Civil Aviation Rules

Notice of Proposed Rule Making

NPRM 2414/139-36

28 August 2024

Part 139

Aerodromes –

Certification and Operation

Consequential Amendments

Nil

Docket 24/14/CAR139/36

2024 Rules Review

Rule Applicable 04th November 2024

Background to the Civil Aviation Rules

The Papua New Guinea (PNG) Civil Aviation Rules (CARs) establish the *minimum* regulatory safety standards and boundary for participants to gain entry into, operate within, and exit the PNG civil aviation system. The PNG Rules are divided into Parts and each Part contains a series of individual rules which relate to a particular aviation activity.

Advisory Circulars accompany many rule Parts and contain information about standards, practices and procedures that the Director has been established to be an '*Acceptable Means of Compliance*' (AMC) for the associated rule. An Advisory Circular may also contain Guidance Material (GMs) and Explanatory Material (EMs) to facilitate compliance with the rule requirements.

The objective of the Civil Aviation Rules system is to obtain a balance of responsibility between, on the one hand, the State and regulatory authority, the Civil Aviation Safety Authority of PNG (CASA PNG) and, on the other hand, those who provide services and exercise privileges in the civil aviation system. This balance must enable the State and regulatory authority to set standards for, and monitor performance of aviation participants whilst providing the maximum flexibility for the participants to develop compliance within the safety boundary.

Section 45 of the *Civil Aviation Act 2000* prescribes general requirements for participants in the civil aviation system and requires, amongst other things, participants to carry out their activities safely and in accordance with the relevant prescribed safety standards and practices. Section 69 of the Act allows the Minister to make ordinary rules for any of the following purposes:

(a) The implementation of Papua New Guinea's obligations under the Convention
(b) To provide for a safe, sustainable, effective and efficient aviation services
(c) The provision of aviation meteorological services, search and rescue services and civil aviation security programmers and services
(d) Assisting aviation safety and security, including but not limited to personal security
(e) Assisting economic development
(f) Improving access and mobility
(g) Protecting and promoting public health
(h) Ensuring environmental sustainability
(i) Any matter related or reasonably incidental to any of the following:

    (1) The Minister's functions and role under section 8 of the Act;
    (2) The Authority's general objects and functions under section 11 of the Act;
    (3) The Authority's functions in relation to safety under section 12 of the Act;
    (4) The Director's functions and powers under section of 17 the Act and
    (5) The Director's powers under section 52A, 53 and 54 of the Act

(j) Any other matter contemplated by any provision of the Act.

Table of Content

Note: Page numbers may not coincide with the Table of Contents and are subject to change.

1. Purpose of this NPRM

The purpose of this Notice of Proposed Rulemaking (NPRM) is to put forward for consideration the proposed amendments to Civil Aviation Rule (CAR) Part 139.

2. Background to the Proposal

2.1 General Summary

Civil Aviation Rule (CAR) Part 139 Aerodromes – Certification and Operation came into force on 1 January 2004. The Part formed the nucleus of the aerodrome requirements and applied to an aerodrome serving any aeroplane having a seating configuration of 20 seats or more, excluding any required flight crew member seat, that is engaged in regular air transport operations.

To date, 6 amendments to the Part have been enacted,

(a) Amendment 01 – 1st January 2015

(b) Amendment 02 – 1st May 2017

(c) Amendment 03 – 13th November 2018

(d) Amendment 04 – 1st April 2019

(e) Amendment 05 – 4th December 2019

(f) Amendment 06 – 3rd April 2023

(g) Amendment 07 – 7th November 2024

This NPRM Part 139 Amendment 07 includes;

(1) Amendment of Requirement for Certification in rule 139.3 to include aerodromes serving any aeroplanes engaged in international operations irrespective of its seating capacity and configurations. Currently, rule 139.3 limits the Requirement for Certification to aerodromes serving aeroplanes of 20 passenger seating configuration and above.

(2) Non-certificated Aerodrome Requirements in rule 139.13 have been deleted from Part 139. Part 139 requirements only apply to applicants for, and holders of, aerodrome certificates.

(3) Rescue Firefighting requirements in Subpart B have been deleted to avoid duplication of same requirements in the Appendices.

(4) Appendices include applicable Annex 14 Volume I Recommended Practices.

2.2 NPRM Development

The proposal to amend Part 139 was triggered by the ICAO Universal Safety Oversight Audit Programme (USOAP) audit on the State of Papua New Guinea in June 2023. The outcome of audit in terms of Effective Implementation (EI) of ICAO Standards and Recommended Practices (SARPS) in the Aerodrome and Ground Aids (AGA) audit area saw PNG scoring 57.6% which is below the Global Average of 62.5%. Out of the 53 Non-Satisfactory (NS) Protocol Questions (PQs) from the audit, 22 of them were NS due to the State's non-compliance with of the ICAO Recommended Practices (RPs) of Annex 14 Volume I. The current Part 139 only contains ICAO Standards and not the RPs. *The State's decision for not adopting RPs in the past is based on one of the objectives of the Civil Aviation Act s2(a); "… establish rules to promote aviation safety at reasonable cost".*

2.3 Key Stakeholders

The Civil Aviation Safety Authority identifies the following as key stakeholders for the proposed rule amendments contained in this NPRM:

(a) The Civil Aviation Safety Authority
(b) The Minister for Transport and Civil Aviation
(c) Aviation Document Holders
(d) Other interested stakeholders

3. Issues Addressed during Development

The were no major issues addressed during the development of this NPRM.

3.1 Consequential Amendments

There are no consequencial amendments affecting other Rule Parts except for the definitions in rule 139.2 to be moved to Part 1.

3.2 Exemptions

As a result of the adoption of ICAO Annex 14 Volume I Recommended Practices (RPs), the State's Annex 14 Volume 1 Compliance Checklist will be updated to include the State's compliance with the RPs. However, there will not be any filing of significant differences as a result of the adoption of RPs.

3.3 ICAO SARPS and Level of Risk to Papua New Guinea Aviation Safety

The proposed rule amendment are intended to comply with all applicable SARPs in Annex 14, Volume I — Aerodrome Design and Operations.

Compliance with RPs by the aerodrome operators may have a positive impact on the level of safety, raising the safety margin above the minimum standards enforced by the current rules.

3.4 Compliance Costs

The cost factor on compliance with the introduced RPs may not be immediate but may come into play in the long term. Although aerodrome operator's may require time, funding and resources to establish and maintain compliance with the RPs, the new rules will specify that the RPs are not mandatory but desired, and the word "may" will be used instead of "must"

or "shall". Compliance with RPs is left to the aerodrome operators to plan their transition into compliance with the understanding that an RP in future may become a Standard. Promulgation of RPs may be beneficial to the aerodrome operators and users for planning purposes as well as promoting standardisation of aerodrome facilities across all aerodromes.

4. Summary of changes

The following are the proposed amendments to the current Part 139;

Current Rule	Changes
139.3(a)	Include aerodromes serving aeroplanes engaged in international operations without any limitation on passenger seating capacity and configuration.
139.3(b)	Delete the ending part from the word "or" that makes reference to non-certificated aerodromes.
139.13	Delete to avoid referencing non-certificated aerodromes in Part 139.
139.59	Delete part heading "category determination" in order to keep only the requirement for provision of rescue and firefighting (RFF) in rule 139.59 and make reference to RFF standards and recommended practices in Appendix 5.2.
139.	Delete to avoid duplication of same requirements in the Appendices.
139.63	Delete to avoid duplication of same requirements in the Appendices.
139.65	Delete to avoid duplication of same requirements in the Appendices.
139.67	Delete to avoid duplication of same requirements in the Appendices.
139.69	Delete to avoid duplication of same requirements in the Appendices.
Appendices	Included applicable Annex 14 Volume I recommended practices.

5. Legislative Analysis

5.1 Power to Make Rules

The Minister may make ordinary rules under sections 69, 70, 71 and 72 of the *Civil Aviation Act 2000*, for various purposes including implementing Papua New Guinea's obligations under the Convention, assisting aviation safety and security, and any matter contemplated under the Act.

These proposed rules are made pursuant to:

(a) Section 69(1)(a) which provides for the Minister to make rules for the implementation of Papua New Guinea's obligations under the Convention;

(b) Section 72(a) which provides for the Minister to make rule for the designation, classification and certification of-

(1) Air services:

(2) Aerodrome operators:

(3) Aviation security providers:

(4) Aviation training organizations"

(5) Aircraft design, manufacture, maintenance and supply organizations:

(6) Air traffic services;

(7) Aviation meteorological services:

(8) Aeronautical communication services:

(9) Aeronautical procedures.

The proposed amendment of Part 140 complies with the requirements of the *Civil Aviation Act 2000* and does not contravene the Constitution, the Aerodrome (Business Concession) Act 2000, Civil Aviation (Air Craft Operator Liability) Act 1975, Aircraft Charges Act, Airport Departure Tax Act, Explosive Act 1952, Firearms Act 1978, Customs Act 1951, Plant, Disease and Control Act 1953 and the Environmental Act 2000.

The proposed Rule has been checked for language and compliance with the legal conventions of Papua New Guinea.

5.2 Matters to be taken into account

The development of this NPRM and the proposed rule changes take into account the matters under section 75 of the Act that the Minister must take into account when making ordinary rules including the following:

5.2.1 ICAO Standards and Recommended Practices

The proposed rule amendments comply with Recommended Practices of Annex 14, Volume I — Aerodrome Design and Operations.

5.2.2 Assisting Economic Development

The proposed rule amendments will impact economic development in the long term planning of aerodrome transitioning into compliance with the introduced RPs.

5.2.3 Assisting Safety and Security

Compliance with Annex 14 Volume I Recommended Practices (RPs) by the aerodrome operators and users may have a positive impact on the level of safety, raising the safety margin above the minimum standards enforced by the current rules.

Some of the RPs relate to aerodrome security. The aerodrome operator's compliance with these additional security requirements (RPs) may have a positive impact on aviation security.

5.2.4 Improving Access and Mobility

The proposed rule amendments will have no additional impact on access and mobility.

5.2.5 Protecting and Promoting Public Health

The proposed rule amendments will have no additional impact on protecting and promoting public health.

5.2.6 Ensuring Environmental Sustainability

The proposed rule amendments will have no additional impact on environmental sustainability.

6. Submissions on the NPRM

6.1 Submissions are invited

Interested persons are invited to participate in the making of the proposed rules by submitting written data, views, or comments. All submissions will be considered before final action on the proposed rulemaking is taken. If there is a need to make any significant change to the rule requirements in this proposal as a result of the submissions received, then interested persons may be invited to make further submissions.

6.2 Examination of Submissions

All submissions will be available in the rules docket for examination by interested persons both before and after the closing date for submissions. A consultation summary will be published on the CA web site and provided to each person who submits a written submission on this NPRM. Submissions may be examined by application to the Docket Clerk at the Civil Aviation Safety Authority Headquarter Building 1, Level 1, Morea Tobo Road, Six Mile, NCD Port Moresby between 8:30 am and 3:30 pm on weekdays, except statutory holidays.

6.3 Disclosure

Submitters should note that any information attached to submissions will become part of the docket file and will be available to the public for examination at the CASA office.

Submitters should state clearly if there is any information in their submission that is commercially sensitive or for some other reason the submitter does not want the information to be released to other interested parties.

7. How to make a submission

Submissions may be sent by the following methods:

by Mail: Docket Clerk (NPRM 2414/139-36)
Civil Aviation Safety Authority
PO Box 1941
BOROKO

National Capital District

delivered: Docket Clerk (NPRM 2414/139-36)
Civil Aviation Safety Authority
Morea-Tobo Road
Six Mile, Jacksons Airport
Port Moresby NCD

by Email: Docket Clerk (NPRM 2414/139-36)
rules@casapng.gov.pg

7.1 Final date for submissions

Comments must be received before ***COB,01st October 2024.***

7.2 Availability of the NPRM

Any person may obtain a copy of this NPRM from-

CASA web site: www.casapng.gov.pg

or at a cost from

Docket Clerk
Civil Aviation Safety Authority Headquarter
Building 1, Level 1
Morea-Tobo Road
Six Mile, Jacksons Airport
Port Moresby NCD

7.3 Further information

For further information, contact:

Taras Garap (Ms)
Manager – Legal Services
CASA PNG
tgarap@casapng.gov.pg

Ph.: 325 7320 Mob: 70319368

Proposed Rule Amendments

Part 139

Aerodromes – Certification and Operation

Subpart A — General

139.3 Requirement for certificate

~~(a) A person must not operate an aerodrome serving any aeroplane having a passenger seating configuration of 20 seats or more, excluding any required flight crew member seat, that is engaged in regular air operations for the carriage of passengers to, from or within Papua New Guinea except under the authority of, an aerodrome operating certificate issued by the Director under the Act and in accordance with this Part.~~

(a) A person must not operate an aerodrome except under the authority of an aerodrome operating certificate issued by the Director under the Act and in accordance with this Part when serving any aeroplane:

(1) engaged in air operations to or from Papua New Guinea; and

(2) having a passenger seating configuration of 20 seats or more, excluding any required flight crew member seat, that is engaged in ~~regular~~ scheduled air operations for the carriage of passengers within Papua New Guinea.

(b) A person operating an aerodrome who is not required to hold an aerodrome operating certificate under paragraph (a), may apply for an aerodrome certificate under this Part ~~or must meet the minimum aerodrome standards acceptable to the Director required by rule 139.13.~~

~~**139.13 Non-certificated aerodrome requirements**~~

~~A person operating an aerodrome who is not required to hold an aerodrome operating certificate must comply with the minimum aerodrome standards acceptable to the Director.~~

Subpart B — Certification Requirements

139.53 Aerodrome design requirements

~~(a)~~ An applicant for the grant of an aerodrome operating certificate must ensure that: -

(a) the physical characteristics of the aerodrome, the obstacle limitation surfaces, the visual aids for navigation and denoting obstacles and restricted areas, and the equipment and installations for the aerodrome are commensurate with: -

(1) the characteristics of the aircraft that the aerodrome is intended to serve; and

(2) the lowest meteorological minima intended for each runway; and

(3) the ambient light conditions intended for the operation of aircraft on each runway.

(b) the physical characteristics, obstacle limitation surfaces, visual aids, and equipment and installations provided at the aerodrome ~~must~~ meet the applicable standards in Appendices 3 to 9.

139.59 Rescue and firefighting ~~– category determination~~

(a) An applicant for the grant of an aerodrome operating certificate must, for any International aerodrome, and any other aerodrome when so required by the Director in the interest of safety, provide rescue and firefighting capability at that aerodrome that complies with the standards and recommended practices ~~requirements~~ specified in Appendix ~~I~~5.2.

~~139.61 Rescue and firefighting – extinguishing agents~~

~~An applicant for the grant of an aerodrome operating certificate must have the minimum extinguishing agents in accordance with Appendix I.2.3 for the category determined under rule 139.59 and as specified in Appendix I.2.2, Table I-1.~~

~~139.63 Rescue and firefighting – vehicles~~

~~(a) Subject to paragraphs (b) and (d), an applicant for the grant of an aerodrome operating certificate must have the minimum rescue and firefighting vehicles for the aerodrome category determined under rule 139.59 and as specified in Appendix I.2.2.~~

~~Table 3.~~ ~~Minimum rescue and firefighting vehicles~~

~~Aerodrome category~~	~~Rescue and fire fighting vehicles~~
~~1~~	~~1~~
~~2~~	~~1~~
~~3~~	~~1~~
~~4~~	~~1~~

~~5~~	~~1~~
~~6~~	~~2~~
~~7~~	~~2~~
~~8~~	~~3~~
~~9~~	~~3~~
~~10~~	~~3~~

~~(b) Subject to paragraph (c), each vehicle required by paragraph (a) must be equipped for two-way voice radio communications with at least: -~~

(1) ~~each of the other required rescue and firefighting vehicles required for the aerodrome; and~~

(2) ~~the aerodrome control service or aerodrome flight information service serving the aerodrome; and~~

(3) ~~other stations as specified in the applicant's aerodrome emergency plan.~~

~~(c) Where only 1 vehicle is required by paragraph (a) and there is no aerodrome control service or aerodrome flight information service serving the aerodrome and the aerodrome emergency plan does not provide for contact with other stations, the vehicle does not need to be equipped for two-way voice radio communications.~~

~~(d) Each vehicle required by paragraph (a) must: -~~

(1) ~~have a flashing or rotating beacon; and~~

(2) ~~be marked in a single conspicuous colour of red or yellowish green.~~

~~139.65 Rescue and firefighting – personnel requirements~~

~~An applicant for the grant of an aerodrome operating certificate must establish a procedure for ensuring that all rescue and firefighting personnel at their aerodrome are: -~~

(1) ~~equipped with adequate protective clothing and rescue equipment needed to do their duties; and~~

(2) ~~trained, are medically and physically fit, and are competent in the use of the rescue and firefighting equipment; and~~

(3) ~~receiving recurrent training and regular practice to maintain their competency; and~~

(4) ~~sufficient in number and are readily available to operate the rescue and firefighting vehicle or vehicles and the equipment at maximum capacity; and~~

(5) ~~alerted by siren, alarm, or other means to any existing or impending emergency requiring their assistance.~~

~~139.67 Rescue and firefighting – response capability~~

~~An applicant for the grant of an aerodrome operating certificate must, when required by the Director, demonstrate the following rescue and firefighting response capability in optimum conditions of visibility and surface conditions that complies with the requirements in Appendix I.2.4.~~

~~139.69 Rescue and firefighting – communication and alerting system~~

~~An applicant for the grant of an aerodrome operating certificate must provide a discrete communication system linking a fire station with the control tower, any other fire station on the aerodrome and the rescue and fire fighting vehicles.~~

~~Appendix A — Aerodrome Reference Code~~

~~An aerodrome reference code — code number and letter — which is selected for aerodrome planning purposes must be determined in accordance with the characteristics of the aeroplane for which an aerodrome facility is intended.~~

~~The aerodrome reference code numbers and letters must have the meanings assigned to them in Table A-1.~~

~~The code number for element 1 must be determined from Table A-1, column 1, selecting the code number corresponding to the highest value of the aeroplane reference field lengths of the aeroplanes for which the runway is intended.~~

~~The code letter for element 2 must be determined from Table A-1, by selecting the code letter which corresponds to the greatest wingspan of the aeroplanes for which the facility is intended.~~

~~Table A-1. Aerodrome reference code~~

~~Code number~~	~~Aeroplane reference field length~~
~~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 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~~

~~Appendix B — Aerodrome Data~~

~~B.1 Aeronautical data~~

~~Determination and reporting of aerodrome-related aeronautical data must be in accordance with the accuracy and integrity classification required to meet the needs of the end-users of aeronautical data.~~

~~Where aerodrome mapping data is made available, the selection of the aerodrome mapping data features to be collected must be made with consideration of the intended applications.~~

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

~~B.2 Aerodrome reference point~~

~~An aerodrome reference point must be established for an aerodrome.~~

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

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

~~B.3 Aerodrome and runway elevations~~

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

~~For an aerodrome used by international civil aviation for non-precision approaches, the elevation and geoid undulation of each threshold, the elevation of the runway end and any significant high and low intermediate points along the runway must be measured to the accuracy of one-half metre or foot and reported to the aeronautical information services authority.~~

~~For precision approach runway, the elevation and geoid undulation of the threshold, the elevation of the runway end and the highest elevation of the touchdown zone must be measured to the accuracy of one-quarter metre or foot and reported to the aeronautical information services authority.~~

~~B.4 Aerodrome reference temperature~~

~~An aerodrome reference temperature must be determined for an aerodrome in degrees Celsius.~~

~~B.5 Aerodrome dimensions and related information~~

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

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

~~Strip, RESA and Stopway length width to the nearest metre or foot, surface type and arresting system — location (which runway end) and description~~

~~taxiway — designation, width, surface type;~~

~~apron — surface type, aircraft stands;~~

~~the boundaries of the air traffic control service;~~

~~clearway — length to the nearest metre or foot, ground profile;~~

~~visual aids for approach procedures, marking and lighting of runways, taxiways and aprons, other visual guidance and control aids on taxiways and aprons, including taxi holding positions and stopbars, and location and type of visual docking guidance systems;~~

~~location and radio frequency of any VOR aerodrome checkpoint;~~

~~location and designation of standard taxi-routes; and~~

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

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

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

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

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

~~B.6 — Strength of pavements~~

~~The bearing strength of a pavement must be determined.~~

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

~~the pavement classification number (PCN);~~

~~pavement type for ACN-PCN determination;~~

~~subgrade strength category;~~

~~maximum allowable tire pressure category or maximum allowable tire pressure value;~~

~~evaluation method.~~

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

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

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

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

~~(1) Pavement type for ACN-PCN determination:~~

	~~Code~~
~~Rigid pavement~~	~~R~~
~~Flexible pavement~~	~~F~~

~~(2) Subgrade strength category:~~

	~~Code~~
~~High strength: characterized by K = 150 MN/m3 and representing all K values above 120 MN/m3 for rigid pavements, and by CBR = 15 and representing all CBR values above 13 for flexible pavements.~~	~~A~~

~~Medium strength: characterized by K = 80 MN/m3 and representing a range in K of 60 to 120 MN/m3 for rigid pavements, and by CBR = 10 and representing a range in CBR of 8 to 13 for flexible pavements.~~ ~~B~~

~~Low strength: characterized by K = 40 MN/m3 and representing a range in K of 25 to 60 MN/m3 for rigid pavements, and by CBR = 6 and representing a range in CBR of 4 to 8 for flexible pavements.~~ ~~C~~

~~Ultra low strength: characterized by K = 20 MN/m3 and representing all K values below 25 MN/m3 for rigid pavements, and by CBR = 3 and representing all CBR values below 4 for flexible pavements.~~ ~~D~~

~~(3) Maximum allowable tire pressure category:~~

	~~Code~~
~~Unlimited: no pressure limit~~	~~W~~
~~High: pressure limited to 1.75 MPa~~	~~X~~
~~Medium: pressure limited to 1.25 MPa~~	~~Y~~
~~Low: pressure limited to 0.50 MPa~~	~~Z~~

~~(4) Evaluation method:~~

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

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

~~— maximum allowable aircraft mass; and~~

~~— maximum allowable tire pressure.~~

~~B.7 Pre-flight altimeter check location~~

~~One or more pre-flight altimeter check locations must be established for an aerodrome.~~

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

~~B.8 Declared distances~~

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

~~take-off run available;~~

~~take-off distance available;~~

~~accelerate-stop distance available; and~~

~~landing distance available.~~

~~B.9 Condition of the movement area and related facilities~~

~~B.9.1 Condition of the movement area~~

~~Information on the condition of the movement area and the operational status of related facilities must be provided to the appropriate aeronautical information services units, and similar information of operational significance to the air traffic services units, to enable those units to provide the necessary information to arriving and departing aircraft. The information must be kept up to date and changes in conditions reported without delay.~~

~~The condition of the movement area and the operational status of related facilities must be monitored, and reports on matters of operational significance affecting aircraft and aerodrome operations must be provided in order to take appropriate action, particularly in respect of the following:~~

~~construction or maintenance work;~~

~~rough or broken surfaces on a runway, a taxiway or an apron;~~

~~water on a runway, a taxiway or an apron;~~

~~other contaminants on a runway, taxiway or apron;~~

~~other temporary hazards, including parked aircraft;~~

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

~~failure of the normal or secondary power supply.~~

~~To facilitate compliance with B.9.1(a) and (b), inspections of the movement area must be carried out each day at least once where the code number is 1 or 2 and at least twice where the code number is 3 or 4.~~

~~B.9.2 Water on a runway~~

~~Information that a runway or portion thereof may be slippery when wet must be made available.~~

~~Notification must be given to aerodrome users when the friction level of a paved runway or portion thereof is less than that specified by the Director in accordance with J.2(c), (d) and (e).~~

~~B.10 Rescue and firefighting~~

~~Information concerning the level of protection provided at an aerodrome for aircraft rescue and firefighting purposes must be made available.~~

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

~~B.11 Visual approach slope indicator systems~~

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

~~associated runway designation number;~~

~~type of system according to E.3.13(b). For an AT-VASIS, PAPI or APAPI installation, the side of the runway on which the lights are installed, i.e. left or right, must be given;~~

~~where the axis of the system is not parallel to the runway centre line, the angle of displacement and the direction of displacement, i.e. left or right, must be indicated;~~

~~nominal approach slope angle(s). For a T-VASIS or an AT-VASIS this must be angle Θ according to the formula in Figure E-18 and for a PAPI and an APAPI this must be angle (B + C) ÷ 2 and (A + B) ÷ 2, respectively as in Figure E-20; and~~

~~minimum eye height(s) over the threshold of the on-slope signal(s). For a T-VASIS or an AT-VASIS this must be the lowest height at which only the wing bar(s) are visible; however, the additional heights at which the wing bar(s) plus one, two or three fly-down light units come into view may also be reported if such information would be of benefit to aircraft using the approach. For a PAPI this must be the setting angle of the third unit from the runway minus 2′, i.e. angle B minus 2′, and for an APAPI this must be the setting angle of the unit farther from the runway minus 2′, i.e. angle A minus 2′.~~

~~B.12 Coordination between aeronautical information services and aerodrome authorities~~

~~To ensure that aeronautical information services units obtain information to enable them to provide up-to-date pre-flight information and to meet the need for in-flight information, arrangements must be made between aeronautical information services and aerodrome authorities responsible for aerodrome services to report to the responsible aeronautical information services unit, with a minimum of delay:~~

~~information on the status of certification of aerodromes and aerodrome conditions (ref. B.9, B.10 and B.11);~~

~~the operational status of associated facilities, services and navigation aids within their area of responsibility;~~

~~any other information considered to be of operational significance.~~

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

~~Of a particular importance are changes to aeronautical information that affect charts and/or computer-based navigation systems which qualify to be notified by the aeronautical information regulation and control (AIRAC) system. The predetermined, internationally agreed AIRAC effective dates in addition to 14 days postage time must be observed by the responsible aerodrome services when submitting the raw information/data to aeronautical information services.~~

~~The aerodrome services responsible for the provision of raw aeronautical information/data to the aeronautical information services must do that while taking into account accuracy and integrity requirements required to meet the needs of the end-user of aeronautical data.~~

~~Appendix C — Physical Characteristics~~

~~C.1 — Runways~~

~~C.1.1 Surface of runways~~

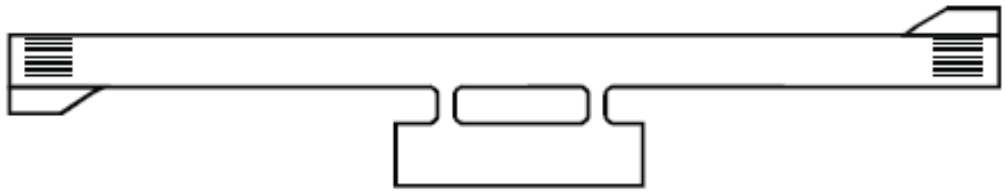
~~The surface of a runway must be constructed without irregularities that would impair the runway surface friction characteristics or otherwise adversely affect the take-off or landing of an aeroplane.~~

~~A paved runway must be so constructed or resurfaced as to provide surface friction characteristics at or above the minimum friction level prescribed under this Part.~~

~~C.2 — Runway turn pads~~

~~C.2.1 Design of a runway turn pad~~

~~Where the end of a runway is not served by a taxiway or a taxiway turnaround and where the code letter is D, E or F, a runway turn pad must be provided to facilitate a 180-degree turn of aeroplanes shown below.~~



~~Figure C-1. Typical turn pad layout~~

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

~~OMGWS~~

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

~~[a] If the turn pad is intended to be used by aeroplanes with a wheel base less than 18 m.~~

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

~~C.2.2 Surface of runway turn pads~~

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

~~C.3 Runway strips~~

~~C.3.1 Design of a runway strip~~

~~A runway and any associated stopways must be included in a strip.~~

~~C.3.2 Length of runway strips~~

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

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

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

~~30 m where the code number is 1 and the runway is a non-instrument one.~~

~~C.3.3 Width of runway strips~~

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

~~140 m where the code number is 3 or 4; and~~

~~70 m where the code number is 1 or 2;~~

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

~~C.3.4 Objects on runway strips~~

~~No fixed object, other than visual aids required for air navigation or those required for aircraft safety purposes and which must be sited on the runway strip, and satisfying the relevant frangibility requirements in Appendix E must be permitted on a runway strip:~~

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

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

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

~~No mobile object must be permitted on those parts of the runway strip as defined in paragraph (a) during the use of the runway for landing or take-off.~~

~~C.3.5 Grading of runway strips~~

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

~~C.4 Runway end safety areas~~

~~C.4.1 Design of a runway end safety areas~~

~~A runway end safety area must be provided at each end of a runway strip where:~~

~~the code number is 3 or 4; and~~

~~the code number is 1 or 2 and the runway is an instrument one.~~

~~C.4.2 Dimensions of runway end safety areas~~

~~A runway end safety area must extend from the end of a runway strip to a distance of at least 90 metres where:~~

~~the code number is 3 or 4; and~~

~~the code number is 1 or 2 and the runway is an instrument one.~~

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

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

~~C.5 Stopways~~

~~C.5.1 Width of stopways~~

~~A stopway must have the same width as the runway with which it is associated.~~

~~C.5.2 Surface of stopways~~

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

~~C.6 Taxiways~~

~~C.6.1 Design of a taxiway~~

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

~~OMGWS~~

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

[a] *If the turn pad is intended to be used by aeroplanes with a wheel base less than 18 m.*

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

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

Table C-1. Taxiway minimum separation distances

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

C.6.2 Taxiways on bridges

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

C.7 Taxiway strips

A taxiway, other than an aircraft stand taxi lane, must be included in a strip.

~~C.8 Holding bays, runway-holding positions, intermediate holding positions and road-holding positions~~

~~C.8.1 Design of a holding position~~

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

~~on the taxiway, at the intersection of a taxiway and a runway; and~~

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

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

~~A road-holding position must be established at an intersection of a road with a runway.~~

~~C.8.2 Location of holding positions~~

~~The distance between a holding bay, runway-holding position established at a taxiway/runway intersection or road-holding position and the centre line of a runway must be in accordance with Table C-2 and, in the case of a precision approach runway, such that a holding aircraft or vehicle will not interfere with the operation of radio navigation aids.~~

~~Table C-2. Minimum distance from the runway centre line to a holding bay, runway-holding position or road-holding position~~

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

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

~~b. This distance may need to be increased to avoid interference with radio navigation aids, particularly the glide path and localizer facilities.~~

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

~~The location of a runway-holding position established in accordance with paragraph C.8.1(b) must be such that a holding aircraft or vehicle will not infringe the obstacle free zone, approach surface, take-off climb surface or ILS/MLS critical/ sensitive area or interfere with the operation of radio navigation aids.~~

~~C.9 Isolated aircraft parking position~~

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

~~Appendix D — Obstacle Restriction and Removal~~

~~D.1 — Obstacle limitation surfaces~~

~~D.1.1 Conical surface~~

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

~~Characteristics: — The limits of the conical surface must comprise:~~

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

~~an upper edge located at a specified height above the inner horizontal surface.~~

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

~~D.1.2 Inner Horizontal surface~~

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

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

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

~~D.1.3 Approach surface~~

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

~~Characteristics. — The limits of the approach surface must comprise:~~

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

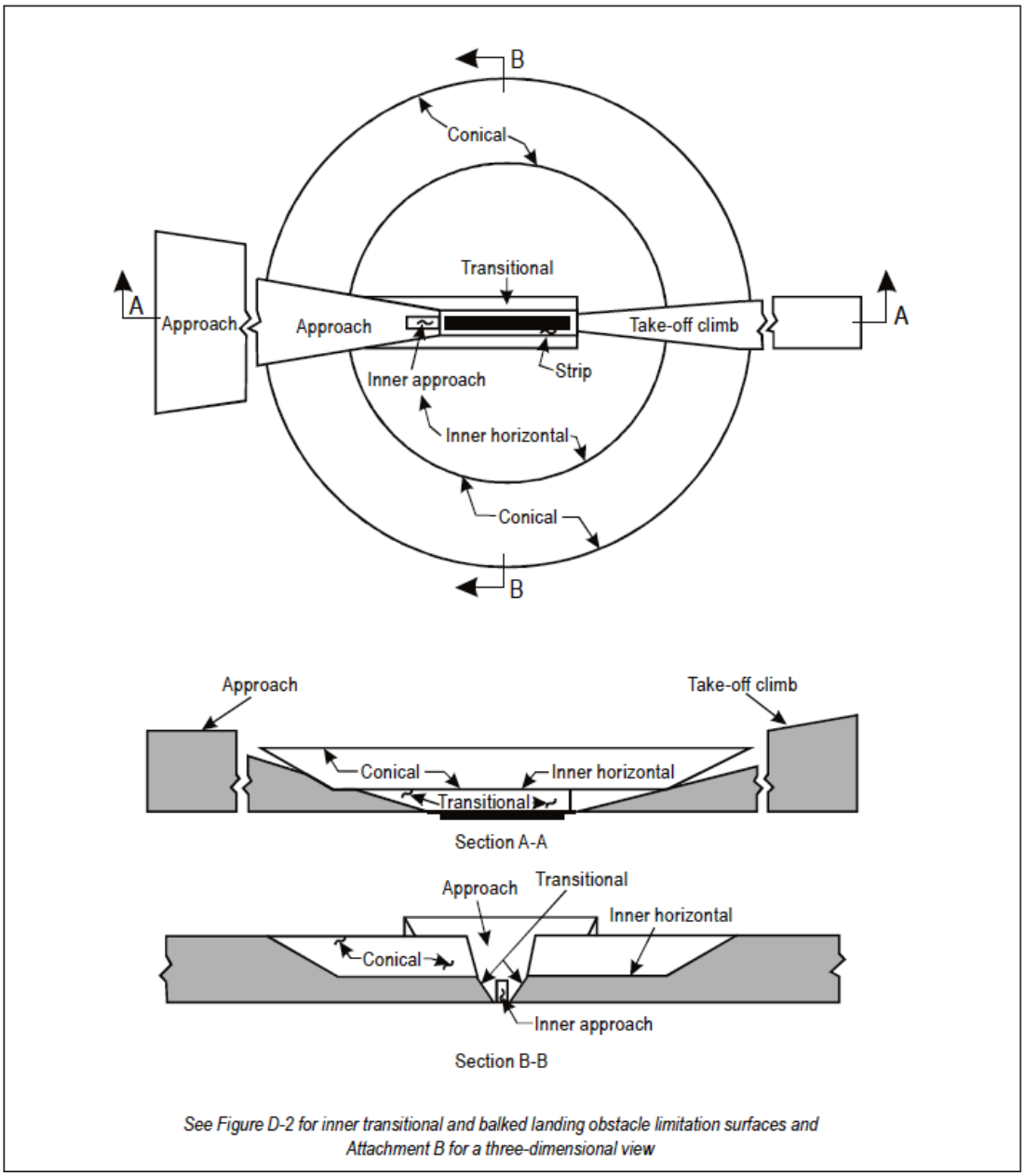
~~two sides originating at the ends of the inner edge and diverging uniformly at a specified rate from the extended centre line of the runway;~~

~~an outer edge parallel to the inner edge; and~~

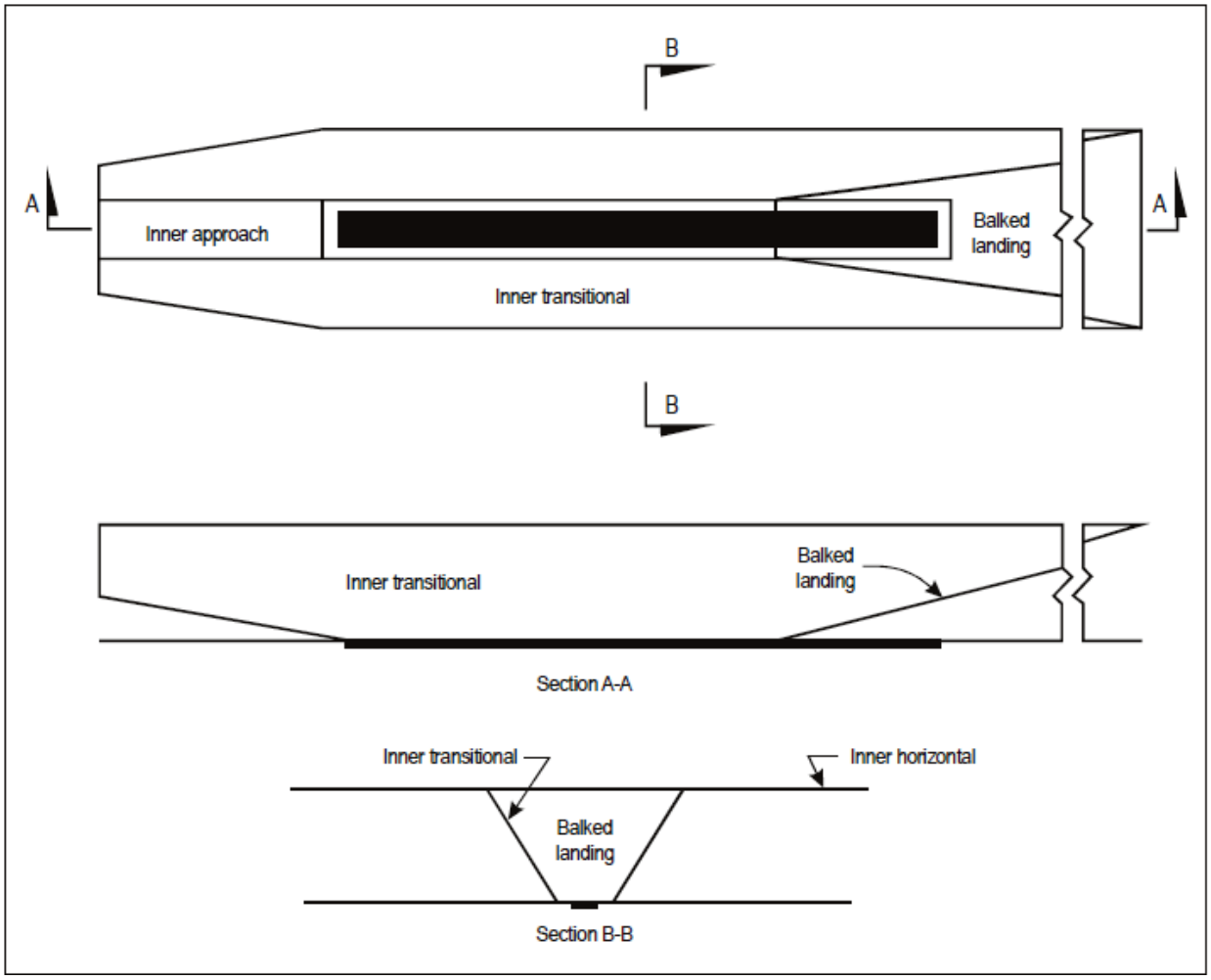
~~the above surfaces must be varied when lateral offset, offset or curved approaches are utilized, specifically, two sides originating at the ends of the inner edge and diverging uniformly at a specified rate from the extended centre line of the lateral offset, offset or curved ground track.~~

~~The elevation of the inner edge must be equal to the elevation of the midpoint of the threshold.~~

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



~~Figure D-1 Obstacle limitation surfaces~~



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

~~D.1.4 Inner approach surface~~

~~Description. Inner approach surface: A rectangular portion of the approach surface immediately preceding the threshold.~~

~~Characteristics. The limits of the inner approach surface must comprise:~~

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

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

~~an outer edge parallel to the inner edge.~~

~~D.1.5 Transitional surface~~

~~Description. — Transitional surface: A complex surface along the side of the strip and part of the side of the approach surface, that slopes upwards and outwards to the inner horizontal surface.~~

~~Characteristics. — The limits of a transitional surface must comprise:~~

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

~~an upper edge located in the plane of the inner horizontal surface.~~

~~The elevation of a point on the lower edge must be:~~

~~along the side of the approach surface — equal to the elevation of the approach surface at that point; and~~

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

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

~~D.1.6 Inner transitional surface~~

~~Description. — Inner transitional surface: A surface similar to the transitional surface but closer to the runway.~~

~~Characteristics. — The limits of an inner transitional surface must comprise:~~

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

~~an upper edge located in the plane of the inner horizontal surface.~~

~~The elevation of a point on the lower edge must be:~~

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

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

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

~~D.1.7 Balked landing surface~~

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

~~Characteristics. The limits of the balked landing surface must comprise:~~

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

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

~~an outer edge parallel to the inner edge and located in the plane of the inner horizontal surface.~~

~~The elevation of the inner edge must be equal to the elevation of the runway centre line at the location of the inner edge.~~

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

~~D.1.8 Take-off climb surface~~

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

~~Characteristics. The limits of the take-off climb surface must comprise:~~

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

~~two sides originating at the ends of the inner edge, diverging uniformly at a specified rate from the take-off track to a specified final width and continuing thereafter at that width for the remainder of the length of the take-off climb surface; and~~

~~an outer edge horizontal and perpendicular to the specified take-off track.~~

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

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

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

~~D.2 Obstacle limitation surfaces requirements~~

~~D.2.1 Non-instrument runways~~

~~The following obstacle limitation surfaces must be established for a non-instrument runway:~~

~~conical surface;~~

~~inner horizontal surface;~~

~~approach surface; and~~

~~transitional surfaces.~~

~~The heights and slopes of the surfaces must not be greater than, and their other dimensions not less than, those specified in Table D-1.~~

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

~~D.2.2 Non-precision approach runways~~

~~The following obstacle limitation surfaces must be established for a non-precision approach runway:~~

~~conical surface;~~

~~inner horizontal surface;~~

~~approach surface; and~~

~~transitional surfaces.~~

~~The heights and slopes of the surfaces must not be greater than, and their other dimensions not less than, those specified in Table D-1, except in the case of the horizontal section of the approach surface described in paragraph (c) below.~~

~~The approach surface must be horizontal beyond the point at which the 2.5 per cent slope intersects:~~

~~a horizontal plane 150 m above the threshold elevation; or~~

~~the horizontal plane passing through the top of any object that governs the obstacle clearance altitude/height (OCA/H); whichever is the higher.~~

~~New objects or extensions of existing objects must not be permitted above an approach surface within 3 000 m of the inner edge or above a transitional surface except when, in the opinion of the appropriate authority, the new object or extension would be shielded by an existing immovable object.~~

~~D.2.3 Precision approach runway~~

~~The following obstacle limitation surfaces must be established for a precision approach runway category I:~~

~~conical surface;~~

~~inner horizontal surface;~~

~~approach surface; and~~

~~transitional surfaces.~~

~~The following obstacle limitation surfaces must be established for a precision approach runway category II or III:~~

~~conical surface;~~

~~inner horizontal surface;~~

~~approach surface and inner approach surface;~~

~~transitional surfaces;~~

~~inner transitional surfaces; and~~

~~balked landing surface.~~

~~The heights and slopes of the surfaces must not be greater than, and their other dimensions not less than, those specified in Table D-1, except in the case of the horizontal section of the approach surface described in paragraph (d) below.~~

~~The approach surface must be horizontal beyond the point at which the 2.5 per cent slope intersects:~~

~~a horizontal plane 150 m above the threshold elevation; or~~

~~the horizontal plane passing through the top of any object that governs the obstacle clearance limit; whichever is the higher.~~

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

Table D-1. Dimensions and slopes of obstacle limitation surfaces – Approach runways

APPROACH RUNWAYS

RUNWAY CLASSIFICATION

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

a. All dimensions are measured horizontally unless specified otherwise.

b. Variable length (see D-2.2(a) or D-2.3(d)).

c. Distance to the end of strip.

e. Where the code letter is F (Column (3) of Table A-1), the width is increased to 140 m for the runway that is intended to be used by Code number 4 aeroplanes.

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

D.2.4 Runways meant for take-off

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

take-off climb surface.

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

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

Table D-2. Dimensions and slopes of obstacle limitation surfaces

RUNWAYS MEANT FOR TAKE-OFF

(1)	(2)	(3)	(4)
Distance from runway end[b]			
Final width	380 m	580 m	1 200 m
			2%[d]

a. All dimensions are measured horizontally unless specified otherwise.

b. The take-off climb surface starts at the end of the clearway if the clearway length exceeds the specified distance.

~~Appendix E — Visual Aids for Navigation~~

~~E.1 — Indicators and signalling devices~~

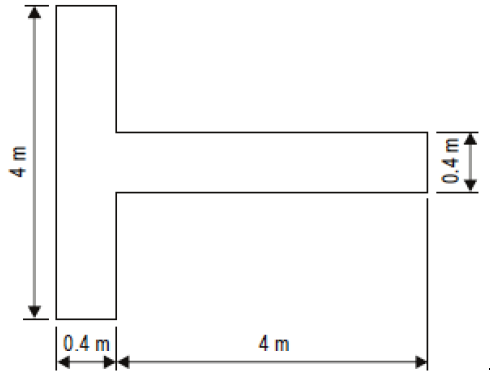
~~E.1.1 Wind direction indicators~~

~~An aerodrome must be equipped with at least one wind direction indicator.~~

~~A wind direction indicator (windsock) must be located on the left hand side of each paved runway threshold so as to be visible from aircraft in flight or on the movement area and in such a way as to be free from the effects of air disturbances caused by nearby objects~~

~~E.1.2 Landing direction indicator~~

~~(a) Where provided, a landing direction indicator must be located in a conspicuous place on the aerodrome.~~



~~**Figure E-1. Landing direction indicator**~~

~~(b) The shape and minimum dimensions of a landing "T" must be as shown in Figure E-1. The colour of the landing "T" must be either white or orange, the choice being dependent on the colour that contrasts best with the background against which the indicator will be viewed. Where required for use at night the landing "T" must either be illuminated or outlined by white lights.~~

~~E.1.3 Signalling lamp~~

~~A signalling lamp must be provided at a controlled aerodrome in the aerodrome control tower.~~

~~E.1.4 Signal area~~

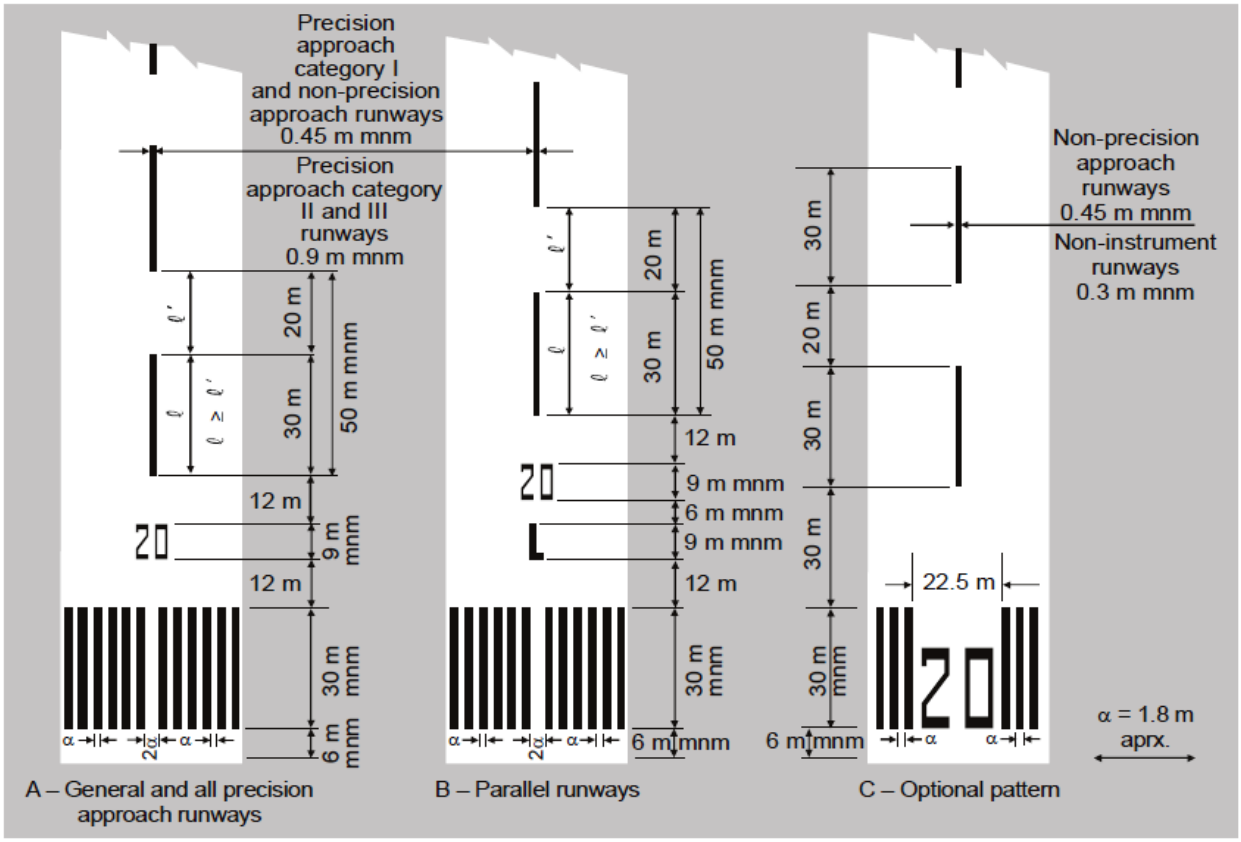
~~The signal area must be an even horizontal surface at least 9 m square.~~

~~E.2 — Markings~~

~~E.2.1 Interruption of runway markings~~

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

~~(b) At an intersection of a runway and taxiway the markings of the runway must be displayed and the markings of the taxiway interrupted, except that runway side stripe markings may be interrupted.~~



~~Figure E-2. Runway designation, centre line and threshold markings~~

~~E.2.2 Colour and conspicuity~~

~~(a) Runway markings must be white.~~

~~(b) Taxiway markings, runway turn pad markings and aircraft stand markings must be yellow.~~

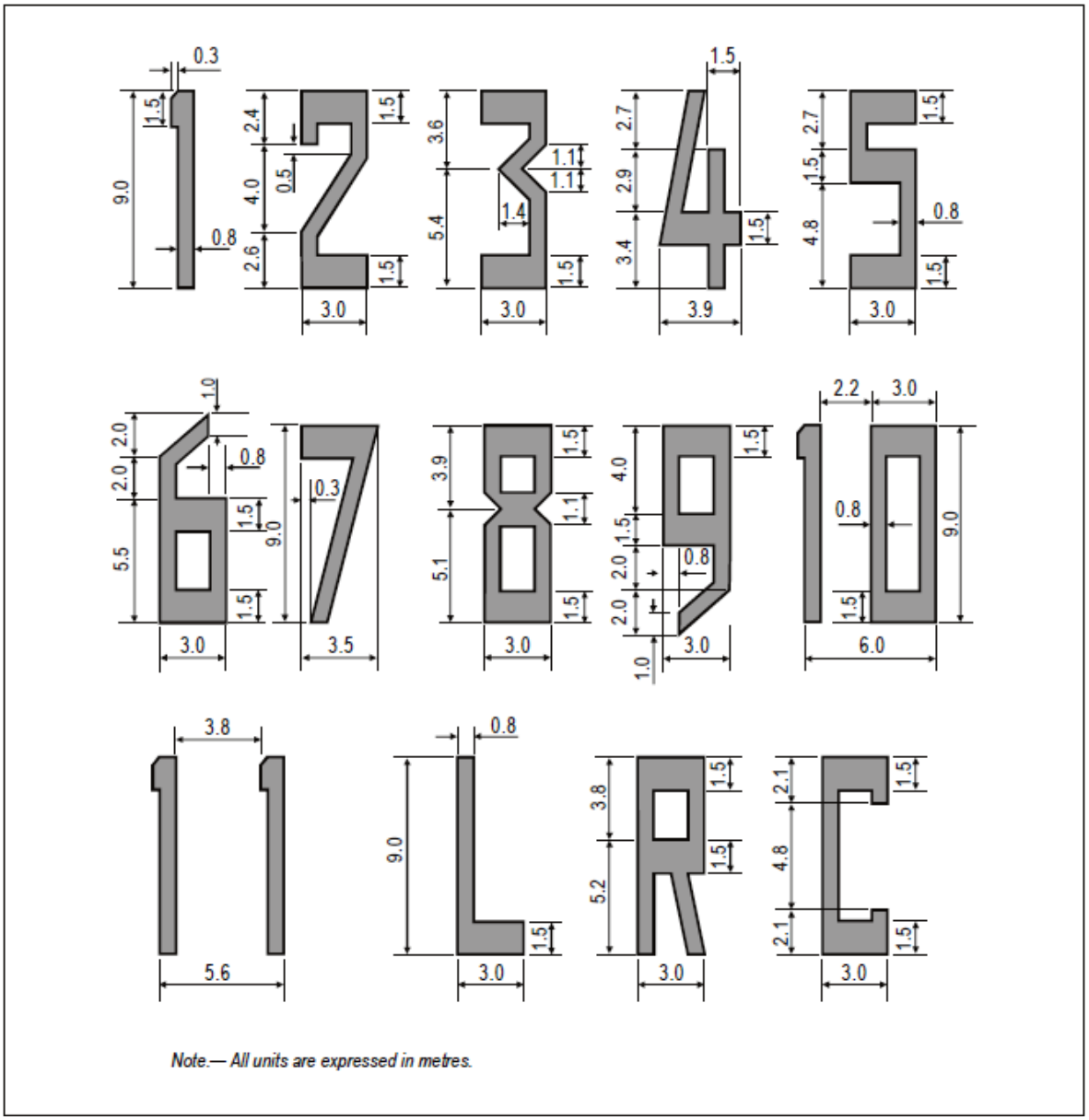
~~(c) Apron safety lines must be of a conspicuous colour which must contrast with that used for aircraft stand markings.~~

~~E.2.3 Runway designation marking~~

~~(a) A runway designation marking must be provided at the thresholds of a paved runway.~~

~~(b) A runway designation marking must be located at a threshold as shown in Figure E-2 as appropriate.~~

~~(c) A runway designation marking must consist of a two-digit number and on parallel runways must be supplemented with a letter. On a single runway, dual parallel runways and triple parallel runways the two-digit number must be the whole number nearest the one-tenth of the magnetic North when viewed from the direction of approach. On four or more parallel runways, one set of adjacent runways must be numbered to the nearest one-tenth magnetic azimuth and the other set of adjacent runways numbered to the next nearest one-tenth of the magnetic azimuth. When the above rule would give a single digit number, it must be preceded by a zero.~~



~~**Figure E-3. Form and proportions of numbers and letters for runway designation markings**~~

~~(d) In the case of parallel runways, each runway designation number must be supplemented by a letter as follows, in the order shown from left to right when viewed from the direction of approach:~~

~~for two parallel runways: "L" "R";~~

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

~~for four parallel runways: "L" "R" "L" "R";~~

~~for five parallel runways: "L" "C" "R" "L" "R" or "L" "R" "L" "C" "R"; and~~

~~for six parallel runways: "L" "C" "R" "L" "C" "R".~~

~~(e) The numbers and letters must be in the form and proportion shown in Figure E-3. The dimensions must be not less than those shown in Figure E-3, but where the numbers are incorporated in the threshold marking, larger dimensions must be used in order to fill adequately the gap between the stripes of the threshold marking.~~

~~E.2.4 Runway centre line marking~~

~~(a) A runway centre line marking must be provided on a paved runway.~~

~~(b) A runway centre line marking must be located along the centre line of the runway between the runway designation markings as shown in Figure E-2, except when interrupted in compliance with E.2.1.(a)~~

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

~~(d) The width of the stripes must be not less than:~~

~~0.90m on precision approach category II and III runways;~~

~~0.45 m on non-precision approach runways where the code number is 3 or 4, and precision approach category I runways; and~~

~~0.30 m on non-precision approach runways where the code number is 1 or 2, and on non-instrument runways.~~

~~E.2.5 Threshold marking~~

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

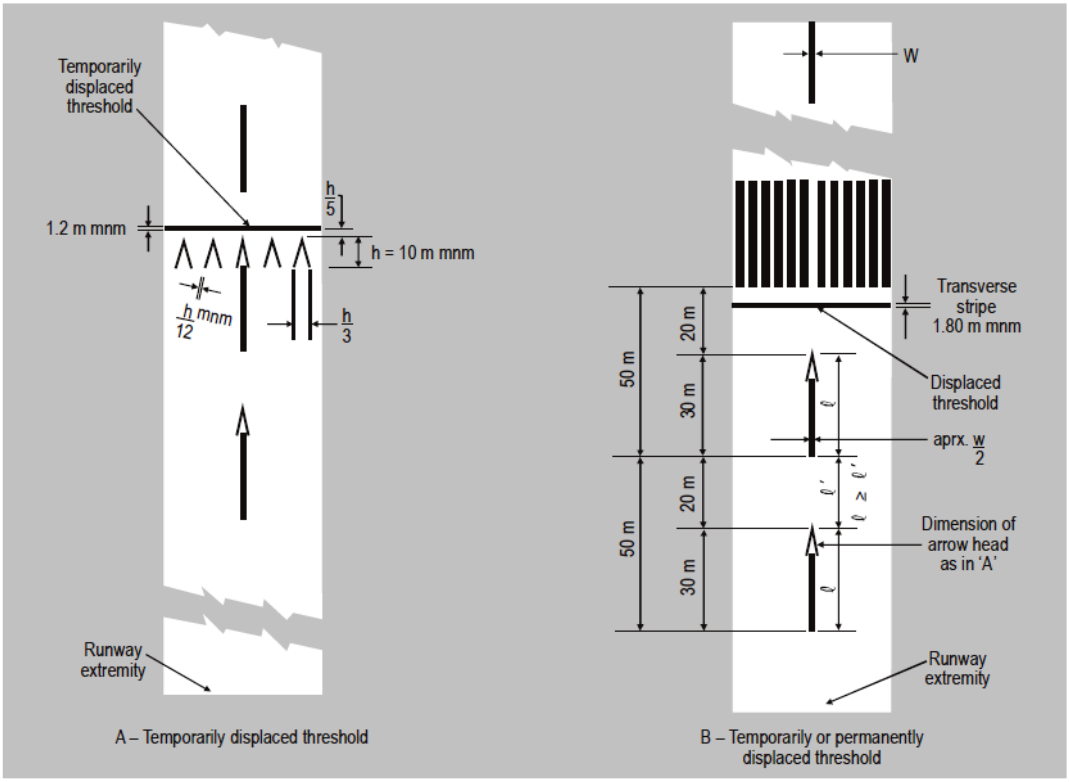
~~(b) The stripes of the threshold marking must commence 6 m from the threshold.~~

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

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

~~except that on non-precision approach and non-instrument runways 45 m or greater in width, they may be as shown in Figure E-2 (C).~~

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



~~Figure E-4. Displaced threshold markings~~

~~E.2.6 Transverse stripe~~

~~A transverse stripe must be not less than 1.80 m wide.~~

~~E.2.7 Arrows~~

~~(a) Where a runway threshold is permanently displaced, arrows conforming to Figure E-4 (B) must be provided on the portion of the runway before the displaced threshold.~~

~~(b) When a runway threshold is temporarily displaced from the normal position, it must be marked as shown in Figure E-4 (A) or E-4 (B) and all markings prior to the displaced threshold must be obscured except the runway centre line marking, which must be converted to arrows.~~

~~E.2.8 Aiming point marking~~

~~(c) An aiming point marking must be provided at each approach end of a paved instrument runway where the code number is 2, 3 or 4.~~

~~(d) The aiming point marking must commence no closer to the threshold than the distance indicated in the appropriate column of Table E-1, except that, on a runway equipped with a visual~~

approach slope indicator system, the beginning of the marking must be coincident with the visual approach slope origin.

Table E-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 1 200 m (3)	1 200 m up to but not including 2 400 m (4)	2 400 m and above
Distance from threshold to	150 m	250 m	300 m	400 m
Length of stripe[a]				
			6–10 m[b]	6–10 m[b]
	6 m[c]	9 m[c]		
Lateral spacing between inner sides			18–22.5 m	18–22.5 m

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

(e) An aiming point marking must consist of two conspicuous stripes. The dimensions of the stripes and the lateral spacing between their inner sides must be in accordance with the provisions of the appropriate column of Table E-1. Where a touchdown zone marking is provided, the lateral spacing between the markings must be the same as that of the touchdown zone marking.

E.2.9 Touchdown zone marking

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

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

Landing distance available

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

~~E.2.10 Runway side stripe marking~~

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

~~E.2.11 Taxiway centre line marking~~

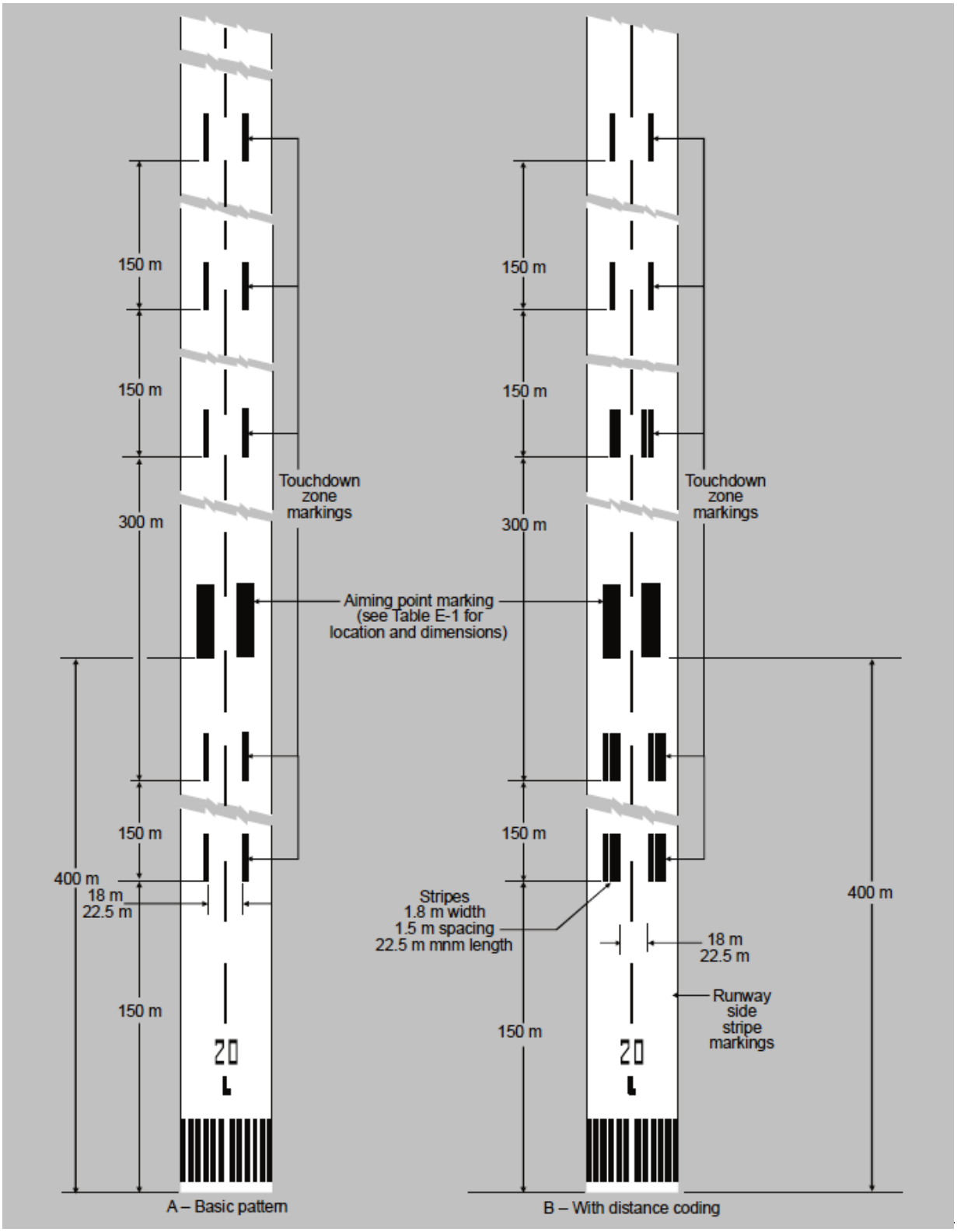
~~(a) Taxiway centre line marking must be provided on a paved taxiway and apron where the code number is 3 or 4 in such a way as to provide continuous guidance between the runway centre line and aircraft stands.~~

~~(b) Taxiway centre line marking must be provided on a paved runway when the runway is part of a standard taxi- route and:~~

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

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

~~(c) Where provided, enhanced taxiway centre line marking must be installed at each taxiway/runway intersection.~~



~~Figure E-5. Aiming point and touchdown zone markings~~

~~**(illustrated for a runway with a length of 2 400 m or more)**~~

~~(d) Where provided~~

~~an enhanced taxiway centre line marking must extend from the runway-holding position Pattern A (as defined in Figure E-6, Taxiway markings) to a distance of up to 47 m in the direction of travel away from the runway. See Figure E-7 (a).~~

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

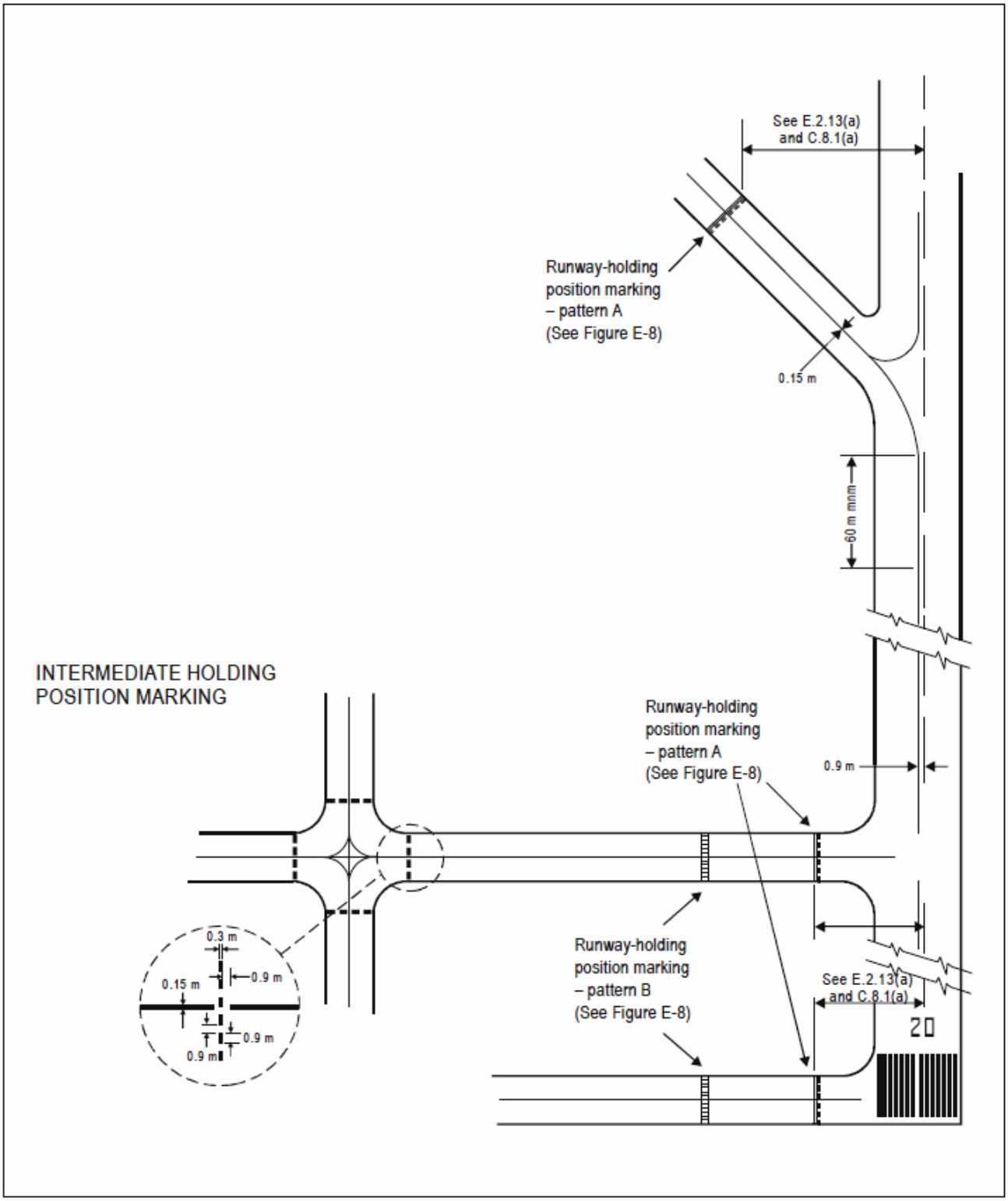
~~If the enhanced taxiway centre line marking continues through a taxiway/taxiway intersection that is located within 47 m of the runway-holding position marking, the enhanced taxiway centre line marking must be interrupted 1.5 m prior to and after the point where the intersected taxiway centre line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

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

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

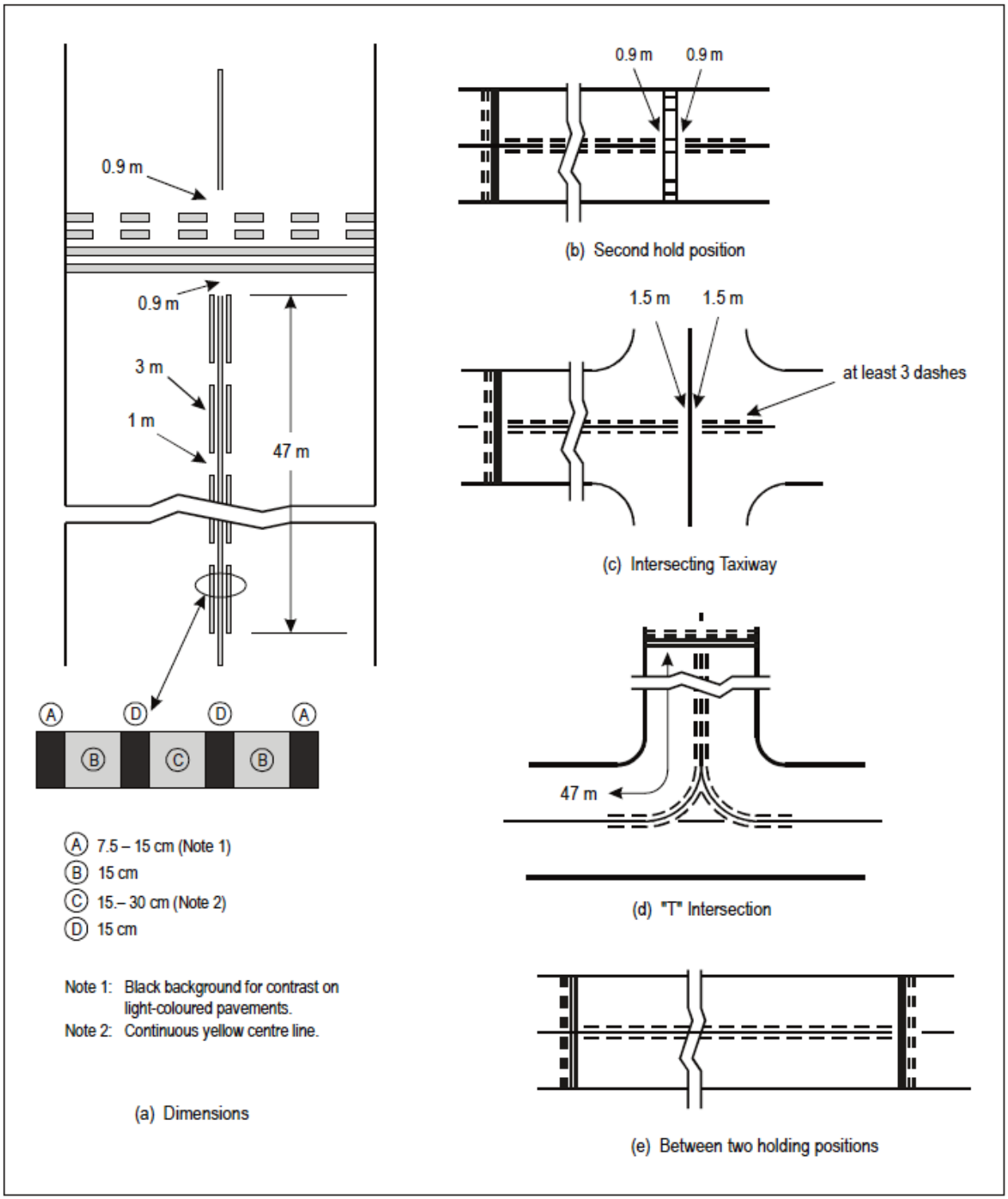
~~(e) A taxiway centre line marking must be at least 15 cm in width and continuous in length except where it intersects with a runway-holding position marking or an intermediate holding position marking as shown in Figure E-6.~~

~~(f) Enhanced taxiway centre line marking must be as shown in Figure E-7.~~



~~Figure E-6. Taxiway markings~~

~~(shown with basic runway markings)~~



~~Figure E-7. Enhanced taxiway centre line marking~~

~~E.2.12 Runway turn pad marking~~

~~(a) Where a runway turn pad is provided, a runway turn pad marking must be provided for continuous guidance to enable an aeroplane to complete a 180-degree turn and align with the runway centre line.~~

~~(b) A runway turn pad marking must be at least 15 cm in width and continuous in length.~~

~~E.2.13 Runway-holding position marking~~

~~(a) A runway-holding position marking must be displayed along a runway-holding position.~~

~~(b) At an intersection of a taxiway and a non-instrument, non-precision approach or take-off runway, the runway- holding position marking must be as shown in Figure E-6, pattern A.~~

~~(c) Where a single runway-holding position is provided at an intersection of a taxiway and a precision approach category I, II or III runway, the runway-holding position marking must be as shown in Figure E-6, pattern A. Where two or three runway-holding positions are provided at such an intersection, the runway-holding position marking closer (closest) to the runway must be as shown in Figure E-6, pattern A and the markings farther from the runway must be as shown in Figure E-6, pattern B.~~

~~(d) The runway-holding position marking displayed at a runway-holding position established in accordance with C.8.2(a) must be as shown in Figure E-6, pattern A.~~

~~(e) Until 26 November 2026, the dimensions of runway-holding position markings must be as shown in Figure E-8, pattern A1 (or A2) or pattern B1 (or B2), as appropriate.~~

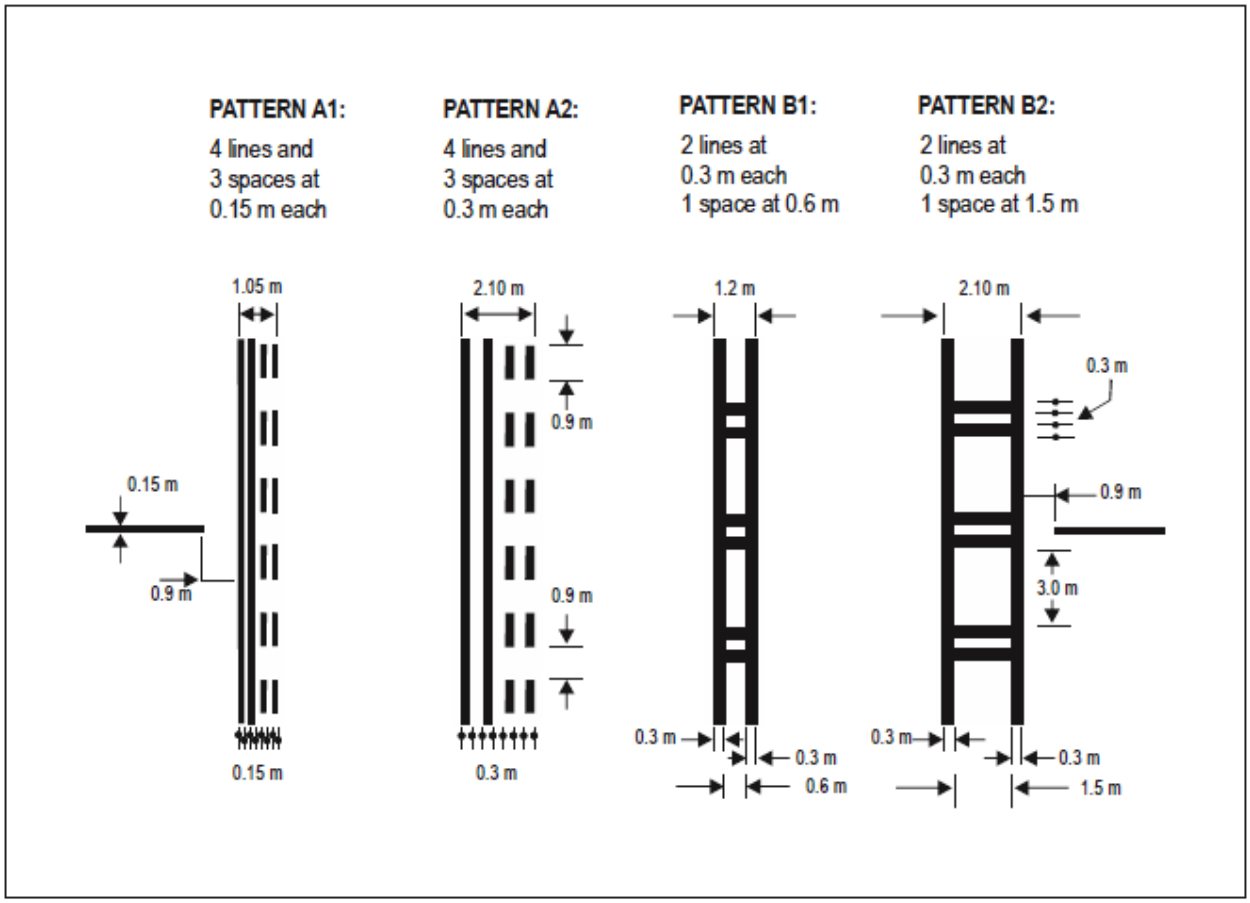
~~(f) As of 26 November 2026, the dimensions of runway-holding position markings must be as shown in Figure E-8, pattern A2 or pattern B2, as appropriate.~~

~~(g) The runway-holding position marking displayed at a runway/runway intersection must be perpendicular to the centre line of the runway forming part of the standard taxi-route. The pattern of the marking must be as shown in Figure E-8, pattern A2.~~

~~E.2.14 Intermediate holding position marking~~

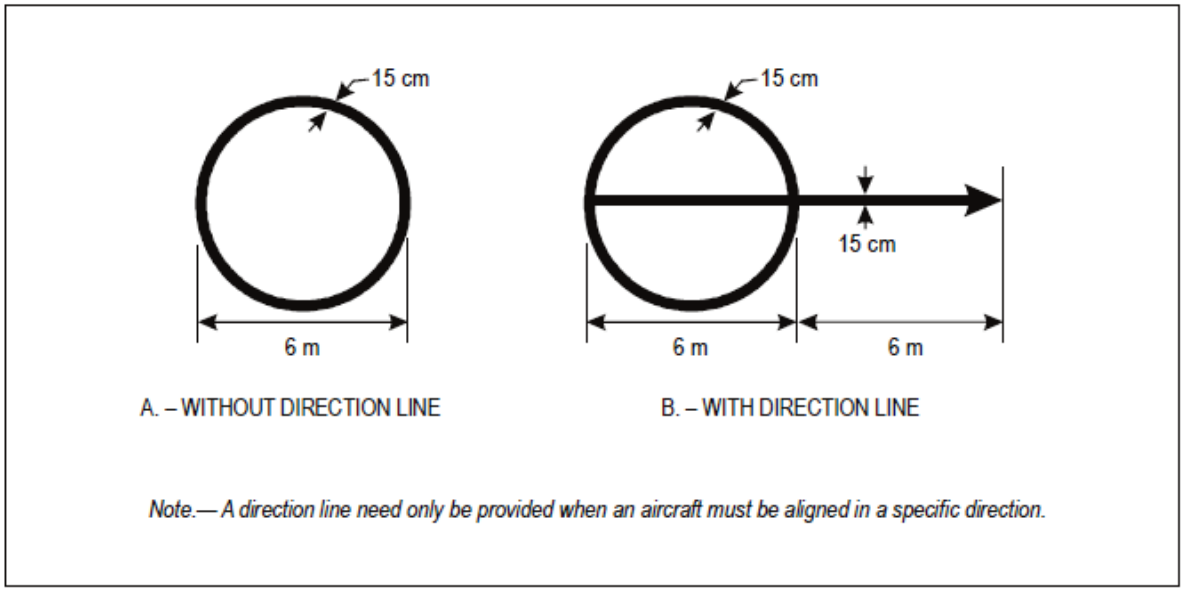
~~(a) Where an intermediate holding position marking is displayed at an intersection of two paved taxiways, it must be located across the taxiway at sufficient distance from the near edge of the intersecting taxiway to ensure safe clearance between taxiing aircraft. It must be coincident with a stop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

~~(b) An intermediate holding position marking must consist of a single broken line as shown in Figure E-6.~~



~~Figure E-8. Runway-holding position markings~~

~~(Note. Patterns A1 and B1 are no longer valid after 2026)~~



~~Figure E-9. VOR aerodrome checkpoint marking~~

~~E.2.15 VOR aerodrome checkpoint marking~~

~~(a) When a VOR aerodrome checkpoint is established, it must be indicated by a VOR aerodrome checkpoint marking and sign.~~

~~(b) A VOR aerodrome checkpoint marking must be centred on the spot at which an aircraft is to be parked to receive the correct VOR signal.~~

~~(c) A VOR aerodrome checkpoint marking must consist of a circle 6 m in diameter and have a line width of 15 cm (see Figure E-9 (A)).~~

~~E.2.16 Apron safety lines~~

~~Apron safety lines must be located so as to define the areas intended for use by ground vehicles and other aircraft servicing equipment, etc., to provide safe separation from aircraft.~~

~~E.2.17 Road-holding position marking~~

~~(a) A road-holding position marking must be provided at all road entrances to a runway.~~

~~(b) The road-holding position marking must be located across the road at the holding position.~~

~~(c) The road-holding position marking must be in accordance with the local road traffic regulations.~~

~~E.2.18 Mandatory instruction marking~~

~~(a) Where it is impracticable to install a mandatory instruction sign in accordance with E.4.2(a), a mandatory instruction marking must be provided on the surface of the pavement.~~

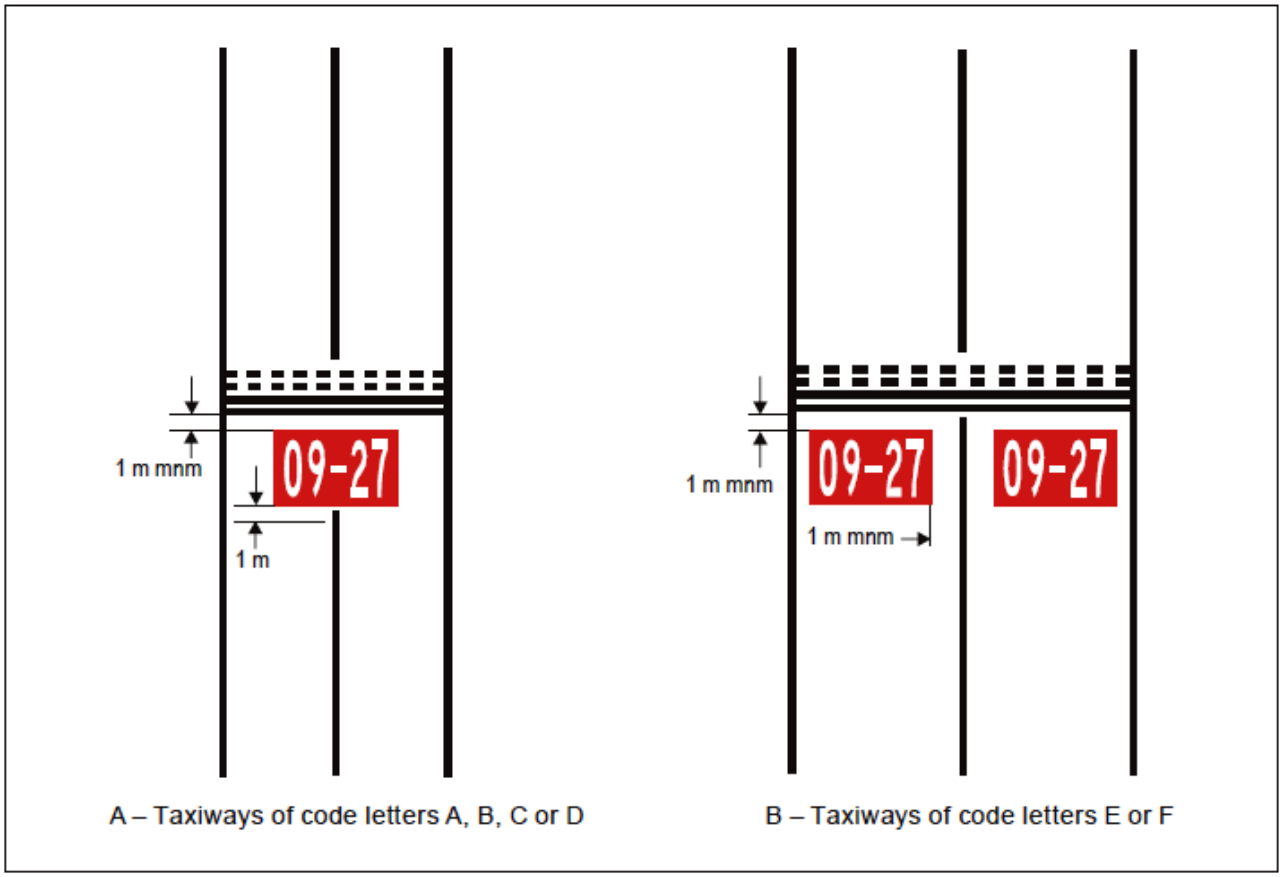
~~(b) The mandatory instruction marking on taxiways where the code letter is A, B, C or D must be located across the taxiway equally placed about the taxiway centre line and on the holding side of the runway-holding position marking as shown in Figure E-10 (A). The distance between the nearest edge of the marking and the runway-holding position marking or the taxiway centre line marking must be not less than 1 m.~~

~~(c) The mandatory instruction marking on taxiways where the code letter is E or F must be located on both sides of the taxiway centre line marking and on the holding side of the runway-holding position marking as shown in Figure E-10 (B). The distance between the nearest edge of the marking and the runway-holding position marking or the taxiway centre line marking must be not less than 1 m.~~

~~(d) A mandatory instruction marking must consist of an inscription in white on a red background. Except for a NO ENTRY marking, the inscription must provide information identical to that of the associated mandatory instruction sign.~~

~~(e) A NO ENTRY marking must consist of an inscription in white reading NO ENTRY on a red background.~~

~~(f) Where there is insufficient contrast between the marking and the pavement surface, the mandatory instruction marking must include an appropriate border, preferably white or black.~~



~~**Figure E-10. Mandatory instruction marking**~~

~~E.2.19 Information marking~~

~~(a) Where an information sign would normally be installed and is impractical to install, as determined by the appropriate authority, an information marking must be displayed on the surface of the pavement.~~

~~(b) An information marking must consist of:~~

~~(1) an inscription in yellow upon a black background, when it replaces or supplements a location sign; and~~

~~(2) an inscription in black upon a yellow background, when it replaces or supplements a direction or destination sign.~~

~~(c) Where there is insufficient contrast between the marking background and the pavement surface, the marking must include:~~

~~(1) a black border where the inscriptions are in black; and~~

~~(2 a yellow border where the inscriptions are in yellow.~~

~~E.3 Lights~~

~~E.3.1 Lights which may endanger the safety of aircraft~~

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

~~E.3.2 Elevated approach lights~~

~~(a) Elevated approach lights and their supporting structures must be frangible except that, in that portion of the approach lighting system beyond 300 m from the threshold:~~

~~(1) where the height of a supporting structure exceeds 12 m, the frangibility requirement must apply to the top 12 m only; and~~

~~(2) where a supporting structure is surrounded by non-frangible objects, only that part of the structure that extends above the surrounding objects must be frangible.~~

~~(b) When an approach light fixture or supporting structure is not in itself sufficiently conspicuous, it must be suitably marked.~~

~~E.3.3 Elevated lights~~

~~Elevated runway, stopway and taxiway lights must be frangible. Their height must be sufficiently low to preserve clearance for propellers and for the engine pods of jet aircraft.~~

~~E.3.4 Surface lights~~

~~Light fixtures inset in the surface of runways, stopways, taxiways and aprons must be so designed and fitted as to withstand being run over by the wheels of an aircraft without damage either to the aircraft or to the lights themselves.~~

~~E.3.5 Light intensity and control~~

~~(a) The intensity of runway lighting must be adequate for the minimum conditions of visibility and ambient light in which use of the runway is intended, and compatible with that of the nearest section of the approach lighting system when provided.~~

~~(b) Where a high-intensity lighting system is provided, a suitable intensity control must be incorporated to allow for adjustment of the light intensity to meet the prevailing conditions. Separate intensity controls or other suitable methods must be provided to ensure that the following systems, when installed, can be operated at compatible intensities:~~

~~(1) approach lighting system;~~

~~(2) runway edge lights;~~

~~(3) runway threshold lights;~~

~~(4) runway end lights;~~

~~(5) runway centre line lights;~~

~~(6) runway touchdown zone lights; and~~

~~(7) taxiway centre line lights.~~

~~(c) On the perimeter of and within the ellipse defining the main beam in CASA Advisory Circulars in the 139 series, the maximum light intensity value must not be greater than three times the minimum light intensity value measured in accordance with CASA Advisory Circulars in the 139 series.~~

~~(d) On the perimeter of and within the rectangle defining the main beam in CASA Advisory Circulars in the 139 series, the maximum light intensity value must not be greater than three times the minimum light intensity value measured in accordance with CASA Advisory Circulars in the 139 series.~~

~~E.3.6 Aeronautical beacons~~

~~(a) Where operationally necessary an aerodrome beacon or an identification beacon must be provided at each aerodrome intended for use at night.~~

~~(b) The operational requirement must be determined having regard to the requirements of the air traffic using the aerodrome, the conspicuity of the aerodrome features in relation to its surroundings and the installation of other visual and non-visual aids useful in locating the aerodrome.~~

~~E.3.7 Aerodrome beacons~~

~~(a) An aerodrome beacon must be provided at an aerodrome intended for use at night if one or more of the following conditions exist:~~

~~(1) aircraft navigate predominantly by visual means;~~

~~(2) reduced visibilities are frequent; or~~

~~(3) it is difficult to locate the aerodrome from the air due to surrounding lights or terrain.~~

~~(b) The aerodrome beacon must be located on or adjacent to the aerodrome in an area of low ambient background lighting.~~

~~(c) The aerodrome beacon must show either coloured flashes alternating with white flashes, or white flashes only. The frequency of total flashes must be from 20 to 30 per minute. Where used, the coloured flashes emitted by beacons at land aerodromes must be green, and coloured flashes emitted~~

by beacons at water aerodromes must be yellow. In the case of a combined water and land aerodrome, coloured flashes, if used, must have the colour characteristics of whichever section of the aerodrome is designated as the principal facility.

(d) The light from the beacon must show at all angles of azimuth. The vertical light distribution must extend upwards from an elevation of not more than 1° to an elevation determined by the appropriate authority to be sufficient to provide guidance at the maximum elevation at which the beacon is intended to be used, and the effective intensity of the flash must be not less than 2 000 cd.

E.3.8 Identification beacon

(a) An identification beacon must be provided at an aerodrome which is intended for use at night and cannot be easily identified from the air by other means.

(b) The identification beacon must be located on the aerodrome in an area of low ambient background lighting.

(c) An identification beacon at a land aerodrome must show at all angles of azimuth. The vertical light distribution must extend upwards from an elevation of not more than 1° to an elevation determined by the appropriate authority to be sufficient to provide guidance at the maximum elevation at which the beacon is intended to be used, and the effective intensity of the flash must be not less than 2 000 cd.

(d) An identification beacon must show flashing green at a land aerodrome and flashing yellow at a water aerodrome.

(e) The identification characters must be transmitted in the International Morse Code.

E.3.9 Approach lighting systems

(a) Non-precision approach runway – where physically practicable, a simple approach lighting system as specified in E.3.5 must be provided to serve a non-precision approach runway, except when the runway is used only in conditions of good visibility or sufficient guidance is provided by other visual aids.

(b) Precision approach runway category I – where physically practicable, a precision approach category I lighting system as specified in E.3.11 must be provided to serve a precision approach runway category I.

(c) Precision approach runway categories II and III – a precision approach category II and III lighting system as specified in E.3.12 must be provided to serve a precision approach runway category II or III.

E.3.10 Simple approach lighting systems

~~(a) A simple approach lighting system must consist of a row of lights on the extended centre line of the runway extending, whenever possible, over a distance of not less than 420 m from the threshold with a row of lights forming a crossbar 18 m or 30 m in length at a distance of 300 m from the threshold.~~

~~(b) The lights forming the crossbar must be as nearly as practicable in a horizontal straight line at right angles to, and bisected by, the line of the centre line lights. The lights of the crossbar must be spaced so as to produce a linear effect, except that, when a crossbar of 30 m is used, gaps may be left on each side of the centre line. These gaps must be kept to a minimum to meet local requirements and each must not exceed 6 m.~~

~~(c) The lights forming the centre line must be placed at longitudinal intervals of 60 m, except that, when it is desired to improve the guidance, an interval of 30 m may be used. The innermost light must be located either 60 m or 30 m from the threshold, depending on the longitudinal interval selected for the centre line lights.~~

~~(d) The system must lie as nearly as practicable in the horizontal plane passing through the threshold, provided that:~~

~~(1) no object other than an ILS or MLS azimuth antenna must protrude through the plane of the approach lights within a distance of 60 m from the centre line of the system; and~~

~~(2) no light other than a light located within the central part of a crossbar or a centre line barrette (not their extremities) must be screened from an approaching aircraft.~~

~~Any ILS or MLS azimuth antenna protruding through the plane of the lights must be treated as an obstacle and marked and lighted accordingly.~~

~~(e) The lights of a simple approach lighting system must be fixed lights and the colour of the lights must be such as to ensure that the system is readily distinguishable from other aeronautical ground lights, and from extraneous lighting if present. Each centre line light must consist of either:~~

~~(1) a single source; or~~

~~(2) a barrette at least 3 m in length.~~

~~E.3.11 Precision approach category I lighting system~~

~~(a) A precision approach category I lighting system must consist of a row of lights on the extended centre line of the runway extending, wherever possible, over a distance of 900 m from the runway threshold with a row of lights forming a crossbar 30 m in length at a distance of 300 m from the runway threshold.~~

~~(b) The lights forming the crossbar must be as nearly as practicable in a horizontal straight line at right angles to, and bisected by, the line of the centre line lights. The lights of the crossbar must be~~

~~spaced so as to produce a linear effect, except that gaps may be left on each side of the centre line. These gaps must be kept to a minimum to meet local requirements and each must not exceed 6 m.~~

~~(c) The lights forming the centre line must be placed at longitudinal intervals of 30 m with the innermost light located 30 m from the threshold.~~

~~(d) The system must lie as nearly as practicable in the horizontal plane passing through the threshold, provided that:~~

~~(1) no object other than an ILS or MLS azimuth antenna must protrude through the plane of the approach lights within a distance of 60 m from the centre line of the system; and~~

~~(2) no light other than a light located within the central part of a crossbar or a centre line barrette (not their extremities) must be screened from an approaching aircraft.~~

~~Any ILS or MLS azimuth antenna protruding through the plane of the lights must be treated as an obstacle and marked and lighted accordingly.~~

~~(e) The centre line and crossbar lights of a precision approach category I lighting system must be fixed lights showing variable white. Each centre line light position must consist of either:~~

~~(1) a single light source in the innermost 300 m of the centre line, two light sources in the central 300 m of the centre line and three light sources in the outer 300 m of the centre line to provide distance information; or~~

~~(2) a barrette.~~

~~(f) Where the serviceability level of the approach lights specified as a maintenance objective in J.5.(f) can be demonstrated, each centre line light position may consist of either:~~

~~(1) a single light source; or~~

~~(2) a barrette.~~

~~(g) The barrettes must be at least 4 m in length. When barrettes are composed of lights approximating to point sources, the lights must be uniformly spaced at intervals of not more than 1.5 m.~~

~~(h) If provided, each barrette flashing light must be flashed twice a second in sequence, beginning with the outermost light and progressing toward the threshold to the innermost light of the system. The design of the electrical circuit must be such that these lights can be operated independently of the other lights of the approach lighting system.~~

~~(i) If the centre line consists of lights as described in (e)(1) or (e)(2), additional crossbars of lights to the crossbar provided at 300 m from the threshold must be provided at 150 m, 450 m, 600 m and 750 m from the threshold. The lights forming each crossbar must be as nearly as practicable in~~

~~a horizontal straight line at right angles to, and bisected by, the line of the centre line lights. The lights must be spaced so as to produce a linear effect, except that gaps may be left on each side of the centre line. These gaps must be kept to a minimum to meet local requirements and each must not exceed 6 m.~~

~~(j) Where the additional crossbars described in (i) are incorporated in the system, the outer ends of the crossbars must lie on two straight lines that either are parallel to the line of the centre line lights or converge to meet the runway centre line 300 m from threshold.~~

~~(k) The lights must be in accordance with the specifications of CASA Advisory Circulars in the 139 series.~~

~~E.3.12 Precision approach category II and III lighting system~~

~~(a) The approach lighting system must consist of a row of lights on the extended centre line of the runway, extending, wherever possible, over a distance of 900 m from the runway threshold. In addition, the system must have two side rows of lights, extending 270 m from the threshold, and two crossbars, one at 150 m and one at 300 m from the threshold, all as shown in Figure E-14. Where the serviceability level of the approach lights specified as maintenance objectives in J.5.(c) can be demonstrated, the system may have two side rows of lights, extending 240 m from the threshold, and two crossbars, one at 150 m and one at 300 m from the threshold, all as shown in Figure E-15.~~

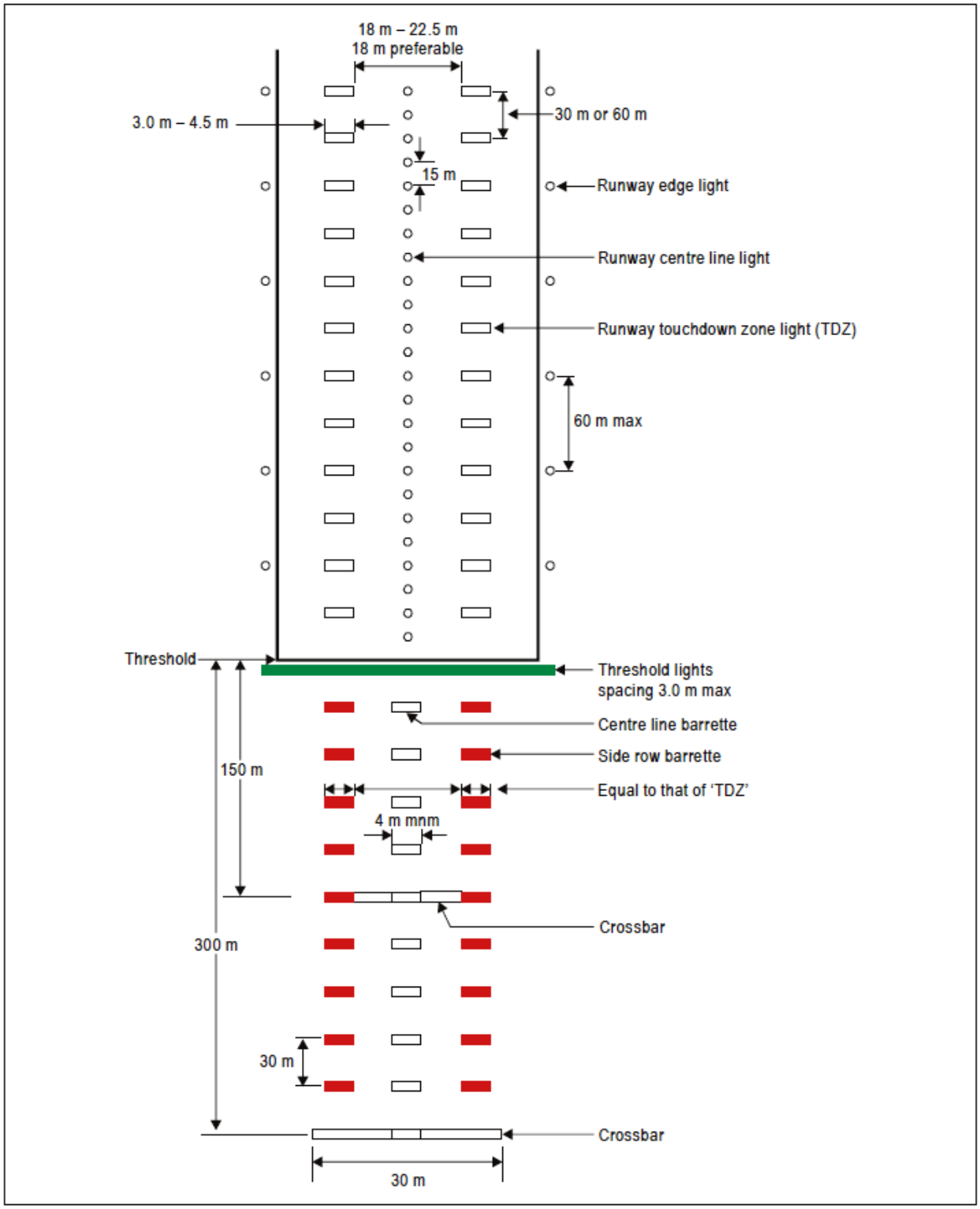
~~(b) The lights forming the centre line must be placed at longitudinal intervals of 30 m with the innermost lights located 30 m from the threshold.~~

~~(c) The lights forming the side rows must be placed on each side of the centre line, at a longitudinal spacing equal to that of the centre line lights and with the first light located 30 m from the threshold. Where the serviceability level of the approach lights specified as maintenance objectives in J.5(c) can be demonstrated, lights forming the side rows may be placed on each side of the centre line, at a longitudinal spacing of 60 m with the first light located 60 m from the threshold. The lateral spacing (or gauge) between the innermost lights of the side rows must be not less than 18 m nor more than 22.5 m, and preferably 18 m, but in any event must be equal to that of the touchdown zone lights.~~

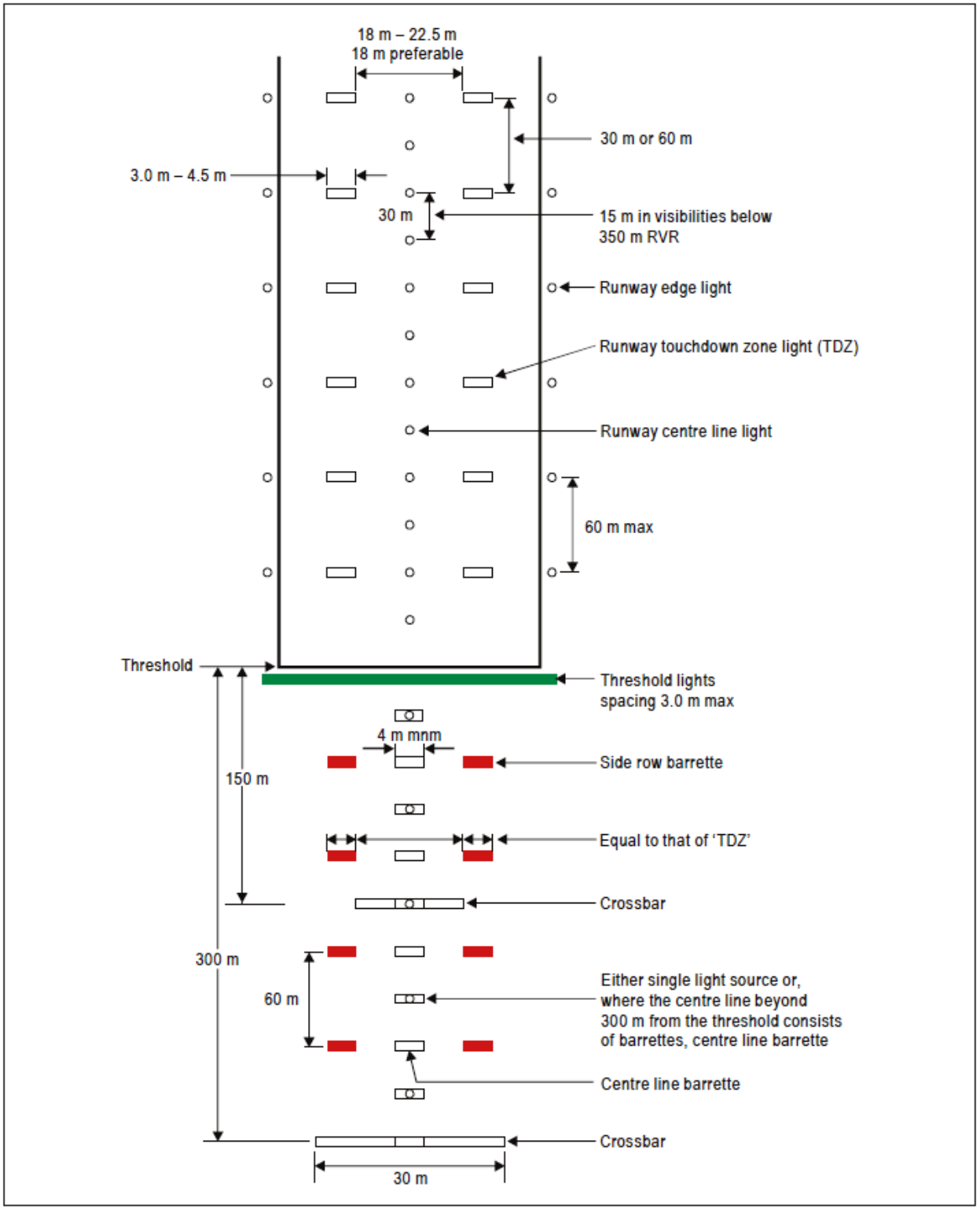
~~(d) The crossbar provided at 150 m from the threshold must fill in the gaps between the centre line and side row lights.~~

~~(e) The crossbar provided at 300 m from the threshold must extend on both sides of the centre line lights to a distance of 15 m from the centre line.~~

~~(f) If the centre line beyond a distance of 300 m from the threshold consists of lights as described in (j)(1) or (j)(2), additional crossbars of lights must be provided at 450 m, 600 m and 750 m from the threshold.~~



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


18 m – 22.5 m
18 m preferable
30 m or 60 m
3.0 m – 4.5 m
30 m
15 m in visibilities below
350 m RVR
Runway edge light
Runway touchdown zone light (TDZ)
Runway centre line light
60 m max
Threshold
Threshold lights
spacing 3.0 m max
4 m mnm
Side row barrette
150 m
Equal to that of 'TDZ'
Crossbar
300 m
60 m
Either single light source or,
where the centre line beyond
300 m from the threshold consists
of barrettes, centre line barrette
Centre line barrette
Crossbar
30 m

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

~~(g) Where the additional crossbars described in (e) are incorporated in the system, the outer ends of these crossbars must lie on two straight lines that either are parallel to the centre line or converge to meet the runway centre line 300 m from the threshold.~~

~~(h) The system must lie as nearly as practicable in the horizontal plane passing through the threshold, provided that:~~

~~(1) no object other than an ILS or MLS azimuth antenna must protrude through the plane of the approach lights within a distance of 60 m from the centre line of the system; and~~

~~(2) no light other than a light located within the central part of a crossbar or a centre line barrette (not their extremities) must be screened from an approaching aircraft.~~

~~Any ILS or MLS azimuth antenna protruding through the plane of the lights must be treated as an obstacle and marked and lighted accordingly.~~

~~(i) The centre line of a precision approach category 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 centre line may consist of single light sources showing variable white. Where the serviceability level of the approach lights specified as maintenance objectives in J.5(c) can be demonstrated, the centre line of a precision approach category II and III lighting system for the first 300 m from the threshold may consist of either:~~

~~(1) barrettes, where the centre line beyond 300 m from the threshold consists of barrettes as described in (k)(2); or~~

~~(2) alternate single light sources and barrettes, where the centre line beyond 300 m from the threshold consists of single light sources as described in (k)(2), with the innermost single light source located 30 m and the innermost barrette located 60 m from the threshold; or~~

~~(3) single light sources where the threshold is displaced 300 m or more;~~

~~all of which must show variable white.~~

~~(j) Beyond 300 m from the threshold each centre line light position must consist of either:~~

~~(1) a barrette as used on the inner 300 m; or~~

~~(2) two light sources in the central 300 m of the centre line and three light sources in the outer 300 m of the centre line;~~

~~all of which must show variable white.~~

~~(k) Where the serviceability level of the approach lights specified as maintenance objectives in J.5(c) can be demonstrated, beyond 300 m from the threshold each centre line light position may consist of either:~~

~~(1) a barrette; or~~

~~(2) a single light source;~~

~~all of which must show variable white.~~

~~(l) The barrettes must be at least 4 m in length. When barrettes are composed of lights approximating to point sources, the lights must be uniformly spaced at intervals of not more than 1.5 m.~~

~~(m) If provided, each barrette flashing light must be flashed twice a second in sequence, beginning with the outermost light and progressing toward the threshold to the innermost light of the system. The design of the electrical circuit must be such that these lights can be operated independently of the other lights of the approach lighting system.~~

~~(n) The side row must consist of barrettes showing red. The length of a side row barrette and the spacing of its lights must be equal to those of the touchdown zone light barrettes.~~

~~(o) The lights forming the crossbars must be fixed lights showing variable white. The lights must be uniformly spaced at intervals of not more than 2.7 m.~~

~~(p) The intensity of the red lights must be compatible with the intensity of the white lights.~~

~~(q) The lights must be in accordance with the specifications of CASA Advisory Circulars in the 1*39 series*.~~

~~E.3.13 Visual approach slope indicator systems~~

~~(a) A visual approach slope indicator system must be provided to serve the approach to a runway whether or not the runway is served by other visual approach aids or by non-visual aids, where one or more of the following conditions exist:~~

~~(1) the runway is used by turbojet or other aeroplanes with similar approach guidance requirements;~~

~~(2) the pilot of any type of aeroplane may have difficulty in judging the approach due to:~~

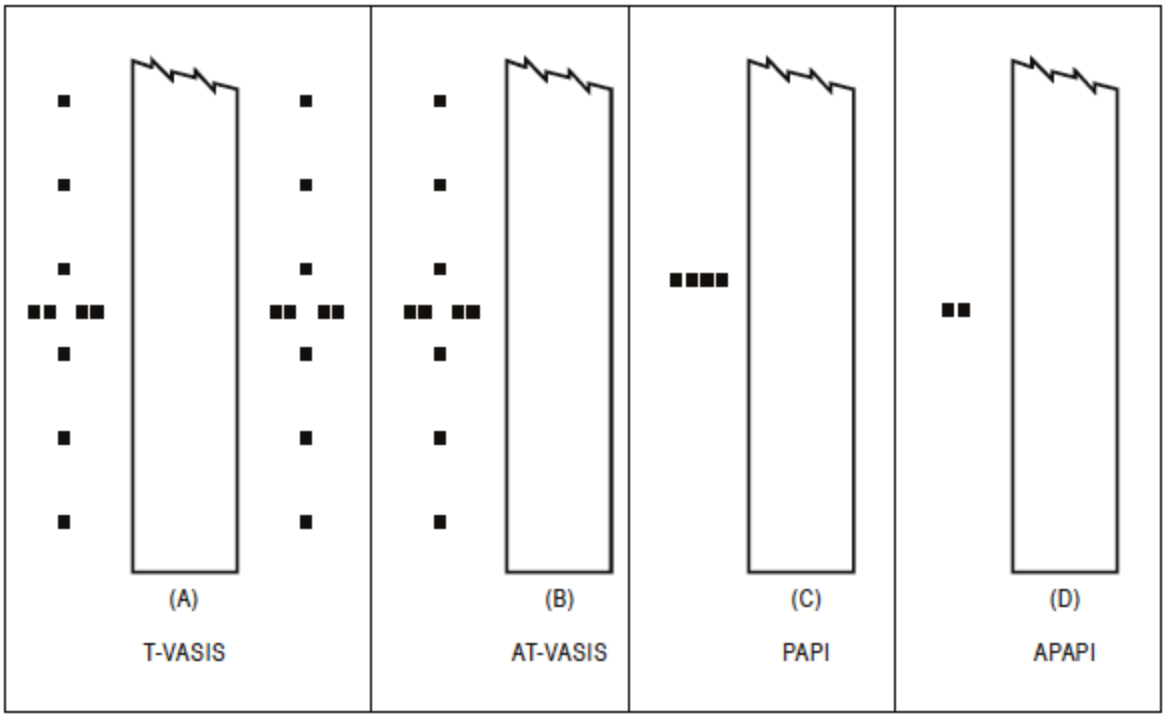
~~(i) inadequate visual guidance such as is experienced during an approach over water or featureless terrain by day or in the absence of sufficient extraneous lights in the approach area by night; or~~

~~(ii) misleading information such as is produced by deceptive surrounding terrain or runway slopes;~~

~~(3) 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;~~

~~(4) physical conditions at either end of the runway present a serious hazard in the event of an aeroplane undershooting or overrunning the runway; and~~

~~(5) terrain or prevalent meteorological conditions are such that the aeroplane may be subjected to unusual turbulence during approach.~~



~~Figure E-16. Visual approach slope indicator systems~~

~~(b) The standard visual approach slope indicator systems must consist of the following:~~

~~(1) T-VASIS and AT-VASIS conforming to the specifications contained in E.3.14 to E.3.17 inclusive;~~

~~(2) PAPI and APAPI systems conforming to the specifications contained in E.3.18 to E.3.21 inclusive;~~

~~as shown in Figure E-16.~~

~~(c) PAPI, T-VASIS or AT-VASIS must be provided where the code number is 3 or 4 when one or more of the conditions specified in E.3.13 exist.~~

~~(d) PAPI or APAPI must be provided where the code number is 1 or 2 when one or more of the conditions specified in E.3.13(a) exist.~~

~~E.3.14 T-VASIS and AT-VASIS~~

~~(a) The T-VASIS must consist of twenty light units symmetrically disposed about the runway centre line in the form of two wing bars of four light units each, with bisecting longitudinal lines of six lights, as shown in Figure E-17.~~

~~(b) The 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.~~

~~(c) The light units must be constructed and arranged in such a manner that the pilot of an aeroplane during an approach will:~~

~~(1) when above the approach slope, see the wing bar(s) white, and one, two or three fly-down lights, the more fly-down lights being visible the higher the pilot is above the approach slope;~~

~~(2) when on the approach slope, see the wing bar(s) white; and~~

~~(3) when below the approach slope, see the wing bar(s) and one, two or three fly-up lights white, the more fly-up lights being visible the lower the pilot is below the approach slope; and when well below the approach slope, see the wing bar(s) and the three fly-up lights red.~~

~~When on or above the approach slope, no light must be visible from the fly-up light units; when on or below the approach slope, no light must be visible from the fly-down light units.~~

~~E.3.15 Sitting of T-VASIS and AT-VASIS~~

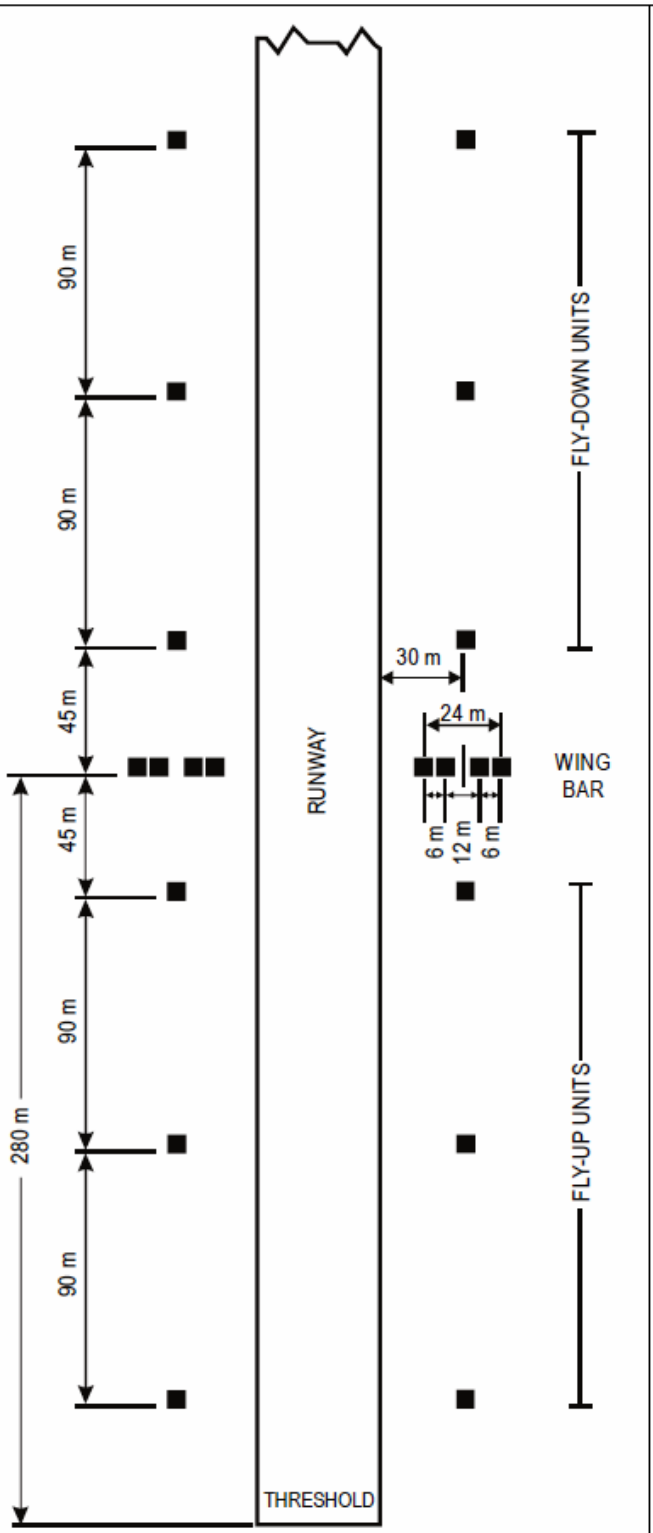
~~The light units must be located as shown in Figure E-17, subject to the installation tolerances given therein.~~

~~E.3.16 Characteristics of the T-VASIS and AT-VASIS light units~~

~~(a) The systems must be suitable for both day and night operations.~~

~~(b) 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 must 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 white beam 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 white beam from approximately the approach slope down to 1°54′ vertical angle and a red beam below a 1°54′ vertical angle. The angle of the top of the red beam in the wing bar units and fly-up units may be increased to comply with E.3.17(d).~~

~~(c) The light intensity distribution of the fly-down, wing bar and fly-up light units must be as shown in CASA Advisory Circulars in the 139 series.~~



INSTALLATION TOLERANCES

The appropriate authority may:

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

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

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

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

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

e) where there is a transverse slope in the ground, adjust the longitudinal distance of two light units or two wing bars to compensate for the difference in level between them as necessary to meet the requirements of E.3.12(g).

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

a) the selected approach slope;

b) the longitudinal slope of the runway; and

c) the selected nominal eye height over the threshold.

~~Figure E-17. Sitting of light for T-VASIS~~

~~(d) The colour transition from red to white in the vertical plane must be such as to appear to an observer, at a distance of not less than 300 m, to occur over a vertical angle of not more than 15′.~~

~~(e) At full intensity the red light must have a Y coordinate not exceeding 0.320.~~

~~(f) 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.~~

~~(g) 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.~~

~~(h) 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 minimize the probability of the slots being wholly or partially blocked by snow or ice where these conditions are likely to be encountered.~~

~~E.3.17 Approach slope and elevation setting of T-VASIS and AT-VASIS light beams~~

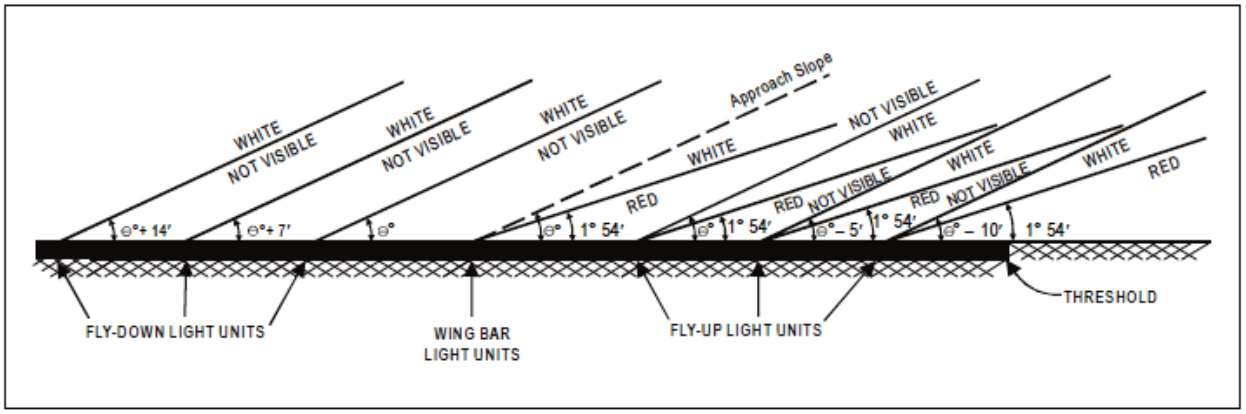
~~(a) The approach slope must be appropriate for use by the aeroplanes using the approach.~~

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

~~(c) 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 that of 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 light units must decrease by 5′ of arc in angle of elevation at each successive unit away from the wing bar. The cut-in angle of the bottom of the beam of the fly-down light units must increase by 7′ of arc at each successive unit away from the wing bar (see Figure E-18).~~

~~(d) 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 light units are visible would clear all objects in the approach area by a safe margin if any such light did not appear red.~~

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



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

~~E.3.18 PAPI and APAPI~~

~~(a) The PAPI system must consist of a wing bar of four sharp transition multi-lamp (or paired single lamp) units equally spaced. The system must be located on the left side of the runway unless it is physically impracticable to do so.~~

~~(b) The APAPI system must consist of a wing bar of two sharp transition multi-lamp (or paired single lamp) units. The system must be located on the left side of the runway unless it is physically impracticable to do so.~~

~~(c) The wing bar of a PAPI must be constructed and arranged in such a manner that a pilot making an approach will:~~

~~(1) 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;~~

~~(2) when above the approach slope, see the one unit nearest the runway as red and the three units farthest from the runway as white; and when further above the approach slope, see all the units as white; and~~

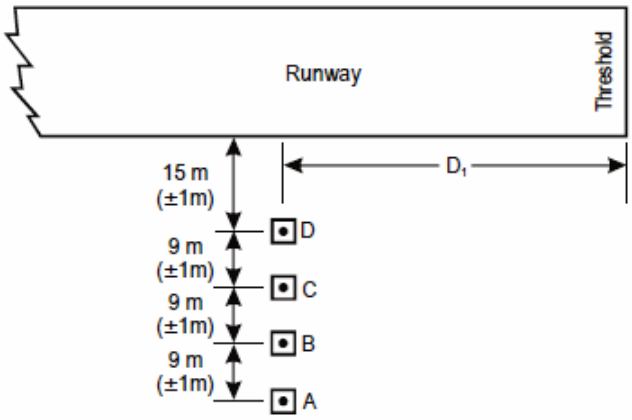
~~(3) when below the approach slope, see the three units nearest the runway as red and the unit farthest from the runway as white; and when further below the approach slope, see all the units as red.~~

~~(d) The wing bar of an APAPI must be constructed and arranged in such a manner that a pilot making an approach will:~~

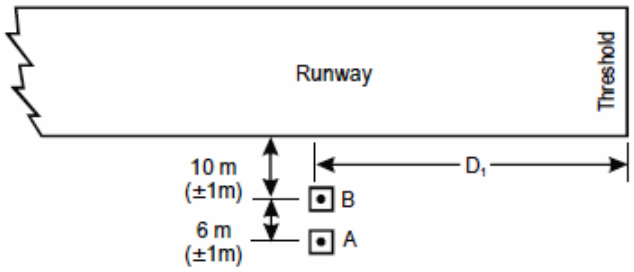
~~(1) when on or close to the approach slope, see the unit nearer the runway as red and the unit farther from the runway as white;~~

~~(2) when above the approach slope, see both the units as white; and~~

~~(3) when below the approach slope, see both the units as red.~~



Typical PAPI wing bar



Typical APAPI wing bar

INSTALLATION TOLERANCES

a) Where a PAPI or APAPI is installed on a runway not equipped with an ILS or MLS, the distance D_1 shall be calculated to ensure that the lowest height at which a pilot will see a correct approach path indication (Figure E-20, angle B for a PAPI and angle A for an APAPI) provides the wheel clearance over the threshold specified in Table E-2 for the most demanding amongst aeroplanes regularly using the runway.

b) Where a PAPI or APAPI is installed on a runway equipped with an ILS and/or MLS, the distance D_1 shall be calculated to provide the optimum compatibility between the visual and non-visual aids for the range of eye-to-antenna heights of the aeroplanes regularly using the runway. The distance shall be equal to that between the threshold and the effective origin of the ILS glide path or MLS minimum glide path, as appropriate, plus a correction factor for the variation of eye-to-antenna heights of the aeroplanes concerned. The correction factor is obtained by multiplying the average eye-to-antenna height of those aeroplanes by the cotangent of the approach angle. However, the distance shall be such that in no case will the wheel clearance over the threshold be lower than that specified in column (3) of Table E-2.

Note.— See Section E.2.8 for specifications on aiming point marking. Guidance on the harmonization of PAPI, ILS and/or MLS signals is contained in the *Aerodrome Design Manual* (Doc 9157), Part 4.

c) If a wheel clearance, greater than that specified in a) above is required for specific aircraft, this can be achieved by increasing D_1.

d) Distance D_1 shall be adjusted to compensate for differences in elevation between the lens centres of the light units and the threshold.

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

f) A spacing of 6 m (±1 m) between PAPI units should be used on code numbers 1 and 2. In such an event, the inner PAPI unit shall be located not less than 10 m (±1 m) from the runway edge.

Note.— Reducing the spacing between light units results in a reduction in usable range of the system.

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

~~**Figure E-19. Siting of PAPI and APAPI**~~

~~E.3.19 Sitting of PAPI and APAPI~~

~~The light units must be located as in the basic configuration illustrated in Figure 5-19, subject to the installation tolerances given therein. The units forming a wing bar 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.~~

~~E.3.20 Characteristics of the PAPI and APAPI light units~~

~~(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 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 coordinate not exceeding 0.320.~~

~~(d) The light intensity distribution of the light units must be as shown in Advisory Circular 139 Series.~~

~~(e) Suitable intensity control must be provided so as 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 and dirt on optically 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.~~

~~E.3.21 Approach slope and elevation setting of PAPI and APAPI light beams~~

~~(a) The approach slope as defined in Figure E-20 must be appropriate for use by the aeroplanes using the approach.~~

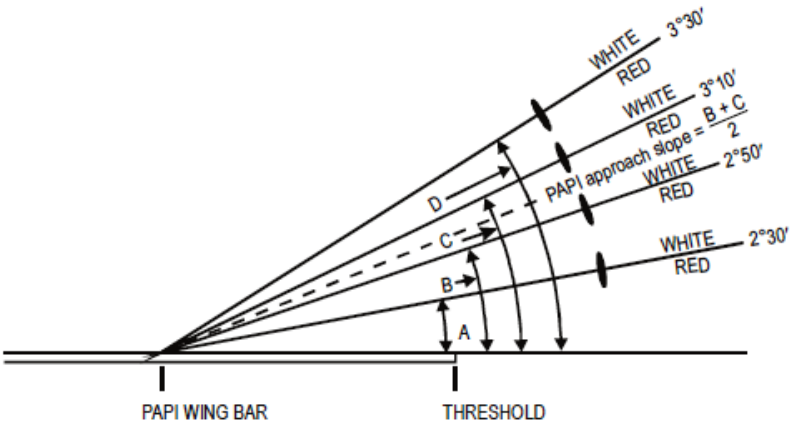
~~(b) When the runway is equipped with an ILS and/or MLS, the siting and the angle of elevation of the light units must be such that the visual approach slope conforms as closely as possible with the glide path of the ILS and/or the minimum glide path of the MLS, as appropriate.~~

~~(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 Table E-2).~~

~~(d) The angle of elevation settings of the light units in an APAPI wing bar must be such that, during an approach, the pilot of an aeroplane observing the lowest on slope signal, i.e. one white and one red, will clear all objects in the approach area by a safe margin (see Table E-2).~~

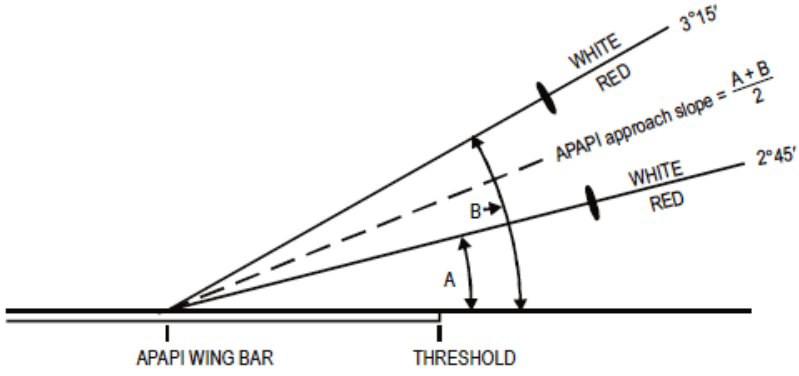
~~(e) The azimuth spread of the light beam must be suitably restricted where an object located outside the obstacle protection surface of the PAPI or APAPI system, but within the lateral limits of its light beam, is found to extend above the plane of the obstacle protection surface and an aeronautical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

~~(f) Where wing bars are installed on each side of the runway to provide roll guidance, corresponding units must be set at the same angle so that the signals of each wing bar change symmetrically at the same time.~~



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

A — 3° PAPI ILLUSTRATED



B — 3° APAPI ILLUSTRATED

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

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

~~Eye-to-wheel height of aeroplane in the approach~~	~~Desired wheel clearance~~	~~Minimum wheel clearance~~
~~(1)~~	~~(2)~~	~~(3)~~

		3[e]
3 m up to but not including 5 m	9	4
5 m up to but not including 8 m	9	5
8 m up to but not including 14 m	9	6

a. In selecting the eye-to-wheel height group, only aeroplanes meant to use the system on a regular basis must be considered. The most demanding amongst such aeroplanes must determine the eye-to-wheel height group.

b. Where practicable the desired wheel clearances shown in column (2) must be provided.

c. The wheel clearances in column (2) may be reduced to no less than those in column (3) where an aeronautical study indicates that such reduced wheel clearances are acceptable.

d. When a reduced wheel clearance is provided at a displaced threshold it must be ensured that the corresponding desired wheel clearance specified in column (2) will be available when an aeroplane at the top end of the eye-to-wheel height group chosen overflies the extremity of the runway.

E.3.22 Obstacle protection surface

(a) An obstacle protection surface must be established when it is intended to provide a visual approach slope indicator system.

(b) The characteristics of the obstacle protection surface, i.e. origin, divergence, length and slope, must correspond to those specified in the relevant column of Table E-3 and in Figure E-21.

(c) New objects or extensions of existing objects must not be permitted above an obstacle protection surface except when, in the opinion of the appropriate authority, the new object or extension would be shielded by an existing immovable object.

(d) Existing objects above an obstacle protection surface must be removed except when, in the opinion of the appropriate authority, the object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety of operations of aeroplanes.

(e) Where an aeronautical study indicates that an existing object extending above an obstacle protection surface (OPS) could adversely affect the safety of operations of aeroplanes, one or more of the following measures must be taken:

(1) remove the object;

(2) suitably raise the approach slope of the system;

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

(4) displace the axis of the system and its associated obstacle protection surface by no more than 5°; and

~~(5) suitably displace the system upwind of the threshold such that the object no longer penetrates the OPS.~~

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

~~Surface dimensions~~	~~Runway type/code number~~							
	~~Non-instrument~~				~~Instrument~~			
	~~1~~	~~2~~	~~3~~	~~4~~	~~1~~	~~2~~	~~3~~	~~4~~
		~~80 m~~[a]						
~~Distance from the visual approach slope indicator~~	~~D_1+30 m~~	~~D_1+60 m~~	~~D_1+60 m~~	~~D_1+60 m~~	~~D_1+60 m~~	~~D_1+60 m~~	~~D_1+60 m~~	~~D_1+60 m~~
~~Divergence (each side)~~	~~10%~~	~~10%~~	~~10%~~	~~10%~~	~~15%~~	~~15%~~	~~15%~~	~~15%~~
		~~7 500 m~~[b]				~~7 500 m~~[b]		
~~*Slope*~~								
~~(a) T-VASIS and AT-VASIS~~	~~–~~[c]	~~1.9°~~	~~1.9°~~	~~1.9°~~	~~–~~	~~1.9°~~	~~1.9°~~	~~1.9°~~
~~(b) PAPI~~[d]	~~–~~	~~A−0.57°~~	~~A−0.57°~~	~~A−0.57°~~	~~A−0.57°~~	~~A−0.57°~~	~~A−0.57°~~	~~A−0.57°~~
~~(c) APAPI~~[d]	~~A−0.9°~~	~~A−0.9°~~	~~–~~	~~–~~	~~A−0.9°~~	~~A−0.9°~~	~~–~~	~~–~~

~~a. This length is to be increased to 150 m for a T-VASIS or AT-VASIS.~~

~~b. This length is to be increased to 15 000 m for a T-VASIS or AT-VASIS.~~

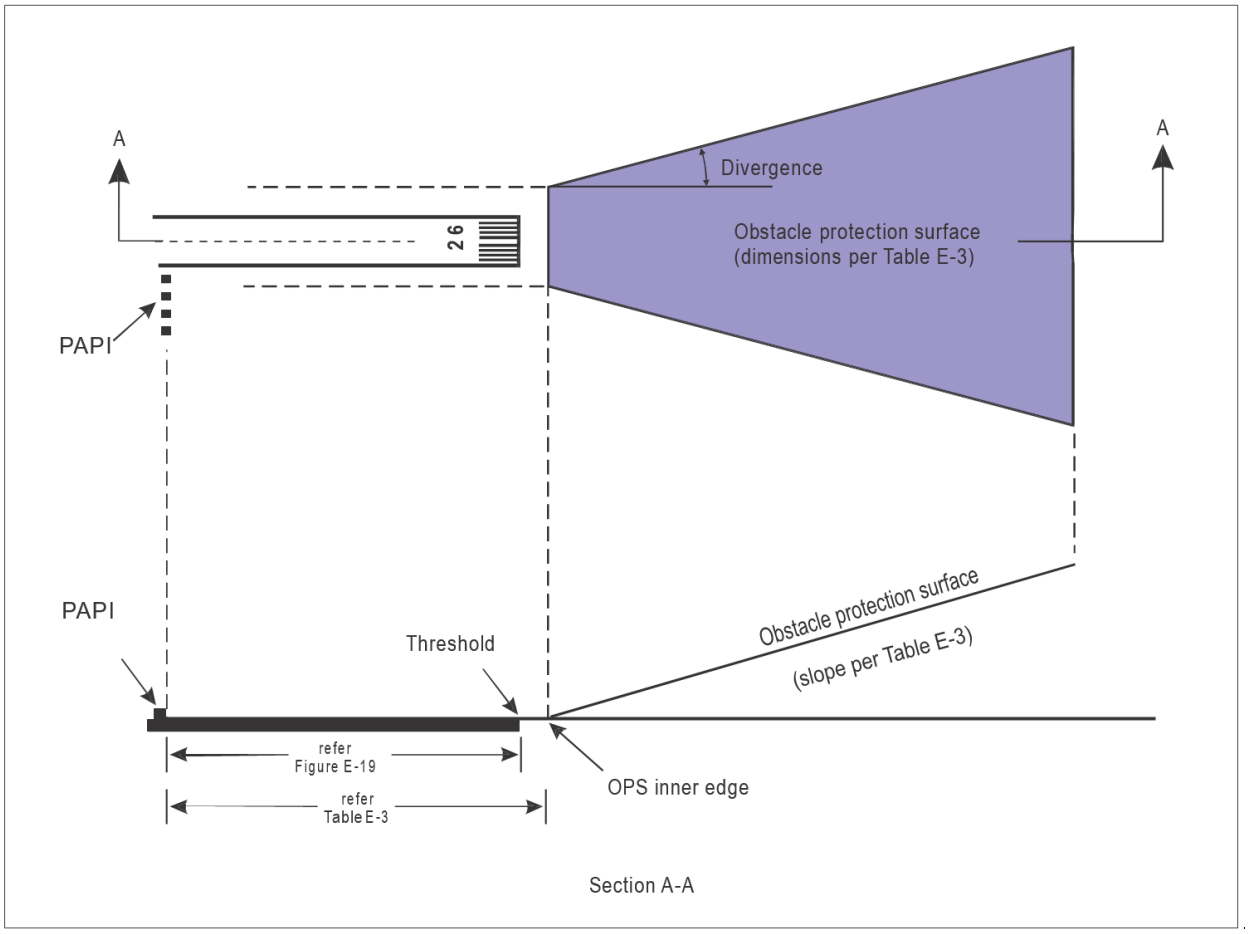
~~c. No slope has been specified if a system is unlikely to be used on runway type/code number indicated. d. Angles as indicated in Figure E-20.~~

~~e. D_1 is the distance of the visual approach slope indicator system from threshold prior to any displacement to remedy object penetration of the OPS~~

~~E.3.23 Runway threshold identification lights~~

~~(a) Runway threshold identification lights must be located symmetrically about the runway centre line, in line with the threshold and approximately 10 m outside each line of runway edge lights.~~

~~(b) The lights must be visible only in the direction of approach to the runway.~~



~~Figure E-21. Obstacle protection surface for visual approach slope indicator systems~~

~~E.3.24 Runway edge lights~~

~~(a) 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.~~

~~(b) Runway edge lights must be placed along the full length of the runway and must be in two parallel rows equidistant from the centre line.~~

~~(c) 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.~~

~~(d) The lights must be uniformly spaced in rows at intervals of not more than 60 m for an instrument runway, and at intervals of not more than 100 m for a non-instrument runway. The lights on opposite sides of the runway axis must be on lines at right angles to that axis. At intersections of runways, lights may be spaced irregularly or omitted, provided that adequate guidance remains available to the pilot.~~

~~(e) Runway edge lights must be fixed lights showing variable white, except that:~~

~~(1) in the case of a displaced threshold, the lights between the beginning of the runway and the displaced threshold must show red in the approach direction; and~~

~~(2) a section of the lights 600 m or one-third of the runway length, whichever is the less, at the remote end of the runway from the end at which the take-off run is started, may show yellow.~~

~~(f) The runway edge lights must show at all angles in azimuth necessary to provide guidance to a pilot landing or taking off in either direction. When the runway edge lights are intended to provide circling guidance, they must show at all angles in azimuth.~~

~~(g) In all angles of azimuth required in (f), runway edge lights must show at angles up to 15° above the horizontal with an intensity adequate for the conditions of visibility and ambient light in which use of the runway for take-off or landing is intended. In any case, the intensity must be at least 50 cd except that at an aerodrome without extraneous lighting, the intensity of the lights may be reduced to not less than 25 cd to avoid dazzling the pilot.~~

~~(h) Runway edge lights on a precision approach runway must be in accordance with the specifications of CASA Advisory Circulars in the 139 series.~~

~~E.3.25 Runway threshold and wing bar lights~~

~~(a) Runway threshold lights must be provided for a runway equipped with runway edge lights, except on a non- instrument or non-precision approach runway where the threshold is displaced and wing bar lights are provided.~~

~~(b) When a threshold is at the extremity of a runway, the threshold lights must be placed in a row at right angles to the runway axis as near to the extremity of the runway as possible and, in any case, not more than 3 m outside the extremity.~~

~~(c) When a threshold is displaced from the extremity of a runway, threshold lights must be placed in a row at right angles to the runway axis at the displaced threshold.~~

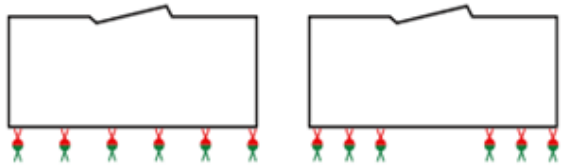
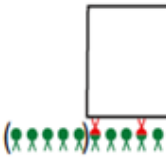
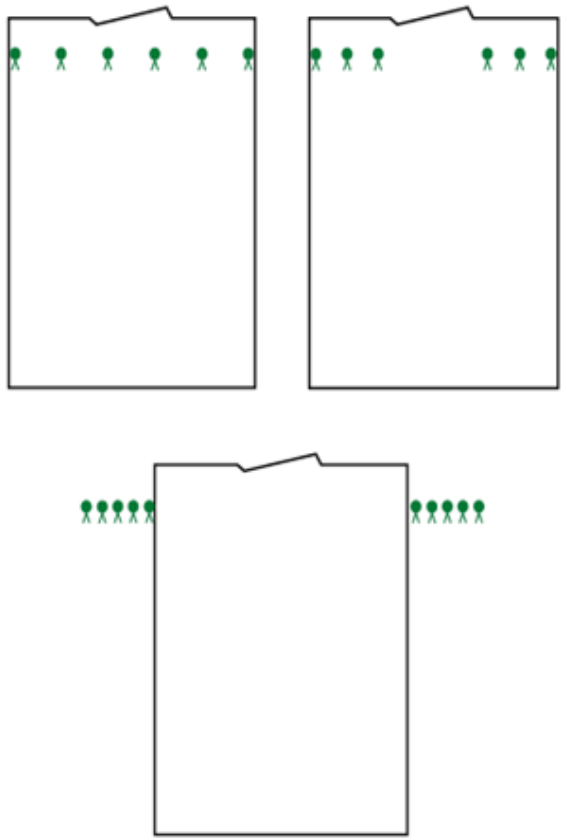
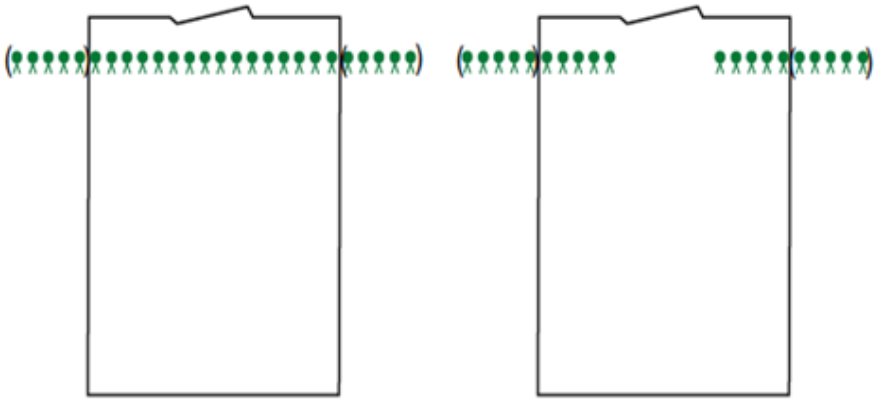
~~(d) Threshold lighting must consist of:~~

~~(1) on a non-instrument or non-precision approach runway, at least six lights;~~

~~(2) on a precision approach runway category I, at least the number of lights that would be required if the lights were uniformly spaced at intervals of 3 m between the rows of runway edge lights; and~~

~~(3) on a precision approach runway category II or III, lights uniformly spaced between the rows of runway edge lights at intervals of not more than 3 m.~~

~~(e) Wing bar lights must be provided on a non-instrument or non-precision approach runway where the threshold is displaced and runway threshold lights are required, but are not provided..~~

CONDITION	LIGHTS	RUNWAY TYPE		
		NON-INSTRUMENT AND NON-PRECISION APPROACH RUNWAYS	PRECISION APPROACH RUNWAYS CATEGORY I	PRECISIO
THRESHOLD AT RUNWAY EXTREMITY	RUNWAY THRESHOLD AND RUNWAY END LIGHTS			
THRESHOLD DISPLACED FROM RUNWAY EXTREMITY	RUNWAY THRESHOLD LIGHTS			

~~(f) Wing bar lights must be symmetrically disposed about the runway centre line at the threshold in two groups, i.e. wing bars. Each wing bar must be formed by at least five lights extending at least 10 m outward from, and at right angles to, the line of the runway edge lights, with the innermost light of each wing bar in the line of the runway edge lights.~~

~~(g) Runway threshold and wing bar lights must be fixed unidirectional lights showing green in the direction of approach to the runway. The intensity and beam spread of the lights must be adequate for the conditions of visibility and ambient light in which use of the runway is intended.~~

~~(h) Runway threshold lights on a precision approach runway must be in accordance with the specifications of CASA Advisory Circulars in the 139 series.~~

~~(i) Threshold wing bar lights on a precision approach runway must be in accordance with the specifications of CASA Advisory Circulars in the 139 series~~

~~E.3.26 Runway end lights~~

~~(a) Runway end lights must be provided for a runway equipped with runway edge lights.~~

~~(b) Runway end lights must be placed on a line at right angles to the runway axis as near to the end of the runway as possible and, in any case, not more than 3 m outside the end.~~

~~(c) Runway end lights must be fixed unidirectional lights showing red in the direction of the runway. The intensity and beam spread of the lights must be adequate for the conditions of visibility and ambient light in which use of the runway is intended.~~

~~(d) Runway end lights on a precision approach runway must be in accordance with the specifications of CASA Advisory Circulars in the 139 series.~~

~~E.3.27 Runway centre line lights~~

~~(a) Runway centre line lights must be provided on a precision approach runway category II or III.~~

~~(b) Runway centre line lights must be provided on a runway intended to be used for take-off with an operating minimum below an RVR of the order of 400 m.~~

~~(c) Runway centre line lights must be located along the centre line of the runway, except that the lights may be uniformly offset to the same side of the runway centre line by not more than 60 cm where it is not practicable to locate them along the centre line. The lights must be located from the threshold to the end at longitudinal spacing of approximately 15 m. Where the serviceability level of the runway centre line lights specified as maintenance objectives in J.5(c) or J.5(g), as appropriate, can be demonstrated and the runway is intended for use in runway visual range conditions of 350 m or greater, the longitudinal spacing may be approximately 30 m.~~

~~(d) Runway centre line lights must be fixed lights showing variable white from the threshold to the point 900 m from the runway end; alternate red and variable white from 900 m to 300 m from the runway end; and red from 300 m to the runway end, except that for runways less than 1 800 m in~~

~~length, the alternate red and variable white lights must extend from the midpoint of the runway usable for landing to 300 m from the runway end.~~

~~(c) Runway centre line lights must be in accordance with the specifications of CASA Advisory Circulars in the 139 series.~~

~~E.3.28 Runway touchdown zone lights~~

~~(a) Touchdown zone (TDZ) lights must be provided in the touchdown zone of a precision approach runway category II or III.~~

~~(b) Touchdown zone lights must extend from the threshold for a longitudinal distance of 900 m, except that, on runways less than 1 800 m in length, the system must be shortened so that it does not extend beyond the midpoint of the runway. The pattern must be formed by pairs of barrettes symmetrically located about the runway centre line. The lateral spacing between the innermost lights of a pair of barrettes must be equal to the lateral spacing selected for the touchdown zone marking. The longitudinal spacing between pairs of barrettes must be either 30 m or 60 m.~~

~~(c) A barrette must be composed of at least three lights with a spacing between the lights of not more than 1.5 m.~~

~~(d) Touchdown zone lights must be fixed unidirectional lights showing variable white.~~

~~(e) Touchdown zone lights must be in accordance with the specifications of CASA Advisory Circulars in the 139 series.~~

~~E.3.29 Simple touchdown zone lights~~

~~(a) Simple touchdown zone lights must be a pair of lights located on each side of the runway centre line 0.3 m beyond the upwind edge of the final touchdown zone marking. The lateral spacing between the inner lights of the two pairs of lights must be equal to the lateral spacing selected for the touchdown zone marking. The spacing between the lights of the same pair must not be more than 1.5 m or half the width of the touchdown zone marking, whichever is greater. (See Figure E-24.)~~

~~(b) Simple touchdown zone lights must be fixed unidirectional lights showing variable white, aligned so as to be visible to the pilot of a landing aeroplane in the direction of approach to the runway.~~

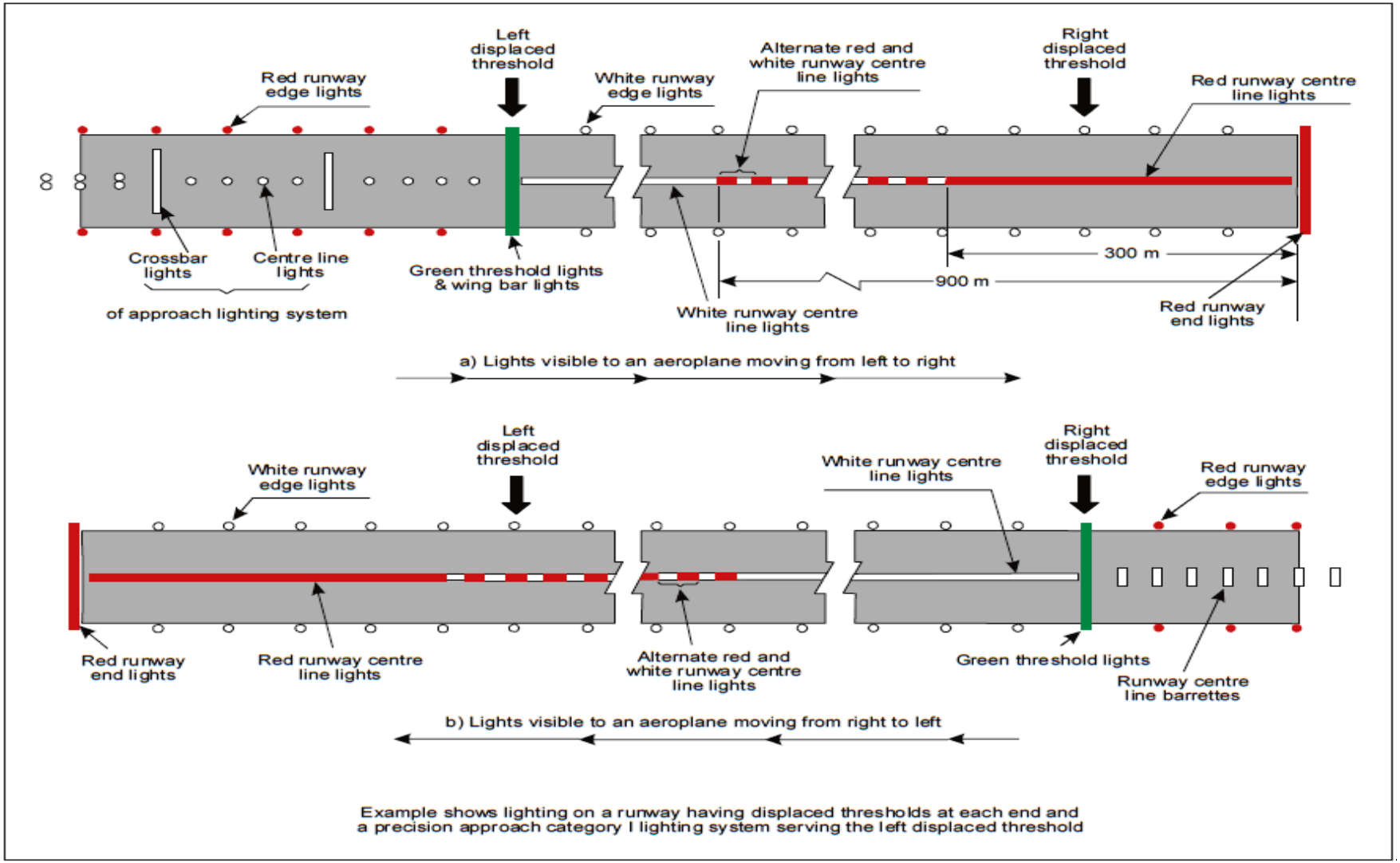
~~(c) Simple touchdown zone lights must be in accordance with the specifications in CASA Advisory Circulars in the 139 series.~~

~~E.3.30 Rapid exit taxiway indicator lights~~

~~(a) Rapid exit taxiway indicator lights must not be displayed in the event of any lamp failure or other failure that prevents the display of the light pattern depicted in Figure E-25, in full.~~

~~(b) A set of rapid exit taxiway indicator lights must be located on the runway on the same side of the runway centre line as the associated rapid exit taxiway, in the configuration shown in Figure~~

~~E-25. In each set, the lights must be located 2 m apart and the light nearest to the runway centre line must be displaced 2 m from the runway centre line.~~

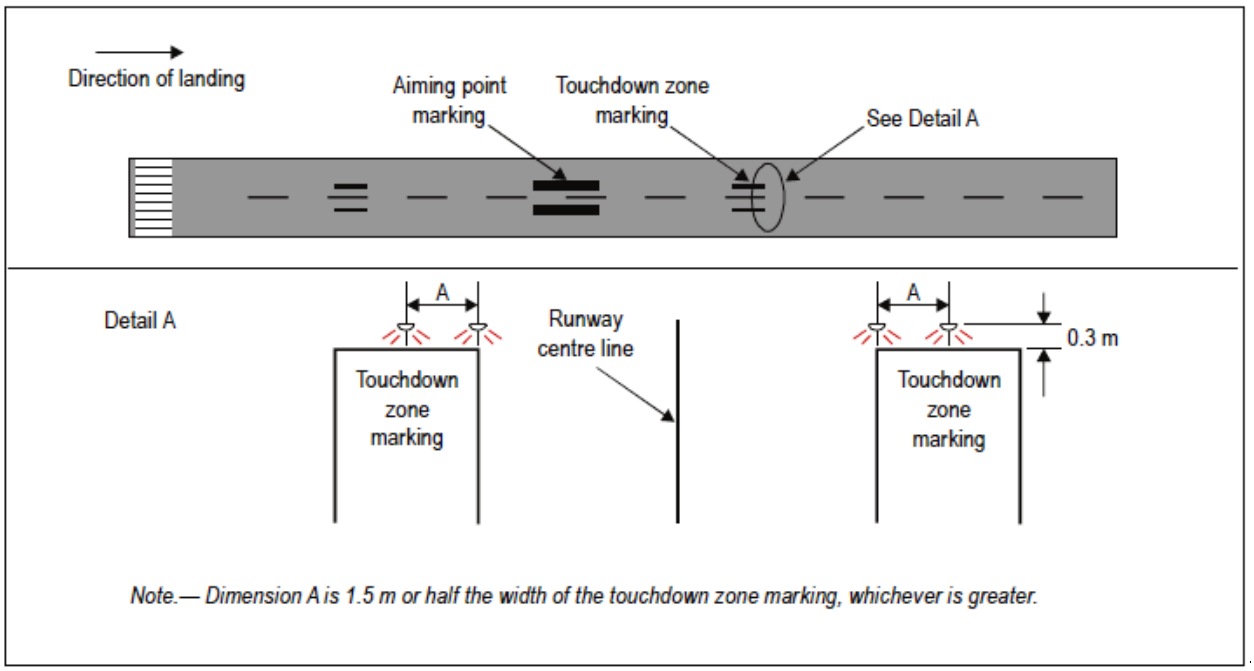


~~Figure E-23. Example of approach and runway lighting for runway with displaced thresholds~~

~~(c) Where more than one rapid exit taxiway exists on a runway, the set of rapid exit taxiway indicator lights for each exit must not overlap when displayed.~~

~~(d) Rapid exit taxiway indicator lights must be fixed unidirectional yellow lights, aligned so as to be visible to the pilot of a landing aeroplane in the direction of approach to the runway.~~

~~(e) Rapid exit taxiway indicator lights must be in accordance with the specifications in CASA Advisory Circulars in the 139 series, as appropriate.~~



~~Figure E-24. Simple touchdown zone lighting~~

~~E.3.31 Stopway lights~~

~~(a) Stopway lights must be provided for a stopway intended for use at night.~~

~~(b) Stopway lights must be placed along the full length of the stopway and must be in two parallel rows that are equidistant from the centre line and coincident with the rows of the runway edge lights. Stopway lights must also be provided across the end of a stopway on a line at right angles to the stopway axis as near to the end of the stopway as possible and, in any case, not more than 3 m outside the end.~~

~~(c) Stopway lights must be fixed unidirectional lights showing red in the direction of the runway.~~

~~E.3.32 Taxiway centre line lights~~

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

~~(b) Taxiway centre line lights must be provided on a runway forming part of a standard taxi-route and intended for taxiing in runway visual range conditions less than a value of 350 m, except that these lights need not be provided where the traffic density is light and taxiway edge lights and centre line marking provide adequate guidance.~~

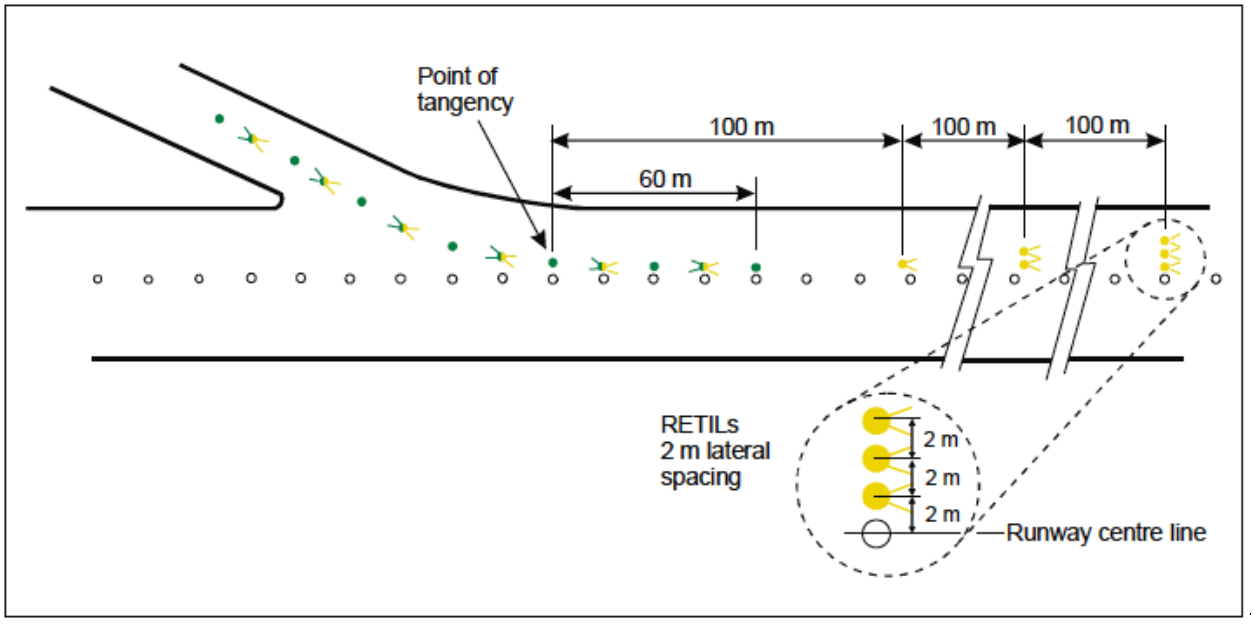
~~(c) If provided, taxiway centre line lights on a taxiway other than an exit taxiway and on a runway forming part of a standard taxi-route must be fixed lights showing green with beam dimensions such that the light is visible only from aeroplanes on or in the vicinity of the taxiway.~~

~~(d) Taxiway centre line lights on an exit taxiway must be fixed lights. Alternate taxiway centre line lights must show green and yellow from their beginning near the runway centre line to the perimeter of the ILS/MLS critical/sensitive area or the lower edge of the inner transitional surface, whichever is farthest from the runway; and thereafter all lights must show green (Figure E-26). The first light in the exit centre line must always show green, and the light nearest to the perimeter must always show yellow.~~

~~(e) Taxiway centre line lights must be in accordance with the specifications of CASA Advisory Circulars 139 Series for:~~

~~(1) taxiways intended for use in runway visual range conditions of less than a value of 350 m; and~~

~~(2) other taxiways.~~



~~Figure E-25. Rapid exit taxiway indicator lights (RETILS)~~

~~E.3.33 Taxiway edge lights~~

~~(a) Taxiway edge lights must be provided at the edges of a runway turn pad, holding bay, apron, etc., intended for use at night and on a taxiway not provided with taxiway centre line lights and intended for use at night, except that taxiway edge lights need not be provided where,~~

~~considering the nature of the operations, adequate guidance can be achieved by surface illumination or other means.~~

~~(b) Taxiway edge lights must be provided on a runway forming part of a standard taxi route and intended for taxiing at night where the runway is not provided with taxiway centre line lights.~~

~~(c) Taxiway edge lights must be fixed lights showing blue. The lights must show up to at least 75° above the horizontal and at all angles in azimuth necessary to provide guidance to a pilot taxiing in either direction. At an intersection, exit or curve the lights must be shielded as far as practicable so that they cannot be seen in angles of azimuth in which they may be confused with other lights.~~

~~(d) The intensity of taxiway edge lights must be at least 2 cd from 0° to 6° vertical, and 0.2 cd at any vertical angles between 6° and 75°.~~

~~E.3.34 Runway turn pad lights~~

~~(a) Runway turn pad lights must be provided for continuous guidance on a runway turn pad intended for use in runway visual range conditions less than a value of 350 m, to enable an aeroplane to complete a 180-degree turn and align with the runway centre line.~~

~~(b) Runway turn pad lights must be unidirectional fixed lights showing green with beam dimensions such that the light is visible only from aeroplanes on or approaching the runway turn pad.~~

~~(c) Runway turn pad lights must be in accordance with the specifications of CASA Advisory Circulars in the 139 series, as appropriate.~~

~~E.3.35 Stop bars~~

~~(a) A stop bar must be provided at every runway holding position serving a runway when it is intended that the runway will be used in runway visual range conditions less than a value of 350 m, except where:~~

~~(1) appropriate aids and procedures are available to assist in preventing inadvertent incursions of traffic onto the runway; or~~

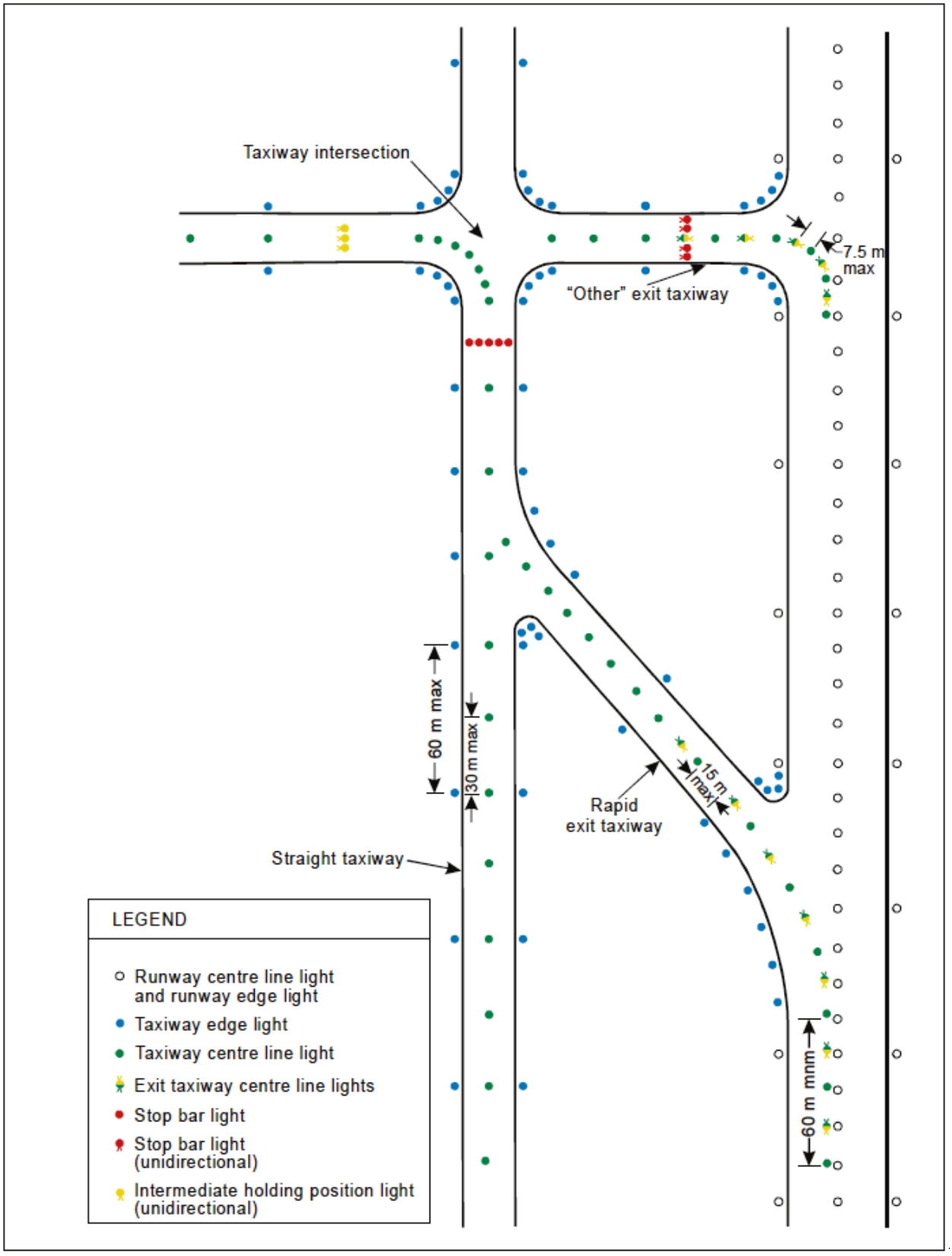
~~(2) operational procedures exist to limit, in runway visual range conditions less than a value of 550 m, the number of:~~

~~(i) aircraft on the manoeuvring area to one at a time; and~~

~~(ii) vehicles on the manoeuvring area to the essential minimum.~~

~~(b) A stop bar must be provided at every runway holding position serving a runway when it is intended that the runway will be used in runway visual range conditions of values between 350 m and 550 m, except where:~~

~~(1) appropriate aids and procedures are available to assist in preventing inadvertent incursions of traffic onto the runway; or~~

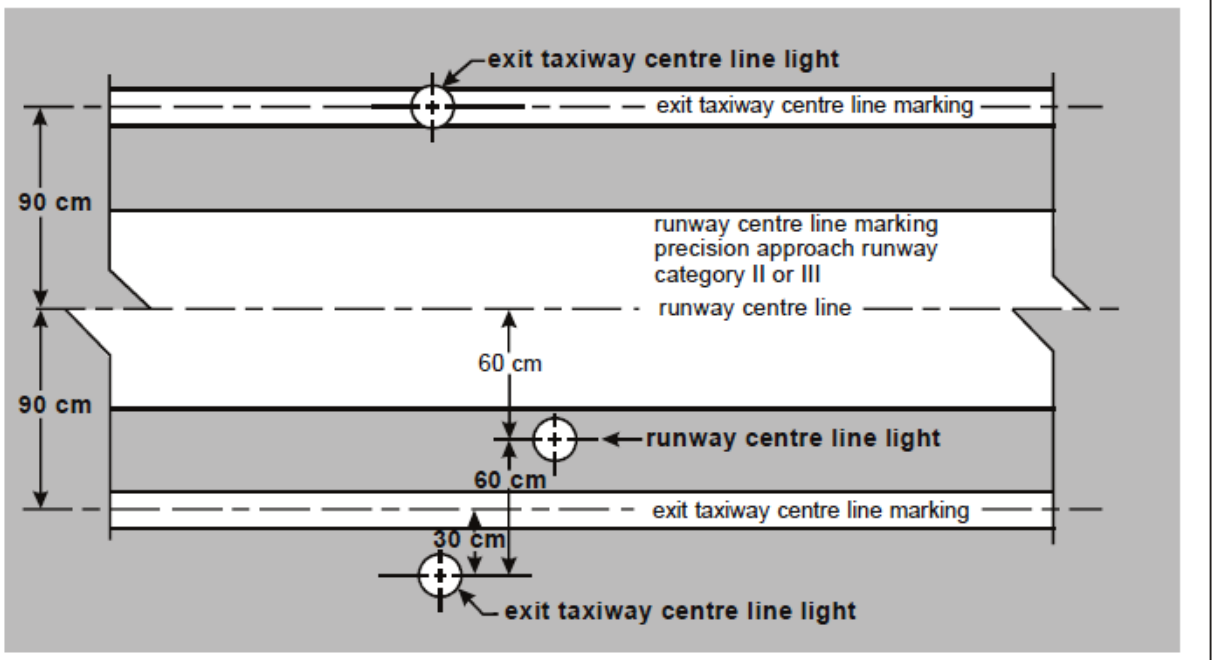


~~**Figure E-26. Taxiway lighting**~~

~~(2) operational procedures exist to limit, in runway visual range conditions less than a value of 550 m, the number of:~~

~~(i) aircraft on the manoeuvring area to one at a time; and~~

~~(ii) vehicles on the manoeuvring area to the essential minimum.~~



Tolerances for offset runway centre line lights and
taxiway centre line lights to maintain 60 cm separation.

~~Figure E-27. Offset runway and taxiway centre line lights~~

~~(c) Where there is more than one stop bar associated with a taxiway/runway intersection, only one must be illuminated at any given time.~~

~~(d) Stop bars must be located across the taxiway at the point where it is desired that traffic stop. Where the additional lights are provided, these lights must be located not less than 3 m from the taxiway edge.~~

~~(e) Stop bars must consist of lights spaced at uniform intervals of no more than 3 m across the taxiway, showing red in the intended direction(s) of approach to the intersection or runway-holding position.~~

~~(f) Stop bars installed at a runway-holding position must be unidirectional and must show red in the direction of approach to the runway.~~

~~(g) Where the additional lights are provided, these lights must have the same characteristics as the lights in the stop bar, but must be visible to approaching aircraft up to the stop bar position.~~

~~(h) The intensity in red light and beam spreads of stop bar lights must be in accordance with the specifications in CASA Advisory Circulars in the 139 series, as appropriate.~~

~~(i) The lighting circuit must be designed so that:~~

~~(1) stop bars located across entrance taxiways are selectively switchable;~~

~~(2) stop bars located across taxiways intended to be used only as exit taxiways are switchable selectively or in groups;~~

~~(3) when a stop bar is illuminated, any taxiway centre line lights installed beyond the stop bar must be extinguished for a distance of at least 90 m; and~~

~~(4) stop bars are interlocked with the taxiway centre line lights so that when the centre line lights beyond the stop bar are illuminated the stop bar is extinguished and vice versa.~~

~~E.3.36 Intermediate holding position lights~~

~~(a) Except where a stop bar has been installed, intermediate holding position lights must be provided at an intermediate holding position intended for use in runway visual range conditions less than a value of 350 m.~~

~~(b) Intermediate holding position lights must be located along the intermediate holding position marking at a distance of 0.3 m prior to the marking.~~

~~(c) Intermediate holding position lights must consist of three fixed unidirectional lights showing yellow in the direction of approach to the intermediate holding position with a light distribution similar to taxiway centre line lights if provided. The lights must be disposed symmetrically about and at right angle to the taxiway centre line, with individual lights spaced 1.5 m apart.~~

~~E.3.37 Runway guard lights~~

~~(a) Runway guard lights, Configuration A, must be provided at each taxiway/runway intersection associated with a runway intended for use in:~~

~~(1) runway visual range conditions less than a value of 550 m where a stop bar is not installed; and~~

~~(2) runway visual range conditions of values between 550 m and 1 200 m where the traffic density is heavy.~~

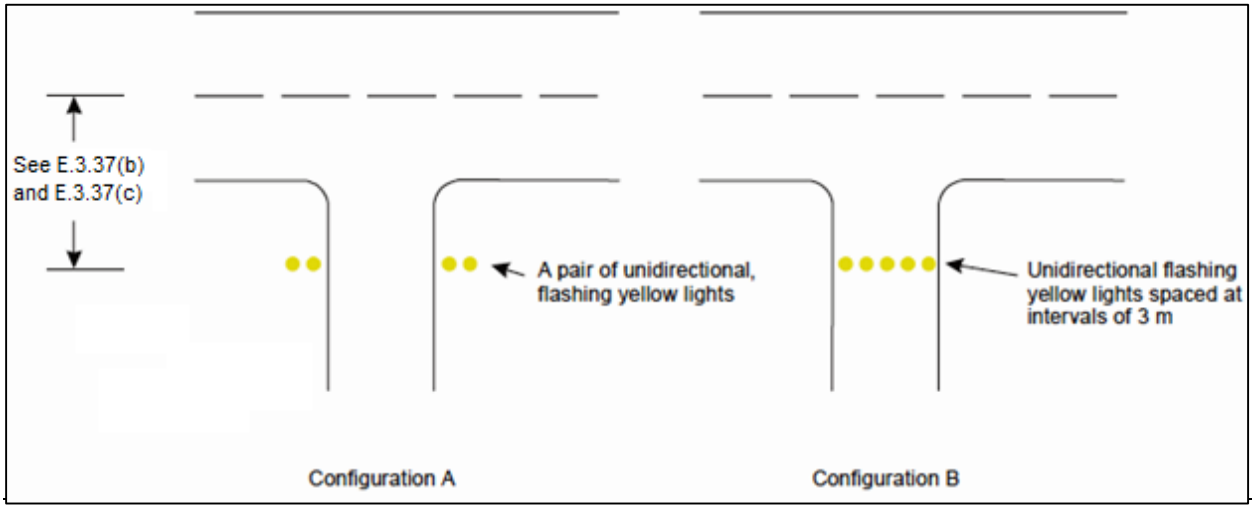
~~(b) Runway guard lights, Configuration A, must be located at each side of the taxiway at a distance from the runway centre line not less than that specified for a take-off runway in Table C-2.~~

~~(c) Runway guard lights, Configuration B, must be located across the taxiway at a distance from the runway centre line not less than that specified for a take-off runway in Table C-2.~~

~~(d) Runway guard lights, Configuration A, must consist of two pairs of yellow lights.~~

~~(e) Runway guard lights, Configuration B, must consist of yellow lights spaced at intervals of 3 m across the taxiway.~~

~~(f) The light beam must be unidirectional and aligned so as to be visible to the pilot of an aeroplane taxiing to the holding position.~~



~~Figure E-29. Runway guard lights~~

~~(g) The lights in each unit of Configuration A must be illuminated alternately.~~

~~(h) For Configuration B, adjacent lights must be alternately illuminated and alternative lights must be illuminated in unison.~~

~~(g) The lights must be illuminated between 30 and 60 cycles per minute and the light suppression and illumination periods must be equal and opposite in each light.~~

~~E.3.38 Apron floodlighting~~

~~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.~~

~~E.3.39 Visual docking guidance system~~

~~(a) A visual docking guidance system must be provided when it is intended to indicate, by a visual aid, the precise positioning of an aircraft on an aircraft stand and other alternative means, such as marshallers, are not practicable.~~

~~(b) The system must provide both azimuth and stopping guidance.~~

~~(c) 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.~~

~~(d) The azimuth guidance unit and the stopping position indicator must be of a design such that:~~

~~(1) a clear indication of malfunction of either or both is available to the pilot; and~~

~~(2) they can be turned off.~~

~~(e) 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 stand markings, the aircraft stand manoeuvring guidance lights, if present, and the visual docking guidance system.~~

~~(f) 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.~~

~~(g) 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.~~

~~(h) The azimuth guidance unit must be located on or close to the extension of the stand centre line ahead of the aircraft so that its signals are visible from the cockpit of an aircraft throughout the docking manoeuvre and aligned for use at least by the pilot occupying the left seat.~~

~~(i) 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.~~

~~(j) When azimuth guidance is indicated by colour change, green must be used to identify the centre line and red for deviations from the centre line.~~

~~(k) 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.~~

~~(l) The stopping position indicator must be usable at least by the pilot occupying the left seat.~~

~~(m) 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.~~

~~(n) The stopping position indicator must show the stopping position for the aircraft for which 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.~~

~~(o) 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 stop point a third colour may be used to warn that the stopping point is close.~~

~~E.3.40 Advanced visual docking guidance system~~

~~(a) The A-VDGS must be suitable for use by all types of aircraft for which the aircraft stand is intended.~~

~~(b) The A-VDGS must be used only in conditions in which its operational performance is specified.~~

~~(c) The docking guidance information provided by an A-VDGS must not conflict with that provided by a conventional visual docking guidance system on an aircraft stand if both types are provided and are in operational use. A method of indicating that the A-VDGS is not in operational use or is unserviceable must be provided.~~

~~(d) The A-VDGS must be located such that unobstructed and unambiguous guidance is provided to the person responsible for, and persons assisting, the docking of the aircraft throughout the docking manoeuvre.~~

~~(e) The A-VDGS must provide, at minimum, the following guidance information at the appropriate stage of the docking manoeuvre:~~

~~(1) an emergency stop indication;~~

~~(2) the aircraft type and model for which the guidance is provided;~~

~~(3) an indication of the lateral displacement of the aircraft relative to the stand centre line;~~

~~(4) the direction of azimuth correction needed to correct a displacement from the stand centre line;~~

~~(5) an indication of the distance to the stop position;~~

~~(6) an indication when the aircraft has reached the correct stopping position; and~~

~~(7) a warning indication if the aircraft goes beyond the appropriate stop position.~~

~~(f) The A-VDGS must be capable of providing docking guidance information for all aircraft taxi speeds encountered during the docking manoeuvre.~~

~~(g) The time taken from the determination of the lateral displacement to its display must not result in a deviation of the aircraft, when operated in normal conditions, from the stand centre line greater than 1 m.~~

~~(h) Symbols and graphics used to depict guidance information must be intuitively representative of the type of information provided.~~

~~(i) Information on the lateral displacement of the aircraft relative to the stand centre line must be provided at least 25 m prior to the stop position.~~

~~Table E-4. A-VDGS recommended displacement accuracy~~

Guidance information	Maximum deviation at stop position (stop area)	Maximum deviation at 9 m from stop position	Maximum deviation at 15 m from stop position	Maximum deviation at 25 m from stop position
Azimuth	±250 mm	±340 mm	±400 mm	±500 mm
Distance	±500 mm	±1 000 mm	±1 300 mm	Not specified

~~(j) Continuous closure distance and closure rate must be provided from at least 15 m prior to the stop position.~~

~~(k) Throughout the docking manoeuvre, an appropriate means must be provided on the A-VDGS to indicate the need to bring the aircraft to an immediate halt. In such an event, which includes a failure of the A-VDGS, no other information must be displayed.~~

~~(l) Provision to initiate an immediate halt to the docking procedure must be made available to personnel responsible for the operational safety of the stand.~~

~~E.3.41 Aircraft stand manoeuvring guidance lights~~

~~(a) Aircraft stand manoeuvring guidance lights must be collocated with the aircraft stand markings.~~

~~(b) Aircraft stand manoeuvring guidance lights, other than those indicating a stop position, must be fixed yellow lights, visible throughout the segments within which they are intended to provide guidance.~~

~~(c) The lights indicating a stop position must be fixed unidirectional lights showing red.~~

~~E.3.42 Road-holding position light~~

~~(a) A road-holding position light must be provided at each road-holding position serving a runway when it is intended that the runway will be used in runway visual range conditions less than a value of 350 m.~~

~~(b) A road-holding position light must be located adjacent to the holding position marking 1.5 m (±0.5 m) from one edge of the road, i.e. left or right as appropriate to the local traffic regulations.~~

~~(c) The road-holding position light must comprise:~~

~~(1) a controllable red (stop)/green (go) traffic light; or~~

~~(2) a flashing red light.~~

~~(d) The road-holding position light beam must be unidirectional and aligned so as to be visible to the driver of a vehicle approaching the holding position.~~

~~(e) The intensity of the light beam must be adequate for the conditions of visibility and ambient light in which the use of the holding position is intended, but must not dazzle the driver.~~

~~(f) The flash frequency of the flashing red light must be between 30 and 60 flashes per minute.~~

~~E.3.43 No-entry bar~~

~~(a) The intensity in red light and beam spreads of no-entry bar lights must be in accordance with the specifications in CASA Advisory Circulars in the 139 series, as appropriate.~~

~~(b) The lighting circuit must be designed so that:~~

~~(1) no-entry bars are switchable selectively or in groups;~~

~~(2) when a no-entry bar is illuminated, any taxiway centre line lights installed beyond the no-entry bar, when viewed towards the runway, must be extinguished for a distance of at least 90 m; and~~

~~(3) when a no-entry bar is illuminated, any stop bar installed between the no-entry bar and the runway must be extinguished.~~

~~E.3.44 Runway status lights~~

~~(a) Where provided, RELs must be offset 0.6 m from the taxiway centre line on the opposite side to the taxiway centre line lights and begin 0.6 m before the runway-holding position extending to the edge of the runway. An additional single light must be placed on the runway 0.6 m from the runway centre line and aligned with the last two taxiway RELs.~~

~~(b) RELs must consist of at least five light units and must be spaced at a minimum of 3.8 m and a maximum of 15.2 m longitudinally, depending upon the taxiway length involved, except for a single light installed near the runway centre line.~~

~~(c) Where provided, THLs must be offset 1.8 m on each side of the runway centre line lights and extend, in pairs, starting at a point 115 m from the beginning of the runway and, thereafter, every 30 m for at least 450 m.~~

~~(d) Where provided, RELs must consist of a single line of fixed in pavement lights showing red in the direction of aircraft approaching the runway.~~

~~(e) RELs must illuminate as an array at each taxiway/runway intersection where they are installed less than two seconds after the system determines a warning is needed.~~

~~(f) Intensity and beam spread of RELs must be in accordance with the specifications of CASA Advisory Circulars in the 139 series.~~

~~(g) Where provided, THLs must consist of two rows of fixed in pavement lights sh owing red facing the aircraft taking off.~~

~~(h) THLs must illuminate as an array on the runway less than two seconds after the system determines a warning is needed.~~

~~(i) Intensity and beam spread of THLs must be in accordance with the specifications of CASA Advisory Circulars in the 139 series.~~

~~E.4 Signs~~

~~E.4.1 General~~

~~(a) Signs must be provided to convey a mandatory instruction, information on a specific location or destination on a movement area or to provide other information to meet the requirements of I.7(a).~~

~~(b) Signs must be frangible. Those located near a runway or taxiway must be sufficiently low to preserve clearance for propellers and the engine pods of jet aircraft. The installed height of the sign must not exceed the dimension shown in the appropriate column of Table E-5.~~

~~(c) Signs must be rectangular, as shown in Figures E-30 and E-31 with the longer side horizontal.~~

~~(d) The only signs on the movement area utilizing red must be mandatory instruction signs.~~

~~(e) The inscriptions on a sign must be in accordance with the provisions of CASA Advisory Circulars in the 139 series.~~

~~**Table E-5. Location distances for taxiing guidance signs including runway exit signs**~~

Sign height (mm)				Perpendicular distance from defined taxiway pavement edge to near side of sign	Perpendicular distance from defined runway pavement edge to near side of sign
Code number	Legend	Face (min.)	Installed (max.)		
1 or 2	200	400	700	5–11 m	3–10 m
1 or 2	300	600	900	5–11 m	3–10 m
3 or 4	300	600	900	11–21 m	8–15 m
3 or 4	400	800	1 100	11–21 m	8–15 m

~~(f) Signs must be illuminated in accordance with the provisions of CASA Advisory Circulars in the 139 series when intended for use:~~

~~(1) in runway visual range conditions less than a value of 800 m; or~~

~~(2) at night in association with instrument runways; or~~

~~(3) at night in association with non-instrument runways where the code number is 3 or 4.~~

~~(g) Signs must be retroreflective and/or illuminated in accordance with the provisions of CASA Advisory Circulars in the 139 series when intended for use at night in association with non-instrument runways where the code number is 1 or 2.~~

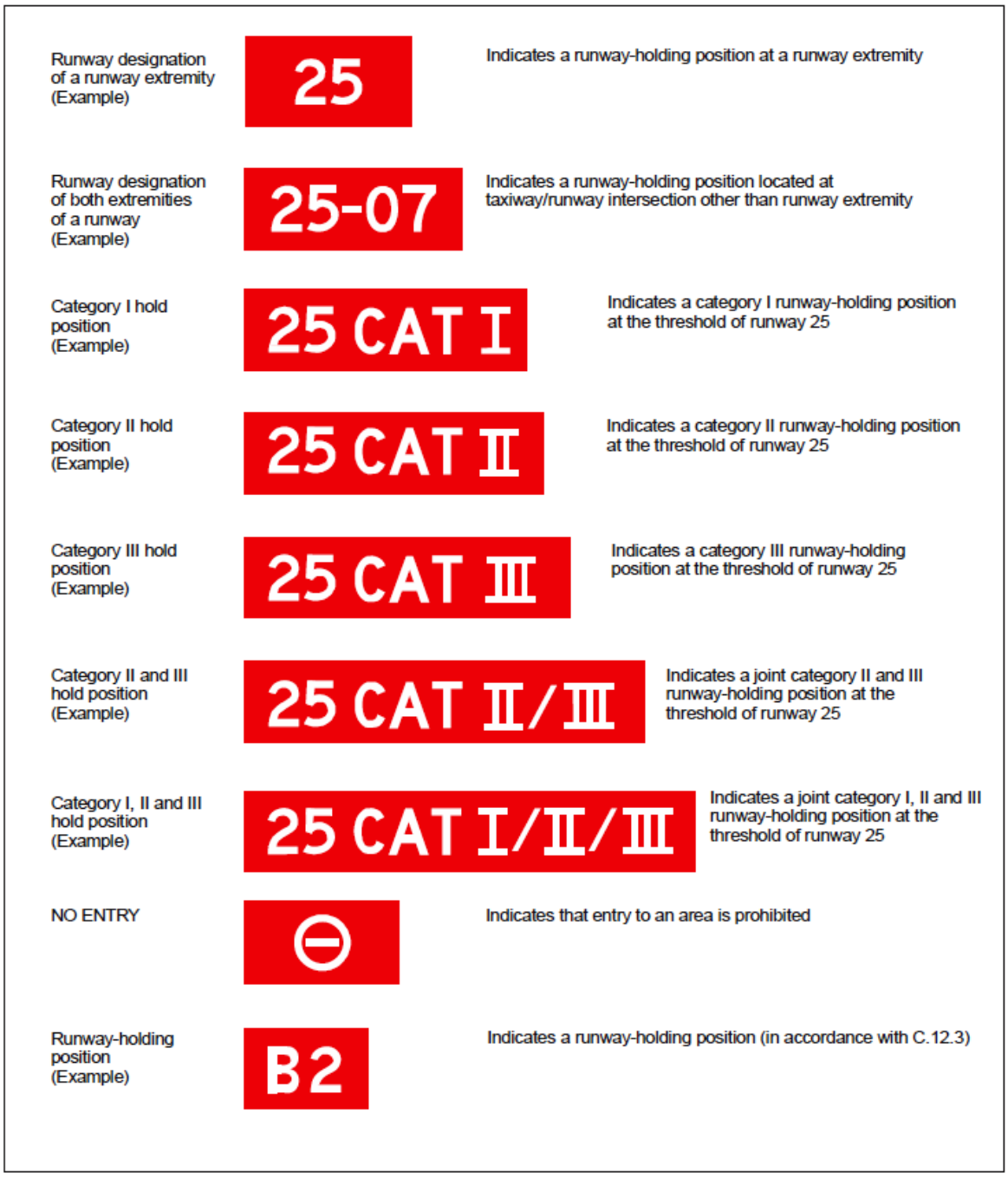
~~(h) A variable message sign must show a blank face when not in use.~~

~~(i) In case of failure, a variable message sign must not provide information that could lead to unsafe action from a pilot or a vehicle driver.~~

~~E.4.2 Mandatory instruction signs~~

~~(a) A mandatory instruction sign must be provided to identify a location beyond which an aircraft taxiing or vehicle must not proceed unless authorized by the aerodrome control tower.~~

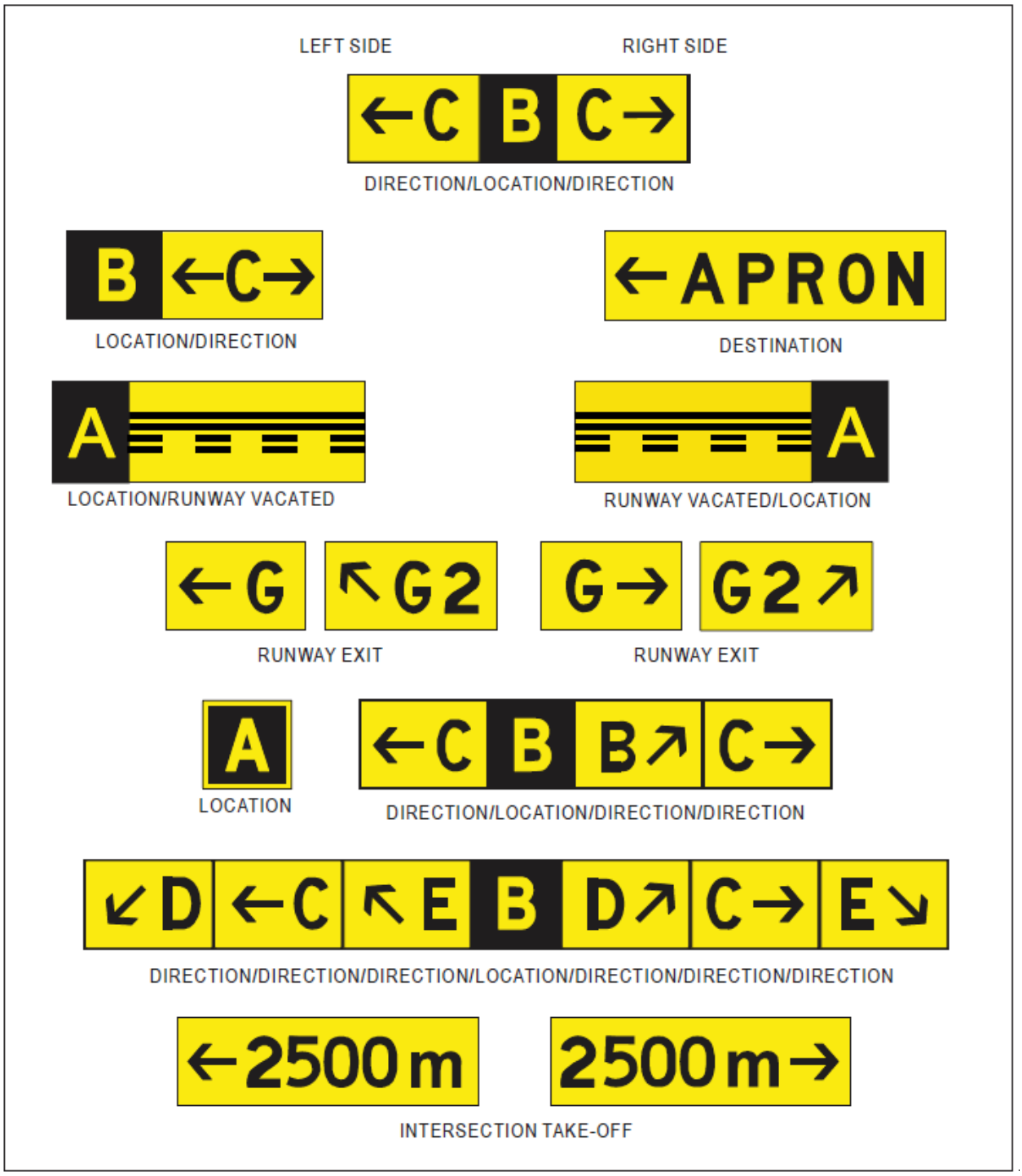
~~(b) Mandatory instruction signs must include runway designation signs, category I, II or III holding position signs, runway holding position signs, road holding position signs and NO ENTRY signs.~~



~~Figure E-30. Mandatory instruction signs~~

~~(c) A pattern "A" runway-holding position marking must be supplemented at a taxiway/runway intersection or a runway/runway intersection with a runway designation sign.~~

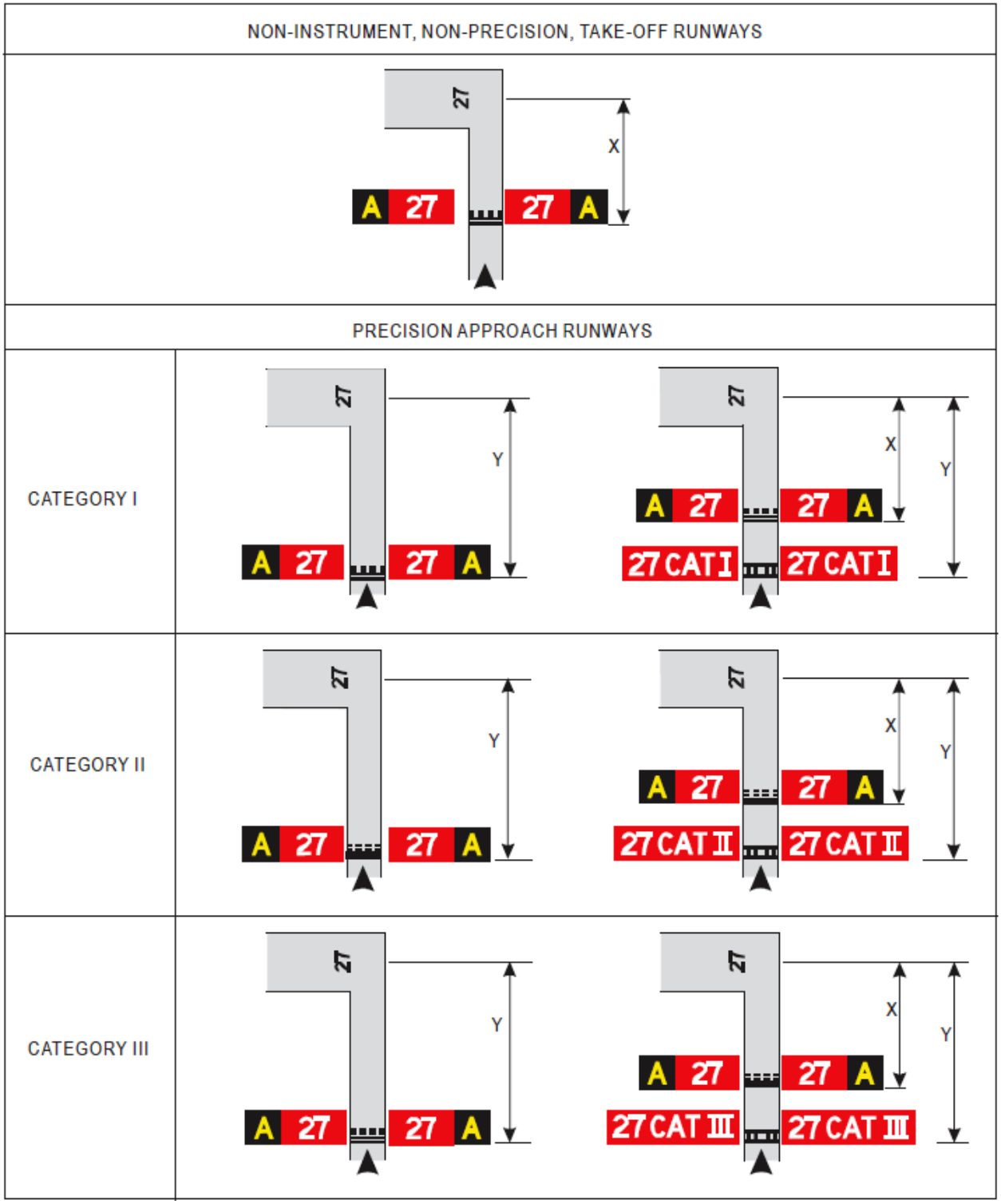
~~(d) A pattern "B" runway-holding position marking must be supplemented with a category I, II or III holding position sign.~~



~~**Figure E-31. Information signs**~~

~~(e) A pattern "A" runway-holding position marking at a runway-holding position established in accordance with C.8.1(b) must be supplemented with a runway-holding position sign.~~

~~(f) A NO ENTRY sign must be provided when entry into an area is prohibited.~~



~~*Note — Distance X is established in accordance with Table C-2. Distance Y is established at the edge of the ILS/MLS critical/sensitive area*~~

~~**Figure E-32. Examples of sign positions at taxiway/runway intersections**~~

~~(g) A runway designation sign at a taxiway/runway intersection or a runway/runway intersection must be located on each side of the runway holding position marking facing the direction of approach to the runway.~~

~~(h) A category I, II or III holding position sign must be located on each side of the runway-holding position marking facing the direction of the approach to the critical area.~~

~~(i) A NO ENTRY sign must be located at the beginning of the area to which entrance is prohibited on each side of the taxiway as viewed by the pilot.~~

~~(j) A runway-holding position sign must be located on each side of the runway holding position established in accordance with C.8.1(b), facing the approach to the obstacle limitation surface or ILS/MLS critical/sensitive area, as appropriate.~~

~~(k) A mandatory instruction sign must consist of an inscription in white on a red background.~~

~~(l) The inscription on a runway designation sign must consist of the runway designations of the intersecting runway properly oriented with respect to the viewing position of the sign, except that a runway designation sign installed in the vicinity of a runway extremity may show the runway designation of the concerned runway extremity only.~~

~~(m) The inscription on a category I, II, III, joint II/III or joint I/II/III holding position sign must consist of the runway designator followed by CAT I, CAT II, CAT III, CAT II/III or CAT I/II/III, as appropriate.~~

~~(n) The inscription on a NO ENTRY sign must be in accordance with Figure E-30.~~

~~(o) The inscription on a runway-holding position sign at a runway-holding position established in accordance with C.8.1(b) must consist of the taxiway designation and a number.~~

~~(p) Where installed, the inscriptions/symbol of Figure E-30 must be used.~~

~~E.4.3 Information signs~~

~~(a) An information sign must be provided where there is an operational need to identify by a sign, a specific location, or routing (direction or destination) information.~~

~~(b) Information signs must include: direction signs, location signs, destination signs, runway exit signs, runway vacated signs and intersection take-off signs.~~

~~(c) A runway exit sign must be provided where there is an operational need to identify a runway exit.~~

~~(d) A runway vacated sign must be provided where the exit taxiway is not provided with taxiway centre line lights and there is a need to indicate to a pilot leaving a runway the perimeter of the ILS/MLS critical/sensitive area or the lower edge of the inner transitional surface, whichever is farther from the runway centre line.~~

~~(e) A combined location and direction sign must be provided when it is intended to indicate routing information prior to a taxiway intersection.~~

~~(f) A direction sign must be provided when there is an operational need to identify the designation and direction of taxiways at an intersection.~~

~~(g) A location sign must be provided in conjunction with a runway designation sign except at a runway/runway intersection.~~

~~(h) A location sign must be provided in conjunction with a direction sign, except that it may be omitted where an aeronautical study indicates that it is not needed.~~

~~(i) Except as specified in E.4.3(k) information signs shall, wherever practicable, be located on the left-hand side of the taxiway in accordance with Table E-5.~~

~~(j) At a taxiway intersection, information signs must be located prior to the intersection and in line with the intermediate holding position marking. Where there is no intermediate holding position marking, the signs must be installed at least 60 m from the centre line of the intersecting taxiway where the code number is 3 or 4, and at least 40 m where the code number is 1 or 2.~~

~~(k) A runway exit sign must be located on the same side of the runway as the exit is located (i.e. left or right) and positioned in accordance with Table E-5.~~

~~(l) A runway exit sign must be located prior to the runway exit point in line with a position at least 60 m prior to the point of tangency where the code number is 3 or 4, and at least 30 m where the code number is 1 or 2.~~

~~(m) A runway vacated sign must be located at least on one side of the taxiway. The distance between the sign and the centre line of a runway must be not less than the greater of the following:~~

~~(1) the distance between the centre line of the runway and the perimeter of the ILS/MLS critical/sensitive area; or~~

~~(2) the distance between the centre line of the runway and the lower edge of the inner transitional surface.~~

~~(n) Where provided in conjunction with a runway vacated sign, the taxiway location sign must be positioned outboard of the runway vacated sign.~~

~~(o) An intersection take-off sign must be located at the left-hand side of the entry taxiway. The distance between the sign and the centre line of the runway must be not less than 60 m where the code number is 3 or 4, and not less than 45 m where the code number is 1 or 2.~~

~~(p) A taxiway location sign installed in conjunction with a runway designation sign must be positioned outboard of the runway designation sign.~~

~~(q) An information sign other than a location sign must not be collocated with a mandatory instruction sign.~~

~~(r) An information sign other than a location sign must consist of an inscription in black on a yellow background.~~

~~(s) A location sign must consist of an inscription in yellow on a black background and where it is a stand-alone sign must have a yellow border.~~

~~(t) The inscription on a runway exit sign must consist of the designator of the exit taxiway and an arrow indicating the direction to follow.~~

~~(u) The inscription on a runway vacated sign must depict the pattern A runway-holding position marking as shown in Figure E-31.~~

~~(v) The inscription on an intersection take-off sign must consist of a numerical message indicating the remaining take-off run available in metres plus an arrow, appropriately located and oriented, indicating the direction of the take-off as shown in Figure E-31.~~

~~(w) The inscription on a destination sign must comprise an alpha, alphanumerical or numerical message identifying the destination plus an arrow indicating the direction to proceed as shown in Figure E-31.~~

~~(x) The inscription on a direction sign must comprise an alpha or alphanumerical message identifying the taxiway(s) plus an arrow or arrows appropriately oriented as shown in Figure E-31.~~

~~(y) The inscription on a location sign must comprise the designation of the location taxiway, runway or other pavement the aircraft is on or is entering and must not contain arrows.~~

~~(z) Where a location sign and direction signs are used in combination:~~

~~(1) all direction signs related to left turns must be placed on the left side of the location sign, and all direction signs related to right turns must be placed on the right side of the location sign, except that where the junction consists of one intersecting taxiway, the location sign may alternatively be placed on the left-hand side;~~

~~(2) the direction signs must be placed such that the direction of the arrows departs increasingly from the vertical with increasing deviation of the corresponding taxiway;~~

~~(3) an appropriate direction sign must be placed next to the location sign where the direction of the location taxiway changes significantly beyond the intersection; and~~

~~(4) adjacent direction signs must be delineated by a vertical black line as shown in Figure E-31.~~

~~(aa) A taxiway must be identified by a designator comprising a letter, letters or a combination of a letter or letters followed by a number.~~

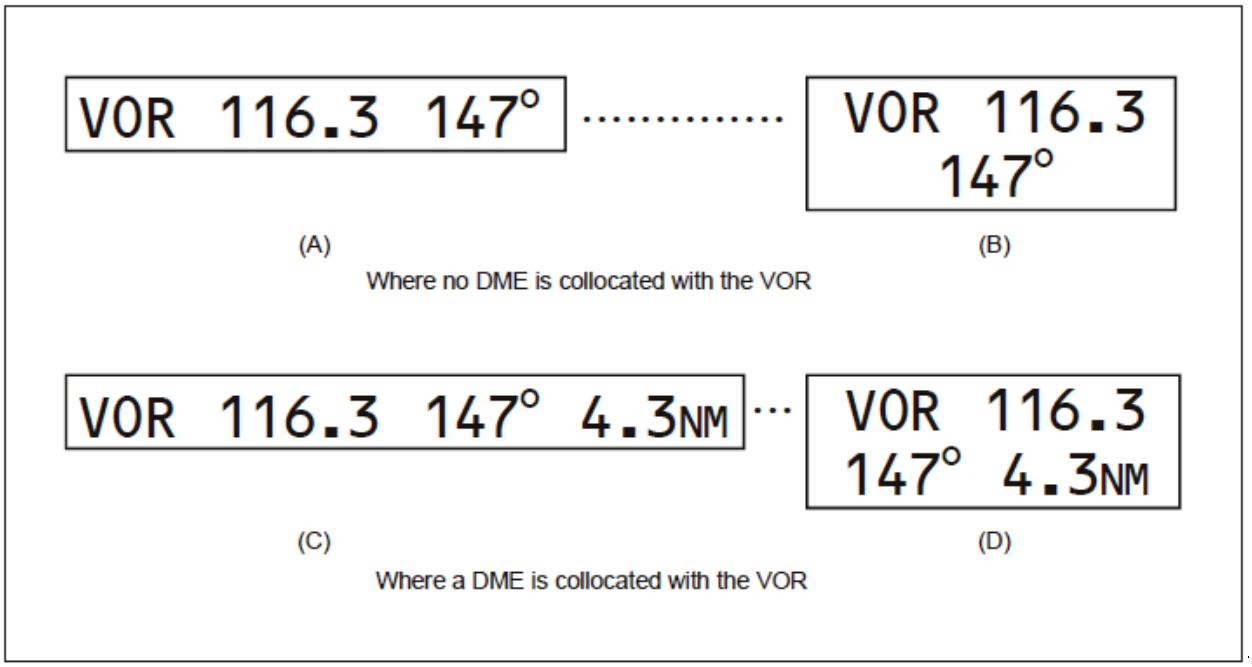
~~(ab) The use of numbers alone on the manoeuvring area must be reserved for the designation of runways.~~

~~E.4.4 VOR aerodrome checkpoint sign~~

~~(a) When a VOR aerodrome checkpoint is established, it must be indicated by a VOR aerodrome checkpoint marking and sign.~~

~~(b) A VOR aerodrome checkpoint sign must be located as near as possible to the checkpoint and so that the inscriptions are visible from the cockpit of an aircraft properly positioned on the VOR aerodrome checkpoint marking.~~

~~(c) A VOR aerodrome checkpoint sign must consist of an inscription in black on a yellow background.~~



~~Figure E-33. VOR aerodrome checkpoint sign~~

~~E.4.5 Aerodrome identification sign~~

~~The aerodrome identification sign must consist of the name of the aerodrome.~~

~~E.4.6 Road-holding position sign~~

~~(a) A road-holding position sign must be provided at all road entrances to a runway.~~

~~(b) The road-holding position sign must be located 1.5 m from one edge of the road (left or right as appropriate to the local traffic regulations) at the holding position.~~

~~(c) A road-holding position sign must consist of an inscription in white on a red background.~~

~~(d) The inscription on a road-holding position sign must be in the national language, be in conformity with the local traffic regulations and include the following:~~

~~(1) a requirement to stop; and~~

~~(2) where appropriate:~~

~~(i) a requirement to obtain ATC clearance; and~~

~~(ii) location designator.~~

~~(e) A road-holding position sign intended for night use must be retroreflective or illuminated.~~

~~E.5 Markers~~

~~E.5.1 General~~

~~Markers must be frangible. Those located near a runway or taxiway must be sufficiently low to preserve clearance for propellers and for the engine pods of jet aircraft.~~

~~E.5.2 Stopway edge markers~~

~~The stopway edge markers must be sufficiently different from any runway edge markers used to ensure that the two types of markers cannot be confused.~~

~~E.5.3 Taxiway edge markers~~

~~(a) A taxiway edge marker must be retroreflective blue.~~

~~(b) Taxiway edge markers must be frangible. Their height must be sufficiently low to preserve clearance for propellers and for the engine pods of jet aircraft.~~

~~E.5.4 Taxiway centre line markers~~

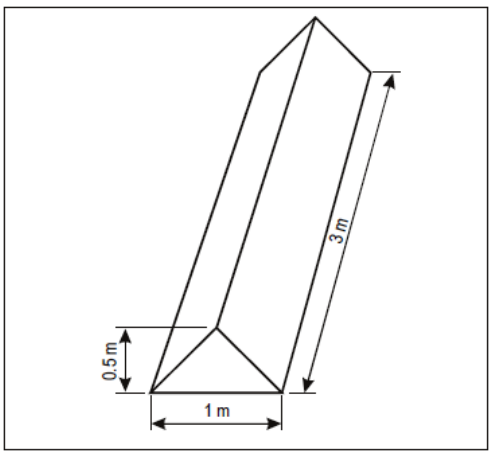
~~(a) A taxiway centre line marker must be retroreflective green.~~

~~(b) Taxiway centre line markers must be so designed and fitted as to withstand being run over by the wheels of an aircraft without damage either to the aircraft or to the markers themselves.~~

~~E.5.5 Boundary markers~~

~~(a) Boundary markers must be provided at an aerodrome where the landing area has no runway.~~

~~(b) Boundary markers must be spaced along the boundary of the landing area at intervals of not more than 200 m, if the type shown in Figure E-34 is used, or approximately 90 m, if the conical type is used with a marker at any corner.~~



~~**Figure E-34. Boundary markers**~~

~~Appendix F Visual Aids for Denoting Obstacles~~

~~F.1 Objects to be marked and/or lighted~~

~~F.1.1 Objects within the lateral boundaries of the obstacle limitation surfaces~~

~~(a) Vehicles and other mobile objects, excluding aircraft, on the movement area of an aerodrome are obstacles and must be marked and, if the vehicles and aerodrome are used at night or in conditions of low visibility, lighted, except that aircraft servicing equipment and vehicles used only on aprons may be exempt.~~

~~(b) Elevated aeronautical ground lights within the movement area must be marked so as to be conspicuous by day. Obstacle lights must not be installed on elevated ground lights or signs in the movement area.~~

~~(c) All obstacles within the distance specified in the following Table C-1, column 11 or 12, from the centre line of a taxiway, an apron taxiway or aircraft stand taxi lane must be marked and, if the taxiway, apron taxiway or aircraft stand taxi lane is used at night, lighted.~~

~~(d) A fixed obstacle that extends above an approach surface within 3 000 m of the inner edge or above a transitional surface must be marked and, if the runway is used at night, lighted, except that:~~

~~(1) such marking and lighting may be omitted when the obstacle is shielded by another fixed obstacle;~~

~~(2) the marking may be omitted when the obstacle is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m;~~

~~(3) the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day; and~~

~~(4) the lighting may be omitted where the obstacle is a lighthouse and an aeronautical study indicates the lighthouse light to be sufficient.~~

~~(e) A fixed object that extends above an obstacle protection surface must be marked and, if the runway is used at night, lighted.~~

~~F.2 Marking and/or lighting of objects~~

~~F.2.1 General~~

~~(a) The presence of objects which must be lighted, as specified in F.1, must be indicated by low-, medium- or high- intensity obstacle lights, or a combination of such lights.~~

~~(b) Low-intensity obstacle lights, Types A, B, C, D and E, medium-intensity obstacle lights, Types A, B and C, high-intensity obstacle lights Type A and B, must be in accordance with the specifications in Table F-1 and CASA Advisory Circulars in the 139 series.~~

Table F-1. Characteristics of obstacle lights

			Peak intensity (cd) at given Background			
			Day	Twilight	Night	Light Distribution
Low-intensity, Type A (fixed obstacle)	Red	Fixed				
Low-intensity, Type B (fixed obstacle)	Red	Fixed				
Low-intensity, Type C (mobile	Yellow/Blue	Flashing				
Low-intensity, Type D (follow-me	Yellow	Flashing				
Low-intensity, Type E	Red	Flashing				Table F-2 (Type
Medium-intensity, Type A	White	Flashing				
Medium-intensity, Type B	Red	Flashing				
High-intensity, Type A	White	Flashing				
High-intensity, Type B	White	Flashing				

a) See F.2.2(c)

b) For flashing lights, effective intensity as determined in accordance with the Aerodrome Design Manual (Doc 9157), Part 4.

Table F-2. Light distribution for low-intensity obstacle lights

	Minimum intensity (a)	Maximum intensity (a)	Vertical beam spread	
			Minimum beam spread	Intensity
Type A	10 cd (b)	N/A	10°	5 cd
Type B	32 cd (b)	N/A	10°	16 cd
Type C	40 cd (b)	400 cd	12° (d)	20 cd
Type D	200 cd (c)	400 cd	N/A (e)	N/A

a) 360° horizontal. For flashing lights, the intensity is read into effective intensity, as determined in accordance with the Aerodrome Design Manual (Doc 9157), Part 4.

b) Between 2 and 10° vertical. Elevation vertical angles are referenced to the horizontal when the light is levelled.

c) Between 2 and 20° vertical. Elevation vertical angles are referenced to the horizontal when the light is levelled.

d) Peak intensity should be located at approximately 2.5° vertical.

Table F-3. Light distribution for medium- and high-intensity obstacle lights according to benchmark intensities of Table F-1

Benchmark intensity	Minimum requirements					Recommendations				
	Vertical elevation angle (b)			Vertical beam spread		Vertical elevation angle (b)			Vertical beam spread	
	0°		1°			0°	1°	10°		
	Minimum average intensity (a)	Minimum intensity (a)	Minimum intensity (a)	Minimum beam spread		Maximum intensity (a)	Maximum intensity (a)	Maximum intensity (a)	Maximum beam spread	
200 000	200 000	150 000	75 000	3°	75 000	250 000	112 500	7 500	7°	75 000
100 000	100 000	75 000	37 500	3°	37 500	125 000	56 250	3 750	7°	37 500
20 000	20 000	15 000	7 500	3°	7 500	25 000	11 250	750	N/A	N/A
2 000	2 000	1 500	750	3°	750	2 500	1 125	75	N/A	N/A

a) 360° horizontal. All intensities are expressed in Candela. For flashing lights, the intensity is read into effective intensity, as determined in accordance with the Aerodrome Design Manual (Doc 9157), Part 4.

b) Elevation vertical angles are referenced to the horizontal when the light unit is levelled.

(c) The number and arrangement of low-, medium- or high-intensity obstacle lights at each level to be marked must be such that the object is indicated from every angle in azimuth. Where a light is shielded in any direction by another part of the object, or by an adjacent object, additional lights must be provided on that adjacent object or the part of the object that is shielding the light, in such a way as to retain the general definition of the object to be lighted. If the shielded light does not contribute to the definition of the object to be lighted, it may be omitted.

F.2.2 Mobile objects

(a) All mobile objects to be marked must be coloured or display flags.

(b) Flags used to mark mobile objects must be displayed around, on top of, or around the highest edge of the object. Flags must not increase the hazard presented by the object they mark.

(c) Flags used to mark mobile objects must not be less than 0.9 m on each side and must consist of a chequered pattern, each square having sides of not less than 0.3 m. The colours of the pattern must contrast each with the other and with the background against which they will be seen. Orange and white or alternatively red and white must be used, except where such colours merge with the background.

~~(d) Low-intensity obstacle lights, Type C, must be displayed on vehicles and other mobile objects excluding aircraft.~~

~~(e) Low-intensity obstacle lights, Type C, displayed on vehicles associated with emergency or security must be flashing blue and those displayed on other vehicles must be flashing yellow.~~

~~(f) Low-intensity obstacle lights, Type D, must be displayed on follow-me vehicles.~~

~~(g) Low-intensity obstacle lights on objects with limited mobility such as aerobridges must be fixed red, and as a minimum be in accordance with the specifications for low-intensity obstacle lights, Type A, in Table F-1. The intensity of the lights must be sufficient to ensure conspicuity considering the intensity of the adjacent lights and the general levels of illumination against which they would normally be viewed.~~

~~F.2.3 Fixed objects~~

~~(a) All fixed objects to be marked shall, whenever practicable, be coloured, but if this is not practicable, markers or flags must be displayed on or above them, except that objects that are sufficiently conspicuous by their shape, size or colour need not be otherwise marked.~~

~~(b) Flags used to mark fixed objects must be displayed around, on top of, or around the highest edge of, the object. When flags are used to mark extensive objects or groups of closely spaced objects, they must be displayed at least every 15 m. Flags must not increase the hazard presented by the object they mark.~~

~~(c) Flags used to mark fixed objects must not be less than 0.6 m on each side.~~

~~(d) Markers displayed on or adjacent to objects must be located in conspicuous positions so as to retain the general definition of the object and must be recognizable in clear weather from a distance of at least 1 000 m for an object to be viewed from the air and 300 m for an object to be viewed from the ground in all directions in which an aircraft is likely to approach the object. The shape of markers must be distinctive to the extent necessary to ensure that they are not mistaken for markers employed to convey other information, and they must be such that the hazard presented by the object they mark is not increased.~~

~~(e) In the case of an object to be lighted, one or more low-, medium- or high-intensity obstacle lights must be located as close as practicable to the top of the object.~~

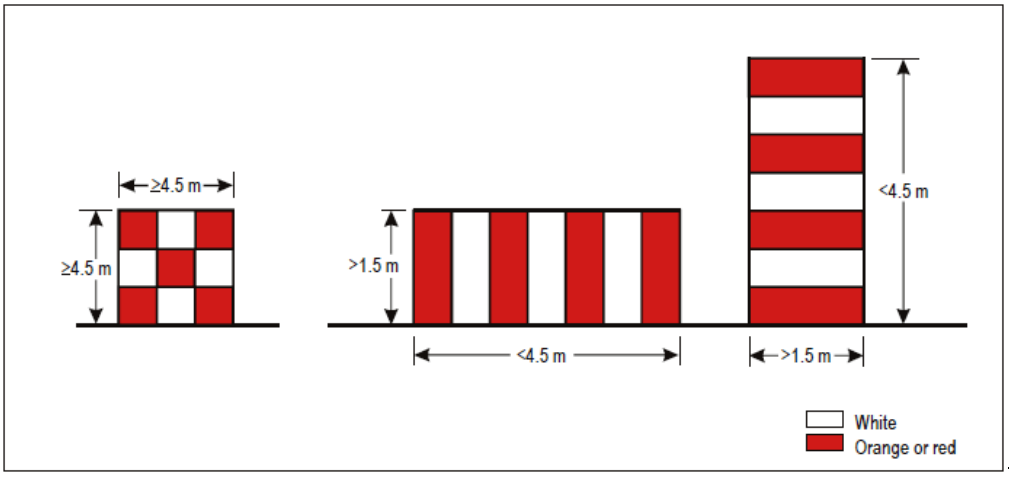
~~(f) In the case of a tower or antenna structure indicated by high-intensity obstacle lights by day with an appurtenance, such as a rod or an antenna, greater than 12 m where it is not practicable to locate a high-intensity obstacle light on the top of the appurtenance, such a light must be located at the highest practicable point and, if practicable, a medium-intensity obstacle light, Type A, mounted on the top.~~

~~(g) In the case of an extensive object or of a group of closely spaced objects to be lighted that are:~~

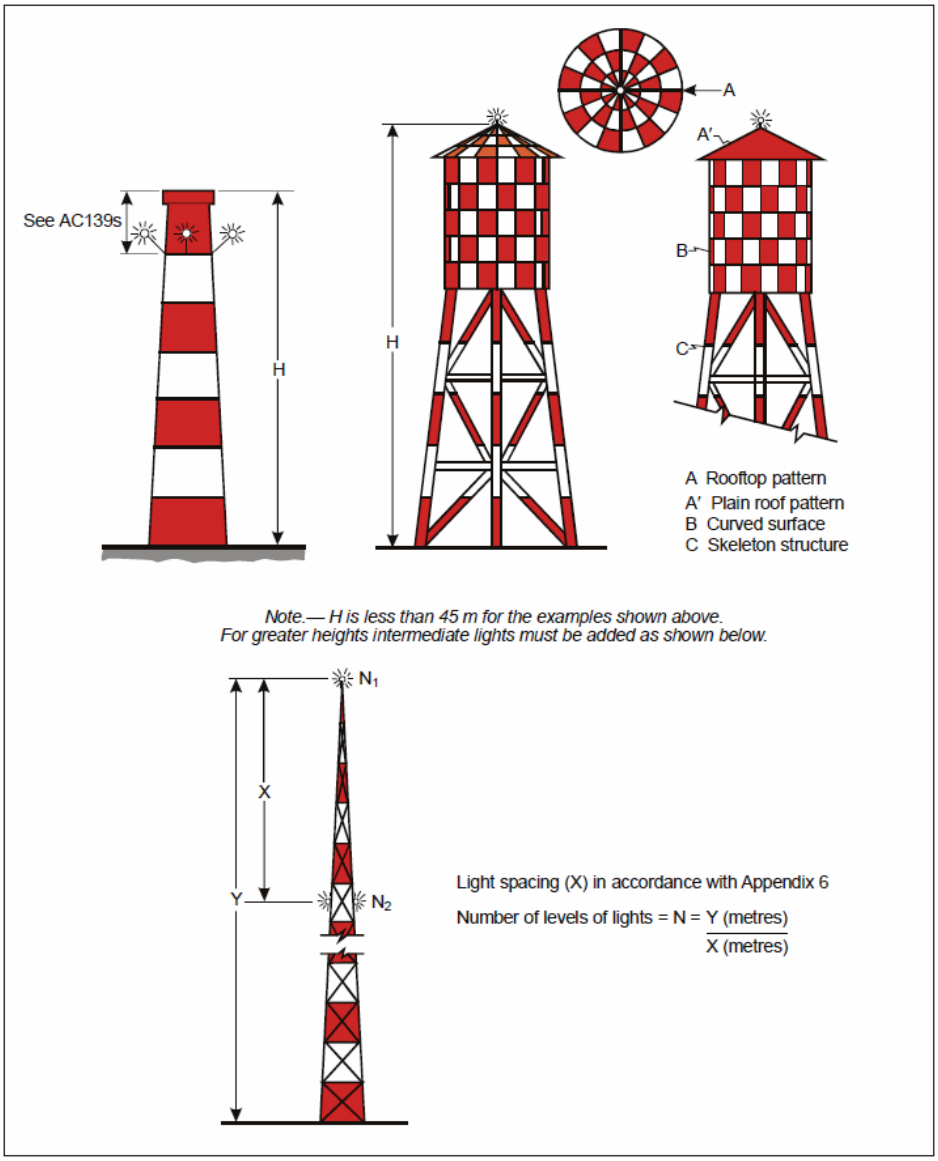
~~(1) penetrating a horizontal obstacle limitation surface (OLS) or located outside an OLS, the top lights must be so arranged as to at least indicate the points or edges of the object highest~~

~~in relation to the obstacle limitation surface or above the ground, and so as to indicate the general definition and the extent of the objects; and~~

~~(2) penetrating a sloping OLS, the top lights must be so arranged as to at least indicate the points or edges of the object highest in relation to the OLS, and so as to indicate the general definition and the extent of the objects. If two or more edges are of the same height, the edge nearest the landing area must be marked.~~



~~Figure F-1. Basic marking patterns~~



~~Figure F-2. Examples of marking and lighting of tall structures~~

~~Table F-4. Marking band widths~~

Longest dimension		
Greater than	Not exceeding	Band width
1.5 m	210 m	1/7 of longest dimension
210 m	270 m	1/9 " " "
270 m	330 m	1/11 " " "
330 m	390 m	1/13 " " "
390 m	450 m	1/15 " " "
450 m	510 m	1/17 " " "
510 m	570 m	1/19 " " "
570 m	630 m	1/21 " " "

~~(h) Where lights are applied to display the general definition of an extensive object or a group of closely spaced objects, and~~

~~(1) low-intensity lights are used, they must be spaced at longitudinal intervals not exceeding 45 m; and~~

~~(2) medium-intensity lights are used, they must be spaced at longitudinal intervals not exceeding 900 m.~~

~~(i) High-intensity obstacle lights, Type A, and medium-intensity obstacle lights, Types A and B, located on an object must flash simultaneously.~~

~~(j) Where an object is indicated by medium-intensity obstacle lights, Type A, and the top of the object is more than 105 m above the level of the surrounding ground or the elevation of tops of nearby buildings (when the object to be marked is surrounded by buildings), additional lights must be provided at intermediate levels. These additional intermediate lights must be spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 105 m.~~

~~(k) Where an object is indicated by medium-intensity obstacle lights, Type B, and the top of the object is more than 45 m above the level of the surrounding ground or the elevation of tops of nearby buildings (when the object to be marked is surrounded by buildings), additional lights must be provided at intermediate levels. These additional intermediate lights must be alternately low-intensity obstacle lights, Type B, and medium-intensity obstacle lights, Type B, and must be spaced as equally as practicable between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 52 m.~~

~~(l) Where an object is indicated by medium-intensity obstacle lights, Type C, and the top of the object is more than 45 m above the level of the surrounding ground or the elevation of tops of nearby buildings (when the object to be marked is surrounded by buildings), additional lights must be provided at intermediate levels. These additional intermediate lights must be spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 52 m.~~

~~(m) Where high-intensity obstacle lights, Type A, are used, they must be spaced at uniform intervals not exceeding 105 m between the ground level and the top light(s) specified in F.2.3(e), except that where an object to be marked is surrounded by buildings, the elevation of the tops of the buildings may be used as the equivalent of the ground level when determining the number of light levels.~~

~~(n) Where high-intensity obstacle lights, Type A, are used, they must be spaced at uniform intervals not exceeding 105 m between the ground level and the top light(s) specified in F.2.3(e), except that where an object to be marked is surrounded by buildings, the elevation of the tops of the buildings may be used as the equivalent of the ground level when determining the number of light levels.~~

~~(o) Where an object is indicated by medium-intensity obstacle lights, Type A, additional lights must be provided at intermediate levels. These additional intermediate lights must be spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 105 m.~~

~~(p) Where an object is indicated by medium-intensity obstacle lights, Type B, additional lights must be provided at intermediate levels. These additional intermediate lights must be alternately low-intensity obstacle lights, Type B, and medium-intensity obstacle lights, Type B, and must be spaced as equally as practicable between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 52 m.~~

~~(q) Where an object is indicated by medium-intensity obstacle lights, Type C, additional lights must be provided at intermediate levels. These additional intermediate lights must be spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 52 m.~~

~~F.2.4 Wind turbines~~

~~A wind turbine must be marked and/or lighted if it is determined to be an obstacle.~~

~~F.2.5 Overhead wires, cables, etc., and supporting towers~~

~~(a) Markers displayed on or adjacent to objects must be located in conspicuous positions so as to retain the general definition of the object and must be recognizable in clear weather from a distance of at least 1 000 m for an object to be viewed from the air and 300 m for an object to be viewed from the ground in all directions in which an aircraft is likely to approach the object. The shape of markers must be distinctive to the extent necessary to ensure that they are not mistaken for markers employed to convey other information, and they must be such that the hazard presented by the object they mark is not increased.~~

~~(b) Where high-intensity obstacle lights, Type B, are used, they must be located at three levels:~~

~~(1) at the top of the tower;~~

~~(2) at the lowest level of the catenary of the wires or cables; and~~

~~(3) at approximately midway between these two levels.~~

~~Appendix G Visual Aids for Denoting Restricted Use Areas~~

~~G.1 Closed runways and taxiways, or part thereof~~

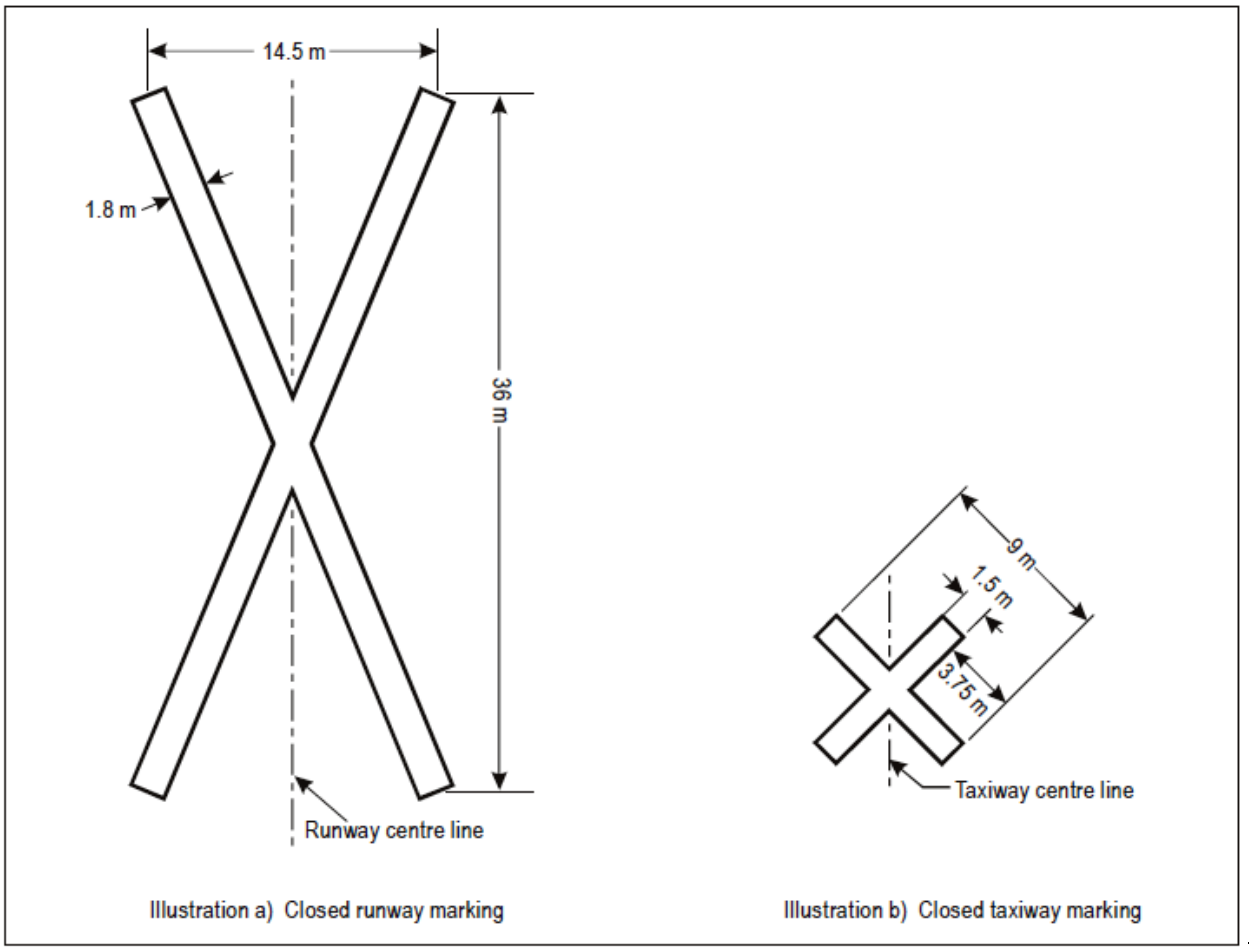
~~(a) A closed marking must be displayed on a runway or taxiway, or portion thereof, which is permanently closed to the use of all aircraft.~~

~~(b) On a runway a closed marking must be placed at each end of the runway, or portion thereof, declared closed, and additional markings must be so placed that the maximum interval between markings does not exceed 300 m. On a taxiway a closed marking must be placed at least at each end of the taxiway or portion thereof closed.~~

~~(c) The closed marking must be of the form and proportions as detailed in Figure G-1, Illustration a), when displayed on a runway, and must be of the form and proportions as detailed in Figure G-~~

~~1, Illustration b), when displayed on a taxiway. The marking must be white when displayed on a runway and must be yellow when displayed on a taxiway.~~

~~(d) When a runway or taxiway or portion thereof is permanently closed, all normal runway and taxiway markings must be obliterated.~~



~~Figure G-1. Closed runway and taxiway markings~~

~~(e) Lighting on a closed runway or taxiway or portion thereof must not be operated, except as required for maintenance purposes.~~

~~(f) In addition to closed markings, when the runway or taxiway or portion thereof closed is intercepted by a usable runway or taxiway which is used at night, unserviceability lights must be placed across the entrance to the closed area at intervals not exceeding 3 m (see G.4(d)).~~

~~G.2 Non-load-bearing surfaces~~

~~Shoulders for taxiways, runway turn pads, holding bays and aprons and other non-load-bearing surfaces which cannot readily be distinguished from load-bearing surfaces and which, if used by aircraft, might result in damage to the aircraft must have the boundary between such areas and the load-bearing surface marked by a taxi side stripe marking.~~

~~G.3 Unserviceable areas~~

~~(a) Unserviceability markers must be displayed wherever any portion of a taxiway, apron or holding bay is unfit for the movement of aircraft but it is still possible for aircraft to bypass the area safely. On a movement area used at night, unserviceability lights must be used.~~

~~(b) Unserviceability markers and lights must be placed at intervals sufficiently close so as to delineate the unserviceable area.~~

~~(c) Unserviceability markers must consist of conspicuous upstanding devices such as flags, cones or marker boards.~~

~~(d) An unserviceability light must consist of a red fixed light. The light must have an intensity sufficient to ensure conspicuity considering the intensity of the adjacent lights and the general level of illumination against which it would normally be viewed. In no case must the intensity be less than 10 cd of red light.~~

~~Appendix H — Electrical Systems~~

~~H.1 — Electrical power supply systems for air navigation facilities~~

~~(a) — Adequate primary power supply must be available at aerodromes for the safe functioning of air navigation facilities.~~

~~(b) — The design and provision of electrical power systems for aerodrome visual and radio navigation aids must be such that an equipment failure will not leave the pilot with inadequate visual and non-visual guidance or misleading information.~~

~~(c)The provision of a definition of switch-over time must not require the replacement of an existing secondary power supply before 1 January 2010. However, for a secondary power supply installed after 4 November 1999, the electric power supply connections to those facilities for which secondary power is required must be so arranged that the facilities are capable of meeting the requirements of Table H-1 for maximum switch-over times.~~

~~(d) — For a precision approach runway, a secondary power supply capable of meeting the requirements of Table H-1 for the appropriate category of precision approach runway must be provided. Electric power supply connections to those facilities for which secondary power is required must be so arranged that the facilities are automatically connected to the secondary power supply on failure of the primary source of power.~~

~~(e) — For a runway meant for take-off in runway visual range conditions less than a value of 800 m, a secondary power supply capable of meeting the relevant requirements of Table H-1 must be provided.~~

~~Table H-1. Secondary power supply requirements~~

		Maximum switch-over time
~~Non-instrument~~	~~Visual approach slope indicators[a]~~ ~~Runway edge[b]~~	~~See AC139s~~
~~Non-precision approach~~	~~Approach lighting system~~ ~~Runway end~~	~~15 seconds~~ ~~15 seconds~~
~~Precision approach category I~~	~~Approach lighting system~~ ~~Runway end Essential taxiway[c] Obstacle[a]~~	~~15 seconds~~ ~~15 seconds~~ ~~15 seconds~~

	~~Other parts of the approach lighting system~~	~~15 seconds~~
	~~Runway edge~~	~~15 seconds~~
	~~Runway threshold~~	~~1 second~~
	~~Runway end~~	~~1 second~~
	~~Runway centre line~~	~~1 second~~
	~~Runway touchdown zone~~	~~1 second~~
	~~All stop bars~~	~~1 second~~
	~~Essential taxiway~~	~~15 seconds~~
~~range conditions less than a value of 800 m~~	~~Runway end~~	~~1 second~~
	~~Runway centre line~~	~~1 second~~
	~~All stop bars Essential taxiway[a] Obstacle[a]~~	~~1 second~~
		~~15 seconds~~

~~a. Supplied with secondary power when their operation is essential to the safety of flight operation.~~

~~b. See AC139s, regarding the use of emergency lighting.~~

~~H.2 System design~~

~~(a) For a runway meant for use in runway visual range conditions less than a value of 550 m, the electrical systems for the power supply, lighting and control of the lighting systems included in Table H-1 must be so designed that an equipment failure will not leave the pilot with inadequate visual guidance or misleading information.~~

~~(b) Where the secondary power supply of an aerodrome is provided by the use of duplicate feeders, such supplies must be physically and electrically separate so as to ensure the required level of availability and independence.~~

~~(c) 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.~~

~~H.3 Monitoring~~

~~Where lighting systems are used for aircraft control purposes, such systems must be monitored automatically so as to provide an indication of any fault which may affect the control functions. This information must be automatically relayed to the air traffic services unit.~~

~~Appendix I. Aerodrome Operational Services, Equipment and Installations~~

~~I.1 .1 General~~

~~(a) An aerodrome emergency plan must be established at an aerodrome, commensurate with the aircraft operations and other activities conducted at the aerodrome.~~

~~(b) The aerodrome emergency plan must provide for the coordination of the actions to be taken in an emergency occurring at an aerodrome or in its vicinity.~~

~~(c) The plan must coordinate the response or participation of all existing agencies which, in the opinion of the appropriate authority, could be of assistance in responding to an emergency.~~

~~(d) The plan must observe Human Factors principles to ensure optimum response by all existing agencies participating in emergency operations.~~

~~I.1 .2 Aerodrome emergency exercise~~

~~(a) The plan must contain procedures for periodic testing of the adequacy of the plan and for reviewing the results in order to improve its effectiveness.~~

~~(b) The plan must be tested by conducting:~~

~~(1) a full-scale aerodrome emergency exercise at intervals not exceeding two years and partial emergency exercises in the intervening year to ensure that any deficiencies found during the full-scale aerodrome emergency exercise have been corrected; or~~

~~(2) a series of modular tests commencing in the first year and concluding in a full-scale aerodrome emergency exercise at intervals not exceeding three years;~~

~~and reviewed thereafter, or after an actual emergency, so as to correct any deficiency found during such exercises or actual emergency.~~

~~I.1.3 Emergencies in difficult environments~~

~~The plan must include the ready availability of, and coordination with, appropriate specialist rescue services to be able to respond to emergencies where an aerodrome is located close to water and/or swampy areas and where a significant portion of approach or departure operations takes place over these areas.~~

~~I.2 Rescue and firefighting~~

~~I.2.1 General~~

~~(a) Rescue and firefighting equipment and services must be provided at an aerodrome that is required to under rule 139.59 when serving commercial air transport operations.~~

~~(b) Where an aerodrome is located close to water/swampy areas, or difficult terrain, and where a significant portion of approach or departure operations takes place over these areas, specialist rescue services and firefighting equipment appropriate to the hazard and risk must be available.~~

~~I.2.2 Level of Protection~~

~~(a) The level of protection provided at an aerodrome for rescue and firefighting must be appropriate to the aerodrome category determined using the principles in (b) and (c), except that, where the number of movements of the aeroplanes in the highest category normally using the aerodrome is less than 700 in the busiest consecutive three months, the level of protection provided must be not less than one category below the determined category.~~

~~Table I-1. Aerodrome category for rescue and firefighting~~

Aerodrome category (1)	Aeroplane overall length (2)	Maximum fuselage width (3)
1	0 m up to but not including 9 m	2 m
2	9 m up to but not including 12 m	2 m
3	12 m up to but not including 18 m	3 m
4	18 m up to but not including 24 m	4 m
5	24 m up to but not including 28 m	4 m
6	28 m up to but not including 39 m	5 m
7	39 m up to but not including 49 m	5 m
8	49 m up to but not including 61 m	7 m
9	61 m up to but not including 76 m	7 m
10	76 m up to but not including 90 m	8 m

~~(b) The aerodrome category must be determined from Table I-1 and must be based on the longest aeroplanes normally using the aerodrome and their fuselage width.~~

~~(c) If, after selecting the category appropriate to the longest aeroplane's overall length, that aeroplane's fuselage width is greater than the maximum width in Table I-1, column 3, for that category, then the category for that aeroplane must actually be one category higher.~~

~~(d) During anticipated periods of reduced activity, the level of protection available must be no less than that needed for the highest category of aeroplane planned to use the aerodrome during that time irrespective of the number of movements.~~

~~I.2.3 Extinguishing agents~~

~~(a) The amounts of water for foam production and the complementary agents to be provided on the rescue and firefighting vehicles must be in accordance with the aerodrome category determined under I.2.2(a), (b) & (c) and Table I-1, except that for aerodrome categories 1 and 2 up to 100 per cent of the water may be substituted with complementary agent.~~

~~For the purpose of agent substitution, 1 kg of complementary agent must be taken as equivalent to 1.0 L of water for production of a foam meeting performance level A.~~

~~(b) From 1 January 2015, at aerodromes where operations by aeroplanes larger than the average size in a given category are planned, the quantities of water must be recalculated and the amount of water for foam production and the discharge rates for foam solution must be increased accordingly.~~

~~Table I-2. Minimum usable amounts of extinguishing agents~~

~~Foam meeting performance level A~~			~~Foam meeting performance level B~~		~~Foam meeting performance~~		~~Complementary agents~~	
~~Aerodrome category~~	~~Water (L)~~	~~Discharge rate foam solution/ minute (L)~~	~~Water (L)~~	~~Discharge rate foam solution/ minute (L)~~	~~Water (L)~~	~~Discharge rate foam solution/ minute (L)~~	~~Dry chemical powders (kg)~~	~~Discharge Rate (kg/second)~~
~~(1)~~	~~(2)~~	~~(3)~~	~~(4)~~	~~(5)~~	~~(6)~~	~~(7)~~	~~(8)~~	~~(9)~~
~~1~~	~~350~~	~~350~~	~~230~~	~~230~~	~~160~~	~~160~~	~~45~~	~~2.25~~
~~2~~	~~1 000~~	~~800~~	~~670~~	~~550~~	~~460~~	~~360~~	~~90~~	~~2.25~~
~~3~~	~~1 800~~	~~1 300~~	~~1 200~~	~~900~~	~~820~~	~~630~~	~~135~~	~~2.25~~
~~4~~	~~3 600~~	~~2 600~~	~~2 400~~	~~1 800~~	~~1 700~~	~~1 100~~	~~135~~	~~2.25~~
~~5~~	~~8 100~~	~~4 500~~	~~5 400~~	~~3 000~~	~~3 900~~	~~2 200~~	~~180~~	~~2.25~~
~~6~~	~~11 800~~	~~6 000~~	~~7 900~~	~~4 000~~	~~5 800~~	~~2 900~~	~~225~~	~~2.25~~
~~7~~	~~18 200~~	~~7 900~~	~~12 100~~	~~5 300~~	~~8 800~~	~~3 800~~	~~225~~	~~2.25~~
~~8~~	~~27 300~~	~~10 800~~	~~18 200~~	~~7 200~~	~~12 800~~	~~5 100~~	~~450~~	~~4.5~~
~~9~~	~~36 400~~	~~13 500~~	~~24 300~~	~~9 000~~	~~17 100~~	~~6 300~~	~~450~~	~~4.5~~
~~10~~	~~48 200~~	~~16 600~~	~~32 300~~	~~11 200~~	~~22 800~~	~~7 900~~	~~450~~	~~4.5~~

~~(c) The quantity of foam concentrates separately provided on vehicles for foam production must be in proportion to the quantity of water provided and the foam concentrate selected.~~

~~(d) The discharge rate of the foam solution must not be less than the rates shown in Table I-2.~~

~~(e) The complementary agents must comply with the appropriate specifications of the International Organization for Standardization (ISO).~~

~~I.2.4 Response time~~

~~(a) The operational objective of the rescue and firefighting service must be to achieve a response time not exceeding three minutes to any point of each operational runway, in optimum visibility and surface conditions.~~

~~(b) Any vehicles, other than the first responding vehicle(s), required to deliver the amounts of extinguishing agents specified in Table I-2 must ensure continuous agent application and must arrive no more than four minutes from the initial call.~~

~~(c) All rescue and firefighting personnel must be properly trained to perform their duties in an efficient manner and must participate in live fire drills commensurate with the types of aircraft and type of rescue and firefighting equipment in use at the aerodrome, including pressure-fed fuel fires.~~

~~(d) The rescue and firefighting personnel training programme must include training in human performance, including team coordination.~~

~~I.2.5 Personnel~~

~~All responding rescue and firefighting personnel must be provided with protective clothing and respiratory equipment to enable them to perform their duties in an effective manner.~~

~~I.3 Wildlife strike hazard reduction~~

~~(a) The wildlife strike hazard on, or in the vicinity of, an aerodrome must be assessed through:~~

~~(1) the establishment of a national procedure for recording and reporting wildlife strikes to aircraft;~~

~~(2) the collection of information from aircraft operators, aerodrome personnel and other sources on the presence of wildlife on or around the aerodrome constituting a potential hazard to aircraft operations; and~~

~~(3) an ongoing evaluation of the wildlife hazard by competent personnel.~~

~~(b) Wildlife strike reports must be collected and forwarded to CASA for inclusion in the ICAO Bird Strike Information System (IBIS) database.~~

~~(c) Action must be taken to decrease the risk to aircraft operations by adopting measures to minimize the likelihood of collisions between wildlife and aircraft.~~

~~(d) The appropriate authority must take action to eliminate or to prevent the establishment of garbage disposal dumps or any other source which may attract wildlife to the aerodrome, or its vicinity, unless an appropriate wildlife assessment indicates that they are unlikely to create conditions conducive to a wildlife hazard problem. Where the elimination of existing sites is not possible, the appropriate authority must ensure that any risk to aircraft posed by these sites is assessed and reduced to as low as reasonably practicable.~~

~~I.4 Apron management service~~

~~(a) An apron management service must be provided with radiotelephony communications facilities.~~

~~(b) Where low visibility procedures are in effect, persons and vehicles operating on an apron must be restricted to the essential minimum.~~

~~(c) An emergency vehicle responding to an emergency must be given priority over all other surface movement traffic.~~

~~(d) A vehicle operating on an apron shall:~~

~~(1) give way to an emergency vehicle; an aircraft taxiing, about to taxi, or being pushed or towed; and~~

~~(2) give way to other vehicles in accordance with local regulations.~~

~~(e) An aircraft stand must be visually monitored to ensure that the recommended clearance distances are provided to an aircraft using the stand.~~

~~I.5 Ground servicing of aircraft~~

~~(a) Fire extinguishing equipment suitable for at least initial intervention in the event of a fuel fire and personnel trained in its use must be readily available during the ground servicing of an aircraft, and there must be a means of quickly summoning the rescue and firefighting service in the event of a fire or major fuel spill.~~

~~(b) When aircraft refuelling operations take place while passengers are embarking, on board or disembarking, ground equipment must be positioned so as to allow:~~

~~(1) the use of a sufficient number of exits for expeditious evacuation; and~~

~~(2) a ready escape route from each of the exits to be used in an emergency.~~

~~I.6 Aerodrome vehicle operations~~

~~(a) A vehicle must be operated:~~

~~(1) on a manoeuvring area only as authorized by the aerodrome control tower; and~~

~~(2) on an apron only as authorized by the appropriate designated authority.~~

~~(b) The driver of a vehicle on the movement area must comply with all mandatory instructions conveyed by markings and signs unless otherwise authorized by:~~

~~(1) the aerodrome control tower when on the manoeuvring area; or~~

~~(2) the appropriate designated authority when on the apron.~~

~~(c) The driver of a vehicle on the movement area must comply with all mandatory instructions conveyed by lights.~~

~~(d) The driver of a vehicle on the movement area must be appropriately trained for the tasks to be performed and must comply with the instructions issued by:~~

~~(1) the aerodrome control tower, when on the manoeuvring area; and~~

~~(2) the appropriate designated authority, when on the apron.~~

~~(e) The driver of a radio-equipped vehicle must establish satisfactory two-way radio communication with the aerodrome control tower before entering the manoeuvring area and with the appropriate designated authority before entering the apron. The driver must maintain a continuous listening watch on the assigned frequency when on the movement area.~~

~~I.7 Surface movement guidance and control systems~~

~~(a) A surface movement guidance and control system (SMGCS) must be provided at an aerodrome.~~

~~(b) Where an SMGCS is provided by selective switching of stop bars and taxiway centre line lights, the following requirements must be met:~~

~~(1) taxiway routes which are indicated by illuminated taxiway centre line lights must be capable of being terminated by an illuminated stop bar;~~

~~(2) the control circuits must be so arranged that when a stop bar located ahead of an aircraft is illuminated, the appropriate section of taxiway centre line lights beyond it is suppressed; and~~

~~(3) the taxiway centre line lights are activated ahead of an aircraft when the stop bar is suppressed.~~

~~I.8 Siting of equipment and installations on operational areas~~

~~(a) Unless its function requires it to be there for air navigation or for aircraft safety purposes, no equipment or installation must be:~~

~~(3) on a runway strip, a runway end safety area, a taxiway strip or within the distances specified in Table C-1, column 11, if it would endanger an aircraft; or~~

~~(2) on a clearway if it would endanger an aircraft in the air.~~

~~(b) Any equipment or installation required for air navigation or for aircraft safety purposes which must be located:~~

~~(1) on that portion of a runway strip within:~~

~~(i) 75 m of the runway centre line where the code number is 3 or 4; or~~

~~(ii) 45 m of the runway centre line where the code number is 1 or 2; or~~

~~(2) on a runway end safety area, a taxiway strip or within the distances specified in Table C-1; or c) on a clearway and which would endanger an aircraft in the air; must be frangible and mounted as low as possible.~~

~~(c) Unless its function requires it to be there for air navigation or for aircraft safety purposes, no equipment or installation must be located within 240 m from the end of the strip and within:~~

~~(1) 60 m of the extended centre line where the code number is 3 or 4; or~~

~~(2) 45 m of the extended centre line where the code number is 1 or 2; of a precision approach runway category I, II or III.~~

~~(d) Any equipment or installation required for air navigation or for aircraft safety purposes which must be located on or near a strip of a precision approach runway category I, II or III and which:~~

~~(1) is situated on that portion of the strip within 77.5 m of the runway centre line where the code number is 4 and the code letter is F; or~~

~~(2) is situated within 240 m from the end of the strip and within:~~

~~(i) 60 m of the extended runway centre line where the code number is 3 or 4; or~~

~~(ii) 45 m of the extended runway centre line where the code number is 1 or 2; or~~

~~(3) penetrates the inner approach surface, the inner transitional surface or the balked landing surface; must be frangible and mounted as low as possible.~~

~~I.9 Fencing~~

~~(a) A fence or other suitable barrier must be provided on an aerodrome to prevent the entrance to the movement area of animals large enough to be a hazard to aircraft.~~

~~(b) A fence or other suitable barrier must be provided on an aerodrome to deter the inadvertent or premeditated access of an unauthorized person onto a non-public area of the aerodrome.~~

~~(c) Suitable means of protection must be provided to deter the inadvertent or premeditated access of unauthorized persons into ground installations and facilities essential for the safety of civil aviation located off the aerodrome.~~

~~(d) The fence or barrier must be located so as to separate the movement area and other facilities or zones on the aerodrome vital to the safe operation of aircraft from areas open to public access.~~

~~I.10 Autonomous runway incursion warning system~~

~~(a) Where an ARIWS is installed at an aerodrome:~~

~~(1) it must provide autonomous detection of a potential incursion or of the occupancy of an active runway and a direct warning to a flight crew or vehicle operator;~~

~~(2) it must function and be controlled independently of any other visual system on the aerodrome;~~

~~(3) its visual aid components, i.e. lights, must be designed to conform with the relevant specifications in E.3; and~~

~~(4) failure of part or all of it must not interfere with normal aerodrome operations. To this end, provision must be made to allow the ATC unit to partially or entirely shut down the system.~~

~~(b) Where an ARIWS is installed at an aerodrome, information on its characteristics and status must be provided to the appropriate aeronautical information services for promulgation in the AIP with the description of the aerodrome surface movement guidance and control system and markings.~~

~~Appendix J. Aerodrome Maintenance~~

~~J.1 General~~

~~A maintenance programme, including preventive maintenance where appropriate, must be established at an aerodrome to maintain facilities in a condition which does not impair the safety, regularity or efficiency of air navigation.~~

~~J.2 Pavements~~

~~(a) The surfaces of all movement areas including pavements (runways, taxiways and aprons) and adjacent areas must be inspected and their conditions monitored regularly as part of an aerodrome preventive and corrective maintenance programme with the objective of avoiding and eliminating any foreign object debris (FOD) that might cause damage to aircraft or impair the operation of aircraft systems.~~

~~(b) The surface of a runway must be maintained in a condition such as to prevent formation of harmful irregularities.~~

~~(c) A paved runway must be maintained in a condition so as to provide surface friction characteristics at or above the minimum friction level specified by the Director.~~

~~(d) Runway surface friction characteristics for maintenance purposes must be periodically measured with a continuous friction measuring device using self-wetting features and documented. The frequency of these measurements must be sufficient to determine the trend of the surface friction characteristics of the runway.~~

~~(e) Corrective maintenance action must be taken to prevent the runway surface friction characteristics for either the entire runway or a portion thereof from falling below a minimum friction level specified by the Director.~~

~~J.3 Removal of contaminants~~

~~(a) Standing water, mud, dust, sand, oil, rubber deposits and other contaminants must be removed from the surface of runways in use as rapidly and completely as possible to minimize accumulation.~~

~~(b) Chemicals which may have harmful effects on aircraft or pavements, or chemicals which may have toxic effects on the aerodrome environment, must not be used.~~

~~J.4 Runway pavement overlays~~

~~(a) The longitudinal slope of the temporary ramp, measured with reference to the existing runway surface or previous overlay course, must be:~~

~~(1) 0.5 to 1.0 per cent for overlays up to and including 5 cm in thickness; and~~

~~(2) not more than 0.5 per cent for overlays more than 5 cm in thickness.~~

~~J.5 Visual aids~~

~~(a) A light must be deemed to be unserviceable when the main beam average intensity is less than 50 per cent of the value specified in the appropriate figure in CASA Advisory Circulars in the 139 series. For light units where the designed main beam average intensity is above the value~~

~~shown in CASA Advisory Circulars in the 139 series, the 50 per cent value must be related to that design value.~~

~~(b) A system of preventive maintenance of visual aids must be employed to ensure lighting and marking system reliability.~~

~~(c) The system of preventive maintenance employed for a precision approach runway category II or III must have as its objective that, during any period of category II or III operations, all approach and runway lights are serviceable and that, in any event, at least:~~

~~(1) 95 per cent of the lights are serviceable in each of the following particular significant elements:~~

~~(i) precision approach category II and III lighting system, the inner 450 m;~~

~~(ii) runway centre line lights;~~

~~(iii) runway threshold lights; and~~

~~(iv) runway edge lights;~~

~~(2) 90 per cent of the lights are serviceable in the touchdown zone lights;~~

~~(3) 85 per cent of the lights are serviceable in the approach lighting system beyond 450 m; and~~

~~(4) 75 per cent of the lights are serviceable in the runway end lights.~~

~~In order to provide continuity of guidance, the allowable percentage of unserviceable lights must not be permitted in such a way as to alter the basic pattern of the lighting system. Additionally, an unserviceable light must not be permitted adjacent to another unserviceable light, except in a barrette or a crossbar where two adjacent unserviceable lights may be permitted.~~

~~(d) The system of preventive maintenance employed for a stop bar provided at a runway-holding position used in conjunction with a runway intended for operations in runway visual range conditions less than a value of 350 m must have the following objectives:~~

~~(1) no more than two lights will remain unserviceable; and~~

~~(2) two adjacent lights will not remain unserviceable unless the light spacing is significantly less than that specified.~~

~~(e) The system of preventive maintenance employed for a taxiway intended for use in runway visual range conditions less than a value of 350 m must have as its objective that no two adjacent taxiway centre line lights be unserviceable.~~

~~(f) The system of preventive maintenance employed for a precision approach runway category I must have as its objective that, during any period of category I operations, all approach and runway lights are serviceable and that, in any event, at least 85 per cent of the lights are serviceable in each of the following:~~

~~(1) precision approach category I lighting system;~~

~~(2) runway threshold lights;~~

~~(3) runway edge lights; and~~

~~(4) runway end lights.~~

~~In order to provide continuity of guidance an unserviceable light must not be permitted adjacent to another unserviceable light unless the light spacing is significantly less than that specified.~~

~~(g) The system of preventive maintenance employed for a runway meant for take-off in runway visual range conditions less than a value of 550 m must have as its objective that, during any period of operations, all runway lights are serviceable and that in any event:~~

~~(1) at least 95 per cent of the lights are serviceable in the runway centre line lights (where provided) and in the runway edge lights; and~~

~~(2) at least 75 per cent of the lights are serviceable in the runway end lights.~~

~~In order to provide continuity of guidance, an unserviceable light must not be permitted adjacent to another unserviceable light.~~

~~(h) The system of preventive maintenance employed for a runway meant for take-off in runway visual range conditions of a value of 550 m or greater must have as its objective that, during any period of operations, all runway lights are serviceable and that, in any event, at least 85 per cent of the lights are serviceable in the runway edge lights and runway end lights. In order to provide continuity of guidance, an unserviceable light must not be permitted adjacent to another unserviceable light.~~

APPENDIX A. GENERAL

Introductory Note: This Appendix contains Standards and Recommended Practices (specifications) that prescribe the physical characteristics and obstacle limitation surfaces to be provided for at aerodromes, and certain facilities and technical services normally provided at an aerodrome. It also contains specifications dealing with obstacles outside those limitation surfaces. It is not intended that these specifications limit or regulate the operation of an aircraft.

To a great extent, the specifications for individual facilities detailed in Part 139 Appendix, have been interrelated by a reference code system, described in this chapter, and by the designation of the type of runway for which they are to be provided, as specified in the definitions. This not only

simplifies the reading of this Appendix, but in most cases, provides for efficiently proportioned aerodromes when the specifications are followed.

This document sets forth the minimum aerodrome specifications for aircraft which have the characteristics of those which are currently operating or for similar aircraft that are planned for introduction. Accordingly, any additional safeguards that might be considered appropriate to provide for more demanding aircraft are not taken into account. Such matters are left to appropriate authorities to evaluate and take into account as necessary for each particular aerodrome. Provisions for the accommodation of more demanding aircraft at existing aerodromes can be found in the PANS-Aerodromes (Doc 9981). Guidance on some possible effects of future aircraft on these specifications is given in the CASA PNG Advisory Circular AC139-3.2 Physical Characteristics-Taxiway, Apron, Holding Bays

It is to be noted that the specifications for precision approach runway categories II and III are only applicable to runways intended to be used by aeroplanes in code numbers 3 and 4.

Part 139 Appendix, does not include specifications relating to the overall planning of aerodromes (such as separation between adjacent aerodromes or capacity of individual aerodromes), impact on the environment, or to economic and other non-technical factors that need to be considered in the development of an aerodrome. Information on these subjects is included in the Airport Planning Manual *(Doc 9184), Part 1. Guidance material on the environmental aspects of the development and operation of an aerodrome is included in the* Airport Planning Manual *(Doc 9184), Part 2.*

Aviation security is an integral part of aerodrome planning and operations. Part 139 Appendix, contains several specifications aimed at enhancing the level of security at aerodromes. Specifications on other facilities related to security are given in Annex 17 — Aviation Security *and detailed guidance on the subject is contained in the* Aviation Security Manual *(Doc 8973-Restricted).*

A.1 Applicability

A.1.1 The interpretation of some of the specifications in the Appendices expressly requires the exercising of discretion, the taking of a decision or the performance of a function by the appropriate authority. In other specifications, the expression appropriate authority does not actually appear although its inclusion is implied. In both cases, the responsibility for whatever determination or action is necessary must rest with the State having jurisdiction over the aerodrome.

A.1.2 The specifications, unless otherwise indicated in a particular context, must apply to all aerodromes open to public use in accordance with the requirements of Article 15 of the Chicago Convention. The specifications of Part 139 Appendix C, must apply only to land aerodromes. The specifications in this Part must apply, where appropriate, to heliports but must not apply to stolports.

> *Note.— Although there are at present no specifications relating to stolports, it is intended that specifications for these aerodromes will be included as they are developed. In the interim, guidance material on stolports is given in the* Stolport Manual *(Doc 9150).*

A.1.3 Wherever a colour is referred to in this Part, the specifications for that colour given in AC139-5.1 Visual Aids for Navigation – Indicators and Signalling Devices must apply.

A.2 Common reference systems

A.2.1 Horizontal reference system

World Geodetic System — 1984 (WGS-84) must be used as the horizontal (geodetic) reference system. Reported aeronautical geographical coordinates (indicating latitude and longitude) must be expressed in terms of the WGS-84 geodetic reference datum.

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

A.2.2 Vertical reference system

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

Note 1.— The geoid globally most closely approximates MSL. It is defined as the equipotential surface in the gravity field of the Earth which coincides with the undisturbed MSL extended continuously through the continents.

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

A.2.3 Temporal reference system

A.2.3.1 The Gregorian calendar and Coordinated Universal Time (UTC) must be used as the temporal reference system.

A.2.3.2 When a different temporal reference system is used, this must be indicated in GEN 2.1.2 of the Aeronautical Information Publication (AIP).

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

~~1.3 Certification of aerodromes~~

~~*Note.— The intent of these specifications is to ensure the establishment of a regulatory regime so that compliance with the specifications in this Part can be effectively enforced. It is recognized that the methods of ownership, operation and surveillance of aerodromes differ among States. The most effective and transparent means of ensuring compliance with applicable specifications is the availability of a separate safety oversight entity and a well-defined safety oversight mechanism with support of appropriate legislation to be able to carry out the function of safety regulation of aerodromes. When an aerodrome is granted a certificate, it signifies to aircraft operators and other organizations operating on the aerodrome that, at the time of certification, the aerodrome meets the specifications regarding the facility and its operation, and that it has, according to the certifying authority, the capability to maintain these specifications for the period of validity of the certificate. The certification process also establishes the baseline for continued monitoring of compliance with the specifications. Information on the status of certification of aerodromes would need to be provided to the appropriate aeronautical information services for*~~

~~*promulgation in the Aeronautical Information Publication (AIP). See 2.13.1 and PANS-AIM (Doc 10066), Appendix 2, AD 1.5.*~~

~~1.3.1 States must certify aerodromes used for international operations in accordance with the specifications contained in this Appendix as well as other relevant ICAO specifications through an appropriate regulatory framework.~~

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

~~1.3.2 **Recommendation.—** *States should certify aerodromes open to public use in accordance with these specifications as well as other relevant ICAO specifications through an appropriate regulatory framework.*~~

~~1.3.3 The regulatory framework must include the establishment of criteria and procedures for the certification of aerodromes.~~

~~*Note.— Guidance on a regulatory framework is given in the* Manual on Certification of Aerodromes *(Doc 9774).*~~

~~1.3.4 As part of the certification process, States must ensure that an aerodrome manual which will include all pertinent information on the aerodrome site, facilities, services, equipment, operating procedures, organization and management including a safety management system, is submitted by the applicant for approval/acceptance prior to granting the aerodrome certificate.~~

~~*Note 1.— Contents of an aerodrome manual, including procedures for its submission and approval/acceptance, verification of compliance and granting of an aerodrome certificate, are available in the PANS-Aerodromes (Doc 9981).*~~

~~*Note 2.— The intent of a safety management system is to have in place an organized and orderly approach in the management of aerodrome safety by the aerodrome operator. Annex 19 —* Safety Management *contains the safety management provisions applicable to certified aerodromes. Overarching guidance on safety management systems is provided in the* Safety Management Manual *(Doc 9859) and in the* Manual on Certification of Aerodromes *(Doc 9774). Procedures on the management of change, conduct of safety assessment, reporting and analyses of safety occurrences at aerodromes, runway safety, and continuous monitoring to enforce compliance with applicable specifications so that hazards are identified and risks are assessed and mitigated, are specified in the PANS-Aerodromes (Doc 9981).*~~

A.3 Airport design and master plan

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

A.3.1 **Recommendation.—** *A master plan containing detailed plans for the development of aerodrome infrastructure should be established for aerodromes deemed relevant by States.*

Note 1.— A master plan represents the development plan of a specific aerodrome . It is developed by the aerodrome operator based on economic feasibility, traffic forecasts, and current and future requirements provided by, among others, aircraft operators (see A.3.3).

Note 2.— A master plan may be required when the lack of capacity at an airport, due to conditions such as, but not limited to expected traffic growth, changing weather and climatic conditions or major works to address safety or environmental concerns, would put the connectivity of a geographical area at risk or cause severe disruption to the air transport network.

A.3.2 **Recommendation.—** *The master plan should:*

(e) *contain a schedule of priorities including a phased implementation plan; and*

(f) *be reviewed periodically to take into account current and future aerodrome traffic.*

A.3.3 **Recommendation.—** *Aerodrome stakeholders, particularly aircraft operators, should be consulted in order to facilitate the master planning process using a consultative and collaborative approach.*

Note 1.— Provision of advanced planning data to facilitate the planning process includes future aircraft types, characteristics and numbers of aircraft expected to be used, anticipated growth of aircraft movements, and number of passengers and amount of cargo projected to be handled.

Note 2.— See Annex 9, Chapter 6 on the need for aircraft operators to inform aerodrome operators concerning the former's service, schedule and fleet plans to enable rational planning of facilities and services in relation to the traffic anticipated.

Note 3.— See ICAO's Policies on Charges for Airports and Air Navigation Services *(Doc 9082), Section 1, regarding consultation with users concerning provision of advance planning data and protection of commercially sensitive data.*

A.3.4 Architectural and infrastructure-related requirements for the optimum implementation of international civil aviation security measures must be integrated into the design and construction of new facilities and alterations to existing facilities at an aerodrome.

A.3.5 **Recommendation.—** *The design of aerodromes should take into account land-use and environmental control measures*.

Note.— Guidance on land-use planning and environmental control measures is contained in the Airport Planning Manual *(Doc 9184)*, *Part 2*.

A.4 Aerodrome reference code

Introductory Note.— The intent of the reference code is to provide a simple method for interrelating the numerous specifications concerning the characteristics of aerodromes so as to provide a series of aerodrome facilities that are suitable for the aeroplanes that are intended to operate at the aerodrome. The code is not intended to be used for determining runway length or

pavement strength requirements. The code is composed of two elements which are related to the aeroplane performance characteristics and dimensions. Element 1 is a number based on the aeroplane reference field length and element 2 is a letter based on the aeroplane wingspan. The code letter or number within an element selected for design purposes is related to the critical aeroplane characteristics for which the facility is provided. When applying Part 139 Appendices, first identify the aeroplanes which the aerodrome is intended to serve and then determine the two elements of the code.

ote 1.— The determination of the aeroplane reference field length is solely for the selection of a code number and is not intended to influence the actual runway length provided.

Note 2.— Guidance on determining the runway length is given in the CASA PNG Advisory Circular AC139-3.1 Physical Characteristics-Runways.

Note.— Guidance on determining the aerodrome reference code is given in the CASA PNG Advisory Circulars AC139-3.1 Physical Characteristics-Runways and AC139-3.2 Physical Characteristics-Taxiway, Apron, Holding Bays.

Table A-1. Aerodrome reference code

(see A.4.2 to A.4.4)

Code element 1	
Code number	Aeroplane reference field length
1	Less than 800 m
2	800 m up to but not including 1 200 m
3	1 200 m up to but not including 1 800 m
4	1 800 m and over
Code element 2	
Code letter	Wingspan
A	Up to but not including 15 m
B	15 m up to but not including 24 m

C	24 m up to but not including 36 m
D	36 m up to but not including 52 m
E	52 m up to but not including 65 m
F	65 m up to but not including 80 m

Note 1.— Guidance on planning for aeroplanes with wingspans greater than 80 m is given in the CASA PNG Advisory Circulars AC139-3.1 and AC139-3.2.

Note 2.— Procedures on conducting an aerodrome compatibility study to accommodate aeroplanes with folding wing tips spanning two code letters are given in the PANS-Aerodromes (Doc 9981). Further guidance can be found in the manufacturer's manual on aircraft characteristics for airport planning.

A.5 Specific procedures for aerodrome operations

Introductory Note.— This section introduces PANS-Aerodromes (Doc 9981) for use by an aerodrome undertaking an assessment of its compatibility with the type of traffic or operation it is intending to accommodate. The material in the PANS Aerodromes addresses operational issues faced by existing aerodromes and provides the necessary procedures to ensure the continued safety of operations. Where alternative measures, operational procedures and operating restrictions have been developed, these are detailed in the aerodrome manual and reviewed periodically to assess their continued validity. The PANS-Aerodromes does not substitute nor circumvent the provisions contained in this Part. It is expected that infrastructure on an existing aerodrome or a new aerodrome will fully comply with the requirements in this Part. See CAR Part 175 on a CASA PNG's responsibilities for the listing of its differences to the related ICAO Procedures in its Aeronautical Information Publication.

A.5.1 When the aerodrome accommodates an aeroplane that exceeds the certificated characteristics of the aerodrome, the compatibility between the operation of the aeroplane and aerodrome infrastructure and operations must be assessed and appropriate measures developed and implemented in order to maintain an acceptable level of safety during operations.

Note.— Procedures to assess the compatibility of the operation of a new aeroplane with an existing aerodrome can be found in the PANS-Aerodromes (Doc 9981).

A.5.2 Information concerning alternative measures, operational procedures and operating restrictions implemented at an aerodrome arising from A.5.1 must be promulgated.

Note 1.— See PANS-AIM (Doc 10066), Appendix 2, AD 2.20, on the provision of a detailed description of local traffic regulations.

Note 2.— See PANS-Aerodromes (Doc 9981), Chapter 3, section 3.6, on promulgation of safety information.

APPENDIX B. AERODROME DATA

B.1 Aeronautical data

Note.— Specifications concerning the accuracy and integrity classification related to aerodrome-related aeronautical data are contained in CASA Advisory Circular AC139-2 Aerodrome Data.

B.1.2 **Recommendation.—** *Aerodrome mapping data should be made available to the aeronautical information services for aerodromes deemed relevant by States where safety and/or performance-based operations suggest possible benefits.*

Note 1.— Aerodrome mapping databases related provisions are contained in CASA Advisory Circular AC139-2 Aerodrome Data.

Note 2.— Guidance material concerning the application of aerodrome mapping databases is provided in CASA Advisory Circular AC139-2 Aerodrome Data.

Note 1.— It is intended that the selection of the features to be collected match a defined operational need.

Note 2.— Aerodrome mapping databases can be provided at one of two levels of quality — fine or medium. These levels and the corresponding numerical requirements are defined in RTCA Document DO-272B and European Organization for Civil Aviation Equipment (EUROCAE) Document ED-99C — User Requirements for Aerodrome Mapping Information.

B.1.4 ...

Note.— Detailed specifications concerning digital data error detection techniques are contained in CASA Advisory Circular AC139-2 Aerodrome Data

B.3 Aerodrome and runway elevations

B.3.3 ...

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

B.4 Aerodrome reference temperature

B.4.2 **Recommendation.—** *The aerodrome reference temperature should be the monthly mean of the daily maximum temperatures for the hottest month of the year (the hottest month being that which has the highest monthly mean temperature). This temperature should be averaged over a period of years.*

B.5 Aerodrome dimensions and related information

B.5.5 ...

Note.— CASA Advisory Circular AC139-2 Aerodrome Data, provides requirements for obstacle data determination in Areas 2 and 3.

B.6 Strength of pavements

B.6 Strength of pavements Applicable as of 28 November 2024.

B.6.1 The bearing strength of a pavement must be determined.

B.6.2 The bearing strength of a pavement intended for aircraft of apron (ramp) mass greater than 5 700 kg must be made available using the aircraft classification rating-pavement classification rating (ACR-PCR) method by reporting all of the following information:

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

(h) pavement type for ACR-PCR determination;

(i) subgrade strength category;

(j) maximum allowable tire pressure category or maximum allowable tire pressure value; and

(k) evaluation method.

Note.— Guidance on reporting and publishing of PCRs is contained in the CASA Advisory Circular AC139-3.3 Pavement Bearing Strength.

B.6.3 The PCR reported must indicate that aircraft with an aircraft classification rating (ACR) equal to or less than the reported PCR may operate on the pavement subject to any limitation on the tire pressure or aircraft all-up mass for specified aircraft type(s).

Note.— Different PCRs may be reported if the strength of the pavement is subject to significant seasonal variation.

B.6.4 The ACR of an aircraft must be determined in accordance with the standard procedures associated with the ACR-PCR method.

Note.— The standard procedures for determining the ACR of an aircraft are given in the CASA Advisory Circular AC139-3.3 Pavement Bearing Strength 3. For convenience, dedicated software is available on the ICAO website for computing any aircraft ACR at any mass on rigid and flexible pavements for the four standard subgrade strength categories detailed in 2.6.6(b) below.

B.6.5 For the purposes of determining the ACR, the behaviour of a pavement must be classified as equivalent to a rigid or flexible construction.

B.6.6 Information on pavement type for ACR-PCR determination, subgrade strength category, maximum allowable tire pressure category and evaluation method must be reported using the following codes:

(l) *Pavement type for ACR-PCR determination:*

Code

Rigid pavement	R
Flexible pavement	F

Note.— If the actual construction is composite or non-standard, include a note to that effect (see example 2 below).

(m) *Subgrade strength category:*

Code

High strength: characterized by E = 200 MPa and representing all E values equal to or above A 150 MPa, for rigid and flexible pavements.

Medium strength: characterized by E = 120 MPa and representing a range in E values equal B to or above 100 MPa and strictly less than 150 MPa, for rigid and flexible pavements.

Low strength: characterized by E = 80 MPa and representing a range in E values equal to or C above 60 MPa and strictly less than 100 MPa, for rigid and flexible pavements.

Ultra-low strength: characterized by E = 50 MPa and representing all E values strictly less D than 60 MPa, for rigid and flexible pavements.

(n) *Maximum allowable tire pressure category:*

Code

Unlimited: no pressure limit	W
High: pressure limited to 1.75 MPa	X
Medium: pressure limited to 1.25 MPa	Y
Low: pressure limited to 0.50 MPa	Z

Note.— See Note 5 to 10.2.1 where the pavement is used by aircraft with tire pressures in the upper categories.

(o) *Evaluation method:*

Code

Technical evaluation: representing a specific study of the pavement characteristics and the T types of aircraft which the pavement is intended to serve.

Using aircraft experience: representing a knowledge of the specific type and mass of aircraft U satisfactorily being supported under regular use.

Note.— The following examples illustrate how pavement strength data are reported under the ACR-PCR method. Further guidance on this topic is contained in the Aerodrome Design Manual *(Doc 9157), Part 3.*

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

PCR 760 / R / B / W / T

Example 2.— If the bearing strength of a composite pavement, behaving like a flexible pavement and resting on a highstrength subgrade, has been assessed by using aircraft experience to be PCR 550 and the maximum allowable tire pressure is

1.25 MPa, then the reported information would be:

PCR 550 / F / A / Y / U

Note.— Composite construction.

B.6.7 **Recommendation.—** *Criteria should be established to regulate the use of a pavement by an aircraft with an ACR higher than the PCR reported for that pavement in accordance with B.6.2 and B.6.3.*

Note.— Attachment A, Section 19, details a simple method for regulating overload operations while the CASA Advisory Circular AC139-3.3 Pavement Bearing Strength, includes the descriptions of more detailed procedures for evaluation of pavements and their suitability for restricted overload operations.

B.6.8 The bearing strength of a pavement intended for aircraft of apron (ramp) mass equal to or less than 5 700 kg must be made available by reporting the following information:

(p) maximum allowable aircraft mass; and

(q) maximum allowable tire pressure.

Example: 4 800 kg/0.60 MPa.

B.7 Pre-flight altimeter check location

B.7.2 **Recommendation.—** *A pre-flight check location should be located on an apron.*

Note 1.— Locating a pre-flight altimeter check location on an apron enables an altimeter check to be made prior to obtaining taxi clearance and eliminates the need for stopping for that purpose after leaving the apron.

Note 2.— Normally an entire apron can serve as a satisfactory altimeter check location.

B.8 Declared distances

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

(r) take-off run available;

(s) take-off distance available;

(t) accelerate-stop distance available; and

(u) landing distance available.

Note.— Guidance on calculation of declared distances is given in CASA Advisory Circular AC139-3.1 Physical Characteristics – Runways.

B.9 Condition of the movement area and related facilities

B.9.1 ...

Note.— The nature, format and conditions of the information to be provided are specified in the PANS-AIM (Doc 10066) and the PANS-ATM (Doc 4444). Specific procedures pertaining to works in progress on the movement area and to the reporting of such works are included in the PANS-Aerodromes (Doc 9981).

B.9.2 ...

Note 1.— Other contaminants may include mud, dust, sand, volcanic ash, oil and rubber. Procedures for monitoring and reporting the conditions of the movement area are included in the PANS-Aerodromes (Doc 9981).

Note 2.— The Aeroplane Performance Manual *(Doc 10064) provides guidance on aircraft performance calculation requirements regarding the description of runway surface conditions in B.9.2(c), (d) and (e).*

Note 3.— Origin and evolution of data, assessment process and the procedures are prescribed in the PANS-Aerodromes (Doc 9981). These procedures are intended to fulfil the requirements to achieve the desired level of safety for aeroplane operations prescribed by Annex 6 and Annex 8 and to provide the information fulfilling the syntax requirements for dissemination specified in Annex 15, PANS-AIM (Doc 10066) and the PANS-ATM (Doc 4444).

B.9.3 To facilitate compliance with B.9.1 and B.9.2, the following inspections must be carried out each day:

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

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

Note 1.— Procedures on carrying out daily inspections of the movement area are given in the PANS-Aerodromes (Doc 9981). Further guidance is available in the

CASA Advisory Circular AC139-9.6 Operational Services – Surface Movement Guidance and Control System.

Note 2.— The PANS-Aerodromes (Doc 9981) contains clarifications on the scope of a significant change in the runway surface conditions.

B.9.4 Personnel assessing and reporting runway surface conditions required in B.9.2 and B.9.5 must be trained and competent to perform their duties.

Note 1.— Guidance on training of personnel is given in Attachment A, Section 6.

Note 2.— Information on training for personnel assessing and reporting runway surface conditions is available in the PANS-Aerodromes (Doc 9981).

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

Introductory Note.— The philosophy of the runway condition report is that the aerodrome operator assesses the runway surface conditions whenever water is present on an operational runway. From this assessment, a runway condition code (RWYCC) and a description of the runway surface are reported which can be used by the flight crew for aeroplane performance calculations. This report, based on the type, depth and coverage of contaminants, is the best assessment of the runway surface condition by the aerodrome operator; however, all other pertinent information may be taken into consideration. See CASA Advisory Circular AC139-3.1 Physical Characteristics – Runways., for further details. The PANS-Aerodromes (Doc 9981) contains procedures on the use of the runway condition report and assignment of the RWYCC in accordance with the runway condition assessment matrix (RCAM).

B.9.5 The runway surface condition must be assessed and reported through a runway condition code (RWYCC) and a description using the following terms:

DRY

STANDING WATER

WET

CHEMICALLY TREATED

LOOSE SAND

Note 1.— The runway surface conditions are those conditions for which, by means of the methods described in the PANS-Aerodromes (Doc 9981), the flight crew can derive appropriate aeroplane performance.

Note 2.— The conditions, either singly or in combination with other observations, are criteria for which the effect on aeroplane performance is sufficiently deterministic to allow assignment of a specific runway condition code.

Note 3.— The terms CHEMICALLY TREATED and LOOSE SAND do not appear in the aeroplane performance section but are used in the situational awareness section of the runway condition report.

B.9.6 Whenever an operational runway is contaminated, an assessment of the contaminant depth and coverage over each third of the runway must be made and reported.

Note.— Procedures on depth and coverage reporting are found in the PANS-Aerodromes (Doc 9981).

B.9.9 Information that a runway or portion thereof is slippery wet must be made available.

Note 1.— The surface friction characteristics of a runway or a portion thereof can be degraded due to rubber deposits, surface polishing, poor drainage or other factors. The determination that a runway or portion thereof is slippery wet stems from various methods used solely or in combination. These methods may be functional friction measurements, using a continuous friction measuring device, that fall below a minimum standard as defined by the State, observations by aerodrome maintenance personnel, repeated reports by pilots and aircraft operators based on flight crew experience, or through analysis of aeroplane stopping performance that indicates a substandard surface. Supplementary tools to undertake this assessment are described in the PANS-Aerodromes (Doc 9981).

Note 2.— See B.9.1 and B.13 concerning the provision of information to, and coordination between, appropriate authorities.

B.9.10 Notification must be given to relevant aerodrome users when the friction level of a paved runway or portion thereof is less than the minimum friction level specified by the State in accordance with J.2.3.

Note 1.— Guidance on determining and expressing the minimum friction level is provided in Assessment, Measurement and Reporting of Runway Surface Conditions *(Cir 355).*

Note 2.— Procedures on conducting a runway surface friction characteristics evaluation programme are provided in the PANS-Aerodromes (Doc 9981).

Note 3.— Information to be promulgated in a NOTAM includes specifying which portion of the runway is below the minimum friction level and its location on the runway.

B.10 Disabled aircraft removal

Note.— See I.3 for information on disabled aircraft removal services.

B.10.1 ~~**Recommendation.—**~~ *The telephone/telex number(s) of the office of the aerodrome coordinator of operations for the removal of an aircraft disabled on or adjacent to the movement area should be made available, on request, to aircraft operators.*

B.10.2 ~~**Recommendation.—**~~ *Information concerning the capability to remove an aircraft disabled on or adjacent to the movement area should be made available.*

Note.— The capability to remove a disabled aircraft may be expressed in terms of the largest type of aircraft which the aerodrome is equipped to remove.

B.11 Rescue and firefighting

Note.— See I.2 for information on rescue and firefighting services.

B.11.2 **Recommendation.—** *The level of protection normally available at an aerodrome should be expressed in terms of the category of the rescue and firefighting services as described in I.2*

and in accordance with the types and amounts of extinguishing agents normally available at the aerodrome.

B.11.3 ...

Note.— Changes in the level of protection from that normally available at the aerodrome could result from a change in the availability of extinguishing agents, equipment to deliver the agents or personnel to operate the equipment, etc.

B.11.4 **Recommendation.—** *A change should be expressed in terms of the new category of the rescue and firefighting service available at the aerodrome.*

B.13 Coordination between aeronautical information services and aerodrome authorities

B.13.3 ...

Note.— Detailed specifications concerning the AIRAC system are contained in CASA Advisory Circular AC139-2 Aerodrome Data.

B.13.4 ...

Note 1.— Specifications concerning the accuracy and integrity classification of aerodrome-related aeronautical data are contained in CASA Advisory Circular AC139-2 Aerodrome Data.

Note 2.— Specifications for the issue of NOTAM is contained in CASA Advisory Circular AC139-2 Aerodrome Data.

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

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

APPENDIX C PHYSICAL CHARACTERISTICS

C.1 Runways

Number and orientation of runways

Introductory Note.— Many factors affect the determination of the orientation, siting and number of runways.

One important factor is the usability factor, as determined by the wind distribution, which is specified hereunder. Another important factor is the alignment of the runway to facilitate the provision of approaches conforming to the approach surface specifications of Appendix D. In CASA Advisory Circular AC139-3.1 Physical Characteristics – Runways., information is given concerning these and other factors.

When a new instrument runway is being located, particular attention needs to be given to areas over which aeroplanes will be required to fly when following instrument approach and missed approach procedures, so as to ensure that obstacles in these areas or other factors will not restrict the operation of the aeroplanes for which the runway is intended.

C.1.1 **Recommendation.—** *The number and orientation of runways at an aerodrome should be such that the usability factor of the aerodrome is not less than 95 per cent for the aeroplanes that the aerodrome is intended to serve.*

C.1.2 **Recommendation.—** *The siting and orientation of runways at an aerodrome should, where possible, be such that the arrival and departure tracks minimize interference with areas approved for residential use and other noise-sensitive areas close to the aerodrome in order to avoid future noise problems.*

Note.— Guidance on how to address noise problems is provided in the Airport Planning Manual *(Doc 9184), Part 2, and in* Guidance on the Balanced Approach to Aircraft Noise Management *(Doc 9829).*

C.1.3 Choice of maximum permissible crosswind components

Recommendation.— *In the application of C.1.1 it should be assumed that landing or take-off of aeroplanes is, in normal circumstances, precluded when the crosswind component exceeds:*

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

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

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

Note.— In CASA Advisory Circular AC139-3.1 Physical Characteristics – Runways., guidance is given on factors affecting the calculation of the estimate of the usability factor and allowances which may have to be made to take account of the effect of unusual circumstances.

C.1.4 Data to be used

Recommendation.— *The selection of data to be used for the calculation of the usability factor should be based on reliable wind distribution statistics that extend over as long a period as possible, preferably of not less than five years. The observations used should be made at least eight times daily and spaced at equal intervals of time.*

Note.— These winds are mean winds. Reference to the need for some allowance for gusty conditions is made in CASA Advisory Circular AC139-3.1 Physical Characteristics – Runways..

Location of threshold

C.1.5 **Recommendation.—** *A threshold should normally be located at the extremity of a runway unless operational considerations justify the choice of another location.*

Note.— Guidance on the siting of the threshold is given in CASA Advisory Circular AC139-3.1 Physical Characteristics – Runways..

C.1.6 **Recommendation.—** *When it is necessary to displace a threshold, either permanently or temporarily, from its normal location, account should be taken of the various factors which may have a bearing on the location of the threshold. Where this displacement is due to an unserviceable runway condition, a cleared and graded area of at least 60 m in length should be available between the unserviceable area and the displaced threshold. Additional distance should also be provided to meet the requirements of the runway end safety area as appropriate.*

Note.— Guidance on factors which may be considered in the determination of the location of a displaced threshold is given in CASA Advisory Circular AC139-3.1 Physical Characteristics – Runways.

Actual length of runways

C.1.7 Primary runway

Recommendation.— *Except as provided in C.1.9, the actual runway length to be provided for a primary runway should be adequate to meet the operational requirements of the aeroplanes for which the runway is intended and should be not less than the longest length determined by applying the corrections for local conditions to the operations and performance characteristics of the relevant aeroplanes.*

Note 1.— This specification does not necessarily mean providing for operations by the critical aeroplane at its maximum mass.

Note 2.— Both take-off and landing requirements need to be considered when determining the length of runway to be provided and the need for operations to be conducted in both directions of the runway.

Note 3.— Local conditions that may need to be considered include elevation, temperature, runway slope, humidity and the runway surface characteristics.

Note 4.— When performance data on aeroplanes for which the runway is intended are not known, guidance on the determination of the actual length of a primary runway by application of general correction factors is given in the CASA PNG Advisory Circular AC139-3.1 Physical Characteristics-Runways.

C.1.8 Secondary runway

Recommendation.— *The length of a secondary runway should be determined similarly to primary runways except that it needs only to be adequate for those aeroplanes which require to use that secondary runway in addition to the other runway or runways in order to obtain a usability factor of at least 95 per cent.*

C.1.9 Runways with stopways or clearways

Recommendation.— *Where a runway is associated with a stopway or clearway, an actual runway length less than that resulting from application of C.1.7 or C.1.8, as appropriate, may be considered satisfactory, but in such a case any combination of runway, stopway and clearway provided should permit compliance with the operational requirements for take-off and landing of the aeroplanes the runway is intended to serve.*

Note.— Guidance on use of stopways and clearways is given in CASA Advisory Circular AC139-3.1 Physical Characteristics – Runways.

Width of runways

C.1.10 **Recommendation.—** *The width of a runway should be not less than the appropriate dimension specified in the following tabulation:*

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

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

Note 1.— The combinations of code numbers and OMGWS for which widths are specified have been developed for typical aeroplane characteristics.

Note 2.— Factors affecting runway width are given in the CASA PNG Advisory Circular AC139-3.1 Physical Characteristics-Runways.

Note 3.— See 3.2 concerning the provision of runway shoulders, in particular for Code F aeroplanes with four (or more) engines.

Minimum distance between parallel runways

C.1.11 **Recommendation.—** *Where parallel non-instrument runways are intended for simultaneous use, the minimum distance between their centre lines should be:*

(x) *210 m where the higher code number is 3 or 4;*

(y) *150 m where the higher code number is 2; and*

(z) *120 m where the higher code number is 1.*

Note.— Procedures for wake turbulence categorization of aircraft and wake turbulence separation minima are contained in the PANS-ATM (Doc 4444), Appendix D, D.9, and Appendix E, E.8, respectively.

C.1.12 **Recommendation.—** *Where parallel instrument runways are intended for simultaneous use subject to conditions specified in the PANS-ATM (Doc 4444) and the PANS-OPS (Doc 8168), Volume I, the minimum distance between their centre lines should be:*

(aa) *1 035 m for independent parallel approaches;*

(bb) *915 m for dependent parallel approaches;*

(cc) *760 m for independent parallel departures;*

(dd) *760 m for segregated parallel operations;*

except that:

(1) for segregated parallel operations the specified minimum distance:

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

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

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

Note.— Procedures and facilities requirements for simultaneous operations on parallel or near-parallel instrument runways are contained in the PANS-ATM (Doc 4444), Chapter 6 and the PANS-OPS (Doc 8168), Volume I, Part III, Section 2, and Volume II, Part I, Section 3; Part II, Section 1; and Part III, Section 3, and relevant guidance is contained

in the Manual on Simultaneous Operations on Parallel or Near-Parallel Instrument Runways (SOIR) *(Doc 9643).*

Slopes on runways

C.1.13 Longitudinal slopes

Recommendation.— *The slope computed by dividing the difference between the maximum and minimum elevation along the runway centre line by the runway length should not exceed:*

(ee) *1 per cent where the code number is 3 or 4; and*

(ff) *2 per cent where the code number is 1 or 2.*

C.1.14 **Recommendation.—** *Along no portion of a runway should the longitudinal slope exceed:*

(gg) *1.25 per cent where the code number is 4, except that for the first and last quarter of the length of the runway the longitudinal slope should not exceed 0.8 per cent;*

(hh) *1.5 per cent where the code number is 3, except that for the first and last quarter of the length of a precision approach runway category II or III the longitudinal slope should not exceed 0.8 per cent; and*

(ii) *2 per cent where the code number is 1 or 2.*

C.1.15 Longitudinal slope changes

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

(jj) *1.5 per cent where the code number is 3 or 4; and*

(kk) *2 per cent where the code number is 1 or 2.*

Note.— Guidance on slope changes before a runway is given in CASA Advisory Circular AC139-3.1 Physical Characteristics – Runways.

C.1.16 **Recommendation.—** *The transition from one slope to another should be accomplished by a curved surface with a rate of change not exceeding:*

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

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

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

C.1.17 Sight distance

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

(oo) *any point 3 m above a runway to all other points 3 m above the runway within a distance of at least half the length of the runway where the code letter is C, D, E or F;*

(pp) *any point 2 m above a runway to all other points 2 m above the runway within a distance of at least half the length of the runway where the code letter is B; and*

(qq) *any point 1.5 m above a runway to all other points 1.5 m above the runway within a distance of at least half the length of the runway where the code letter is A.*

Note.— Consideration will have to be given to providing an unobstructed line of sight over the entire length of a single runway where a full-length parallel taxiway is not available. Where an aerodrome has intersecting runways, additional criteria on the line of sight of the intersection area would need to be considered for operational safety. See the CASA PNG Advisory Circular AC139-3.1 Physical Characteristics-Runways.

C.1.18 Distance between slope changes

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

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

(rr) *30 000 m where the code number is 4;*

(ss) *15 000 m where the code number is 3; and*

(tt) *5 000 m where the code number is 1 or 2; or*

(b) 45 m;

whichever is greater.

Note.— Guidance on implementing this specification is given in CASA Advisory Circular AC139-3.1 Physical Characteristics – Runways.

C.1.19 Transverse slopes

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

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

(vv) *2 per cent where the code letter is A or B;*

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

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

Note.— On wet runways with crosswind conditions the problem of aquaplaning from poor drainage is apt to be accentuated. Additional guidance is included in the CASA Advisory

Circular AC139-3.1 Physical Characteristics – Runways and AC139-3.3 Pavement Bearing Strength.

C.1.20 **Recommendation.—** *The transverse slope should be substantially the same throughout the length of a runway except at an intersection with another runway or a taxiway where an even transition should be provided taking account of the need for adequate drainage.*

Note.— Guidance on transverse slope is given in the CASA Advisory Circular AC139-3.3 Pavement Bearing Strength.

Strength of runways

C.1.21 **Recommendation.—** *A runway should be capable of withstanding the traffic of aeroplanes the runway is intended to serve.*

Surface of runways

C.1.22 ...

Note 1.— Surface irregularities may adversely affect the take-off or landing of an aeroplane by causing excessive bouncing, pitching, vibration, or other difficulties in the control of an aeroplane.

Note 2.— Guidance on design tolerances and other information is given in CASA Advisory Circular AC139-3.1 Physical Characteristics – Runways.. Additional guidance is included in the CASA Advisory Circular AC139-3.3 Pavement Bearing Strength.

C.1.23 ...

C.1.24 **Recommendation.—** *The surface of a paved runway should be evaluated when constructed or resurfaced to determine that the surface friction characteristics achieve the design objectives.*

Note.— Additional guidance is included in the CASA Advisory Circular AC139-9.13 Operational Services – Pavement Surface Condition..

C.1.25 **Recommendation.—** *Measurements of the surface friction characteristics of a new or resurfaced paved runway should be made with a continuous friction measuring device using self-wetting features.*

Note.— Additional guidance is included in the CASA Advisory Circular AC139-9.13 Operational Services – Pavement Surface Condition..

C.1.26 **Recommendation.—** *The average surface texture depth of a new surface should be not less than 1.0 mm.*

Note 1.— Macrotexture and microtexture are taken into consideration in order to provide the required surface friction characteristics. Guidance on surface design is given in Attachment A, Section 7.

Note 2.— Guidance on methods used to measure surface texture is given in the CASA Advisory Circular AC139-9.13 Operational Services – Pavement Surface Condition...

Note 3.— Guidance on design and methods for improving surface texture is given in the Aerodrome Design Manual *(Doc 9157), Part 3.*

C.1.27 **Recommendation.—** *When the surface is grooved or scored, the grooves or scorings should be either perpendicular to the runway centre line or parallel to non-perpendicular transverse joints, where applicable.*

Note.— Guidance on methods for improving the runway surface texture is given in the CASA Advisory Circular AC139-3.3 Pavement Bearing Strength.

C.2 Runway shoulders

General

Note.— Guidance on characteristics and treatment of runway shoulders is given in Attachment A, Section 8, and in the CASA Advisory Circular AC139-3.1 Physical Characteristics-Runways.

C.2.1 **Recommendation.—** *Runway shoulders should be provided for a runway where the code letter is D, E or F.*

Width of runway shoulders

C.2.2 **Recommendation.—** *For aeroplanes with OMGWS from 9 m up to but not including 15 m, the runway shoulders should extend symmetrically on each side of the runway so that the overall width of the runway and its shoulders is not less than:*

- *(a) 60 m where the code letter is D or E;*
- *(b) 60 m where the code letter is F with two- or three-engined aeroplanes; and*
- *(b) 75 m where the code letter is F with four (or more)-engined aeroplanes.*

Slopes on runway shoulders

C.2.3 **Recommendation.—** *The surface of the shoulder that abuts the runway should be flush with the surface of the runway and its transverse slope should not exceed 2.5 per cent.*

Strength of runway shoulders

C.2.4 **Recommendation.—** *The portion of a runway shoulder between the runway edge and a distance of 30 m from the runway centre line should be prepared or constructed so as to be capable, in the event of an aeroplane running off the runway, of supporting the aeroplane without inducing structural damage to the aeroplane and of supporting ground vehicles which may operate on the shoulder.*

Note.— Guidance on strength of runway shoulders is given in the CASA Advisory Circular AC139-3.1 Physical Characteristics-Runways.

Surface of runway shoulders

C.2.5 **Recommendation.—** *A runway shoulder should be prepared or constructed so as to resist erosion and the ingestion of the surface material by aeroplane engines.*

C.2.6 **Recommendation.—** *Runway shoulders for code letter F aeroplanes should be paved to a minimum overall width of runway and shoulder of not less than 60 m.*

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

C.3 Runway turn pads

General

C.3.2 **Recommendation.—** *Where the end of a runway is not served by a taxiway or a taxiway turnaround and where the code letter is A, B or C, a runway turn pad should be provided to facilitate a 180-degree turn of aeroplanes.*

Note 1.— Such areas may also be useful if provided along a runway to reduce taxiing time and distance for aeroplanes which may not require the full length of the runway.

Note 2.— Guidance on the design of the runway turn pads is available in the CASA Advisory Circular AC139-3.1 Physical Characteristics-Runways. Guidance on taxiway turnaround as an alternate facility is available in the CASA Advisory Circular AC139-3.2 Physical Characteristics-Taxiway, Apron, Holding Bays

C.3.3 **Recommendation.—** *The runway turn pad may be located on either the left or right side of the runway and adjoining the runway pavement at both ends of the runway and at some intermediate locations where deemed necessary.*

Note.— The initiation of the turn would be facilitated by locating the turn pad on the left side of the runway, since the left seat is the normal position of the pilot-in-command.

C.3.4 **Recommendation.—** *The intersection angle of the runway turn pad with the runway should not exceed 30 degrees.*

C.3.5 **Recommendation.—** *The nose wheel steering angle to be used in the design of the runway turn pad should not exceed 45 degrees.*

C.3.6 ...

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

Slopes on runway turn pads

C.3.7 **Recommendation.—** *The longitudinal and transverse slopes on a runway turn pad should be sufficient to prevent the accumulation of water on the surface and facilitate rapid drainage of surface water. The slopes should be the same as those on the adjacent runway pavement surface.*

Strength of runway turn pads

C.3.8 **Recommendation.—** *The strength of a runway turn pad should be at least equal to that of the adjoining runway which it serves, due consideration being given to the fact that the turn*

pad will be subjected to slow-moving traffic making hard turns and consequent higher stresses on the pavement.

Note.— Where a runway turn pad is provided with flexible pavement, the surface would need to be capable of withstanding the horizontal shear forces exerted by the main landing gear tires during turning manoeuvres.

Surface of runway turn pads

C.3.10 **Recommendation.—** *The surface of a runway turn pad should be so constructed or resurfaced as to provide surface friction characteristics at least equal to that of the adjoining runway.*

Shoulders for runway turn pads

C.3.11 **Recommendation.—** *The runway turn pads should be provided with shoulders of such width as is necessary to prevent surface erosion by the jet blast of the most demanding aeroplane for which the turn pad is intended, and any possible foreign object damage to the aeroplane engines.*

Note.— As a minimum, the width of the shoulders would need to cover the outer engine of the most demanding aeroplane and thus may be wider than the associated runway shoulders.

C.3.12 **Recommendation.—** *The strength of runway turn pad shoulders should be capable of withstanding the occasional passage of the aeroplane it is designed to serve without inducing structural damage to the aeroplane and to the supporting ground vehicles that may operate on the shoulder.*

C.4 Runway strips

General

Width of runway strips

C.4.4 **Recommendation.—** *A strip including a non-precision approach runway should extend laterally to a distance of at least:*

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

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

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

C.4.5 **Recommendation.—** *A strip including a non-instrument runway should extend on each side of the centre line of the runway and its extended centre line throughout the length of the strip, to a distance of at least:*

(yy) *75 m where the code number is 3 or 4;*

(zz) *40 m where the code number is 2; and*

(aaa) *30 m where the code number is 1.*

Objects on runway strips

Note.— See I.9 for information regarding siting of equipment and installations on runway strips.

C.4.6 **Recommendation.—** *An object situated on a runway strip which may endanger aeroplanes should be regarded as an obstacle and should, as far as practicable, be removed.*

Note 1.— Consideration will have to be given to the location and design of drains on a runway strip to prevent damage to an aeroplane accidentally running off a runway. Suitably designed drain covers may be required. For further guidance, see the CASA Advisory Circular AC139-3.1 Physical Characteristics-Runways.

Note 2.— Where open-air or covered storm water conveyances are installed, consideration will have to be given to ensure that their structure does not extend above the surrounding ground so as not to be considered an obstacle. See also Note 1 to C.4.16.

Note 3.— Particular attention needs to be given to the design and maintenance of an open-air storm water conveyance in order to prevent wildlife attraction, notably birds. If needed, it can be covered by a net. Procedures on wildlife management are specified in the PANS-Aerodromes (Doc 9981). Further guidance can be found in the CASA Advisory Circular AC139-3.3 Pavement Bearing Strength.

C.4.7 No fixed object, other than visual aids required for air navigation or those required for aircraft safety purposes and which must be sited on the runway strip, and satisfying the relevant frangibility requirement in Appendix 5, must be permitted on any part of a runway strip of a precision approach runway delineated by the lower edges of the inner transitional surfaces. No mobile object must be permitted on this part of the runway strip during the use of the runway for landing or take-off.

Note.— See Appendix D, section 4.1, for characteristics of inner transitional surfaces.

Grading of runway strips

C.4.8 **Recommendation.—** *That portion of a strip of an instrument runway within a distance of at least:*

(bbb) *75 m where the code number is 3 or 4; and*

(ccc) *40 m where the code number is 1 or 2;*

from the centre line of the runway and its extended centre line should provide a graded area for aeroplanes which the runway is intended to serve in the event of an aeroplane running off the runway.

Note.— Guidance on grading of a greater area of a strip including a precision approach runway where the code number is 3 or 4 is given in Attachment A, Section 8.

C.4.9 **Recommendation.—** *That portion of a strip of a non-instrument runway within a distance of at least:*

(ddd) *75 m where the code number is 3 or 4;*

(eee) *40 m where the code number is 2; and*

(fff) *30 m where the code number is 1;*

from the centre line of the runway and its extended centre line should provide a graded area for aeroplanes which the runway is intended to serve in the event of an aeroplane running off the runway.

C.4.11 **Recommendation.—** *That portion of a strip to at least 30 m before the start of a runway should be prepared against blast erosion in order to protect a landing aeroplane from the danger of an exposed edge.*

Note 1.— The area provided to reduce the erosive effects of jet blast and propeller wash may be referred to as a blast pad.

Note 2.— Guidance on protection against aeroplane engine blast is available in the CASA Advisory Circular AC139-3.2 Physical Characteristics-Taxiway, Apron, Holding Bays

C.4.12 **Recommendation.—** *Where the areas in C.4.11 have paved surfaces, they should be able to withstand the occasional passage of the critical aeroplane for runway pavement design.*

Slopes on runway strips

C.4.13 Longitudinal slopes

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

(ggg) *1.5 per cent where the code number is 4;*

(hhh) *1.75 per cent where the code number is 3; and*

(iii) *2 per cent where the code number is 1 or 2.*

C.4.14 Longitudinal slope changes

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

C.4.15 Transverse slopes

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

(jjj) *2.5 per cent where the code number is 3 or 4; and*

(kkk) *3 per cent where the code number is 1 or 2;*

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

C.4.16 **Recommendation.—** *The transverse slopes of any portion of a strip beyond that to be graded should not exceed an upward slope of 5 per cent as measured in the direction away from the runway.*

Note 1.— Where deemed necessary for proper drainage, an open-air storm water conveyance may be allowed in the non-graded portion of a runway strip and would be placed as far as practicable from the runway.

Note 2.— The aerodrome rescue and firefighting (RFF) procedure would need to take into account the location of openair water conveyances within the non-graded portion of a runway strip.

Strength of runway strips

C.4.17 **Recommendation.—** *That portion of a strip of an instrument runway within a distance of at least:*

(lll) *75 m where the code number is 3 or 4; and*

(mmm) *40 m where the code number is 1 or 2;*

from the centre line of the runway and its extended centre line should be so prepared or constructed as to minimize hazards arising from differences in load-bearing capacity to aeroplanes which the runway is intended to serve in the event of an aeroplane running off the runway.

Note.— Guidance on preparation of runway strips is given in the CASA Advisory Circular AC139-3.1 Physical Characteristics-Runways.

C.4.18 **Recommendation.—** *That portion of a strip containing a non-instrument runway within a distance of at least:*

(nnn) *75 m where the code number is 3 or 4;*

(ooo) *40 m where the code number is 2; and*

(ppp) *30 m where the code number is 1;*

from the centre line of the runway and its extended centre line should be so prepared or constructed as to minimize hazards arising from differences in load-bearing capacity to aeroplanes which the runway is intended to serve in the event of an aeroplane running off the runway.

C.5 Runway end safety areas

General

C.5.1 ...

Note.— Guidance on runway end safety areas is given in Attachment A, Section 9.

C.5.2 **Recommendation.—** *A runway end safety area should be provided at each end of a runway strip where the code number is 1 or 2 and the runway is a non-instrument one.*

Dimensions of runway end safety areas

C.5.3 ...

Note.— Guidance on arresting systems is given in CASA Advisory Circular AC139-3.1 Physical Characteristics-Runways.

C.5.4 **Recommendation.—** *A runway end safety area should, as far as practicable, extend from the end of a runway strip to a distance of at least:*

(a) 240 m where the code number is 3 or 4; or a reduced length when an arresting system is installed;

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

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

C.5.6 **Recommendation.—** *The width of a runway end safety area should, wherever practicable, be equal to that of the graded portion of the associated runway strip.*

Objects on runway end safety areas

Note.— See I.9 for information regarding siting of equipment and installations on runway end safety areas.

C.5.7 **Recommendation.—** *An object situated on a runway end safety area which may endanger aeroplanes should be regarded as an obstacle and should, as far as practicable, be removed.*

Clearing and grading of runway end safety areas

C.5.8 **Recommendation.—** *A runway end safety area should provide a cleared and graded area for aeroplanes which the runway is intended to serve in the event of an aeroplane undershooting or overrunning the runway.*

Note.— The surface of the ground in the runway end safety area does not need to be prepared to the same quality as the runway strip. See, however, C.5.12.

Slopes on runway end safety areas

C.5.9 General

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

C.5.10 Longitudinal slopes

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

C.5.11 Transverse slopes

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

Strength of runway end safety areas

C.5.12 **Recommendation.—** *A runway end safety area should be so prepared or constructed as to reduce the risk of damage to an aeroplane undershooting or overrunning the runway, enhance aeroplane deceleration and facilitate the movement of rescue and firefighting vehicles as required in I.2.33 to I.2.35.*

Note.— Guidance on the strength of a runway end safety area is given in the CASA Advisory Circular AC139-3.1 Physical Characteristics-Runways.

C.6 Clearways

Note.— The inclusion of detailed specifications for clearways in this section is not intended to imply that a clearway has to be provided. CASA Advisory Circular AC139-3.1 Physical Characteristics-Runways, provides information on the use of clearways.

Location of clearways

C.6.1 **Recommendation.—** *The origin of a clearway should be at the end of the take-off run available.*

Length of clearways

C.6.2 **Recommendation.—** *The length of a clearway should not exceed half the length of the take-off run available.*

***Width* of clearways**

C.6.3 **Recommendation.—** *A clearway should extend laterally on each side of the extended centre line of the runway, to a distance of at least:*

(qqq) *75 m for instrument runways; and*

(rrr) *half of the width of the runway strip for non-instrument runways.*

Slopes on clearways

C.6.4 **Recommendation.—** *The ground in a clearway should not project above a plane having an upward slope of 1.25 per cent, the lower limit of this plane being a horizontal line which:*

(sss) *is perpendicular to the vertical plane containing the runway centre line; and*

(ttt) *passes through a point located on the runway centre line at the end of the take-off run available.*

Note.— Because of transverse or longitudinal slopes on a runway, shoulder or strip, in certain cases the lower limit of the clearway plane specified above may be below the corresponding elevation of the runway, shoulder or strip. It is not intended that these surfaces be graded to conform with the lower limit of the clearway plane nor is it intended that terrain or objects which are above the clearway plane beyond the end of the strip but below the level of the strip be removed unless it is considered they may endanger aeroplanes.

C.6.5 **Recommendation.—** *Abrupt upward changes in slope should be avoided when the slope on the ground in a clearway is relatively small or when the mean slope is upward. In such*

situations, in that portion of the clearway within a distance of 22.5 m or half the runway width whichever is greater on each side of the extended centre line, the slopes, slope changes and the transition from runway to clearway should generally conform with those of the runway with which the clearway is associated.

Objects on clearways

Note.— See I.9 for information regarding siting of equipment and installations on clearways.

C.6.6 **Recommendation.—** *An object situated on a clearway which may endanger aeroplanes in the air should be regarded as an obstacle and should be removed.*

C.7 Stopways

Note.— The inclusion of detailed specifications for stopways in this section is not intended to imply that a stopway has to be provided. Attachment A, Section 2, provides information on the use of stopways.

Width of stopways

Slopes on stopways

C.7.2 **Recommendation.—** *Slopes and changes in slope on a stopway, and the transition from a runway to a stopway, should comply with the specifications of C.1.13 to C.1.19 for the runway with which the stopway is associated except that:*

(uuu) *the limitation in C.1.14 of a 0.8 per cent slope for the first and last quarter of the length of a runway need not be applied to the stopway; and*

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

Strength of stopways

C.7.3 **Recommendation.—** *A stopway should be prepared or constructed so as to be capable, in the event of an abandoned take-off, of supporting the aeroplane which the stopway is intended to serve without inducing structural damage to the aeroplane.*

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

C.8 Radio altimeter operating area

General

C.8.1 **Recommendation.—** *A radio altimeter operating area should be established in the pre-threshold area of a precision approach runway.*

Length of the area

C.8.2 **Recommendation.—** *A radio altimeter operating area should extend before the threshold for a distance of at least 300 m.*

Width of the area

C.8.3 **Recommendation.—** *A radio altimeter operating area should extend laterally, on each side of the extended centre line of the runway, to a distance of 60 m, except that, when special circumstances so warrant, the distance may be reduced to no less than 30 m if an aeronautical study indicates that such reduction would not affect the safety of operations of aircraft.*

Longitudinal slope changes

C.8.4 **Recommendation.—** *On a radio altimeter operating area, slope changes should be avoided or kept to a minimum. Where slope changes cannot be avoided, the slope changes should be as gradual as practicable and abrupt changes or sudden reversals of slopes avoided. The rate of change between two consecutive slopes should not exceed 2 per cent per 30 m.*

Note.— Guidance on radio altimeter operating area is given in CASA Advisory Circular AC139-3.1 Physical Characteristics-Runways and in the Manual of AllWeather Operations, *(Doc 9365), Section 5.2. Guidance on the use of radio altimeter is given in the PANS-OPS, Volume II, Part II, Section 1.*

C.9 Taxiways

Note 1.— Unless otherwise indicated, the requirements in this section are applicable to all types of taxiways.

Note 2.— See section E.4.3 for a standardized scheme for the nomenclature of taxiways which may be used to improve situational awareness and as a part of an effective runway incursion prevention measure.

Note 3.— See Attachment A, Section 21, for specific taxiway design guidance which may assist in the prevention of runway incursions when developing a new taxiway or improving existing ones with known runway incursion safety risks.

General

C.9.1 **Recommendation.—** *Taxiways should be provided to permit the safe and expeditious surface movement of aircraft.*

Note.— Guidance on layout and standardized nomenclature of taxiways is given in the CASA Advisory Circular AC139-3.2 Physical Characteristics-Taxiway, Apron, Holding Bays

C.9.2 **Recommendation.—** *Sufficient entrance and exit taxiways for a runway should be provided to expedite the movement of aeroplanes to and from the runway and provision of rapid exit taxiways considered when traffic volumes are high.*

C.9.3 ...

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

Width of taxiways

C.9.4 **Recommendation.—** *A straight portion of a taxiway should have a width of not less than that given by the following tabulation:*

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

Note.— Guidance on width of taxiways is given in the CASA Advisory Circular AC139-3.2 Physical Characteristics-Taxiway, Apron, Holding Bays

Taxiway curves

C.9.5 **Recommendation.—** *Changes in direction of taxiways should be as few and small as possible. The radii of the curves should be compatible with the manoeuvring capability and normal taxiing speeds of the aeroplanes for which the taxiway is intended. The design of the curve should be such that, when the cockpit of the aeroplane remains over the taxiway centre line markings, the clearance distance between the outer main wheels of the aeroplane and the edge of the taxiway should not be less than those specified in C.9.3.*

Note 1.— An example of widening taxiways to achieve the wheel clearance specified is illustrated in Figure C-2. Guidance on the values of suitable dimensions is given in the CASA Advisory Circular AC139-3.2 Physical Characteristics-Taxiway, Apron, Holding Bays

Note 2.— The location of taxiway centre line markings and lights is specified in E.2.8.6 and E.3.17.12.

Note 3.— Compound curves may reduce or eliminate the need for extra taxiway width.

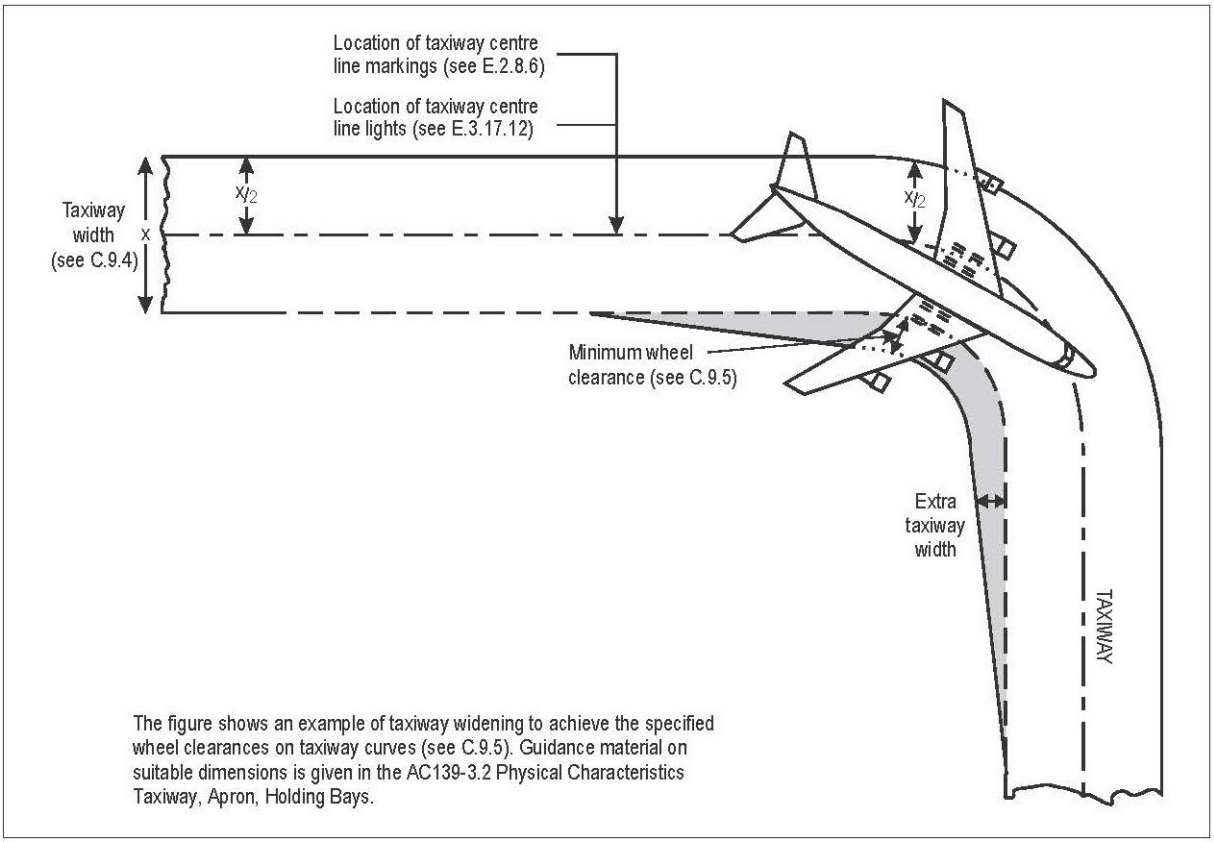


Figure C-2. Taxiway curve

Junctions and intersections

C.9.6 **Recommendation.—** *To facilitate the movement of aeroplanes, fillets should be provided at junctions and intersections of taxiways with runways, aprons and other taxiways. The design of the fillets should ensure that the minimum wheel clearances specified in C.9.3 are maintained when aeroplanes are manoeuvring through the junctions or intersections.*

Note.— Consideration will have to be given to the aeroplane datum length when designing fillets. Guidance on the design of fillets and the definition of the term aeroplane datum length are given in the CASA Advisory Circular AC139-3.2 Physical Characteristics-Taxiway, Apron, Holding Bays

Taxiway minimum separation distances

C.9.7 **Recommendation.—** *The separation distance between the centre line of a taxiway and the centre line of a runway, the centre line of a parallel taxiway or an object should not be less than the appropriate dimension specified in Table C-1, except that it may be permissible to operate with lower separation distances at an existing aerodrome if an aeronautical study indicates that such lower separation distances would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.*

Note 1.— Guidance on factors which may be considered in the aeronautical study is given in the CASA Advisory Circular AC139-3.2 Physical Characteristics-Taxiway, Apron, Holding Bays

Note 2.— ILS and MLS installations may also influence the location of taxiways due to interferences to ILS and MLS signals by a taxiing or stopped aircraft. Information on critical and sensitive areas surrounding ILS and MLS installations is contained in Annex 10 — Aeronautical Telecommunications, Volume I — Radio Navigation Aids, Attachments C and G (respectively).

Note 3.— The separation distances of Table C-1, column 10, do not necessarily provide the capability of making a normal turn from one taxiway to another parallel taxiway. Guidance for this condition is given in the CASA Advisory Circular AC139-3.2 Physical Characteristics-Taxiway, Apron, Holding Bays

Note 4.— The separation distance between the centre line of an aircraft stand taxilane and an object shown in Table C-1, column 13, may need to be increased when jet exhaust wake velocity may cause hazardous conditions for ground servicing.

Slopes on taxiways

C.9.8 Longitudinal slopes

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

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

(xxx) *3 per cent where the code letter is A or B.*

C.9.9 Longitudinal slope changes

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

(yyy) *1 per cent per 30 m (minimum radius of curvature of 3 000 m) where the code letter is C, D, E or F; and*

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

Table C-1. Taxiway minimum separation distances

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

Note 1.— The separation distances shown in columns (2) to (9) represent ordinary combinations of runways and taxiways. The basis for development of these distances is given in the CASA PNG Advisory Circular AC139-3.2 Physical Characteristics-Taxiway, Apron, Holding Bays

Note 2.— The distances in columns (2) to (9) do not guarantee sufficient clearance behind a holding aeroplane to permit the passing of another aeroplane on a parallel taxiway. See the CASA PNG Advisory Circular AC139-3.2 Physical Characteristics-Taxiway, Apron, Holding Bays

C.9.10 Sight distance

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

(a) 3 m above the taxiway, it will be possible to see the whole surface of the taxiway for a distance of at least 300 m from that point, where the code letter is C, D, E or F;

(b) 2 m above the taxiway, it will be possible to see the whole surface of the taxiway for a distance of at least 200 m from that point, where the code letter is B; and

(c) 1.5 m above the taxiway, it will be possible to see the whole surface of the taxiway for a distance of at least 150 m from that point, where the code letter is A.

C.9.11 Tranverse slopes

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

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

(bbbb) *2 per cent where the code letter is A or B.*

Note.— See C.13.4 regarding transverse slopes on an aircraft stand taxilane.

Strength of taxiways

C.9.12 **Recommendation.—** *The strength of a taxiway should be at least equal to that of the runway it serves, due consideration being given to the fact that a taxiway will be subjected to a*

greater density of traffic and, as a result of slow moving and stationary aeroplanes, to higher stresses than the runway it serves.

Note.— Guidance on the relation of the strength of taxiways to the strength of runways is given in the CASA Advisory Circular AC139-3.3 Pavement Bearing Strength..

Surface of taxiways

C.9.13 **Recommendation.—** *The surface of a taxiway should not have irregularities that cause damage to aeroplane structures.*

C.9.14 **Recommendation.—** *The surface of a paved taxiway should be so constructed or resurfaced as to provide suitable surface friction characteristics.*

Note.— Suitable surface friction characteristics are those surface properties required on taxiways that assure safe operation of aeroplanes.

Rapid exit taxiways

Note.— The following specifications detail requirements particular to rapid exit taxiways. See Figure C-3. General requirements for taxiways also apply to this type of taxiway. Guidance on the provision, location and design of rapid exit taxiways is included in the CASA Advisory Circular AC139-3.2 Physical Characteristics-Taxiway, Apron, Holding Bays

C.9.15 **Recommendation.—** *A rapid exit taxiway should be designed with a radius of turn-off curve of at least:*

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

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

to enable exit speeds under wet conditions of:

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

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

Note.— The locations of rapid exit taxiways along a runway are based on several criteria described in the CASA Advisory Circular AC139-3.2 Physical Characteristics-Taxiway, Apron, Holding Bays*, in addition to different speed criteria.*

C.9.16 **Recommendation.—** *The radius of the fillet on the inside of the curve at a rapid exit taxiway should be sufficient to provide a widened taxiway throat in order to facilitate early recognition of the entrance and turn-off onto the taxiway.*

C.9.17 **Recommendation.—** *A rapid exit taxiway should include a straight distance after the turn-off curve sufficient for an exiting aircraft to come to a full stop clear of any intersecting taxiway.*

C.9.18 **Recommendation.—** *The intersection angle of a rapid exit taxiway with the runway should not be greater than 45° nor less than 25° and preferably should be 30°.*

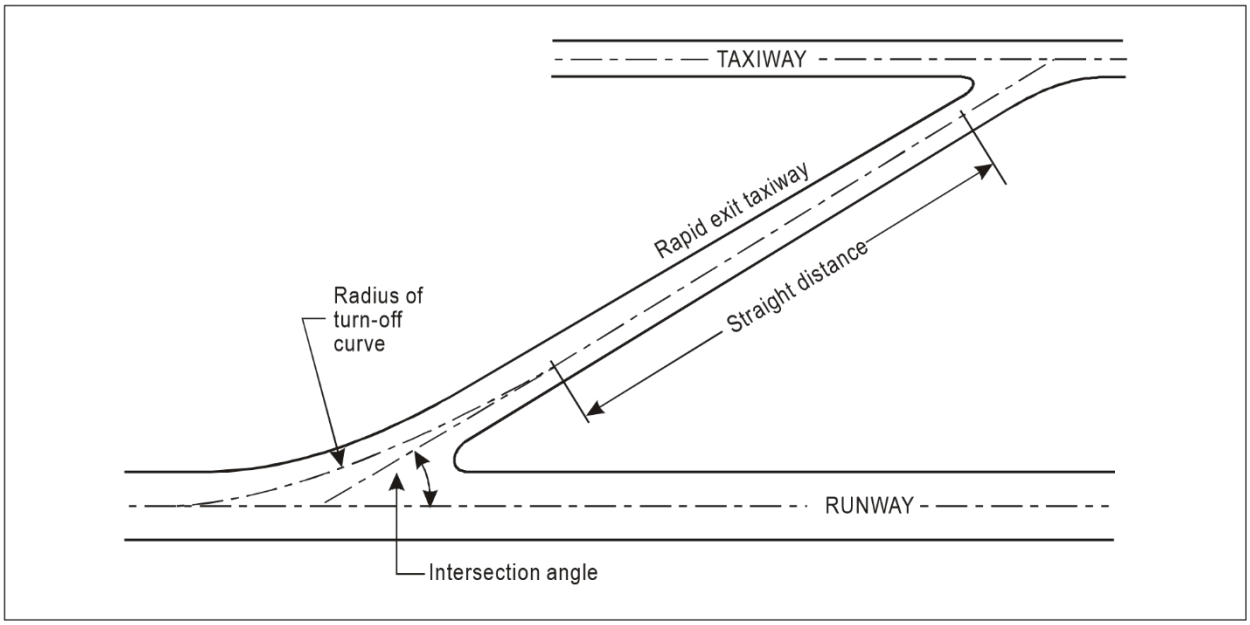


Figure C-3. Rapid exit taxiway

Taxiways on bridges

C.9.20 **Recommendation.—** *Access should be provided to allow rescue and firefighting vehicles to intervene in both directions within the specified response time to the largest aeroplane for which the taxiway bridge is intended.*

Note.— If aeroplane engines overhang the bridge structure, protection of adjacent areas below the bridge from engine blast may be required.

C.9.21 **Recommendation.—** *A bridge should be constructed on a straight section of the taxiway with a straight section on both ends of the bridge to facilitate the alignment of aeroplanes approaching the bridge.*

C.10 Taxiway shoulders

Note.— Guidance on characteristics of taxiway shoulders and on shoulder treatment is given in the CASA Advisory Circular AC139-3.2 Physical Characteristics-Taxiway, Apron, Holding Bays

C.10.1 **Recommendation.—** *Straight portions of a taxiway where the code letter is C, D, E or F should be provided with shoulders which extend symmetrically on each side of the taxiway so that the overall width of the taxiway and its shoulders on straight portions is not less than:*

(gggg) *44 m where the code letter is F;*

(hhhh) *38 m where the code letter is E;*

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

(jjjj) *25 m where the code letter is C.*

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

C.10.2 **Recommendation.—** *When a taxiway is intended to be used by turbine-engined aeroplanes, the surface of the taxiway shoulder should be so prepared as to resist erosion and the ingestion of the surface material by aeroplane engines.*

C.11 Taxiway strips

Note.— Guidance on characteristics of taxiway strips is given in the CASA Advisory Circular AC139-3.2 Physical Characteristics-Taxiway, Apron, Holding Bays

Width of taxiway strips

C.11.2 **Recommendation.—** *A taxiway strip should extend symmetrically on each side of the centre line of the taxiway throughout the length of the taxiway to at least the distance from the centre line given in Table C-1, column 11.*

Objects on taxiway strips

Note.— See I.9 for information regarding siting of equipment and installations on taxiway strips.

C.11.3 **Recommendation.—** *The taxiway strip should provide an area clear of objects which may endanger taxiing aeroplanes.*

Note 1.— Consideration will have to be given to the location and design of drains on a taxiway strip to prevent damage to an aeroplane accidentally running off a taxiway. Suitably designed drain covers may be required. For further guidance, see the CASA Advisory Circular AC139-3.2 Physical Characteristics-Taxiway, Apron, Holding Bays

Note 2.— Where open-air or covered storm water conveyances are installed, consideration will have to be given to ensure that their structure does not extend above the surrounding ground so as not to be considered an obstacle. See also Note 1 to C.11.6.

Note 3.— Particular attention needs to be given to the design and maintenance of an open-air storm water conveyance in order to prevent wildlife attraction, notably birds. If needed, it can be covered by a net. Guidance on wildlife control and reduction can be found in the CASA Advisory Circular AC139-3.3 Pavement Bearing Strength

Grading of taxiway strips

C.11.4 **Recommendation.—** *The centre portion of a taxiway strip should provide a graded area to a distance from the centre line of the taxiway of not less than that given by the following tabulation:*

- *(a) 10.25 m where the OMGWS is up to but not including 4.5 m;*
- *(b) 11 m where the OMGWS is 4.5 m up to but not including 6 m;*
- *(c) 12.50 m where the OMGWS is 6 m up to but not including 9 m;*

(d) 18.50 m where the OMGWS is 9 m up to but not including 15 m, where the code letter is D;

(e) 19 m where the OMGWS is 9 m up to but not including 15 m, where the code letter is E;

(f) 22 m where the OMGWS is 9 m up to but not including 15 m, where the code letter is F.

Note.— Guidance on width of the graded portion of a taxiway is given in the CASA Advisory Circular AC139-3.2 Physical Characteristics-Taxiway, Apron, Holding Bays

Slopes on taxiway strips

C.11.5 **Recommendation.—** *The surface of the strip should be flush at the edge of the taxiway or shoulder, if provided, and the graded portion should not have an upward transverse slope exceeding:*

(kkkk) *2.5 per cent for strips where the code letter is C, D, E or F; and*

(llll) *3 per cent for strips of taxiways where the code letter is A or B;*

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

C.11.6 **Recommendation.—** *The transverse slopes on any portion of a taxiway strip beyond that to be graded should not exceed an upward or downward slope of 5 per cent as measured in the direction away from the taxiway.*

Note 1.— Where deemed necessary for proper drainage, an open-air storm water conveyance may be allowed in the non-graded portion of a taxiway strip and would be placed as far as practicable from the taxiway.

Note 2.— The aerodrome RFF procedure would need to take into account the location of open-air storm water conveyances within the non-graded portion of a taxiway strip.

C.12 Holding bays, runway-holding positions, intermediate holding positions and road-holding positions

General

C.12.1 **Recommendation.—** *Holding bay(s) should be provided when the traffic density is medium or heavy.*

C.12.4 **Recommendation.—** *An intermediate holding position should be established on a taxiway at any point other than a runway-holding position where it is desirable to define a specific holding limit.*

Location

Note.— Guidance for the positioning of runway-holding positions is given in the CASA Advisory Circular AC139-3.2 Physical Characteristics-Taxiway, Apron, Holding Bays

C.12.7 **Recommendation.—** *At elevations greater than 700 m (2 300 ft) the distance of 90 m specified in Table 3-2 for a precision approach runway code number 4 should be increased as follows:*

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

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

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

C.12.8 **Recommendation.—** *If a holding bay, runway-holding position or road-holding position for a precision approach runway code number 4 is at a greater elevation compared to the threshold, the distance specified in Table C-2 should be further increased 5 m for every metre the bay or position is higher than the threshold.*

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

	Code number			
Type of runway	1	2	3	4
Non-instrument	30 m	40 m	75 m	75 m
Non-precision approach	40 m	40 m	75 m	75 m

Precision approach category I	60 m[b]	60 m[b]	90 m[a,b]	90 m[a,b]
Precision approach categories II and III	—	—	90 m[a,b]	90 m[a,b]
Take-off runway	30 m	40 m	75 m	75 m

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

(qqqq) This distance may need to be increased to avoid interference with radio navigation aids, particularly the glide path and localizer facilities. Information on critical and sensitive areas of ILS and MLS is contained in Annex 10, Volume I, Attachments C and G, respectively (see also C.12.6).

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

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

Note 3.— For code number 4 where the width of the inner edge of the inner approach surface is more than 120 m, a distance greater than 90 m may be necessary to ensure that a holding aircraft is clear of the obstacle free zone. For example, a distance of 100 m is based on an aircraft with a tail height of 24 m, a distance from the nose to the highest part of the tail of 62.2 m and a nose height of 10 m holding at an angle of 45° or more with respect to the runway centre line, being clear of the obstacle free zone.

C.13 Aprons

General

C.13.1 **Recommendation.—** *Aprons should be provided where necessary to permit the on- and off-loading of passengers, cargo or mail as well as the servicing of aircraft without interfering with the aerodrome traffic.*

Size of aprons

C.13.2 **Recommendation.—** *The total apron area should be adequate to permit expeditious handling of the aerodrome traffic at its maximum anticipated density.*

Strength of aprons

C.13.3 **Recommendation.—** *Each part of an apron should be capable of withstanding the traffic of the aircraft it is intended to serve, due consideration being given to the fact that some portions of the apron will be subjected to a higher density of traffic and, as a result of slow moving or stationary aircraft, to higher stresses than a runway.*

Slopes on aprons

C.13.4 **Recommendation.—** *Slopes on an apron, including those on an aircraft stand taxilane, should be sufficient to prevent accumulation of water on the surface of the apron but should be kept as level as drainage requirements permit.*

C.13.5 **Recommendation.—** *On an aircraft stand the maximum slope should not exceed 1 per cent.*

Clearance distances on aircraft stands

C.13.6 **Recommendation.—** *An aircraft stand should provide the following minimum clearances between an aircraft entering or exiting the stand and any adjacent building, aircraft on another stand and other objects:*

Code letter	Clearance
(rrrr)	*3 m*
(ssss)	*3 m*
(tttt)	*4.5 m*
(uuuu)	*7.5 m*
(vvvv)	*7.5 m*
(wwww)	*7.5 m*

When special circumstances so warrant, these clearances may be reduced at a nose-in aircraft stand, where the code letter is D, E or F:

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

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

Note.— On aprons, consideration also has to be given to the provision of service roads and to manoeuvring and storage area for ground equipment (see the CASA Advisory Circular AC139-3.2 Physical Characteristics-Taxiway, Apron, Holding Bays, for guidance on storage of ground equipment).

C.14 Isolated aircraft parking position

C.14.2 **Recommendation.—** *The isolated aircraft parking position should be located at the maximum distance practicable and in any case never less than 100 m from other parking positions, buildings or public areas, etc. Care should be taken to ensure that the position is not located over underground utilities such as gas and aviation fuel and, to the extent feasible, electrical or communication cables.*

APPENDIX D. OBSTACLE RESTRICTION AND REMOVAL

Note 1.— The objectives of the specifications in this chapter are to define the airspace around aerodromes to be maintained free from obstacles so as to permit the intended aeroplane operations at the aerodromes to be conducted safely and to prevent the aerodromes from becoming unusable by the growth of obstacles around the aerodromes. This is achieved by establishing a series of obstacle limitation surfaces that define the limits to which objects may project into the airspace.

Note 2.— Objects which penetrate the obstacle limitation surfaces contained in this chapter may in certain circumstances cause an increase in the obstacle clearance altitude/height for an instrument approach procedure or any associated visual circling procedure or have other operational impact on flight procedure design. Criteria for flight procedure design are contained in the Procedures for Air Navigation Services — Aircraft Operations *(PANS-OPS, Doc 8168).*

Note 3.— The establishment of, and requirements for, an obstacle protection surface for visual approach slope indicator systems are specified in E.3.5.42 to E.3.5.46.

D.1 Obstacle limitation surfaces

Note.— See Figure D-1.

Outer horizontal surface

Note.— Guidance on the need to provide an outer horizontal surface and its characteristics is contained in the CASA Advisory Circular AC139-4 Obstacle Restriction and Removal.

Conical surface

Inner horizontal surface

D.1.5 ...

Note.— The shape of the inner horizontal surface need not necessarily be circular. Guidance on determining the extent of the inner horizontal surface is contained in the CASA Advisory Circular AC139-4 Obstacle Restriction and Removal

D.1.6 ...

Note.— Guidance on determining the elevation datum is contained in the CASA Advisory Circular AC139-4 Obstacle Restriction and Removal

Approach surface

D.1.10 ...

Note.— See Figure D-2.

Inner approach surface

Transitional surface

D.1.15 ...

Note.— As a result of b) the transitional surface along the strip will be curved if the runway profile is curved, or a plane if the runway profile is a straight line. The intersection of the transitional surface with the inner horizontal surface will also be a curved or a straight line depending on the runway profile.

Inner transitional surface

Note.— It is intended that the inner transitional surface be the controlling obstacle limitation surface for navigation aids, aircraft and other vehicles that must be near the runway and which is not to be penetrated except for frangible objects. The transitional surface described in 4.1.13 is intended to remain as the controlling obstacle limitation surface for buildings, etc.

D.1.19 ...

Note.— As a result of (b) the inner transitional surface along the strip will be curved if the runway profile is curved or a plane if the runway profile is a straight line. The intersection of

the inner transitional surface with the inner horizontal surface will also be a curved or straight line depending on the runway profile.

Take-off climb surface

D.2 Obstacle limitation requirements

Note.— The requirements for obstacle limitation surfaces are specified on the basis of the intended use of a runway, i.e. take-off or landing and type of approach, and are intended to be applied when such use is made of the runway. In cases where operations are conducted to or from both directions of a runway, then the function of certain surfaces may be nullified because of more stringent requirements of another lower surface.

Non-instrument runways

D.2.3 ...

Note.— Circumstances in which the shielding principle may reasonably be applied are described in the CASA Advisory Circular AC139-4 Obstacle Restriction and Removal

D.2.4 **Recommendation.—** *New objects or extensions of existing objects should not be permitted above the conical surface or inner horizontal surface except when, in the opinion of the appropriate authority, the object would be shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.*

D.2.5 **Recommendation.—** *Existing objects above any of the surfaces required by D.2.1 should as far as practicable be removed except when, in the opinion of the appropriate authority, the object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.*

Note.— Because of transverse or longitudinal slopes on a strip, in certain cases the inner edge or portions of the inner edge of the approach surface may be below the corresponding elevation of the strip. It is not intended that the strip be graded to conform with the inner edge of the approach surface, nor is it intended that terrain or objects which are above the approach surface beyond the end of the strip, but below the level of the strip, be removed unless it is considered they may endanger aeroplanes.

D.2.6 **Recommendation.—** *In considering proposed construction, account should be taken of the possible future development of an instrument runway and consequent requirement for more stringent obstacle limitation surfaces.*

D.2.10 ...

Note.— Circumstances in which the shielding principle may reasonably be applied are described in the CASA Advisory Circular AC139-4 Obstacle Restriction and Removal

D.2.11 **Recommendation.—** *New objects or extensions of existing objects should not be permitted above the approach surface beyond 3 000 m from the inner edge, the conical surface or inner horizontal surface except when, in the opinion of the appropriate authority, the object*

would be shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

D.2.12 **Recommendation.—** *Existing objects above any of the surfaces required by D.2.7 should as far as practicable be removed except when, in the opinion of the appropriate authority, the object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.*

Note.— Because of transverse or longitudinal slopes on a strip, in certain cases the inner edge or portions of the inner edge of the approach surface may be below the corresponding elevation of the strip. It is not intended that the strip be graded to conform with the inner edge of the approach surface, nor is it intended that terrain or objects which are above the approach surface beyond the end of the strip, but below the level of the strip, be removed unless it is considered they may endanger aeroplanes.

Precision approach runways

Note 1.— See I.9 for information regarding siting of equipment and installations on operational areas.

Note 2.— Guidance on obstacle limitation surfaces for precision approach runways is given in the CASA Advisory Circular AC139-4 Obstacle Restriction and Removal

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

(zzzz) inner approach surface;

(aaaaa) inner transitional surfaces; and

(bbbbb) balked landing surface.

D.2.19 ...

Note.— Circumstances in which the shielding principle may reasonably be applied are described in the CASA Advisory Circular AC139-4 Obstacle Restriction and Removal

D.2.20 **Recommendation.—** *New objects or extensions of existing objects should not be permitted above the conical surface and the inner horizontal surface except when, in the opinion of the appropriate authority, an object would be shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.*

D.2.21 **Recommendation.—** *Existing objects above an approach surface, a transitional surface, the conical surface and inner horizontal surface should as far as practicable be removed except when, in the opinion of the appropriate authority, an object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.*

Note.— Because of transverse or longitudinal slopes on a strip, in certain cases the inner edge or portions of the inner edge of the approach surface may be below the

corresponding elevation of the strip. It is not intended that the strip be graded to conform with the inner edge of the approach surface, nor is it intended that terrain or objects which are above the approach surface beyond the end of the strip, but below the level of the strip, be removed unless it is considered they may endanger aeroplanes.

Runways meant for take-off

D.2.24 **Recommendation.—** *The operational characteristics of aeroplanes for which the runway is intended should be examined to see if it is desirable to reduce the slope specified in Table D-2 when critical operating conditions are to be catered to. If the specified slope is reduced, corresponding adjustment in the length of the take-off climb surface should be made so as to provide protection to a height of 300 m.*

Note.— When local conditions differ widely from sea level standard atmospheric conditions, it may be advisable for the slope specified in Table 4-2 to be reduced. The degree of this reduction depends on the divergence between local conditions and sea level standard atmospheric conditions, and on the performance characteristics and operational requirements of the aeroplanes for which the runway is intended.

4.2.25 ...

Note.— Circumstances in which the shielding principle may reasonably be applied are described in the CASA Advisory Circular AC139-4 Obstacle Restriction and Removal.

D.2.26 **Recommendation.—** *If no object reaches the 2 per cent (1:50) take-off climb surface, new objects should be limited to preserve the existing obstacle free surface or a surface down to a slope of 1.6 per cent (1:62.5).*

Table D-2. Dimensions and slopes of obstacle limitation surfaces

RUNWAYS MEANT FOR TAKE-OFF

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

a. All dimensions are measured horizontally unless specified otherwise.
b. The take-off climb surface starts at the end of the clearway if the clearway length exceeds the specified distance.
c. 1 800 m when the intended track includes changes of heading greater than 15° for operations conducted in IMC, VMC by night.
d. See D.2.24 and D.2.26.

D.2.27 **Recommendation.**— *Existing objects that extend above a take-off climb surface should as far as practicable be removed except when, in the opinion of the appropriate authority, an object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.*

Note.— Because of transverse slopes on a strip or clearway, in certain cases portions of the inner edge of the take-off climb surface may be below the corresponding elevation of the strip or clearway. It is not intended that the strip or clearway be graded to conform with the inner edge of the take-off climb surface, nor is it intended that terrain or objects which are above the take-off climb surface beyond the end of the strip or clearway, but below the level of the strip or clearway, be removed unless it is considered they may endanger aeroplanes. Similar considerations apply at the junction of a clearway and strip where differences in transverse slopes exist.

D.3 Objects outside the obstacle limitation surfaces

D.3.1 **Recommendation.**— *Arrangements should be made to enable the appropriate authority to be consulted concerning proposed construction beyond the limits of the obstacle limitation surfaces that extend above a height established by that authority, in order to permit an aeronautical study of the effect of such construction on the operation of aeroplanes.*

D.3.2 **Recommendation.**— *In areas beyond the limits of the obstacle limitation surfaces, at least those objects which extend to a height of 150 m or more above ground elevation should be*

regarded as obstacles, unless a special aeronautical study indicates that they do not constitute a hazard to aeroplanes.

Note.— This study may have regard to the nature of operations concerned and may distinguish between day and night operations.

D.4 Other objects

D.4.1 **Recommendation.—** *Objects which do not project through the approach surface but which would nevertheless adversely affect the optimum siting or performance of visual or non-visual aids should, as far as practicable, be removed.*

D.4.2 **Recommendation.—** *Anything which may, in the opinion of the appropriate authority after aeronautical study, endanger aeroplanes on the movement area or in the air within the limits of the inner horizontal and conical surfaces should be regarded as an obstacle and should be removed in so far as practicable.*

Note.— In certain circumstances, objects that do not project above any of the surfaces enumerated in 4.1 may constitute a hazard to aeroplanes as, for example, where there are one or more isolated objects in the vicinity of an aerodrome.

APPENDIX E. VISUAL AIDS FOR NAVIGATION

E.1 Indicators and signaling devices

E.1.1 Wind direction indicator

Characteristics

E.1.1.3 **Recommendation.—** *The wind direction indicator should be in the form of a truncated cone made of fabric and should have a length of not less than 3.6 m and a diameter, at the larger end, of not less than 0.9 m. It should be constructed so that it gives a clear indication of the direction of the surface wind and a general indication of the wind speed. The colour or colours should be so selected as to make the wind direction indicator clearly visible and understandable from a height of at least 300 m, having regard to background. Where practicable, a single colour, preferably white or orange, should be used. Where a combination of two colours is required to give adequate conspicuity against changing backgrounds, they should preferably be orange and white, red and white, or black and white, and should be arranged in five alternate bands, the first and last bands being the darker colour.*

E.1.1.4 **Recommendation.—** *The location of at least one wind direction indicator should be marked by a circular band 15 m in diameter and 1.2 m wide. The band should be centred about the wind direction indicator support and should be in a colour chosen to give adequate conspicuity, preferably white.*

E.1.1.5 **Recommendation.—** *Provision should be made for illuminating at least one wind indicator at an aerodrome intended for use at night.*

E.1.2 Landing direction indicator

Characteristics

E.1.2.2 **Recommendation.—** *The landing direction indicator should be in the form of a "T".*

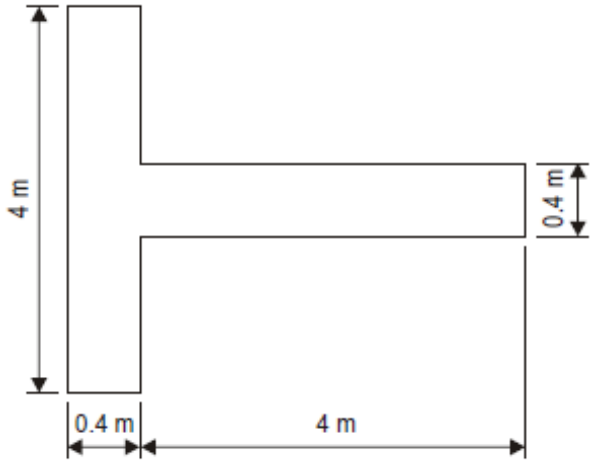


Figure E-1. Landing direction indicator

E.1.3 Signaling lamp

Characteristics

E.1.3.2 **Recommendation.—** *A signaling lamp should be capable of producing red, green and white signals, and of:*

(ccccc) *being aimed manually at any target as required;*

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

(eeeee) *transmitting a message in any one of the three colours by Morse Code up to a speed of at least four words per minute.*

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

E.1.3.3 **Recommendation.—** *The beam spread should be not less than 1° nor greater than 3°, with negligible light beyond 3°. When the signaling lamp is intended for use in the daytime the intensity of the coloured light should be not less than 6 000 cd.*

E.1.4 Signal panels and signal area

Note.— The inclusion of detailed specifications for a signal area in this section is not intended to imply that one has to be provided. Attachment A, Section 16, provides guidance on the need to provide ground signals. Annex 2, Appendix 1, specifies the shape, colour and use of visual ground signals. The CASA Advisory Circular AC139-5.1 Visual Aids for navigation – Indicators & Signalling Devices, provides guidance on their design.

Location of signal area

E.1.4.1 **Recommendation.—** *The signal area should be located so as to be visible for all angles of azimuth above an angle of 10° above the horizontal when viewed from a height of 300 m.*

Characteristics of signal area

E.1.4.3 **Recommendation.—** *The colour of the signal area should be chosen to contrast with the colours of the signal panels used, and it should be surrounded by a white border not less than 0.3 m wide.*

E.2 Markings

E.2.1 General

Interruption of runway markings

E.2.1.2 **Recommendation.—** *The order of importance of runways for the display of runway markings should be as follows:*

(fffff) *1st – precision approach runway;*

(ggggg) *2nd – non-precision approach runway; and*

(hhhhh) *3rd – non-instrument runway*

E.2.1.3 ...

Note.— See E.2.8.7 regarding the manner of connecting runway and taxiway centre line markings.

Colour and conspicuity

E.2.1.4 ...

Note 1.— It has been found that, on runway surfaces of light colour, the conspicuity of white markings can be improved by outlining them in black.

Note 2.— It is preferable that the risk of uneven friction characteristics on markings be reduced in so far as practicable by the use of a suitable kind of paint.

Note 3.— Markings may consist of solid areas or a series of longitudinal stripes providing an effect equivalent to the solid areas.

E.2.1.7 **Recommendation.—** *At aerodromes where operations take place at night, pavement markings should be made with reflective materials designed to enhance the visibility of the markings.*

Note.— Guidance on reflective materials is given in the CASA Advisory Circular AC139-5.1 Visual Aids for navigation – Indicators & Signalling Devices.

Unpaved taxiways

E.2.1.8 **Recommendation.—** *An unpaved taxiway should be provided, so far as practicable, with the markings prescribed for paved taxiways.*

E.2.2 Runway designation marking

Application

E.2.2.2 **Recommendation.—** *A runway designation marking should be provided, so far as practicable, at the thresholds of an unpaved runway.*

Location

E.2.2.3 ...

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

E.2.3 Runway centre line marking

Characteristics

E.2.4 Threshold marking

Application

E.2.4.2 **Recommendation.—** *A threshold marking should be provided at the threshold of a paved non-instrument runway where the code number is 3 or 4 and the runway is intended for use by other than international commercial air transport.*

E.2.4.3 **Recommendation.—** *A threshold marking should be provided, so far as practicable, at the thresholds of an unpaved runway.*

Note.— The CASA Advisory Circular AC139-5.2 Visual Aids for navigation – Markings, shows a form of marking which has been found satisfactory for the marking of downward slopes immediately before the threshold.

Transverse stripe

E.2.4.7 **Recommendation.—** *Where a threshold is displaced from the extremity of a runway or where the extremity of a runway is not square with the runway centre line, a transverse stripe as shown in Figure E-4 (B) should be added to the threshold marking.*

Arrows

E.2.4.10 ...

E.2.5 Aiming point marking

Application

E.2.5.2 **Recommendation.—** *An aiming point marking should be provided at each approach end of:*

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

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

when additional conspicuity of the aiming point is desirable.

E.2.6 Touchdown zone marking

Application

E.2.6.2 **Recommendation.—** *A touchdown zone marking should be provided in the touchdown zone of a paved nonprecision approach or non-instrument runway where the code number is 3 or 4 and additional conspicuity of the touchdown zone is desirable.*

E.2.6.5 **Recommendation.—** *On a non-precision approach runway where the code number is 2, an additional pair of touchdown zone marking stripes should be provided 150 m beyond the beginning of the aiming point marking.*

E.2.7 Runway side stripe marking

Application

E.2.7.2 **Recommendation.—** *A runway side stripe marking should be provided on a precision approach runway irrespective of the contrast between the runway edges and the shoulders or the surrounding terrain.*

Location

E.2.7.3 **Recommendation.—** *A runway side stripe marking should consist of two stripes, one placed along each edge of the runway with the outer edge of each stripe approximately on the edge of the runway, except that, where the runway is greater than 60 m in width, the stripes should be located 30 m from the runway centre line.*

E.2.7.4 **Recommendation.—** *Where a runway turn pad is provided, the runway side stripe marking should be continued between the runway and the runway turn pad.*

Characteristics

E.2.7.5 **Recommendation.—** *A runway side stripe should have an overall width of at least 0.9 m on runways 30 m or more in width and at least 0.45 m on narrower runways.*

E.2.8 Taxiway centre line marking

Application

E.2.8.2 **Recommendation.—** *Taxiway centre line marking should be provided on a paved taxiway and apron where the code number is 1 or 2 in such a way as to provide continuous guidance between the runway centre line and aircraft stands.*

E.2.8.4 **Recommendation.—** *Where it is necessary to denote the proximity of a runway-holding position, enhanced taxiway centre line marking should be provided.*

Note.— The provision of enhanced taxiway centre line marking may form part of runway incursion prevention measures.

Location

E.2.8.6 **Recommendation.—** *On a straight section of a taxiway the taxiway centre line marking should be located along the taxiway centre line. On a taxiway curve the marking should continue from the straight portion of the taxiway at a constant distance from the outside edge of the curve.*

Note.— See C.9.5 and Figure C-2.

E.2.8.7 **Recommendation.—** *At an intersection of a taxiway with a runway where the taxiway serves as an exit from the runway, the taxiway centre line marking should be curved into the runway centre line marking as shown in Figures E-6 and E-26. The taxiway centre line marking should be extended parallel to the runway centre line marking for a distance of at least 60 m beyond the point of tangency where the code number is 3 or 4, and for a distance of at least 30 m where the code number is 1 or 2.*

E.2.8.8 **Recommendation.—** *Where taxiway centre line marking is provided on a runway in accordance with E.2.8.3, the marking should be located on the centre line of the designated taxiway.*

E.2.9 Runway turn pad marking

Location

E.2.9.2 **Recommendation.—** *The runway turn pad marking should be curved from the runway centre line into the turn pad. The radius of the curve should be compatible with the manoeuvring capability and normal taxiing speeds of the aeroplanes for which the runway turn pad is intended. The intersection angle of the runway turn pad marking with the runway centre line should not be greater than 30 degrees.*

E.2.9.3 **Recommendation.—** *The runway turn pad marking should be extended parallel to the runway centre line marking for a distance of at least 60 m beyond the point of tangency where the code number is 3 or 4, and for a distance of at least 30 m where the code number is 1 or 2.*

E.2.9.4 **Recommendation.—** *A runway turn pad marking should guide the aeroplane in such a way as to allow a straight portion of taxiing before the point where a 180-degree turn is to be made. The straight portion of the runway turn pad marking should be parallel to the outer edge of the runway turn pad.*

E.2.9.5 **Recommendation.—** *The design of the curve allowing the aeroplane to negotiate a 180-degree turn should be based on a nose wheel steering angle not exceeding 45 degrees.*

E.2.9.6 **Recommendation.—** *The design of the turn pad marking should be such that, when the cockpit of the aeroplane remains over the runway turn pad marking, the clearance distance between any wheel of the aeroplane landing gear and the edge of the runway turn pad should be not less than those specified in C.3.6.*

Note.— For ease of manoeuvring, consideration may be given to providing a larger wheel-to-edge clearance for codes E and F aeroplanes.

E.2.10 Runway-holding position marking

Application and location

E.2.10.1 ...

Note.— See E.4.2 concerning the provision of signs at runway-holding positions.

Characteristics

E.2.10.7 **Recommendation.—** *Where increased conspicuity of the runway-holding position is required, the dimensions of runway-holding position marking should be as shown in Figure E-8, pattern A2 or pattern B2, as appropriate.*

Note.— An increased conspicuity of the runway-holding position can be required, notably to avoid incursion risks.

E.2.10.8 **Recommendation.—** *Where a pattern B runway-holding position marking is located on an area where it would exceed 60 m in length, the term "CAT II" or "CAT III" as appropriate should be marked on the surface at the ends of the runway-holding position marking and at equal intervals of 45 m maximum between successive marks. The letters should be not less than 1.8 m high and should be placed not more than 0.9 m beyond the holding position marking.*

E.2.11 Intermediate holding position marking

Application and location

E.2.11.1 **Recommendation.—** *An intermediate holding position marking should be displayed along an intermediate holding position.*

E.2.12 VOR aerodrome checkpoint marking

Application

E.2.12.1 ...

Note.— See E.4.4 for VOR aerodrome checkpoint sign.

E.2.12.2 *Site selection*

Note.— Guidance on the selection of sites for VOR aerodrome checkpoints is given in Annex 10, Volume I, Attachment E (AC 171-1 Aeronautical Telecommunications Service Organization Certification).

Characteristics

E.2.12.5 **Recommendation.—** *When it is preferable for an aircraft to be aligned in a specific direction, a line should be provided that passes through the centre of the circle on the desired azimuth. The line should extend 6 m outside the circle in the desired direction of heading and terminate in an arrowhead. The width of the line should be 15 cm (see Figure E-9 (B)).*

E.2.12.6 **Recommendation.—** *A VOR aerodrome checkpoint marking should preferably be white in colour but should differ from the colour used for the taxiway markings.*

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

E.2.13 Aircraft stand marking

Note.— Guidance on the layout of aircraft stand markings is contained in the CASA Advisory Circular AC139-5.2 Visual Aids for navigation – Markings

Application

E.2.13.1 **Recommendation.—** *Aircraft stand markings should be provided for designated parking positions on a paved apron.*

Location

E.2.13.2 **Recommendation.—** *Aircraft stand markings on a paved apron should be located so as to provide the clearances specified in C.13.6 and in C.15.9, respectively, when the nose wheel follows the stand marking.*

Characteristics

E.2.13.3 **Recommendation.—** *Aircraft stand markings should include such elements as stand identification, lead-in line, turn bar, turning line, alignment bar, stop line and lead-out line, as are required by the parking configuration and to complement other parking aids.*

E.2.13.4 **Recommendation.—** *An aircraft stand identification (letter and/or number) should be included in the lead-in line a short distance after the beginning of the lead-in line. The height of the identification should be adequate to be readable from the cockpit of aircraft using the stand.*

E.2.13.5 **Recommendation.—** *Where two sets of aircraft stand markings are superimposed on each other in order to permit more flexible use of the apron and it is difficult to identify which stand marking should be followed, or safety would be impaired if the wrong marking was followed, then identification of the aircraft for which each set of markings is intended should be added to the stand identification.*

Note.— Example: 2A-B747, 2B-F28.

E.2.13.6 **Recommendation.—** *Lead-in, turning and lead-out lines should normally be continuous in length and have a width of not less than 15 cm. Where one or more sets of stand*

markings are superimposed on a stand marking, the lines should be continuous for the most demanding aircraft and broken for other aircraft.

E.2.13.7 **Recommendation.—** *The curved portions of lead-in, turning and lead-out lines should have radii appropriate to the most demanding aircraft type for which the markings are intended.*

E.2.13.8 **Recommendation.—** *Where it is intended that an aircraft proceed in one direction only, arrows pointing in the direction to be followed should be added as part of the lead-in and lead-out lines.*

E.2.13.9 **Recommendation.—** *A turn bar should be located at right angles to the lead-in line, abeam the left pilot position at the point of initiation of any intended turn. It should have a length and width of not less than 6 m and 15 cm, respectively, and include an arrowhead to indicate the direction of turn.*

Note.— The distances to be maintained between the turn bar and the lead-in line may vary according to different aircraft types, taking into account the pilot's field of view.

E.2.13.10 **Recommendation.—** *If more than one turn bar and/or stop line is required, they should be coded.*

E.2.13.11 **Recommendation.—** *An alignment bar should be placed so as to be coincident with the extended centre line of the aircraft in the specified parking position and visible to the pilot during the final part of the parking manoeuvre. It should have a width of not less than 15 cm.*

E.2.13.12 **Recommendation.—** *A stop line should be located at right angles to the alignment bar, abeam the left pilot position at the intended point of stop. It should have a length and width of not less than 6 m and 15 cm, respectively.*

Note.— The distances to be maintained between the stop line and the lead-in line may vary according to different aircraft types, taking into account the pilot's field of view.

E.2.14 Apron safety lines

Note.— Guidance on apron safety lines is contained in the CASA Advisory Circular AC139-5.2 Visual Aids for navigation – Markings

Application

E.2.14.1 **Recommendation.—** *Apron safety lines should be provided on a paved apron as required by the parking configurations and ground facilities.*

Characteristics

E.2.14.3 **Recommendation.—** *Apron safety lines should include such elements as wing tip clearance lines and service road boundary lines as required by the parking configurations and ground facilities.*

E.2.14.4 **Recommendation.—** *An apron safety line should be continuous in length and at least 10 cm in width.*

E.2.16 Mandatory instruction marking

Note.— Guidance on mandatory instruction marking is given in the CASA Advisory Circular AC139-5.2 Visual Aids for navigation – Markings

Application

E.2.16.2 **Recommendation.—** *Where operationally required, such as on taxiways exceeding 60 m in width, or to assist in the prevention of a runway incursion, a mandatory instruction sign should be supplemented by a mandatory instruction marking.*

E.2.16.5 **Recommendation.—** *Except where operationally required, a mandatory instruction marking should not be located on a runway.*

Characteristics

E.2.16.9 **Recommendation.—** *The character height should be 4 m for inscriptions where the code letter is C, D, E or F, and 2 m where the code letter is A or B. The inscriptions should be in the form and proportions shown in CASA Advisory Circular AC139-5.2 Visual Aids for navigation – Markings.*

E.2.16.10 **Recommendation.—** *The background should be rectangular and extend a minimum of 0.5 m laterally and vertically beyond the extremities of the inscription.*

E.2.17 Information marking

Note.— Guidance on information marking is contained in the CASA Advisory Circular AC139-5.2 Visual Aids for navigation – Markings.

Application

E.2.17.2 **Recommendation.—** *Where operationally required an information sign should be supplemented by an information marking.*

E.2.17.3 **Recommendation.—** *An information (location/direction) marking should be displayed prior to and following complex taxiway intersections and where operational experience has indicated the addition of a taxiway location marking could assist flight crew ground navigation.*

E.2.17.4 **Recommendation.—** *An information (location) marking should be displayed on the pavement surface at regular intervals along taxiways of great length.*

Location

E.2.17.5 **Recommendation.—** *The information marking should be displayed across the surface of the taxiway or apron where necessary and positioned so as to be legible from the cockpit of an approaching aircraft.*

Characteristics

E.2.17.8 **Recommendation.—** *The character height should be 4 m. The inscriptions should be in the form and proportions shown in CASA Advisory Circular AC139-5.2 Visual Aids for navigation – Markings*

E.3 Lights

E.3.1 General

Laser emissions which may endanger the safety of aircraft

E.3.1.2 **Recommendation.—** *To protect the safety of aircraft against the hazardous effects of laser emitters, the following protected zones should be established around aerodromes:*

(kkkkk) a laser-beam free flight zone (LFFZ)

(llll) a laser-beam critical flight zone (LCFZ)

(mmmmm) a laser-beam sensitive flight zone (LSFZ).

Note 1.— Figures E-11, E-12 and E-13 may be used to determine the exposure levels and distances that adequately protect flight operations.

Note 2.— The restrictions on the use of laser beams in the three protected flight zones, LFFZ, LCFZ and LSFZ, refer to visible laser beams only. Laser emitters operated by the authorities in a manner compatible with flight safety are excluded. In all navigable airspace, the irradiance level of any laser beam, visible or invisible, is expected to be less than or equal to the maximum permissible exposure (MPE) unless such emission has been notified to the authority and permission obtained.

Note 3.— The protected flight zones are established in order to mitigate the risk of operating laser emitters in the vicinity of aerodromes.

Note 4.— Further guidance on how to protect flight operations from the hazardous effects of laser emitters is contained in the Manual on Laser Emitters and Flight Safety *(Doc 9815).*

Note 5.— See also Annex 11 — Air Traffic Services*, Chapter 2 (CAR Part 172).*

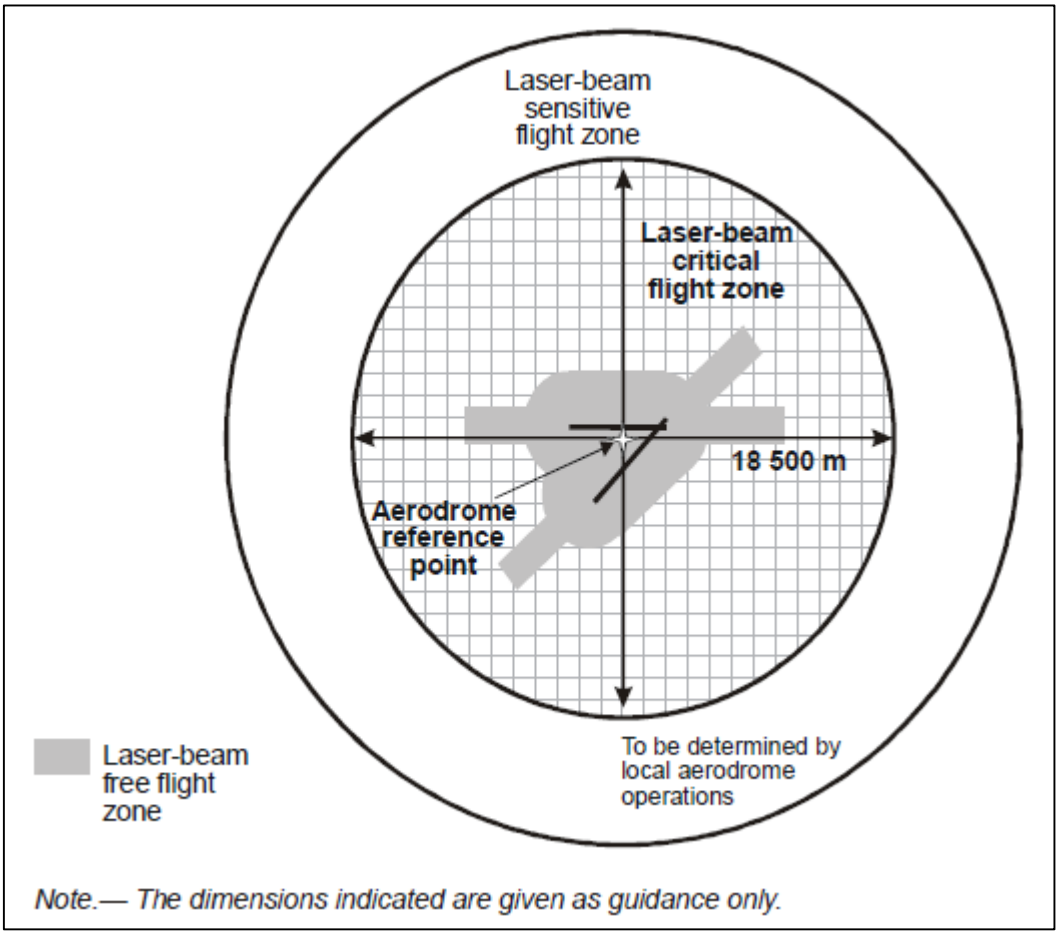


Figure E-11. Protected flight zones

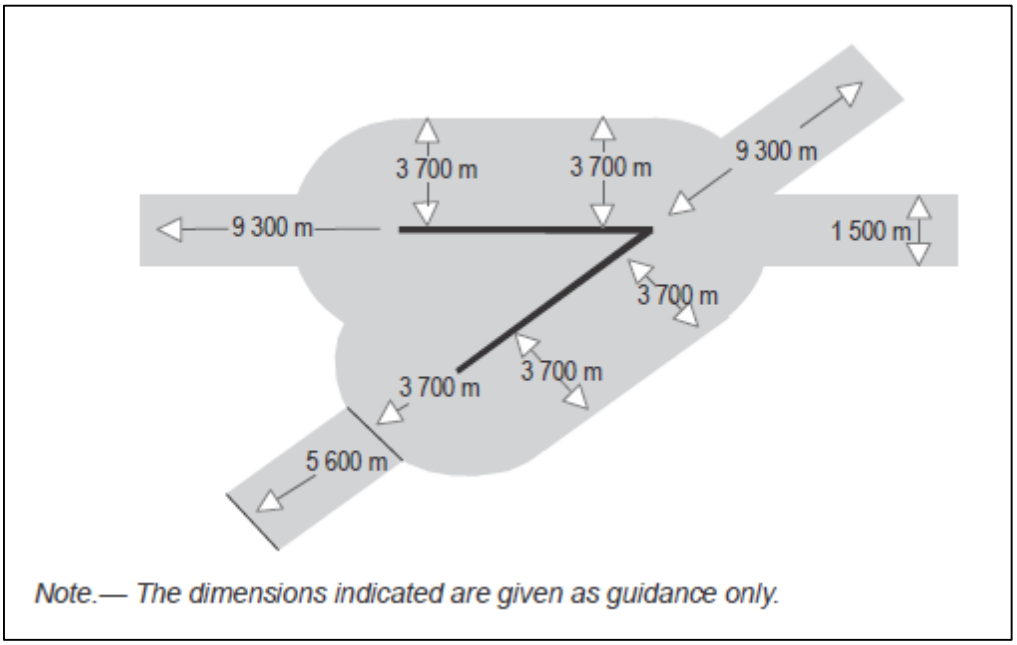


Figure E-12. Multiple runway laser-beam free flight zone

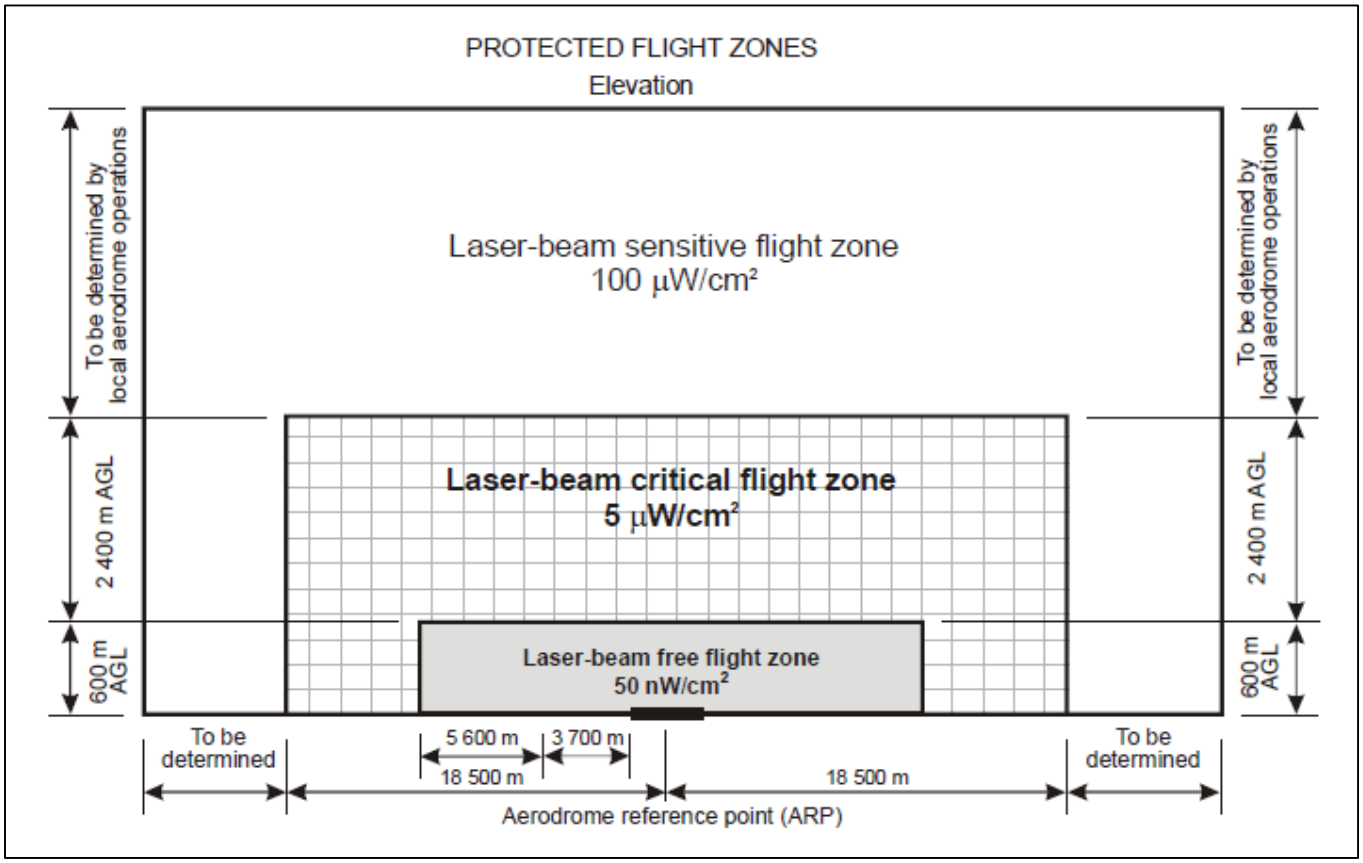


Figure E-13. Protected flight zones with indication of maximum irradiance levels for visible laser beams

Lights which may cause confusion

E.3.1.3 **Recommendation.—** *A non-aeronautical ground light which, by reason of its intensity, configuration or colour, might prevent, or cause confusion in, the clear interpretation of aeronautical ground lights should be extinguished, screened or otherwise modified so as to eliminate such a possibility. In particular, attention should be directed to a nonaeronautical ground light visible from the air within the areas described hereunder:*

(a) *Instrument runway — code number 4:*

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

(b) *Instrument runway — code number 2 or 3:*

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

(c) *Instrument runway — code number 1;*

and non-instrument runway:

within the approach area.

Aeronautical ground lights which may cause confusion to mariners

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

Light fixtures and supporting structures

Note.— See I.9 for information regarding siting of equipment and installations on operational areas, and the CASA Advisory Circular AC139-9.7 Operational Services – Siting of Installations and Frangibility, for guidance on frangibility of light fixtures and supporting structures.

Surface lights

E.3.1.8 **Recommendation.—** *The temperature produced by conduction or radiation at the interface between an installed inset light and an aircraft tire should not exceed 160°C during a 10-minute period of exposure.*

Note.— Guidance on measuring the temperature of inset lights is given in the CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights.

Light intensity and control

Note.— In dusk or poor visibility conditions by day, lighting can be more effective than marking. For lights to be effective in such conditions or in poor visibility by night, they must be of adequate intensity. To obtain the required intensity, it will usually be necessary to make the light directional, in which case the arcs over which the light shows will have to be adequate and so orientated as to meet the operational requirements. The runway lighting system will have to be considered as a whole, to ensure that the relative light intensities are suitably matched to the same end. (See CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights).

E.3.1.9 ...

Note.— While the lights of an approach lighting system may be of higher intensity than the runway lighting, it is good practice to avoid abrupt changes in intensity as these could give a pilot a false impression that the visibility is changing during approach.

E.3.2 Emergency lighting

Application

E.3.2.1 **Recommendation.—** *At an aerodrome provided with runway lighting and without a secondary power supply, sufficient emergency lights should be conveniently available for installation on at least the primary runway in the event of failure of the normal lighting system.*

Note.— Emergency lighting may also be useful to mark obstacles or delineate taxiways and apron areas.

Location

E.3.2.2 **Recommendation.—** *When installed on a runway the emergency lights should, as a minimum, conform to the configuration required for a non-instrument runway.*

Characteristics

E.3.2.3 **Recommendation.—** *The colour of the emergency lights should conform to the colour requirements for runway lighting, except that, where the provision of coloured lights at the threshold and the runway end is not practicable, all lights may be variable white or as close to variable white as practicable.*

E.3.3 Aeronautical beacons

Location

E.3.3.5 **Recommendation.—** *The location of the beacon should be such that the beacon is not shielded by objects in significant directions and does not dazzle a pilot approaching to land.*

Characteristics

E.3.3.7 ...

Note.— At locations where a high ambient background lighting level cannot be avoided, the effective intensity of the flash may be required to be increased by a factor up to a value of 10.

Identification beacon

Location

E.3.3.10 **Recommendation.—** *The location of the beacon should be such that the beacon is not shielded by objects in significant directions and does not dazzle a pilot approaching to land.*

Characteristics

E.3.3.11 ...

Note.— At locations where a high ambient background lighting level cannot be avoided, the effective intensity of the flash may be required to be increased by a factor up to a value of 10.

E.3.3.14 **Recommendation.—** *The speed of transmission should be between six and eight words per minute, the corresponding range of duration of the Morse dots being from 0.15 to 0.2 seconds per dot.*

E.3.4 Approach lighting systems

Application

E.3.4.1 *Application*

(a) Non-instrument runway

Recommendation.— *Where physically practicable, a simple approach lighting system as specified in E.3.4.2 to E.3.4.9 should be provided to serve a non-instrument runway where the code number is 3 or 4 and intended for use at night, except when the runway is used only in conditions of good visibility and sufficient guidance is provided by other visual aids.*

Note.— A simple approach lighting system can also provide visual guidance by day.

(b) ...

Note.— It is advisable to give consideration to the installation of a precision approach category I lighting system or to the addition of a runway lead-in lighting system.

Simple approach lighting system

Location

E.3.4.3 ...

Note 1.— Spacings for the crossbar lights between 1 m and 4 m are in use. Gaps on each side of the centre line may improve directional guidance when approaches are made with a lateral error, and facilitate the movement of rescue and firefighting vehicles.

Note 2.— See Attachment A, Section 11(CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights), for guidance on installation tolerances.

E.3.4.5 **Recommendation.—** *If it is not physically possible to provide a centre line extending for a distance of 420 m from the threshold, it should be extended to 300 m so as to include the crossbar. If this is not possible, the centre line lights should be extended as far as practicable, and each centre line light should then consist of a barrette at least 3 m in length. Subject to the approach system having a crossbar at 300 m from the threshold, an additional crossbar may be provided at 150 m from the threshold.*

Characteristics

E.3.4.7 ...

Note 1.— When the barrette as in (b) is composed of lights approximating to point sources, a spacing of 1.5 m between adjacent lights in the barrette has been found satisfactory.

Note 2.— It may be advisable to use barrettes 4 m in length if it is anticipated that the simple approach lighting system will be developed into a precision approach lighting system.

Note 3.— At locations where identification of the simple approach lighting system is difficult at night due to surrounding lights, sequence flashing lights installed in the outer portion of the system may resolve this problem.

E.3.4.8 **Recommendation.—** *Where provided for a non-instrument runway, the lights should show at all angles in azimuth necessary to a pilot on base leg and final approach. The intensity of the lights should be adequate for all conditions of visibility and ambient light for which the system has been provided.*

E.3.4.9 **Recommendation.—** *Where provided for a non-precision approach runway, the lights should show at all angles in azimuth necessary to the pilot of an aircraft which on final approach does not deviate by an abnormal amount from the path defined by the non-visual aid. The lights should be designed to provide guidance during both day and night in the most adverse conditions of visibility and ambient light for which it is intended that the system should remain usable.*

Precision approach category I lighting system

Location

E.3.4.10 ...

Note.— The installation of an approach lighting system of less than 900 m in length may result in operational limitations on the use of the runway. See Attachment A, Section 11.

E.3.4.11 ...

Note 1.— Spacings for the crossbar lights between 1 m and 4 m are in use. Gaps on each side of the centre line may improve directional guidance when approaches are made with a lateral error, and facilitate the movement of rescue and firefighting vehicles.

Note 2.— See Attachment A, Section 11 (CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights), for guidance on installation tolerances.

Characteristics

E.3.4.17 **Recommendation.—** *If the centre line consists of barrettes as described in E.3.4.14 (b) or E.3.4.15(b), each barrette should be supplemented by a flashing light, except where such lighting is considered unnecessary taking into account the characteristics of the system and the nature of the meteorological conditions.*

E.3.4.19 ...

Note.— See Attachment A, Section 11 (CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights), for detailed configuration.

E.3.4.21 The lights must be in accordance with the specifications of Appendix 2, Figure A2-1 *(CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights).*

Note.— The flight path envelopes used in the design of these lights are given in Attachment A, Figure A-6 (CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights).

Precision approach category II and III lighting system

Location

E.3.4.22 ...

Note.— The length of 900 m is based on providing guidance for operations under category I, II and III conditions. Reduced lengths may support category II and III operations but may impose limitations on category I operations. See Attachment A, Section 11 (CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights).

Characteristics

E.3.4.34 **Recommendation.—** *If the centre line beyond 300 m from the threshold consists of barrettes as described in E.3.4.31(a) or E.3.4.32(a), each barrette beyond 300 m should be supplemented by a flashing light, except where such lighting is considered unnecessary taking into account the characteristics of the system and the nature of the meteorological conditions.*

E.3.4.39 The lights must be in accordance with the specifications of Appendix 2, Figures A2-1 and A2-2.

Note.— The flight path envelopes used in the design of these lights are given in Attachment A, Figure A-6 (CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights).

E.3.5 Visual approach slope indicator systems

Application

E.3.5.1 ...

Note.— Guidance on the priority of installation of visual approach slope indicator systems is contained in Attachment A, Section 12 (CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights).

E.3.5.4 **Recommendation.**— *As of 1 January 2020, the use of T-VASIS and AT-VASIS as standard visual approach slope indicator systems should be discontinued.*

E.3.5.6 **Recommendation.—** *Where a runway threshold is temporarily displaced from the normal position and one or more of the conditions specified in E.3.5.1 exist, a PAPI should be provided except that where the code number is 1 or 2 an APAPI may be provided.*

T-VASIS and AT-VASIS

Siting

E.3.5.10 ...

Note.— The siting of T-VASIS will provide, for a 3° slope and a nominal eye height over the threshold of 15 m (see E.3.5.7 and E.3.5.20), a pilot's eye height over threshold of 13 m to 17 m when only the wing bar lights are visible. If increased eye height at the threshold is required (to provide adequate wheel clearance), then the approaches may be flown with one or more fly-down lights visible. The pilot's eye height over the threshold is then of the following order:

Wing bar lights and one fly-down light visible	*17 m to 22 m*
Wing bar lights and two fly-down lights visible	*22 m to 28 m*
Wing bar lights and three fly-down lights visible	*28 m to 54 m.*

Characteristics of the light units

E.3.5.13 The light intensity distribution of the fly-down, wing bar and fly-up light units must be as shown in Appendix 2, Figure A2-22*(CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights).*

PAPI and APAPI

Description

E.3.5.24 ...

Note.— Where a runway is used by aircraft requiring visual roll guidance which is not provided by other external means, then a second wing bar may be provided on the opposite side of the runway.

E.3.5.25 ...

Note.— Where a runway is used by aircraft requiring visual roll guidance which is not provided by other external means, then a second wing bar may be provided on the opposite side of the runway.

E.3.5.32 The light intensity distribution of the light units must be as shown in Appendix 2, Figure A2-23*(CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights).*

Note.— See the CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights, for additional guidance on the characteristics of light units.

E.3.5.40 ...

Note.— See E.3.5.42 to E.3.5.46 concerning the related obstacle protection surface.

Obstacle protection surface

Note.— The following specifications apply to T-VASIS, AT-VASIS, PAPI and APAPI.

E.3.5.44 ...

Note.— Circumstances in which the shielding principle may reasonably be applied are described in the CASA Advisory Circular AC139-4 Obstacle Restriction and Removal.

E.3.5.46 ...

Note 1.— Guidance on this issue is contained in the CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights

Note 2.— The displacement of the system upwind of the threshold reduces the operational landing distance.

E.3.6 Circling guidance lights

Application

E.3.6.1 **Recommendation.—** *Circling guidance lights should be provided when existing approach and runway lighting systems do not satisfactorily permit identification of the runway and/or approach area to a circling aircraft in the conditions for which it is intended the runway be used for circling approaches.*

Location

E.3.6.2 **Recommendation.—** *The location and number of circling guidance lights should be adequate to enable a pilot, as appropriate, to:*

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

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

E.3.6.3 **Recommendation.—** *Circling guidance lights should consist of:*

(a) lights indicating the extended centre line of the runway and/or parts of any approach lighting system; or

(b) lights indicating the position of the runway threshold; or

(c) lights indicating the direction or location of the runway;

or a combination of such lights as is appropriate to the runway under consideration.

Note.— Guidance on installation of circling guidance lights is given in the CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights

Characteristics

E.3.6.4 **Recommendation.—** *Circling guidance lights should be fixed or flashing lights of an intensity and beam spread adequate for the conditions of visibility and ambient light in which it is intended to make visual circling approaches. The flashing lights should be white, and the steady lights either white or gaseous discharge lights.*

E.3.6.5 **Recommendation.—** *The lights should be designed and be installed in such a manner that they will not dazzle or confuse a pilot when approaching to land, taking off or taxiing.*

E.3.7 Runway lead-in lighting systems

Application

E.3.7.1 **Recommendation.—** *A runway lead-in lighting system should be provided where it is desired to provide visual guidance along a specific approach path, for reasons such as avoiding hazardous terrain or for purposes of noise abatement.*

Note.— Guidance on providing lead-in lighting systems is given in the CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights

Location

E.3.7.2 **Recommendation.—** *A runway lead-in lighting system should consist of groups of lights positioned so as to define the desired approach path and so that one group may be sighted from the preceding group. The interval between adjacent groups should not exceed approximately 1 600 m.*

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

E.3.7.3 **Recommendation.—** *A runway lead-in lighting system should extend from a point as determined by the appropriate authority, up to a point where the approach lighting system, if provided, or the runway or the runway lighting system is in view.*

Characteristics

E.3.7.4 **Recommendation.—** *Each group of lights of a runway lead-in lighting system should consist of at least three flashing lights in a linear or cluster configuration. The system may be augmented by steady burning lights where such lights would assist in identifying the system.*

E.3.7.5 **Recommendation.—** *The flashing lights and the steady burning lights should be white.*

E.3.7.6 **Recommendation.—** *Where practicable, the flashing lights in each group should flash in sequence towards the runway.*

E.3.8 Runway threshold identification lights

Application

E.3.8.1 **Recommendation.—** *Runway threshold identification lights should be installed:*

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

(b) *where a runway threshold is permanently displaced from the runway extremity or temporarily displaced from the normal position and additional threshold conspicuity is necessary.*

Characteristics

E.3.8.3 **Recommendation.—** *Runway threshold identification lights should be flashing white lights with a flash frequency between 60 and 120 per minute.*

E.3.9 Runway edge lights

Application

E.3.9.2 **Recommendation.—** *Runway edge lights should be provided on a runway intended for take-off with an operating minimum below an RVR of the order of 800 m by day.*

Location

E.3.9.5 **Recommendation.—** *Where the width of the area which could be declared as runway exceeds 60 m, the distance between the rows of lights should be determined taking into account the nature of the operations, the light distribution characteristics of the runway edge lights, and other visual aids serving the runway.*

Characteristics

E.3.9.10 Runway edge lights on a precision approach runway must be in accordance with the specifications of Appendix 2, Figure A2-9 or A2-10 *(CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights).*

E.3.10 Runway threshold and wing bar lights

(see Figure E-22)

Location of runway threshold lights

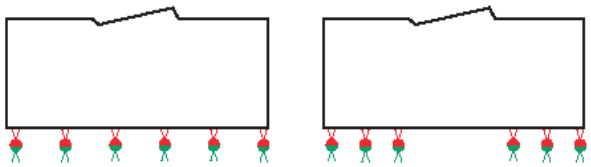
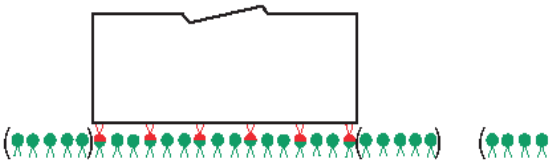
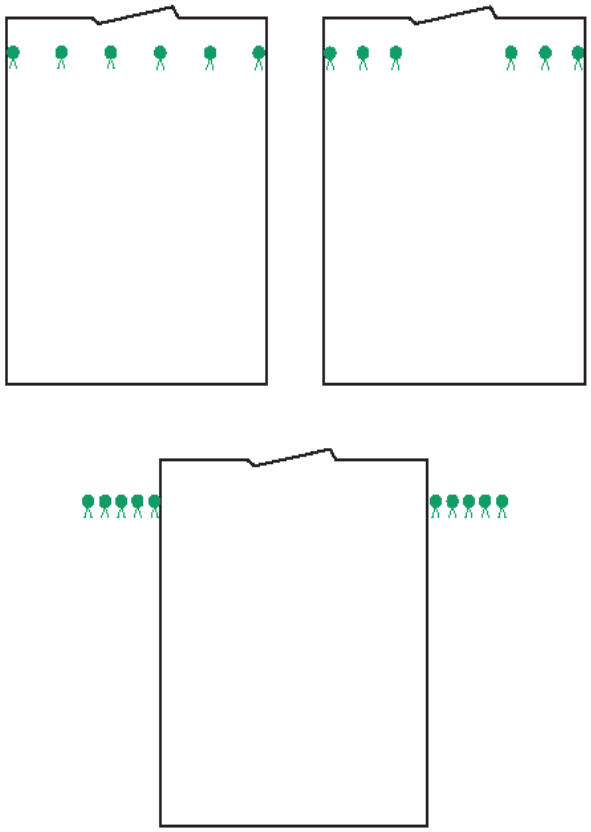
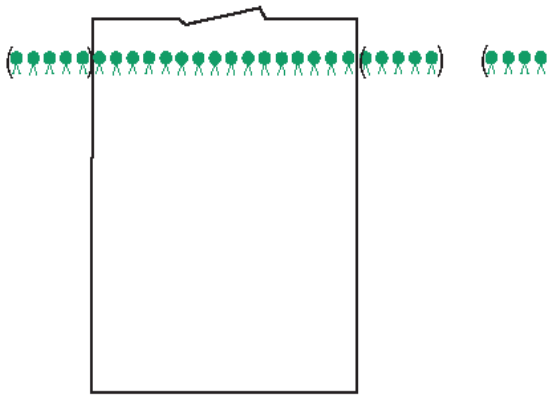
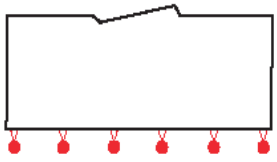
E.3.10.5 **Recommendation.—** *The lights prescribed in E.3.10.4(a) and (b) should be either:*

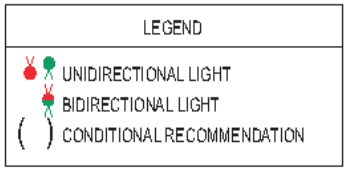
(a) *equally spaced between the rows of runway edge lights; or*

(b) *symmetrically disposed about the runway centre line in two groups, with the lights uniformly spaced in each group and with a gap between the groups equal to the gauge of the touchdown zone marking or lighting, where such is provided, or otherwise not more than half the distance between the rows of runway edge lights.*

Application of wing bar lights

E.3.10.6 **Recommendation.—** *Wing bar lights should be provided on a precision approach runway when additional conspicuity is considered desirable.*

CONDITION	LIGHTS	NON-INSTRUMENT AND NON-PRECISION APPROACH RUNWAYS	PRECISION APPROACH RUNW CATEGORY I
THRESHOLD AT RUNWAY EXTREMITY	RUNWAY THRESHOLD AND RUNWAY END LIGHTS	 [E.3.10.2, E.3.10.4(a), E.3.10.5, E.3.11.2, E.3.11.3]	 [E.3.10.2, E.3.10.4(b), E.3.10.5, E.3.10.8, E.
THRESHOLD DISPLACED FROM RUNWAY EXTREMITY	RUNWAY THRESHOLD LIGHTS	 [E.3.10.3, E.3.10.4(a), E.3.10.5, E.3.10.8]	 [E.3.10.3, E.3.10.4(b), E.3.10.5, E
	RUNWAY END LIGHTS	 [E.3.11.2, E.3.11.3]	



Note.— The minimum
for a runway 45 m wide
installed at the edge.

Characteristics of runway threshold and wing bar lights

E.3.10.10 Runway threshold lights on a precision approach runway must be in accordance with the specifications of Appendix 2, Figure A2-3 *(CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights).*

E.3.10.11 Threshold wing bar lights on a precision approach runway must be in accordance with the specifications of Appendix 2, Figure A2-4 *(CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights).*

E.3.11 Runway end lights

(see Figure E-22)

Application

E.3.11.1 ...

Note.— When the threshold is at the runway extremity, fittings serving as threshold lights may be used as runway end lights.

Location

E.3.11.3 **Recommendation.—** *Runway end lighting should consist of at least six lights. The lights should be either:*

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

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

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

Characteristics

E.3.11.5 Runway end lights on a precision approach runway must be in accordance with the specifications of Appendix 2, Figure A2-8 *(CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights).*

E.3.12 Runway centre line lights

Application

E.3.12.2 **Recommendation.—** *Runway centre line lights should be provided on a precision approach runway category I, particularly when the runway is used by aircraft with high landing speeds or where the width between the runway edge lights is greater than 50 m.*

E.3.12.4 **Recommendation.—** *Runway centre line lights should be provided on a runway intended to be used for takeoff with an operating minimum of an RVR of the order of 400 m or higher when used by aeroplanes with a very high take-off speed, particularly where the width between the runway edge lights is greater than 50 m.*

Location

E.3.12.5 ...

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

E.3.12.6 **Recommendation.—** *Centre line guidance for take-off from the beginning of a runway to a displaced threshold should be provided by:*

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

(b) runway centre line lights; or

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

Where necessary, provision should be made to extinguish those centre line lights specified in b) or reset the intensity of the approach lighting system or barrettes when the runway is being used for landing. In no case should only the single source runway centre line lights show from the beginning of the runway to a displaced threshold when the runway is being used for landing.

Characteristics

E.3.12.7 ...

Note.— Care is required in the design of the electrical system to ensure that failure of part of the electrical system will not result in a false indication of the runway distance remaining.

E.3.12.8 Runway centre line lights must be in accordance with the specifications of Appendix 2, Figure A2-6 or A2-7 *(CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights).*

E.3.13 Runway touchdown zone lights

Location

E.3.13.2 ...

Note.— To allow for operations at lower visibility minima, it may be advisable to use a 30 m longitudinal spacing between barrettes.

Characteristics

E.3.13.4 **Recommendation.—** *A barrette should be not less than 3 m nor more than 4.5 m in length.*

E.3.13.6 Touchdown zone lights must be in accordance with the specifications of Appendix 2, Figure A2-5 *(CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights).*

E.3.14 Simple touchdown zone lights

Note.— The purpose of simple touchdown zone lights is to provide pilots with enhanced situational awareness in all visibility conditions and to help enable pilots to decide whether to commence a go-around if the aircraft has not landed by a certain point on the runway. It is essential that pilots operating at aerodromes with simple touchdown zone lights be familiar with the purpose of these lights.

Application

E.3.14.1 **Recommendation.—** *Except where TDZ lights are provided in accordance with paragraph E.3.13, at an aerodrome where the approach angle is greater than 3.5 degrees and/or the Landing Distance Available combined with other factors increases the risk of an overrun, simple touchdown zone lights should be provided.*

Location

E.3.14.3 **Recommendation.—** *Where provided on a runway without TDZ markings, simple touchdown zone lights should be installed in such a position that provides the equivalent TDZ information.*

Characteristics

E.3.14.5 Simple touchdown zone lights must be in accordance with the specifications in Appendix 2, Figure A2-5.

Note.— As a good operating practice, simple touchdown zone lights are supplied with power on a separate circuit to other runway lighting so that they may be used when other lighting is switched off.

E.3.15 Rapid exit taxiway indicator lights

Note.— The purpose of rapid exit taxiway indicator lights (RETILs) is to provide pilots with distance-to-go information to the nearest rapid exit taxiway on the runway, to enhance situational awareness in low visibility conditions and enable pilots to apply braking action for more efficient roll-out and runway exit speeds. It is essential that pilots operating at aerodromes with runway(s) displaying rapid exit taxiway indicator lights be familiar with the purpose of these lights.

Application

E.3.15.1 **Recommendation.—** *Rapid exit taxiway indicator lights should be provided on a runway intended for use in runway visual range conditions less than a value of 350 m and/or where the traffic density is heavy.*

Note.— See Attachment A, Section 14 (CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights).

Characteristics

E.3.15.6 Rapid exit taxiway indicator lights must be in accordance with the specifications in Appendix 2, Figure A2-6 or Figure A2-7 *(CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights)*, as appropriate.

E.3.15.7 **Recommendation.—** *Rapid exit taxiway indicator lights should be supplied with power on a separate circuit to other runway lighting so that they may be used when other lighting is switched off.*

E.3.16 Stopway lights

5.3.17 Taxiway centre line lights

Application

E.3.17.2 **Recommendation.—** *Taxiway centre line lights should be provided on a taxiway intended for use at night in runway visual range conditions of 350 m or greater, and particularly on complex taxiway intersections and exit taxiways, except that these lights need not be provided where the traffic density is light and taxiway edge lights and centre line marking provide adequate guidance.*

Note.— Where there may be a need to delineate the edges of a taxiway, e.g. on a rapid exit taxiway, or narrow taxiway, this may be done with taxiway edge lights or markers.

E.3.17.3 **Recommendation.—** *Taxiway centre line lights should be provided on an exit taxiway, taxiway and apron in all visibility conditions where specified as components of an advanced*

surface movement guidance and control system in such a manner as to provide continuous guidance between the runway centre line and aircraft stands.

E.3.17.4 ...

Note.— See H.2.3 for provisions concerning the interlocking of runway and taxiway lighting systems.

E.3.17.5 **Recommendation.—** *Taxiway centre line lights should be provided in all visibility conditions on a runway forming part of a standard taxi-route where specified as components of an advanced surface movement guidance and control system.*

Characteristics

E.3.17.7 ...

Note 1.— Care is necessary to limit the light distribution of green lights on or near a runway so as to avoid possible confusion with threshold lights.

Note 2.— For yellow filter characteristics see Appendix 1, 2.2.

Note 3.— The size of the ILS/MLS critical/sensitive area depends on the characteristics of the associated ILS/MLS and other factors. Guidance is provided in Annex 10, Volume I, Attachments C and G.

Note 4.— See E.4.3 for specifications on runway vacated signs.

E.3.17.8 **Recommendation.—** *Where it is necessary to denote the proximity to a runway, taxiway centre line lights should be fixed lights showing alternating green and yellow from the perimeter of the ILS/MLS critical/sensitive area or the lower edge of the inner transitional surface, whichever is farthest from the runway, to the runway and continue alternating green and yellow until:*

(a) their end point near the runway centre line; or

(b) in the case of the taxiway centre line lights crossing the runway, to the opposite perimeter of the ILS/MLS critical/sensitive area or the lower edge of the inner transitional surface, whichever is farthest from the runway.

Note 1.— Care is necessary to limit the light distribution of green lights on or near a runway so as to avoid possible confusion with threshold lights.

Note 2.— The provisions of E.3.17.8 can form part of effective runway incursion prevention measures.

E.3.17.9 Taxiway centre line lights must be in accordance with the specifications of:

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

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

E.3.17.10 **Recommendation.—** *Where higher intensities are required, from an operational point of view, taxiway centre line lights on rapid exit taxiways intended for use in runway visual range conditions less than a value of 350 m should be in accordance with the specifications of Appendix 2, Figure A2-12 (CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights). The number of levels of brilliancy settings for these lights should be the same as that for the runway centre line lights.*

E.3.17.11 **Recommendation.—** *Where taxiway centre line lights are specified as components of an advanced surface movement guidance and control system and where, from an operational point of view, higher intensities are required to maintain ground movements at a certain speed in very low visibilities or in bright daytime conditions, taxiway centre line lights should be in accordance with the specifications of Appendix 2, Figure A2-17, A2-18 or A2-19 (CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights).*

Note.— High-intensity centre line lights should only be used in case of an absolute necessity and following a specific study.

Location

E.3.17.12 **Recommendation.—** *Taxiway centre line lights should normally be located on the taxiway centre line marking, except that they may be offset by not more than 30 cm where it is not practicable to locate them on the marking.*

Taxiway centre line lights on taxiways

Location

E.3.17.13 **Recommendation.—** *Taxiway centre line lights on a straight section of a taxiway should be spaced at longitudinal intervals of not more than 30 m, except that:*

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

(b) intervals less than 30 m should be provided on short straight sections; and

(c) on a taxiway intended for use in RVR conditions of less than a value of 350 m, the longitudinal spacing should not exceed 15 m.

E.3.17.14 **Recommendation.—** *Taxiway centre line lights on a taxiway curve should continue from the straight portion of the taxiway at a constant distance from the outside edge of the taxiway curve. The lights should be spaced at intervals such that a clear indication of the curve is provided.*

E.3.17.15 **Recommendation.—** *On a taxiway intended for use in RVR conditions of less than a value of 350 m, the lights on a curve should not exceed a spacing of 15 m, and on a curve of less than 400 m radius the lights should be spaced at intervals of not greater than 7.5 m. This spacing should extend for 60 m before and after the curve.*

Note 1.— Spacings on curves that have been found suitable for a taxiway intended for use in RVR conditions of 350 m or greater are:

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

Note 2.— See C.9.5 and Figure C-2.

Taxiway centre line lights on rapid exit taxiways

Location

E.3.17.16 **Recommendation.—** *Taxiway centre line lights on a rapid exit taxiway should commence at a point at least 60 m before the beginning of the taxiway centre line curve and continue beyond the end of the curve to a point on the centre line of the taxiway where an aeroplane can be expected to reach normal taxiing speed. The lights on that portion parallel to the runway centre line should always be at least 60 cm from any row of runway centre line lights, as shown in Figure E-27.*

E.3.17.17 **Recommendation.—** *The lights should be spaced at longitudinal intervals of not more than 15 m, except that, where runway centre line lights are not provided, a greater interval not exceeding 30 m may be used.*

Taxiway centre line lights on other exit taxiways

Location

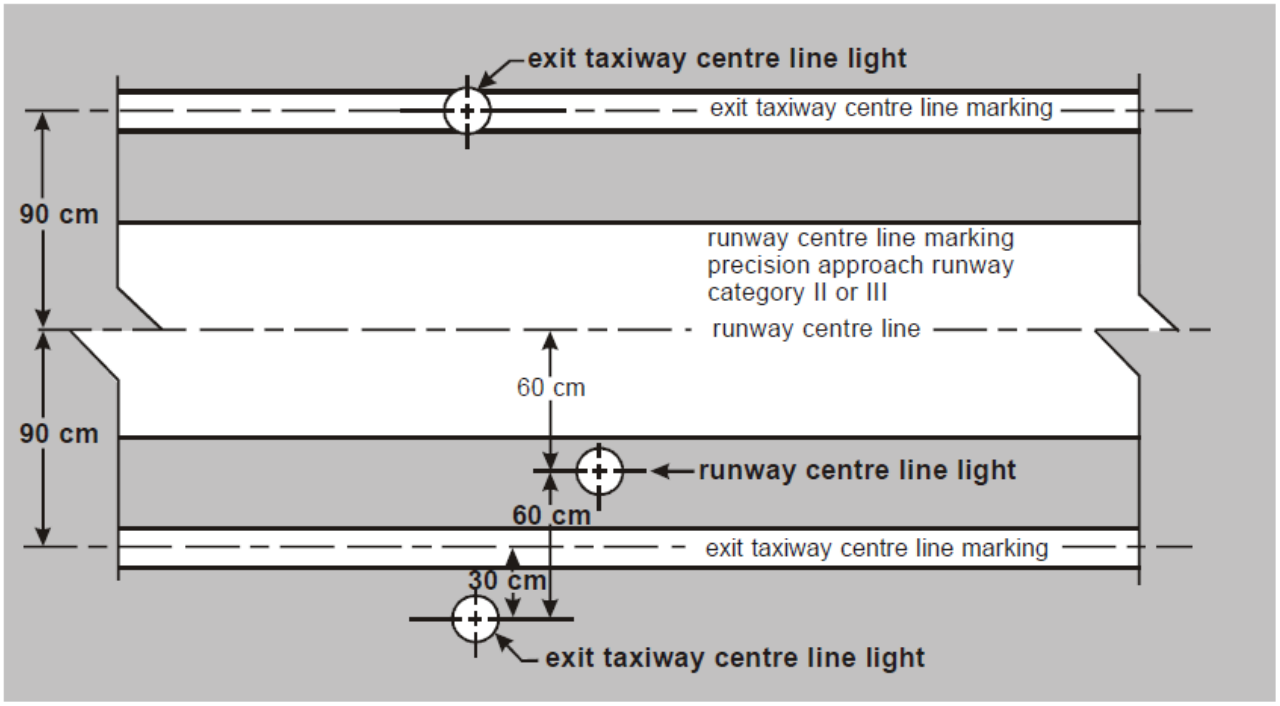
E.3.17.18 **Recommendation.—** *Taxiway centre line lights on exit taxiways other than rapid exit taxiways should commence at the point where the taxiway centre line marking begins to curve from the runway centre line, and follow the curved taxiway centre line marking at least to the point where the marking leaves the runway. The first light should be at least 60 cm from any row of runway centre line lights, as shown in Figure E-27.*

E.3.17.19 **Recommendation.—** *The lights should be spaced at longitudinal intervals of not more than 7.5 m.*

Taxiway centre line lights on runways

Location

E.3.17.20 **Recommendation.—** *Taxiway centre line lights on a runway forming part of a standard taxi-route and intended for taxiing in runway visual range conditions less than a value of 350 m should be spaced at longitudinal intervals not exceeding 15 m.*



Tolerances for offset runway centre line lights and
taxiway centre line lights to maintain 60 cm separation.

Figure E-27. Offset runway and taxiway centre line lights

E.3.18 Taxiway edge lights

Application

E.3.18.1 ...

Note.— See E.5.5 for taxiway edge markers.

E.3.18.2 ...

Note.— See H.2.3 for provisions concerning the interlocking of runway and taxiway lighting systems.

Location

E.3.18.3 **Recommendation.—** *Taxiway edge lights on a straight section of a taxiway and on a runway forming part of a standard taxi-route should be spaced at uniform longitudinal intervals of not more than 60 m. The lights on a curve should be spaced at intervals less than 60 m so that a clear indication of the curve is provided.*

Note.— Guidance on the spacing of taxiway edge lights on curves is given in the CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights.

E.3.18.4 **Recommendation.—** *Taxiway edge lights on a holding bay, apron, etc., should be spaced at uniform longitudinal intervals of not more than 60 m.*

E.3.18.5 **Recommendation.—** *Taxiway edge lights on a runway turn pad should be spaced at uniform longitudinal intervals of not more than 30 m.*

E.3.18.6 **Recommendation.—** *The lights should be located as near as practicable to the edges of the taxiway, runway turn pad, holding bay, apron or runway, etc., or outside the edges at a distance of not more than 3 m.*

E.3.19 Runway turn pad lights

Application

E.3.19.2 **Recommendation.—** *Runway turn pad lights should be provided on a runway turn pad intended for use at night.*

Location

E.3.19.3 **Recommendation.—** *Runway turn pad lights should normally be located on the runway turn pad marking, except that they may be offset by not more than 30 cm where it is not practicable to locate them on the marking.*

E.3.19.4 **Recommendation.—** *Runway turn pad lights on a straight section of the runway turn pad marking should be spaced at longitudinal intervals of not more than 15 m.*

E.3.19.5 **Recommendation.—** *Runway turn pad lights on a curved section of the runway turn pad marking should not exceed a spacing of 7.5 m.*

Characteristics

E.3.19.6 Runway turn pad lights must be unidirectional fixed lights showing green with beam dimensions such that the light is visible only from aeroplanes on or approaching the runway turn pad.

E.3.19.7 Runway turn pad lights must be in accordance with the specifications of Appendix 2, Figure A2-13, A2-14 or A2-15, as appropriate.

E.3.20 Stop bars

Application

Note 1.— A stop bar is intended to be controlled either manually or automatically by air traffic services.

Note 2.— Runway incursions may take place in all visibility or weather conditions. The provision of stop bars at runwayholding positions and their use at night and in visibility conditions greater than 550 m runway visual range can form part of effective runway incursion prevention measures.

E.3.20.1 A stop bar must be provided at every runway-holding position serving a runway when it is intended that the runway will be used in runway visual range conditions less than a value of 350 m, except where:

E.3.20.3 **Recommendation.—** *A stop bar should be provided at an intermediate holding position when it is desired to supplement markings with lights and to provide traffic control by visual means.*

Location

E.3.20.4 Stop bars must be located across the taxiway at the point where it is desired that traffic stop. Where the additional lights specified in E.3.20.6 are provided, these lights must be located not less than 3 m from the taxiway edge.

Characteristics

E.3.20.5 ...

Note.— Where necessary to enhance conspicuity of an existing stop bar, extra lights are installed uniformly.

E.3.20.6 **Recommendation.—** *A pair of elevated lights should be added to each end of the stop bar where the inpavement stop bar lights might be obscured from a pilot's view, for example, by rain, or where a pilot may be required to stop the aircraft in a position so close to the lights that they are blocked from view by the structure of the aircraft.*

E.3.20.9 The intensity in red light and beam spreads of stop bar lights must be in accordance with the specifications in Appendix 2, Figures A2-12 through A2-16 (*CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights*), as appropriate.

E.3.20.10 **Recommendation.—** *Where stop bars are specified as components of an advanced surface movement guidance and control system and where, from an operational point of view, higher intensities are required to maintain ground movements at a certain speed in very low visibilities or in bright daytime conditions, the intensity in red light and beam spreads of stop bar lights should be in accordance with the specifications of Appendix 2, Figure A2-17, A2-18 or A2-19 (CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights).*

Note.— High-intensity stop bars should only be used in case of an absolute necessity and following a specific study.

E.3.20.11 **Recommendation.—** *Where a wide beam fixture is required, the intensity in red light and beam spreads of stop bar lights should be in accordance with the specifications of Appendix 2, Figure A2-17 or A2-19 (CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights).*

E.3.20.12 ...

Note.— Care is required in the design of the electrical system to ensure that all of the lights of a stop bar will not fail at the same time. Guidance on this issue is given in the CASA Advisory Circular AC139-8 Electrical Systems.

E.3.21 Intermediate holding position lights

Note.— See E.2.11 for specifications on intermediate holding position marking.

Application

E.3.21.2 **Recommendation.—** *Intermediate holding position lights should be provided at an intermediate holding position where there is no need for stop-and-go signals as provided by a stop bar.*

E.3.23 Runway guard lights

Note.— Runway incursions may take place in all visibility or weather conditions. The use of runway guard lights at runway-holding positions can form part of effective runway incursion prevention measures. Runway guard lights warn pilots and drivers of vehicles, when operating on taxiways, that they are about to enter a runway. There are two standard configurations of runway guard lights as illustrated in Figure E-29.

Application

E.3.23.1 ...

Note 1.— Runway guard lights, Configuration B, may supplement runway guard lights, Configuration A, when deemed necessary.

Note 2.— Guidance on the design, operation and location of runway guard lights, Configuration B, is given in the CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights.

E.3.23.2 **Recommendation.—** *As part of runway incursion prevention measures, runway guard lights, Configuration A or B, should be provided at each taxiway/runway intersection where runway incursion hot spots have been identified, and used under all weather conditions during day and night.*

E.3.23.3 **Recommendation.—** *Configuration B runway guard lights should not be collocated with a stop bar.*

Characteristics

E.3.23.8 **Recommendation.—** *Where there is a need to enhance the contrast between the on and off state of runway guard lights, Configuration A, intended for use during the day, a visor of sufficient size to prevent sunlight from entering the lens without interfering with the function of the fixture should be located above each lamp.*

Note.— Some other device or design, e.g. specially designed optics, may be used in lieu of the visor.

E.3.23.10 ...

Note.— For guidance on orientation and aiming of runway guard lights, see the CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights.

E.3.23.11 **Recommendation.—** *The intensity in yellow light and beam spreads of lights of Configuration A should be in accordance with the specifications in Appendix 2, Figure A2-24 (CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights).*

E.3.23.12 **Recommendation.—** *Where runway guard lights are intended for use during the day, the intensity in yellow light and beam spreads of lights of Configuration A should be in accordance with the specifications in Appendix 2, Figure A2-25 (CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights).*

E.3.23.13 **Recommendation.—** *Where runway guard lights are specified as components of an advanced surface movement guidance and control system where higher light intensities are required, the intensity in yellow light and beam spreads of lights of Configuration A should be in accordance with the specifications in Appendix 2, Figure A2-25 (CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights).*

Note.— Higher light intensities may be required to maintain ground movement at a certain speed in low visibilities.

E.3.23.14 **Recommendation.—** *The intensity in yellow light and beam spreads of lights of Configuration B should be in accordance with the specifications in Appendix 2, Figure A2-12 (CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights).*

E.3.23.15 **Recommendation.—** *Where runway guard lights are intended for use during the day, the intensity in yellow light and beam spreads of lights of Configuration B should be in accordance with the specifications in Appendix 2, Figure A2-20 (CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights).*

E.3.23.16 **Recommendation.—** *Where runway guard lights are specified as components of an advanced surface movement guidance and control system where higher light intensities are required, the intensity in yellow light and beam spreads of lights of Configuration B should be in accordance with the specifications in Appendix 2, Figure A2-20 (CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights).*

E.3.23.19 ...

Note.— The optimum flash rate is dependent on the rise and fall times of the lamps used. Runway guard lights, Configuration A, installed on 6.6 ampere series circuits have been found to look best when operated at 45 to 50 flashes per minute per lamp. Runway guard lights, Configuration B, installed on 6.6 ampere series circuits have been found to look best when operated at 30 to 32 flashes per minute per lamp.

E.3.24 Apron floodlighting

(see also E.3.17.1 and E.3.18.1)

Application

E.3.24.1 **Recommendation.—** *Apron floodlighting should be provided on an apron and on a designated isolated aircraft parking position intended to be used at night.*

Note 1.— The designation of an isolated aircraft parking position is specified in 3.14.

Note 2.— Guidance on apron floodlighting is given in the CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights.

Location

E.3.24.2 **Recommendation.—** *Apron floodlights should be located so as to provide adequate illumination on all apron service areas, with a minimum of glare to pilots of aircraft in flight and on the ground, aerodrome and apron controllers, and personnel on the apron. The arrangement and aiming of floodlights should be such that an aircraft stand receives light from two or more directions to minimize shadows.*

Characteristics

E.3.24.4 **Recommendation.—** *The average illuminance should be at least the following:*

(nnnnn) *Aircraft stand:*

(ooooo) *horizontal illuminance — 20 lux with a uniformity ratio (average to minimum) of not more than 4 to 1; and*

(ppppp) *vertical illuminance — 20 lux at a height of 2 m above the apron in relevant directions.*

(qqqqq) *Other apron areas:*

(rrrrr) *horizontal illuminance — 50 per cent of the average illuminance on the aircraft stands with a uniformity ratio (average to minimum) of not more than 4 to 1.*

E.3.25 Visual docking guidance system

Application

E.3.25.1 ...

Note.— The factors to be considered in evaluating the need for a visual docking guidance system are in particular: the number and type(s) of aircraft using the aircraft stand, weather conditions, space available on the apron and the precision required for manoeuvring into the parking position due to aircraft servicing installation, passenger loading bridges, etc. See the CASA Advisory Circular AC139-5 Series (Visual Aids for navigation) — Visual Aids *for guidance on the selection of suitable systems.*

Characteristics

E.3.25.3 ...

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.

E.3.25.7 **Recommendation.—** *The system should be usable by all types of aircraft for which the aircraft stand is intended, preferably without selective operation.*

Azimuth guidance unit

Location

E.3.25.10 **Recommendation.—** *The azimuth guidance unit should be aligned for use by the pilots occupying both the left and right seats.*

Stopping position indicator

Location

E.3.25.15 **Recommendation.—** *The stopping position indicator should be usable by the pilots occupying both the left and right seats.*

Characteristics

E.3.25.18 **Recommendation.—** *The stopping position indicator should provide closing rate information over a distance of at least 10 m.*

E.3.26 Advanced visual docking guidance system

Application

Note 1.— Advanced visual docking guidance systems (A-VDGS) include those systems that, in addition to basic and passive azimuth and stop position information, provide pilots with active (usually sensor-based) guidance information, such as aircraft type indication (in accordance with Doc 8643 — Aircraft Type Designators*), distance-to-go information and closing speed. Docking guidance information is usually provided on a single display unit.*

Note 2.— An A-VDGS may provide docking guidance information in three stages: the acquisition of the aircraft by the system, the azimuth alignment of the aircraft, and the stopping position information.

E.3.26.1 **Recommendation.—** *An A-VDGS should be provided where it is operationally desirable to confirm the correct aircraft type for which guidance is being provided and/or to indicate the stand centre line in use, where more than one is provided for.*

E.3.26.3 ...

Note 1.— The use of the A-VDGS in conditions such as weather, visibility and background lighting, both by day and night, would need to be specified.

Note 2.— Care is required in both the design and on-site installation of the system to ensure that glare, reflection of sunlight, or other light in the vicinity, does not degrade the clarity and conspicuity of the visual cues provided by the system.

Location

E.3.26.5 ...

Note.— Usually the pilot-in-command is responsible for the docking of the aircraft. However, in some circumstances, another person could be responsible and this person may be the driver of a vehicle that is towing the aircraft.

Characteristics

E.3.26.7 ...

Note.— See the CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights, for an indication of the maximum aircraft speeds relative to distance to the stopping position.

E.3.26.9 **Recommendation.—** *The information on displacement of the aircraft relative to the stand centre line and distance to the stopping position, when displayed, should be provided with the accuracy specified in Table E-4.*

E.3.26.10 ...

Note.— The use of colour would need to be appropriate and need to follow signal convention, i.e. red, yellow and green mean hazard, caution and normal/correct conditions, respectively. The effects of colour contrasts would also need to be considered.

E.3.26.11 ...

Note.— The indication of the distance of the aircraft from the stop position may be colour-coded and presented at a rate and distance proportional to the actual closure rate and distance of the aircraft approaching the stop point.

E.3.26.13 **Recommendation.—** *Where provided, closure distance displayed in numerals should be provided in metre integers to the stop position and displayed to 1 decimal place at least 3 m prior to the stop position.*

E.3.26.16 **Recommendation.—** *The word "stop" in red characters should be displayed when an immediate cessation of the docking manoeuvre is required.*

E.3.27 Aircraft stand manoeuvring guidance lights

Application

E.3.27.1 **Recommendation.—** *Aircraft stand manoeuvring guidance lights should be provided to facilitate the positioning of an aircraft on an aircraft stand on a paved apron intended for use in poor visibility conditions, unless adequate guidance is provided by other means.*

Location

Characteristics

E.3.27.4 **Recommendation.—** *The lights used to delineate lead-in, turning and lead-out lines should be spaced at intervals of not more than 7.5 m on curves and 15 m on straight sections.*

E.3.27.6 **Recommendation.—** *The intensity of the lights should be adequate for the condition of visibility and ambient light in which the use of the aircraft stand is intended.*

E.3.27.7 **Recommendation.—** *The lighting circuit should be designed so that the lights may be switched on to indicate that an aircraft stand is to be used and switched off to indicate that it is not to be used.*

E.3.28 Road-holding position light

Application

E.3.28.2 **Recommendation.—** *A road-holding position light should be provided at each road-holding position serving a runway when it is intended that the runway will be used in runway visual range conditions of values between 350 m and 550 m.*

Location

E.3.28.3 ...

Note.— See I.9 for the mass and height limitations and frangibility requirements of navigation aids located on runway strips.

Characteristics

E.3.28.4 ...

Note.— It is intended that the lights specified in sub-paragraph a) be controlled by the air traffic services.

E.3.28.6 ...

Note.— The commonly used traffic lights are likely to meet the requirements in E.3.28.5 and E.3.28.6.

E.3.29 No-entry bar

Note.— Runway incursions may take place in all visibility or weather conditions. The use of no-entry bars can form part of effective runway incursion prevention measures.

Application

E.3.29.1 **Recommendation.—** *A no-entry bar should be provided across a taxiway which is intended to be used as an exit only taxiway to assist in preventing inadvertent access of traffic to that taxiway.*

Location

E.3.29.2 **Recommendation.—** *A no-entry bar should be located across the taxiway at the end of an exit only taxiway where it is desired to prevent traffic from entering the taxiway in the wrong direction.*

E.3.29.3 **Recommendation.—** *A no-entry bar should be collocated with a no-entry sign and/or a no-entry marking.*

Characteristics

E.3.29.4 **Recommendation.—** *A no-entry bar should consist of unidirectional lights spaced at uniform intervals of no more than 3 m showing red in the intended direction(s) of approach to the runway.*

Note.— Where necessary to enhance conspicuity, extra lights are installed uniformly.

E.3.29.5 **Recommendation.—** *A pair of elevated lights should be added to each end of the no-entry bar where the inpavement no entry bar lights might be obscured from a pilot's view, for example, by rain, or where a pilot may be required to stop the aircraft in a position so close to the lights that they are blocked from view by the structure of the aircraft.*

E.3.29.6 The intensity in red light and beam spreads of no-entry bar lights must be in accordance with the specifications in Appendix 2, Figures A2-12 through A2-16 (*CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights*), as appropriate.

E.3.29.7 **Recommendation.—** *Where no-entry bars are specified as components of an advanced surface movement guidance and control system and where, from an operational point of view, higher intensities are required to maintain ground movements at a certain speed in very low visibilities or in bright daytime conditions, the intensity in red light and beam spreads of no-entry bar lights should be in accordance with the specifications of Appendix 2, Figure A2-17, A2-18 or A2-19 (CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights).*

Note.— High-intensity no-entry bars are typically used only in case of an absolute necessity and following a specific study.

E.3.29.8 **Recommendation.—** *Where a wide beam fixture is required, the intensity in red light and beam spreads of no-entry bar lights should be in accordance with the specifications of Appendix 2, Figure A2-17 or A2-19 (CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights).*

E.3.30 Runway status lights

Introductory Note.— Runway status lights (RWSL) is a type of autonomous runway incursion warning system (ARIWS). The two basic visual components of RWSL are runway entrance lights (RELs) and take-off hold lights (THLs). Either component may be installed by itself, but the two components are designed to be complementary to each other.

Location

E.3.30.1 ...

Note.— Where two or more runway-holding positions are provided, the runway-holding position referred is that closest to the runway.

E.3.30.3 ...

Note.— Additional THLs may be similarly provided at the starting point of the take-off roll.

Characteristics

E.3.30.6 Intensity and beam spread of RELs must be in accordance with the specifications of Appendix 2, Figures A2-12 and A2-14 (*CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights*).

Note.— Consideration for reduced beam width may be required for some REL lights at acute angled runway/taxiway intersections to ensure the RELs are not visible to aircraft on the runway.

E.3.30.9 Intensity and beam spread of THLs must be in accordance with the specifications of Appendix 2, Figure A2-26 (*CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights*).

E.3.30.10 **Recommendation**.— *RELs and THLs should be automated to the extent that the only control over each system will be to disable one or both systems.*

E.4 Signs

E.4.1 General

Note.— Signs must be either fixed message signs or variable message signs. Guidance on signs is contained in the CASA Advisory Circular AC139-5.4 Visual Aids for navigation – Signs.

Application

E.4.1.1 ...

Note.— See E.2.17 for specifications on information marking.

E.4.1.2 **Recommendation.—** *A variable message sign should be provided where:*

(a) the instruction or information displayed on the sign is relevant only during a certain period of time; and/or

(b) there is a need for variable predetermined information to be displayed on the sign to meet the requirements of I.8.1.

Characteristics

E.4.1.6 The inscriptions on a sign must be in accordance with the provisions of *CASA Advisory Circular AC139-5.4 Visual Aids for navigation – Signs*.

E.4.1.11 **Recommendation.—** *The time interval to change from one message to another on a variable message sign should be as short as practicable and should not exceed 5 seconds.*

E.4.2 Mandatory instruction signs

Note.— See Figure E-30 for pictorial representation of mandatory instruction signs and Figure E-32 for examples of locating signs at taxiway/runway intersections.

Application

E.4.2.2 ...

Note.— See E.4.7 for specifications on road-holding position signs.

E.4.2.5 ...

Note.— See E.2.10 for specifications on runway-holding position marking.

E.4.2.6 **Recommendation.—** *A runway designation sign at a taxiway/runway intersection should be supplemented with a location sign in the outboard (farthest from the taxiway) position, as appropriate.*

Note.— See E.4.3 for characteristics of location signs.

Characteristics

E.4.2.13 **Recommendation.—** *Where, owing to environmental or other factors, the conspicuity of the inscription on a mandatory instruction sign needs to be enhanced, the outside edge of the white inscription should be supplemented by a black outline measuring 10 mm in width for runway code numbers 1 and 2, and 20 mm in width for runway code numbers 3 and 4.*

E.4.3 Information signs

Note.— See Figure E-31 for pictorial representations of information signs.

Application

E.4.3.4 ...

Note.— See E.3.17 for specifications on colour coding taxiway centre line lights.

E.4.3.5 **Recommendation.—** *An intersection take-off sign should be provided when there is an operational need to indicate the remaining take-off run available (TORA) for intersection take-offs.*

E.4.3.6 **Recommendation.—** *Where necessary, a destination sign should be provided to indicate the direction to a specific destination on the aerodrome, such as cargo area, general aviation, etc.*

E.4.3.9 **Recommendation.—** *A location sign should be provided at an intermediate holding position.*

E.4.3.12 **Recommendation.—** *Where necessary, a location sign should be provided to identify taxiways exiting an apron or taxiways beyond an intersection.*

E.4.3.13 **Recommendation.—** *Where a taxiway ends at an intersection such as a ‘‘T’’ and it is necessary to identify this, a barricade, direction sign and/or other appropriate visual aid should be used.*

Location

E.4.3.15 ...

Note.— A location sign installed beyond a taxiway intersection may be installed on either side of a taxiway.

E.4.3.22 **Recommendation.—** *A destination sign should not normally be collocated with a location or direction sign.*

E.4.3.24 **Recommendation.—** *A direction sign, barricade and/or other appropriate visual aid used to identify a ''T'' intersection should be located on the opposite side of the intersection facing the taxiway.*

Characteristics

E.4.3.33 **Recommendation.—** *Where it is necessary to identify each of a series of intermediate holding positions on the same taxiway, the location sign should consist of the taxiway designation and a number.*

E.4.3.36 **Recommendation.—** *When designating taxiways, the use of words such as "inner" and "outer" should be avoided wherever possible.*

E.4.3.39 **Recommendation.—** *Apron stand designators should not be the same as taxiway designators.*

E.4.4 VOR aerodrome checkpoint sign

Application

E.4.4.1 ...

Note.— See E.2.12 for VOR aerodrome checkpoint marking.

Characteristics

E.4.4.4 **Recommendation.—** *The inscriptions on a VOR checkpoint sign should be in accordance with one of the alternatives shown in Figure E-33 in which:*

(sssss) *VOR* *is an abbreviation identifying this as a VOR checkpoint;*

(ttttt) *116.3* *is an example of the radio frequency of the VOR concerned;*

(uuuuu) *147°* *is an example of the VOR bearing, to the nearest degree, which should be indicated at the VOR checkpoint; and*

(vvvvv) *4.3 NM is an example of the distance in nautical miles to a DME collocated with the VOR concerned.*

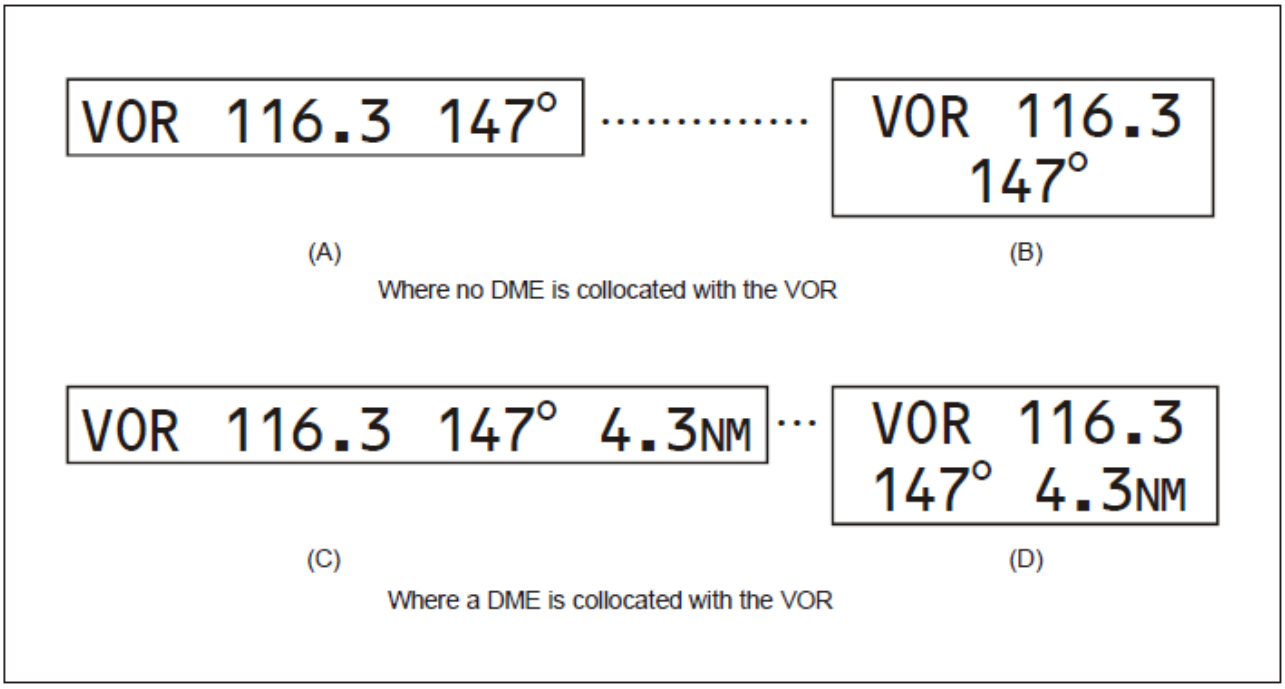


Figure E-33. VOR aerodrome checkpoint sign

Note.— Tolerances for the bearing value shown on the sign are given in Annex 10, Volume I, Attachment E. It will be noted that a checkpoint can only be used operationally when periodic checks show it to be consistently within ±2 degrees of the stated bearing.

E.4.5 Aerodrome identification sign

Application

E.4.5.1 **Recommendation.—** *An aerodrome identification sign should be provided at an aerodrome where there is insufficient alternative means of visual identification.*

Location

E.4.5.2 **Recommendation.—** *The aerodrome identification sign should be placed on the aerodrome so as to be legible, in so far as is practicable, at all angles above the horizontal.*

Characteristics

E.4.5.4 **Recommendation.—** *The colour selected for the sign should give adequate conspicuity when viewed against its background.*

E.4.5.5 **Recommendation.—** *The characters should have a height of not less than 3 m.*

E.4.6 Aircraft stand identification signs

Application

E.4.6.1 **Recommendation.—** *An aircraft stand identification marking should be supplemented with an aircraft stand identification sign where feasible.*

Location

E.4.6.2 **Recommendation.—** *An aircraft stand identification sign should be located so as to be clearly visible from the cockpit of an aircraft prior to entering the aircraft stand.*

Characteristics

E.4.6.3 **Recommendation.—** *An aircraft stand identification sign should consist of an inscription in black on a yellow background.*

E.4.7 Road-holding position sign

Characteristics

E.4.7.4 ...

Note.— Examples of road-holding position signs are contained in the CASA Advisory Circular AC139-5.4 Visual Aids for navigation – Signs.

E.5 Markers

E.5.1 General

...

Note 1.— Anchors or chains, to prevent markers which have broken from their mounting from blowing away, are sometimes used.

Note 2.— Guidance on frangibility of markers is given in the CASA Advisory Circular AC139-9.7 Operational Services – Siting of Installations and Frangibility.

E.5.2 Unpaved runway edge markers

Application

E.5.2.1 **Recommendation.—** *Markers should be provided when the extent of an unpaved runway is not clearly indicated by the appearance of its surface compared with that of the surrounding ground.*

Location

E.5.2.2 **Recommendation.—** *Where runway lights are provided, the markers should be incorporated in the light fixtures. Where there are no lights, markers of flat rectangular or conical shape should be placed so as to delimit the runway clearly.*

Characteristics

E.5.2.3 **Recommendation.—** *The flat rectangular markers should have a minimum size of 1 m by 3 m and should be placed with their long dimension parallel to the runway centre line. The conical markers should have a height not exceeding 50 cm.*

E.5.3 Stopway edge markers

Application

E.5.3.1 **Recommendation.—** *Stopway edge markers should be provided when the extent of a stopway is not clearly indicated by its appearance compared with that of the surrounding ground.*

Characteristics

E.5.3.2 ...

Note.— Markers consisting of small vertical boards camouflaged on the reverse side, as viewed from the runway, have proved operationally acceptable.

E.5.5 Taxiway edge markers

Application

E.5.5.1 **Recommendation.—** *Taxiway edge markers should be provided on a taxiway where the code number is 1 or 2 and taxiway centre line or edge lights or taxiway centre line markers are not provided.*

Location

E.5.5.2 **Recommendation.—** *Taxiway edge markers should be installed at least at the same locations as would the taxiway edge lights had they been used.*

Characteristics

E.5.5.4 **Recommendation.—** *The marked surface as viewed by the pilot should be a rectangle and should have a minimum viewing area of 150 cm^2.*

E.5.6 Taxiway centre line markers

E.5.6.1 **Recommendation.—** *Taxiway centre line markers should be provided on a taxiway where the code number is 1 or 2 and taxiway centre line or edge lights or taxiway edge markers are not provided.*

E.5.6.2 **Recommendation.—** *Taxiway centre line markers should be provided on a taxiway where the code number is 3 or 4 and taxiway centre line lights are not provided if there is a need to improve the guidance provided by the taxiway centre line marking.*

Location

E.5.6.3 **Recommendation.—** *Taxiway centre line markers should be installed at least at the same location as would taxiway centre line lights had they been used.*

Note.— See E.3.17.12 for the spacing of taxiway centre line lights.

E.5.6.4 **Recommendation.—** *Taxiway centre line markers should normally be located on the taxiway centre line marking except that they may be offset by not more than 30 cm where it is not practicable to locate them on the marking.*

Characteristics

E.5.6.6 **Recommendation.—** *The marked surface as viewed by the pilot should be a rectangle and should have a minimum viewing area of 20 cm^2.*

E.5.7 Unpaved taxiway edge markers

Application

E.5.7.1 **Recommendation.—** *Where the extent of an unpaved taxiway is not clearly indicated by its appearance compared with that of the surrounding ground, markers should be provided.*

Location

E.5.7.2 **Recommendation.—** *Where taxiway lights are provided, the markers should be incorporated in the light fixtures. Where there are no lights, markers of conical shape should be placed so as to delimit the taxiway clearly.*

E.5.8 Boundary markers

Location

Characteristics

E.5.8.3 **Recommendation.—** *Boundary markers should be of a form similar to that shown in Figure E-34, or in the form of a cone not less than 50 cm high and not less than 75 cm in diameter at the base. The markers should be coloured to contrast with the background against which they will be seen. A single colour, orange or red, or two contrasting colours, orange and white or alternatively red and white, should be used, except where such colours merge with the background.*

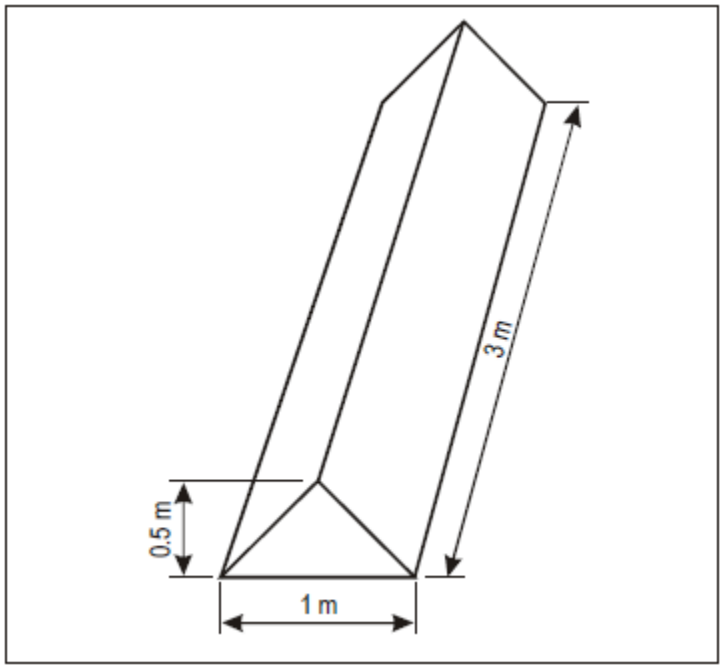


Figure E-34. Boundary markers

APPENDIX F. VISUAL AIDS FOR DENOTING OBSTACLES

F.1 Objects to be marked and/or lighted

Note 1.— The marking and/or lighting of obstacles is intended to reduce hazards to aircraft by indicating the presence of the obstacles. It does not necessarily reduce operating limitations which may be imposed by an obstacle.

Note 2.— An autonomous aircraft detection system may be installed on or near an obstacle (or group of obstacles such as wind farms), designed to operate the lighting only when the system detects an aircraft approaching the obstacle, in order to reduce light exposure to local residents. Guidance on the design and installation of an autonomous aircraft detection system is available in the CASA Advisory Circular AC139-6 Visual Aids for Denoting Obstacles. The availability of such guidance is not intended to imply that such a system has to be provided.

F.1.1 Objects within the lateral boundaries of the obstacle limitation surfaces

F.1.1.4 **Recommendation.—** *A fixed obstacle that extends above a take-off climb surface within 3 000 m of the inner edge of the take-off climb surface should be marked and, if the runway is used at night, lighted, except that:*

(a) such marking and lighting may be omitted when the obstacle is shielded by another fixed obstacle;

(b) the marking may be omitted when the obstacle is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m;

(c) the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day; and

(d) the lighting may be omitted where the obstacle is a lighthouse and an aeronautical study indicates the lighthouse light to be sufficient.

F.1.1.5 **Recommendation.—** *A fixed object, other than an obstacle, adjacent to a take-off climb surface should be marked and, if the runway is used at night, lighted, if such marking and lighting is considered necessary to ensure its avoidance, except that the marking may be omitted when:*

(a) the object is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m; or

(b) the object is lighted by high-intensity obstacle lights by day.

F.1.1.7 **Recommendation.—** *A fixed obstacle that extends above a horizontal surface should be marked and, if the aerodrome is used at night, lighted, except that:*

(a) such marking and lighting may be omitted when:

(1) *the obstacle is shielded by another fixed obstacle; or*

(2) *for a circuit extensively obstructed by immovable objects or terrain, procedures have been established to ensure safe vertical clearance below prescribed flight paths; or*

(3) *an aeronautical study shows the obstacle not to be of operational significance;*

(b) *the marking may be omitted when the obstacle is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m;*

(c) *the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day; and*

(d) *the lighting may be omitted where the obstacle is a lighthouse and an aeronautical study indicates the lighthouse light to be sufficient.*

F.1.1.8 ...

Note.— See 5.3.5 for information on the obstacle protection surface.

F.1.1.9 **Recommendation.—** *Other objects inside the obstacle limitation surfaces should be marked and/or lighted if an aeronautical study indicates that the object could constitute a hazard to aircraft (this includes objects adjacent to visual routes e.g. waterway or highway).*

Note.— See note accompanying D.4.2.

F.1.1.10 **Recommendation.—** *Overhead wires, cables, etc., crossing a river, waterway, valley or highway should be marked and their supporting towers marked and lighted if an aeronautical study indicates that the wires or cables could constitute a hazard to aircraft.*

F.1.2 Objects outside the lateral boundaries of the obstacle limitation surfaces

F.1.2.1 **Recommendation.—** *Obstacles in accordance with D.3.2 should be marked and lighted, except that the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day.*

F.1.2.2 **Recommendation.—** *Other objects outside the obstacle limitation surfaces should be marked and/or lighted if an aeronautical study indicates that the object could constitute a hazard to aircraft (this includes objects adjacent to visual routes e.g. waterway, highway).*

F.1.2.3 **Recommendation.—** *Overhead wires, cables, etc., crossing a river, waterway, valley or highway should be marked and their supporting towers marked and lighted if an aeronautical study indicates that the wires or cables could constitute a hazard to aircraft.*

F.2 Marking and/or lighting of objects

F.2.2 Mobile objects

Marking by colour

F.2.2.2 **Recommendation.—** *When mobile objects are marked by colour, a single conspicuous colour, preferably red or yellowish green for emergency vehicles and yellow for service vehicles, should be used.*

Marking by flags

F.2.2.4 ...

Note.— This table does not include recommended horizontal beam spreads. F.2.1.3 requires 360° coverage around an obstacle. Therefore, the number of lights needed to meet this requirement will depend on the horizontal beam spreads of each light as well as the shape of the obstacle. Thus, with narrower beam spreads, more lights will be required.

(a) 360° horizontal. For flashing lights, the intensity is read into effective intensity, as determined in accordance with the *CASA Advisory Circular AC139-6 Visual Aids for Denoting Obstacles*.

(b) Between 2 and 10° vertical. Elevation vertical angles are referenced to the horizontal when the light is levelled.

(c) Between 2 and 20° vertical. Elevation vertical angles are referenced to the horizontal when the light is levelled.

(d) Peak intensity should be located at approximately 2.5° vertical.

(e) Peak intensity should be located at approximately 17° vertical.

(f) Beam spread is defined as the angle between the horizontal plane and the directions for which the intensity exceeds that mentioned in the "intensity" column.

Table F-3. Light distribution for medium- and high-intensity obstacle lights according to benchmark intensities of Table F-1

Benchmark intensity	Minimum requirements					Recommendations				
	Vertical elevation angle (b)			Vertical beam spread (c)		Vertical elevation angle (b)			Vertical beam spread (c)	
	0°		-1°			0°	-1°	-10°		
	Minimum average intensity (a)	Minimum intensity (a)	Minimum intensity (a)	Minimum beam spread	Intensity (a)	Maximum intensity (a)	Maximum intensity (a)	Maximum intensity (a)	Maximum beam spread	Intensity (a)
200 000	200 000	150 000	75 000	3°	75 000	250 000	112 500	7 500	7°	75 000
100 000	100 000	75 000	37 500	3°	37 500	125 000	56 250	3 750	7°	37 500
20 000	20 000	15 000	7 500	3°	7 500	25 000	11 250	750	N/A	N/A
2 000	2 000	1 500	750	3°	750	2 500	1 125	75	N/A	N/A

Note.— This table does not include recommended horizontal beam spreads. F.2.1.3 requires 360° coverage around an obstacle. Therefore, the number of lights needed to meet this requirement will depend on the horizontal beam spreads of each light as well as the shape of the obstacle. Thus, with narrower beam spreads, more lights will be required.

(a) 360° horizontal. All intensities are expressed in Candela. For flashing lights, the intensity is read into effective intensity, as determined in accordance with the *CASA Advisory Circular AC139-6 Visual Aids for Denoting Obstacles*.

(b) Elevation vertical angles are referenced to the horizontal when the light unit is levelled.

(c) Beam spread is defined as the angle between the horizontal plane and the directions for which the intensity exceeds that mentioned in the "intensity" column.

Note.— An extended beam spread may be necessary under specific configuration and justified by an aeronautical study.

Lighting

F.2.2.5 ...

Note.— See Annex 2 for lights to be displayed by aircraft.

F.2.3 Fixed objects

Note.— The fixed objects of wind turbines are addressed separately in F.2.4 and the fixed objects of overhead wires, cables, etc., and supporting towers are addressed separately in F.2.5.

Marking by colour

F.2.3.2 **Recommendation.—** *An object should be coloured to show a chequered pattern if it has essentially unbroken surfaces and its projection on any vertical plane equals or exceeds 4.5 m in both dimensions. The pattern should consist of rectangles of not less than 1.5 m and not more than 3 m on a side, the corners being of the darker colour. The colours of the pattern should contrast each with the other and with the background against which they will be seen. Orange and white or alternatively red and white should be used, except where such colours merge with the background. (See Figure F-1.)*

F.2.3.3 **Recommendation.—** *An object should be coloured to show alternating contrasting bands if:*

(a) *it has essentially unbroken surfaces and has one dimension, horizontal or vertical, greater than 1.5 m, and the other dimension, horizontal or vertical, less than 4.5 m; or*

(b) *it is of skeletal type with either a vertical or a horizontal dimension greater than 1.5 m.*

The bands should be perpendicular to the longest dimension and have a width approximately 1/7 of the longest dimension or 30 m, whichever is less. The colours of the bands should contrast with the background against which they will be seen. Orange and white should be used, except where such colours are not conspicuous when viewed against the background. The bands on the extremities of the object should be of the darker colour. (See Figures F-1 and F-2.)

Note.— Table F-4 shows a formula for determining band widths and for having an odd number of bands, thus permitting both the top and bottom bands to be of the darker colour.

F.2.3.4 **Recommendation.—** *An object should be coloured in a single conspicuous colour if its projection on any vertical plane has both dimensions less than 1.5 m. Orange or red should be used, except where such colours merge with the background.*

Note.— Against some backgrounds it may be found necessary to use a different colour from orange or red to obtain sufficient contrast.

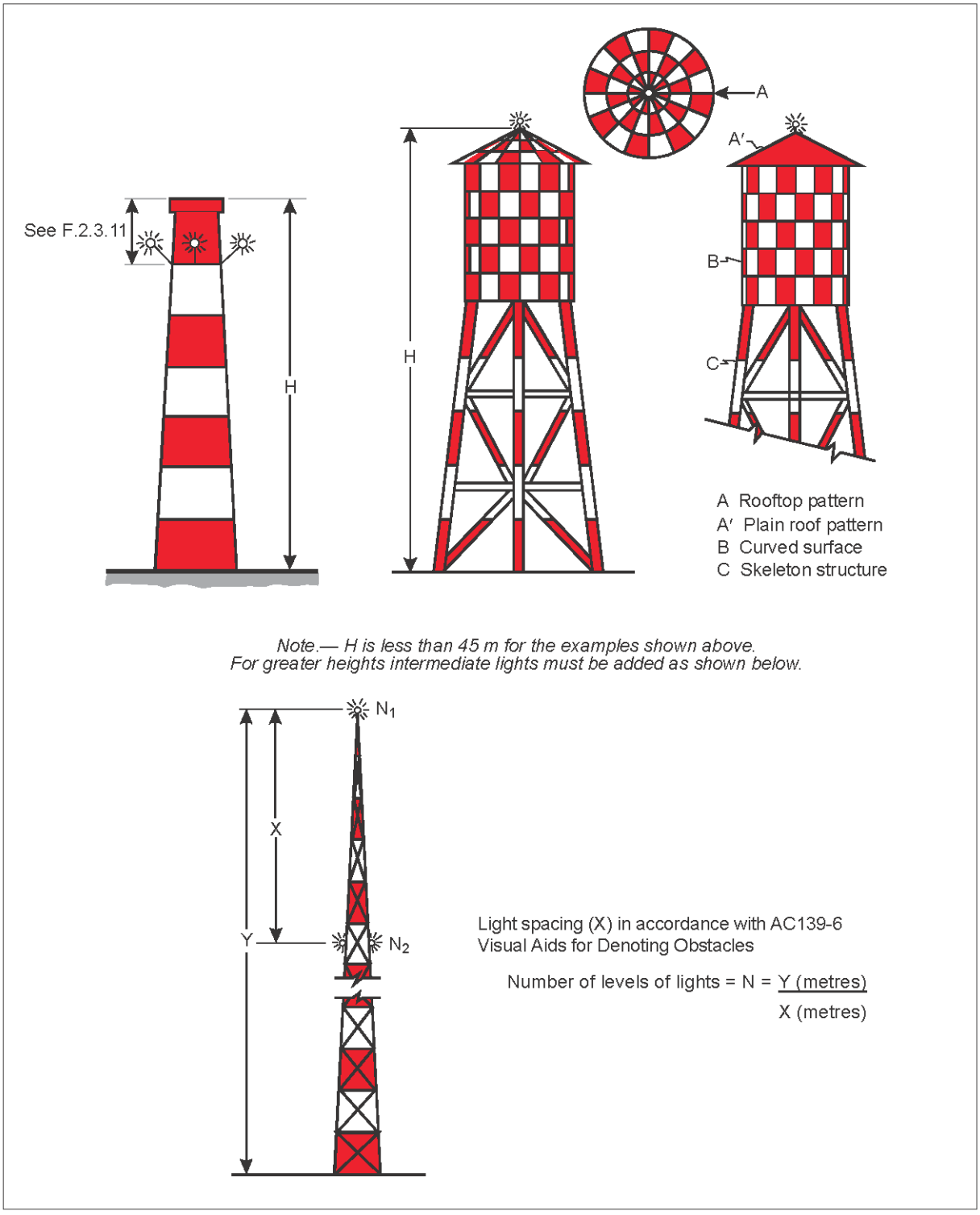


Figure F-2. Examples of marking and lighting of tall structures

F.2.3.7 **Recommendation.—** *Flags used to mark fixed objects should be orange in colour or a combination of two triangular sections, one orange and the other white, or one red and the other white, except that where such colours merge with the background, other conspicuous colours should be used.*

Marking by markers

F.2.3.9 **Recommendation.—** *A marker should be of one colour. When installed, white and red, or white and orange markers should be displayed alternately. The colour selected should contrast with the background against which it will be seen.*

Lighting

F.2.3.10 ...

Note.— Recommendations on how a combination of low-, medium- and/or high-intensity lights on obstacles should be displayed are given in Appendix 5(CASA Advisory Circular AC139-6 Visual Aids for Denoting Obstacles).

F.2.3.11 **Recommendation.—** *In the case of chimney or other structure of like function, the top lights should be placed sufficiently below the top so as to minimize contamination by smoke, etc. (See Figure F-2).*

F.2.3.14 **Recommendation.—** *When the obstacle limitation surface concerned is sloping and the highest point above the OLS is not the highest point of the object, additional obstacle lights should be placed on the highest point of the object.*

F.2.3.17 **Recommendation.—** *The installation setting angles for high-intensity obstacle lights, Type A, should be in accordance with Table F-5.*

Note.— High-intensity obstacle lights are intended for day use as well as night use. Care is needed to ensure that these lights do not create disconcerting dazzle. Guidance on the design, location and operation of high-intensity obstacle lights is given in the CASA Advisory Circular AC139-6 Visual Aids for Denoting Obstacles.

F.2.3.18 **Recommendation.—** *Where, in the opinion of the appropriate authority, the use of high-intensity obstacle lights, Type A, or medium-intensity obstacle lights, Type A, at night may dazzle pilots in the vicinity of an aerodrome (within approximately 10 000 m radius) or cause significant environmental concerns, a dual obstacle lighting system should be provided. This system should be composed of high-intensity obstacle lights, Type A, or medium-intensity obstacle lights, Type A, as appropriate, for daytime and twilight use and medium-intensity obstacle lights, Type B or C, for night-time use*

Lighting of objects with a height less than 45 m above ground level

F.2.3.19 **Recommendation.—** *Low-intensity obstacle lights, Type A or B, should be used where the object is a less extensive one and its height above the surrounding ground is less than 45 m.*

F.2.3.20 **Recommendation.—** *Where the use of low-intensity obstacle lights, Type A or B, would be inadequate or an early special warning is required, then medium- or high-intensity obstacle lights should be used.*

F.2.3.21 **Recommendation.—** *Low-intensity obstacle lights, Type B, should be used either alone or in combination with medium-intensity obstacle lights, Type B, in accordance with F.2.3.22.*

F.2.3.22 **Recommendation.—** *Medium-intensity obstacle lights, Type A, B or C, should be used where the object is an extensive one. Medium-intensity obstacle lights, Types A and C, should be used alone, whereas medium-intensity obstacle lights, Type B, should be used either alone or in combination with low-intensity obstacle lights, Type B.*

Note.— A group of buildings is regarded as an extensive object.

Lighting of objects with a height 45 m to a height less than 150 m above ground level

F.2.3.23 **Recommendation.—** *Medium-intensity obstacle lights, Type A, B or C, should be used. Medium-intensity obstacle lights, Types A and C, should be used alone, whereas medium-intensity obstacle lights, Type B, should be used either alone or in combination with low-intensity obstacle lights, Type B.*

Lighting of objects with a height 150 m or more above ground level

F.2.3.28 **Recommendation.—** *High-intensity obstacle lights, Type A, should be used to indicate the presence of an object if its height above the level of the surrounding ground exceeds 150 m and an aeronautical study indicates such lights to be essential for the recognition of the object by day.*

F.2.3.30 **Recommendation.—** *Where, in the opinion of the appropriate authority, the use of high-intensity obstacle lights, Type A, at night may dazzle pilots in the vicinity of an aerodrome (within approximately 10 000 m radius) or cause significant environmental concerns, medium-intensity obstacle lights, Type C, should be used alone, whereas mediumintensity obstacle lights, Type B, should be used either alone or in combination with low-intensity obstacle lights, Type B.*

F.2.4 Wind turbines

F.2.4.1 ...

Note 1.— Additional lighting or markings may be provided where in the opinion of the State such lighting or markings are deemed necessary.

Note 2.— See D.3.1 and D.3.2

Markings

F.2.4.2 **Recommendation.—** *The rotor blades, nacelle and upper 2/3 of the supporting mast of wind turbines should be painted white, unless otherwise indicated by an aeronautical study.*

Lighting

F.2.4.3 **Recommendation.—** *When lighting is deemed necessary, in the case of a wind farm, i.e. a group of two or more wind turbines, the wind farm should be regarded as an extensive object and the lights should be installed:*

(a) to identify the perimeter of the wind farm;

(b) respecting the maximum spacing, in accordance with F.2.3.15, between the lights along the perimeter, unless a dedicated assessment shows that a greater spacing can be used;

(c) so that, where flashing lights are used, they flash simultaneously throughout the wind farm;

(d) so that, within a wind farm, any wind turbines of significantly higher elevation are also identified wherever they are located; and

(e) at locations prescribed in (a), (b) and (d), respecting the following criteria:

(1) *for wind turbines of less than 150 m in overall height (hub height plus vertical blade height), medium-intensity lighting on the nacelle should be provided;*

(2) *for wind turbines from 150 m to 315 m in overall height, in addition to the medium-intensity light installed on the nacelle, a second light serving as an alternate should be provided in case of failure of the operating light. The lights should be installed to assure that the output of either light is not blocked by the other; and*

(3) *in addition, for wind turbines from 150 m to 315 m in overall height, an intermediate level at half the nacelle height of at least three low-intensity Type E lights, as specified in 6.2.1.3, should be provided. If an aeronautical study shows that low-intensity Type E lights are not suitable, low-intensity Type A or B lights may be used.*

Note.— The above F.2.4.3(e) does not address wind turbines of more than 315 m of overall height. For such wind turbines, additional marking and lighting may be required as determined by an aeronautical study.

F.2.4.4 **Recommendation.—** *The obstacle lights should be installed on the nacelle in such a manner as to provide an unobstructed view for aircraft approaching from any direction.*

F.2.4.5 **Recommendation.—** *Where lighting is deemed necessary for a single wind turbine or short line of wind turbines, the installation should be in accordance with F.2.4.3(e) or as determined by an aeronautical study.*

F.2.5 Overhead wires, cables, etc., and supporting towers

Marking

F.2.5.1 **Recommendation.—** *The wires, cables, etc., to be marked should be equipped with markers; the supporting tower should be coloured.*

Marking by colours

F.2.5.2 **Recommendation.—** *The supporting towers of overhead wires, cables, etc., that require marking should be marked in accordance with F.2.3.1 to F.2.3.4, except that the marking of the supporting towers may be omitted when they are lighted by high-intensity obstacle lights by day.*

Marking by markers

F.2.5.4 **Recommendation.—** *A marker displayed on an overhead wire, cable, etc., should be spherical and have a diameter of not less than 60 cm.*

F.2.5.5 **Recommendation.—** *The spacing between two consecutive markers or between a marker and a supporting tower should be appropriate to the diameter of the marker, but in no case should the spacing exceed:*

(a) 30 m where the marker diameter is 60 cm progressively increasing with the diameter of the marker to

(b) 35 m where the marker diameter is 80 cm and further progressively increasing to a maximum of

(c) 40 m where the marker diameter is of at least 130 cm.

Where multiple wires, cables, etc., are involved, a marker should be located not lower than the level of the highest wire at the point marked.

F.2.5.6 **Recommendation.—** *A marker should be of one colour. When installed, white and red, or white and orange markers should be displayed alternately. The colour selected should contrast with the background against which it will be seen.*

F.2.5.7 **Recommendation.—** *When it has been determined that an overhead wire, cable, etc., needs to be marked but it is not practicable to install markers on the wire, cable, etc., then high-intensity obstacle lights, Type B, should be provided on their supporting towers.*

Lighting

F.2.5.8 **Recommendation.—** *High-intensity obstacle lights, Type B, should be used to indicate the presence of a tower supporting overhead wires, cables, etc., where:*

(a) an aeronautical study indicates such lights to be essential for the recognition of the presence of wires, cables, etc.; or

(b) it has not been found practicable to install markers on the wires, cables, etc.

F.2.5.9 ...

Note.— In some cases, this may require locating the lights off the tower.

F.2.5.10 **Recommendation.—** *High-intensity obstacle lights, Type B, indicating the presence of a tower supporting overhead wires, cables, etc., should flash sequentially; first the middle light, second the top light and last, the bottom light. The intervals between flashes of the lights should approximate the following ratios:*

Flash interval between	Ratio of cycle time
middle and top light	*1/13*
top and bottom light	*2/13*
bottom and middle light	*10/13.*

Note.— High-intensity obstacle lights are intended for day use as well as night use. Care is needed to ensure that these lights do not create disconcerting dazzle. Guidance on the design, operation and the location of high-intensity obstacle lights is given in the CASA Advisory Circular AC139-6 Visual Aids for Denoting Obstacles.

F.2.5.11 **Recommendation.—** *Where, in the opinion of the appropriate authority, the use of high-intensity obstacle lights, Type B, at night may dazzle pilots in the vicinity of an aerodrome (within approximately 10 000 m radius) or cause significant environmental concerns, a dual obstacle lighting system should be provided. This system should be composed of high-intensity obstacle lights, Type B, for daytime and twilight use and medium-intensity obstacle lights, Type B, for nighttime use. Where medium-intensity lights are used they should be installed at the same level as the high-intensity obstacle light Type B.*

F.2.5.12 ***Recommendation.—*** *The installation setting angles for high-intensity obstacle lights, Type B, should be in accordance with Table F-5.*

Table F-5. Installation setting angles for high-intensity obstacle lights

Height of light unit above terrain (AGL)		Angle of the peak of the beam above the horizontal
Greater than	Not exceeding	
151 m		0°
122 m	151 m	1°
92 m	122 m	2°
	92 m	3°

APPENDIX G. VISUAL AIDS FOR DENOTING RESTRICTED USE AREAS

G.1 Closed runways and taxiways, or parts thereof

Application

G.1.2 **Recommendation.—** *A closed marking should be displayed on a temporarily closed runway or taxiway or portion thereof, except that such marking may be omitted when the closing is of short duration and adequate warning by air traffic services is provided.*

Characteristics

G.1.4 ...

Note 1.— When an area is temporarily closed, frangible barriers or markings utilizing materials other than paint or other suitable means may be used to identify the closed area.

Note 2.— Procedures pertaining to the planning, coordination, monitoring and safety management of works in progress on the movement area are specified in the PANS-Aerodromes (Doc 9981).

G.2 Non-load-bearing surfaces

Application

G.2.1 ...

Note.— The marking of runway sides is specified in E.2.7.

Location

G.2.2 **Recommendation.—** *A taxi side stripe marking should be placed along the edge of the load-bearing pavement, with the outer edge of the marking approximately on the edge of the load-bearing pavement.*

Characteristics

G.2.3 **Recommendation.—** *A taxi side stripe marking should consist of a pair of solid lines, each 15 cm wide and spaced 15 cm apart and the same colour as the taxiway centre line marking.*

Note.— Guidance on providing additional transverse stripes at an intersection or a small area on the apron is given in the CASA Advisory Circular AC139-7 Visual Aids for Denoting Restricted Use Areas.

G.3 Pre-threshold area

Application

G.3.1 **Recommendation.—** *When the surface before a threshold is paved and exceeds 60 m in length and is not suitable for normal use by aircraft, the entire length before the threshold should be marked with a chevron marking.*

Location

G.3.2 **Recommendation.—** *A chevron marking should point in the direction of the runway and be placed as shown in Figure G-2.*

Characteristics

G.3.3 **Recommendation.—** *A chevron marking should be of conspicuous colour and contrast with the colour used for the runway markings; it should preferably be yellow. It should have an overall width of at least 0.9 m.*

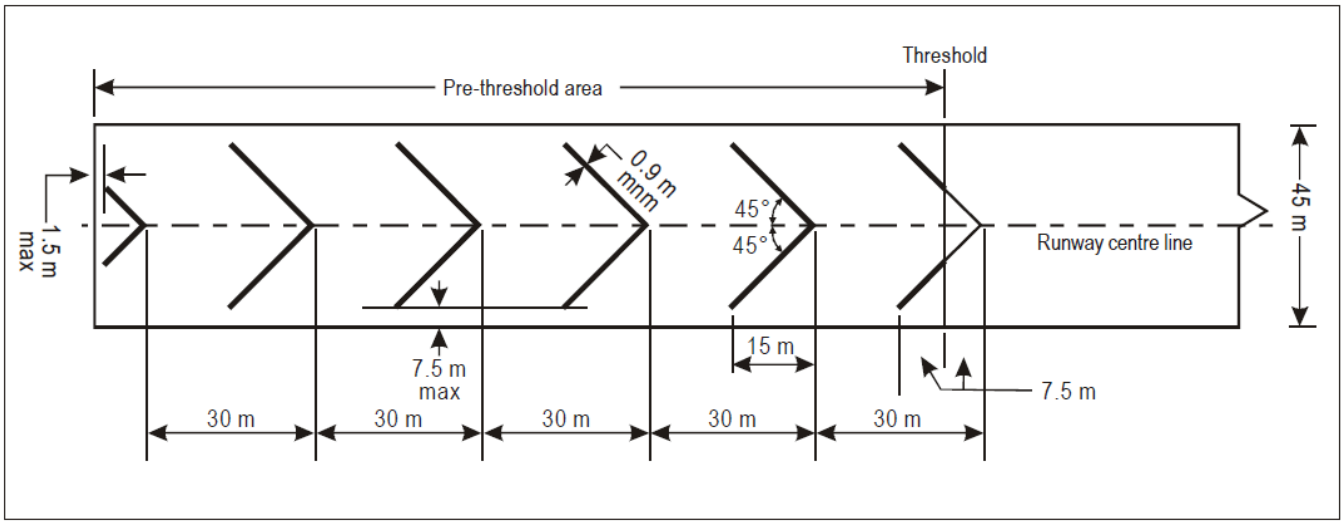


Figure G-2. Pre-threshold marking

G.4 Unserviceable areas

Application

G.4.1 ...

Note 1.— Unserviceability markers and lights are used for such purposes as warning pilots of a hole in a taxiway or apron pavement or outlining a portion of pavement, such as on an

apron, that is under repair. They are not suitable for use when a portion of a runway becomes unserviceable, nor on a taxiway when a major portion of the width becomes unserviceable. In such instances, the runway or taxiway is normally closed.

Note 2.— Procedures pertaining to the planning, coordination, monitoring and safety management of works in progress on the movement area are specified in the PANS-Aerodromes (Doc 9981).

Location

G.4.2 ...

Note.— Guidance on the location of unserviceability lights is given in CASA Advisory Circular AC139-7 Visual Aids for Denoting Restricted Use Areas.

Characteristics of unserviceability cones

G.4.5 ***Recommendation.***— *An unserviceability cone should be at least 0.5 m in height and red, orange or yellow or any one of these colours in combination with white.*

Characteristics of unserviceability flags

G.4.6 **Recommendation.—** *An unserviceability flag should be at least 0.5 m square and red, orange or yellow or any one of these colours in combination with white.*

Characteristics of unserviceability marker boards

G.4.7 **Recommendation.—** *An unserviceability marker board should be at least 0.5 m in height and 0.9 m in length, with alternate red and white or orange and white vertical stripes.*

APPENDIX H. ELECTRICAL SYSTEMS

H.1 Electrical power supply systems for air navigation facilities

Introductory Note.— The safety of operations at aerodromes depends on the quality of the supplied power. The total electrical power supply system may include connections to one or more external sources of electric power supply, one or more local generating facilities and to a distribution network including transformers and switchgear. Many other aerodrome facilities supplied from the same system need to be taken into account while planning the electrical power system at aerodromes.

H.1.2 ...

Note.— The design and installation of the electrical systems need to take into consideration factors that can lead to malfunction, such as electromagnetic disturbances, line losses, power quality, etc. Additional guidance is given in the CASA Advisory Circular AC139-8 Electrical Systems.

H.1.3 Recommendation.— *Electric power supply connections to those facilities for which secondary power is required should be so arranged that the facilities are automatically connected to the secondary power supply on failure of the primary source of power.*

H.1.4 Recommendation.— *The time interval between failure of the primary source of power and the complete restoration of the services required by H.1.10 should be as short as practicable, except that for visual aids associated with non-precision, precision approach or take-off runways the requirements of Table H-1 for maximum switch-over times should apply.*

Note.— A definition of switch-over time is given in Appendix 1.

Visual aids

Application

H.1.8 **Recommendation.—** *At an aerodrome where the primary runway is a non-precision approach runway, a secondary power supply capable of meeting the requirements of Table H-1 should be provided except that a secondary power supply for visual aids need not be provided for more than one non-precision approach runway.*

H.1.9 Recommendation.— *At an aerodrome where the primary runway is a non-instrument runway, a secondary power supply capable of meeting the requirements of H8.1.4 should be provided, except that a secondary power supply for visual aids need not be provided when an emergency lighting system in accordance with the specification of E.3.2 is provided and capable of being deployed in 15 minutes.*

H.1.10 Recommendation.— *The following aerodrome facilities should be provided with a secondary power supply capable of supplying power when there is a failure of the primary power supply:*

(a) the signalling lamp and the minimum lighting necessary to enable air traffic services personnel to carry out their duties;

Note.— The requirement for minimum lighting may be met by other than electrical means.

(b) all obstacle lights which, in the opinion of the appropriate authority, are essential to ensure the safe operation of aircraft;

(c) approach, runway and taxiway lighting as specified in H.1.6 to H.1.9;

(d) meteorological equipment;

(e) essential security lighting, if provided in accordance with I.11;

(f) essential equipment and facilities for the aerodrome responding emergency agencies;

(g) floodlighting on a designated isolated aircraft parking position if provided in accordance with E.3.24.1; and

(h) illumination of apron areas over which passengers may walk.

Note.— Specifications for secondary power supply for radio navigation aids and ground elements of communications systems are given in CAR Part 171.

H.1.11 Recommendation.— *Requirements for a secondary power supply should be met by either of the following:*

(wwwww) 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

(xxxxx) standby power unit(s), which are engine generators, batteries, etc., from which electric power can be obtained.

Note.— Guidance on electrical systems is included in the CASA Advisory Circular AC139-8 Electrical Systems.

Table H-1. Secondary power supply requirements

(see H.1.4)

Runway	Lighting aids requiring power	Maximum switch-over time
Non-instrument	Visual approach slope indicators[a]	See H.1.4 and H.1.9
	Runway edge[b]	
	Runway threshold[b]	
	Runway end[b]	
	Obstacle[a]	
Non-precision approach	Approach lighting system	15 seconds
	Visual approach slope indicators[a, d]	15 seconds
	Runway edge[d]	15 seconds
	Runway threshold[d]	15 seconds
	Runway end	15 seconds
	Obstacle[a]	15 seconds
Precision approach category I	Approach lighting system	15 seconds
	Runway edge[d]	15 seconds
	Visual approach slope indicators[a, d]	15 seconds
	Runway threshold[d]	15 seconds
	Runway end	15 seconds
	Essential taxiway[a]	15 seconds
	Obstacle[a]	15 seconds
Precision approach category II/III	Inner 300 m of the approach lighting system	1 second
	Other parts of the approach lighting system	15 seconds
	Obstacle[a]	15 seconds
	Runway edge	15 seconds
	Runway threshold	1 second
	Runway end	1 second
	Runway centre line	1 second
	Runway touchdown zone	1 second
	All stop bars	1 second
	Essential taxiway	15 seconds
Runway meant for take-off in runway visual range conditions less than a value of 800 m	Runway edge	15 seconds[c]
	Runway end	1 second
	Runway centre line	1 second
	All stop bars	1 second
	Essential taxiway[a]	15 seconds
	Obstacle[a]	15 seconds

a. Supplied with secondary power when their operation is essential to the safety of flight operation.
b. See Appendix E, E.3.2, regarding the use of emergency lighting.
c. One second where no runway centre line lights are provided.
d. One second where approaches are over hazardous or precipitous terrain.

H.2 System design

H.2.1 ...

Note.— Guidance on means of providing this protection is given in the CASA Advisory Circular AC139-8 Electrical Systems.

H.3 Monitoring

Note.— Guidance on this subject is given in the CASA Advisory Circular AC139-8 Electrical Systems.

H.3.1 Recommendation.— *A system of monitoring should be employed to indicate the operational status of the lighting systems.*

H.3.3 Recommendation.— *Where a change in the operational status of lights has occurred, an indication should be provided within two seconds for a stop bar at a runway-holding position and within five seconds for all other types of visual aids.*

H.3.4 Recommendation.— *For a runway meant for use in runway visual range conditions less than a value of 550 m, the lighting systems detailed in Table H-1 should be monitored automatically so as to provide an indication when the serviceability level of any element falls below the minimum serviceability level specified in J.5.7 to J.5.11, as appropriate. This information should be automatically relayed to the maintenance crew.*

H.3.5 Recommendation.— *For a runway meant for use in runway visual range conditions less than a value of 550 m, the lighting systems detailed in Table H-1 should be monitored automatically to provide an indication when the serviceability level of any element falls below the minimum level specified by the appropriate authority below which operations should not continue. This information should be automatically relayed to the air traffic services unit and displayed in a prominent position.*

Note.— Guidance on air traffic control interface and visual aids monitoring is included in the CASA Advisory Circular AC139-8 Electrical Systems

APPENDIX I. AERODROME OPERATIONAL SERVICES, EQUIPMENT AND INSTALLATIONS

I.1 Aerodrome emergency planning

General

Introductory Note.— Aerodrome emergency planning is the process of preparing an aerodrome to cope with an emergency occurring at the aerodrome or in its vicinity. The objective of aerodrome emergency planning is to minimize the effects of an emergency, particularly in respect of saving lives and maintaining aircraft operations. The aerodrome emergency plan sets forth the procedures for coordinating the response of different aerodrome

agencies (or services) and of those agencies in the surrounding community that could be of assistance in responding to the emergency. Guidance material to assist the appropriate authority in establishing aerodrome emergency planning is given in the CASA Advisory Circular AC139-9.1 Operational Services-Emergency Planning.

I.1.2 ...

Note 1.— Examples of emergencies are: aircraft emergencies, sabotage including bomb threats, unlawfully seized aircraft, dangerous goods occurrences, building fires, natural disaster and public health emergencies.

Note 2.— Examples of public health emergencies are increased risk of travellers or cargo spreading a serious communicable disease internationally through air transport and severe outbreak of a communicable disease potentially affecting a large proportion of aerodrome staff.

I.1.3 ...

Note 1.— Examples of agencies are:

(yyyyy) *on the aerodrome: air traffic control units, rescue and firefighting services, aerodrome administration, medical and ambulance services, aircraft operators, security services, and police;*

(zzzzz) *off the aerodrome: fire departments, police, health authorities (including medical, ambulance, hospital and public health services), military, and harbour patrol or coast guard.*

Note 2.— Public health services include planning to minimize adverse effects to the community from health-related events and deal with population health issues rather than provision of health services to individuals.

I.1.4 **Recommendation.—** *The plan should provide for cooperation and coordination with the rescue coordination centre, as necessary.*

I.1.5 **Recommendation.—** *The aerodrome emergency plan document should include at least the following:*

(a) *types of emergencies planned for;*

(b) *agencies involved in the plan;*

(c) *responsibility and role of each agency, the emergency operations centre and the command post, for each type of emergency;*

(d) *information on names and telephone numbers of offices or people to be contacted in the case of a particular emergency; and*

(e) *a grid map of the aerodrome and its immediate vicinity.*

I.1.6 ...

Note 1.— Guidance material on human factors principles can be found in the Human Factors Training Manual *(Doc 9683).*

Note 2.— General principles and procedures on the training of aerodrome personnel, including training programmes and competence checks, are specified in the PANS-Aerodromes (Doc 9981).

Emergency operations centre and command post

I.1.7 Recommendation.— *A fixed emergency operations centre and a mobile command post should be available for use during an emergency.*

I.1.8 Recommendation.— *The emergency operations centre should be a part of the aerodrome facilities and should be responsible for the overall coordination and general direction of the response to an emergency.*

I.1.9 Recommendation.— *The command post should be a facility capable of being moved rapidly to the site of an emergency, when required, and should undertake the local coordination of those agencies responding to the emergency.*

I.1.10 Recommendation.— *A person should be assigned to assume control of the emergency operations centre and, when appropriate, another person the command post.*

Communication system

I.1.11 Recommendation.— *Adequate communication systems linking the command post and the emergency operations centre with each other and with the participating agencies should be provided in accordance with the plan and consistent with the particular requirements of the aerodrome.*

Aerodrome emergency exercise

I.1.12 ...

Note.— The plan includes all participating agencies and associated equipment.

I.1.13 ...

Note 1.— The purpose of a full-scale exercise is to ensure the adequacy of the plan to cope with different types of emergencies. The purpose of a partial exercise is to ensure the adequacy of the response to individual participating agencies and components of the plan, such as the communications system. The purpose of modular tests is to enable concentrated effort on specific components of established emergency plans.

Note 2.— Guidance material on airport emergency planning is available in the CASA Advisory Circular AC139-9.1 Operational Services-Emergency Planning.

Emergencies in difficult environments

I.1.14 Recommendation.— *At those aerodromes located close to water and/or swampy areas, or difficult terrain, the aerodrome emergency plan should include the establishment, testing and assessment at regular intervals of a predetermined response for the specialist rescue services.*

I.1.15 **Recommendation.—** *An assessment of the approach and departure areas within 1 000 m of the runway threshold should be carried out to determine the options available for intervention.*

Note.— Guidance material on assessing approach and departure areas within 1 000 m of runway thresholds can be found in CASA Advisory Circular AC139-9.2 Operational Services-Rescure and Firefighting.

I.2 Rescue and firefighting

General

Introductory Note.— The principal objective of a rescue and firefighting service is to save lives in the event of an aircraft accident or incident occurring at, or in the immediate vicinity of, an aerodrome. The rescue and firefighting service is provided to create and maintain survivable conditions, to provide egress routes for occupants and to initiate the rescue of those occupants unable to make their escape without direct aid. The rescue may require the use of equipment and personnel other than those assessed primarily for rescue and firefighting purposes.

The most important factors bearing on effective rescue in a survivable aircraft accident are: the training received, the effectiveness of the equipment and the speed with which personnel and equipment designated for rescue and firefighting purposes can be put into use.

Requirements to combat building and fuel farm fires, or to deal with foaming of runways, are not taken into account.

Application

I.2.1 ...

Note.— Public or private organizations, suitably located and equipped, may be designated to provide the rescue and firefighting service. It is intended that the fire station housing these organizations be normally located on the aerodrome, although an off-aerodrome location is not precluded provided the response time can be met.

I.2.2 ...

Note 1.— Special firefighting equipment need not be provided for water areas; this does not prevent the provision of such equipment if it would be of practical use, such as when the areas concerned include reefs or islands.

Note 2.— The objective is to plan and deploy the necessary life-saving flotation equipment as expeditiously as possible in a number commensurate with the largest aeroplane normally using the aerodrome.

Note 3.— Additional guidance is available in CASA Advisory Circular AC139-9.2 Operational Services-Rescure and Firefighting.

Level of protection to be provided

I.2.3 ...

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

I.2.4 **Recommendation.—** *The level of protection provided at an aerodrome for rescue and firefighting should be equal to the aerodrome category determined using the principles in I.2.5 and I.2.6.*

I.2.5 ...

Note.— To categorize the aeroplanes using the aerodrome, first evaluate their overall length and second, their fuselage width.

I.2.6 ...

Note 1.— See guidance in the CASA Advisory Circular AC139-9.2 Operational Services-Rescure and Firefighting, for categorizing aerodromes, including those for all-cargo aircraft operations, for rescue and firefighting purposes.

Note 2.— Principles and procedures on training, including training programmes and competence checks, are specified in the PANS-Aerodromes (Doc 9981). Further guidance on the training of personnel, rescue equipment for difficult environments, and other facilities and services for rescue and firefighting is given in CASA Advisory Circular AC139-9.2 Operational Services-Rescure and Firefighting.

Table I-1. Aerodrome category for rescue and firefighting

Aerodrome category (1)	Aeroplane overall length (2)	Maximum fuselage width (3)
1	0 m up to but not including 9 m	2 m
2	9 m up to but not including 12 m	2 m
3	12 m up to but not including 18 m	3 m
4	18 m up to but not including 24 m	4 m
5	24 m up to but not including 28 m	4 m
6	28 m up to but not including 39 m	5 m
7	39 m up to but not including 49 m	5 m
8	49 m up to but not including 61 m	7 m
9	61 m up to but not including 76 m	7 m
10	76 m up to but not including 90 m	8 m

Extinguishing agents

I.2.8 **Recommendation.—** *Both principal and complementary agents should normally be provided at an aerodrome.*

Note.— Descriptions of the agents may be found in the CASA Advisory Circular AC139-9.2 Operational Services-Rescure and Firefighting.

I.2.9 **Recommendation.—** *The principal extinguishing agent should be:*

(a) a foam meeting the minimum performance level A; or

(b) a foam meeting the minimum performance level B; or

(c) a foam meeting the minimum performance level C; or

(d) a combination of these agents;

except that the principal extinguishing agent for aerodromes in categories 1 to 3 should preferably meet a performance level B or C foam.

Note.— Information on the required physical properties and fire extinguishing performance criteria needed for a foam to achieve an acceptable performance level A, B or C rating is given in the CASA Advisory Circular AC139-9.2 Operational Services-Rescure and Firefighting.

I.2.10 Recommendation.— *The complementary extinguishing agent should be a dry chemical powder suitable for extinguishing hydrocarbon fires.*

Note 1.— When selecting dry chemical powders for use with foam, care must be exercised to ensure compatibility.

Note 2.— Alternate complementary agents having equivalent firefighting capability may be utilized. Additional information on extinguishing agents is given in the CASA Advisory Circular AC139-9.2 Operational Services-Rescure and Firefighting.

I.2.11 ...

Note 1.— The amounts of water specified for foam production are predicated on an application rate of 8.2 L/min/m^2 for a foam meeting performance level A, 5.5 L/min/m^2 for a foam meeting performance level B and 3.75 L/min/m^2 for a foam meeting performance level C.

Note 2.— When any other complementary agent is used, the substitution ratios need to be checked.

I.2.12 ...

Note.— Guidance on the determination of quantities of water and discharge rates based on the largest overall length of aeroplane in a given category is available in CASA Advisory Circular AC139-9.2 Operational Services-Rescure and Firefighting.

Table E-2. Minimum usable amounts of extinguishing agents

	Foam meeting performance level A		Foam meeting performance level B		Foam meeting performance level C		Complementary agents	
Aerodrome category	Water (L)	Discharge rate foam solution/ minute (L)	Water (L)	Discharge rate foam solution/ minute (L)	Water (L)	Discharge rate foam solution/ minute (L)	Dry chemical powders (kg)	Discharge Rate (kg/second)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	350	350	230	230	160	160	45	2.25
2	1 000	800	670	550	460	360	90	2.25
3	1 800	1 300	1 200	900	820	630	135	2.25
4	3 600	2 600	2 400	1 800	1 700	1 100	135	2.25
5	8 100	4 500	5 400	3 000	3 900	2 200	180	2.25
6	11 800	6 000	7 900	4 000	5 800	2 900	225	2.25
7	18 200	7 900	12 100	5 300	8 800	3 800	225	2.25
8	27 300	10 800	18 200	7 200	12 800	5 100	450	4.5
9	36 400	13 500	24 300	9 000	17 100	6 300	450	4.5
10	48 200	16 600	32 300	11 200	22 800	7 900	450	4.5

Note.— The quantities of water shown in columns 2, 4 and 6 are based on the average overall length of aeroplanes in a given category.

I.2.14 **Recommendation.—** *The amount of foam concentrate provided on a vehicle should be sufficient to produce at least two loads of foam solution.*

I.2.15 **Recommendation.—** *Supplementary water supplies, for the expeditious replenishment of rescue and firefighting vehicles at the scene of an aircraft accident, should be provided.*

I.2.16 **Recommendation.—** *When a combination of different performance level foams are provided at an aerodrome, the total amount of water to be provided for foam production should be calculated for each foam type and the distribution of these quantities should be documented for each vehicle and applied to the overall rescue and firefighting requirement.*

I.2.18 The complementary agents must comply with the appropriate specifications of the International Organization for Standardization (ISO) – Publication 7202 (Powder).

I.2.19 **Recommendation.—** *The discharge rate of complementary agents should be no less than the values shown in Table I-2.*

I.2.20 **Recommendation.—** *Dry chemical powders should only be substituted with an agent that has equivalent or better firefighting capabilities for all types of fires where complementary agent is expected to be used.*

Note.— Guidance on the use of complementary agents can be found in the CASA Advisory Circular AC139-9.2 Operational Services-Rescure and Firefighting.

I.2.21 **Recommendation.—** *A reserve supply of foam concentrate, equivalent to 200 per cent of the quantities identified in Table I-2, should be maintained on the aerodrome for vehicle replenishment purposes.*

Note.— Foam concentrate carried on fire vehicles in excess of the quantity identified in Table I-2 can contribute to the reserve.

I.2.22 **Recommendation.—** *A reserve supply of complementary agent, equivalent to 100 per cent of the quantity identified in Table I-2, should be maintained on the aerodrome for vehicle replenishment purposes. Sufficient propellant gas should be included to utilize this reserve complementary agent.*

I.2.23 **Recommendation.—** *Category 1 and 2 aerodromes that have replaced up to 100 per cent of the water with complementary agent should hold a reserve supply of complementary agent of 200 per cent.*

I.2.24 **Recommendation.—** *Where a major delay in the replenishment of the supplies is anticipated, the amount of reserve supply in I.2.21, I.2.22 and I.2.23 should be increased as determined by a risk assessment.*

Note.— See the CASA Advisory Circular AC139-9.2 Operational Services-Rescure and Firefighting for guidance on the conduct of a risk analysis to determine the quantities of reserve extinguishing agents.

Rescue equipment

I.2.25 **Recommendation.—** *Rescue equipment commensurate with the level of aircraft operations should be provided on the rescue and firefighting vehicle(s).*

Note.— Guidance on the rescue equipment to be provided at an aerodrome is given in the CASA Advisory Circular AC139-9.2 Operational Services-Rescure and Firefighting.

Response time

I.2.27 **Recommendation.—** *The operational objective of the rescue and firefighting service should be to achieve a response time not exceeding two minutes to any point of each operational runway, in optimum visibility and surface conditions.*

I.2.28 **Recommendation.—** *The operational objective of the rescue and firefighting service should be to achieve a response time not exceeding three minutes to any other part of the movement area, in optimum visibility and surface conditions.*

Note 1.— Response time is considered to be the time between the initial call to the rescue and firefighting service, and the time when the first responding vehicle(s) is (are) in position to apply foam at a rate of at least 50 per cent of the discharge rate specified in Table I-2.

Note 2.— Optimum visibility and surface conditions are defined as daytime, good visibility, no precipitation with normal response route free of surface contamination, e.g. water.

I.2.29 **Recommendation.—** *To meet the operational objective as nearly as possible in less than optimum conditions of visibility, especially during low visibility operations, suitable guidance, equipment and/or procedures for rescue and firefighting services should be provided.*

Note.— Additional guidance is available in the CASA Advisory Circular AC139-9.2 Operational Services-Rescure and Firefighting.

I.2.31 **Recommendation.—** *Any vehicles, other than the first responding vehicles(s), required to deliver the amounts of extinguishing agents specified in Table I-2 should ensure continuous agent application and should arrive no more than three minutes from the initial call.*

I.2.32 **Recommendation.—** *A system of preventive maintenance of rescue and firefighting vehicles should be employed to ensure effectiveness of the equipment and compliance with the specified response time throughout the life of the vehicle.*

Emergency access roads

I.2.33 **Recommendation.—** *Emergency access roads should be provided on an aerodrome where terrain conditions permit their construction, so as to facilitate achieving minimum response times. Particular attention should be given to the provision of ready access to approach areas up to 1 000 m from the threshold, or at least within the aerodrome boundary. Where a fence is provided, the need for convenient access to outside areas should be taken into account.*

Note.— Aerodrome service roads may serve as emergency access roads when they are suitably located and constructed.

I.2.34 **Recommendation.—** *Emergency access roads should be capable of supporting the heaviest vehicles which will use them, and be usable in all weather conditions. Roads within 90 m of a runway should be surfaced to prevent surface erosion and the transfer of debris to the runway. Sufficient vertical clearance should be provided from overhead obstructions for the largest vehicles.*

I.2.35 **Recommendation.—** *When the surface of the road is indistinguishable from the surrounding area, edge markers should be placed at intervals of about 10 m.*

Fire stations

I.2.36 **Recommendation.—** *All rescue and firefighting vehicles should normally be housed in a fire station. Satellite fire stations should be provided whenever the response time cannot be achieved from a single fire station.*

I.2.37 **Recommendation.—** *The fire station should be located so that the access for rescue and firefighting vehicles into the runway area is direct and clear, requiring a minimum number of turns.*

Communication and alerting systems

I.2.38 **Recommendation.—** *A discrete communication system should be provided linking a fire station with the control tower, any other fire station on the aerodrome and the rescue and firefighting vehicles.*

I.2.39 **Recommendation.—** *An alerting system for rescue and firefighting personnel, capable of being operated from that station, should be provided at a fire station, any other fire station on the aerodrome and the aerodrome control tower.*

Number of rescue and firefighting vehicles

I.2.40 **Recommendation.—** *The minimum number of rescue and firefighting vehicles provided at an aerodrome should be in accordance with the following tabulation:*

Aerodrome category	Rescue and firefighting vehicles
1	*1*
2	*1*
3	*1*
4	*1*
5	*1*
6	*2*
7	*2*
8	*3*
9	*3*
10	*3*

Note.— Guidance on minimum characteristics of rescue and firefighting vehicles is given in the CASA Advisory Circular AC139-9.2 Operational Services-Rescure and Firefighting.

Personnel

I.2.41 ...

Note 1.— Guidance to assist the appropriate authority in providing proper training is given in CASA Advisory Circular AC139-9.2 Operational Services-Rescure and Firefighting.

Note 2.— Fires associated with fuel discharged under very high pressure from a ruptured fuel tank are known as "pressure-fed fuel fires".

I.2.42 ...

Note.— Guidance material to design training programmes on human performance and team coordination can be found in the Human Factors Training Manual *(Doc 9683).*

I.2.43 **Recommendation.—** *During flight operations, sufficient trained and competent personnel should be designated to be readily available to ride the rescue and firefighting vehicles and to operate the equipment at maximum capacity. These personnel should be deployed in a way that ensures that minimum response times can be achieved and that continuous agent application at the appropriate rate can be fully maintained. Consideration should also be given for personnel to use hand lines, ladders and other rescue and firefighting equipment normally associated with aircraft rescue and firefighting operations.*

I.2.44 **Recommendation.—** *In determining the minimum number of rescue and firefighting personnel required, a task resource analysis should be completed and the level of staffing documented in the Aerodrome Manual.*

Note.— Guidance on the use of a task resource analysis can be found in the CASA Advisory Circular AC139-9.2 Operational Services-Rescure and Firefighting.

I.3 Disabled aircraft removal

Note.— Guidance on removal of a disabled aircraft, including recovery equipment, is given in the CASA Advisory Circular AC139-9.3 Operational Services-Disabled Aircraft Removal. See also CAR Part 12 — Accidents, Incidents and statistics. Investigation *concerning protection of evidence, custody and removal of aircraft.*

I.3.1 **Recommendation.—** *A plan for the removal of an aircraft disabled on, or adjacent to, the movement area should be established for an aerodrome, and a coordinator designated to implement the plan, when necessary.*

I.3.2 **Recommendation.—** *The disabled aircraft removal plan should be based on the characteristics of the aircraft that may normally be expected to operate at the aerodrome, and include among other things:*

(a) a list of equipment and personnel on, or in the vicinity of, the aerodrome which would be available for such purpose; and

(b) arrangements for the rapid receipt of aircraft recovery equipment kits available from other aerodromes.

I.4 Wildlife strike hazard reduction

Note.— The presence of wildlife (birds and other animals) on, or in the vicinity of an aerodrome poses a serious threat to aircraft operational safety.

(aaaaaa) I.4.1 ...

Note.— See CAR Part 175.

I.4.2 ...

Note.— The IBIS is designed to collect and disseminate information on wildlife strikes to aircraft. Information on the system is included in the Manual on the ICAO Bird Strike Information System (IBIS) *(Doc 9332)* (forthcoming).

I.4.3 ...

Note.— Procedures on the management of wildlife hazards on and in the vicinity of an aerodrome, including the establishment of a wildlife hazard management programme (WHMP), wildlife risk assessment, land-use management and personnel training, are specified in the PANS-Aerodromes (Doc 9981), Part II, Chapters 1 and 6. Further guidance is given in the CASA Advisory Circular AC139-9.3 Operational Services-Wildlife Strike Hazard Reduction.

I.4.5 Recommendation.— *States should give due consideration to aviation safety concerns related to land developments in the vicinity of the aerodrome that may attract wildlife.*

I.5 Apron management service

I.5.1 Recommendation.— *When warranted by the volume of traffic and operating conditions, an appropriate apron management service should be provided on an apron by an aerodrome ATS unit, by another aerodrome operating authority, or by a cooperative combination of these, in order to:*

(a) regulate movement with the objective of preventing collisions between aircraft, and between aircraft and obstacles;

(b) regulate entry of aircraft into, and coordinate exit of aircraft from, the apron with the aerodrome control tower; and

(c) ensure safe and expeditious movement of vehicles and appropriate regulation of other activities.

I.5.2 Recommendation.— *When the aerodrome control tower does not participate in the apron management service, procedures should be established to facilitate the orderly transition of aircraft between the apron management unit and the aerodrome control tower.*

Note.— Procedures on apron safety are specified in the PANS-Aerodromes (Doc 9981). Guidance on an apron management service is given in the CASA Advisory Circular AC139-9.5 Operational Services-Apron Safety and Vehicle Control, and in CASA Advisory Circular AC139-9.6 Operational Services-Surface Movement Guidance and Control System (SMGCS).

I.5.4 ...

Note.— Guidance on related special procedures is given in the CASA Advisory Circular AC139-9.6 Operational Services-Surface Movement Guidance and Control System (SMGCS).

I.5.7 ...

Note.— Procedures on the training of operational personnel, and on apron safety and operations, are specified in the PANS-Aerodromes (Doc 9981), Part II, Chapters 1 and 7.

I.7 Aerodrome vehicle operations

Note 1.— Procedures on the establishment of an airside driver permit scheme and vehicle/equipment safety requirements, including detailed personnel training, are specified in the PANS-Aerodromes (Doc 9981), Part II, Chapter 9.

Note 2.— Guidance on aerodrome vehicle operations is contained in Attachment A, Section 18, and on traffic rules and regulations for vehicles in the CASA Advisory Circular AC139-9.6 Operational Services-Surface Movement Guidance and Control System (SMGCS).

Note 3.— It is intended that roads located on the movement area be restricted to the exclusive use of aerodrome personnel and other authorized persons, and that access to the public buildings by an unauthorized person will not require use of such roads.

I.8 Surface movement guidance and control systems

Application

I.8.1 ...

Note.— Guidance on surface movement guidance and control systems is contained in the CASA Advisory Circular AC139-9.6 Operational Services-Surface Movement Guidance and Control System (SMGCS).

Characteristics

I.8.2 **Recommendation.—** *The design of an SMGCS should take into account:*

(a) *the density of air traffic;*

(b) *the visibility conditions under which operations are intended;*

(c) *the need for pilot orientation;*

(d) *the complexity of the aerodrome layout; and*

(e) *movements of vehicles.*

I.8.3 **Recommendation.—** *The visual aid components of an SMGCS, i.e. markings, lights and signs, should be designed to conform with the relevant specifications in 5.2, 5.3 and 5.4, respectively.*

I.8.4 **Recommendation.—** *An SMGCS should be designed to assist in the prevention of inadvertent incursions of aircraft and vehicles onto an active runway.*

I.8.5 **Recommendation.—** *The system should be designed to assist in the prevention of collisions between aircraft, and between aircraft and vehicles or objects, on any part of the movement area.*

Note.— Guidance on control of stop bars through induction loops and on a visual taxiing guidance and control system is contained in the CASA Advisory Circular AC139-9.6 Operational Services-Surface Movement Guidance and Control System (SMGCS).

I.8.6 ...

Note 1.— See Sections E.3.17 and E.3.20 for specifications on taxiway centre line lights and stop bars, respectively.

Note 2.— Guidance on installation of stop bars and taxiway centre line lights in SMGCSs is given in the CASA Advisory Circular AC139-9.6 Operational Services-Surface Movement Guidance and Control System (SMGCS).

I.8.7 **Recommendation.—** *Surface movement radar for the manoeuvring area should be provided at an aerodrome intended for use in runway visual range conditions less than a value of 350 m.*

I.8.8 **Recommendation.—** *Surface movement radar for the manoeuvring area should be provided at an aerodrome other than that in I.8.7 when traffic density and operating conditions are such that regularity of traffic flow cannot be maintained by alternative procedures and facilities.*

Note.— Guidance on the use of surface movement radar is given in the CASA Advisory Circular AC139-9.6 Operational Services-Surface Movement Guidance and Control System (SMGCS)and in the Air Traffic Services Planning Manual *(Doc 9426).*

I.9 Siting of equipment and installations on operational areas

Note 1.— Requirements for obstacle limitation surfaces are specified in D.2.

Note 2.— The design of light fixtures and their supporting structures, light units of visual approach slope indicators, signs, and markers, is specified in E.3.1, E.3.5, E.4.1 and E.5.1, respectively. Guidance on the frangible design of visual and non-visual aids for navigation is given in the CASA Advisory Circular AC139-9.7 Operational Services-Siting of Installations and Frangibility.

I.9.3 **Recommendation.—** *Any equipment or installation required for air navigation or for aircraft safety purposes which must be located on the non-graded portion of a runway strip should be regarded as an obstacle and should be frangible and mounted as low as possible.*

Note.— Guidance on the siting of navigation aids is contained in the CASA Advisory Circular AC139-9.7 Operational Services-Siting of Installations and Frangibility.

I.9.6 Recommendation.— *Any equipment or installation required for air navigation or for aircraft safety purposes which is an obstacle of operational significance in accordance with D.2.4, D.2.11, D.2.20 or D.2.27 should be frangible and mounted as low as possible.*

I.10 Fencing

Application

I.10.2 A fence or other suitable barrier must be provided on an aerodrome to deter the inadvertent or premeditated access of an unauthorized person onto a non-public area of the aerodrome.

Note 1.— This is intended to include the barring of sewers, ducts, tunnels, etc., where necessary to prevent access.

Note 2.— Special measures may be required to prevent the access of an unauthorized person to runways or taxiways which overpass public roads.

Location

I.10.5 Recommendation.— *When greater security is thought necessary, a cleared area should be provided on both sides of the fence or barrier to facilitate the work of patrols and to make trespassing more difficult. Consideration should be given to the provision of a perimeter road inside the aerodrome fencing for the use of both maintenance personnel and security patrols.*

I.11 Security lighting

Recommendation.— *At an aerodrome where it is deemed desirable for security reasons, a fence or other barrier provided for the protection of international civil aviation and its facilities should be illuminated at a minimum essential level. Consideration should be given to locating lights so that the ground area on both sides of the fence or barrier, particularly at access points, is illuminated.*

I.12 Autonomous runway incursion warning system (ARIWS)

Note 1.— The inclusion of detailed specifications for an autonomous runway incursion warning system (ARIWS) in this section is not intended to imply that an ARIWS has to be provided at an aerodrome.

Note 2.— The implementation of an ARIWS is a complex issue deserving careful consideration by aerodrome operators, air traffic services and States, and in coordination with the aircraft operators.

Note 3.— CASA Advisory Circular AC139-9.9 Operational Services-Autonomous Runway Incursion Warning System (ARIWS), provides a description of an ARIWS and information on its use.

Characteristics

I.12.1 ...

Note 1.— An ARIWS may be installed in conjunction with enhanced taxiway centre line markings, stop bars or runway guard lights.

Note 2.— It is intended that the system(s) be operational under all weather conditions, including low visibility.

Note 3.— An ARIWS may share common sensory components of an SMGCS or A-SMGCS, however, it operates independently of either system.

Note.— Detailed specifications concerning the AIP are contained in PANS-AIM (Doc 10066).

APPENDIX J. AERODROME MAINTENANCE

J.1 General

J.1.1 ...

Note 1.— Preventive maintenance is programmed maintenance work done in order to prevent a failure or degradation of facilities.

Note 2.— "Facilities" are intended to include such items as pavements, visual aids, fencing, drainage systems, electrical systems and buildings.

J.1.2 Recommendation.— *The design and application of the maintenance programme should observe human factors principles.*

Note 1.— Guidance material on human factors principles can be found in the Human Factors Training Manual *(Doc 9683) and in the CASA Advisory Circular AC139-9.1 Operational Services-Emergency Planning.*

Note 2.— General principles and procedures on the training of aerodrome personnel, including training programmes and competence checks, are specified in the PANS-Aerodromes (Doc 9981).

J.2 Pavements

J.2.1 ...

Note 1.— See B.9.3 for inspections of movement areas.

Note 2.— Procedures on carrying out daily inspections of the movement area and control of FOD are given in the CASA Advisory Circular AC139-9.6 Operational Services-Surface Movement Guidance and Control System (SMGCS).

Note 3.— Additional guidance on sweeping/cleaning of surfaces is contained in the CASA Advisory Circular AC139-10.1 Maintenance-Pavements.

Note 4.— Guidance on precautions to be taken in regard to the surface of shoulders is given in Attachment A, Section 8, and the CASA PNG Advisory Circular AC139-3.2 Physical Characteristics-Taxiway, Apron, Holding Bays

Note 5.— Where the pavement is used by large aircraft or aircraft with tire pressures in the upper categories referred to in B.6.6(c), particular attention should be given to the integrity of light fittings in the pavement and pavement joints.

J.2.2 ...

Note.— See CASA Advisory Circular AC139-3.1 Runways.

J.2.3 ...

Note.— CASA Advisory Circular AC139-9.13 Operational Services – Pavement Surface *contains further information on this subject.*

J.2.4 ...

Note 1.— Guidance on evaluating the runway surface friction characteristics is provided in CASA Advisory Circular AC139-9.13 Operational Services – Pavement Surface.

Note 2.— The objective of J.2.3 to J.2.8 is to ensure that the surface friction characteristics for the entire runway remain at or above a minimum friction level specified by the State.

J.2.7 ...

Note.— A portion of runway in the order of 100 m long may be considered significant for maintenance or reporting action.

J.2.8 **Recommendation**.— *The runway surface should be visually assessed, as necessary, under natural or simulated rain conditions for ponding or poor drainage and where required, corrective maintenance action taken.*

J.2.9 **Recommendation.—** *When a taxiway is used by turbine-engined aeroplanes, the surface of the taxiway shoulders should be maintained so as to be free of any loose stones or other objects that could be ingested by the aeroplane engines.*

Note.— Guidance on this subject is given in the CASA PNG Advisory Circular AC139-3.2 Physical Characteristics-Taxiway, Apron, Holding Bays

J.3 Removal of contaminants

J.3.1 ...

Note.— Information on the use of chemicals for aerodrome pavements is given in the PANS-Aerodromes (Doc 9981).

J.4 Runway pavement overlays

Note.— The following specifications are intended for runway pavement overlay projects when the runway is to be returned temporarily to an operational status before resurfacing is complete. This may necessitate a temporary ramp between the new and old runway surfaces. Guidance on overlaying pavements and assessing their operational status is given in the CASA Advisory Circular AC139-10.3 Maintenance-Runway Pavement Overlays.

J.4.2 Recommendation.— *Overlaying should proceed from one end of the runway toward the other end so that based on runway utilization most aircraft operations will experience a down ramp.*

J.4.3 Recommendation.— *The entire width of the runway should be overlaid during each work session.*

J.4.5 Recommendation.— *The overlay should be constructed and maintained above the minimum friction level specified in J.2.3.*

J.5 Visual aids

Note 1.— These specifications are intended to define the maintenance performance level objectives. They are not intended to define whether the lighting system is operationally out of service.

Note 2.— The energy savings of light emitting diodes (LEDs) are due in large part to the fact that they do not produce the infra-red heat signature of incandescent lamps.

Note 3.— Enhanced vision systems (EVS) technology relies on the infra-red heat signature provided by incandescent lighting. CAR Part 175 protocols provide an appropriate means of notifying aerodrome users of EVS when lighting systems are converted to LED.

J.5.2 ...

Note.— Guidance on preventive maintenance of visual aids is given in the CASA Advisory Circular AC139-10.6 Maintenance-Visual Aids.

J.5.3 Recommendation.— *The system of preventive maintenance employed for a precision approach runway category II or III should include at least the following checks:*

(a) visual inspection and in-field measurement of the intensity, beam spread and orientation of lights included in the approach and runway lighting systems;

(b) control and measurement of the electrical characteristics of each circuitry included in the approach and runway lighting systems; and

(c) control of the correct functioning of light intensity settings used by air traffic control.

J.5.4 Recommendation.— *In-field measurement of intensity, beam spread and orientation of lights included in approach and runway lighting systems for a precision approach runway category II or III should be undertaken by measuring all lights, as far as practicable, to ensure conformance with the applicable specification of CASA Advisory Circular AC139-5.3 Visual Aids for navigation – Lights.*

J.5.5 **Recommendation.—** *Measurement of intensity, beam spread and orientation of lights included in approach and runway lighting systems for a precision approach runway category II or III should be undertaken using a mobile measuring unit of sufficient accuracy to analyse the characteristics of the individual lights.*

J.5.6 **Recommendation.—** *The frequency of measurement of lights for a precision approach runway category II or III should be based on traffic density, the local pollution level, the reliability of the installed lighting equipment and the continuous assessment of the results of the in-field measurements but, in any event, should not be less than twice a year for in-pavement lights and not less than once a year for other lights.*

J.5.7 ...

Note.— With respect to barrettes, crossbars and runway edge lights, lights are considered to be adjacent if located consecutively and:

(bbbbbb) *laterally: in the same barrette or crossbar; or*

(cccccc) *longitudinally: in the same row of edge lights or barrettes.*

J.5.10 ...

Note.— In barrettes and crossbars, guidance is not lost by having two adjacent unserviceable lights.

J.5.13 **Recommendation.—** *During low visibility procedures the appropriate authority should restrict construction or maintenance activities in the proximity of aerodrome electrical system*