conversion chart based on the actual spacing of the runway lights; and

(f) include in the aerodrome manual:

(i) the specific procedures for the conduct of runway visibility assessments at the aerodrome; and

(ii) the names of persons authorised to conduct runway visibility assessments.

10.19.3 Appointed Persons Conducting Runway Visibility Assessments

10.19.3.1 An appointed RV assessor must, before appointment, and at all time after appointment, have the following attributes and qualifications:

(a) a distant visual acuity of 6/12 or better in each eye separately and 6/9 or better binocular (with or without correcting lenses);

(b) a certificate of proficiency in aeronautical radio telephony;

(c) the competence to operate on the manoeuvring area of the aerodrome;

(d) demonstrated competence in the following:

(i) identifying the location of each point of observation;

(ii) identifying the visibility markers for each point of observation;

(iii) identifying the relevant runway edge lights for making a runway visibility assessment;

(iv) using the conversion table and the visibility markers chart;

(v) reporting a runway visibility assessment.

10.19.4 Procedures for Conducting a Runway Visibility Assessment

10.19.4.1 Runway visibility assessments must be conducted without using any optical devices to enhance normal distance vision.

10.19.4.2 The appointed RV assessor conducting the runway visibility assessment must:

(a) make the assessment from a nominated observation point; and

(b) carry out the observation by:

(i) establishing the farthest visible runway edge lights or visibility markers that can be seen and identified; and

(ii) determining the distance, in metres to the nearest 50 m increment, using the conversion table or the visibility markers chart; and

(iii) immediately reporting to the ATS facility that serves the aerodrome, if available, or to the person who requested the report, the RV along the specified runway in the following format:

RUNWAY VISIBILITY, RUNWAY [runway number], THRESHOLD [distance assessed in metres] {if applicable: MIDPOINT [distance assessed in metres]}, ASSESSED AT [time] UTC; and

(iv) if the RV varies during the assessment, report the lowest value observed; and

(c) not report any weather phenomena that are reducing the runway visibility unless he or she is approved for the purpose by RCAA; and

Notes:

1. The term ***optical devices*** does not include spectacles or contact lenses that the person usually wears for normal distance vision.
2. As far as practicable, observations should not be made through a window during day time or particularly at night.

(d) limit reports to the following range of values:

(i) lowest limit — 350 m; and

(ii) upper limit — 1500 m.

Note: Where the runway visibility is below 350 m, the runway visibility should be reported as “less than 350 m”.

10.19.4.3 An RV assessment may only be provided to a pilot if the assessment was conducted within the previous 20 minutes.

CHAPTER 11: STANDARDS FOR OTHER AERODROME FACILITIES

Section 11.1: General

11.1.1 Introduction

11.1.1.1 This Chapter contains standards on aspects of aerodrome design and operations that are not covered elsewhere in this Manual.

11.1.2 Standards For Siting and Clearance Areas for Airways Facilities on Airports

11.1.2.1 Airways facilities at an airport permit the safe navigation of aircraft within the airspace of an airway, and include; navigation aids along the airway and for approach and landing at aerodromes, communication facilities, meteorological facilities and ATC facilities.

11.1.2.2 The airways facilities for the safe, efficient operation of aircraft in the terminal area surrounding an airport and on the airport manoeuvring area need, in most instances, to be located on or at the perimeter of the aerodrome. Some of these facilities, in particular the precision approach facilities, must be positioned in precise geometric relativity to runways or runway centreline extensions. Most facilities have associated site clearance areas surrounding the site location to ensure proper operation of the facility.

11.1.2.3 The standards herein set out:

(a) The general requirement for sites, and the specific site and clearance area dimensions (for those types of facilities for which it is possible to specify such), for existing facilities; and

(b) The responsibilities of the aerodrome operator for preservation of sites and their clearance areas for planned or existing facilities.

> **Note:** Many of these facilities are provided and maintained by Air Navigation Services provider. Aerodrome operators should also liaise with Air Navigation Services provider on the technical requirements of individual airways facilities.

11.1.2.4 For new facilities follow the manufacturer’s instructions.

11.1.3 General Siting Requirements

11.1.3.1 The siting criteria define the minimum requirements for uncompromised performance of each facility. Non-compliance or infringement of the site criteria and associated clearance areas does not always result in a particular facility being unserviceable or unsafe, but the functions may be degraded. Such degradation may, however, necessitate the facilities removal from service in some instances. Any potential infringement by the aerodrome operator to the criteria for existing or planned facilities is to be referred to Air Navigation Services provider by the aerodrome operator.

11.1.3.2 The general requirements for airways facilities are a finite site for their physical installation, i.e. shelters, foundations, towers, antennae plus a reasonable service area around the physical features. In many instances, there is also a requirement for a clearance zone around this space, in some instances relatively extensive, for the purposed of ensuring transmission of electromagnetic waves without interference from extraneous sources, or for the purpose of unimpeded vision in the cases of ATC towers or RFFS stations.

11.1.3.3 The responsibilities of the aerodrome operator in complying with the requirements of this standard include:

(a) the controls on the erection of structures, e.g. buildings, hangars, fences, roads within specified distances and height limitations, of existing or planned airways facilities;

(b) control on vehicles or aircraft entering, traversing or parking within specified clearance areas; and

(c) ensuring that Air Navigation Services provider is consulted on the effect of proposed aerodrome works or developments on the airways facilities. Even temporary construction works such as stockpiling of materials may have an effect, particularly on precision approach aids.

Notes:

1. Requirements for obstacle limitation surfaces are specified in Chapter 7.
2. The design of markers, signs, light fixtures and their supporting structures, and light units of visual approach slope indicators is specified in Sections 8.2, 8.6, 9.1 and 9.9, respectively. Guidance on the frangible design of visual and non-visual aids for navigation is given in the Aerodrome Design Manual (Doc 9157) Part 6.
3. When siting any airways facility, and in particular an ILS, consideration must be given to paragraph 6.2.22 in relation to runway strip transverse slope limitations and the possible exceedance of the 5% transverse slope standard.

11.1.3.4 Paragraphs 11.1.6 to 11.1.15.3 in this section set out the standards for siting requirements for Communication, Navigation and Surveillance (***CNS***) facilities used for aircraft guidance and air traffic control. They include specified siting requirements and the dimensions of restricted areas around the sites to ensure that radio transmissions are not unacceptably affected by other aerodrome infrastructure, buildings, hangars, vehicles, personnel or other obstacles.

11.1.3.5 The standards for the CNS facilities are generic in that they are based on known areas for acceptable operation at all locations under normal conditions. However, it is known by the CNS provider of the CNS facilities that, depending on the location and the type of facility and the proposed airport development, the dimensions of some of the restricted areas may be infringed without leading to unacceptable technical or operational affect to the functional performance of the facility. Paragraph 11.1.4.6 applies to permit the infringement of any of the standards for CNS facilities at an aerodrome, if the CNS provider of the CNS facilities considers that the dimensions of a restricted area may be infringed without leading to unacceptable technical or operational degradation in the functional performance of the facility, having regard to the location and the type of facility and the proposed aerodrome development.

11.1.3.6 An aerodrome operator may proceed with a proposed aerodrome development that infringes any of the standards for CNS facilities set out in paragraphs 11.1.6 to 11.1.15.3 inclusive if the aerodrome operator has the written authorisation of RCAA. For this purpose, RCAA must request the CNS provider of CNS facilities to undertake an assessment of the impact of the proposed aerodrome development on the performance of CNS facilities.

11.1.3.7 If the proposed development is acceptable to RCAA, having regard to the assessment by the CNS provider and any applicable standards in this MOS, RCAA must authorise the development and provide the aerodrome operator with a copy of the assessment. The aerodrome operator must retain the assessment for not less than 3 years and allow a RCAA inspector to examine the assessment at the request of the inspector.

11.1.4 Siting of Equipment and Installations on Operational Areas

11.1.4.1 Unless its function requires it to be there for air navigation purposes, equipment or an installation must not be located:

(a) on a runway strip, a runway end safety area, or a taxiway strip, if it would endanger an aircraft; or

(b) within the area specified in Table 6.3-5 as the minimum separation distance between the centreline of a taxiway (including an apron taxiway) and a building, structure, vehicle, wall, plant, equipment, parked aeroplane or road, if it would endanger an aircraft; or

(c) on a clearway, if it would endanger an aircraft in the air.

11.1.4.2 Equipment or an installation required for air navigation purposes must be frangible and mounted as low as possible if it is located on any of the following:

(a) that portion of a runway strip within:

  (i) 75 m of the runway centreline — where the runway code number is 3 or 4; or

  (ii) 45 m of the runway centreline — where the runway code number is 1 or 2; or

(b) a runway end safety area or a taxiway strip; or

(c) within the distances specified in Table 6.3-5 between a taxiway centreline and a paragraph 6.3.17.1 (c) object; or

(d) on a clearway.

Notes:

1. Any equipment or installation required for air navigation purposes which must be located on the non-graded portion of a runway strip should be regarded as an obstacle and should be frangible and mounted as low as possible.
2. Guidance on the siting of navigation aids is contained in the Aerodrome Design Manual (Doc 9157) Part 6.

11.1.4.3 Unless its function requires it to be there for air navigation purposes, for a precision approach runway Category I, II or III, equipment or an installation must not be located within the following distances:

(a) 240 m from the end of the runway strip;

(b) 60 m from the extended centreline — where the runway code number is 3 or 4; or

(c) 45 m from the extended centreline — where the code number is 1 or 2.

11.1.4.4 Equipment or an installation required for air navigation purposes must be frangible and mounted as low as possible if it is located on or near the runway strip of a precision approach runway Category I, II or III, and it is:

(a) situated on that portion of the strip within 77.5 m of the runway centreline — where the code number is 4 and the code letter is F; or

(b) situated within 240 m from the end of the strip and within:

  (i) 60 m of the extended runway centreline — where the code number is 3 or 4; or

  (ii) 45 m of the extended runway centreline — where the code number is 1 or 2; or

(c) penetrating the inner approach surface, the inner transitional surface or the balked landing surface.

Note: Any equipment or installation required for air navigation purposes which is an obstacle of operational significance in accordance with Section 7.4 should be frangible and mounted as low as possible.

CHAPTER 12: OPERATING STANDARDS FOR REGISTERED AERODROMES

Section 12.1: General

12.1.1 Introduction

12.1.1.1 Unlike a certified aerodrome where the aerodrome operating procedures are regulated through an aerodrome manual, the procedures for a registered aerodrome are simpler.

> **Note:** However, operators of registered aerodromes should consider developing an aerodrome manual similar to that required of certified aerodrome operators in order to keep all relevant aerodrome information and documentation in 1 volume.

12.1.1.2 The operator of a registered aerodrome is required to:

(a) Ensure that the aerodrome operational information which he or she has provided and published in AIP is current;

(b) When it is not, promptly advise pilots, through the NOTAM system. of changes which may affect aircraft operations; and

(c) Submit to RCAA an aerodrome safety inspection report conducted by an approved person, annually or at a timing as agreed by RCAA.

12.1.1.2A For paragraph 2.1.2.3A, for each non-compliant facility:

(a) the following details must be recorded in an appropriate manual and kept up-to-date:

(i) identification of the facility;

(ii) the date or period when the facility was first introduced or last upgraded (as the case may be);

(iii) a description of the Standards with which the facility complies, including a supporting reference to the version and date of the MOS or other aerodrome facility standard which contains this standard;

(iv) details (if any) of the plans and timescale for replacing or upgrading the facility so that it complies with this MOS; and

(b) the details mentioned in subparagraph (a) must be included in each aerodrome safety inspection report mentioned in subparagraph 12.1.1.2 (c).

12.1.1.2B For paragraph 12.1.1.2A, ***Standards*** means the standards set out in the version of the MOS or other aerodrome facility standard that applied to the facility when it was first introduced or last upgraded (as the case may be).

12.1.1.3 To ensure that the aerodrome information provided is current, means that the aerodrome facilities must be maintained to the standard when the aerodrome was registered or if a facility is upgraded to a new standard, to that standard.

12.1.1.4 To be able to promptly advise changes, operators of registered aerodromes need to have personnel and procedures to conduct timely serviceability inspections, identify changed circumstances and make reports.

12.1.1.5 Although formal documentation of all facets of aerodrome operations are not required, it is in the interest of the operator of a registered aerodrome to be able to demonstrate that he or she is discharging the duty of care in providing a safe facility for aircraft operations. To avoid confusion and misunderstanding, all arrangements regarding aerodrome safety functions must be in writing.

12.1.1.6 If a registered aerodrome fails to meet safety requirements, RCAA may suspend or cancel the registration. RCAA Aerodrome Inspectors may conduct scheduled or unscheduled inspections of the aerodrome to assess whether a registered aerodrome is meeting safety requirements.

12.1.1.7 The standards and procedures of this Chapter are intended to assist operators of registered aerodromes to meet on-going aerodrome safety requirements.

12.1.2 Aerodrome Reporting Officer

12.1.2.1 The operator of a registered aerodrome must have in place, experienced or appropriately trained persons, known as reporting officers, to carry out the aerodrome safety functions. Attributes required include:

(a) Knowledge of the standards that the aerodrome has to be maintained to;

(b) Mature self-starter who can be relied on to conduct regular serviceability inspections of the safety elements of the aerodrome;

(c) Having the written and oral communication skills to initiate NOTAM or to communicate aerodrome condition status to ATC, pilots and other aerodrome users.

12.1.2.2 Reporting officers are normally directly under the employ of the operator of the aerodrome. However, at an aerodrome where aerodrome operator’s employees may not be available at all times, other persons may be nominated as reporting officers, for example the local agent of the airline during the period of regular public transport operations conducted by the airline concerned. Before entrusting the reporting function to a person, the aerodrome operator must ensure that the person is trained and has the appropriate attributes.

12.1.2.3 Reporting officers must be provided with appropriate radios in their vehicles so they can maintain a listening watch of aircraft activities on and in the vicinity of the aerodrome during working hours.

12.1.3 Aerodrome Serviceability Inspections

12.1.3.1 Aerodrome serviceability inspections are visual checks of elements of the aerodrome which may impact on aircraft safety. A checklist of contents of the inspection must be developed, commensurate with the size and complexity of the aerodrome.

12.1.3.2 The checklist must encompass at least the follow areas:

(a) Surface condition of the movement area, including cleanliness

(b) Surface condition of the runway, particularly the usability of unsealed pavements in wet conditions;

(c) Markings, markers, wind direction indicators and aerodrome lighting systems;

(d) any obstacles which may infringe the approach, take-off, transitional, inner horizontal or other surfaces nominated by the procedure designer;

(e) Animal or bird activities on and in the vicinity of the aerodrome;

(f) Check fences or other devices that prevent persons and vehicles getting on the movement area;

(g) Check currency of any outstanding NOTAM initiated.

> **Note:** Elements of matters to be checked for are similar to those detailed in Chapter 10: Section 10.2.

12.1.4 Frequency of Serviceability Inspection

12.1.4.1 At an aerodrome with daily regular public transport operations, serviceability inspections must be carried out daily, preferably before the scheduled operations.

12.1.4.2 Additional serviceability inspections must be conducted after significant weather phenomena such as strong wind gust or heavy rain.

12.1.4.3 At an aerodrome without daily regular public transport operations, serviceability inspections may be reduced to before each regular public transport operation or not less than 2 per week, whichever is more.

12.1.5 Record of Inspections and Remedial Actions

12.1.5.1 The operator of a registered aerodrome must maintain an inspection logbook to demonstrate that inspections have been carried out. Beside recording the inspections, the logbook should also record significant aerodrome upgrading or remedial works.

12.1.5.2 The logbook must be kept for at least 12 months or the agreed period of the aerodrome safety inspection, whichever is longer. The logbook must be made available to a RCAA Aerodrome Inspector conducting inspection of the aerodrome and to the qualified person who conducts the annual or periodic safety inspection.

12.1.6 Reporting Changes

12.1.6.1 Where a change in the aerodrome conditions requires a NOTAM to be issued this must be done in accordance with Section 10.3.

> **Note:** A copy of Notification of Changes to Serviceability of a Registered Aerodrome to the AIS Officeis shown in Section 12.2.

12.1.6.2 Record of NOTAM initiated should be kept for at least a year or the agreed period of safety inspection, whichever is longer.

12.1.7 Aerodrome Works

12.1.7.1 Aerodrome works must be arranged so as not to create any hazard to aircraft or confusion to pilots.

12.1.7.2 Aerodrome works may be carried out without closing the aerodrome provided safety precautions are adhered to.

12.1.7.3 Where aerodrome works are carried out without closing the aerodrome, the aerodrome works safety procedures specified in Chapter 10: Section 10.10 for certified aerodromes are equally applicable to registered aerodromes.

12.1.8 Safety Inspection Report

12.1.8.1 RCARs (Aerodromes) requires a registered aerodrome used by aircraft to prepare and submit to RCAA annually, or at a periodicity as agreed by RCAA, a safety inspection of the aerodrome. Matters to be addressed in the report are also prescribed in the regulations.

12.1.8.2 The report must provide a true picture of the state of the aerodrome in its compliance with applicable standards. Where corrective action or necessary improvements are identified, the aerodrome operator must provide a statement of how the corrective action or improvements would be addressed.

12.1.9 Reporting of Obstacles

If the aerodrome is served by an instrument approach procedure, any obstacles, or proposed construction, that may infringe the obstacle limitation surface of the aerodrome, or other areas nominated by the designer of the instrument approach procedure, are to be reported to the designer.

CHAPTER 13: RADIO COMMUNICATION FACILITIES PROVIDED BY AN AERODROME OPERATOR

Section 13.1: General

13.1.1 Introduction

13.1.1.1 Subpart F of RCARs (Aerodromes) prescribes the provision of certain types of radio communication facilities at particular aerodromes for the purpose of enhancing the safety of air navigation. The radio communication facility required may be either a Certified Air/Ground Radio Service or a Frequency Confirmation System.

13.1.1.2 This Chapter specifies the requirements and the standards for the provision of the above two types of radio communication services.

13.1.2 Definitions and Abbreviations

13.1.2.1 When the following terms or abbreviations are used in this Chapter, they have the meaning given:

AAIS: Automatic Aerodrome Information Service means a service that provides current, routine information to aircraft arriving at or departing from an aerodrome by means of repetitive broadcasts on a discrete frequency.

AFRU: Aerodrome Frequency Response Unit.

CTAF: Common Traffic Advisory Frequency

Frequency Confirmation System means a ground radio system for an aerodrome that, if it receives a transmission from an aircraft on the MBZ frequency or the CTAF for the aerodrome, sends a signal or message to the aircraft confirming that the transmission has been received.

MBZ: Mandatory Broadcast Zone

VHF: Very High Frequency

Section 13.2: Reserved

Section 13.3: Frequency Confirmation System

13.3.1 Requirement for Frequency Confirmation System

13.3.1.1 At all non-controlled aerodromes located in an MBZ, and at those non-controlled aerodromes in CTAF areas which are used not less than 5 times per week by aircraft engaged in air transport operations that have a maximum passenger seating capacity greater than nine, a ground-based frequency confirmation system is required. This requirement may be practically satisfied by one of the following facilities:

(a) a certified air/ground radio service (CA/GRS); or

(b) an aerodrome frequency response unit (AFRU); or

(c) a Unicom service.

13.3.2 Aerodrome Frequency Response Unit (AFRU)

13.3.2.1 The AFRU is an electronic, ground based, aviation safety enhancement device, intended for use on the CTAF or MBZ frequency at non-controlled aerodromes. It is essentially an internally controlled VHF transceiver with a pre-recorded message transmission capability. AFRU transmissions are triggered when the AFRU receiver detects aircraft transmissions on the correct aerodrome frequency. This response capability is intended to reduce the incidence of incorrect VHF radio frequency channel selection by pilots. If the pilot is aware of the presence of an AFRU in a CTAF area or MBZ, the AFRU will assist in alerting pilots to these situations by providing an automatic transmission on the aerodrome frequency to confirm the receipt of a transmission by an aircraft within radio range. The confirming AFRU transmission will be either a short pre-recorded voice message (e.g. aerodrome name followed by MBZ or CTAF (as relevant), or a short (300 millisecond) tone burst, depending upon radio transmission activity by aircraft operating on that frequency in the preceding 5 minutes, and the form of the pilot’s transmission to the AFRU.

13.3.2.2 An AFRU may also have an optional facility incorporated to operate the runway lights during hours of reduced light and darkness.

13.3.3 Use of the AFRU

13.3.3.1 The AFRU will be suitable for installation at non-controlled aerodromes. It may also be utilised at those aerodromes which are controlled during busier traffic hours, and which become an MBZ after hours during control tower closure. (In this latter role, the AFRU must only be activated during the hours when the tower is closed; for that purpose the AFRU must have a remote activation capability).

13.3.4 Operating Performance Requirements of AFRU

13.3.4.1 When an aircraft operating in radio range of the AFRU makes a transmission (radio broadcast or unmodulated carrier burst) on the aerodrome frequency, the AFRU must be able to detect the presence of aircraft VHF carrier transmissions of 2 seconds or more in duration, and, at the end of the aircraft transmission, it must automatically respond with either one of the following types of transmissions on that frequency:

(a) A pre-recorded short voice message, (normally taking the form of the aerodrome location) if there has been no other received aircraft transmissions in the previous 5 minutes; or

(b) A short (300 ms) tone burst if any aircraft transmissions have been received in the previous 5 minutes.

13.3.4.2 In addition, the AFRU must also be able to detect and respond to any aircraft transmissions which consist of three sequential carrier bursts over a five second period, with the pre-recorded voice message as at (a) above, regardless of radio transmission activity by aircraft in the last 5 minutes.

13.3.5 Reserved

13.3.6 AFRU with PAL Features

Note: See Section 9.3 for standards for PAL.

13.3.6.1 Optional Additional AFRU Function - Pilot-Activated Lighting Control: Optional additional functionality may be provided with the AFRU unit to provide for aircraft actuated operation of the aerodrome lights at the aerodrome at which the AFRU is located, during night hours or other times of low natural light levels. This option shall emulate the function of the existing PAL circuitry, but permit operation on the CTAF or MBZ frequency.

13.3.6.2 The Pilot Activated Lighting (PAL) option includes a light sensor mounted remotely from the AFRU. During the time the light sensor detects that the natural light intensity is less than a preset level (adjustable on the AFRU unit), and on receipt of an aircraft transmission of three carrier bursts (three PTT clicks) over a five-second period, the AFRU will provide separate relay outputs to operate the airport lighting circuitry (runway lights and illumination of the wind indicator) at the aerodrome. The AFRU will then transmit the standard reply of the normal pre-recorded voice message (the aerodrome name and MBZ or CTAF), followed by the additional recorded voice message of “runway lights on”. The runway lights will operate for a period of either 30 minutes or 60 minutes. The operating period of either 30 minutes or 60 minutes will be preset within the unit. Ten (10) minutes prior to the end of the 30 or 60 minutes period, the windsock light will flash at 1 second intervals and the MBZ/CTAF response, followed by the announcement "runway lights 10 minutes remaining" will be broadcast. At any time during the period of time that the lights are operated, receipt of a further transmission of three carrier bursts shall reset the timing period back to either 30 or 60 minutes.

13.3.7 Technical Specifications for Optional Pilot-Activated Lighting Control

13.3.7.1 **Fail-safe Relay Output Switching of Runway and Windsock:** Fail-safe switching of runway and windsock outputs to be provided. Outputs to be relay controlled, +12 VDC, for driving remote lighting circuits. (Other configurations to match aerodrome lighting circuitry are permissible, but must be fail-safe, i.e. in the event of failure of the AFRU, the aerodrome lights will be actuated and remain actuated).

13.3.7.2 **Ambient Light Sensor:** The ambient light sensor device is to be infinitely adjustable from full darkness to bright daylight. Preset control to be located in the AFRU unit, or in the sensor housing.

13.3.7.3 **Operation:** The PAL output will activate on receipt of 3 correct PTT bursts (as per standard AFRU). If ‘dark’ =< pre-set darkness level, the normal MBZ/CTAF response message will be transmitted, followed by one of two messages: “runway lights on" message if the lights are activated, or “no runway lights”, depending on whether or not lights have actually illuminated. This is to be sensed in the AFRU by a signal output by a current transducer in the lighting circuitry, and shall only confirm lights on if the runway lighting system is drawing current.

13.3.7.4 **Timing:** Timings shall emulate the existing PAL system in use, i.e. 30 or 60 minutes preset for lights on, windsock lighting flashes at 1 second rate for the last 10 minutes, and shall be microprocessor controlled within the AFRU unit. Timings to be internally preset. Timer countdown to recommence on receipt of further transmission of 3 PTT bursts during the period that the lights are in operation.

13.3.8 AFRU+PAL Commissioning Flight Test

13.3.8.1 A flight check of the AFRU and the optional PAL function shall be to the satisfaction of a RCAA inspector. The flight test will ensure the functionality of the AFRU and optional PAL at appropriate points on the aerodrome and out to the limits of the relevant CTAF area or MBZ area.

13.3.8.2 On the ground:

(a) check activation of AFRU and PAL from the parking apron(s) of the aerodrome.

(b) check all specified functionality of the AFRU and PAL option.

13.3.8.3 In the air:

(a) check proper performance of AFRU at line of sight distances out to 20 NM radius of the aerodrome at altitudes of 3,000 to 5,000 feet AGL.

(b) check that AFRU Receiver sensitivity and Transmitter power levels are adjusted to ensure that the AFRU does not activate, and does not transmit, beyond approx 30 NM radius.

(c) check that voice and tone responses are clear and legible. Check that three microphone clicks of 1 second ON, 1 second OFF within 5 second period will activate voice response. (Tolerance on 1 second ON or OFF is 0.5 seconds).

(d) ensure that the AFRU does not trigger falsely during aircraft transmissions. Ensure that no interruptions occur to aircraft transmissions by false triggering of the AFRU during the aircraft transmission.

(e) check and ensure proper operation of the PAL option as follows:

  (i) ensure lights are activated by three microphone clicks at a radius of 15 NM in line-of-sight from the aerodrome, to altitudes of 3,000 to 5,000 feet AGL.

  (ii) ensure that lights remain activated for either 30 minute or 60 minute preset period after activation.

(iii) ensure receipt of correct recorded voice responses after activation.

(iv) ensure that illuminated wind indicator flashes 10 minutes before the completion of the 30 or 60 minute period of operation of the lights.

(v) ensure that lights are reset for the pre-set 30 or 60 minutes period following an aircraft transmission of three microphone clicks at any time within the pre-set 30 or 60 minutes period.

Section 13.4: Unicom Services

13.4.1 General

13.4.1.1 Unicom (Universal Communications) services are non-ATS radio communication services provided on an MBZ frequency or CTAF to enhance the value of information normally available about a non-controlled aerodrome. A Unicom service is not a Certified Air/Ground Radio Service.

13.4.1.2 The primary function of the frequencies (MBZ/CTAF) used for Unicom services is to provide the means for pilots to exchange traffic information for separation purposes. Unicom services, being a secondary use of these frequencies, must not inhibit the exchange of aircraft to aircraft traffic information.

13.4.1.3 Participation in Unicom services by an aerodrome operator, whether for the purposes of a frequency confirmation system or otherwise, is to be limited to the exchange of radio messages concerning:

(a) confirmation of the CTAF/MBZ frequency selected by aircraft;

(b) general aerodrome weather reports;

(c) aerodrome information;

(d) estimated times of arrival and departure;

(e) passenger requirements;

(f) aircraft refuelling arrangements;

(g) maintenance and servicing of aircraft including the ordering of urgently required parts;

(h) unscheduled landings by aircraft.

13.4.1.4 General aerodrome weather reports provided by a Unicom operator are to be limited to simple, factual statements about the weather, unless the Unicom operator is authorised by RCAA to make meteorological observations.