AERODROME STANDARDS and RECOMMENDED PRACTICES

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Land Aerodromes

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5th Edition

Effective date: September 15th 2015

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ABBREVIATIONS

ACN Aircraft classification number
AGN Aircraft group number
AIS Aeronautical information service
ALSF-2 Approach lighting system with flashing lights for category II or III operations
AOM Airport operations manual
APAPI Abbreviated precision approach path indicator
ARCAL Aircraft radio control of aerodrome lighting
ARP Aerodrome reference point
ASDA Accelerate stop distance available
A-SMGCS Advanced surface movement and guidance control system
A-VDGS Advanced visual docking guidance system
ATF Aerodrome traffic frequency
ATS Air traffic services
CAT I Category I operations
CAT II Category II operations
CAT III Category III operations
CBR California bearing ratio
cd Candela (light intensity)
CIE Commission Internationale de l'éclairage
cm Centimetre
E East
EMAS engineered material arresting system
EWH Eye to wheel height
FAA Federal Aviation Administration (USA)
ft Foot
GNSS Global navigation satellite system
HAA Height above aerodrome
HAT Height above threshold
ICAO International Civil Aviation Organization
IFR Instrument flight rules
ILS Instrument landing system
IMC Instrument meteorological conditions
km/h Kilometre per hour
kt Knot
LAHSO Land and hold short operations
LDA Landing distance available
LDIN Runway lead-in lighting system
m Metre
MALS Medium intensity approach lighting system
MALSF Medium intensity approach lighting system with sequenced flashing lights
MALSR Medium intensity approach lighting system with runway alignment indicator lights
max Maximum
min Minimum
MLS Microwave landing system
mm Millimetre
ms Millisecond
MSL Mean sea level
N North
NM Nautical mile
NOTAM Notice to airmen
ODALS Omnidirectional approach lighting system
OFZ Obstacle free zone
OIS Obstacle identification surface
OLS Obstacle limitation surface
OPS Obstacle protection surface
PAPI Precision approach path indicator
PCN Pavement classification number
RAIL Runway alignment indicator lights
REL Runway entrance lights
RESA Runway end safety area
RETIL Rapid exit taxiway indicator lights
RIL Runway intersection lights
RGL Runway guard lights
RTIL Runway threshold identification lights
RVR Runway visual range
RWSL Runway status lights
S South
secs Seconds (as in degrees, minutes, seconds)
SM Statute mile
SMGCS Surface movement and guidance control system
SSALS Simplified short approach lighting system
SSALR Simplified short approach lighting system with runway alignment lights
T True
TCCA Transport Canada Civil Aviation
TDZ Touchdown zone
TDZE Touchdown zone elevation
TDZL Touchdown zone lighting
THL Take-off hold lights
TODA Take-off distance available
TORA Take-off run available
TP Transport Canada publication
VAGS Visual alignment guidance system
VDGS Visual docking guidance system
VFR Visual flight rules
VMC Visual meteorological conditions
W West
WAAS Wide area augmented system
WGS-84 World Geodetic System 1984

MF Mandatory frequency

PREAMBLE

Previous editions of TP 312 were of a design based concept that was easily applied to the construction of a new facility where there are no space constraints. This design based concept dates back to the 1960s at a time when aircraft performance was inferior to that of the current modern fleet.

However, the modern aircraft fleet has performance characteristics that are significantly different from those of the 1960s. Advancements in technology have resulted in significant changes to aircraft design and performance, enabling operations of airliner-type aircraft on much shorter runways than was originally envisioned. Aircraft such as the CRJ, DH8, ATR42 are capable of operations on runways that are short in comparison to similar operations in the 1960s, thereby opening access to many sites across Canada that previously had limited/no airline type service.

Also, the *Criteria for the Development of Instrument Procedures* (TP 308) used in Canada, like that of the FAA's Terminal Instrument Procedures (TERPS) on which it is based, is of an operational concept whereas the aircraft size and approach speed are primary considerations in the establishment of the appropriate parameters. However, the concept of the airport standards in 3rd and 4th editions outlining the ground infrastructure requirements that support the instrument approach is of a design based concept. This has resulted in numerous oversight challenges over the years with the application of TP 312 due to the differing concepts and lack of harmonization between TP 312 and TP 308.

It has been proven over the years that in order to address issues commonly experienced at Canadian aerodromes a more oriented operational approach was needed. Regulatory oversight activities have noted on numerous occasions that some of these design based specifications were difficult to apply at an evolving aerodrome that has to deal with changes in level of service and type of traffic using the facility, sometimes on a daily basis.

Changes in the administrative model of Canadian airports due to privatization has also increased the need for an operational based concept that is adaptable to the airport operator needs and objectives, all while ensuring safety in on-going operations.

Therefore, the airport standards document TP 312 has been adapted for use in an operational concept to reflect and support the operational reality of aircraft capabilities and aviation activities in Canada. In doing so, there would be a consistency in the operational concepts in North America since the FAA has been using this concept for the application of airport requirements for many decades.

With the above operational difficulties noted on some specifications, the document was updated with the participation of industry experts in the field of aerodrome operations, design, and aircraft operations. These individuals worked in unison with Transport Canada and the Department of National Defence with a common objective of having a cohesive safety document, while maintaining flexibility for operations and development of the aerodrome.

This document has been updated to harmonize, where possible with:

- current ICAO specifications such as those related to the introduction of new large aircraft (ICAO Code F);
- Canadian airspace design criteria as applied in *Criteria for the Development of Instrument Procedures* (TP 308); and
- Advances in lighting technology such as those related to the introduction of light emitting diodes (LEDs).

For consistency with the *Canadian Aviation Regulations* (CARs), this edition of TP 312 contains 'Standards' only. Some of the application standards in this document have no set criteria to require the implementation and therefore the application standard includes the use of "where provided…" When the text makes reference to these open standards whose application is not mandated, the text specifies that the standard is only valid when an element relating to the standard is provided. However if the airport operator chooses to provide, then all the standards associated with that particular element are mandatory.

For the planning and design of airport infrastructure or level of service changes, the 5th edition of TP 312 edition establishes the minimum level of compliance required. Recommendations and other guidance information contained in previous editions may be found in Transport Canada's Advisory Circulars, or ICAO Annexes and Aerodrome Design/Service Manuals.

Under this 5th edition, the certification level of service will be established based on the aircraft using the site (dimensions and approach speed), or planned usage as declared by the airport operator. Runway length will no longer be of prime consideration in the overall concept. This change will put the level of service decision in the hands of the airport operator since it is ultimately their business decision. This certification level of service will be published in the Aeronautical Publications for use by aircrews in determining the suitability of the aerodrome for the intended operation pursuant to CAR 602.96(2)(b).

INTRODUCTION

These standards complement subpart 302 of the *Canadian Aviation Regulations* (CARs). They set out requirements such as: physical characteristics, obstacle limitation surfaces, visual aids and technical services the aerodrome operator at a certified land aerodrome (airport) provides to support aircraft operations. Other standards, established under Part III of the CARs form part of the overall safety specifications to satisfy the requirements of aerodrome certification.

Unlike previous editions of TP 312 that were of a design based concept, TP312 5th edition incorporates an operationally based concept. The implementation of standards under the operational concept is primarily based on aerodrome operational level and physical aircraft characteristics, such as:

- the size of the critical aircraft (see the reference number system in Chapter 1),
- the type of runway (non-instrument, non-precision or precision), and
- the aerodrome operational visibility limits.

The interrelationship between the above elements sets forth the **minimum** requirements for a land aerodrome to be certified. Rapidly changing technologies in aircraft performance and avionics have a very real potential to impact future aerodrome operations. An increase in the size of critical aircraft or the provision of lower landing, departure or taxi limits will require the aerodrome operator to re-assess the aerodrome facilities and/or operational procedures to ensure they provide the required standards.

To implement this operationally based concept into aerodrome certification will require the publication of:

- the maximum aircraft size that the aerodrome is certified to;
- the runways, taxiways and aprons that are only suitable for smaller aircraft, and
- the aerodrome operational visibility limit.

This will allow the air operator to determine that the aerodrome meets the recognized safety requirements/parameters for their aircraft type and operation as implemented through the Part III certification program for aerodromes.

At locations where aircraft operations occur below a visibility value of RVR2600 (½ SM), the implementation of a Surface Movement and Guidance Control System (SMGCS) or Advanced Surface Movement and Guidance Control System (A-SMGCS) needs to be considered as part of the Reduced / Low Visibility Operations Plan. The specifications in this document support operations at or above visibility values of RVR300.

CAUTION: The reader is advised that the text associated with an italicized ***Note:*** is informative in nature and has no legal effect.

AMENDMENTS TO TP 312 5th EDITION

Amendment	Subject(s)	Effective date
0	Original document	September 15th 2015

CHAPTER 1.
GENERAL

CHAPTER 1. GENERAL

1.1 DEFINITIONS

IN THESE STANDARDS:

Accuracy. A degree of conformance between the estimated or measured value and the true value. (*Précision)*

Note: For measured positional data, the accuracy is normally expressed in terms of a distance from a stated position where the true position falls with a defined confidence.

Aerodrome beacon. Aeronautical beacon used to indicate the location of an aerodrome from the air. *(Phare d'aérodrome)*

Aerodrome elevation. The highest runway elevation point on the aerodrome. *(Altitude de l'aérodrome)*

Aerodrome reference point. The designated geographical location of an aerodrome. *(Point de référence d'aérodrome)*

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

Aeronautical evaluation. The process of examining an aeronautical concern in order to assess its impact. *(Évaluation aéronautique)*

Aeronautical ground light. Any light specifically provided as an aid to air navigation, other than a light displayed on an aircraft. *(Feu aéronautique à la surface)*

Aircraft approach speed category. A grouping of aircraft based on a reference landing speed (V_{REF}), if specified, or if V_{REF} is not specified, 1.3 times stall speed (V_{SO}) at the maximum certificated landing weight. V_{REF}, V_{SO}, and the maximum certificated landing weight are those values as established for the aircraft by the certification authority of the country of registry.

- <u>Category A</u>: Speed less than 91 kt. *(Catégorie A)*
- <u>Category B</u>: Speed 91 kt or more but less than 121 kt. *(Catégorie B)*
- <u>Category C</u>: Speed 121 kt or more but less than 141 kt. *(Catégorie C)*
- <u>Category D</u>: Speed 141 kt or more but less than 166 kt. *(Catégorie D)*
- <u>Category E</u>: Speed 166 kt or more. *(Catégorie E) (Catégories de vitesses d'approche)*

Note: FAA Airport Design Advisory Circular (AC) 150/5300-13A contains a partial aircraft listing of aircraft approach speeds. Further information may be obtained from the aircraft manufacturer.

Aircraft classification number (ACN). A number expressing the relative structural loading effect of an aircraft on a pavement for a specified standard subgrade category. *(Numéro de classification d'aéronef)*

Aircraft stand. A designated area on an apron to be used for parking an aircraft. *(Poste de stationnement d'aéronef)*

Aircraft stand taxilane. A portion of an apron providing access to aircraft stands. *(Voie d'accès de poste de stationnement d'aéronef)*

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

Bearing strength. The structural ability of a surface to support loads imposed by aircraft. *(Force portante)*

Blast pad. An area before the threshold that is prepared to resist erosion arising from jet exhaust or propeller wash. *(Plate-forme anti-souffle)*

California bearing ratio (CBR). A measure of the load bearing capacity of a given sample of soil expressed as a ratio relative to the load bearing capacity of crushed limestone. *(Indice portant californien)*

Note: The load bearing capacity of crushed limestone is expressed as a CBR of 100.

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

Clearway. A defined rectangular area over land or water under the control of the aerodrome operator, selected as a suitable area over which an aircraft may make a portion of its initial climb to a specified height. *(Prolongement dégagé)*

Critical aircraft. The aircraft identified as having the most demanding operational requirements with respect to the determination of movement area dimensions, and other aerodrome physical characteristics at the aerodrome or part thereof. *(Avion critique)*

Note: "Part thereof" could be a single taxiway, runway, apron, runway end safety area, or an area of the aerodrome that includes a combination of these.

Declared distances. The distances that the aerodrome operator declares available for the aircraft take-off run, take-off distance, accelerate-stop distance, and landing distance requirements. The distances are categorized as follows:

- Take-off run available (TORA). The length of the runway available and suitable for the ground run of an aircraft taking off. *(Distance de roulement utilisable au décollage)*
- Take-off distance available (TODA). The length of the take-off run available plus the length of the clearway, if provided. *(Distance de décollage utilisable)*
- Accelerate-stop distance available (ASDA). The length of the take-off run available plus length of the stopway, if provided. *(Distance utilisable pour l'accélération-arrêt)*
- Landing distance available (LDA). The length of the runway available and suitable for the ground run of an aircraft landing. *(Distance d'atterrissage utilisable) (Distances déclarées)*

Effective intensity. The effective intensity of a flashing light is equal to the intensity of a fixed light of the same colour that will produce the same visual range under identical conditions of observation. *(Intensité efficace)*

Elevation. The vertical distance of a point or a level, on or affixed to the surface of the earth, measured from MSL. *(Altitude)*

Fixed by function NAVAID. An air navigation aid (NAVAID) that must be positioned in a particular location in order to provide an essential benefit for civil aviation is fixed by function. Exceptions are:

(a) Equipment shelters, junction boxes, transformers, and other appurtenances that support a fixed by function NAVAID *are not* fixed by function unless operational requirements require them to be located in close proximity to the NAVAID.

(b) Some NAVAIDs, such as non-directional beacons or localizers, can provide beneficial performance to civil aviation even when they are not located at their optimal location. These NAVAIDS *are not* fixed by function. *(NAVAID fixe de par sa fonction)*

Fixed light. A light having constant luminous intensity when observed from a fixed point. *(Feu fixe)*

Flashing light. A light showing one or more flashes at regular intervals. The flash characteristic may be produced by variety of means such as capacitor discharge, rotation or occulting. *(Feu à éclats)*

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

Note: Guidance on design for frangibility is contained in the ICAO Aerodrome Design Manual, Part 6.

Geoid undulation. The distance of the geoid above (positive) or below (negative) the mathematical reference ellipsoid. *(Ondulation du géoïde)*

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

Hazard beacon. An aeronautical beacon used to designate a danger to air navigation. *(Phare de danger)*

Holding bay. A defined area, where aircraft can be held, or bypassed, to facilitate efficient surface movement of aircraft. *(Plate-forme d'attente de circulation)*

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

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

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

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

(c) critical data: there is a high probability when using corrupted critical data that the continued safe flight and landing of an aircraft would be severely at risk with the potential for catastrophe. *(données critiques) (Classification de l'intégrité (données aéronautiques))*

Intermediate holding position. A designated position intended for traffic control at which taxiing aircraft and vehicles stop and hold until further cleared to proceed, when so instructed by the aerodrome control tower. *(Point d'attente intermédiaire)*

Marker. An object displayed above ground level to indicate an obstacle or delineate a boundary. *(Balise)*

Marking. A symbol or group of symbols displayed on the surface of the movement area to convey aeronautical information. *(Marque)*

Obstacle. All fixed (whether temporary or permanent) and mobile objects that are located within an area protected for the surface movement of aircraft or that project into a defined surface intended to identify obstacles or protect aircraft in flight. *(Obstacle)*

Obstacle free zone (OFZ). The airspace above the precision obstacle free zone, approach surface, inner transitional surface, and that portion of the strip bounded by these surfaces, which is not penetrated by any obstacle, except for frangible visual NAVAIDs that need to be located in the OFZ because of their function. *(Zone dégagée d'obstacles)*

Obstacle identification surface (OIS). A surface that is used to identify obstacles that project into the airspace associated with an aerodrome. Obstacle identification surfaces consist of the following:

- Outer obstacle identification surface. A surface located in a horizontal plane above an aerodrome and the surrounding area. *(Surface d'identification d'obstacles extérieure)*
- Approach obstacle identification surface. An inclined plane preceding the threshold of a runway. *(Surface d'identification d'obstacles à l'approche)(Surface d'identification d'obstacles)*

Obstacle limitation surface (OLS). A surface that establishes the limit to which objects may project into the airspace associated with an aerodrome so that aircraft operations at the aerodrome may be conducted safely. OLS consist of the following:

- Inner transitional surface. A complex surface extending lengthwise on the runway strip that extends upwards and outwards to the outer obstacle identification surface.*(Surface de transition intérieure)*
- Approach surface. An inclined plane preceding the threshold of a runway. *(Surface d'approche)*
- Take-off surface. An inclined plane beyond the end of the runway or clearway, if provided. *(Surface de décollage)*
- Transitional surface. A complex surface along the side of the runway strip and all or part of the side of the approach surface, that slopes upwards and outwards to a specified height. *(Surface de transition)(Surface de limitation d'obstacle)*

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

Note: PCN is the ICAO pavement strength reporting format.

Primary runway(s). Runway(s) used in preference to others as identified by the aerodrome operator. *(Piste(s) principale(s))*

Private taxiway. A taxiway that is not:

- used for scheduled commercial passenger carrying operations, or
- connected directly to a runway. *(Voie de circulation privée)*

Road-holding position. A designated position at which vehicles may be required to hold. *(Point d'attente sur voie de service)*

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

Runway end safety area (RESA). An area symmetrical about the extended runway centreline intended to reduce the severity of damage to an aeroplane undershooting or overrunning the runway. *(Aire de sécurité d'extrémité de piste)*

Runway-holding position. A designated position intended to protect a runway, an obstacle free zone, or an ILS or MLS critical/sensitive area at which taxiing aircraft and vehicles stop and hold, unless otherwise authorized by the air traffic service unit. *(Point d'attente avant piste)*

Runway safety area. A defined area, within the runway strip intended to reduce the risk of damage to aircraft running off a runway. *(Aire de sécurité de piste)*

Runway strip. A defined area, which includes the runway and stopway where provided, intended to protect aircraft flying over it during take-off or landing operations. *(Bande de piste)*

Runway turn pad. A defined area on a land aerodrome adjacent to a runway for the purpose of completing a 180-degree turn on a runway. *(Aire de demi-tour de piste)*

Runway types. Runways intended for the operation of aircraft and categorized as follows:

- Non-instrument runway. A runway intended for the operation of aircraft using visual approach procedures, or an instrument approach procedure down to a height above aerodrome (HAA)/ height above threshold (HAT) not lower than 500 ft. *(Piste à vue)*
- Non-precision runway. A runway served by visual and non-visual navigation aids that provides at least lateral guidance adequate for instrument approach procedure down to a HAA/ HAT lower than 500 ft but not lower than 250 ft, and with an approach visibility not less than ¾ SM (RVR4000). *(Piste de non-précision)*
- Precision runway *(Piste de précision)*

  -- Category I - A runway served by visual and non-visual navigation aids that provide lateral and vertical guidance adequate for an instrument approach procedure down to a HAT lower than 250 ft but not lower than 200 ft, or with an approach visibility less than ¾ SM (RVR4000) but not less than ½ SM (RVR2600); *(Catégorie I)*

  -- Category II - A runway served by visual and non-visual navigation aids that provide lateral and vertical guidance adequate for an instrument approach procedure down to a HAT lower than 200 ft but not lower than 100 ft, or with an approach visibility less than ½ SM (RVR2600) but not less than ¼ SM (RVR1200); *(Catégorie II)*

  -- Category III - A runway served by visual and non-visual navigation aids that provide lateral and vertical guidance adequate for an instrument approach procedure to a HAT lower than 100 ft or no decision height, or with an approach visibility less than ¼ SM (RVR1200) or no visibility (RVR) limit. (Catégorie III) (*Types de piste)*

Shielding. A situation whereby an obstacle may be unmarked or unlighted because of its proximity to other adjacent marked or lighted obstacles of equal or greater height. *(Défilement)*

Note: An aircraft whose path of flight would avoid the dominant obstacle would as a result fly over the shielded obstacle without risk of collision.

Stopway. A defined rectangular area on the ground at the end of take-off run available prepared as a suitable area in which an aircraft can be stopped in the case of a rejected take-off. *(Prolongement d'arrêt)*

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

Take-off runway. A runway intended for take-off only. *(Piste de décollage)*

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

- Apron taxiway. A portion of an apron designated as a taxiway providing a through taxi route across the apron. *(Voie de circulation d'aire de trafic)*
- Rapid exit taxiway. A taxiway connected to a runway at an acute angle and designed to allow landing aircraft to turn off at higher speeds than are achieved on other exit taxiways, thereby minimizing runway occupancy times. *(Voie de sortie rapide) (Voie de circulation)*

Taxiway safety area. A defined area, within the taxiway strip, intended to reduce the risk of damage to aircraft running off a taxiway. *(Aire de sécurité de voie de circulation)*

Taxiway strip. An area, including the taxiway, intended to protect an aircraft operating on the taxiway. *(Bande de voie de circulation)*

Threshold. The beginning of that portion of the runway declared usable for landing by the aerodrome operator. *(Seuil)*

Touchdown zone. The first 3 000 ft of the runway LDA or the first third of the runway, whichever is less, measured from the threshold in the direction of landing. *(Zone de toucher des roues)*

Transverse slope. The slope of a runway, taxiway, or a strip measured perpendicular to the centreline. *(Pente transversale)*

World Geodetic System 1984 (WGS-84). The geodetic co-ordinate reference system used in international civil aviation that allows the user to mathematically describe (in degrees of latitude and longitude) any position on the earth's surface. WGS-84 uses a global set of ground stations as references. *(Système géodésique mondial 1984)*

1.2 AIRCRAFT GROUP NUMBER (AGN)

Note 1: The purpose of the AGN is to provide a simple method for interrelating the numerous technical specifications concerning the aerodrome and the characteristics of the critical aircraft for which the aerodrome, or part thereof is provided.

Note 2: The objective is to provide aerodrome facilities that are suitable for the aircraft that are intended to operate at the aerodrome, or part thereof.

1.2.1.1 An AGN is determined, in accordance with the characteristics of the critical aircraft, for each part of the manoeuvring area.

1.2.1.2 The AGN (column I) is determined from Tables 1-1 or 1-2 as appropriate, by selecting the value which corresponds to the declared critical aircraft:

(a) wing span;

(b) outer main gear span; or

(c) tail height,

for which the manoeuvring area or part thereof is intended. In certain cases, the approach speed will be a consideration in the determination of the AGN.

Note: Table 1-1 is used for determining AGN for characteristics in the runway environment. Table 1-2 is used for determining AGN for characteristics in the taxiway environment.

Table 1-1: Runway Environment		
Column I	Column II	Column III
Aircraft Group Number	**Wing Span**	**Outer Main Gear Span (a)**
I (for approach speed CAT C or D use AGN IIIB)	Less than 14.94 m	Less than 4.5 m
II (for approach speed CAT C or D use AGN IIIB)	14.94 m up to but not including 24.10 m	4.5 m up to but not including 6 m
IIIA (for approach speed CAT C or D use AGN IIIB)	24.10 m up to but not including 36.00 m	6 m up to but not including 9 m
IIIB (includes groups I - IIIA with C & D approach speeds)	24.10 m up to but not including 36.00 m	6 m up to but not including 9 m
IV	36.00 m up to but not including 52.12 m	9 m up to but not including 14 m
V	52.12 m up to but not including 65.23 m	9 m up to but not including 14 m
VI	65.23 m up to but not including 79.86 m	14 m up to but not including 16 m

(a) – Distance between the outside edges of the main gear wheels.

Note: Table 1-1 includes consideration of the higher approach speeds that occur in the runway environment.

*Example on use of the tables: An aircraft has a wingspan of 20 m, a gear span of 4.7 m and a design approach speed of 129 kt (as per 1.3*stall speed). A standard references the use of Column II (wingspan) of Table 1-1 for its application. The aircraft falls into AGN II when referencing across the columns; however, the associated note directs the use of AGN IIIB due to the approach speed being in the C category. For Table 1-2, the AGN is read directly across from the column referenced in the appropriate standard.*

Table 1-2: Taxiway Environment			
Column I	Column II	Column III	Column IV
Aircraft Group Number	**Wing Span**	**Outer Main Gear Span (a)**	**Tail Height**
I	Less than 14.94 m	Less than 4.5 m	Less than 6.10 m
II	14.94 m up to but not including 24.10 m	4.5 m up to but not including 6 m	6.10 m up to but not including 9.15 m
IIIA	24.10 m up to but not including 36.00 m	6 m up to but not including 9 m	6.10 m up to but not including 9.15 m
IIIB	24.10 m up to but not including 36.00 m	6 m up to but not including 9 m	9.15 m up to but not including 13.72 m
IV	36.00 m up to but not including 52.12 m	9 m up to but not including 14 m	13.72 m up to but not including 18.30 m
V	52.12 m up to but not including 65.23 m	9 m up to but not including 14 m	18.30 m up to but not including 20.12 m
VI	65.23 m up to but not including 79.86 m	14 m up to but not including 16 m	20.12 m up to but not including 24.40 m

(a) – Distance between the outside edges of the main gear wheels.

CHAPTER 2. AERODROME DATA

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Note 1: This chapter contains specifications relating to the provision of data to be recorded in the airport operations manual (AOM) and reported to the aeronautical information service (AIS) provider where applicable.

Note 2: The resolution requirements for the determination of aeronautical data are in accordance with ICAO Annexes 4 and 15 at the time of publication of this chapter.

2.1 GENERAL

2.1.1 Definitions

Surveyed means by a land surveyor, professional accredited by the appropriate authority, or by recognized methodology accepted by the AIS provider.
Determined means by computation or plotting.
Recorded means recorded in the AOM.
Reported means recorded in the AOM and submitted to the AIS provider.

2.1.2 Units of Measurement

2.1.2.1 Elevations are given to the nearest foot.

2.1.2.2 Except as specified, linear dimensions are given to the nearest one-half metre.

2.1.2.3 Except as specified, geographic coordinates are given in latitude and longitude (degrees, minutes, seconds) to the nearest hundredths of seconds.

2.1.2.4 Except as specified, coordinates are measured in accordance with the WGS-84 reference datum.

Note: Information on the WGS 84 reference datum is found in the ICAO World Geodetic System—1984 (WGS-84) Manual (Doc 9674).

2.1.2.5 Elevations are measured in accordance with the Canadian Geodetic Vertical Datum (2013).

2.1.2.6 Except as specified, bearings are given to the nearest one hundredth of a degree.

2.1.2.7 The determination and reporting of aerodrome-related aeronautical data is in accordance with the accuracy and integrity classification set forth in Tables 1 to 5 contained in Appendix 2A—Aeronautical Data Quality Requirements.

Note 1: Accuracy requirements for aeronautical data are based upon a 95% confidence level and in that respect, three types of positional data are identified:

- *surveyed points (e.g. runway threshold),*
- *calculated points (e.g. mathematical calculations from the known surveyed points of thresholds for determination of the aerodrome reference point); and*
- *declared points (e.g. flight information region boundary points).*

Note 2: Further guidance is available in the ICAO World Geodetic System—1984 (WGS-84) Manual (Doc 9674).

2.2 GEOGRAPHIC DATA

2.2.1 Aerodrome Reference Point (ARP)

2.2.1.1 An aerodrome reference point is determined and reported.

2.2.1.2 The aerodrome reference point is determined by the mean of the:

(a) latitudes of the furthest north runway threshold and furthest south runway threshold; and

(b) longitudes of the furthest east runway threshold and furthest west runway threshold.

Note 1: The determination of the aerodrome reference point could be based on the actual or planned location of runway thresholds.

Note 2: While an ARP may be re-established, it normally remains at the established position due to the associated impacts of a move on airspace design.

2.2.1.3 The position of the aerodrome reference point is reported in degrees, minutes and seconds.

2.2.1.4 The elevation assigned to the aerodrome reference point is the elevation of the lowest point on the runway(s).

2.2.2 Runway Threshold and End Coordinates

2.2.2.1 The geographic coordinates of the runway threshold are surveyed at the centreline and reported for each runway.

2.2.2.2 Where the runway end is not co-located with the threshold, the geographic coordinates for the runway end are surveyed at the centreline and reported.

Note: The runway end coordinates should be taken at the end of TORA.

2.2.2.3 Where a stopway is provided, the coordinates for the end of ASDA are surveyed at the centreline and reported.

2.2.3 Aerodrome and Runway Elevations

2.2.3.1 The aerodrome elevation is surveyed and reported.

2.2.3.2 For each runway, the elevation of the thresholds and the high and low points in each third along the runway is surveyed at the centreline and reported.

2.2.3.3 For each runway, the highest elevation of the touchdown zone is surveyed at the centreline and reported.

2.2.3.4 The geoid undulation is determined and reported for:

(a) the aerodrome elevation position, and

(b) each threshold of a precision or non-precision runway.

2.2.4 Aerodrome Magnetic Variation

2.2.4.1 The magnetic variation for the aerodrome reference point is determined and reported to the nearest degree from magnetic north.

2.3 AERODROME DIMENSIONS AND RELATED INFORMATION

2.3.1 General

2.3.1.1 Where provided, the following data is determined and recorded, and reported as applicable:

(a) runway—true bearing, designation number, length and width to the nearest foot, threshold & runway end coordinates, overall slope, slope per third of length, surface type, strength (ACN-PCN method), surface CBR and determination methodology for gravel runways, AGN, type of runway, and certification level for use (RVR or visibility);

(b) lengths and widths of the runway and taxiway strips;

(c) lengths, widths and surface types of the runway and taxiway safety areas, runway end safety areas (including EMAS), and stopways where provided;

(d) taxiway—designation, width, surface type, strength (ACN-PCN method), AGN, and certification level for use (RVR or visibility);

(e) apron—surface type, strength (ACN-PCN method), aircraft stand locations;

(f) clearway—length and width;

(g) subject to (x), obstacles identified by an obstacle identification surface as follows:

(i) the coordinates of the highest point to the tenth of a second; and

(ii) the elevation of the highest point;

(x) The coordinates and elevation for terrain, or a group of obstacles such as wind turbines, are reported for the highest point only, provided the overall size of the infringement into the obstacle identification surface is provided.

(h) visual approach aids such as approach lighting, PAPIs, marking and lighting of runways, taxiways and aprons, other visual guidance and control aids on taxiways and aprons, including runway-holding positions and stop bars;

(i) routing and designation of published taxi-routes; and

(j) where visual approach slope guidance is provided such as PAPI or APAPI, the mean eye height over threshold of the approach slope, nominal approach slope angle, and axis displacement and direction from runway centreline where applicable.

2.3.1.2 Where the facility supports operations below visibility conditions less than RVR1200 (¼ SM), the geographical coordinates of each aircraft stand provided for use in these visibility conditions are surveyed and reported.

2.3.1.3 Where provided, the geographical coordinates of the taxiway centreline are surveyed and reported in degrees, minutes, seconds and hundredths of seconds.

Note: The provision of taxiway centreline coordinates support low visibility operations where aircraft use technologies such as the moving map to navigate the manoeuvring area.

2.3.2 Declared Distances

General

2.3.2.1 The following distances are determined and reported to the nearest foot for each runway

(a) take-off run available (TORA);

(b) take-off distance available (TODA);

(c) accelerate-stop distance available (ASDA); and

(d) landing distance available (LDA).

2.3.2.2 The calculation of declared distances is as illustrated in Figure 2-1.

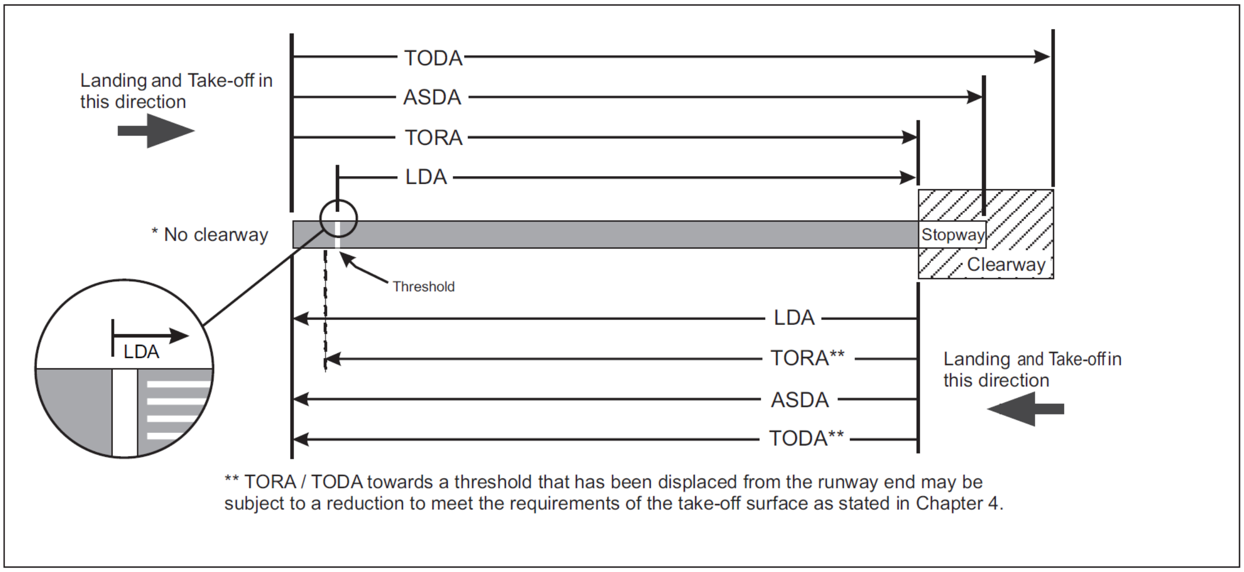


Figure 2-1: Illustration of declared distances

2.3.2.3 Where Land and Hold Short Operations (LAHSO) are conducted, the reduced LDA on the intersected runway is determined and reported as the distance between the threshold and the runway-holding position marking in accordance with Figure 2-2: Illustration of LAHSO distances.

Note: LAHSO includes landing and holding short of an intersecting runway, taxiway, predetermined point, approach or departure flight path.

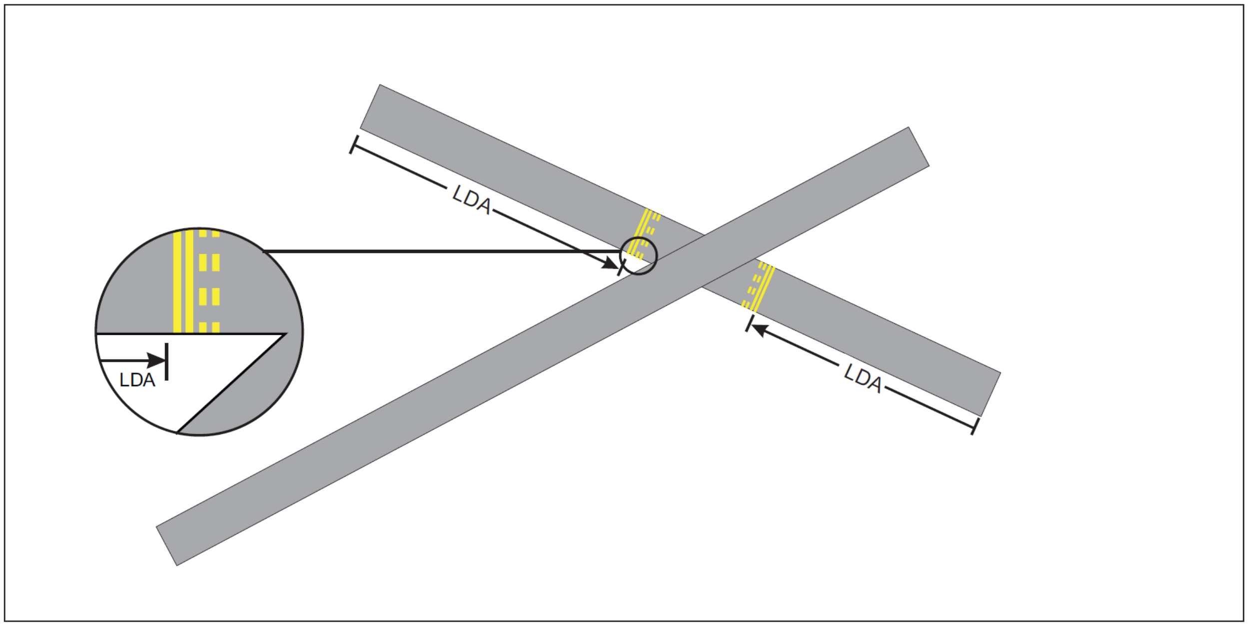


Figure 2-2 Illustration of LAHSO distances

2.3.2.4 Where intersection departures are conducted, the reduced TORA for intersection take-offs is determined and reported in accordance with Figure 2-3: Illustration of intersection take-off run distances.

Note: Only TORA is published for intersection departures.

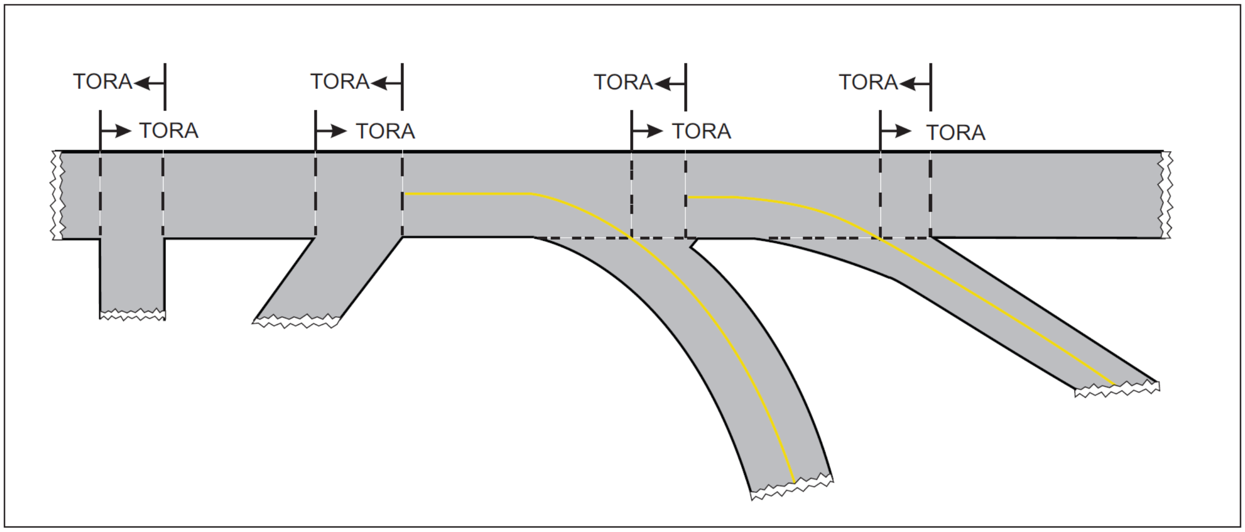


Figure 2-3: Illustration of of intersection take-off run distances.

2.3.3 ICAO Type A Obstacle Charts

Note: Guidance on ICAO Type A charts can be found in Annex 4—Aeronautical Charts *of the* Convention on International Civil Aviation.

Application

2.3.3.1 The operator of an aerodrome supporting international commercial passenger operations provides to the aeronautical information service (AIS) provider the information required to compile ICAO Type A obstacle charts in the format required by the AIS provider for all runways serving AGNs IIIB and above in Table 1-1, Column II.

General

2.3.3.2 An obstacle survey with the following information is provided for each runway:

(a) runway designation, magnetic and true bearings, declared distances, width, and surface type;

(b) length and width of the clearway, if provided;

(c) dimensions of the take-off flight path area;

(d) runway threshold and departure end elevations;

(e) location, height above MSL, and nature of each object within the take-off flight path area identified as obstacles; and

(f) the date the obstacle survey was completed.

Note: Subsequent submissions need only contain the results of the obstacle survey and any other items of the information that have changed.

2.3.3.3 Any new activity resulting in a change to any of the items required in 2.3.3.2 is submitted to the aeronautical information service provider.

Requirement for obstacle survey

2.3.3.4 Subject to 2.3.3.5, a survey of the take-off flight path area is done at a frequency not exceeding 5 years.

Note: The increase in building construction in proximity of the aerodrome may be such that a frequency less than 5 years is required.

2.3.3.5 A survey is not required if it can be ascertained that there are no new obstacles in the take-off flight path area and a report is made to the AIS provider to that effect.

Characteristics

Take-off Flight Path Area

2.3.3.6 The take-off flight path area consists of a quadrilateral area on the surface of the earth lying directly below, and symmetrically disposed about, the take-off flight path. This area has the following characteristics:

(a) it commences at the end of the declared TODA;

(b) its width at the point of origin is 180 m and this width increases at the rate of 0.25D to a maximum of 1 800 m where D is the distance from the point of origin; and

(c) it extends to the point beyond which no obstacles exist or to a distance of 10.0 km, whichever is the lesser.

Plane surface

2.3.3.7 The plane surface of the take-off flight path area has the following characteristics:

(a) its elevation at the point of origin is equivalent to the elevation at the end of the TORA, or clearway plane elevation at the end of the clearway, whichever is higher;

(b) it extends from the origin along the extended runway centreline at an upward slope of 1.2% to the end of the take-off flight path area.

Obstacles

2.3.3.8 Objects, including mobile objects in the take-off flight path area that protrude above the plane surface are regarded as obstacles. As a minimum, 4.3 m of clearance is provided above the crown of a road; for a railway, 6 m above the top of the rails. An aeronautical evaluation, determining the height of the most critical obstacle, establishes the minimum clearance height above a waterway, river, canal, etc.

2.4 STRENGTH OF PAVEMENTS

Definitions

Paved surface means a surface of asphaltic concrete (flexible) or Portland cement concrete (rigid).

2.4.1 General

Application

2.4.1.1 The bearing strength of a pavement in the movement area is determined and reported as follows:

(a) For movement areas intended for aircraft of an apron gross weight greater than 5 700 kg, the bearing strength of a pavement is made available using the aircraft classification number - pavement classification number (ACN-PCN) method by reporting all of the following information:

(i) the pavement classification number (PCN);

(ii) pavement type for ACN-PCN determination;

(iii) subgrade strength category;

(iv) maximum allowable tire pressure category or maximum allowable tire pressure value; and

(v) evaluation method.

(b) For movement areas intended for aircraft of an apron gross weight equal to or less than 5 700 kg, the bearing strength of a pavement is made available by reporting the following information:

(i) maximum allowable aircraft gross weight; and

(ii) maximum tire pressure (e.g. 4 000 kg / 0.50 MPa).

2.4.1.2 The surface strength of an unpaved surface, such as gravel or grass, is determined using a recognized CBR evaluation method and reported as follows:

(a) CBR number;

(b) surface type; and

(c) evaluation method.

TABLE 2.4.2.2—Pavement Classification Number (PCN) Reporting Codes

Pavement Type for ACN-PCN Determination	Codes
Rigid Pavement	R
Flexible Pavement	F
If the actual pavement construction is composite or non-standard, a note is included to that effect (see example 2 below).	
Subgrade Strength Category	
<u>High Strength</u>: characterized by k=150 MN/m^3 and representing all k values above 120 MN/m^3 for rigid pavements, and by CBR=15 and representing all CBR values above 13 for flexible pavements.	A
<u>Medium Strength</u>: characterized by k=80 MN/m^3 and representing a range in k of 60 to 120 MN/m^3 for rigid pavements, and by CBR=10 and representing a range in CBR of 8 to 13 for flexible pavements.	B
<u>Low Strength</u>: characterized by k=40 MN/m^3 and representing a range in k of 25 to 60 MN/m^3 for rigid pavements, and by CBR=6 and representing a range in CBR of 4 to 8 for flexible pavements.	C
<u>Ultra Low Strength</u>: characterized by k=20 MN/m^3 and representing all k values below 25 MN/m^3 for rigid pavements, and by CBR=3 and representing all CBR values below 4 for flexible pavements.	D
k = the bearing modulus determined at the slab/base course interface	
CBR = California bearing ratio	
Maximum Allowable Tire Pressure Category or Value	
The maximum allowable tire pressure is reported by either:	
(i) using the code letters listed below:	
<u>Unlimited</u>: no tire pressure limitation	W
<u>High</u>: tire pressure limited to 1.75 MPa	X
<u>Medium</u>: tire pressure limited to 1.25 MPa	Y
<u>Low</u>: tire pressure limited to 0.50 MPa	Z
or by:	
(ii) stating the actual tire pressure limitation in MPa, except that where no tire pressure limitation is applicable, the code **W** is reported.	
Evaluation Method	
<u>Technical Evaluation</u>: representing the results of a specific engineering study of the structural characteristics of the pavement and application of pavement structural behaviour technology.	T
<u>Using Aircraft Experience</u>: representing a knowledge of the specific type and weight of aircraft satisfactorily being supported by the pavement under regular use.	U

Note 1: The following examples illustrate how pavement strength data are reported using the ACN-PCN method.
Note 2: For paved surfaces, the PCN takes into account any seasonal variations, which may result in a temporary reduction in pavement strength. For non-paved surfaces such as gravel, any seasonal reduction from the reported strength should be indicated by the means of an explanatory note.

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

Example 2: If the bearing strength of a composite pavement, behaving like a flexible pavement and resting on a high strength subgrade has been assessed by using aircraft experience to be PCN 50 and the maximum allowable tire pressure is 1.25 MPa, then the reported information would be:

PCN 50/ F/ A/1.25 MPa/ U (Preferred method); or PCN 50/ F/ A/Y/ U Note: Composite construction.

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

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

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

2.4.2 ACN-PCN Method of Reporting

2.4.2.1 The behaviour of a pavement is classified as equivalent to a rigid or flexible construction, for the purposes of determining the ACN.

2.4.2.2 Information on pavement type for PCN determination, subgrade strength category, maximum allowable tire pressure category and evaluation method is reported using the codes specified in Table 2.4.2.2.

2.4.2.3 The PCN is reported to an accuracy of the nearest whole number.

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

2.5 CONDITION OF THE MOVEMENT AREA AND RELATED FACILITIES

2.5.1 General

2.5.1.1 Information on the condition of the manoeuvring area and the operational status of related facilities is communicated to the appropriate aeronautical information service units, and similar information of operational significance to the air traffic services units, to enable those units to provide the necessary information to arriving and departing aircraft. The information is kept up to date and changes in conditions are reported without delay.

Note: The above also includes the reporting of information associated with winter operations and disseminated using the standard Aircraft Movement Surface Condition Report (AMSCR) process.

2.5.1.2 The condition of the movement area and the operational status of related facilities are monitored and reports on matters of operational significance or affecting aircraft performance are communicated to AIS where provided, or the aircrew directly, in respect of the following:

(a) construction or maintenance work;

(b) rough or broken surfaces on a runway, a taxiway or an apron;

(c) contaminants such as snow, slush, frost or ice on a runway, a taxiway or an apron;

(d) standing water on a runway, a taxiway or an apron;

(e) snow banks or drifts adjacent to a runway, a taxiway or an apron;

(f) the application of anti-icing, de-icing liquid chemicals, or sand on a runway, taxiway or apron;;

(g) other temporary hazards;

(h) low friction characteristics of the runway per 2.5.1.3;

(i) failure or irregular operation of part or all of the aerodrome visual aids; and

(j) failure of the normal or secondary power supply.

2.5.1.3 A runway or its portion is deemed as having low friction, such as due to rubber accumulation or surface texture degradation, when the friction measurements, as measured by a continuous friction measuring device, are below the minimum friction level specified in 9.1.2.2.

Note 1: When a runway has low friction, this is normally disseminated to the aircrews through NOTAM, ATIS, etc... stating the <u>runway may be slippery when wet</u>.

Note 2: 2.5.1.3 excludes any condition associated with winter operations.

Appendix 2A
Aeronautical Data Quality Requirements

APPENDIX 2A—AERONAUTICAL DATA QUALITY REQUIREMENTS

Table 1. Latitude and Longitude

Latitude and Longitude	Accuracy Data Type	Integrity Classification
Aerodrome reference point	30 m surveyed or calculated	routine
Runway thresholds	1 m surveyed	critical
Runway end (flight path alignment point)	1 m surveyed	critical
Runway centreline points	1 m surveyed	critical
Runway-holding position	0.5 m surveyed	critical
Taxiway centreline/parking guidance line points	0.5 m surveyed	essential
Intermediate holding position	0.5 m surveyed	essential
Exit guidance line *(taxiway centreline marking exiting from the runway)*	0.5 m surveyed	essential
Apron boundaries (polygon)	1 m surveyed	routine
De-icing/anti-icing facility (polygon)	1 m surveyed	routine
Aircraft stand points/INS checkpoints	0.5 m surveyed	routine

Table 2. Elevation/Altitude/Height

Elevation/Altitude/Height	Accuracy Data Type	Integrity Classification
Aerodrome elevation	1.0 ft surveyed	essential
WGS-84 geoid undulation at aerodrome elevation position	1.0 ft surveyed	essential
Runway threshold, non-precision approaches	1.0 ft surveyed	essential
WGS-84 geoid undulation at runway threshold, non-precision approaches	1.0 ft surveyed	essential
Runway threshold, precision approaches	0.5 ft surveyed	critical
WGS-84 geoid undulation at runway threshold, precision approaches	0.5 ft surveyed	critical
Runway centreline points	0.5 ft surveyed	critical
Taxiway centreline/parking guidance line points	1 m surveyed	essential

Table 3. Declination and Magnetic Variation		
Declination/Variation	**Accuracy Data Type**	**Integrity Classification**
Aerodrome magnetic variation	1° surveyed	essential

Table 4. Bearing		
Bearing	**Accuracy Data type**	**Integrity Classification**
Runway bearing (True)	1/100° surveyed	routine

Table 5. Length/Distance/Dimension		
Length/Distance/Dimension	**Accuracy Data Type**	**Integrity Classification**
Runway length	1 ft surveyed	critical
Runway width	1 ft surveyed	essential
Threshold displacement distance	1 ft surveyed	routine
Stopway length and width	1 ft surveyed	critical
Clearway length and width	1 ft surveyed	essential
Landing distance available	1 ft surveyed	critical
Take-off run available	1 ft surveyed	critical
Take-off distance available	1 ft surveyed	critical
Accelerate-stop distance available	1 ft surveyed	critical
Taxiway width	1 ft surveyed	essential

Note : See ICAO Annex 15, Appendix 8, for graphical illustrations of obstacle data collection surfaces and criteria used to identify obstacles in the defined areas.

CHAPTER 3. PHYSICAL CHARACTERISTICS

CHAPTER 3. PHYSICAL CHARACTERISTICS

3.1 RUNWAYS

3.1.1 General

Width of Runways

3.1.1.1 The runway has the minimum width specified in Table 3.1.1.1, except where an aircraft is approved in the aircraft flight manual to operate on a narrower runway.

Table 3.1.1.1—Minimum Runway Width (in metres)

Aircraft Group Number *Table 1-1 Column III*	Non-Instrument / Non-Precision Runways	Precision Runways
I	18	23
II	23	30
III (A & B)	30	30
IV	45	45
V *(2)*	45	45
VI *(2)*	60	60

Note: Some aircraft may require additional width to comply with their operational standards.

Separation of Parallel Runways

3.1.1.2 Where parallel runways are provided for simultaneous use under visual meteorological conditions only, the minimum distance between their centrelines is as specified in Table 3.1.1.2.

Table 3.1.1.2—Minimum Separation of Parallel Runway Centrelines (in metres)

Aircraft Group Number *Table 1-1 Column II*	I	II	IIIA	IIIB	IV	V	VI
Separation	120	150	150	214	214	214	214

Note: Guidance on planning and conducting simultaneous operations on parallel or near–parallel instrument approach runways is contained in Criteria for the Development of Instrument Procedures, Volume 3 (TP 308).

3.1.2 Slopes on Runways

Longitudinal Runway Slopes

3.1.2.1 The maximum longitudinal slope along any portion of the runway is as specified in Table 3.1.2.1, except that for the first and last quarter of the length of the runway the longitudinal slope is a maximum of 0.8% where the runway is a category III precision runway.

Table 3.1.2.1—Maximum Longitudinal Runway Slope on Any Portion

Aircraft Group Number *Table 1-1 Column II*	I	II	IIIA	IIIB	IV	V	VI
Maximum slope	2.0 %	2.0 %	2.0 %	1.5 %	1.25 %	1.25 %	1.25 %

Longitudinal slope changes

3.1.2.2 Where longitudinal slope changes cannot be avoided, the maximum slope change between two consecutive slopes is as specified in Table 3.1.2.2:

Table 3.1.2.2—Maximum Longitudinal Slope Change Between Two Slopes							
Aircraft Group Number *Table 1-1 Column II*	I	II	IIIA	IIIB	IV	V	VI
Maximum slope change	2.0 %	2.0 %	2.0 %	1.5 %	1.5 %	1.5 %	1.5 %

Note: Short abrupt slope changes can affect aircraft instrumentation, controllability and structural load issues.

3.1.2.3 The transition from one longitudinal slope to another is accomplished by a curved surface with a rate of change per 30 m not exceeding the values in Table 3.1.2.3:

Table 3.1.2.3—Maximum Longitudinal Slope Rate of Change							
Aircraft Group Number *Table 1-1 Column II*	I	II	IIIA	IIIB	IV	V	VI
Rate of change	0.4 %	0.4 %	0.4 %	0.2 %	0.1 %	0.1 %	0.1 %

Note: See Figure 3-1: Runway Longitudinal Slope Limitations, Example 1

Distance Between Slope Changes

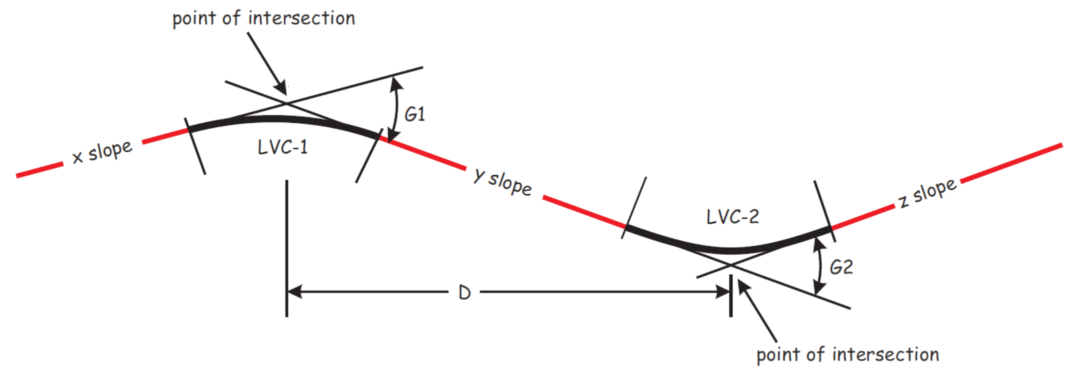
3.1.2.4 The minimum distance between the points of intersection of two successive curves is the greater of:

(a) the sum of the absolute numerical values of the corresponding slope changes multiplied by the appropriate value in Table 3.1.2.4; or

(b) 45 m.

Table 3.1.2.4—Calculation Value to Determine the Minimum Distances Between Slope Changes (in metres)							
Aircraft Group Number *Table 1-1 Column II*	I	II	IIIA	IIIB	IV	V	VI
Value	5 000	5 000	5 000	15 000	30 000	30 000	30 000

Note 1: See Figure 3-1: Runway longitudinal slope limitations, Example 2



D = minimum distance between points of intersection between slope changes
LVC = Length of vertical curve
G1, G2 = slope change (maximum of 1.5%)

Example 1: ***Minimum LVC***

slopes: $x = 0.4\%$; $y = -0.6\%$; $z = 0.9\%$

slope change $G1 = |x - y| = |0.4 - (-0.6)| = 1.0\%$
slope change $G2 = |y - z| = |-0.6 - 0.9| = 1.5\%$

minimum $LVC1 = (G1*30)/\text{rate of change}$ *[Table 3.1.2.3]*
$= (1.0*30)/0.1 = 300\ m$

minimum $LVC2 = (G2*30)/0.1$
$= (1.5*30)/0.1 = 450\ m$

Example 2: ***Minimum D***

slopes: $x = 0.4\%$; $y = -0.6\%$; $z = 0.9\%$

slope change $G1 = |x - y| = |0.4 - (- 0.6)| = 1.0\%$
slope change $G2 = |y - z| = |-0.6 - 0.9| = 1.5\%$

L = value for the specified AGN [Table 3.1.2.54]

$D = L * (G1 + G2)/100$
$= 30\,000 *(1.0 + 1.5)/100 = 750\ m$

Figure 3-1: Runway longitudinal slope limitations

Runway Pavement Overlays

Note: The following standard is intended for runway pavement overlay projects when the runway is to be returned to an operational status before overlay of the entire runway is complete, thus normally necessitating a temporary ramp between the new and old runway surfaces. Guidance on overlaying pavements and assessing their operational status is given in the ICAO Aerodrome Design Manual, Part 3.

3.1.2.5 The maximum longitudinal slope of the temporary ramp is a maximum of 1.0 % measured with reference to the existing runway surface or previous overlay course.

Transverse Slopes

3.1.2.6 To promote drainage, the maximum transverse slope of the runway is as specified in Table 3.1.2.6.

Table 3.1.2.6—Maximum Runway Transverse Slope							
Aircraft Group Number *Table 1-1 Column II*	I	II	IIIA	IIIB	IV	V	VI
Paved surface *(e.g. asphalt, or concrete)*	2.0 %	2.0 %	1.5 %	1.5 %	1.5 %	1.5 %	1.5 %
Unpaved surface *(e.g. gravel, or turf)*	2.5 %	2.5 %	2.5 %	2.5 %	2.5 %	2.5 %	2.5 %

Note: A transverse slope between 2.0–2.5% facilitates drainage on an unpaved surface.

3.1.3 Surface of Runways

3.1.3.1 The pavement of the runway is without irregularities that would result in reduced friction characteristics or adversely affect aircraft operations.

Note 1: Surface irregularities may adversely affect the take–off or landing of an aircraft by causing excessive bouncing, pitching, vibration, or other control difficulties.

Note 2: Guidance on design tolerances and other information is in the ICAO Annex 14 and ICAO Aerodrome Design Manual, Part 3. *Guidance on friction characteristics of new runway surfaces is given in the* ICAO Airport Services Manual, Part 2. *Guidance on methods for improving the runway surface texture is given in the* ICAO Aerodrome Design Manual, Part 3.

Note 3: See Chapter 9 for standards relating to runway friction levels.

3.1.4 Runway Strips

Application

3.1.4.1 The runway and any associated stopways are included in a strip.

General

3.1.4.2 **(1)** Subject to (2), the elevation of any point on the runway strip is the same as the highest elevation of the nearest point on the runway centreline or runway edges, whichever is higher.

(2) In the situation of intersecting runways, the runways and runways safety areas within the common portion of both runway strips may be such that parts exceed the permissible elevation of the intersected runway.

Note: The runway strip elevation refers to the bottom surface of an imaginary horizontal surface not necessarily the ground profile within the strip area.

Length of Runway Strip

3.1.4.3 The strip extends before the threshold and beyond the end of the runway, or stopway if provided, to the minimum distance specified in Table 3.1.4.3.

Table 3.1.4.3—Runway Strip Length
Minimum distances before threshold and beyond end of runway, or stopway if provided (in metres)

Aircraft Group Number *Table 1-1 Column II*	I	II	IIIA	IIIB	IV	V	VI
Non-instrument	30	60	60	60	60	60	60
Non-precision	60	60	60	61	61	61	61
Precision	61	61	61	61	61	61	61

Width of Runway Strip

3.1.4.4 The runway strip extends laterally each side of the runway centreline and extended centreline to the minimum distance specified in Table 3.1.4.4.

Table 3.1.4.4—Runway Strip Width
Minimum distances each side of runway centreline and extended centreline (in metres

Aircraft Group Number *Table 1-1 Column II*	I	II	IIIA	IIIB	IV	V	VI
Non-instrument	30	40	40	75	75	75	75
Non-precision	75	75	75	122	122	122	122
Precision	122	122	122	122	122	122	122

Objects in the Runway Strip, Runway Safety Area and Runway End Safety Area

Fixed objects

3.1.4.5 The runway strip, runway safety area, and runway end safety area are clear of all fixed objects except for the following;

(a) Visual aids identified in Chapter 5;

(b) Fixed by function NAVAIDs required on the strip, due to their air navigation function and meeting the relevant frangibility requirement, may be installed on the runway strip, but no closer than the distances in Table 3.1.4.5;

(c) Bird scaring devices, required on the strip to manage the bird hazard in the vicinity of runways and meeting the relevant ICAO frangibility requirements may be installed on the runway strip, but no closer than the greatest runway-holding position distance established for the runway as per Standard 3.6.1.3; or

(d) Recognized aircraft arrestor bed.

Table 3.1.4.5—Obstacle Free Portion of the Runway Strip
Minimum distances each side of runway centreline and extended centreline in metres

Aircraft Group Number *Table 1-1 Column II*	I	II	IIIA	IIIB	IV	V	VI
Non-instrument	30	40	40	61	61	61	61
Non-precision	40	40	61	61	61	61	61
Precision	46	46	61	61	61	61	61

Note 1: Other factors may increase the minimum distance for installation of electronic equipment and NAVAIDs, such as the inner transitional surface for a precision runway.

Note 2: Parked aircraft or vehicles are considered fixed objects.

3.1.4.6 Other objects, including terrain, located within the runway strip beyond the runway safety area, are of a maximum height that:

(a) does not protrude above a 5% slope commencing at the outer edge of the runway safety area (perpendicular from runway centreline), measured outwards toward the nearest edge of the strip; and

(b) subject to 3.1.4.7, does not exceed the elevation of the nearest centreline point on the runway.

3.1.4.7 Where the highest elevation point on the runway is at the runway edge, the highest elevation of the two runway edges nearest the runway centreline described in (b) is used as the reference elevation.

Note: See Figure 3-2 for depiction of an object beyond the runway safety area.

Mobile objects

3.1.4.8 Obstacle free zones and runway end safety areas are free of mobile objects while the runway is in use for arrivals (aircraft on final approach within 2 NM) or departures, with the exception of equipment and radio-equipped personnel associated with in-flight inspections of navigation and landing aids while flight inspections are being carried out.

3.1.5 Runway Safety Area

Application

3.1.5.1 A runway safety area is provided for all runways, and stopways where provided.

Location

3.1.5.2 The runway safety area extends each side of the runway centreline and extended centreline within the strip, to the minimum distances specified in Table 3.1.5.2.

Table 3.1.5.2—Runway Safety Area
Minimum distances of each side of centreline and extended centreline (in metres)

Aircraft Group Number *Table 1-1 Column II*	I	II	IIIA	IIIB	IV	V	VI
Non-instrument	30	40	40	75	75	75	75
Non-precision	40	40	40	75	75	75	75
Precision	40	45	45	75	75	75	75

Characteristics

3.1.5.3 Where a portion of the runway safety area abutting the edge of the runway is paved, the pavement is flush with the abutting surface and extends symmetrically on each side of the runway.

3.1.5.4 The unpaved portion of the runway safety area that abuts a paved surface has a maximum drop of 5 cm at the paved edge.

Slopes on Runway Safety Area

Longitudinal slope changes

3.1.5.5 Slope changes on the runway safety area are gradual with no abrupt changes or sudden reversals.

3.1.5.6 The longitudinal slope of the runway safety area prior to the threshold and beyond the runway, and stopway, where provided, is as specified in Table 3.1.5.6.

Table 3.1.5.6—Longitudinal Slope Tolerance for Runway Strip End Area

Aircraft Group Number *Table 1-1 Column II*	I	II	IIIA	IIIB	IV	V	VI
Acceptable slope range	+2.0 % to -2.0 %	+2.0 % to -2.0 %	+2.0 % to -2.0 %	+1.75 % to -1.75 %	+1.5 % to -1.5 %	+1.5 % to -1.5 %	+1.5 % to -1.5 %

Transverse slopes

3.1.5.7 Subject to 3.1.5.8, the transverse slopes on the runway safety area are adequate to prevent the accumulation of water on the runway surface and runway safety area, and do not exceed the values specified in Table 3.1.5.7 as measured from the nearest runway edge.

Table 3.1.5.7—Permissible Transverse Slope Range in the Runway Safety Area

Aircraft Group Number *Table 1-1 Column II*	I	II	IIIA	IIIB	IV	V	VI
Transverse slope range (below the horizontal plane)	0 to minus 3.0 %	0 to minus 3.0 %	0 to minus 3.0 %	0 to minus 2.5 %	0 to minus 2.5 %	0 to minus 2.5 %	0 to minus 2.5 %

3.1.5.8 **(1)** Subject to (2), the transverse slope for the first three metres (3 m) from the paved edge may be a maximum of 5.0% below the horizontal plane to facilitate drainage.

(2) In the situation of intersecting runways, the common portion of both runway safety areas may be such that parts exceed the permissible slopes of the intersected runway safety area provided that slope changes are minimized to avoid any abrupt slope changes between the two runway safety areas.

Drainage Ditches

3.1.5.9 Drainage ditches are located outside the runway safety area and runway end safety area.

Strength of the Runway Safety Area

3.1.5.10 The strength of the terrain in the runway safety area, under dry conditions, minimizes hazards arising from differences in load-bearing capacity to aircraft, which the runway is intended to serve in the event of an aircraft running off the runway.

3.1.5.11 Paved portions of the runway safety area abutting the runway edge support aircraft without inducing structural damage to the aircraft.

3.1.5.12 Where the runway is intended to serve AGNs IV, V or VI, the runway safety area is stabilized to minimize erosion, out to a distance from runway centreline of 30 m, 30 m and 37.5 m respectively.

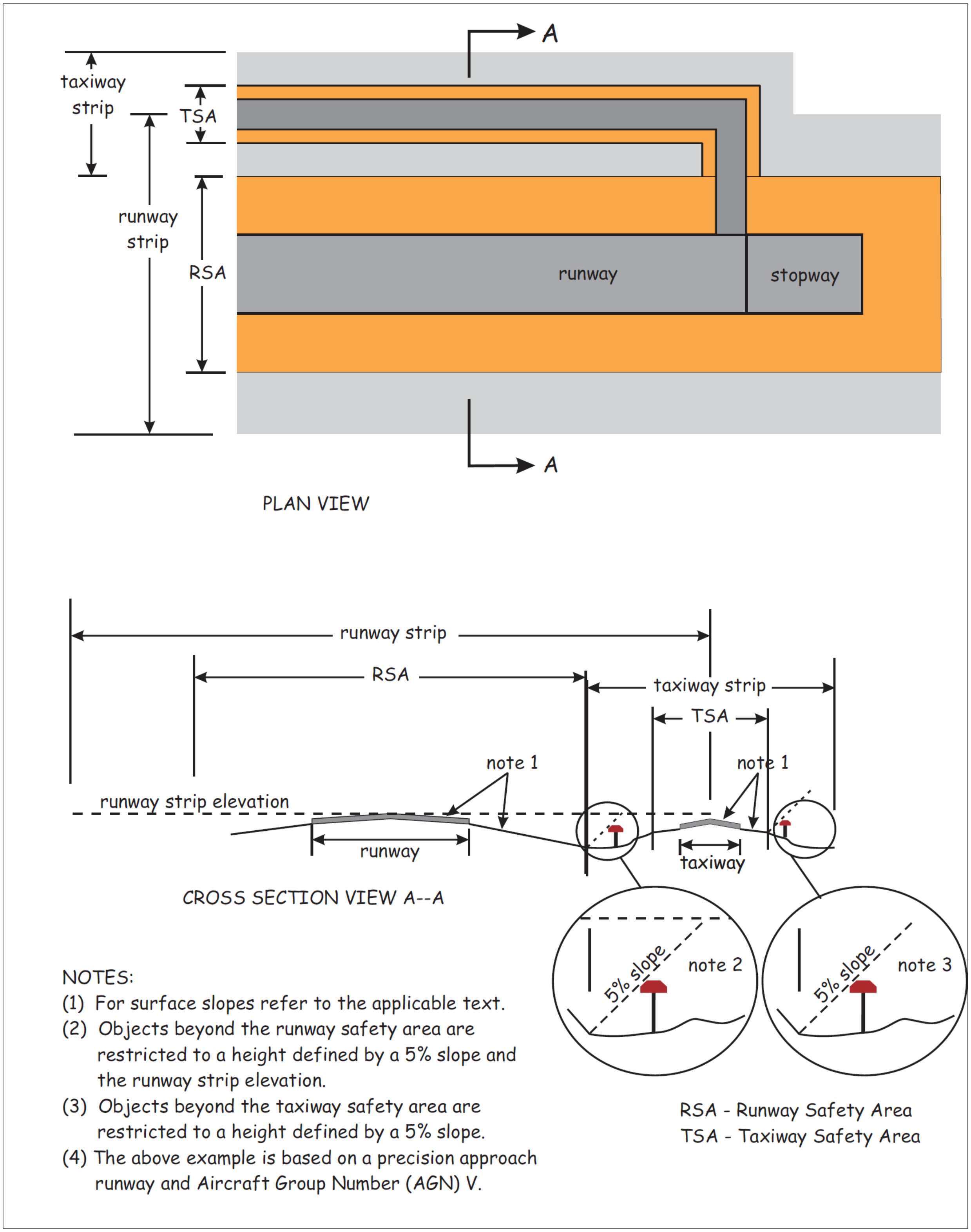


Figure 3-2: Runway/Taxiway safety area

3.2 RUNWAY END SAFETY AREAS

Application

Note: The objective of a runway end safety area is to have an area free of objects, other than frangible visual and navigational aids required to be there by function, so as to reduce the severity of damage to an aircraft overrunning or undershooting the runway and to facilitate the movement of rescue and fire fighting vehicles.

3.2.1.1 Subject to sections 3.2.1.2 and 3.2.1.3, a runway end safety area is provided where the runway length is:

(a) 1 200 m or greater; or

(b) less than 1 200 m and the runway type is non-precision or precision; and

(c) the runway is used by scheduled passenger-carrying operations of an air carrier operating aircraft designed for more than 9 passenger seats as determined by the aircraft type certificate.

3.2.1.2 This section does not apply to aerodromes located north of the 60th degree parallel that only serve air carrier operations utilizing aircraft with less than 31 passenger seats.

3.2.1.3 A runway end safety area may not be provided prior to the declared LDA where one of the following is operational on the runway in use:

(a) precision approach path indicator (PAPI);

(b) abbreviated precision approach path indicator (APAPI); or

(c) instrument landing system glide slope.

3.2.1.4 Where the full length of a runway end safety area is not available prior to or beyond the runway as specified, the declared distances for TORA, ASDA and/or LDA are reduced accordingly.

Location

3.2.1.5 For departures, the runway end safety area originates at the end of the declared TORA or ASDA, if greater.

3.2.1.6 Subject to section 3.2.1.3, for arrivals, the runway end safety areas originates at the commencement of the LDA and at the end of the LDA.

Characteristics

3.2.1.7 The runway end safety area:

(a) has a minimum width twice of the associated runway;

(b) extends away from the runway;

(c) is centred on the extended runway centreline; and

(d) subject to section 3.2.1.8, has a minimum length of 150 m to the end of the RESA.

Note: The 150 m length is inclusive of the runway safety area beyond the runway end.

3.2.1.8 Where a recognized EMAS is installed within the RESA and complies with section 3.2.1.10, the overall RESA length may be reduced.

3.2.1.9 The terrain in the runway end safety area:

(a) has no abrupt slope changes or open ditches;

(b) has an adequate slope to prevent the accumulation of water;

(c) beyond the runway strip, has maximum transverse and longitudinal slopes of 5% downwards;

(d) does not protrude into an obstacle limitation surface (OLS); and

(e) under dry conditions, is of sufficient strength to reduce the severity of structural damage to the critical aircraft overrunning/undershooting the runway.

3.2.1.10 Where an EMAS is installed, it is designed to:

(a) stop the critical aircraft at a runway exit speed of 70 kt without imposing loads that exceed the aircraft's design limits causing major structural damage to the aircraft; and

(b) not protrude into an OLS.

Objects in the Runway End Safety Area

3.2.1.11 The runway end safety area is free of objects, including equipment and installations, other than visual aids, instrument landing system (ILS) localizer and monitoring antennas, associated mounting structures, and fencing, required to be there by function and satisfying the frangibility requirements for all elements above grade.

Note: A service road within the RESA would need to be free of vehicular traffic during aircraft operations on the associated runway.

3.3 STOPWAYS

Application

3.3.1.1 Where a stopway is provided, it is as specified in this section.

Location

3.3.1.2 The origin of the stopway is at the end of the TORA.

Characteristics

Width

3.3.1.3 The stopway has the same width as the associated runway.

Slopes

3.3.1.4 The slopes for the stopway are as specified in 3.1.2.1 to 3.1.2.6 for the runway with which the stopway is associated except that:

(a) the limitation in 3.1.2.1 of 0.8% for the first and last quarter of the length of a runway need not be applied to the stopway; and

(b) at the junction of the stopway and runway and along the length of the stopway, the maximum rate of slope change may be 0.3% per 30 m (minimum radius of curvature of 10 000 m) for a runway where the AGN is IIIB and higher in Column II of Table 1-1.

Strength

3.3.1.5 The stopway is capable, in the event of a rejected take-off, of supporting the AGN for which the runway is intended to serve without causing structural damage to the aircraft.

Surface

3.3.1.6 The surface of a stopway provides a coefficient of friction similar to that of the associated runway.

Objects on Stopways

3.3.1.7 The stopway is clear of objects.

3.4 RUNWAY TURN PAD

Application

3.4.1.1 Where a runway turn pad is provided, it is such that, when the cockpit of the critical aircraft for which the turn pad is intended remains over the turn pad taxiway centreline marking, the clearance between any wheel of the aircraft landing gear and the edge of the turn pad complies with the minimum distances in 3.5.1.3.

3.5 TAXIWAYS

3.5.1 General

Application

3.5.1.1 The specifications of this section are applicable to all taxiways, except for private taxiways which need not adhere to the following: 3.5.1.2, 3.5.1.3, Table 3.5.1.4 taxiway centreline to object, 3.5.1.5, 3.5.1.6, and section 3.5.4.

Characteristics

Width of Taxiways

3.5.1.2 The minimum width of the taxiway is as specified in Table 3.5.1.2.

Table 3.5.1.2—Minimum Taxiway Widths (in metres)

AGN *(Table 1-2 Column III)*	**Taxiway Width**
I	7.5
II	10.5
III (A & B)	15.0
IV	23.0
V	23.0
VI	25.0

Taxiway Curves, Junctions and Intersections

3.5.1.3 When the cockpit of an aircraft remains over the centreline, the minimum clearance between the outer main wheel and the taxiway edge is as specified in Table 3.5.1.3.

Table 3.5.1.3—Minimum Outer Main Wheel to Taxiway Edge Clearance (in metres)

AGN *Table 1-2 Column III*	**Minimum Clearance**
I	1.5
II	2.25
III (A & B)	3.0 on straight portions 3.0 on curved portions for aircraft with less than 18 m wheelbase 4.5 on curved portions for aircraft with equal to or greater than 18 m wheelbase
IV	4.5
V	4.5
VI	4.5

Taxiway Minimum Separation Distances

3.5.1.4 The minimum separation distance between the centreline of a taxiway and the centreline of a runway, the centrelines of parallel taxiways, or the taxiway centreline to an object is as specified in Table 3.5.1.4.

Table 3.5.1.4—Taxiway Minimum Separation Distances (in metres)

AGN *Table 1-2 Column II*	I	II	IIIA	IIIB	IV	V	VI
NON-INSTRUMENT RUNWAY							
Taxiway centreline to runway centreline	37.5	52.0	58.0	93.0	101.0	107.5	115.0
Taxiway centreline to taxiway centreline	23.0	32.0	44.0	44.0	63.0	76.0	91.0
Taxiway centreline to object	15.5	20.0	26.0	26.0	37.0	43.5	51.0
NON-PRECISION RUNWAY							
Taxiway centreline to runway centreline	67.5	72.0	90.0	122.0	122.0	122.0	153.0
Taxiway centreline to taxiway centreline	23.0	32.0	44.0	44.0	63.0	76.0	91.0
Taxiway centreline to object	15.5	20.0	26.0	26.0	37.0	43.5	51.0
PRECISION RUNWAY at sea level (1),(2)							
Taxiway centreline to runway centreline	CAT I						
	77.0	92.0	107.0	122.0	122.0	122.0	153.0
	CAT II or III						
	122.0	122.0	122.0	122.0	122.0	153.0	168.0
Taxiway centreline to taxiway centreline	23.0	32.0	44.0	44.0	63.0	76.0	91.0
Taxiway centreline to object	15.5	20.0	26.0	26.0	37.0	43.5	51.0

(1)The taxiway to runway centreline distances noted in Table 3.5.1.4 for precision runways are the minimum distances at sea level. Any increase in aerodrome elevation above sea level (ASL), or taxiway elevation versus runway elevation could increase the minimum distance required and needs to be reassessed so that no part of an aircraft (tail top, wing tip) on the taxiway infringes the obstacle free zone (OFZ) (including the inner transitional surfaces). This assessment would consider the aircraft as being on the edge of the taxiway nearest to the runway. See 4.1.4—Inner Transitional Surface.

(2) In all cases, an aircraft and other mobile objects are to be clear of the OFZ. See Table 1-2, Column IV for tail heights to be considered and section 4.1.4 for the inner transitional surface.

(3) The separation distances for taxiway to runway and taxiway to taxiway are based on the assumption of equivalent AGNs on each surface. Reduced separation distances may be possible for mixed operations using site specific, TCCA approved procedures supported by an aeronautical evaluation.

(4) The above separations are based on the assumption of taxiway widths being at the minimum required for the relevant AGN. Where a taxiway is wider than the minimum, additional separation will be required to account for an aircraft being at the edge of the operational taxiway surface. Consult with TCCA where these situations exist at the site.

Slopes on Taxiways

Note: Guidance on the design of taxiways is included in the ICAO Aerodrome Design Manual, Part 2.

Transverse Slopes

3.5.1.5 The transverse slope of a taxiway is sufficient to prevent the accumulation of standing water on the surface.

Surface of Taxiways

3.5.1.6 The surface of a taxiway is without irregularities that may cause damage to aircraft structures.

3.5.2 Rapid Exit Taxiways

3.5.2.1 Subject to 3.5.2.2, the rapid exit taxiway has a turn-off radius that enables an exit speed of 50 kt under wet conditions of the critical AGN assigned to the taxiway.

3.5.2.2 Where the turn-off radius would not permit a 50-kt exit speed, the exit speed is published.

3.5.2.3 The rapid exit taxiway includes sufficient straight distance after the turn-off curve for an exiting aircraft to come to a full stop, clear of any intersecting taxiway or runway.

Note: While an aircraft may stop clear of an upcoming taxiway or runway, the tail of the holding aircraft may not be clear of the inner transitional and other surfaces, thereby impacting the usability of the runway. See Chapter 4 for more information.

3.5.2.4 The intersection angle of a rapid exit taxiway with the runway is a maximum of 45°.

3.5.3 Taxiways on Bridges

3.5.3.1 Except for private taxiway bridges overlaying a roadway not accessible for public use, the minimum width of a taxiway bridge, as measured perpendicularly to the taxiway centreline, is consistent with the minimum width of the taxiway safety area provided for that taxiway in Table 3.5.4.5.

3.5.3.2 A proven and non-hazardous positive aircraft restraint system is provided on a taxiway bridge at the edge of the full load bearing surface for the critical aircraft.

No structural members project more than 5 cm above grade, with the exception of parapets. Parapets are constructed at a height of 30 cm to help contain aircraft and vehicles that wander to the pavement edge. Parapets are constructed to the strength requirements of CAN/CSA-S6-06 *Canadian Highway Bridge Design Code.*

3.5.3.3 Where the load bearing capability of that portion of the taxiway bridge beyond the taxiway surface does not support the static and dynamic loads imposed by the critical aircraft, the bearing capability is such that it can prevent an aircraft veering off the taxiway from falling to the road deck below.

Note: See section 5.3.32 Unserviceability/Closed Lights for supplemental lighting requirements on taxiway bridges.

3.5.4 Taxiway Strips

Application

3.5.4.1 A taxiway is included in a strip.

Location

3.5.4.2 The taxiway strip extends symmetrically on each side of the taxiway centreline throughout the length of the taxiway to the minimum distance specified in Table 3.5.1.4 for taxiway centreline to object distances.

Characteristics

Objects on Taxiway Strips

3.5.4.3 Subject to 3.5.4.4, except for the visual aids described in chapter 5 and positive aircraft restraint systems on taxiway bridges described in 3.5.3.2, objects including natural objects are located outside the taxiway safety area.

Note: A typical positive aircraft restraint system is a curb (single or multiple) designed to prevent the critical aircraft from excursion off the bridge while providing engine clearance.

3.5.4.4 The maximum height of objects, including terrain, within the taxiway strip beyond the taxiway safety area, are of a maximum height that does not protrude above a slope of plus 5% commencing at the outer edge of the taxiway safety area (perpendicular from the taxiway centreline), measured outwards toward the nearest edge of the strip.

Taxiway Safety Area

3.5.4.5 The taxiway safety area extends each side of the taxiway centreline and taxiway edge to the minimum distances specified in Table 3.5.4.5.

Table 3.5.4.5—Minimum Taxiway Safety Area Distance from Taxiway Centreline and Edge (in metres)

Aircraft Group Number *Table 1-2 Column II*	I	II	IIIA	IIIB	IV	V	VI
From taxiway centreline	11.0	12.5	12.5	12.5	19.0	22.0	30.0
From taxiway edge	3.0	4.5	6.0	6.0	7.5	10.5	17.5

Surface of the Taxiway Safety Area

3.5.4.6 The surface of the taxiway safety area beyond the taxiway edge is:

(a) graded to have a maximum slope of plus 2.5% with reference to the transverse slope of the adjacent taxiway surface;

(b) a maximum of 5% slope below the horizontal plane;

(c) if paved, flush with the paved surface to which it abuts;

(d) if unpaved, no lower than 5 cm from the paved surface to which it abuts;

(e) except for 3.5.3.3 taxiway bridges, of a strength under dry conditions capable of reducing the risk of structural damage to aircraft running off the taxiway; and

(f) prepared and maintained to:

(i) resist erosion; and

(ii) reduce ingestion of surface material by aircraft.

Note: Where a taxiway is located within the runway strip, the physical characteristics related to the runway, such as strip and runway safety area, may be more stringent.

3.6 HOLDING BAYS, RUNWAY-HOLDING POSITIONS, AND ROAD-HOLDING POSITIONS

3.6.1 Holding Positions

Application

3.6.1.1 A holding position is established for aircraft and/or vehicles:

(a) at an intersection of a taxiway with a runway;

(b) at all runway/runway intersections, except as noted in 3.6.1.2*;*

(c) at the intersection of a road with a runway or taxiway;

(d) at the intersection of a holding bay with a runway; and

(e) on any part of the movement area, or roadway if the location or alignment of the taxiway/runway/roadway is such that a taxiing aircraft, vehicle or other mobile object would infringe upon an OFZ or interfere with the operation of radio navigation aids.

3.6.1.2 A runway-holding position need not be located at a runway/runway intersection if there is inadequate room to hold vehicles or aircraft in this area in accordance with Table 3.6.1.3 and procedures are established to avoid usage of this area as a holding area.

Location

3.6.1.3 The minimum distance between a holding bay, runway-holding position established at a taxiway/runway intersection, runway/runway, or road-holding position and the centreline of a runway is:

(a) in accordance with Table 3.6.1.3; and

(b) increased so that a holding aircraft or vehicle does not interfere with the operation of radio navigation aids or infringe an OFZ.

Note: The inner transitional surface on a precision runway has a vertical component that varies with aerodrome elevation. See section 4.1.4 for standards relating to the Inner transitional Surface.

Table 3.6.1.3—Runway-Holding Position
Minimum Distances from Runway Centreline (in metres)

Aircraft Group Number *Table 1-1 Column II*	I	II	IIIA	IIIB	IV	V	VI
NON-INSTRUMENT	30	40	40	75	75	75	75
NON-PRECISION	40	40	61	75	75	75	75
PRECISION *(at sea level)*	75	75	75	90	90	90	90

(1) The distances provided for precision runways are for sea level elevations and may have to be increased to reflect the actual elevation of the aerodrome above sea level. The aerodrome elevation forms part of the inner transitional considerations, therefore the minimum distance required needs to be reassessed so that no part of an aircraft (tail tip, wing tip) at the holding position infringes the obstacle free zone (OFZ), including the inner transitional surfaces. See Chapter 4 regarding standards relating to the elevation adjustment for the inner transitional surface.

(2) The distances are based on a taxiway to runway intercept angle of 90°, and assume the holding position elevation is no higher than the nearest runway centreline elevation. Where the taxiway (or runway) intercepts the runway at a lesser angle than 90°, the minimum distance required needs to be reassessed so that no part of an aircraft (tail tip, wing tip) at the holding position infringes the OFZ, including the inner transitional surfaces. See Chapter 4 regarding standards relating to the inner transitional surface and other parts of the OFZ.

(3) The distances specified may need to be increased to avoid interference with radio navigation aids, particularly where there are glide path and localizer installations. For information on critical and sensitive areas of ILS or MLS, consult with the air navigation service provider.

(4) For a runway used for take-off operations only, the distances in the non-instrument group may be used.

(5) Precision CAT II or III runway operations typically require an increase to the specified distances to avoid interference with radio navigation aids and the OFZ specific to these operations.

CHAPTER 4. OBSTACLE MANAGEMENT

CHAPTER 4. OBSTACLE MANAGEMENT

4.1 OBSTACLE LIMITATION SURFACES (OLS)

4.1.1 General

Note 1: Obstacle limitation surfaces (OLS) define the airspace around the runway to be maintained free of obstacles.

Note 2: For the establishment of instrument approaches to a runway, compliance to the Criteria for the Development of Instrument Procedures, TP 308***,*** *as specified under Part VIII of the* Canadian Aviation Regulations *is also required.*

Note 3: See Figures 4-1 (a) and (b) for an overview of OLS.

<u>Application</u>

4.1.1.1 Inner transitional, transitional and approach surfaces are established for all runways.

4.1.1.2 A take-off surface is established where:

(a) the opposite threshold does not coincide with the end of TORA and the instrument departure climb gradient has not been assessed; or

(b) a clearway has been established.

Note: See Figure 4-9 for depiction of a take-off surface at the end of a clearway.

<u>General</u>

4.1.1.3 The OLS for non-instrument runways serving AGN IIIB and higher aircraft, and all non-precision and precision runways are as specified in Table 4-1(a).

4.1.1.4 Subject to 4.1.1.5, the OLSs for non-instrument runways, serving AGN I, II, and IIIA aircraft are as specified in Table 4-1(a).

4.1.1.5 Where the OLS cannot be established at a non-instrument runway in accordance with Table 4-1(a) due to the presence of obstacles, the OLSs are as specified in Tables 4-1(b), (c), or (d), and the runway strip width is increased to match the full width of the of the approach surface inner edge.

Note: See Figure 4-2(a) for depiction of modified non-instrument OLS. The most practical application of these modified surfaces is to address natural obstacles; however it can also be used to address man-made obstacles.

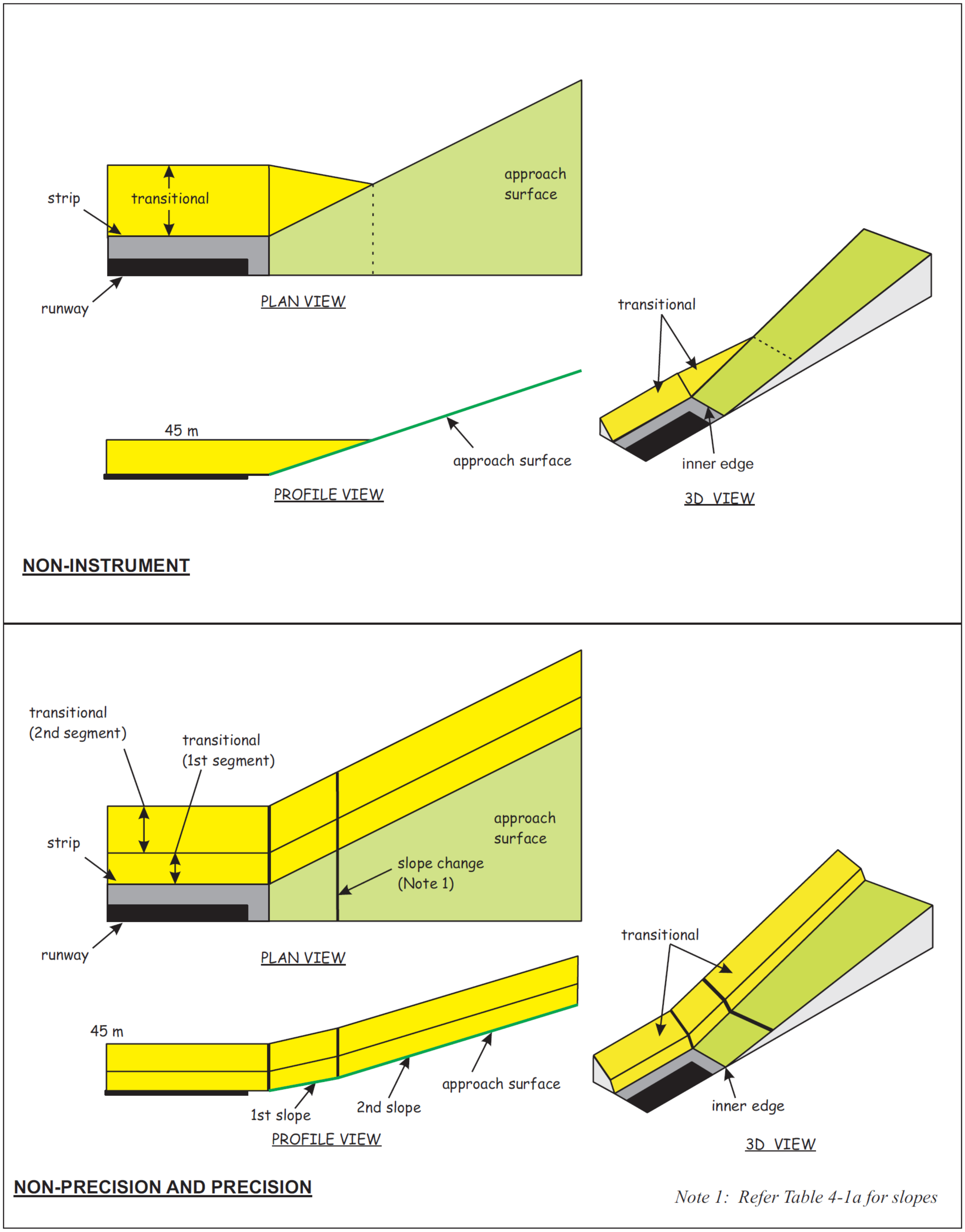


Figure 4-1(a): Obstacle limitation surfaces (OLS)

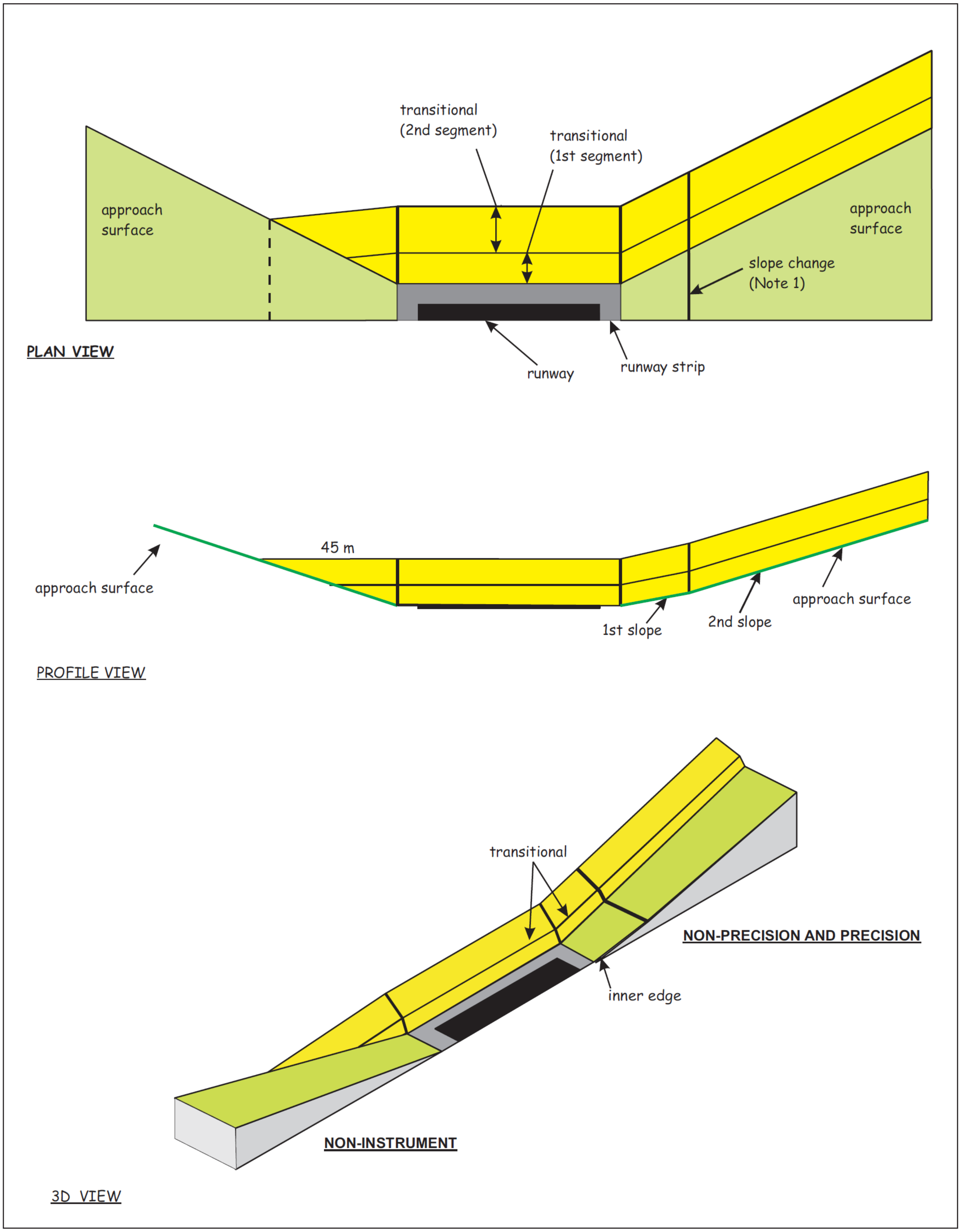


Figure 4-1(b): OLS for a runway with a precision/non-precision end and non-instrument end

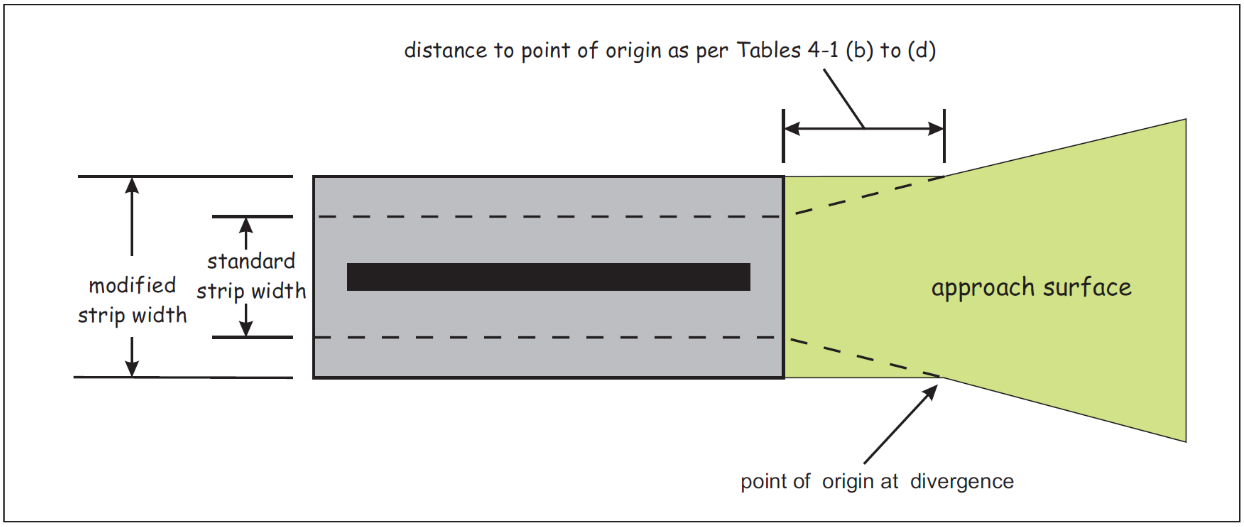


Figure 4-2(a): Modified obstacle limitation surface

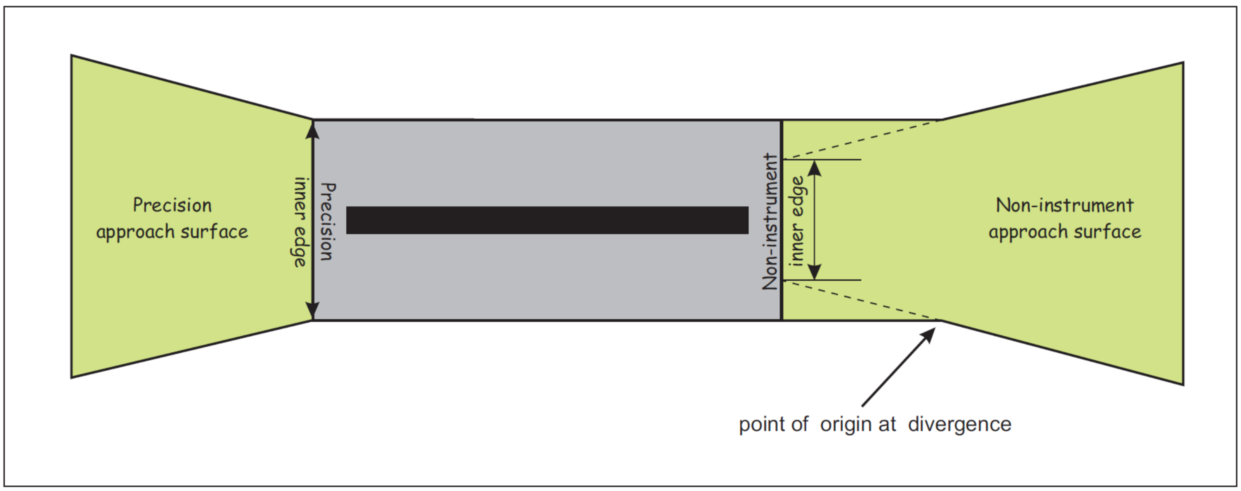


Figure 4-2(b): Example of a runway with a precision approach surface at one end and a non-instrument approach surface at the opposite end

Characteristics

4.1.2 Approach Surface

4.1.2.1 Subject to 4.1.2.2, 4.1.2.3, 4.1.2.4 and 4.1.2.5, the approach surface comprises:

(a) an inner edge of specified length, perpendicular to and located on each side of the extended centreline of the runway, at the specified distance from the threshold;

(b) two sides beginning at the ends of the inner edge, diverging at a specified rate, in the direction of take-off, ending at the outer edge; and

(c) an outer edge perpendicular to the centreline of the approach surface, at the specified length from the inner edge.

4.1.2.2 Where a precision or non-precision instrument approach procedure is offset from the extended runway centreline the divergence on the affected side of the approach surface is increased in the same direction and number of degrees as the offset of the instrument approach procedure.

4.1.2.3 Where an obstacle is to be avoided, an approach surface offset from the extended runway centreline may be established for non-instrument and non-precision runways provided that;

(a) there are geographical points and/or other visual aids available to reference the offset approach;

(b) procedures relating to the offset approach are published;

(c) the divergence on the affected side of the approach surface is increased in the same direction and number of degrees as the off-set from the extended runway centreline; and

(d) a final straight-in segment is established in accordance to Table 4.1.2.3.

Table 4.1.2.3
Straight Segment for Offset Approaches

Intercept Angle °	Minimum Length (m)
< 5°	0
5° < 10°	458
10° < 20°	915
20° < 30°	1372

4.1.2.4 Where an offset surface has been established, the side opposite the offset, (identified as area “D”) in Figure 4-3 is assessed, using the same slope as the approach surface, for the identification of obstacles that may require marking, lighting and publication.

Note: See Figure 4-3 for depiction of an offset approach surface.

4.1.2.5 Where the inner edge of the approach surface is lesser than the width of the runway strip, the approach surface is as presented in Figure 4-2 (b).

Note: This situation occurs where there is a higher level of service at the opposite end of the runway, e.g. precision at one end and non-instrument at the opposite end.

4.1.2.6 The elevation of the inner edge is equal to the elevation of the threshold.

Note: In certain cases 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 beyond the end of the runway be graded to conform to the inner edge. See 4.1.6.2.

4.1.2.7 The slope of the approach surface is measured in the vertical plane containing the centreline of the runway.

4.1.2.8 The width and length of the approach surface is measured in the horizontal plane.

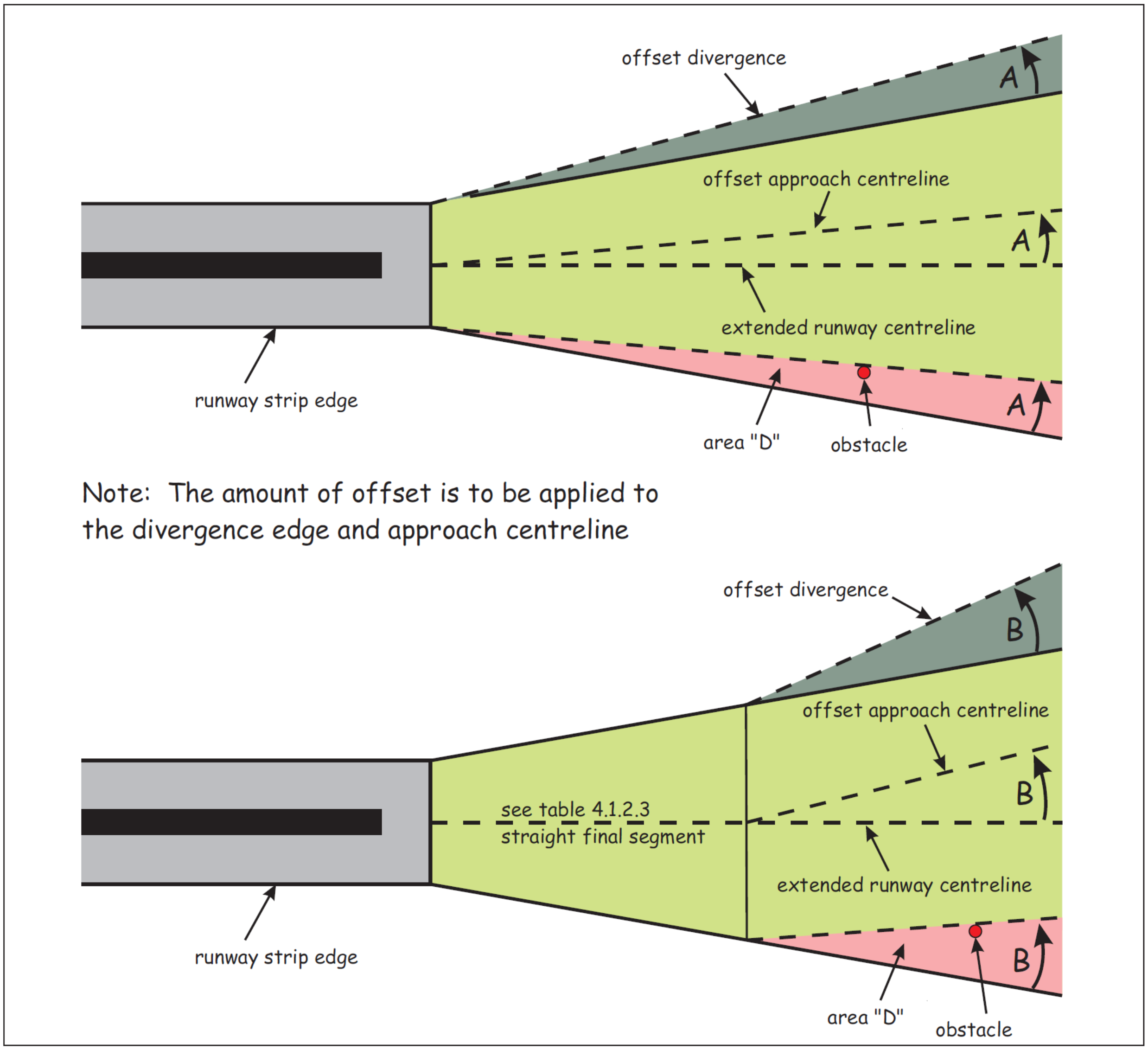


Figure 4-3: Offset approach surface

4.1.3 Take-off Surface

4.1.3.1 The take-off surface comprises:

(a) an inner edge, perpendicular to and located on each side of the centreline of the runway, at the end of the TORA; or

(b) where a clearway is provided, an inner edge, perpendicular to and located on each side of the extended centreline of the runway at the upper limit of the clearway plane;

(c) two sides beginning at the ends of the inner edge, diverging at the same rate as the approach surface associated with that end of the runway, in the direction of take-off, ending at the outer edge; and

(d) an outer edge perpendicular to the centreline of the approach surface, at 4 000 m from the inner edge.

4.1.3.2 The elevation of the inner edge is equal to the elevation of the runway end, or the end of the clearway plane where provided.

4.1.3.3 The length of the inner edge is 75 m on each side of the extended centreline, or the width of the runway strip, whichever is lesser.

4.1.3.4 The slope of the take-off surface, measured in the vertical plane containing the extended centreline of the runway, is:

(a) 5% for an AGN I runway,

(b) 4% for an AGN II runway,

(c) 2.5% for an AGN IIIA and above runway.

Note 1: See Figure 4-4: Mitigation for penetration of take-off surface.

Note 2: See Figure 4-9 for depiction of a take-off surface with a clearway.

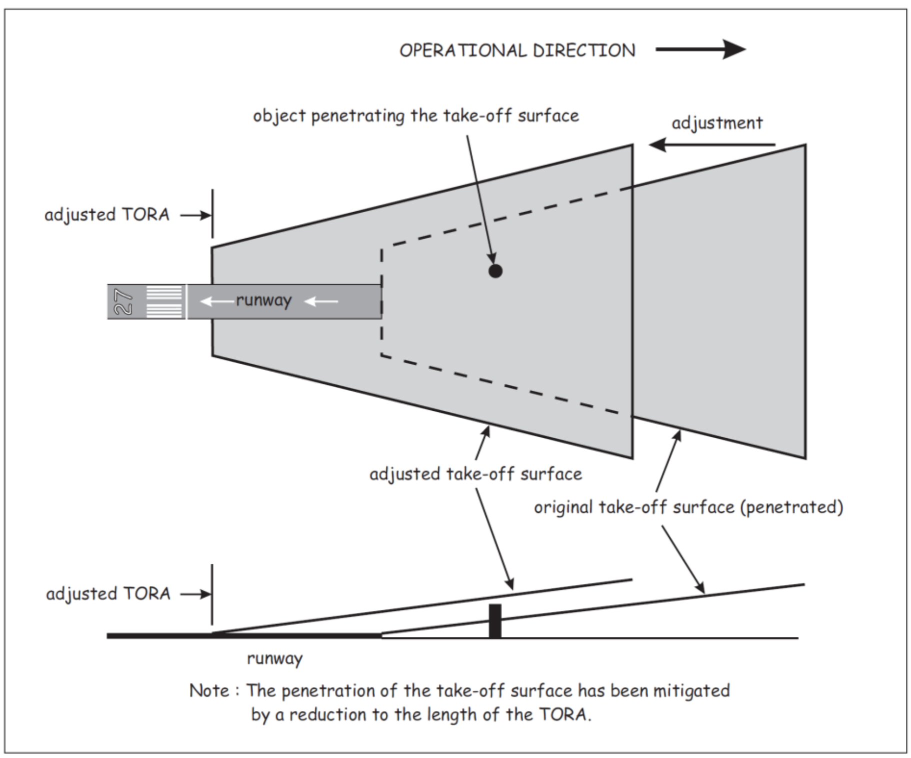


Figure 4-4: Mitigation for penetration of take-off surface

4.1.4 Inner Transitional Surface

Note 1: The inner transitional surface is the controlling OLS for navigation aids, mobile objects such as aircraft and other vehicles that must be near the runway. Only frangible visual NAVAIDS that need to be located within this area, because of their function, are permitted. The transitional surface described in section 4.1.5 is the controlling OLS for fixed objects such as buildings, parked aircraft and vehicles, etc. Other surfaces may also impact upon the same area, such as where an approach surface overlays the displaced portion of a runway.

Note 2: Where slopes are expressed as a ratio, the first number is the vertical rise, the second the horizontal run.

4.1.4.1 The limits of the inner transitional surface on the runway strip begins at the elevation of the nearest point of the runway centreline and extended centreline, at the specified distance extending outwards at a right angle to the runway centreline and at the specified vertical slope(s) up to an elevation of 45 m above the aerodrome reference point (ARP).

4.1.4.2 For **precision AGN III (A & B) -VI runways, except category II/III**, the inner transitional surface begins at the specified distance from the runway centreline, then rises vertically for a height "H", and then slopes 1:6 out to a height of 45 m above the ARP.

$$H_{\text{metres}} = 18.4 - 0.094(S_{\text{metres}}) - 0.003(E_{\text{metres}}).$$

*Note: **"S"** is equal to the most demanding wingspan of the aircraft using the runway and **"E"** is equal to the runway threshold elevation above sea level (ASL).*

4.1.4.3 For precision AGN I & II runways, except category II or III, the inner transitional surface begins at the specified distance from the runway centreline, then slopes 1:3 out to a height of 45 m above the ARP.

4.1.4.4 For precision runways with CAT II or III approach limits, the inner transitional surface begins at the specified distance from runway centreline, then rises vertically for a height "H", then slopes 1:5 outward to a distance "Y" from runway centreline, and then slopes 1:6 outward to a height of 45 m above the ARP.

$$H_{\text{metres}} = 16 - 0.13(S_{\text{metres}}) - 0.0022(E_{\text{metres}})$$

$$Y_{\text{metres}} = 132 + 1.08(S_{\text{metres}}) - 0.024(E_{\text{metres}})$$

*Note: **"S"** is equal to the most demanding wingspan of the aircraft using the runway and **"E"** is equal to the runway threshold elevation above sea level (ASL). Beyond the distance **"Y"** from runway centreline the inner transitional CAT II or III surface is identical to that for the CAT I.*

4.1.4.5 For non-precision runways and non-instrument runways, the inner transitional surface begins at the specified distance from the runway centreline, and then rises vertically to a height of 45 m above the ARP.

Note: See Figure 4-5 for depiction of the inner transitional surface.

4.1.5 Transitional Surface

4.1.5.1 For precision and non-precision runways, the transitional surface adjacent to the runway, comprises:

(a) subject to (c), a first segment commencing at the edge of the runway strip extending outwards at a right angle to the runway centreline, at a vertical slope of 1:4 up to an elevation of 23 m above the nearest elevation point on the runway centreline; and

(b) a second segment beginning at the upper point of the first segment extending outwards at a right angle to the runway centreline, at a vertical slope of 1:7 up to the point that is 45 m above the ARP.

(c) where the highest elevation point on the runway is at the nearest or opposing runway edge, the highest elevation of the two runway edges nearest the runway centreline described in (a) is used as the reference elevation.

4.1.5.2 For non-instrument runways, the transitional surface adjacent to a runway comprises:

(a) a lower edge beginning at the edge of the runway strip extending outwards at a right angle to the runway centreline, at the specified vertical slope; and

(b) an upper edge located at an elevation 45 m above the ARP.

4.1.5.3 For precision and non-precision runways, the limits of the transitional surface adjacent to the approach slope comprise:

(a) a lower segment beginning at the edge of the approach surface extending outwards at a right angle to the extended runway centreline, at a vertical slope of 1:4, up to an elevation of 23 m above the elevation point on the approach surface; and

(b) an upper segment beginning at the upper point of the lower segment extending outwards at a right angle to the extended runway centreline at a vertical slope of 1:7 up to a point that is 45 m above the elevation point on the approach surface.

4.1.5.4 **(1)** Subject to (2), for non-instrument runways, the limits of the transitional surface adjacent to the approach slope comprise;

(a) a lower edge beginning at the edge of the approach surface extending outwards at a right angle to the extended runway centreline, at the specified vertical slope; and

(b) an upper edge located at an elevation of 45 m above the ARP.

(2) Where the runway is precision or non-precision at the other end, the limits of the transitional surface adjacent to the non-instrument approach slope comprise:

(a) a lower segment beginning at the edge of the approach surface extending outwards at a right angle to the extended runway centreline, at a vertical slope of 1:4, up to an elevation of 23 m above the nearest elevation point on the runway centreline; and

(b) an upper segment beginning at the upper point of the lower segment extending outwards at a right angle to the extended runway centreline at a vertical slope of 1:7 up to a point that is 45 m above the elevation point of the ARP.

Note: See Figure 4-1(b) for depiction of 4.1.5.4(2)

4.1.5.5 The elevation of a point on the lower edge of the transitional surface is:

(a) on the sides of the approach surface, equal to the elevation of the approach surface at that point; and,

(b) on the sides of the runway strip, is the same as the highest elevation of the nearest point on the runway centreline or runway edges, whichever is higher.

Note: See Figure 4-5 for depiction of the transitional and inner transitional surfaces.

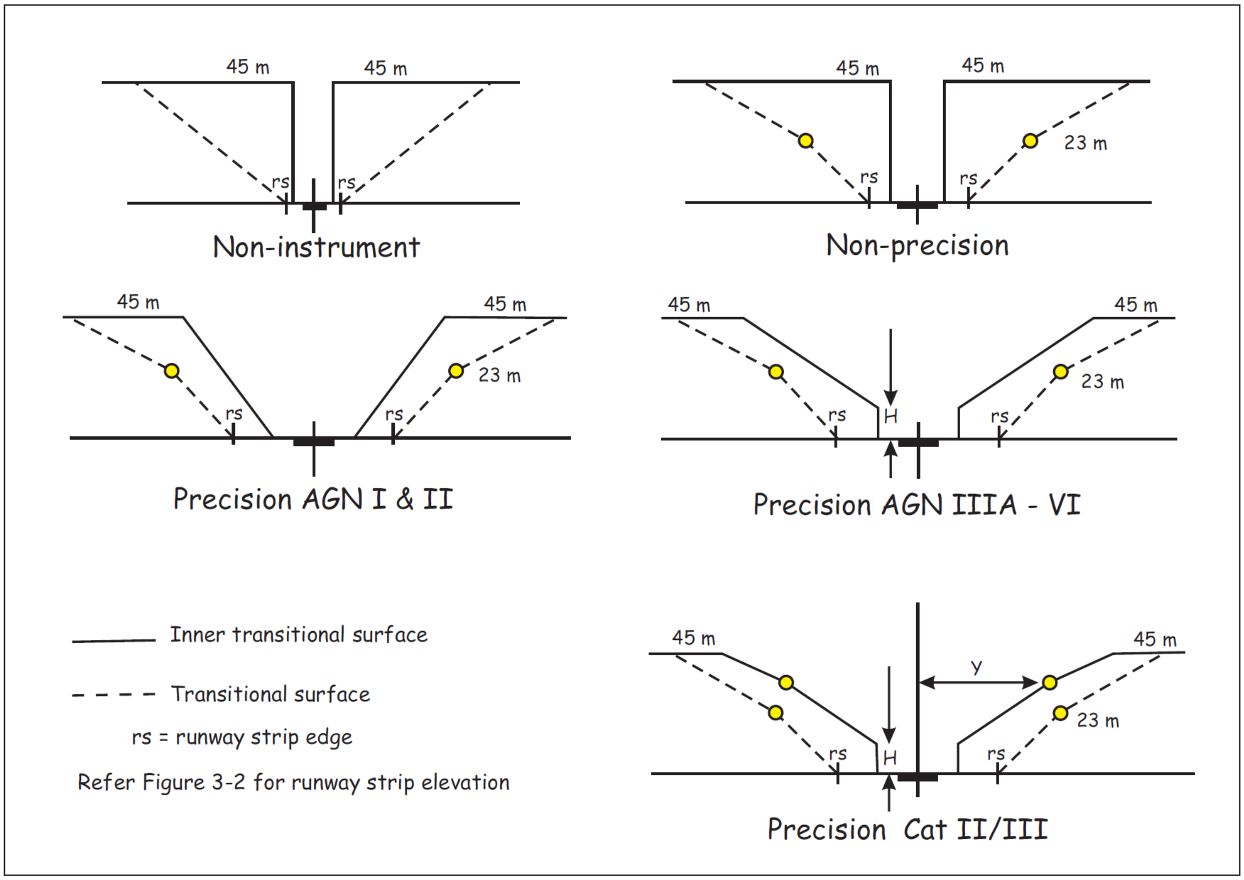


Figure 4-5: Transitional and inner transitional surfaces

4.1.6 Obstacle Restriction and Removal

4.1.6.1 Subject to 4.1.6.2, fixed objects, including terrain, are clear of an OLS, except for the visual aids specified in Chapter 5 and fixed by function NAVAIDS that must be located within the runway strip (laterally from the runway) and meeting the frangibility requirements.

4.1.6.2 Terrain in the runway strip area beyond the runway end may be above the point of origin of the adjoining approach surface, provided that:

(a) the terrain is not higher than the terrain elevation at the strip end until reaching the point of intersection with the approach surface, and

(b) thereafter is no higher than the approach surface.

Note 1: See Figure 4-6 for depiction of terrain in the strip end area.

Note 2: See Chapter 3 for slope limitations within the runways strip.

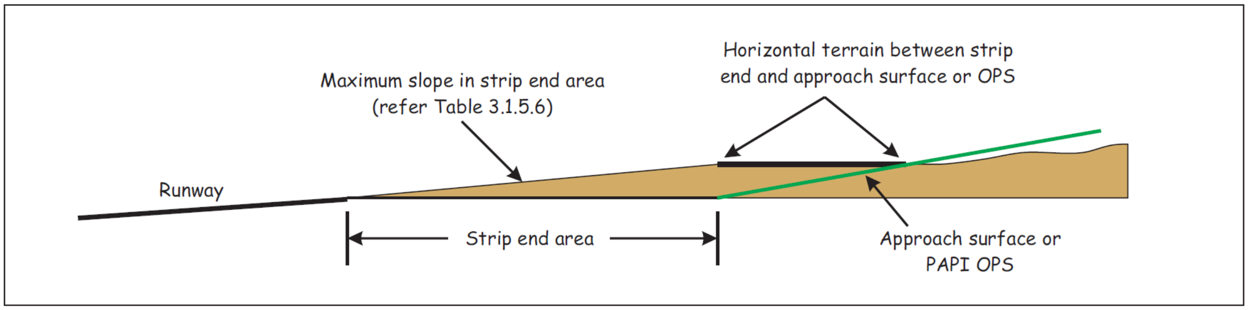


Figure 4-6: Terrain beyond strip end and exceeding approach surface or OPS

4.1.6.3 Mobile objects do not protrude into the approach, take-off, and inner transitional surfaces (OFZ) while the runway is in use for arrivals (aircraft on arrival within 2 NM) or departures.

Note: Also, see the requirements of the precision obstacle free zone in 4.2

4.1.6.4 Mobile objects do not protrude into the Transitional Surface unless required to be there by function.

Note: Under certain runway/taxiway configurations mobile aircraft and aerodrome operational vehicles (mowers, snow plough, wildlife control vehicles and other vehicles related to the operation of that runway) may infringe upon the transitional surface and are considered to be there by function.

4.1.6.5 A transportation corridor underlying an OLS is considered an object and is protected as follows:

(a) A minimum of 5.2 m is allowed above the crown of a multi-lane highway, 4.7 m above the crown of other roads, and 7.0 m above the top of the rails of a railway, except where procedures are established to ensure the OLS is not infringed while the runway is in use during arrivals and departures.

(b) The minimum height to be allowed above a waterway, river, canal, etc. is determined by an aeronautical evaluation to establish the height of the most critical obstacle. The results of the aeronautical evaluation are recorded in the airport operations manual (AOM).

4.2 PRECISION OBSTACLE FREE ZONE (POFZ)

Note: Runway with thresholds not located at the beginning of the runway or with taxiways prior to the threshold may be operationally impacted by the requirements of the precision obstacle free zone (POFZ).

Application

4.2.1.1 A POFZ is provided for a precision runway when:

(a) a vertically guided approach is provided to the runway;

(b) the reported ceiling is below 250 ft or visibility conditions less than RVR4000 (¾ SM); and,

(c) an aircraft is on its final approach within 2 NM of the runway threshold.

Location

4.2.1.2 The POFZ extends before the threshold of a precision runway.

Characteristics

4.2.1.3 The POFZ:

(a) extends 61 m prior to the threshold;

(b) has a width of 122 m on each side of the extended runway centreline; and

(c) extends upward vertically from the surface

Note: See Figure 4-7 for depiction of the precision obstacle free zone.

4.2.1.4 When the operational conditions for maintaining a POFZ are met, the area is kept free of all:

(a) fixed objects except for visual aids required to be there by function; and

(b) mobile objects including aircraft, except for the wing of an aircraft holding on a taxiway waiting for runway clearance; however, neither the fuselage nor the tail may infringe the POFZ.

Note: The protection of the POFZ requires the involvement of ATC if there is to be a primary holding position within the area of the POFZ, or if taxiing aircraft will infringe into the POFZ.

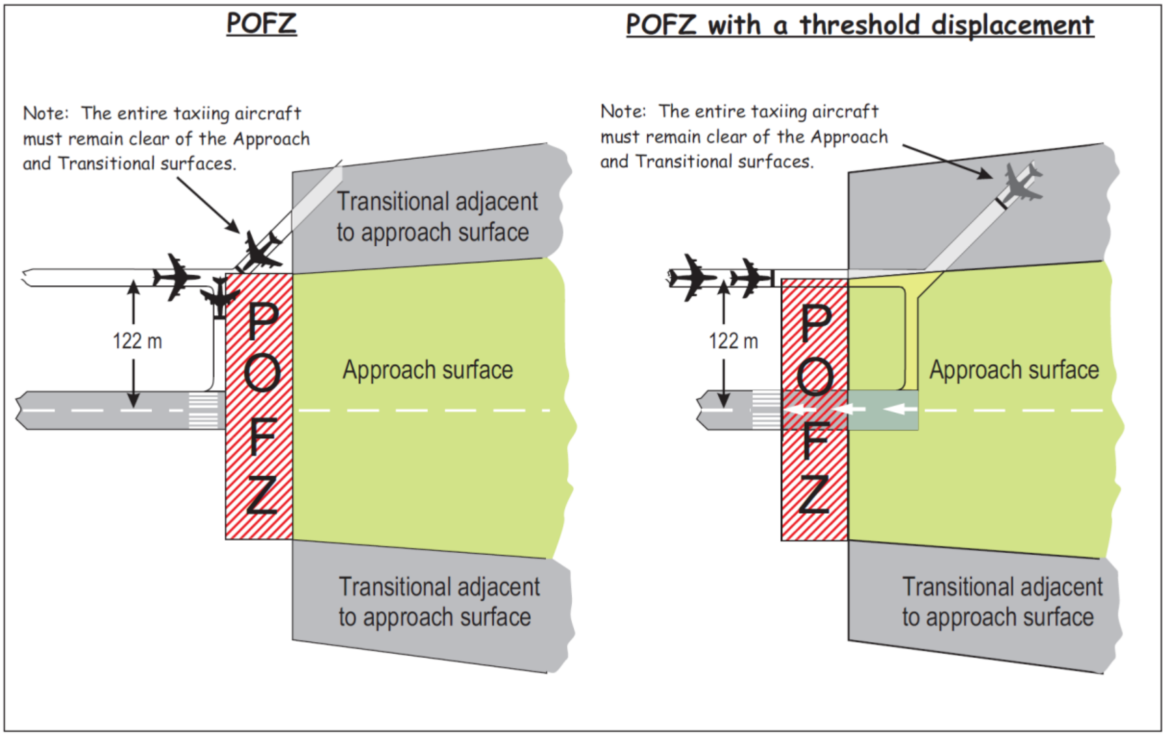


Figure 4-7: Precision Obstacle Free Zone

4.3 OBSTACLE IDENTIFICATION SURFACES (OIS)

Note: Obstacle identification surfaces (OIS) are provided for the purposes of identifying obstacles that require assessment as part of airspace protection for aircraft manoeuvring in the vicinity of an aerodrome. Objects that protrude into an OIS may under certain circumstances cause an increase in the obstacle clearance altitude/height for an instrument approach procedure or any associated visual circuit procedure.

4.3.1 Approach Obstacle Identification Surfaces

Application

4.3.1.1 An approach obstacle identification surface is established for precision runways and non-precision runways serving AGNs IIIB and higher.

Note: See Figure 4-8 for an overview of obstacle identification surfaces (OIS).

Location

4.3.1.2 Subject to 4.1.2.4 *(offset approach surface)* the approach obstacle identification surface is as specified in Table 4-1(e).

Characteristics

4.3.1.3 The limits of the approach obstacle identification surface comprise:

(a) an inner edge of specified length perpendicular to and located on each side of the extended centreline of the runway, at the specified distance from the threshold;

(b) two sides beginning at the ends of the inner edge, diverging uniformly at the specified rate in the direction of take-off, ending at the outer edge; and

(c) an outer edge parallel to the inner edge at the specified length from the Inner edge.

4.3.1.4 The elevation of the inner edge is equal to the elevation of the threshold.

4.3.1.5 The slope of the approach obstacle identification surface is measured in the vertical plane containing the centreline of the runway and is of a constant slope.

4.3.1.6 The width and length of the approach obstacle identification surface is measured in the horizontal plane.

4.3.2 Outer Obstacle Identification Surfaces

Application

4.3.2.1 An outer obstacle identification surface is established at the aerodrome.

Location

4.3.2.2 The outer obstacle identification surface is centred on the ARP.

Characteristics

4.3.2.3 The outer obstacle identification surface comprises a common plane established at a constant elevation of 45 m above the ARP, extending horizontally through 360° to a distance of 4 000 m.

Note: See Table 4-1(e) for dimensional characteristics of the outer obstacle identification surface.

4.3.3 Obstacle Identification Requirements

General

4.3.3.1 A transportation corridor underlying an OIS is considered an object and is protected as follows:

(a) A minimum of 5.2 m is allowed above the crown of a multilane highway, 4.7 m above the crown of other roads, and 7 m above the top of the rails of a railway, except where procedures are established to ensure the OIS is not infringed upon while the runway is in use during arrivals and departures.

(b) The minimum height to be allowed above a waterway, river, canal, etc. is determined by an aeronautical evaluation to establish the height of the most critical obstacle. The results of the aeronautical evaluation are recorded in the AOM.

4.3.3.2 An object infringing upon an OIS is reported to both the aeronautical information service provider and TCCA for further assessment regarding:

(a) the requirement to light, mark or chart the object;

(b) any impact on VFR arrival/departure and circuit procedures;

(c) any impact on IFR arrival/departure procedures; and

(d) any impact on aerodrome zoning regulations, where applicable.

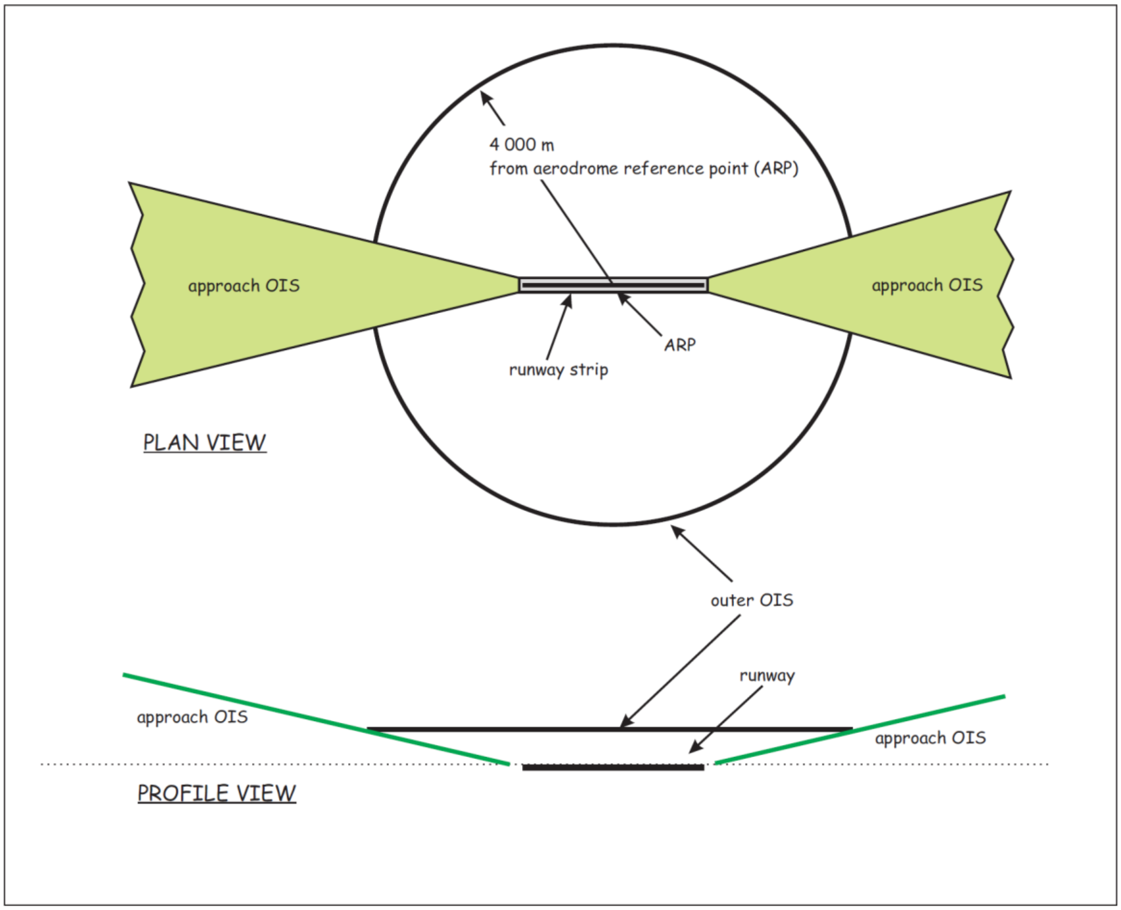


Figure 4-8: Obstacle identification surfaces (OIS)

Note: Units for Tables 4-1 (a) through (e) are in metres unless otherwise specified

Table 4-1(a)—Obstacle Limitation Surfaces

NON-INSTRUMENT									
Aircraft Group Number - *Table 1-1 Column II*			**I**	**II**	**IIIA**	**IIIB**	**IV**	**V**	**VI**
Approach: Length of inner edge each side of centreline			30	40	40	75	75	75	75
	Distance from threshold		30	60	60	60	60	60	60
	Divergence		10 %	10 %	10 %	10 %	10 %	10 %	10 %
	First section	Length	2 500	2 500	2 500	3 000	720	720	720
		Slope	5 %	4 %	4 %	3.33 %	2.5 %	2.5 %	2.5 %
	Second section	Length	-	-	-	-	2 280	2 280	2 280
		Slope	-	-	-	-	2.9 %	2.9 %	2.9 %
	Total length		2 500	2 500	2 500	3 000	3 000	3 000	3 000
Transitional:	First segment		20 %	20 %	20 %	14.3 %	14.3 %	14.3 %	14.3 %
	Second segment		-	-	-	-	-	-	-
Inner Transitional: Distance from centreline			30	40	40	61	61	61	61
	Slope		vertical	vertical	vertical	vertical	vertical	vertical	vertical
NON-PRECISION									
Approach: Length of inner edge each side of centreline			75	75	75	122	122	122	122
	Distance from threshold		60	60	60	61	61	61	61
	Divergence		10 %	10 %	10 %	15 %	15 %	15 %	15 %
	First section	Length	2 500	2 500	2 500	720	720	720	720
		Slope	3.33 %	3.33 %	3.33 %	2.5 %	2.5 %	2.5 %	2.5 %
	Second section	Length	-	-	-	4 280	4 280	4 280	4 280
		Slope	-	-	-	2.9 %	2.9 %	2.9 %	2.9 %
	Total length		2 500	2 500	2 500	5 000	5 000	5 000	5 000
Transitional:	Slope first segment		25 %	25 %	25 %	25 %	25 %	25 %	25 %
	Slope second segment		14.3 %	14.3 %	14.3 %	14.3 %	14.3 %	14.3 %	14.3 %
Inner Transitional: Distance from centreline			40	40	61	61	61	61	61
	Slope		vertical	vertical	vertical	vertical	vertical	vertical	vertical
PRECISION									
Approach: Length of inner edge each side of centreline			122	122	122	122	122	122	122
	Distance from threshold		61	61	61	61	61	61	61
	Divergence		15 %	15 %	15 %	15 %	15 %	15 %	15 %
	First section	Length	720	720	720	720	720	720	720
		Slope	2.5 %	2.5 %	2.5 %	2.0 %	2.0 %	2.0 %	2.0 %
	Second section	Length	4 280	4 280	4 280	4 280	4 280	4 280	4 280
		Slope	2.9 %	2.9 %	2.9 %	2.9 %	2.9 %	2.9 %	2.9 %
	Total length		5 000	5 000	5 000	5 000	5 000	5 000	5 000
Transitional:	Slope first segment		25 %	25 %	25 %	25 %	25 %	25 %	25 %
	Slope second segment		14.3 %	14.3 %	14.3 %	14.3 %	14.3 %	14.3 %	14.3 %
Inner Transitional: Distance from centreline			46	46	61	61	61	61	61
	Slope first segment		33.3 %	33.3 %	vertical	vertical	vertical	vertical	vertical
	Slope second segment	CAT I	n/a (4)	n/a (4)	16.7 %	16.7 %	16.7 %	16.7 %	16.7 %
		CAT II/III	-	-	-	20 %	20 %	20 %	20 %
	Slope third segment (CAT II/III only)		-	-	-	16.7 %	16.7 %	16.7 %	16.7 %

Note 1: See paragraphs 4.1.4.2 to 4.1.4.4 for vertical height of precision inner transitional.

Note 2: This table does not consider CAT II or III operations for group I, II or IIIA aircraft. Consult with Transport Canada for specific needs in this situation.

Table 4-1(b)—Modified Obstacle Limitation Surfaces							
NON-INSTRUMENT (Transitional slopes - 33%)							
Aircraft Group Number - *Table 1-1 Column II*	I	II	IIIA	IIIB	IV	V	VI
Approach				Not available			
Length of inner edge each side of centreline	45	45	45				
Distance from threshold	30	60	60				
Point of origin of divergence beyond the strip end	150	150	150				
Divergence	10 %	10 %	10 %				
Length	2 500	2 500	2 500				
Slope	5%	4%	4%				
Total Length	2 500	2 500	2 500				
Transitional							
Slope	33 %	33 %	33 %				
Inner Transitional							
Slope	vertical	vertical	vertical				
Distance from each side of centreline line	30	30	40				

Table 4-1(c)—Modified Obstacle Limitation Surfaces							
NON-INSTRUMENT (Transitional slopes - 50%)							
Aircraft Group Number - *Table 1-1 Column II*	I	II	IIIA	IIIB	IV	V	VI
Approach				Not available			
Length of inner edge each side of centreline	60	60	60				
Distance from threshold	30	60	60				
Point of origin of divergence beyond the strip end	300	300	300				
Divergence	10 %	10 %	10 %				
Length	2 500	2 500	2 500				
Slope	5 %	4 %	4 %				
Total Length	2 500	2 500	2 500				
Transitional							
Slope	50 %	50 %	50 %				
Inner Transitional							
Slope	vertical	vertical	vertical				
Distance from each side of centreline line	30	30	40				

Table 4-1(d)—Modified Obstacle Limitation Surfaces							
NON-INSTRUMENT (Transitional slopes – Vertical)							
Aircraft Group Number - *Table 1-1 Column II*	I	II	IIIA	IIIB	IV	V	VI
Approach							
Length of inner edge each side of centreline	60	75	122	Not available			
Distance from threshold	30	60	60				
Point of origin of divergence beyond the strip end	300	450	900				
Divergence	10 %	10 %	10 %				
Length	2 500	2 500	2 500				
Slope	5 %	4 %	4 %				
Total Length	2 500	2 500	2 500				
Transitional							
Slope	vertical	vertical	vertical				
Inner Transitional							
Slope	vertical	vertical	vertical				
Distance from each side of centreline line	30	30	40				

Table 4-1(e)—Obstacle Identification Surfaces								
Aircraft Group Number - *Table 1-1 Column II*		**I**	**II**	**IIIA**	**IIIB**	**IV**	**V**	**VI**
NON-INSTRUMENT								
Outer ID Surface	Height	45	45	45	45	45	45	45
	Radius	4 000	4 000	4 000	4 000	4 000	4 000	4 000
NON-PRECISION								
Outer ID Surface	Height	45	45	45	45	45	45	45
	Radius	4 000	4 000	4 000	4 000	4 000	4 000	4 000
Approach ID Surface	Length of inner edge each side of centreline	---	---	---	122	122	122	122
	Distance from threshold	---	---	---	61	61	61	61
	Divergence	---	---	---	15 %	15 %	15 %	15 %
	Length	---	---	---	5 000	5 000	5 000	5 000
	Slope	---	---	---	2.5 %	2.5 %	2.5 %	2.5 %
PRECISION								
Outer ID Surface	Height	45	45	45	45	45	45	45
	Radius	4 000	4 000	4 000	4 000	4 000	4 000	4 000
Approach ID Surface	Length of inner edge each side of centreline	122	122	122	122	122	122	122
	Distance from threshold	61	61	61	61	61	61	61
	Divergence	15 %	15 %	15 %	15 %	15 %	15 %	15 %
	Length	15 000	15 000	15 000	15 000	15 000	15 000	15 000
	Slope	2.5 %	2.5 %	2.5 %	2.0 %	2.0 %	2.0 %	2.0 %

4.4 CLEARWAY

Application

4.4.1.1 Where a clearway is provided, it is as specified in this section.

Location

4.4.1.2 The clearway begins at the end of the TORA.

Characteristics

Length

4.4.1.3 The maximum length of a clearway is half of the TORA.

Note: The length of the clearway is dependent on meeting the obstacle clearance requirements.

Width

4.4.1.4 The clearway extends laterally to a distance of 75 m, on each side of the extended centreline of the runway or the width of the runway strip, whichever is less.

Slopes

4.4.1.5 The clearway plane slopes upward with a slope of 1.25%:

(a) the lower limit of this plane being a horizontal line that:

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

(ii) passes through a point located on the runway centreline at the end of the TORA; and

(b) the upper limit of this plane being a horizontal line that:

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

(ii) abuts the inner edge of the take-off surface.

Note 1: See Figure 4-9 for depiction of clearway plane.

Note 2: See section 4.1.3 for standards relating to the take-off surface.

Obstacles in the Clearway Plane

4.4.1.6 Subject to 4.4.1.7, no object except visual aids and frangible NAVAIDs of low mass (e.g. LOC monitoring antenna) provided in accordance with the standards in this document protrudes above the clearway plane~~.~~

Note: Where an object protrudes above the clearway plane or the take-off surface, the declared length of the clearway is reduced as required to obtain clearance of the obstacle.

Note: A clearway may extend outside the aerodrome boundary only if the aerodrome operator has established the necessary procedures and documentation to ensure that the obstacle protection requirements of the clearway are met.

4.4.1.7 Terrain does not protrude through the clearway plane or take-off surface except:

(a) in the runway strip beyond the end of the runway, the terrain may continue at the same longitudinal slope of the runway, and

(b) beyond the runway strip, the maximum height of the terrain is not higher than the elevation at the end of the runway strip until the terrain convergences with the clearway plane.

Note 1: See Figure 4-9 for depiction of clearway plane and take-off surface.

Note 2: See Figure 4-6 for depiction of terrain in the approach surface.

4.4.1.8 A transportation corridor underlying a clearway plane and take-off surface is considered an object and is protected as follows:

(a) A minimum of 5.2 m is allowed above the crown of a multi-lane highway, 4.7 m above the crown of other roads, and 7.0 m above the top of the rails of a railway, except where procedures are established to ensure the clearway plane and take-off surface is not infringed while the runway is in use during departures.

(b) The minimum height to be allowed above a waterway, river, canal, etc. is determined by an aeronautical evaluation to establish the height of the most critical obstacle. The results of the aeronautical evaluation are recorded in the AOM.

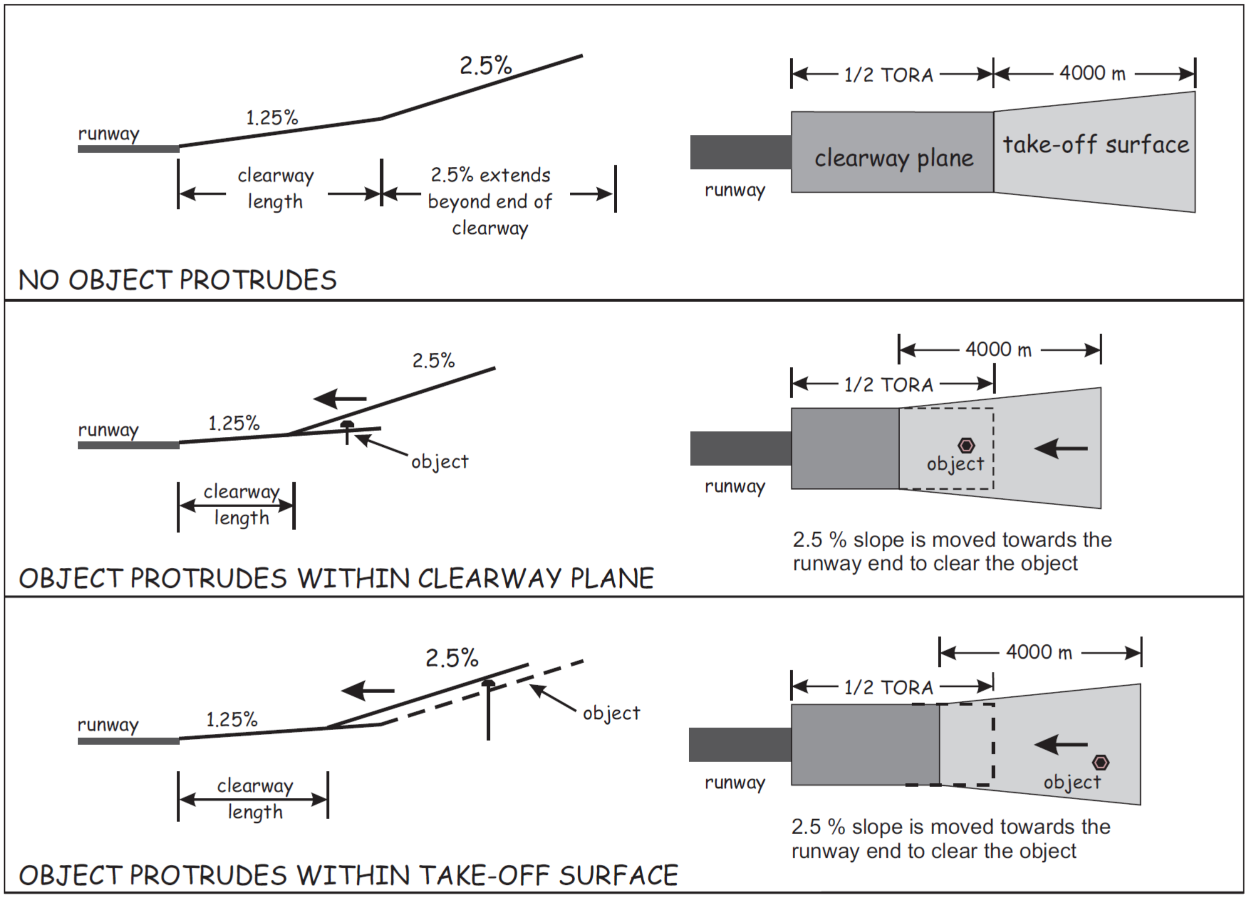


Figure 4-9: Clearway plane

CHAPTER 5.
VISUAL AIDS

CHAPTER 5. VISUAL AIDS

Note: The visual aids and pattern specifications outlined in this section need to be respected within the tolerances provided in an effort to have a standardized presentation to aircrews. Other non-specified visual indications on the manoeuvring areas can distort the overall presentation of the visual aid and affect the intended perception by aircrews.

5.0 GENERAL

5.0.0.1 Approach lighting systems, aerodrome flight manoeuvring area hazard beacons, and visual aids provided on the movement area of the aerodrome, are as specified.

5.1 WIND DIRECTION INDICATORS

Application

5.1.1.1 The aerodrome is equipped with at least one wind direction indicator.

Location

5.1.1.2 The wind direction indicator is located so as to be visible from aircraft in flight and in such a way as to be free from the effects of air disturbances caused by nearby objects.

5.1.1.3 A wind direction indicator is located near each end of the runway where the runway is greater than 1 200 m in length.

Note: The wind direction indicator is typically located adjacent to the touchdown zone.

5.1.1.4 The wind direction indicator is located:

(a) at a minimum of 60 m from the runway edge; and

(b) any additional distance to be clear of the obstacle free zones.

5.1.1.5 Subject to 5.1.1.2, a runway of 1 200 m or less in length has a wind direction indicator located:

(a) centrally on the aerodrome; or

(b) near each end of the runway.

Note: Where the wind direction indicator is located near the runway end, it is typically positioned in proximity to the aiming point markings.

5.1.1.6 The wind direction indicator has a maximum height of 7.5 m above grade and is frangibly mounted at the base when located within the runway strip.

Note: When the wind direction indicator is located outside the runway strip, the structure needs to be clear of all OLS.

Characteristics

5.1.1.7 The wind direction indicator is of the form of a truncated cone made of fabric.

5.1.1.8 Subject to 5.1.1.9, the wind direction indicator has a length of 3.6 m and a diameter at the larger end of 0.9 m.

5.1.1.9 The wind direction indicator for a runway serving AGNs I or II has a minimum length of 2.5 m and a minimum diameter at the larger end of 0.45 m.

5.1.1.10 The wind direction indicator is of a conspicuous colour, or a combination of colours and gives adequate visibility against changing backgrounds.

5.1.1.11 The taper of the wind direction indicator from the throat to the trailing end is designed to cause the indicator to fully extend when subjected to a wind speed of 15 kt.

5.1.1.12 The wind direction indicator moves freely about the vertical support structure and, when subjected to wind speed of 3 kt or more, indicates the wind direction within ±5°.

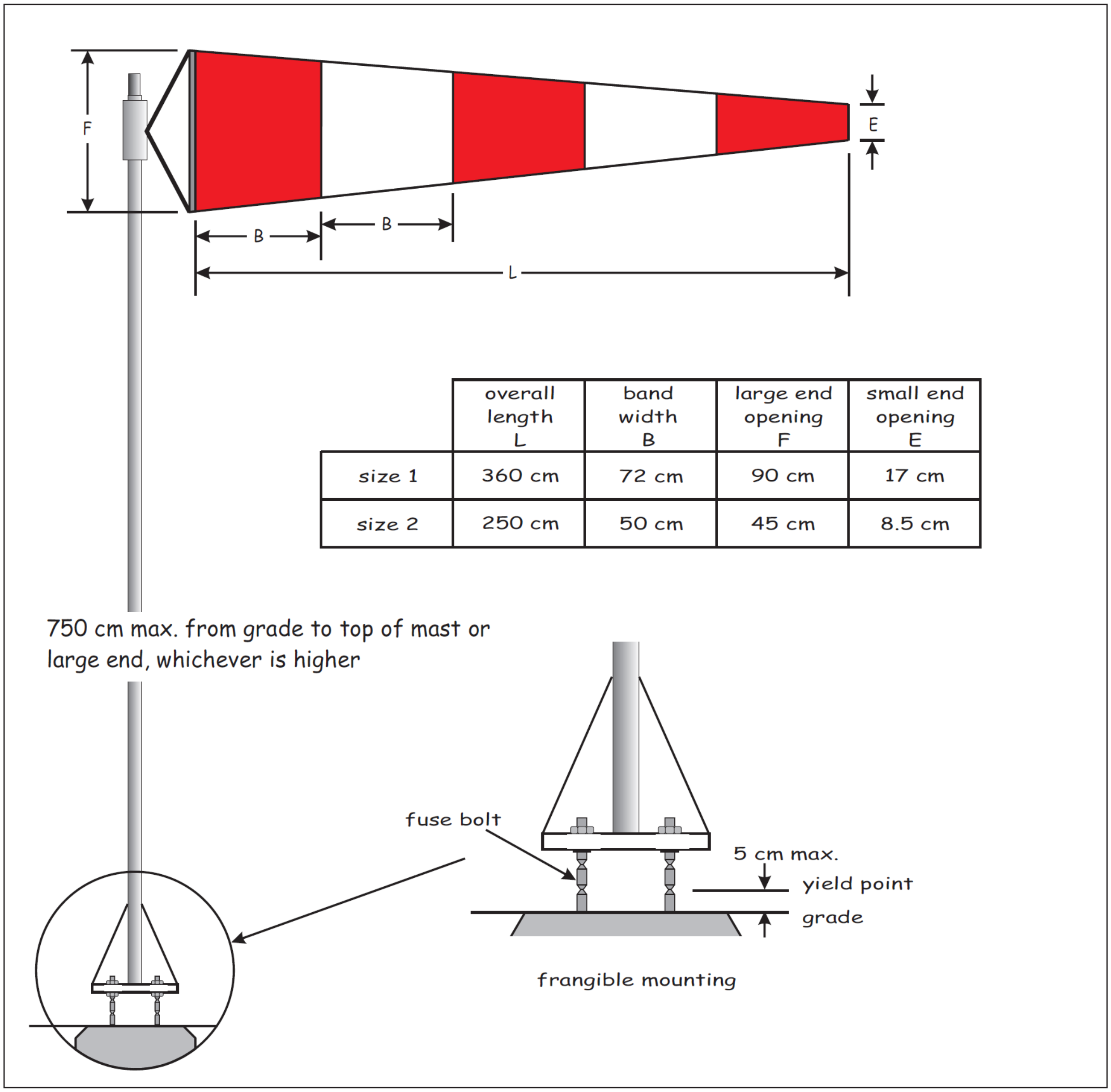
5.1.1.13 All wind direction indicators serving runways used at night are illuminated.

Photometric requirements

5.1.1.14 The wind direction indicator is illuminated as follows:

(a) Externally lighted wind cone assemblies are supplied with sufficient overhead light fixtures to provide a minimum of 20 lux illumination on any point of horizontal planes described by the complete rotation of the upper surface of a fully extended cone.

(b) Internally lighted wind cone assemblies are supplied with a lamp to provide, on the top and lateral surfaces of the fabric windsock, an average luminance of 34.3 to 102.8 cd/m^2 and a minimum luminance at any point of 6.8 cd/m^2.



	overall length L	band width B	large end opening F	small end opening E
size 1	360 cm	72 cm	90 cm	17 cm
size 2	250 cm	50 cm	45 cm	8.5 cm

Figure 5-1: Typical wind direction indicator

5.2 MARKINGS

5.2.1 General

5.2.1.1 The markings in this document are applicable to paved movement areas and road surfaces, as specified in the respective standards.

Note 1: Markings are striated except where noted such as for the runway designator, runway side stripe, threshold bar, demarcation bar and chevrons which are solid markings.

Note 2: The visibility of the markings may be improved by outlining the marking with a black outline.

Interruption of Runway Markings

5.2.1.2 At an intersection of two (or more) runways the markings of the primary runway is displayed and the markings of the other runway(s) are interrupted by the width of the primary runway, except for the runway side stripe marking which is interrupted in all situations.

5.2.1.3 Runway-holding position markings on a runway interrupt other runway markings with the exception of runway designation markings.

5.2.1.4 The order of importance of runways for the display of runway markings is as follows:

- 1st – precision runway;
- 2nd – non-precision runway;
- 3rd – non-instrument runway.

Note 1: Refer to section 5.2.13 for taxiway centreline and section 5.2.16 for runway-holding position markings on a runway.

Note 2: Where precision runways intersect, the commonly used runway is normally the primary runway.

Colour

5.2.1.5 All markings on the runway are white, except for the following which are yellow;

(a) the demarcation bar marking;

(b) a runway-holding position marking;

(c) a taxiway centreline marking; and

(d) the auxiliary services marking.

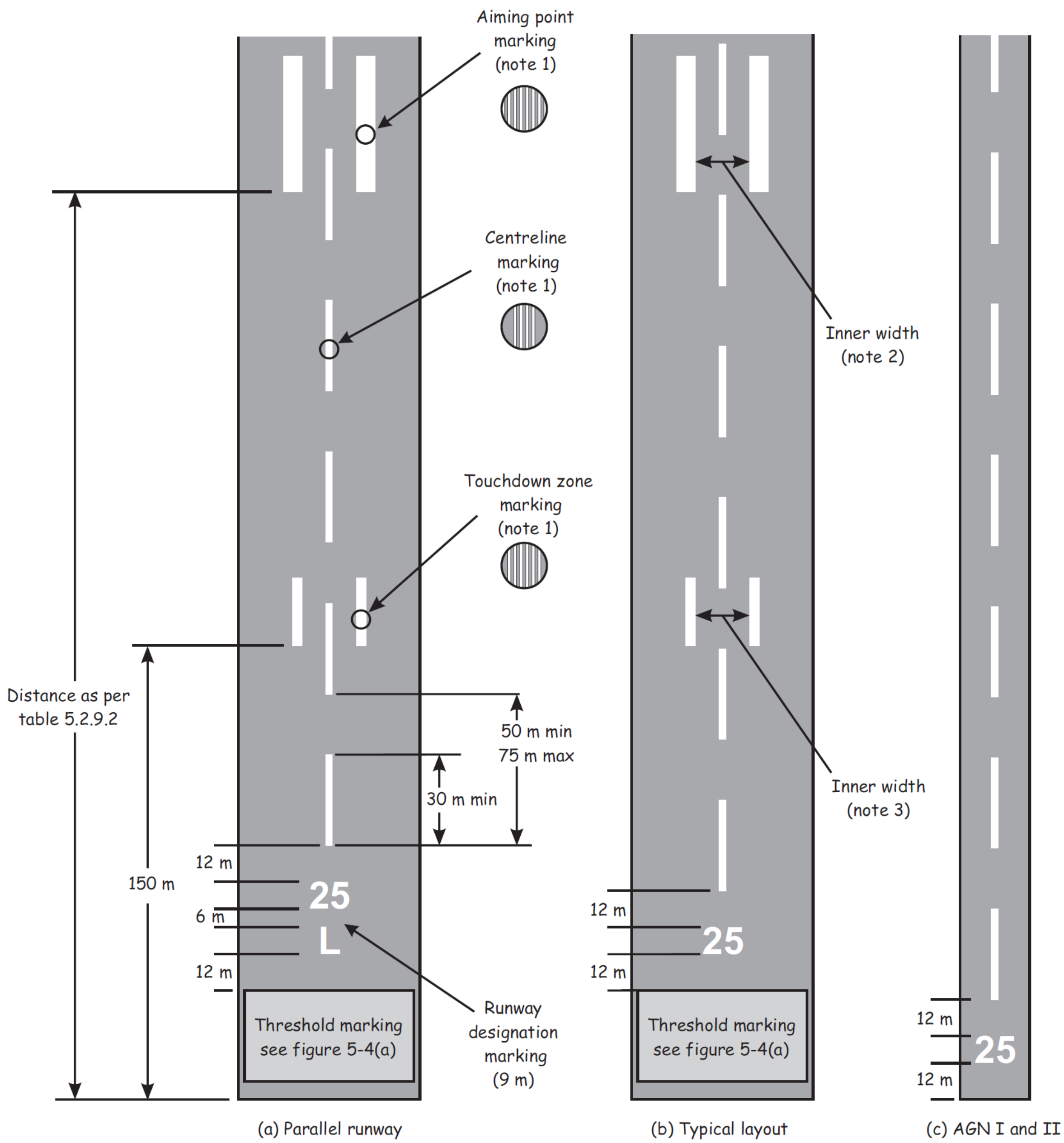
5.2.1.6 Taxiway centreline and side stripe markings, runway and taxiway safety area markings, runway-holding position markings, aircraft stand taxilane, chevron markings, manoeuvring area delimitation markings and aircraft stand centreline markings are yellow.

5.2.1.7 Vehicle corridor and pedestrian walkway markings on an apron are white.

5.2.1.8 Parking area boundary and other apron safety lines are white, or white and red, except that red is not used where an aircraft would cross the line.

Note 1: Green may be used to mark an area that is not intended for operational use by aircraft, such as islands of pavement.

5.2.1.9 The marking colours are in accordance with Appendix 5A.



Note 1: Aiming point, touchdown zone and centreline markings are striated. Refer: 5.2.8.4, 5.2.9.5 and 5.2.10.5
Note 2: For more information on marking tolerances, refer to the respective standards.
Note 3: Inside dimension of aiming point marking, refer 5.2.10.6 and Table 5.2.9.2
Note 4: Inside dimension of touchdown zone marking, refer 5.2.9.6 and Table 5.2.9.2

Figure 5-2: Runway designation, centreline and threshold markings

5.2.2 Runway Designation Marking

Application

5.2.2.1 A runway designation marking is provided at the threshold of a paved runway.

Location

5.2.2.2 Subject to 5.2.2.3, the lower edge of runway designation marking is located 12 m (±0.3 m) from the top edge of the threshold marking, or from threshold where no threshold marking is provided.

5.2.2.3 Where a letter forms part of the runway designation marking, it is located in accordance with 5.2.2.2. The lower edge of the number is then located at longitudinal distance of 6 m (±0.3 m) from the top of the letter.

5.2.2.4 The runway designation marking is centred on the runway centreline using the overall width of the designation [number and letter as applicable].

Note: See Figure 5-2 for locating the runway designation marking.

Characteristics

5.2.2.5 The runway designation marking consists of a solid two-digit number and on parallel runways is supplemented with a solid letter.

5.2.2.6 Subject to 5.2.2.9, on a single runway, dual parallel runways and triple parallel runways, the two-digit number is the whole number nearest the one-tenth of the magnetic azimuth (north), when viewed from the direction of the final approach.

Note 1: For example, where the magnetic azimuth is 183°, the runway designator would be 18, and for a magnetic azimuth of 187°, the runway designator would be 19. For a magnetic azimuth ending in "5", such as 185°, the runway designator can be either 18 or 19.

Note 2: Where measurements are taken in fractions of a degree, for example 184.65°, this value would be rounded to the nearest degree – 185. The above formula would then be applied.

5.2.2.7 Subject to 5.2.2.9, on four or more parallel runways, one set of adjacent runways is numbered to the nearest one-tenth magnetic azimuth, and the other set of adjacent runways is numbered to the next nearest one-tenth of the magnetic azimuth.

Note: For example, where the magnetic azimuth is between 150.0° and 159.99°, the runway designator of the two left runways would be 15L and 15R respectively, and the runway designator of the two right runways would be 16L and 16R respectively.

5.2.2.8 When the above rules would generate a single digit number, it is preceded by a zero.

5.2.2.9 In cases of aerodromes located within the boundaries of Canadian northern domestic airspace, the runway designation requirements prescribed in 5.2.2.6 and 5.2.2.7 apply except that TRUE azimuth rather than magnetic azimuth is used.

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

- for two parallel runways: "L" "R";
- for three parallel runways: "L" "C" "R";
- for four parallel runways: "L" "R" "L" "R"

5.2.2.11 The numbers and letters are in the form and proportion shown in Figure 5-3. The dimensions are in accordance with Figure 5-3 (±5cm).

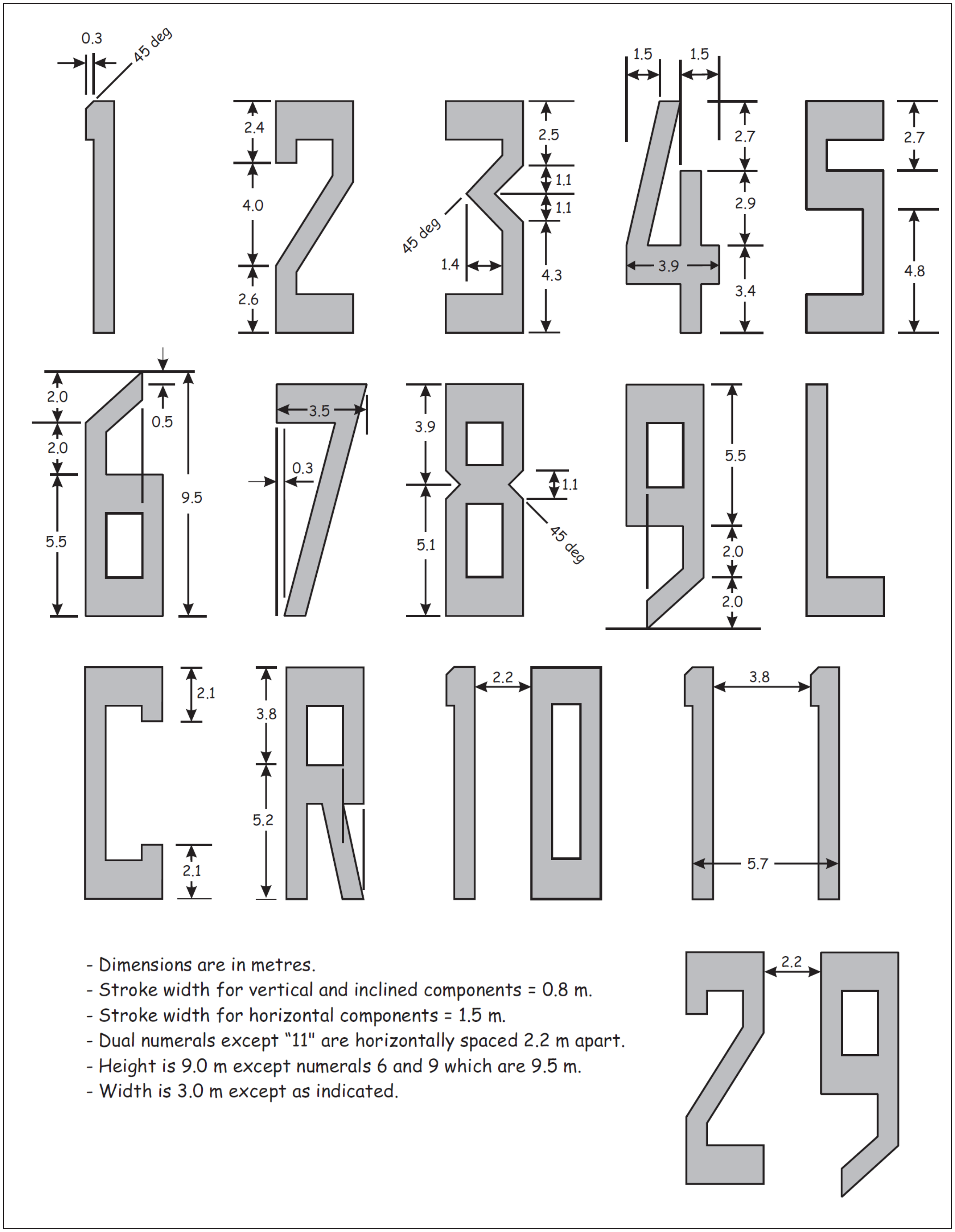


Figure 5-3: Form and proportion of runway designation markings

5.2.3 Threshold Marking

Application

5.2.3.1 A threshold marking is provided at the threshold of a paved runway serving AGNs IIIA and above.

Location

5.2.3.2 Subject to 5.2.3.3, the threshold marking commences 6 m (±0.3 m) from the threshold.

5.2.3.3 Where the threshold marking would be located on an intersecting runway (for example a "T" configuration), the threshold marking is relocated upwind so as to be clear of the intersecting runway.

Note: The runway designation marking would also move accordingly since its location is referenced to the threshold marking. Refer to Figure 5-4(b) for depiction of positioning.

Characteristics

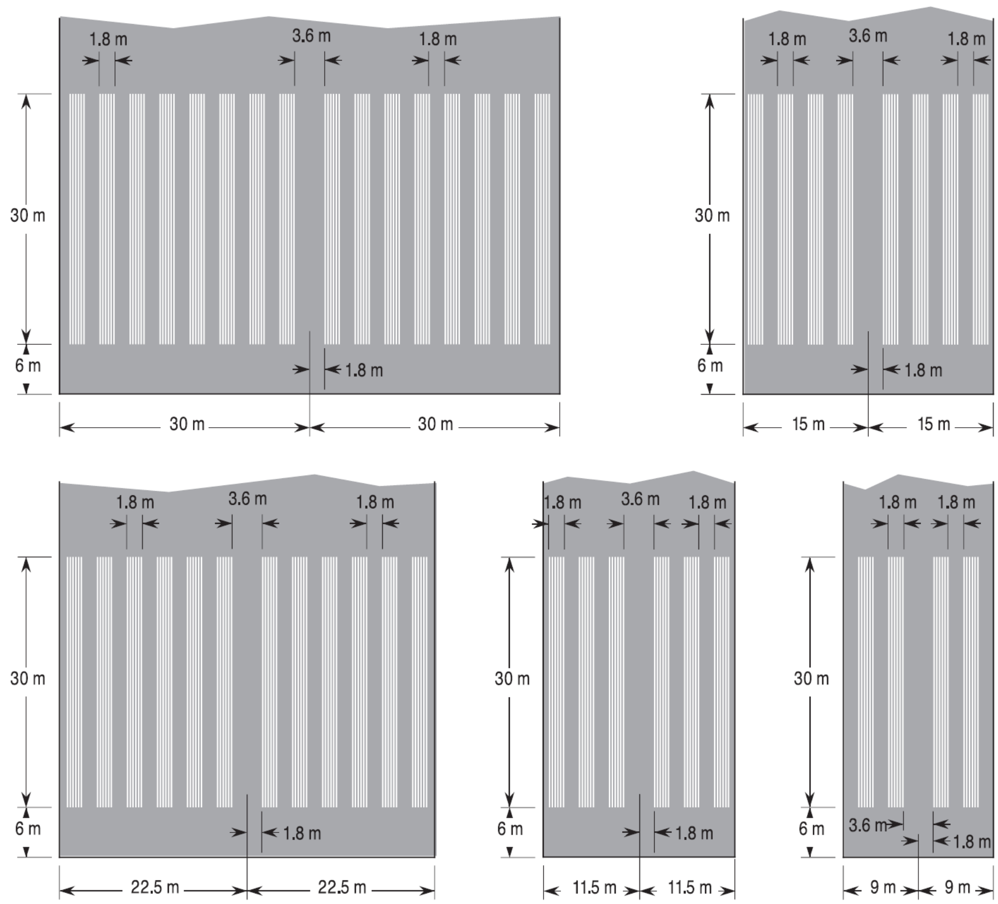
5.2.3.4 The threshold marking extends laterally to within 3 m of, but not beyond, the edge of the runway, or runway side stripe marking if provided.

5.2.3.5 The threshold marking is separated into two symmetrical groups of longitudinal stripes, separated by a 3.6 m (±0.2 m) gap centered on the centreline of the runway.

5.2.3.6 Each stripe within a group is 30 m long (±0.3 m), 1.8 m (±0.1 m) wide and spaced 1.8 m (±0.1 m) from the next stripe.

5.2.3.7 The stripe is striated with a series of uniformly spaced longitudinal painted lines and gaps with widths of 15 cm (±5 cm) providing a minimum of 50% paint coverage of the stripe.

Note: See Figure 5-4(a) for depiction of the threshold marking.



Note 1: Depicted markings are striated.

Note 2: The markings depicted are for standard runway widths.

Note 3: For information on marking tolerances, refer to the standard.

Figure 5-4(a): Threshold markings

5.2.4 Threshold Bar

Application

5.2.4.1 Subject to 5.2.4.2, a threshold bar is provided where:

(a) the beginning of a runway is not square with the runway centreline;

(b) the runway threshold is not co-located with the extremity of the opposing runway;

(c) a paved stopway precedes the threshold of a runway; or

(d) the threshold markings are positioned as per 5.2.3.3.

5.2.4.2 Where a runway threshold is temporarily displaced from the beginning of a runway:

(a) a threshold bar is provided; or

(b) flags, cones or marker boards of a conspicuous colour or combination of colours are added to mark the temporary threshold location.

Location

5.2.4.3 The lower edge of the threshold bar is located at the designated threshold position.

Note: See Figures 5-4(b), 5-5 and 5-6 to locate the threshold bar.

Characteristics

5.2.4.4 The threshold bar extends perpendicular and outwards from the runway centreline, to both sides of the runway.

5.2.4.5 The threshold bar is:

(a) a solid line, 1.8 m (±0.1 m) in width; and

(b) white in colour.

5.2.5 Demarcation Bar

Application

5.2.5.1 A demarcation bar is provided where a paved stopway, blast pad or taxiway precedes the pre-threshold area of a runway.

Location

5.2.5.2 The demarcation bar is located entirely within the stopway, blast pad or taxiway with its upper edge at the transition point to the runway.

Note: See Figure 5-5 to locate the demarcation bar.

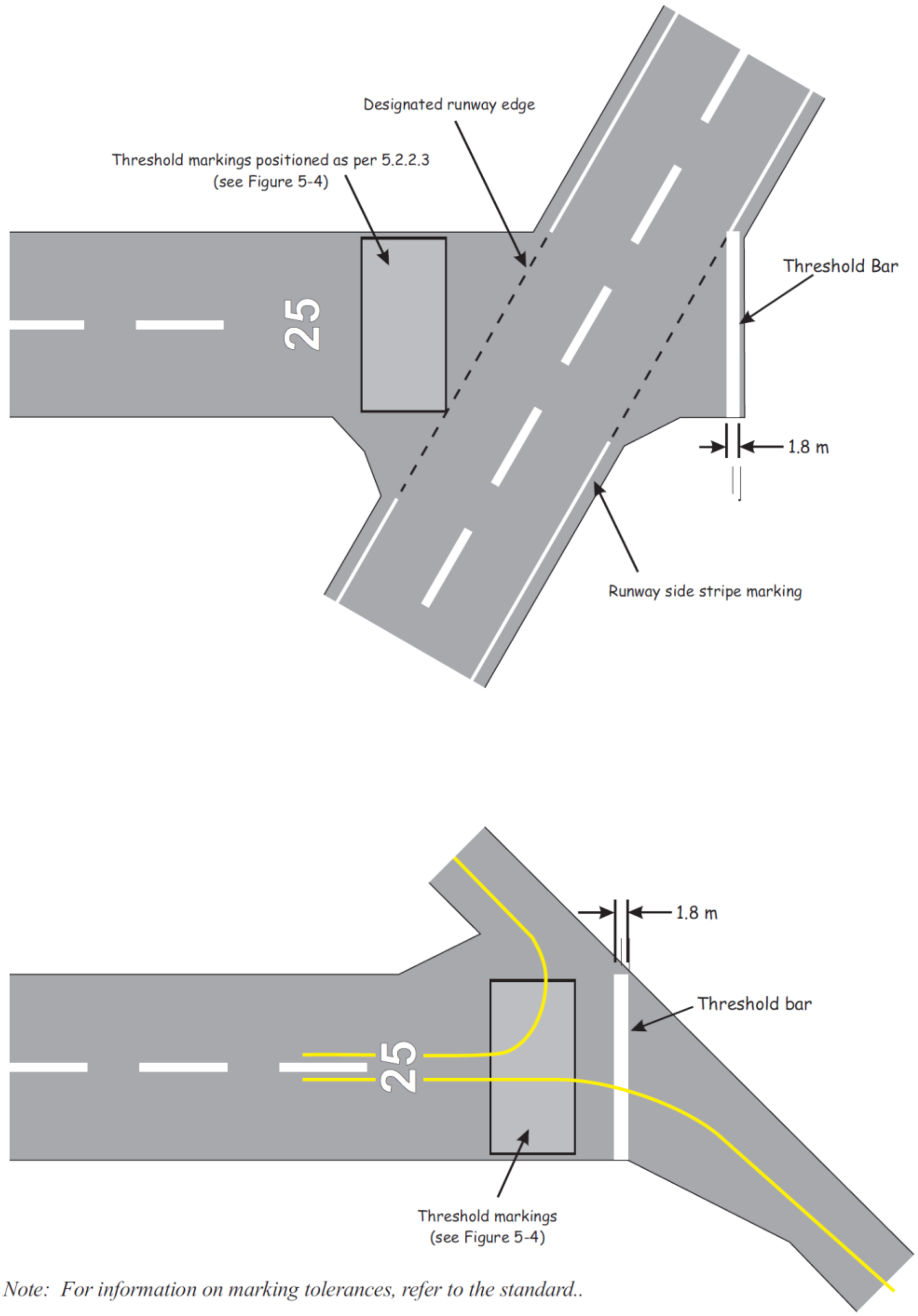
Characteristics

5.2.5.3 The demarcation bar extends perpendicular to the runway centreline, to both sides of the runway.

5.2.5.4 The demarcation bar is:

(a) a solid line, 0.9 m (±0.1 m) in width; and

(b) yellow in colour.



Note: For information on marking tolerances, refer to the standard..

Figure 5-4(b): Threshold markings (with threshold bar)

5.2.6 Arrows

Application

5.2.6.1 Where a runway threshold is permanently displaced from the runway end, arrows are provided on the portion of the runway before the threshold.

5.2.6.2 Where a runway threshold is temporarily displaced from the runway end, arrows are provided on the portion of the runway before the threshold except if the temporary displacement is for a short period of time alternate means such as markers can be used.

Note 1: When the portion of the runway is unfit for the surface movement of aircraft, refer to section 5.2.24 for the provision of closed markings.

Note 2: When the portion of the runway is maintained as a stopway, refer to section 5.2.7 for the provision of chevron markings.

Location

5.2.6.3 The arrows are located as shown in Figure 5-6.

Characteristics

5.2.6.4 The characteristic of the arrow and arrowhead is as shown in Figure 5-6.

5.2.6.5 Subject to 5.2.6.6, all runway markings prior to the threshold are removed except for the runway centreline stripes that are converted to arrows.

5.2.6.6 Where a threshold is temporarily displaced for a short period of time, the use of flags, cones, or marker boards of a conspicuous colour or combination of colours is acceptable in lieu of the above requirements.

5.2.7 Chevron Marking

Application

5.2.7.1 When the surface abutting a runway end is a paved stopway or blast pad, and exceeds 60 m in length, the entire length beyond the runway end is marked with a chevron marking.

Note: Chevron markings are not to be applied to closed portions of runways (see 5.2.24)

5.2.7.2 Where a chevron marking has been applied, a threshold bar marking or demarcation bar marking is provided, as appropriate.

Note: See sections 5.2.4 Threshold Bar and 5.2.5 Demarcation Bar.

Location

5.2.7.3 The chevron marking points in the direction of the runway and originates at the threshold, or demarcation bar if provided, as shown in Figure 5-5.

5.2.7.4 The interval between chevrons is uniform between 15 – 30 m.

Characteristics

5.2.7.5 The chevron has a uniform width of 0.9 m (±0.1 m).

5.2.7.6 The first and last chevrons are one half (½) chevrons as depicted in Figure 5-5.

Note: See Figure 5-5 for depiction of the chevron marking.

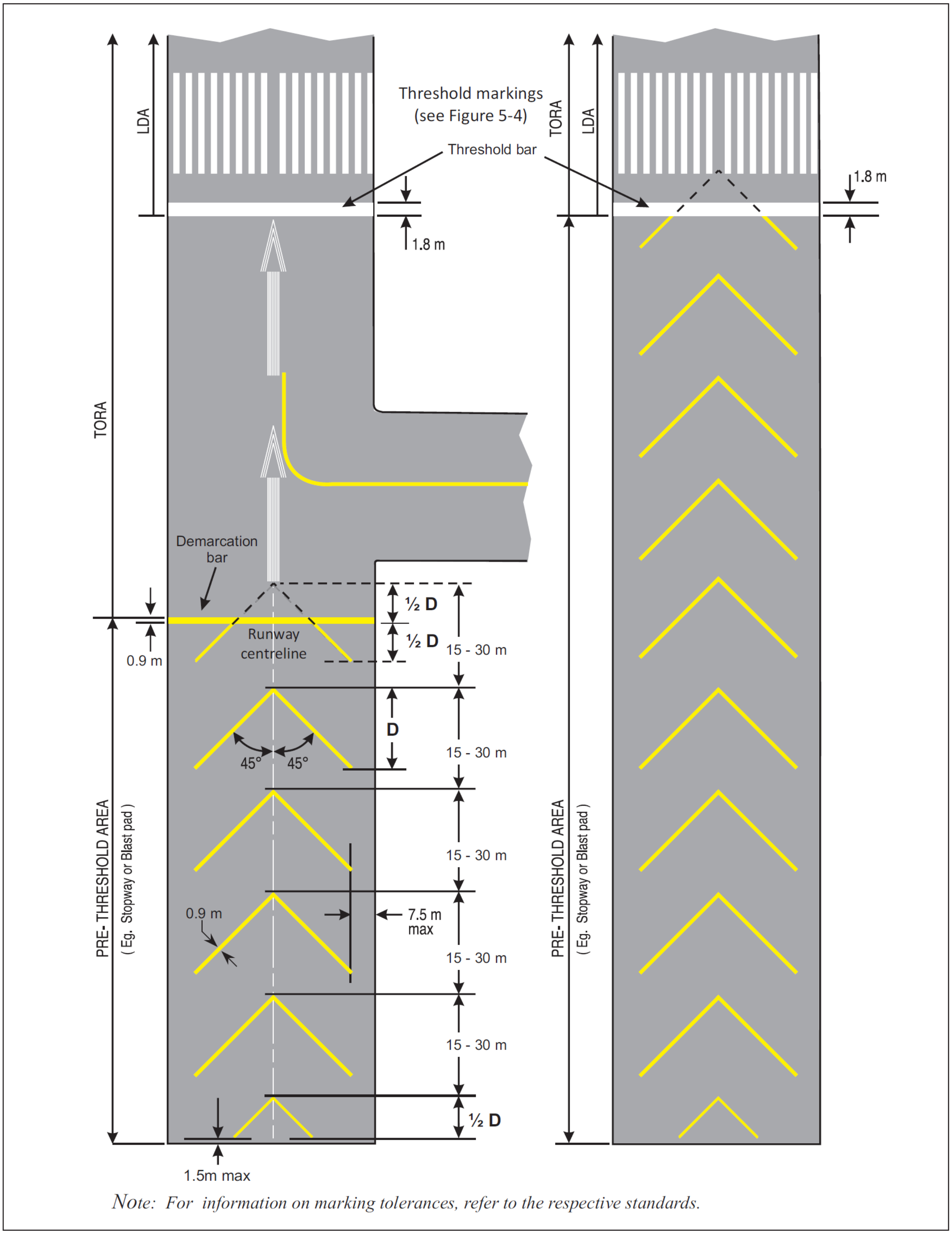
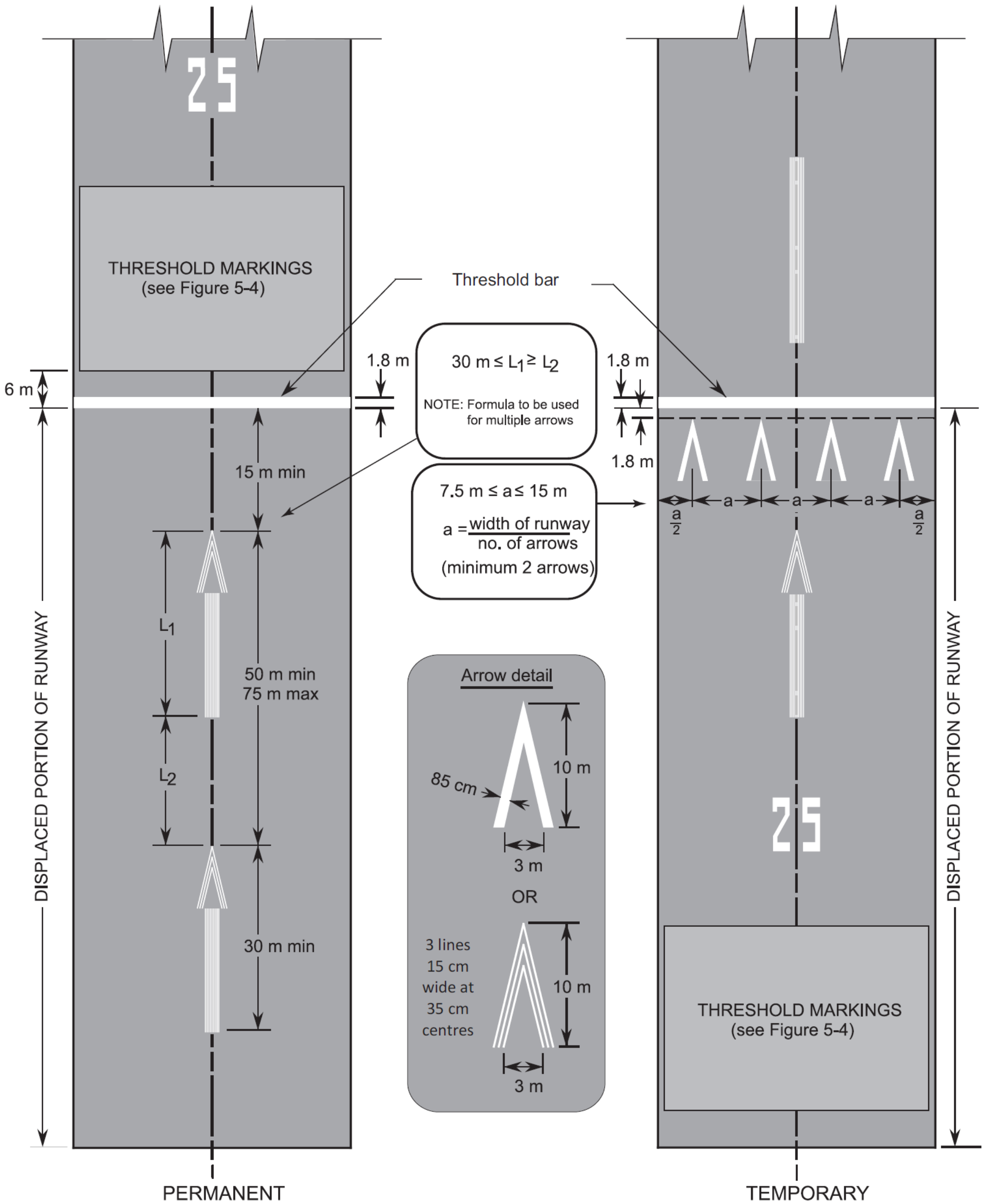


Figure 5-5: Chevrons, threshold bar and demarcation bar markings



Note: For information on marking tolerances, refer to the standard.

Figure 5-6(a): Arrow markings

5.2.8 Runway Centreline Marking

Application

5.2.8.1 A runway centreline marking is provided on a paved runway.

Location

5.2.8.2 Subject to 5.2.1.3, the runway centreline marking is located along the centreline of the runway between the runway designation markings.

5.2.8.3 The runway centreline marking commences 12 m (±0.3 m) beyond the runway designation marking and ends 12 m (±0.3 m) from the runway designation marking at the opposite end.

Note: See Figure 5-2 for depiction of the runway centreline marking.

Characteristics

5.2.8.4 The marking stripe is striated with a series of uniformly spaced longitudinal lines and gaps with widths of 15 cm (±5 cm) yielding a minimum of 50% paint coverage of the stripe.

5.2.8.5 The length of a stripe plus a gap is not less than 50 m or more than 75 m.

5.2.8.6 The length of each stripe is:

(a) at least equal to the length of the gap or 30 m, whichever is greater; and

(b) within a tolerance of ±0.3 m of the design length of the marking.

5.2.8.7 Subject to 5.2.8.8, the width of the runway centreline marking is:

(a) for AGNs I, II and IIIA, 1.05 m - 2.25 m;

(b) for AGNs IIIB and above, 2.25 m – 2.55 m.

5.2.8.8 A temporary runway centreline marking has a minimum width of 1.05 m for all AGNs.

Note: A temporary runway centreline marking is typically provided when the runway is overlaid in sections and returned to temporary operational status between construction periods.

5.2.9 Aiming Point Marking

Application

5.2.9.1 An aiming point marking is provided on a paved runway that serves AGNs IIIA and above.

Location

5.2.9.2 Subject to 5.2.9.3, the aiming point marking commences at the distance indicated in the appropriate column of Table 5.2.9.2.

5.2.9.3 At a runway intersection, the aiming point marking is displaced up to ±60 m to avoid conflicting with the markings of the primary runway.

.

Table 5.2.9.2—Location and Dimensions of Aiming Point Markings				
	Landing Distance Available			
Location and dimensions	Less than 800 m	800 m up to but not including 1 200 m	1 200 m up to but not including 2 400 m	2 400 m and above
Distance from threshold to the beginning of marking	150 m ±1 m	250 m ±1 m	300 m ±1 m	400 m ±1 m
Length of marking (1)	30 - 45 m	30 - 45 m	45 - 60 m	45 - 60 m
Width of marking *(see 5.2.9.4)*	4.05 m ±0.15 m	6.15 m ±0.15 m	6.15 - 10.05 m	6.15 - 10.05 m
Lateral spacing between inner sides of markings	6 m ±0.3 m	9 m ±0.3 m	18 - 22.5 m (2)	18 - 22.5 m (2)

Note 1: The greater dimension of the specified ranges is beneficial where increased visibility is required.

Note 2: The lateral spacing may be varied within these limits to minimize contamination of the marking by rubber deposits.

Note 3: See Figure 5-6(b) for depiction of aiming point markings.

Characteristics

5.2.9.4 An aiming point marking consists of two conspicuous stripes.

5.2.9.5 The stripes are striated with a series of uniformly spaced longitudinal lines and gaps with widths of 15 cm (±5 cm) yielding a minimum of 50% paint coverage of the marking.

5.2.9.6 Subject to 5.2.9.7, the dimensions of the stripes and the lateral spacing between their inner sides are in accordance with the appropriate column of Table 5.2.9.2.

5.2.9.7 Where the width of the runway is less than 45 m and the application of the marking as specified would result in it being partially beyond the runway edge, the width of the marking and lateral spacing between the markings is reduced in proportion to the reduced runway width so that the marking is entirely within the runway surface.

5.2.10 Touchdown Zone Marking

Application

5.2.10.1 A touchdown zone marking is provided on a paved runway

(a) serving aircraft groups numbers IIIB and above; or

(b) categorized as a precision runway serving aircraft groups number IIIA.

Location

5.2.10.2 Subject to 5.2.10.3, the touchdown zone marking consists of pairs of stripes symmetrically disposed about the runway centreline with the number of such pairs related to the declared landing distance available (LDA) as presented in Table 5.2.10.2.

Table 5.2.10.2—Touchdown Zone (TDZ) Marking Pairs

Distance between thresholds / Declared LDA (metres)	Location of TDZ markings distance from threshold (metres)	Location of aiming point marking distance from threshold (metres)	Pairs of TDZ markings
less than 900 m	300	150	1
900 m up to but not including 1200 m	150 and 450	250	2
1200 m up to but not including 1500 m	150, 450 and 600	300	3
1500 m up to but not including 2400 m	150, 450, 600 and 750	300	4
2400 m or more	150, 300, 600, 750 and 900	400	5

Note 1: The location of pairs of touchdown zone markings are based on a horizontal spacing of 150 m with one pair replaced by an aiming point marking when the touchdown zone marking would otherwise be within 50m of the aiming point marking. Refer to Figure 5-6(b).

5.2.10.3 Where the touchdown zone marking is to be displayed in both approach directions of a runway, the number of pairs is related to the distance between the thresholds.

Characteristics

5.2.10.4 The touchdown zone marking matches the pattern shown in Figure 5–2.

5.2.10.5 The stripes are:

(a) striated with a series of uniformly spaced longitudinal lines and gaps with widths of 15 cm (±5 cm) yielding a minimum of 50% paint coverage of the marking;

(b) 22.5 m (±0.3 m) long and 3.15 m (±0.15 m) wide.

5.2.10.6 The lateral spacing between the inner sides of the stripes is equal to that of the aiming point marking.

Note: The lateral spacing of the stripes is also equal to the lateral spacing of the red barrettes of the ALSF-2 lighting system, where provided.

5.2.10.7 The pairs of stripes are positioned at a longitudinal spacing of 150 m (±1.0 m) beginning from the threshold except that pairs of touchdown zone markings coincident with or located within 50 m of an aiming point marking are deleted from the pattern.

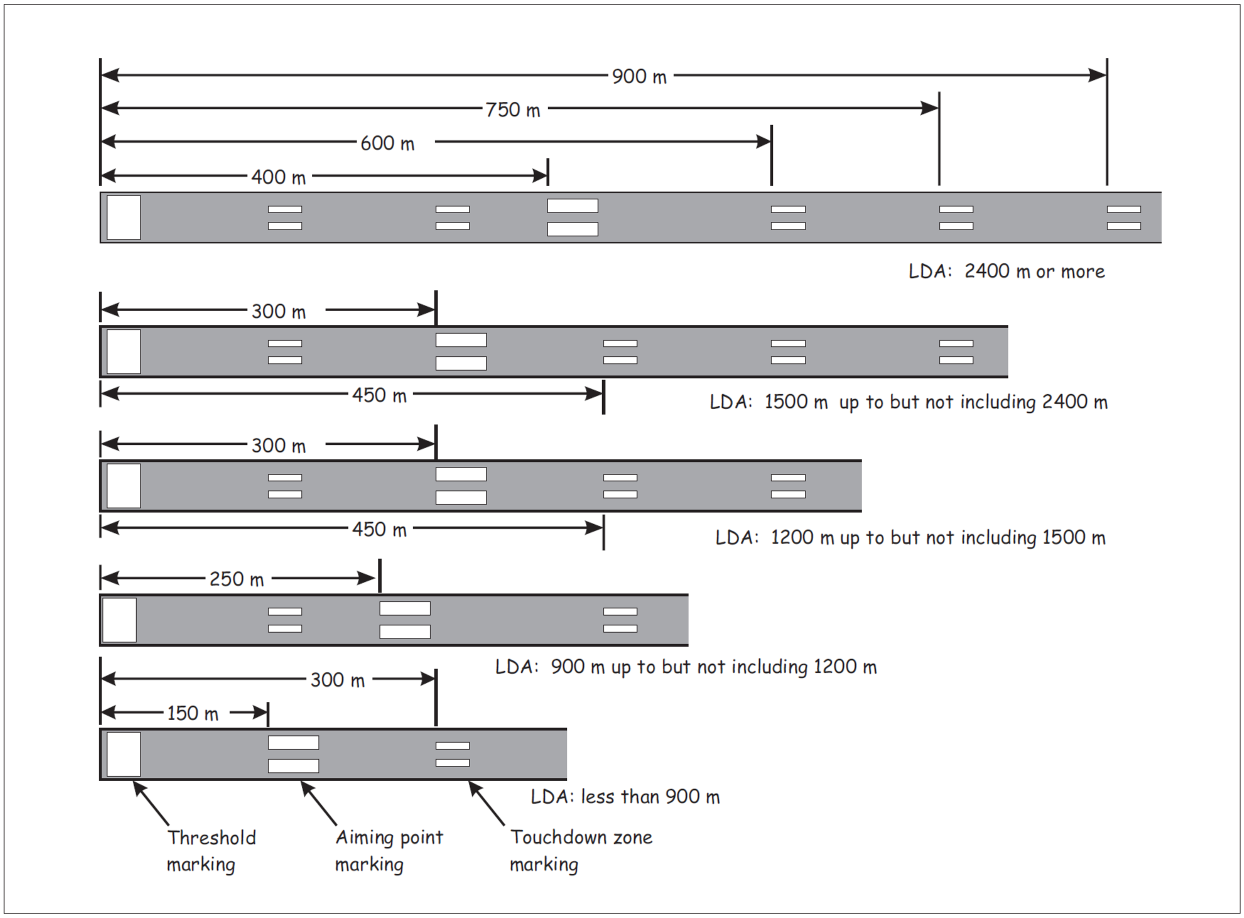


Figure 5-6(b): Aiming point and touchdown zone markings

5.2.11 Runway Side Stripe Marking

Application

5.2.11.1 A runway side stripe marking is provided:

(a) on a paved runway bridge; or

(b) where there is a lack of contrast between the paved runway edges and the adjacent areas.

Note: The intent of the runway side stripe is to provide visual emphasis to the edges of the runway along its full length. For marking the closed portion of an adjacent surface refer to the closed markings section.

Location

5.2.11.2 The runway side stripe marking consists of a stripe placed along the full length of each edge of the runway.

5.2.11.3 The runway side stripe marking is placed on the runway with the outer edge of each stripe matching the edge of the runway.

5.2.11.4 The runway side stripe marking is interrupted at a runway/runway intersection or at a runway/taxiway intersection.

Characteristics

5.2.11.5 The runway side stripe has a solid line width of 0.9 m (±0.1 m) on runways 30 m or more in width and 0.45 m (±0.05 m) on narrower runways.

Note: See Figure 5-7 for depiction of the runway side stripe marking.

5.2.12 Runway Safety Area Marking

Note: A runway safety area marking is provided where there is a desire to supplement the runway side stripes to identify paved areas adjacent to the sides of the runway that are not intended for use by aircraft.

Application

5.2.12.1 A runway safety area marking is provided on a paved runway bridge.

5.2.12.2 Where provided, the runway safety area marking pattern is as specified.

Location

5.2.12.3 The runway safety area marking is positioned between the runway side stripes and the pavement edge.

Note: See Figure 5-7 for depiction of the runway safety area marking.

Characteristics

5.2.12.4 The runway safety area marking consists of stripes 0.9 m (±0.1 m) in width and spaced 30 m (±0.3 m) apart. The layout of these stripes is referenced to the runway centre point. The stripes are slanted at an angle of 45° to the runway centreline and are oriented as shown in Figure 5-7. The marking commences at the edge to the runway side stripe and is extended for a maximum length of 10.5 m or to within 1.5 m of the paved surface edge, whichever is the lesser length.

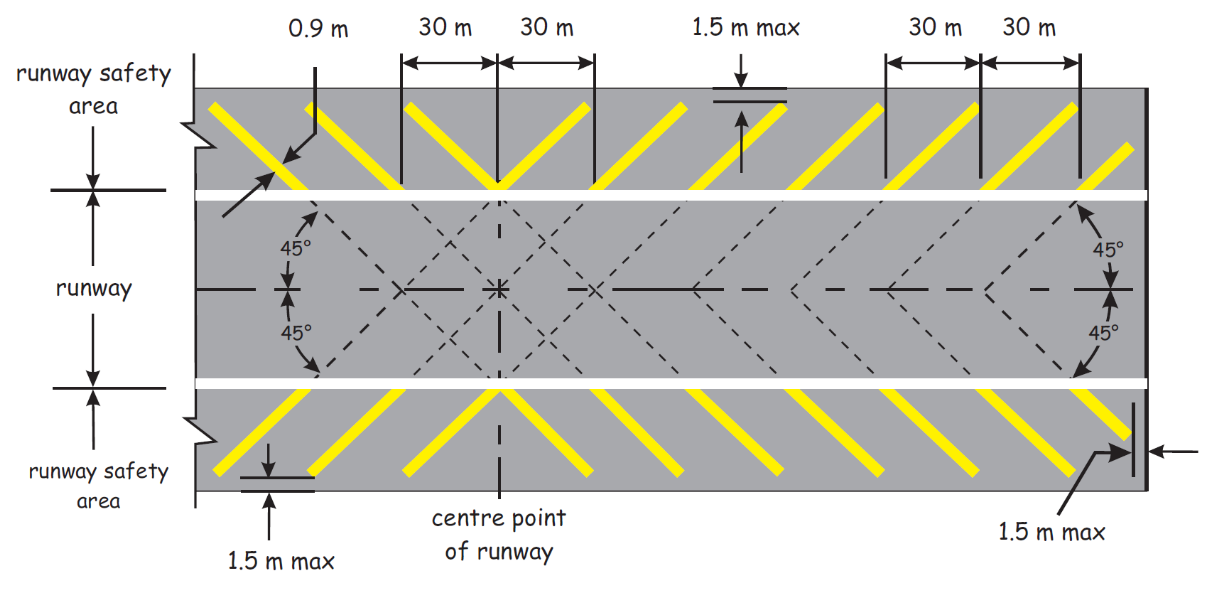


Figure 5-7: Runway side stripe and safety area markings

5.2.13 Taxiway Centreline Marking

Note 1: This section also includes standards relating to the enhancement of the taxiway centreline. See 5.2.13.10 – 5.2.13.14.

Note 2: See Figure 5-8 for an overview of taxiway centreline markings.

Application

5.2.13.1 A taxiway centreline marking is provided on a paved:

(a) taxiway;

(b) runway turn pad;

(c) de-icing facility area;

(d) apron; or

(e) runway when the runway is part of a standard taxi route, and the taxiway centreline is not coincident with the runway centreline,

in such a way as to provide continuous guidance between the runway centreline and the point on the apron where the aircraft commences manoeuvring for parking.

Location

5.2.13.2 The taxiway centreline marking on a paved runway is located along the centreline of the standard taxi route, where the taxiway centreline is not coincident with the runway centreline.

5.2.13.3 The taxiway centreline marking on a straight section of taxiway is located along the taxiway centreline. On a taxiway curve, the marking continues from the straight portion of the taxiway at a constant distance from the outside edge of the curve.

Note: See 3.5.1.3 and Figure 5-8.

5.2.13.4 Where the taxiway serves as an exit from the runway, the taxiway centreline marking is curved onto the runway, extending parallel to the runway centreline marking for the following minimum distance beyond the point of tangency:

(a) 30 m where the taxiway is intended for AGNs I, II, and IIIA;

(b) 60 m where the taxiway is intended for AGNs IIIB and above.

5.2.13.5 The portion of the taxiway centreline marking that runs parallel to the runway centreline is located:

(a) 0.9 m (±0.1 m) from the runway centreline where the width of the runway centreline marking is less than 1.5 m;

(b) 1.8 m (±0.1 m) from the runway centreline where the width of the runway centreline marking is 1.5 m or greater.

5.2.13.6 The taxiway centreline continues across the runway where the taxiway is normally used by ATC as a runway-crossing route.

5.2.13.7 The spacing between a taxiway centreline marking and another marking for which the taxiway centreline has been interrupted is 0.9 m (±0.1 m).

5.2.13.8 The location of the taxiway centreline marking is such that when the cockpit of the critical aircraft remains over the marking, the clearance between any wheel of the aircraft and the edge of the taxiway, or runway turn pad as applicable is not less than the distances specified in 3.5.1.3.

Characteristics

5.2.13.9 The taxiway centreline marking is of uniform width between 15–30 cm (±5 cm) and continuous in length, except where the taxiway centreline intersects a runway-holding position marking, runway designation marking, taxiway intersection marking, painted sign markings (mandatory instruction or information sign marking), it is interrupted 0.9 m (±0.1 m) before and after the intersecting marking.

Note: See Figures 5-9 and 5-12 for depiction of taxiway centreline interruption.

Enhancement of the taxiway centreline marking

Application

5.2.13.10 Where the taxiway centreline marking is enhanced, it is as specified in 5.2.13.11 to 5.2.13.14.

Location

5.2.13.11 The taxiway centreline is enhanced for a distance of 47 m (±1.0 m) prior to a runway-holding position marking, except for the following situations:

(a) If the taxiway centreline to be enhanced continues through a taxiway/taxiway intersection that is located within 47 m of a runway-holding position marking, the taxiway centreline enhancement is terminated 1.5 m prior to the point where the other taxiway centreline crosses the enhanced taxiway centreline.

(b) If the enhanced taxiway centreline intersects another runway-holding position marking that is located within 47 m of a runway-holding position marking, then the entire taxiway centreline between the two runway-holding position markings is enhanced. However, in no case is the taxiway centreline enhanced between the primary runway-holding position marking and the runway.

(c) If a CAT II or III holding position marking is within 47 m of a primary runway-holding position marking, the enhanced taxiway centreline is interrupted the same as it is for a regular taxiway centreline marking (i.e. 0.9 m on each side of the marking).

5.2.13.12 The taxiway centreline markings are enhanced at all taxiway/runway intersections at the aerodrome.

Note 1: An enhanced taxiway centreline is associated with the larger runway-holding position marking. See pattern A2 in Figure 5-12. See 5.2.16.3

Characteristics

5.2.13.13 The enhanced taxiway centreline marking:

(a) consists of parallel dashed lines located on each side of the regular taxiway centreline marking; and

(b) commences and terminates 0.9 m (±0.1 m) from any runway-holding position marking or intermediate holding position marking.

5.2.13.14 The dashed outer lines are:

(a) 3 m (±0.15 m) in length with a gap of 1.0 m (±0.1 m) as shown in Figure 5-9.

(b) 15 cm (±5 cm) wide; and

(c) located 15 cm (±5 cm) from the edge of the regular taxiway centreline marking.

Note: See Figure 5-9 for depiction of an enhanced taxiway centreline marking.

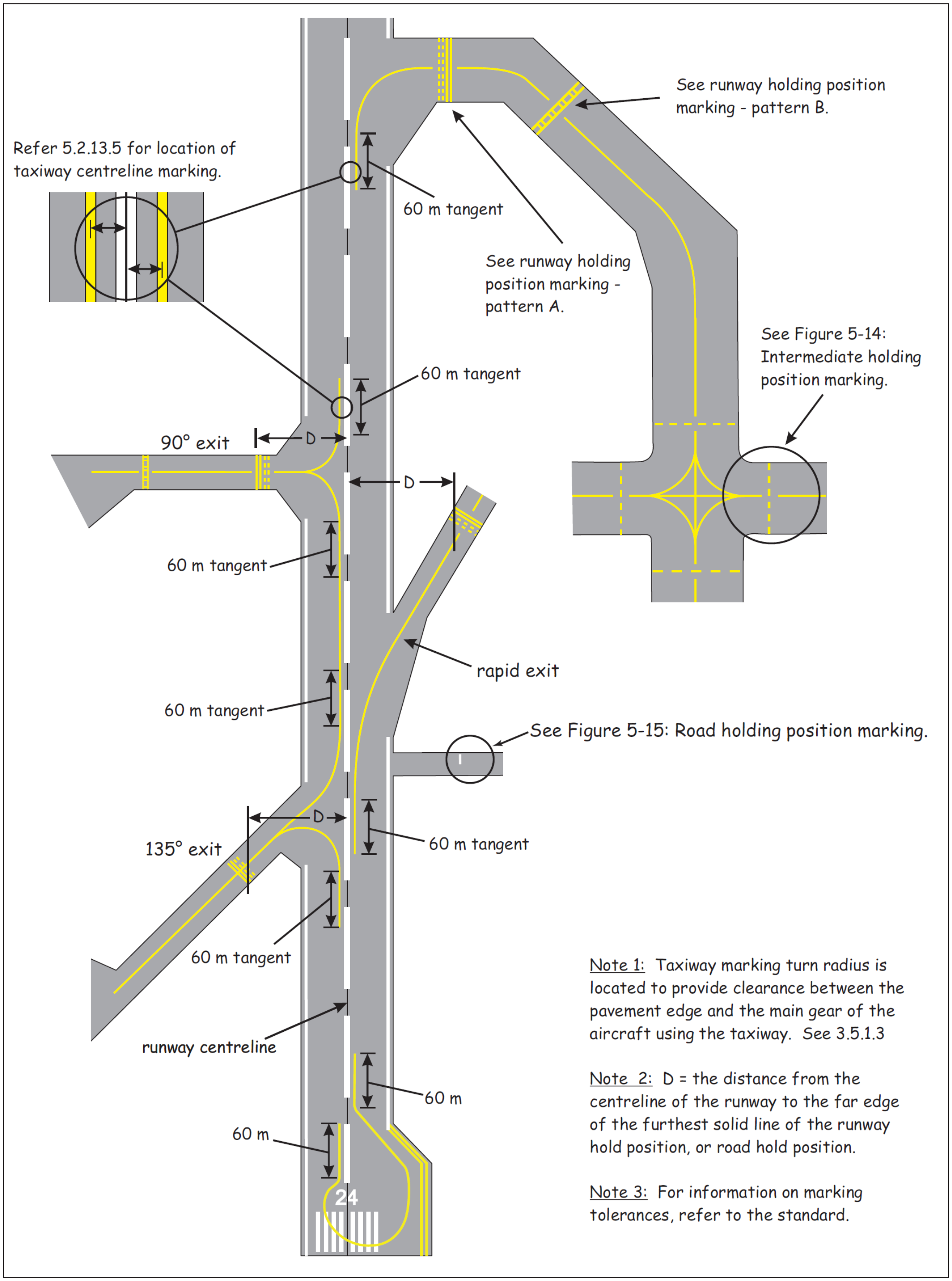
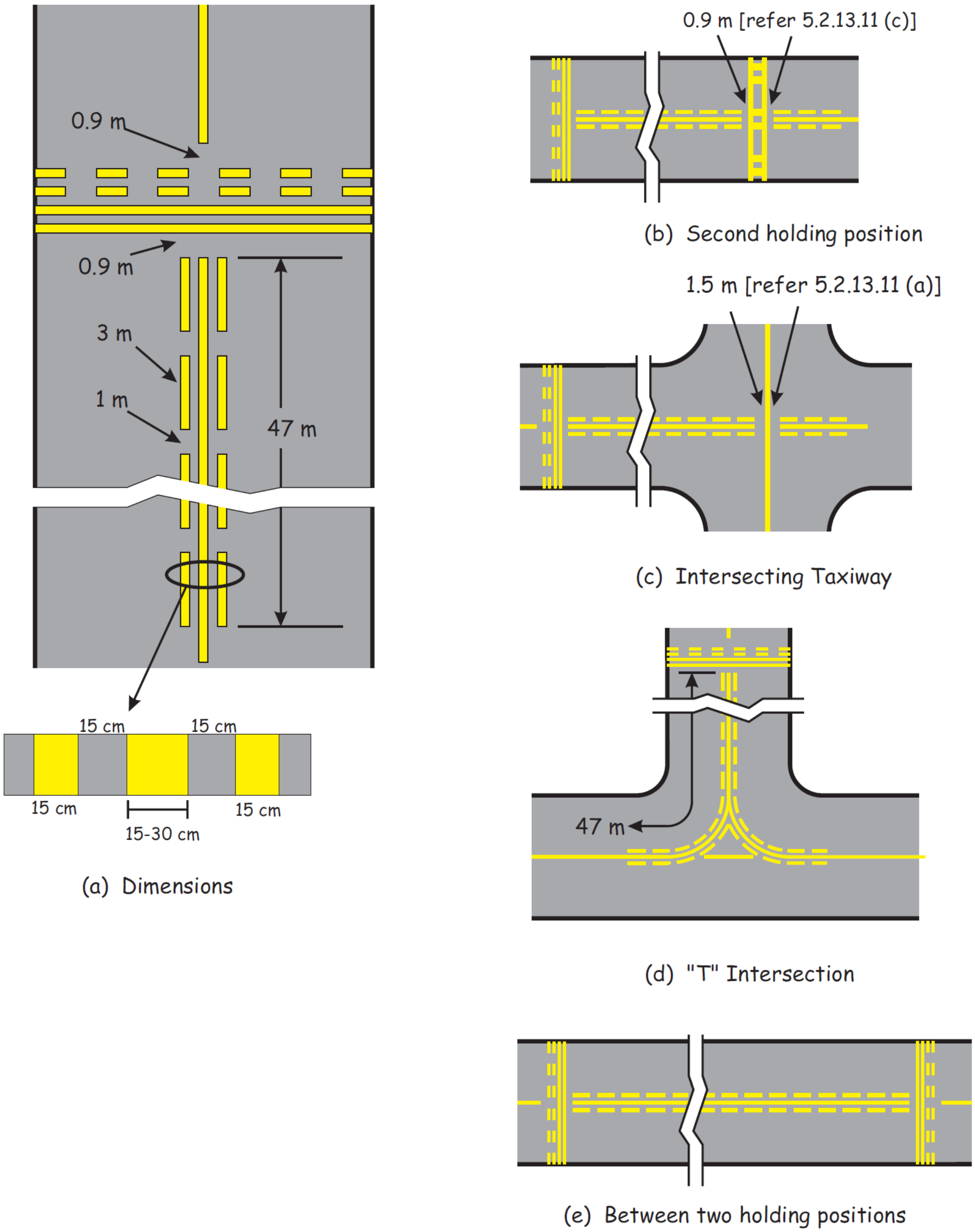


Figure 5-8: Taxiway markings



Note: For information on marking tolerances, refer to the standard.

Figure 5-9: Enhancement of the taxiway centreline marking

5.2.14 Taxi Side Stripe Marking

Application

5.2.14.1 A taxi side stripe marking is provided;

(a) on a paved taxiway bridge;

(b) when the paved area of a taxiway, runway turn pad or holding bay declared for operational use by aircraft does not coincide with the edge of the pavement; or

(c) when a paved surface not intended for aircraft operations abuts an apron.

Note: Two types of markings are used depending upon whether the aircraft is supposed to cross the edge of the surface.

Location

5.2.14.2 The outer edge of the taxi side stripe marking is located along the edge of the pavement declared for use by aircraft.

Characteristics

5.2.14.3 The taxi side stripe marking at a location where aircraft would not cross consists of a pair of solid lines, each 15 cm (±5 cm) wide and spaced 15 cm (±5 cm) apart and the same colour as the taxiway centreline marking as depicted in Figure 5-10.

5.2.14.4 The taxi side stripe marking at a location where aircraft would cross consists of a pair of broken lines, each 15 cm (±5 cm) wide and spaced 15 cm (±5 cm) apart with the solid dash being 4.5 m in length followed by a 7.5 m gap the same colour as the taxiway centreline marking as depicted in Figure 5-10.

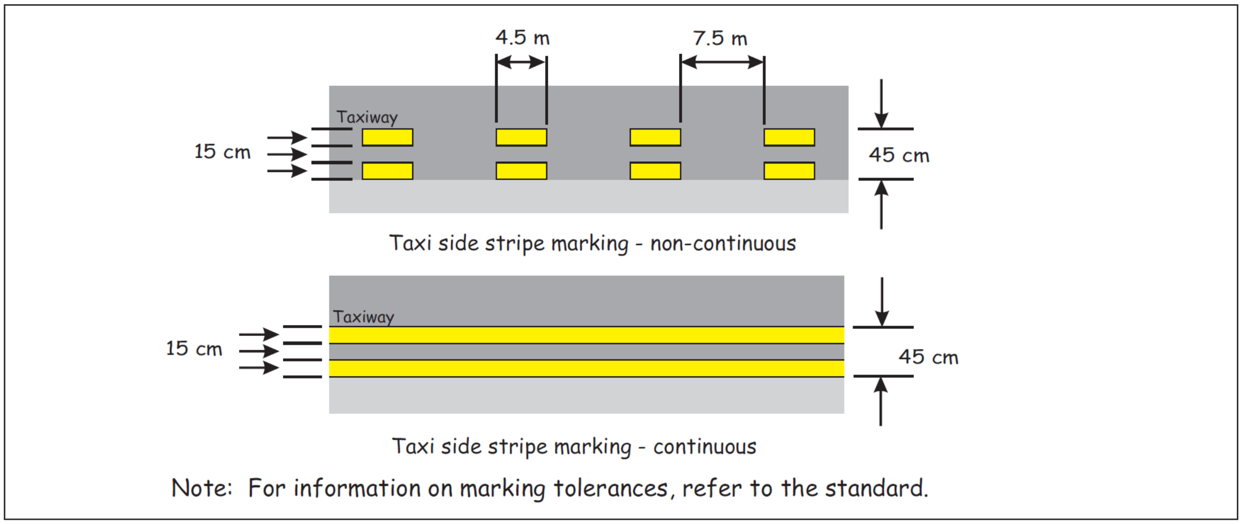


Figure 5-10: Taxi side stripe marking

5.2.15 Taxiway Safety Area Marking

Note: Taxiway safety area marking is provided where there is a desire to supplement the taxi side stripe marking to identify paved areas adjacent to the sides of the taxiway that are not intended for use by aircraft.

Application

5.2.15.1 A taxiway safety area marking is provided on a paved taxiway bridge.

5.2.15.2 Where provided, the taxiway safety area marking is as specified in this section.

Location

5.2.15.3 Except for taxiway bridges in 5.2.15.4, the stripes on straight taxiway sections are placed perpendicular to the taxi side stripe marking and uniformly spaced at maximum distance of 30 m between stripes. On curves, the stripes are placed uniformly at a maximum of 15 m between the curve tangents.

5.2.15.4 On taxiway bridges, the stripes are placed perpendicular to the taxi side stripe marking and uniformly spaced at a maximum distance of 7.5 m between stripes.

Characteristics

5.2.15.5 The taxiway safety area marking:

(a) is a 0.9 m (±0.1 m) wide yellow stripe; and
(b) extends to within 1.5 m of the pavement edge or is 7.5 m in length, whichever is less.

Note: See Figure 5-11 for depiction of the taxiway safety area marking.

Note: See section 5.3.32—Unserviceability/Closed Lights for lighting requirements on taxiway bridges.

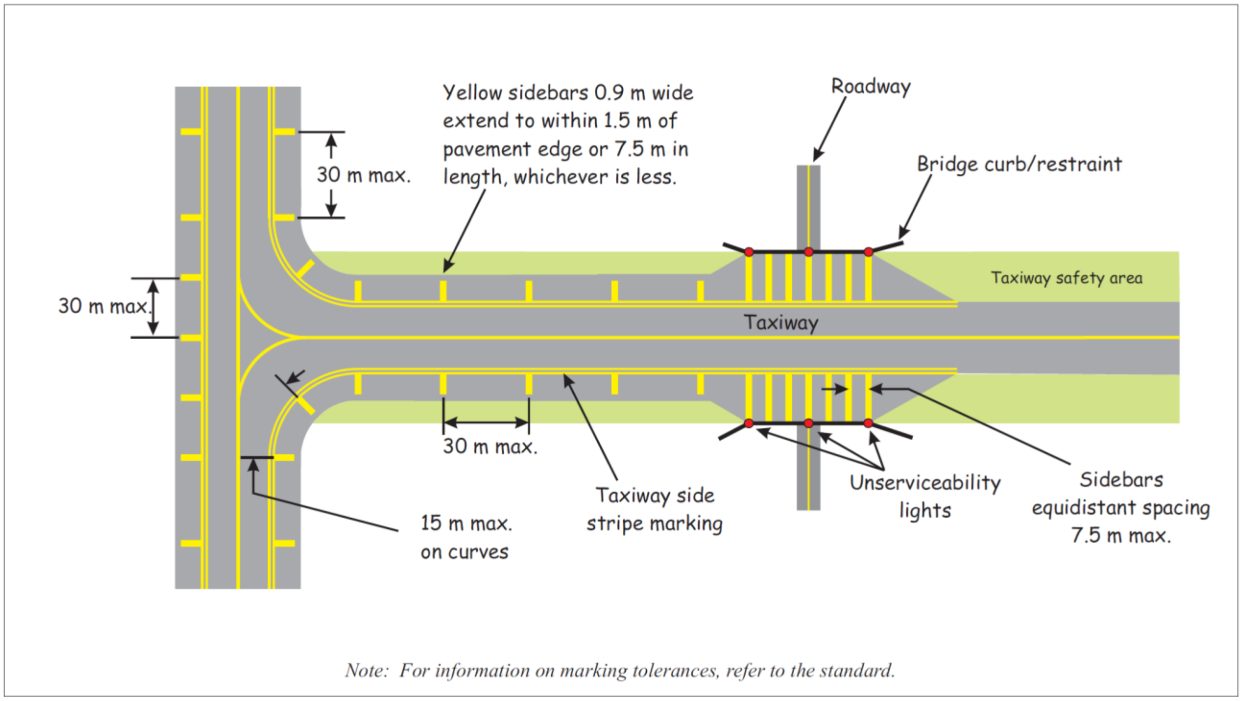


Figure 5-11: Taxiway safety area marking

5.2.16 Runway-Holding Position Marking

Application

5.2.16.1 A runway-holding position marking is displayed at a holding position established in accordance with 3.6.1.1.

Note: See section 5.4.2 concerning the provision of a holding position sign.

Location

5.2.16.2 The runway-holding position marking at a taxiway/runway or runway/runway intersection is located at the distance established pursuant to 3.6.1.3, measured 90° from the centre of the runway to the nearest point on the holding side of the runway-holding position marking, as depicted in Figure 5-8.

Characteristics

5.2.16.3 The runway-holding position marking is as follows:

(a) Subject to (c), where a single runway-holding position is provided at an intersection of a taxiway and a runway or OFZ, the runway-holding position marking is as shown in Figure 5-12, pattern A1 or A2.

(b) Subject to (c), where two runway-holding positions are provided, the marking closest to the runway is as shown in Figure 5-12, pattern A1 or A2 and remaining runway-holding position marking is as shown in Figure 5-12, pattern B1 or B2. There are no more than two runway-holding positions at any single runway/taxiway intersection.

(c) Where the taxiway centreline marking prior to the runway-holding position has been enhanced as per 5.2.13.11 to 5.2.13.14, the runway-holding position marking is as shown in Figure 5-12, pattern A2.

5.2.16.4 The runway-holding position marking displayed on a runway is as shown in Figure 5-12, pattern A2 and B2 if required.

Note 1: Runway-holding position markings on a runway are commonly highlighted in black for increased visibility.

Note 2: The installation of a pattern B runway-holding position marking and associated CAT I, II or III signs requires the positive control of aircraft by ATC to direct aircraft to hold at these positions.

5.2.16.5 The runway-holding position marking:

(a) is displayed across the width of the taxiway or runway;

(b) is at right angles to the taxiway(s) centreline(s) or runway centreline;

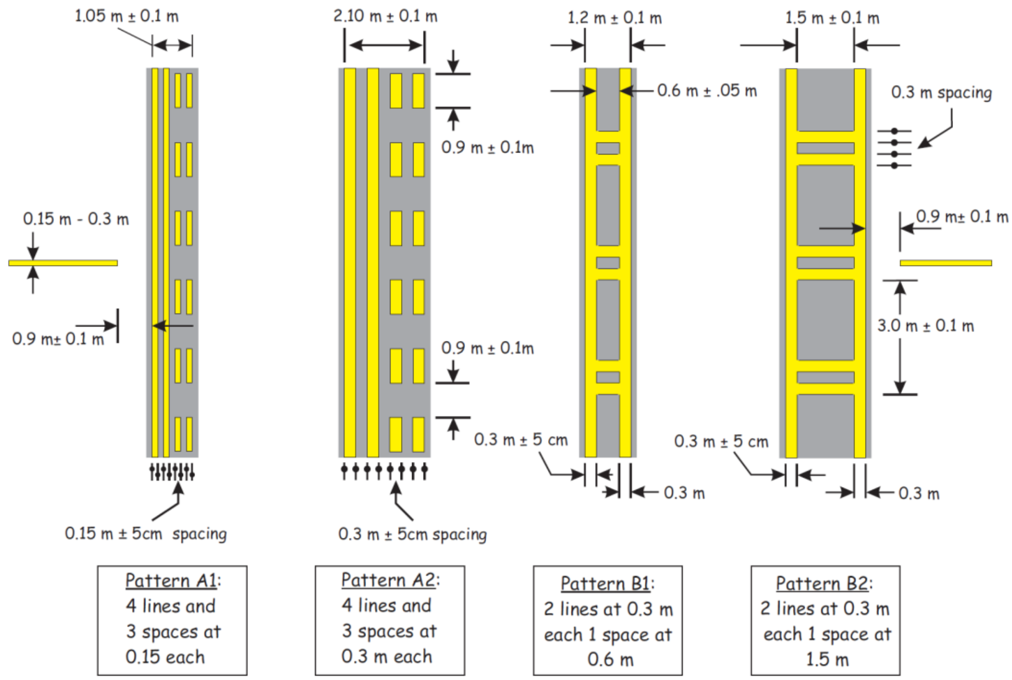
(c) when displayed on a runway, continues across (overlays) the runway markings except for the designation markings; and

(d) where the taxiway serves AGN V and VI aircraft, may extend 7.5 m (±0.15 m) onto the paved taxiway safety area where provided, from the edge of the taxiway. The runway-holding position marking continues across (overlays) the taxiway edge marking.

Note: See Figure 5-12 and Figure 5-13 for depiction of the runway-holding position marking.

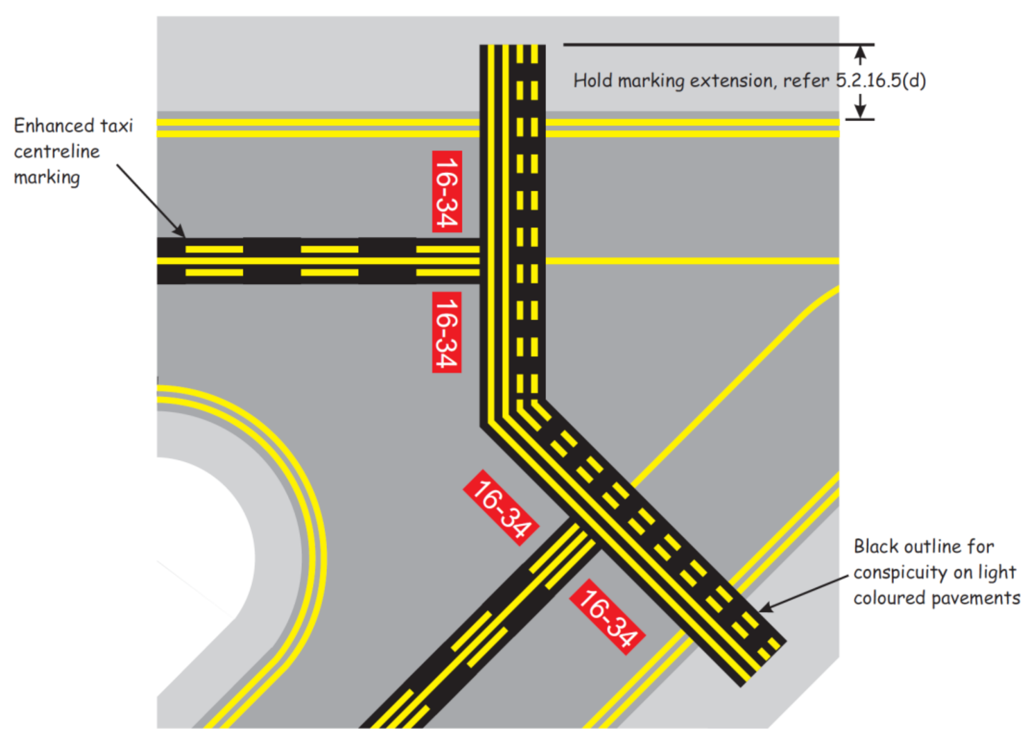
5.2.16.6 Where more than one taxiway centreline marking intercepts a runway-holding position marking it is supplemented with painted sign pavement markings as shown in Figure 5-13.

Note 1: See section 5.2.21 for painted sign pavement markings and section 5.4.2 for mandatory signs.



Note 1: Tolerances are depicted for each of the dimensions utilized.
Note 2: The contrast of marking on concrete and light coloured pavements may be increased by providing a black background and border.

Figure 5-12: Runway-holding position markings



Note: See section 5.2.21 for standards regarding the provision of painted sign pavement markings.

Figure 5-13: Runway-holding position markingwith enhanced taxiway centreline and extended holding position markings

5.2.17 Intermediate Holding Position Marking

Application

5.2.17.1 An intermediate holding position marking is established at an intersection of two taxiways or at a geographic position fix on a taxiway or taxilane, where aircraft may be asked to hold as part of normal taxi routing.

Location

5.2.17.2 The intermediate holding position marking is located at such position that a holding aircraft would not protrude into the intersecting taxiway strip.

Note: Signage requirements for taxiway intersection positions are addressed in section 5.4.3—Information Signs.

Characteristics

5.2.17.3 The intermediate holding position marking consists of a single 0.3 m (±0.05 m) wide broken line with 0.9 m (±0.1 m) dashes and gaps as shown in Figure 5-14.

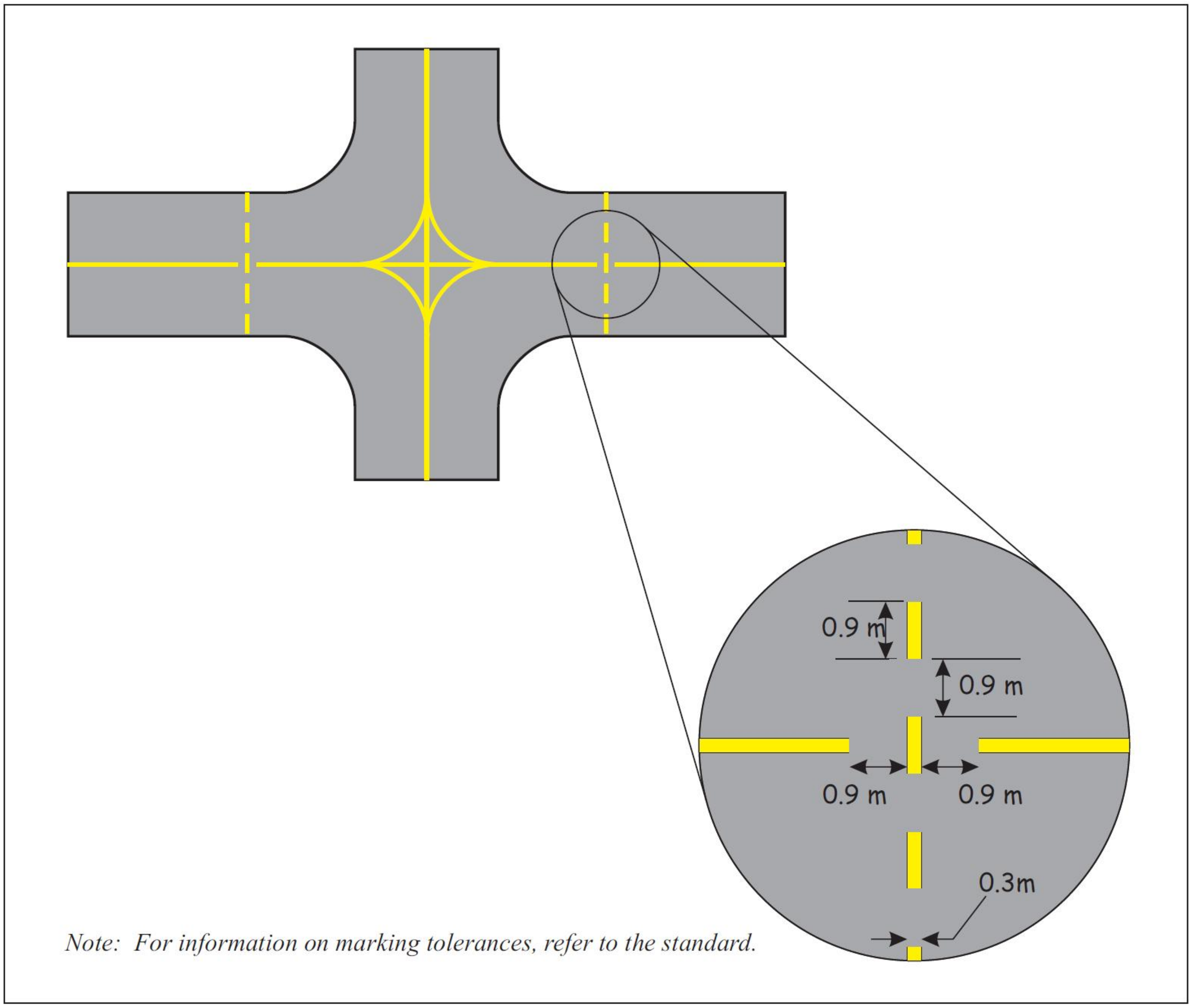


Figure 5-14: Intermediate holding position marking

5.2.18 Road-Holding Position Marking

Application

5.2.18.1 A road holding position marking is displayed on a paved road surface:

(a) at a holding position for vehicles established in accordance with 3.6.1.1, or

(b) at a position where vehicles are required to stop on a vehicle corridor.

Location

5.2.18.2 The road holding position marking is located at the distance from the:

(a) runway centreline as established pursuant to 3.6.1.3; or

(b) taxiway centreline as per the taxiway centreline to object separation in Table 3.5.1.4

Note: See Figure 5-15 to locate the road holding position marking.

Characteristics

5.2.18.3 The holding position marking displayed on a road consists of a white transverse stripe of 0.6 m (±0.05 m) in width as depicted in Figure 5-15.

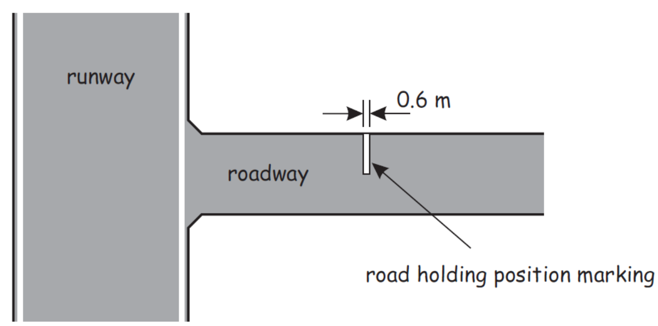


Figure 5-15: Road-holding position marking

5.2.19 Geographic Position Fix Marking

Note: Geographic position fix markings are typically installed when points are necessary to identify the location of taxiing aircraft during low visibility operations.

Application

5.2.19.1 Where provided, the geographic position fix marking is as specified in this section.

Location

5.2.19.2 The geographic position fix marking is located:

(a) 1.5 m (±0.15 m) prior to the taxiway intersection marking; and

(b) on the left side of the taxiway centreline at a distance of 1.0 m (±0.1 m).

Characteristics

5.2.19.3 The geographic position fix marking has:

(a) an overall diameter of 2.3 m (±0.15 m);

(b) a 15 cm (±5 cm) yellow outer ring and yellow characters on a black background; and

(c) a character height of 1.3 m (±0.15 m).

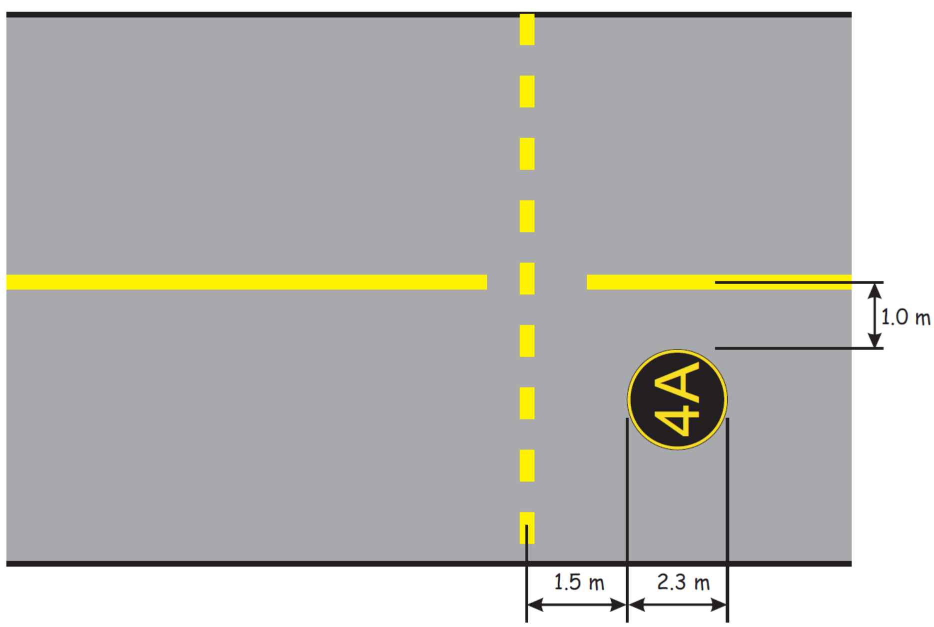
Note: See Figure 5-16 for depiction of the geographic position fix marking.

5.2.19.4 The character on a geographic position fix marking is:

(a) when situated on an apron, composed of a numeric/alpha or alpha/numeric/alpha;

(b) when situated on a taxiway, composed of a numeric/alpha with the alpha being the designation of the taxiway; and

(c) in accordance with the forms and proportions of Figure 5-19.



Note: For information on marking tolerances, refer to standard.

Figure 5-16: Geographic position fix marking

5.2.20 Manoeuvring Area Delimitation Marking

Note: A manoeuvring area delimitation marking is used where:

(a) it is necessary to delineate the area where ATC aircraft control is provided and not provided as part of the agreement between the aerodrome operator and the ATC unit; or

(b) there is an ATC controlled taxiway on an apron.

Application

5.2.20.1 Where provided, the manoeuvring area delimitation marking is as specified in this section.

Location

5.2.20.2 The manoeuvring area delimitation marking is located on an apron at a distance from taxiway centreline satisfying the minimum taxiway centreline to object distances stated in Table 3.5.1.4.

Note: See Figure 5-17 for depiction of the manoeuvring area delimitation marking.

5.2.20.3 The manoeuvring area delimitation marking is made up of two parallel lines 15 cm (±5 cm) wide, one solid and one dashed, with 15 cm (±5 cm) spacing between them. The solid line being on the side of the boundary where ATC is not provided, typically the apron side.

5.2.20.4 The stripe and the gap of the dashed line are each 0.9 m (±0.1 m) in length.

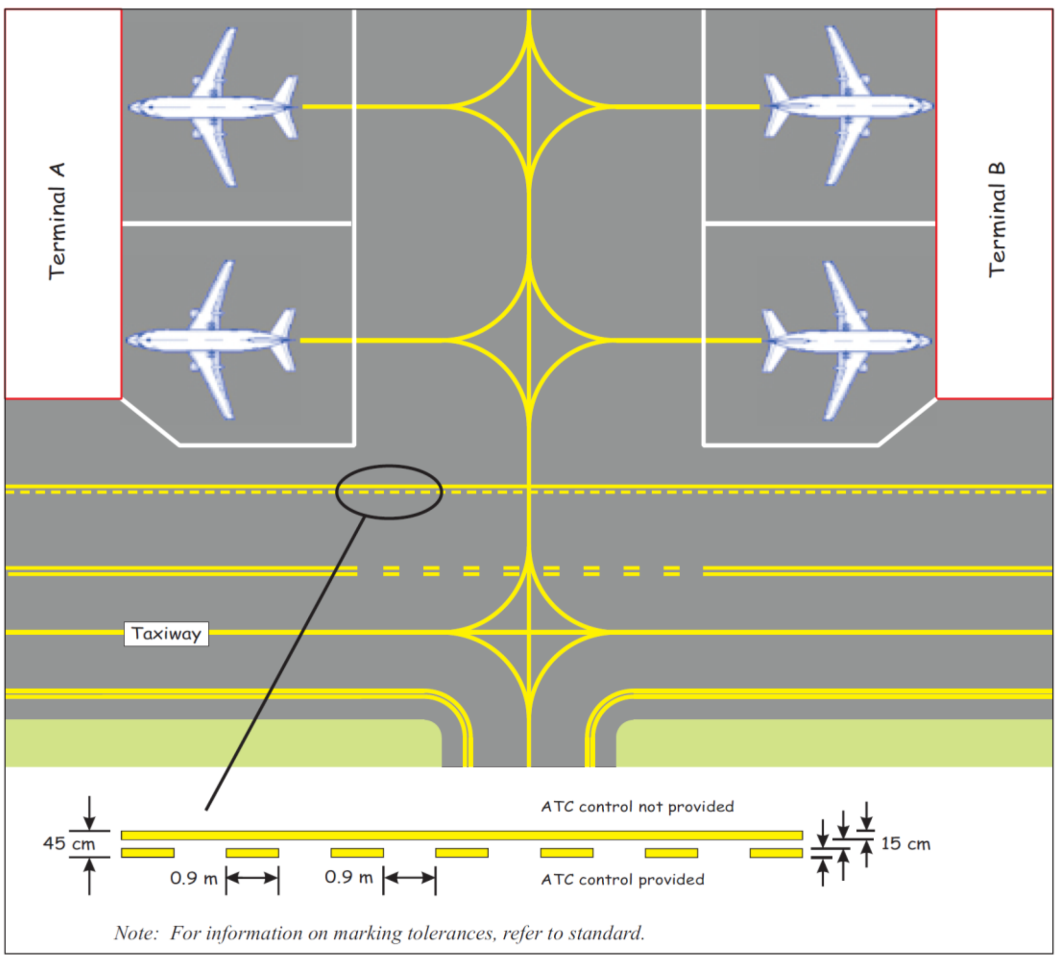


Figure 5-17: Manoeuvring area delimitation marking

5.2.21 Painted Sign Pavement Marking

Mandatory Instruction or Information Sign Markings

Note: Painted sign markings are used to both supplement and enhance aerodrome signage and in some cases replace signage where it is not possible to install the sign.

Application

5.2.21.1 A mandatory instruction sign marking is provided at the runway-holding position marking where:

(a) the taxiway width at the runway-holding position exceeds 60 m;

(b) the runway-holding position marking contains an angle;

(c) a mandatory instruction sign has been omitted in accordance with 5.4.2.8; or

(d) there is a need to supplement existing signage.

5.2.21.2 An information sign marking is provided on taxiway or apron surfaces where:

(a) the installation of a required sign is physically impractical; or

(b) there is a need to supplement existing signage.

Location

5.2.21.3 The painted sign marking (mandatory instruction or information marking) is located on a taxiway or apron only.

5.2.21.4 The mandatory instruction sign marking, on a taxiway serving AGN I – IV, is located across the taxiway; it is equally placed about the taxiway centreline and on the holding side of the runway-holding position marking.

5.2.21.5 The mandatory instruction sign marking, on a taxiway serving AGN V and VI, is located on both sides of the taxiway centreline marking and on the holding side of the runway-holding position marking. The distance between the nearest edge of the marking and the edge of the taxiway centreline marking is a minimum of 1.0 m. (±0.1 m).

5.2.21.6 The mandatory instruction sign marking is located on the holding side of the runway-holding position or taxiway intersection marking at a distance from the edge of the marking of:

(a) 0.9 m (±0.1 m); or

(b) 1.4 m (±0.1 m) when inset runway guard or stop bars are installed.

5.2.21.7 The information sign marking is:

(a) located on the left, right or centre of the taxiway centreline; and

(b) at a distance of 1.0 m (±0.1 m) from the edge of the taxiway centreline marking where located on the left or right side.

Note: See Figure 5-18 for depiction of painted sign pavement markings.

5.2.21.8 An information sign marking other than a location sign marking is not collocated with a mandatory instruction sign marking.

Characteristics

5.2.21.9 Except for a no-entry sign marking, the information provided and the colour of the inscription, background and border is the same as the corresponding sign. Painted mandatory instruction sign markings used to supplement the installation of elevated mandatory instruction signs may be installed without the location marking.

5.2.21.10 The no-entry sign marking consists of a white inscription “NO ENTRY” on a red background.

5.2.21.11 Mandatory instruction and information sign markings have:

(a) characters of the proportion shown in Figure 5-19; and

(b) an overall height of 1.8 m to 4.0 m

Note 1: An overall height of 4 m is typically provided for the larger AGNs.

Note 2: The characters in Figure 5-19 are derived from a transformation of a hypothetical elevated sign with the Federal Highways Administration (FHWA) Series D characters by a factor of 2.5 for height. The spacing of characters within the message is obtained by proportioning from Table 5.4.7.7. For example, if the pavement sign is to be 4 m in height, the hypothetical elevated sign would then be 4000/2.5 = 1600 mm in height and the character spacing would be proportioned to 4 times that of the 400 mm sign in Table 5.4.7.7.

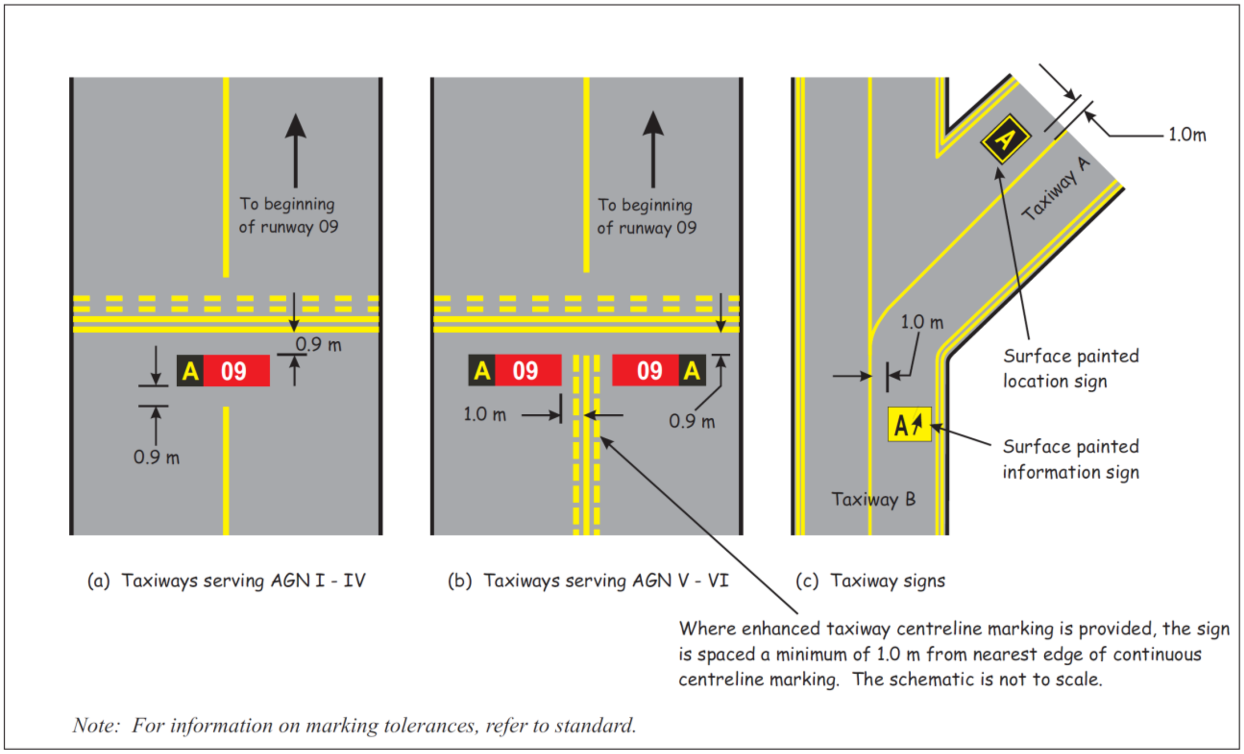


Figure 5-18: Painted sign markings

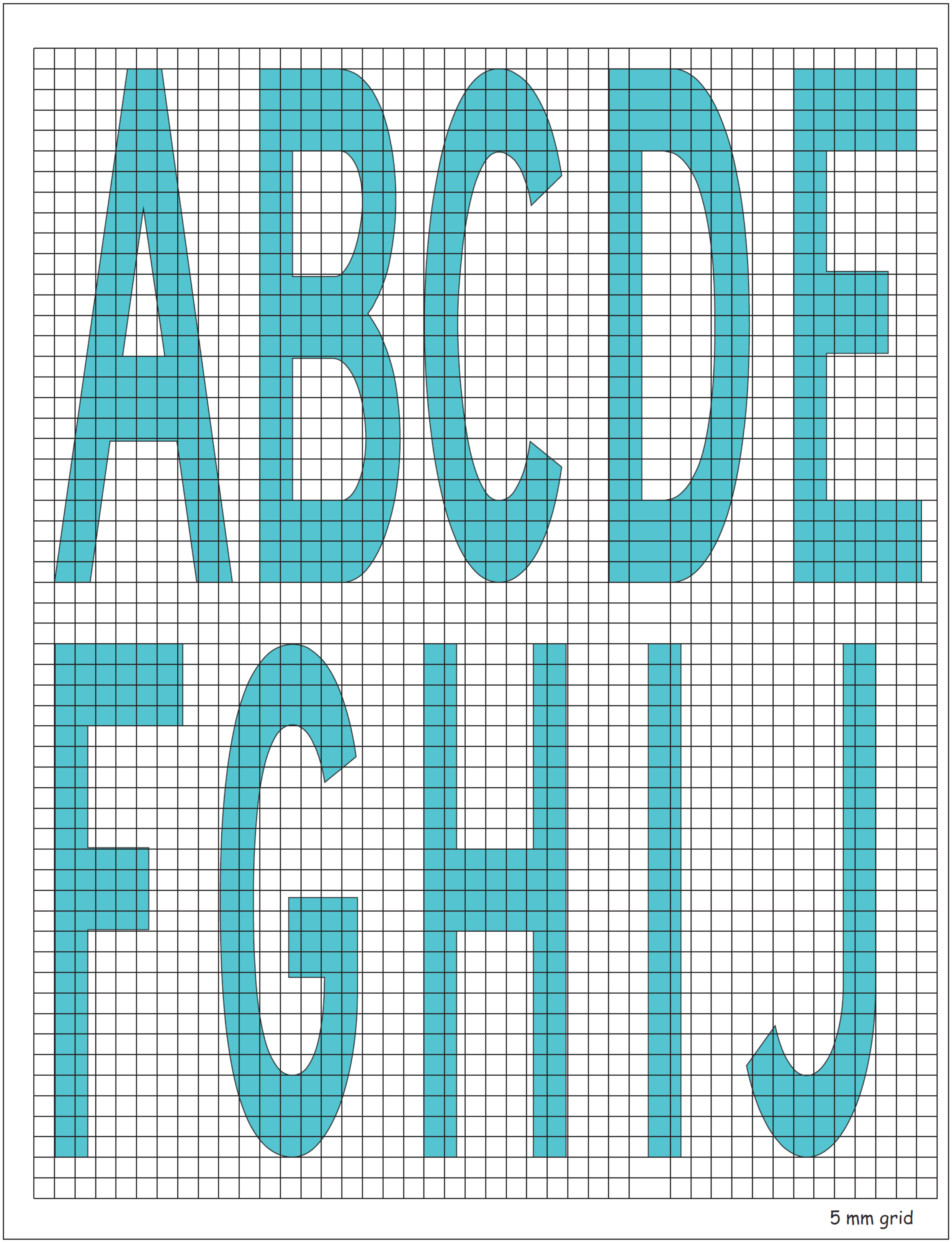


Figure 5-19(a): Painted sign markings—forms of characters

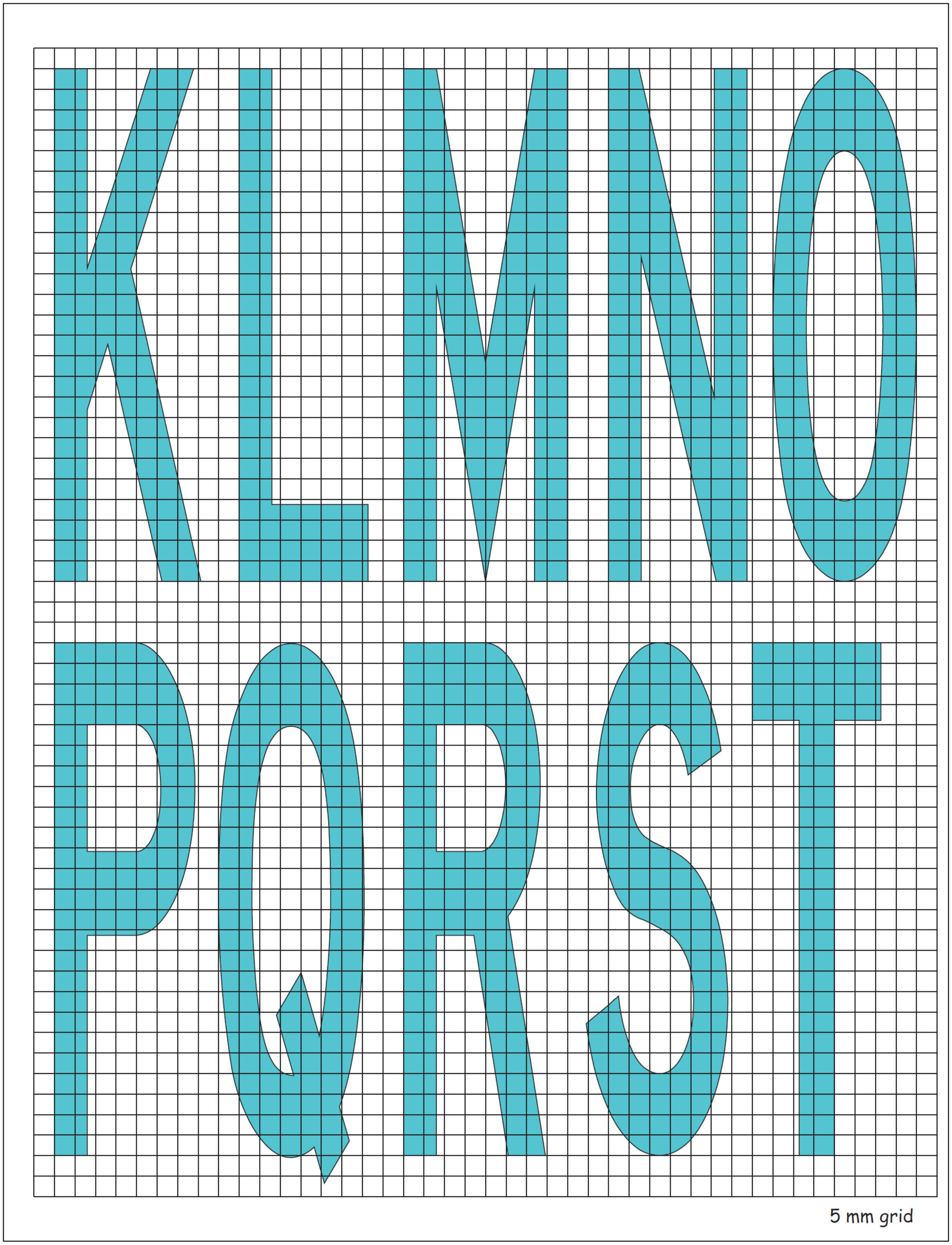


Figure 5-19(b): Painted sign markings—forms of characters

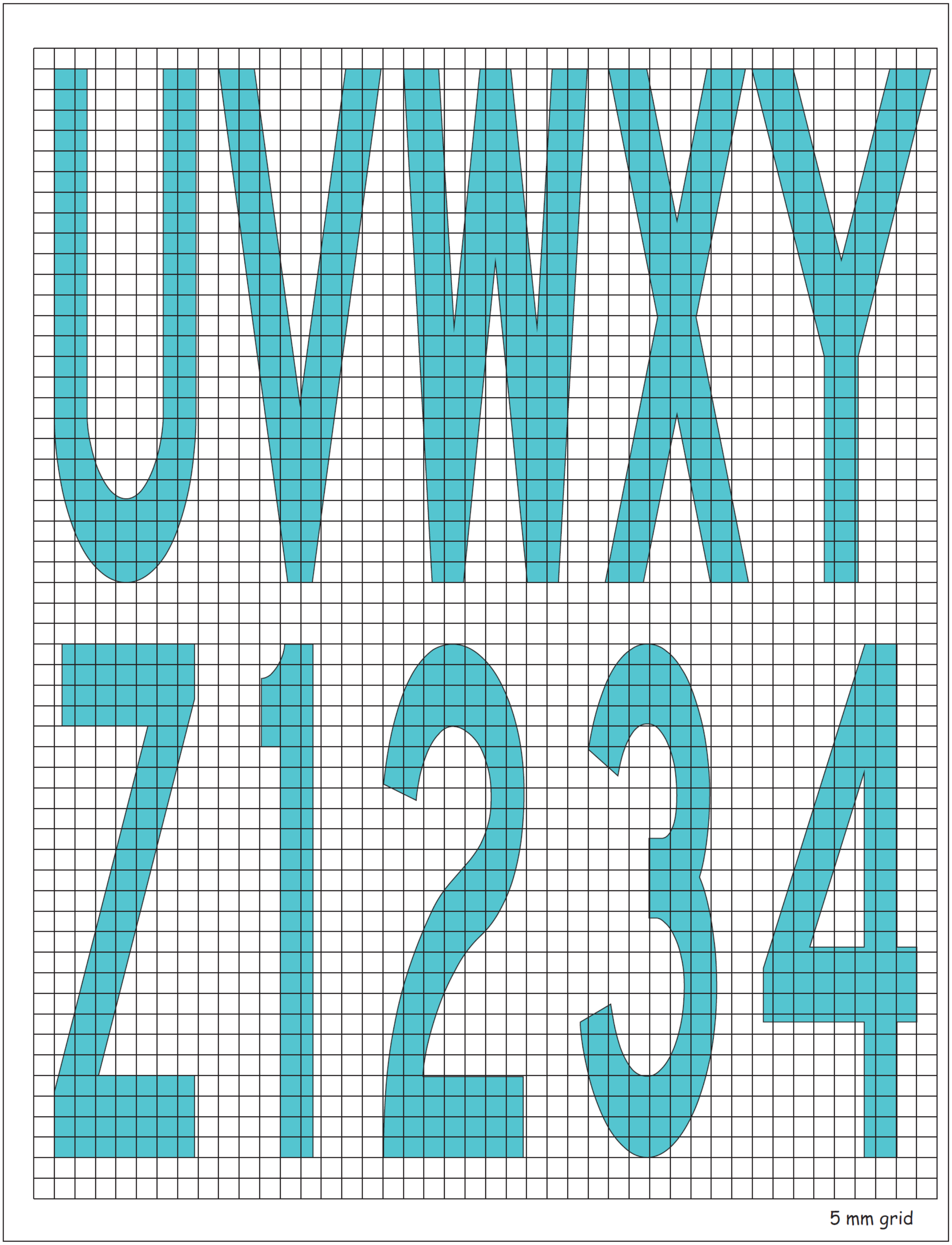


Figure 5-19(c): Painted sign markings—forms of characters

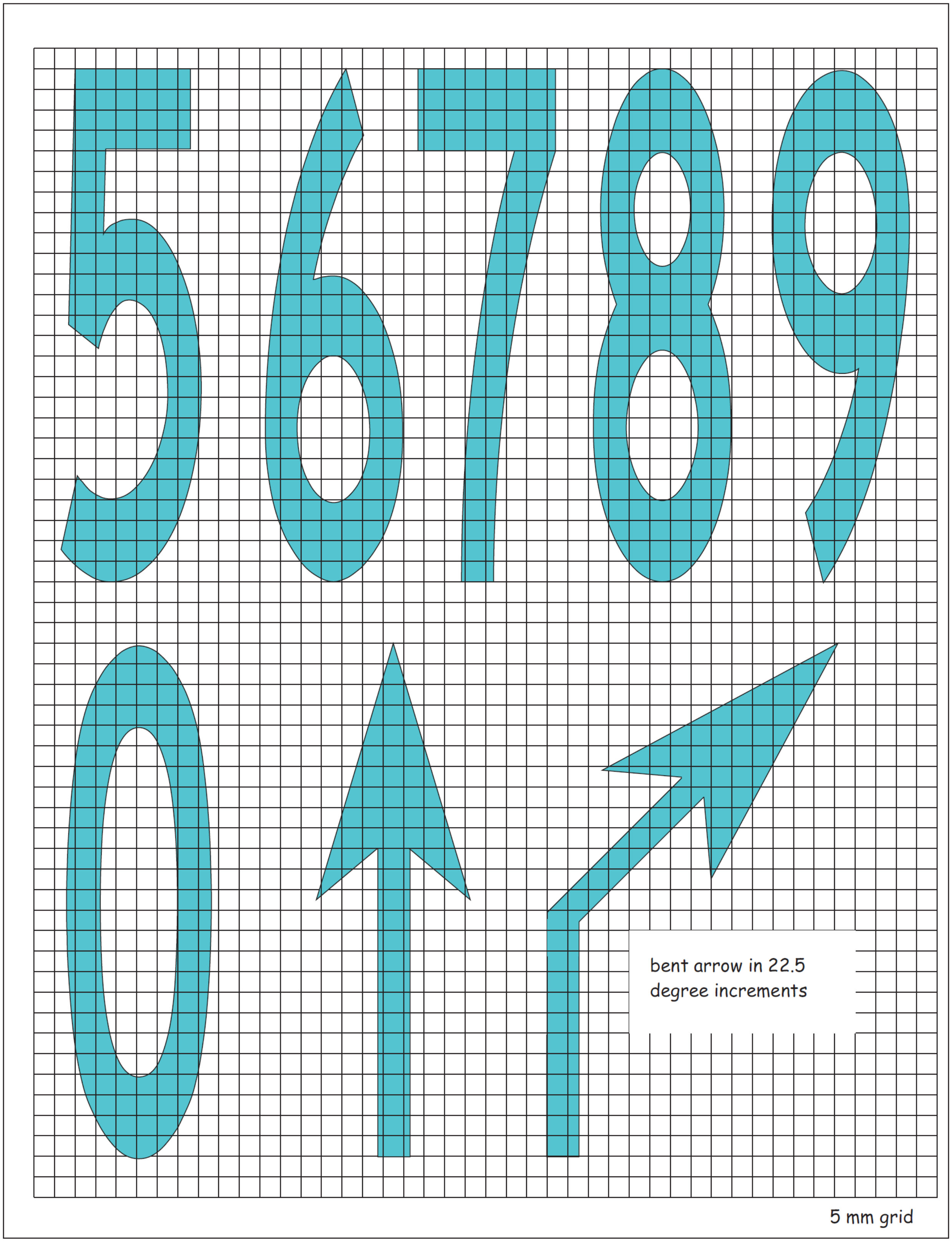
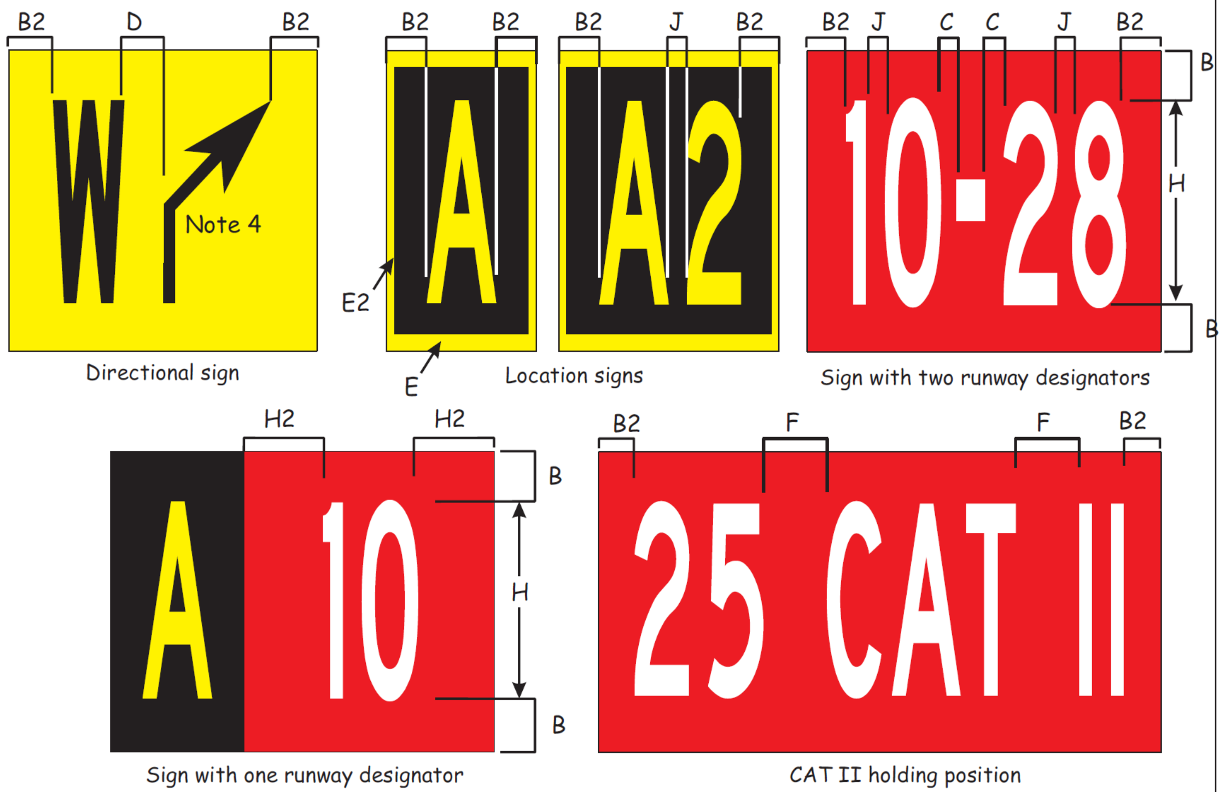
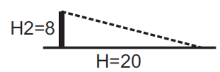


Figure 5-19(d): Painted sign markings—forms of characters



(1) The pavement sign marking character height H is obtained by stretching an elevated sign character H2 by a factor of 2.5. The horizontal [width] dimensions are unchanged from that of the elevated sign character.



(2) Where the location sign is physically separate, it is provided with a rectangular border.
(3) The space between words or groups of characters forming an abbreviation or symbol should be equal to 0.5 to 0.75 of the height of the characters used except that where an arrow is located with a single character, the space may be reduced to not less than one quarter of the height of the character in order to provide a good visual balance.
(4) The arrow is rotated. Thus, the width of a diagonal member is to the specified stroke width for horizontal elements.

SPACING FOR CHARACTERS, BORDERS & ARROWS (millimetres)

H	1800	4000	Pavement sign character height
H2	720	1600	Equivalent elevated sign character height [H/2.5]
B	450	1000	Minimum spacing [verticle] between LEGEND and border or EDGE of exposed sign face. B=H/4
B2	180	400	Minimum spacing [horizontal] between LEGEND and border or EDGE of exposed sign face. B2=H2/4
C	172.8	384	Spacing between dash or dot and letter or numeral [code 1]
D	0.5 - 0.75 H2		Spacing range between ARROW and letter, numeral or symbol [refer note 3]
E	144	320	Horizontal border of Location sign [width is 0.5 of the stroke width] E= H/12.5
E2	57.6	128	Verticle border of Location sign [width is 0.5 of the stroke width] E2 = H2/12.5
F	0.5 - 0.75 H2		Character GROUP SPACE (spacing between "CAT" and any legend or symbol).
J	Character to character spacing. Refer spacings table for elevated signs and proportion to H2		
S	115.2	256	Stroke width [verticle elements] S = H2/6.25

Figure 5-19(e): Painted sign markings—forms of characters

5.2.22 Information Message Marking

Note: An information message marking is text painted on the paved surface of an apron without the overall background that is associated with the painted sign pavement marking.

Application

5.2.22.1 Where provided, the information message marking is as specified in this section.

Location

5.2.22.2 An information message marking is restricted to apron areas.

Characteristics

5.2.22.3 The information message marking for use by aircraft is yellow.

5.2.23 Ancillary Services Marking

Note: The ancillary services' marking is provided to identify the location of various airfield elements such as taxiway edge lights, catch basins and manhole covers.

Application

5.2.23.1 Where provided, the ancillary services marking is as specified in this section.

Characteristics

5.2.23.2 The ancillary services marking:

(a) is a single yellow line 15 cm (±5 cm);

(b) is 90° to the runway or taxiway edge;

(c) does not extend onto the manoeuvring surface greater than 4 m from the edge; and

(d) does not interfere with other markings.

5.2.24 Unserviceable/Closed Marking

General

5.2.24.1 When a runway, taxiway or portion thereof is permanently closed, all markings other than the closed markings are removed.

Application

5.2.24.2 Where a runway, taxiway or portion thereof is closed or becomes unserviceable an unserviceable/closed marking is displayed except where the closure is for a short period and other means of advising aircraft and vehicle operators are used.

Location

5.2.24.3 On a runway, the unserviceable/closed marking is placed at each end of the runway, or portion thereof, declared closed. Additional markings are placed so that the maximum interval between markings does not exceed 300 m.

5.2.24.4 On a taxiway, the unserviceable/closed marking is placed at each end of the taxiway or portion thereof declared closed.

Characteristics

5.2.24.5 Subject to 5.2.24.7, the unserviceable/closed marking on a runway is white and of the form and proportions detailed in Figure 5-20, Illustration A.

5.2.24.6 Subject to 5.2.24.7, on a taxiway or apron, the unserviceable/closed marking is yellow and of the form and proportions detailed in Figure 5-20, Illustration B.

5.2.24.7 On unpaved surfaces, or for the temporary (short) closure of a paved surface, the following may be used as alternatives:

(a) subject to section 5.3.33, lighted closed markers can be used in lieu of unserviceable/closed markings for closures of short duration;

(b) on a runway, markings utilizing materials other than paint or other suitable means may be used;

(c) on a taxiway or apron, frangible barriers or markings utilizing materials other than paint or other suitable means may be used

Note 1: The intent of (b) is to allow for the use of alternatives to paint such as a large plastic X that would be of the form and proportions of Figure 5-20.

Note 2: See sections 5.3.32 and 5.3.33 for information on the lighting of unserviceable areas.

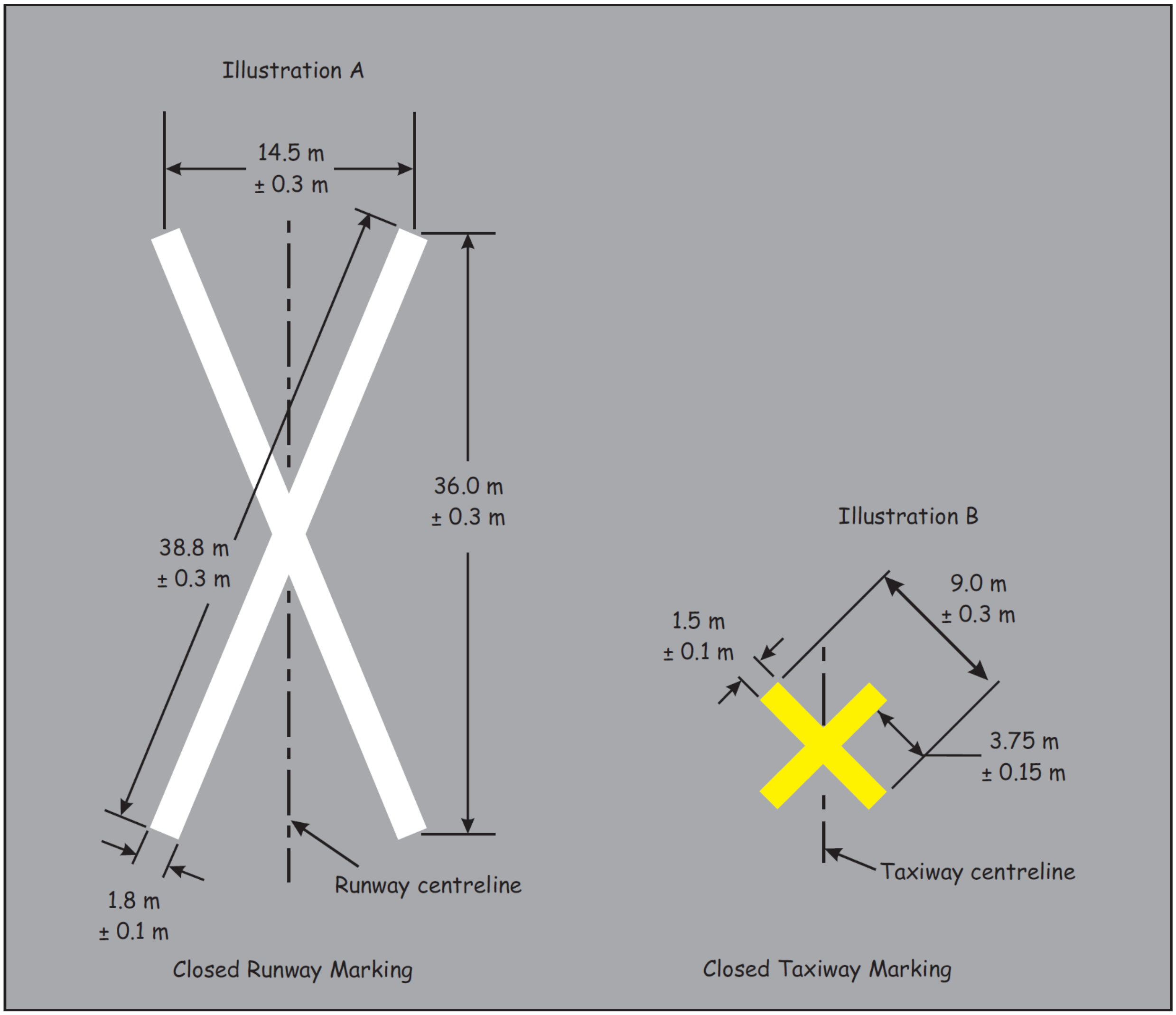


Figure 5-20: Closed runway and taxiway markings

5.3 LIGHTING

5.3.1 General

5.3.1.1 When a runway, taxiway, apron or portion thereof is permanently closed, all lighting is removed.

5.3.1.2 When a runway, taxiway, apron or portion thereof is closed for a short duration, all associated lighting, such as threshold, edge, end, centreline, and approach lighting is turned off, blacked out or occluded except where the lighting is required to be on for maintenance purposes.

5.3.1.3 Edge lights, including threshold and runway end lights, are placed outside the edges of the area declared for use as a movement area at a constant distance (±0.3 m), of up to 3 m from the declared operational edge.

Note: Edge light fixtures may be of the elevated or inset type.

Elevated lights

5.3.1.4 Elevated light fixtures and their supporting structures on the runway strip, taxiway strip, RESA, and apron areas:

(a) are frangible, and

(b) have the frangible break point located 0 to 5 cm above grade.

5.3.1.5 Elevated edge light fixtures are mounted to a maximum height of 35 cm above the edge of the operational surface (runway, taxiway, apron, etc…), subject to the following;

(a) the top of the light fixture may be raised to a maximum height of 75 cm when located 3 m from the edge of the operational surface using a ratio of 1 cm per 3.75 cm as the light fixture is moved out from the 1.5 m to the 3 m position; and

(b) when the light is raised above the 35 cm height, a minimum clearance of 15 cm is provided between the top of the light fixture and any overhanging part of the aircraft expected to operate on the surface when its main gear is coincident with the edge of the operational surface.

Note 1: See Figure 5-21 for depiction of edge light fixture mounting height.

Note 2: Elevated edge light fixtures include runway end and threshold lights.

Inset lights

5.3.1.6 Inset light fixtures located in the surface of runways, stopways, taxiways and aprons are 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.

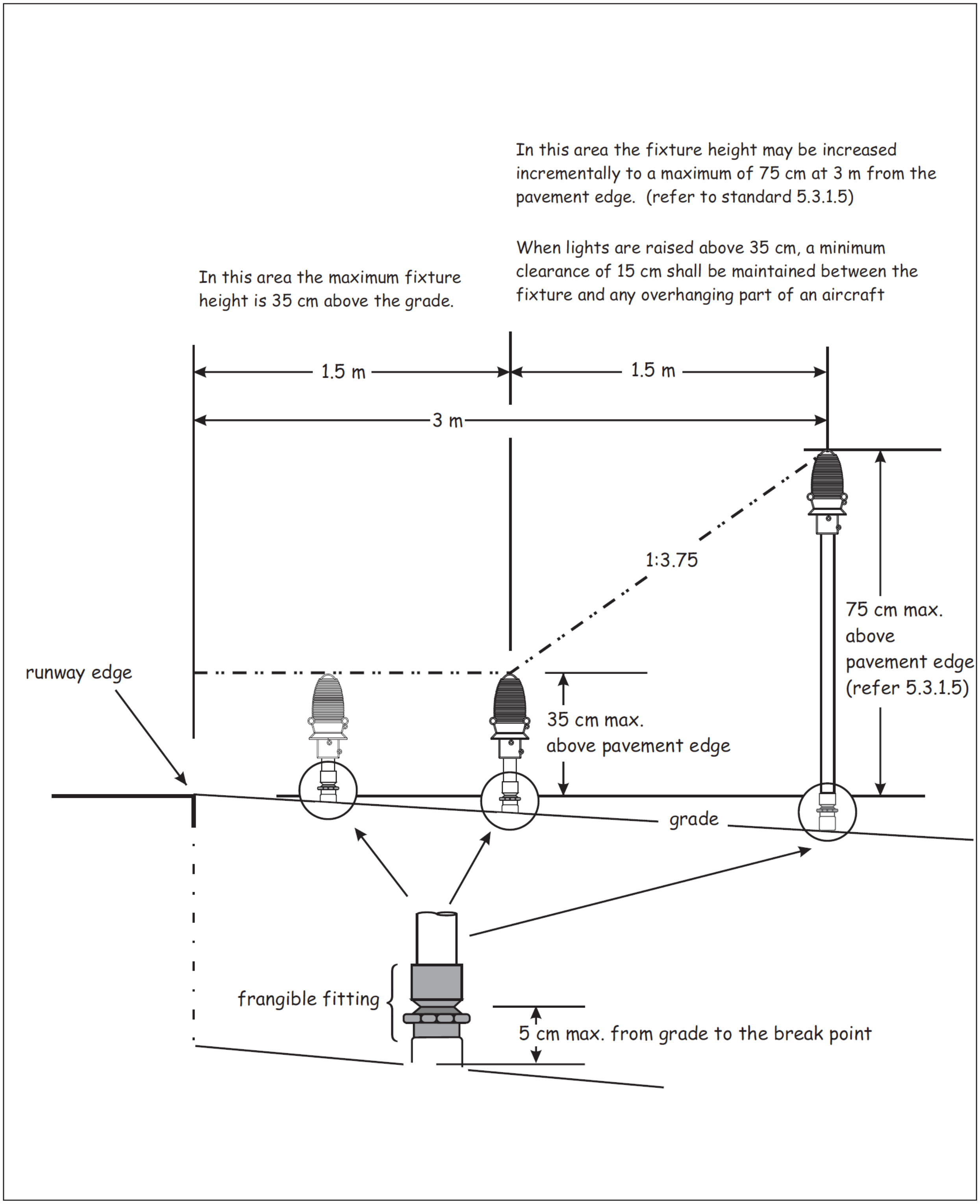


Figure 5-21: Elevated light mounting height

Light Intensity and Control

5.3.1.7 Medium and high intensity aerodrome lighting systems are provided with brightness steps as shown in Table 5.3.1.7.

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Table 5.3.1.7—Lighting Systems Brightness Steps

Lighting System		Number of Intensity Steps	Intensity Steps – Used and Not Used				
ALSF-2	S	5	5	4	3	2	1
SSALS and SSALR	S	5	5	4	3	2	1
RAIL (3)		5	5 high	4 high	3 medium	2 low	1 low
Runway centreline		5	5	4	3	2	1
Taxiway centreline		5	5	4	3	2	1
Touchdown zone		5	5	4	3	2	1
Land and hold short lights		5	5	4	3	2	1
Stop bar		5	5	4	3	2	1
High intensity runway edge (1)		5	5	4	3	2	1
Exit taxiway centreline (4)		5	5	4	3	2	1
PAPI/APAPI		5	5	4	3	2	1
RETIL (4)(5)		5	5	4	3	2	1
RGL		5	5	4	3	2	1
MALSR and MALSF (2)	S	3	3	2	1		
MALS (2)		3	3	2	1		
RAIL (3)		3	3	2	1		
ODALS		3	3	2	1		
Medium intensity runway edge (1)		3	3	2	1		
Taxiway edge lighting (6)		3	3	2	1		
RTIL		3	3	2	1		
RGL		3	3	2	1		
VAGS		3	3	2	1		
PAPI/APAPI		3	3	2	1		
RTIL		1	1				
Guidance signs (6)		1	1				
Wind direction indicator(6)		1	1				

S = Steady burning portion of the approach lighting system
(1) Includes runway threshold, end and wing bar lights.
(2) MALS and MALSF may be operated with two intensity settings.
(3) RAIL as used for ALSF-2, SSALR, MALSR and MALSF.
(4) RETIL and exit taxiway centreline lighting are operated at the same intensity step as the runway centreline lighting.
(5) An interlock is provided to prevent the RETIL being turned ON without the runway lighting being ON.
(6) Where guidance signs or wind direction indicators are connected to an adjacent runway or taxiway circuit, they are designed to provide the required luminance values regardless of the current selection.

Photometrics

5.3.1.8 On the perimeter of and within the ellipse defining the main beam [inner ellipse] in Appendix 5B, Figures B-1 to B-10 and (a) in Figure B-24, the maximum light intensity value is not greater than three times the minimum light intensity value measured in accordance with Appendix 5B, Figure B-11.

5.3.1.9 On the perimeter of and within the rectangle defining the main beam [inner rectangle] in Appendix 5B, Figures B-12 to B-17 and (b) in Figure B-24, the maximum light intensity value is not greater than 3 times the minimum light intensity value measured in accordance with Appendix 5B, Figure B-18.

Note: The minimum light intensity is 0.5 times the minimum average intensity specified for the main beam.

5.3.1.10 Subject to 5.3.1.11, colours of lights are in accordance with Appendix 5A.

5.3.1.11 Where the standard requires the colour of light to be “variable white” and the lighting system installed uses solid state lighting, the “variable white” is to be interpreted as “white” with the chromaticity boundary equations as specified for Figure A-1(b) of Appendix 5A.

5.3.2 Not Allocated

5.3.3 Aerodrome Beacon

Application

5.3.3.1 An aerodrome beacon is provided where the aerodrome is difficult to identify from the air at night.

Location

5.3.3.2 The aerodrome beacon is located on, or adjacent to, the aerodrome in an area of low ambient background lighting.

5.3.3.3 The location of the beacon is such that it:

(a) is not shielded by objects in significant directions of approach, or

(b) does not cause conflicting visual indications to the pilot approaching to land.

Characteristics

General

5.3.3.4 The aerodrome beacon shows white flashes.

Rotating Type

5.3.3.5 The frequency of total flashes is from 24 flashes per minute (fpm), ±2 fpm.

5.3.3.6 The light from the beacon shows at all angles of azimuth.

5.3.3.7 The vertical light distribution extends upwards from an elevation of not more than 1°.

5.3.3.8 Subject to 5.3.3.9, the aerodrome beacon provides an effective intensity distribution of the flash, in accordance with Table 5.3.3.8.

Table 5.3.3.8—Intensity Distribution of Rotating Beacons Medium Intensity	
Elevation angle (degrees)	Minimum effective intensity of flash (candelas)
1 to 2	25 000
3 to 7	50 000
8 to 10	25 000

5.3.3.9 For aerodromes with high ambient background lighting, the light unit provides an effective intensity distribution of the flash in accordance with Table 5.3.3.9.

Table 5.3.3.9—Intensity Distribution of Rotating Beacons High Intensity	
Elevation angle (degrees)	Minimum effective intensity of flash (candelas)
1 to 2	37 500
3 to 7	75 000
8 to 10	37 500

Note: The light beam centre is set at 5° above the horizontal plane (0°) for the parameters of Tables 5.3.3.8 and 5.3.3.9.

5.3.3.10 The effective duration of individual flashes is 75 to 300 ms.

Flashing Type

Intensities

5.3.3.11 The beacon is provided with three site selectable intensities (not available for selection by air traffic services) of 3 000, 6 000 and 12 000 nominal peak effective candelas.

Note 1: The intensity setting is normally selected at the time of installation in consideration of the ambient lighting conditions and possible glare to the pilot or air traffic services personnel.

Note 2: Normally the beacon is set for 6 000 effective candelas and may be later adjusted should this be found to be insufficient or excessive, depending upon the site conditions.

Flash Rate

5.3.3.12 The unit has a flash rate of between 20 to 30 flashes per minute.

Note: The lower flash rate may be required for aerodromes with nearby white flashing medium intensity obstruction lights.

Flash Duration

5.3.3.13 The flash duration is 100–250 ms.

Note: This flash duration may consist of a rapid sequence of flashes, giving the appearance of a continuous single flash.

Distribution

5.3.3.14 The distribution of the light signal is as follows:

(a) **Horizontal—**The flash head provides an omnidirectional output of 360° horizontal.

(b) **Minimum Peak Intensity—**The minimum peak intensity is as specified in 5.3.3.11 minus 25%.

(c) **Beam Spread—**The beam spread, defined as the angular distance between the points of intensity, which is half of the actual peak intensity, is a minimum of 3° vertical.

(d) When the light unit is installed as per the manufacturer's instructions, the intensity at 0° elevation angle (horizontal) is at least as great as the minimum specified beam peak intensity.

(e) **Stray Light**—To reduce stray light, the intensity at 10° below horizontal, at any radial, is not greater than 3% of the peak intensity at the same radial.

5.3.4 Aerodrome Flight Manoeuvring Area Hazard Lights

Note: Aerodrome flight manoeuvring area hazard lights delineate a safe flight manoeuvring area for night operations at aerodromes that have hazardous high terrain features in the vicinity of the flight circuit pattern.

Application

5.3.4.1 Aerodrome flight manoeuvring area hazard lights are provided where a risk assessment indicates that flight safety at night would be enhanced by lighting the hazardous terrain with a visual indication of the boundaries of the safe flight manoeuvring area.

General

5.3.4.2 The dimension of the flight manoeuvring area to be free of obstacles:

(a) is determined by drawing arcs with a minimum radius of 2.3 NM centred on each runway threshold and joining those arcs with tangent lines; and

(b) provides a minimum of 100 m vertical obstacle clearance with respect to the aircraft operating altitude referenced in 5.3.4.3.

Note: See Figure 5-22 for depiction of the flight manoeuvring area and placement of lights.

Location

5.3.4.3 The lights are located so as to be visible to pilot(s) operating at the highest authorized circling IMC minimum descent altitude and to pilot(s) operating in VMC from any position within the traffic pattern.

5.3.4.4 The lights are located at approximately the same elevation.

5.3.4.5 Each aerodrome flight manoeuvring area hazard light system consists of a group of lights positioned so as to define the extent of the safe manoeuvring area and so that each light in the system can be seen from the preceding one. Where appropriate, the lights of cities and towns may be included to aid in the determination of the safe flight manoeuvring area.

Characteristics

5.3.4.6 The aerodrome flight manoeuvring area hazard light is an omnidirectional, red or white flashing with an effective intensity of 2 000 candelas during night operations.

Note 1: Where there are multiple units, consideration to have these lights operate in unison.

Note 2: Refer to CARs Standard 621 for type CL-864 and CL-865 light units.

5.3.4.7 Monitoring of the aerodrome flight manoeuvring area hazard lights is provided to ensure that the appropriate authorities are aware of an outage and a voice advisory and/or NOTAM action is promulgated.

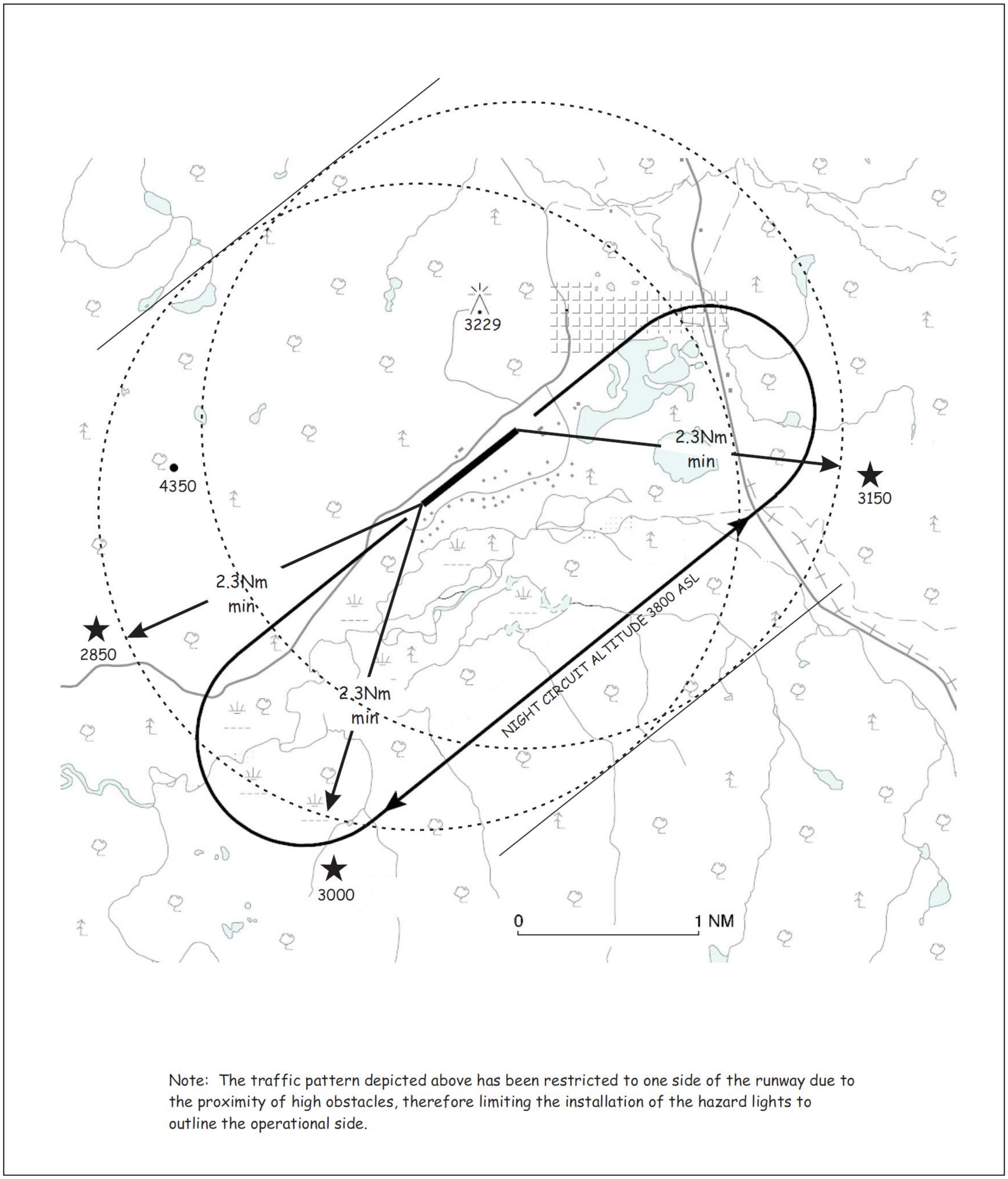


Figure 5-22: Aerodrome flight manoeuvring area hazards lights

5.3.5 APPROACH LIGHTING SYSTEMS

Acronyms

MALS Medium intensity approach lighting system
MALSF Medium intensity approach lighting system with sequenced flashing lights
MALSR Medium intensity approach lighting system with runway alignment indicator lights
ODALS Omnidirectional approach lighting system
SSALS Short simplified approach lighting system
SSALR Simplified short approach lighting system with runway alignment indicator lights
ALSF-2 Approach lighting system with flashing lights for category II or III operations

Note: See Figure 5-23 for depiction of approach lighting systems.

Application

5.3.5.1 A SSALR approach lighting system is provided for a precision runway supporting a category I approach.

5.3.5.2 An ALSF-2 approach lighting system is provided for a precision runway supporting a category II or III approach.

5.3.5.3 All approach lighting systems provided at an aerodrome are in accordance with the specifications provided in this document.

General

5.3.5.4 No object protrudes through the plane of lights within a distance of 60 m from the centreline of the approach lighting system or runway strip width, whichever is lesser unless it:

(a) is lightweight, frangible;

(b) is required to be there by function; and

(c) does not shield any light from the pilots view in those directions intended for operational use.

5.3.5.5 The overall height of elevated approach light fixtures located within 90 m of the runway threshold is:

(a) in accordance with Figure 5-21 within the first 3 m from runway threshold, and

(b) no greater than 75 cm above threshold elevation.

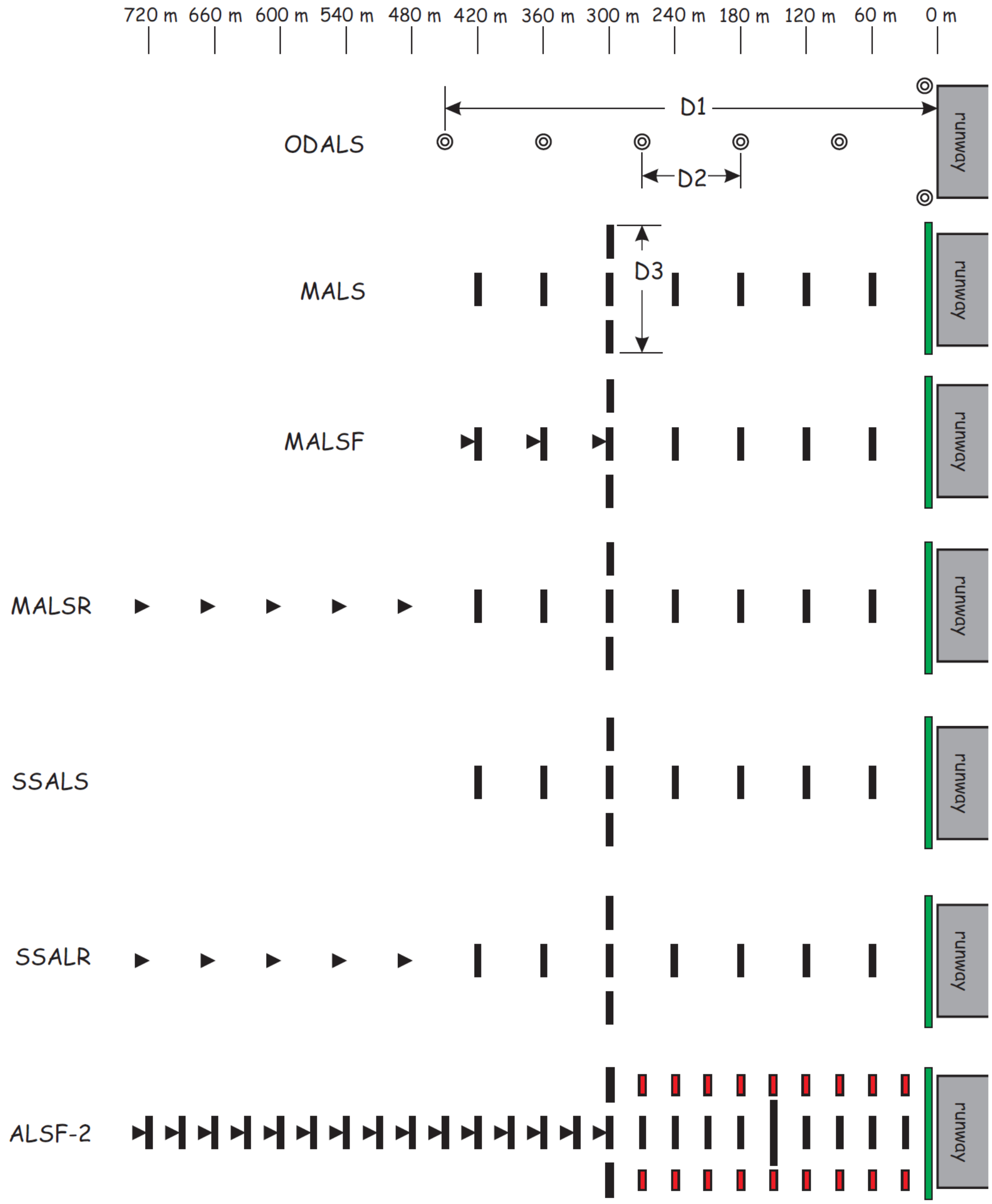
5.3.5.6 Any transportation corridor passing through the approach light area is considered as an object with a minimum height of:

(a) for a multi-lane highway, 5.2 m above the crown of the highway;

(b) for other roads, 4.3 m above the crown of a road;

(c) for a railway, 7 m above the top of the rails; and

(d) for a specific waterway, the height of the critical object is determined by an aeronautical evaluation and recorded in the aerodrome operations manual.



system	D1 length	D2 light spacing	D3 crossbar width
ODALS	450 m	90 m	n/a
MALS	420 m	60 m	21 m
MALSF	420 m	60 m	21 m
MALSR	720 m	60 m	21 m
SSALS	420 m	60 m	21 m
SSALR	720 m	60 m	21 m
ALSF-2	720 m	30 m	30 m

Figure 5-23: Approach lighting systems configurations

Omnidirectional Approach Lighting System (ODALS)

Location

5.3.5.7 An ODALS consists of five (5) lights installed on the extended centreline of the runway extending over a total distance of 450 m (+30, -0 m), and two (2) light units, one each abeam the runway threshold.

Note: See Figure 5–24 for depiction of an ODALS.

5.3.5.8 The lights forming the centreline of the ODALS are as follows:

(a) light unit at station 90 is installed at 90 m (+ 7.5, - 0 m) from the threshold;

(b) the remaining lights are spaced at intervals of 90 m (±7.5 m); and

(c) the lateral installation tolerance is +/- 1 m from the extended runway centreline.

5.3.5.9 The two lights installed at the threshold are located:

(a) symmetrically about the runway centreline or extended centreline, such that the difference in the distance of the two lights to the runway centreline does not exceed 2 m;

(b) at a lateral distance of 12 m (+10.5 m -0.0 m) from the runway edge or extended runway edge; and

(c) in a line perpendicular to the extended runway centreline at equidistant positions longitudinally from the threshold (+ 30 m, - 0.0 m).

5.3.5.10 Subject to 5.3.5.11, the light centres of the elevated ODALS fixtures including and beyond light station 180 lie within ±3 cm of the horizontal datum, which is 35 cm above the threshold crown elevation.

5.3.5.11 Where it is necessary for the elevated centreline fixtures of the ODALS to deviate from the horizontal plane due to terrain features, to minimize the height of supporting structures, or to achieve clearance over an object, sloping segments are permitted as follows:

(a) only one (1) slope change after 90 m is permitted;

(b) where a slope change is established, the preceding segment is horizontal;

(c) the slope is a maximum of ±2.0%; and

(d) the light centres are installed with a vertical tolerance of ±3 cm.

Note 1: See Figure 5-25 for depiction of the ODALS profile and limit of light centres.

Note 2: The slope referenced in (a) is measured through the centre of each lamp.

Note 3: The light unit at station 90 may be installed with overall height of 75 cm above threshold elevation without being counted as a slope change. See 5.3.5.5.

5.3.5.12 The tops of the two (2) threshold light units are installed within a vertical tolerance of +1.0 m/-0.5 m of the runway threshold elevation.

Characteristics

5.3.5.13 The individual lights of an ODALS consist of single omnidirectional variable white flashing light units.

5.3.5.14 Each light is flashed in sequence, beginning with the outermost light and progressing toward the threshold to the innermost light of the system. The centreline lights are sequenced with 1/15 second interval between flashes. The two (2) runway threshold units flash simultaneously 4/15 seconds after the innermost centreline light. The cycle begins again 7/15 seconds after the flash of the two (2) runway threshold lights giving an overall rate of 60 cycles per minute (±10%).

5.3.5.15 The ODALS has a variable intensity control with three (3) intensity settings in accordance with 5.3.1.7.

5.3.5.16 Subject to 5.3.5.17, the lights:

(a) show at all angles of azimuth above 2° and are visible from any direction; and

(b) are in accordance with the specifications of Appendix 5B, Figure B-23.

5.3.5.17 Where shielding is applied to reduce a dazzling effect, the shielding is as follows:

(a) limited to light at station 90, 0a and 0b;

(b) only on the non-approach side;

(c) centred parallel to the runway centreline; and

(d) with a maximum azimuth spread of 180°.

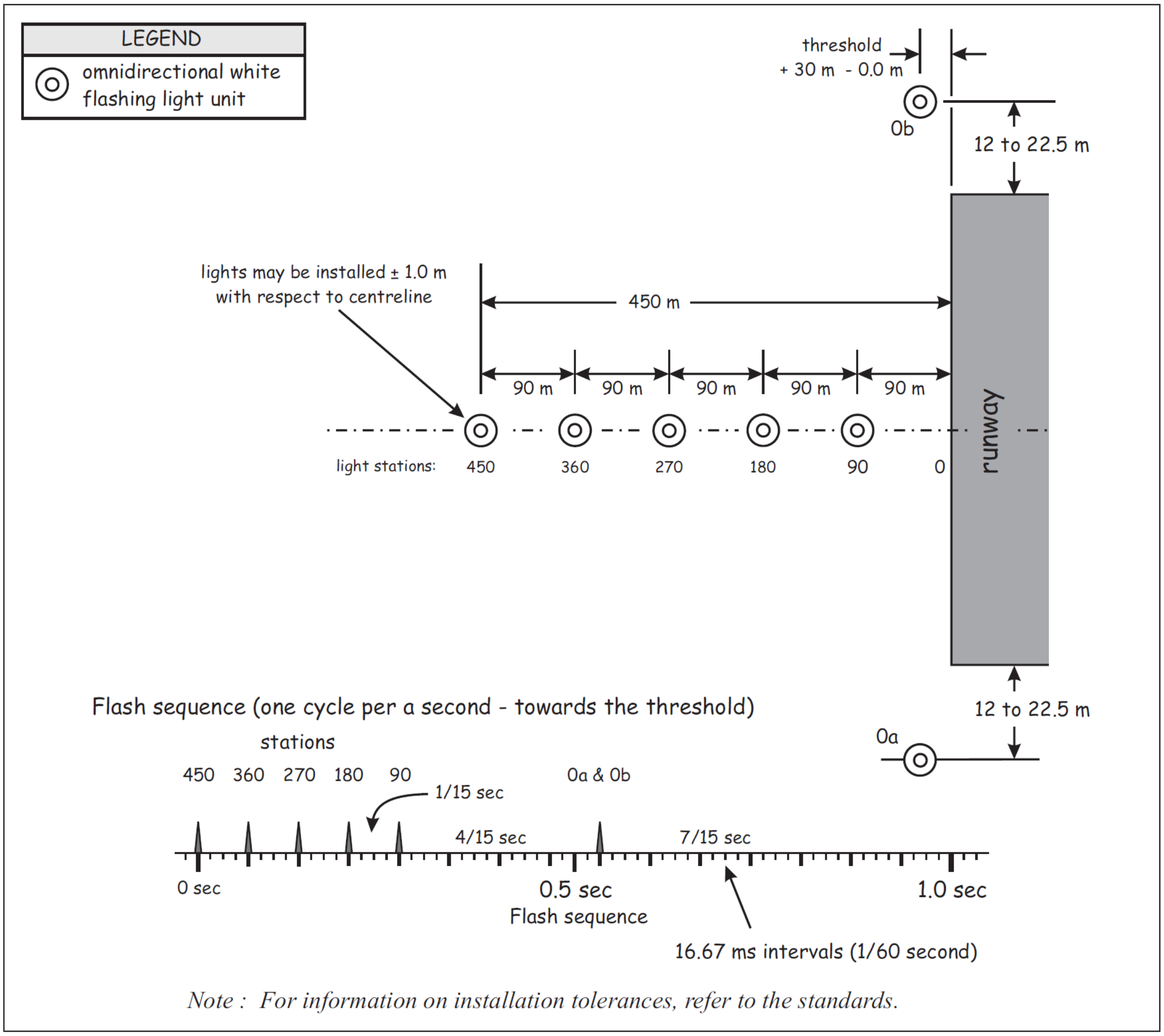


Figure 5-24: ODALS configuration

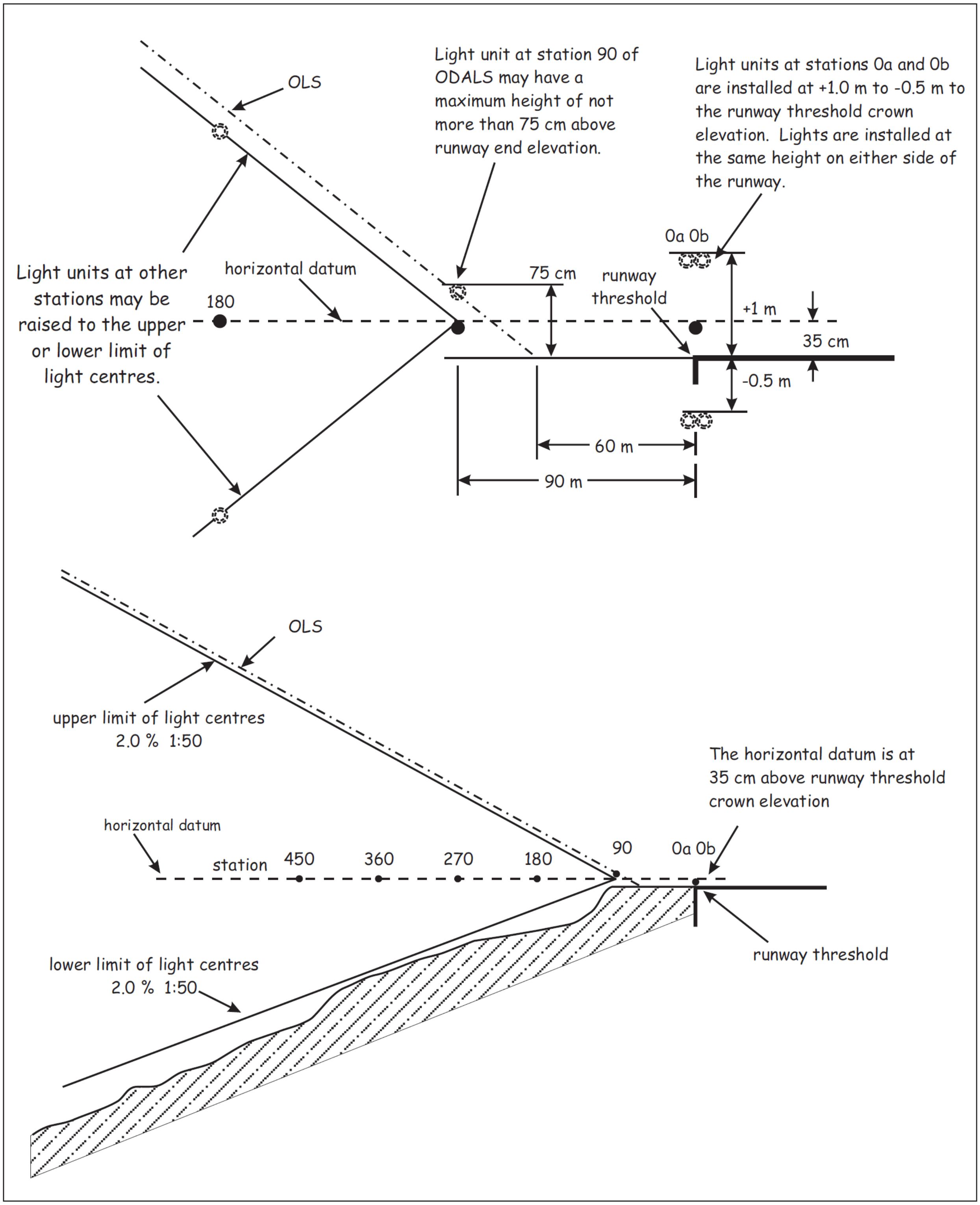


Figure 5-25: ODALS profile and limit of light centres

Medium Intensity Approach Lighting System (MALS)

Note: The MALS consists of the steady burning lights of a MALSR.

Location

5.3.5.18 The MALS is installed on the extended centreline of the runway extending over a distance of 420 m (+15 m, -0 m) and consists of:

(a) seven (7) centreline barrettes, placed at longitudinal intervals of 60 m (±7 m) with the innermost barrette located 60 m (+7 m, -0 m) from the threshold;

(b) a crossbar located at 300 m (±15 m) from the runway threshold, in line with the centreline barrette. The crossbar contains two side barrettes centred 7.5 m from the extended runway centreline; and

(c) approach threshold lights specified in section 5.3.6.

Note: See Figure 5-26 for depiction of MALS configuration.

5.3.5.19 Subject to 5.3.5.20, the light centres of the elevated MALS fixtures beyond the strip end lie within ±3 cm of the horizontal plane which is 35 cm above the threshold.

5.3.5.20 Where it is necessary for the elevated MALS fixtures of the system to deviate from the horizontal plane due to terrain features, to minimize the height of supporting structures, or to achieve clearance over an object, sloping segments are permitted as follows:

(a) the slope starts not less than 90 m outwards from the runway threshold;

(b) only one rising gradient segment is permitted;

(c) only three changes in profile gradient are permitted;

(d) the slope gradient is kept to a minimum and does not exceed a rising gradient of 2.0%, nor a falling gradient of 1.0% to a point 420 m from the threshold, and from this point, the falling gradient does not exceed 2.5%;

(e) the slope segment extends over a minimum of three (3) light units and starts and ends at a light unit; and

(f) the sloping segment continues to the end of the approach light system, reverts to the horizontal, or begins a falling gradient provided that the final segment extends over a distance of three (3) light units.

Note: See Figure 5-27 for depiction of MALS profile and limit of light centres.

5.3.5.21 The transverse tolerance for the installed position of an individual MALS barrette centre is ±15 cm.

5.3.5.22 The centreline barrettes and crossbar lights of a MALS are fixed lights showing variable white.

5.3.5.23 The centreline barrettes of the MALS each contain five (5) lights with centres 1.0 m (±3 cm) apart, having an overall width of 4 m (±3 cm).

5.3.5.24 The crossbar side barrettes of the MALS each contain five (5) lights with centres 1.5 m (±3 cm) apart, having an overall width of 6 m (±3 cm).

5.3.5.25 The vertical tolerance with respect to an individual MALS light centre within a barrette is ±3 cm.

Characteristics

5.3.5.26 The steady burning lights of the MALS are in accordance with the specifications of Appendix 5B, Figure B-22.

5.3.5.27 The MALS lights are aligned laterally with their beam axis parallel to the extended runway centreline (±1.0°). The vertical alignment of lights is in accordance with Table 5.3.5.27 (±1.0°) and Figure 5-28.

Table 5.3.5.27
Angle of Elevation Settings for Approach Lighting Systems other than ALSF-2

station	MALS	MALSF	MALSR	SSALS	SSALR
0	3.1	3.1	3.1	5.5	5.5
60	3.2	3.2	3.2	5.5	5.5
120	3.3	3.3	3.3	5.5	5.5
180	3.4	3.4	3.4	5.5	5.5
240	3.4	3.4	3.4	5.5	5.5
300	3.5	3.5 (6.0)	3.5	5.5	5.5
360	3.6	3.6 (6.0)	3.6	5.5	5.5
420	3.7	3.7 (6.0)	3.7	5.5	5.5
480			(6.0)		(6.0)
540			(6.0)		(6.0)
600			(6.0)		(6.0)
660			(6.0)		(6.0)
720			(6.0)		(6.0)

Note 1: These angle settings are for elevated lights installed at the elevation of the horizontal. Figure 5-28 provides guidance on adjustments to the vertical aiming for lights that are not installed at the elevation of the horizontal datum. Inset approach lights are designed to incorporate the required viewing angles.

Note 2: Elevation settings for flashing lights are in brackets.

5.3.5.28 The MALS has a variable intensity control with three (3) intensity settings in accordance with 5.3.1.7.

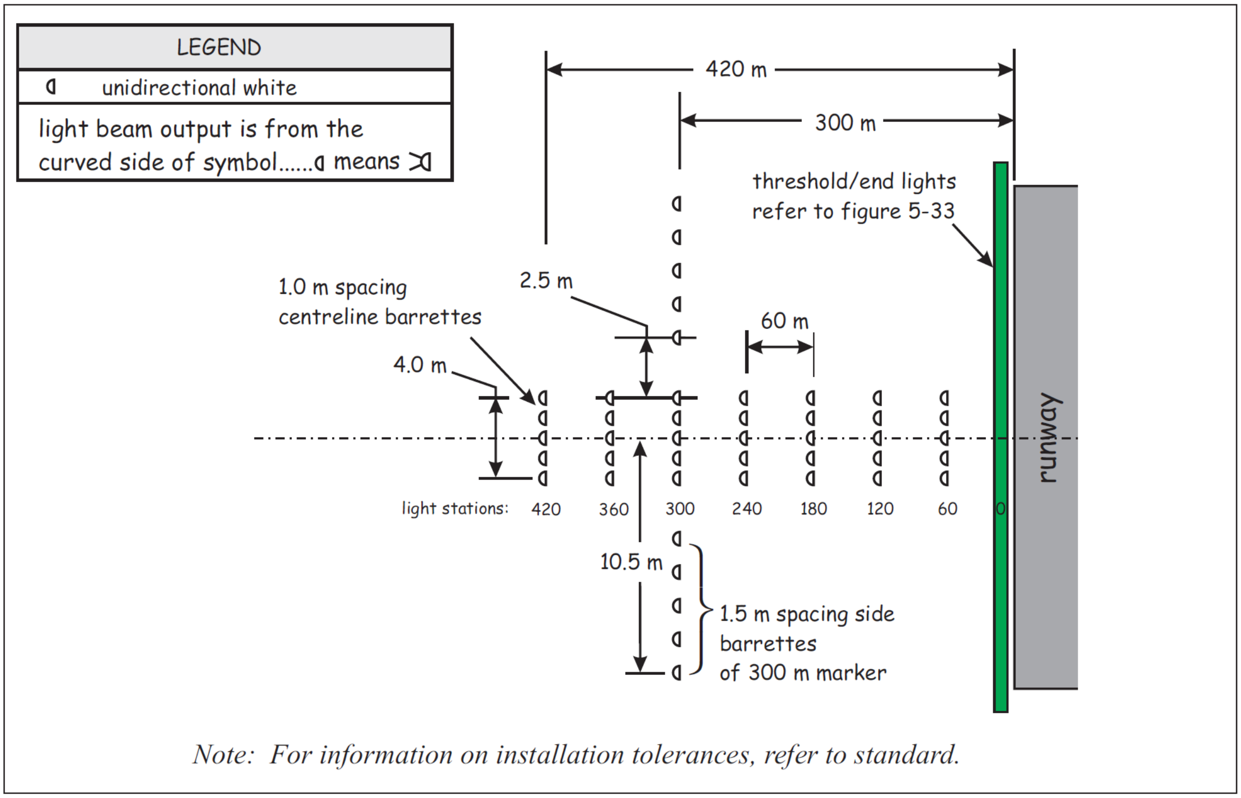


Figure 5-26: MALS / SSALS configuration

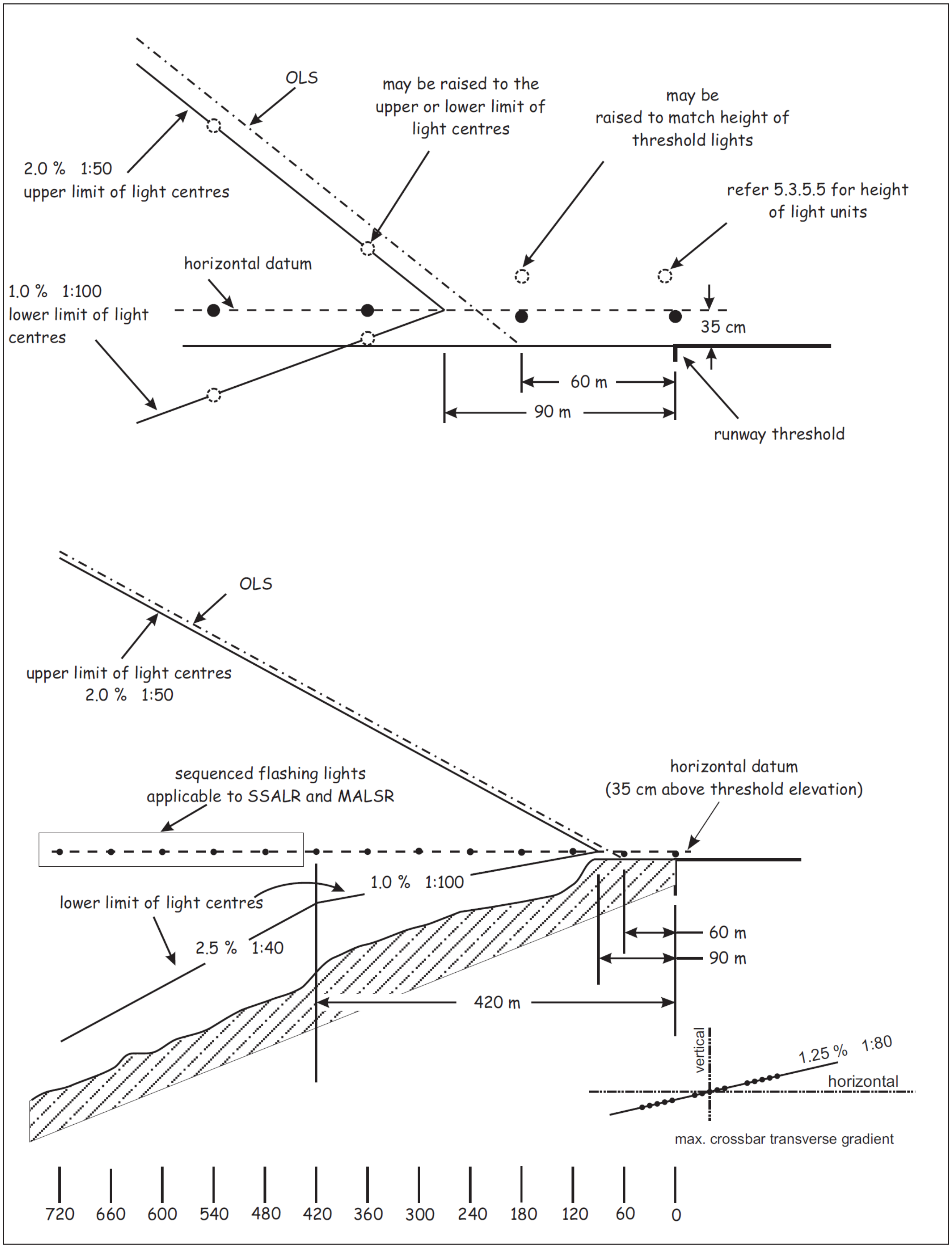
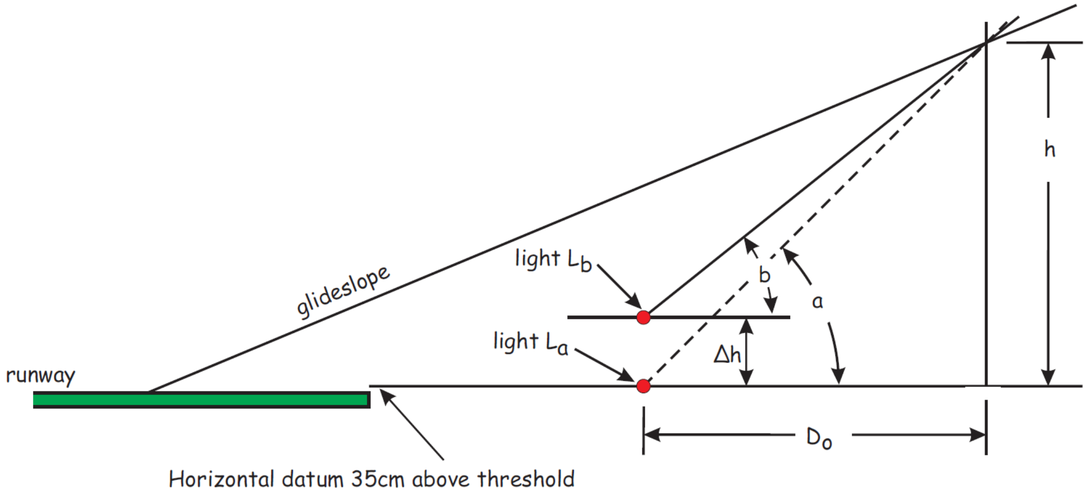


Figure 5-27: SSALR / SSALS / MALSR / MALSF / MALS profile and limit of light centres



Formula for angle adjustment: $b = \tan^{-1}(h - \Delta h)/Do$ (for lights below the horizontal, Δh is negative)

- "h" is the height of the glide slope which is intersected by the beams of lights L_a and L_b for the distance Do.
  $h = Do * \tan a$
- "a" is the elevation setting angle for the particular station is taken from Table 5.3.5.88 for ALSF-2 and SSALR, and table 5.3.5.24 for MALSR, MALSF and MALS.
- "b" is the corrected elevation setting angle.
- "D_o" is the designated distance of 1442 m [4732 ft] for MALS and 380 m [1248 ft] for ALSF-2.
- "Δh" is the height of the light above the horizontal plane passing through the threshold.

Figure 5-28: Correction of elevated setting angle

Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR)

Note: A MALSR has a similar presentation as a SSALR with medium intensity fixtures.

<u>Location</u>

5.3.5.29 The MALSR is installed on the extended centreline of the runway over a distance of 720 m (+ 15 m, - 0 m) and consists of:

(a) seven (7) centreline barrettes over a length of 420 m (±15 m), placed at longitudinal intervals of 60 m (±7 m) with the innermost barrette located 60 m (+7 m, – 0 m) from the threshold;

(b) a crossbar located at 300 m (±15 m) from the runway threshold, in line with the centreline barrette. The crossbar contains two (2) side barrettes centred 7.5 m from the extended runway centreline;

(c) five (5) sequenced flashing RAIL placed at longitudinal intervals of 60 m (±7 m) with the innermost light located 60 m (±7 m) beyond the outermost centreline barrette; and

(d) approach threshold lights specified in section 5.3.6.

Note: See Figure 5-29 for depiction of MALSR configuration.

5.3.5.30 Subject to 5.3.5.31, the light centres of the elevated MALSR fixtures beyond the strip end lie within ±3 cm of the horizontal plane, which is 35 cm above the threshold.

5.3.5.31 Where it is necessary for the elevated fixtures of the MALSR to deviate from the horizontal plane due to terrain features, to minimize the height of supporting structures, or to achieve clearance over an object, sloping segments are permitted as follows:

(a) the slope starts not less than 90 m outwards from the runway threshold;

(b) only one (1) rising gradient segment is permitted;

(c) only three (3) changes in profile gradient are permitted;

(d) the slope gradient is kept to a minimum and does not exceed a rising gradient of 2.0%, nor a falling gradient of 1.0% to a point 420 m from the threshold, and from this point, the falling gradient does not exceed 2.5%;

(e) the slope segment extends over a minimum of three (3) light units and starts and ends at a light unit; and

(f) the sloping segment continues to the end of the approach light system, reverts to the horizontal, or begins a falling gradient provided that the final segment extends over a distance of three (3) light units.

Note: See Figure 5-27 for depiction of approach lighting profile and limit of light centres.

5.3.5.32 The transverse tolerance for the installed position of an individual MALSR barrette centre is ±15 cm.

5.3.5.33 The centreline barrettes and crossbar lights of the MALSR are fixed lights showing variable white.

5.3.5.34 The centreline barrettes of the MALSR each contain five (5) lights with centres 1.0 m (±3.0 cm) apart, having an overall width of 4 m (±3 cm).

5.3.5.35 The crossbar barrettes of the MALSR each contain five (5) lights with centres 1.5 m (±3.0 cm) apart, having an overall width of 6 m (±3 cm).

5.3.5.36 The vertical tolerance with respect to an individual MALSR light centre within a barrette is ±3.0 cm.

Characteristics

5.3.5.37 Each light of the RAIL portion of the MALSR flashes twice a second (±25 ms) with a time interval between flashes of adjacent units of 35 ms (±5 ms) beginning with the outermost light and progressing toward the threshold to the innermost light of the system. Any remaining time in each sequence occurs between the flash of the last unit and the flash of the first unit.

The design of the triggering circuit is such that failure of one or more of the flash units does not affect operation of the remaining units.

The design of the electrical circuit is such that the RAIL can only be operated when the other lights of the approach lighting system are on. The RAIL can be turned off leaving the steady burning lights in operation. The steady burning lights cannot be turned off leaving the RAIL in operation. The RAIL can only be energized when the steady burning lights are operational.

5.3.5.38 The lights of the MALSR are in accordance with the specifications of Appendix 5B, Figure B-22 for the steady burning lights, and Figure B-23 for the sequenced RAIL.

5.3.5.39 The MALSR lights are aligned laterally with their beam axis parallel to the extended runway centreline (±1.0°). The vertical alignment of lights is in accordance with Table 5.3.5.27 (±1.0°) and Figure 5-28.

5.3.5.40 The MALSR has a variable intensity control with three (3) intensity settings in accordance with 5.3.1.7.

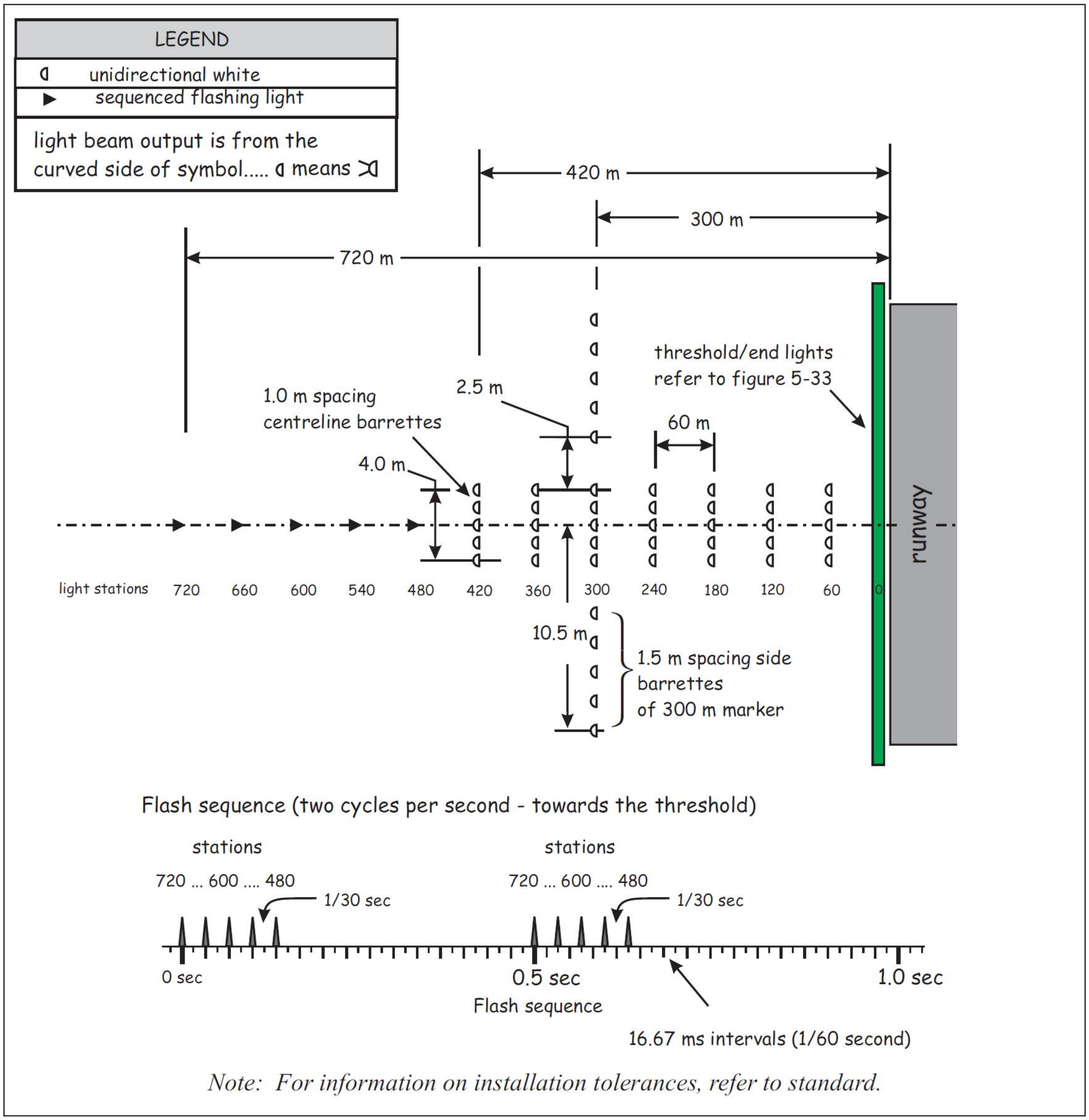


Figure 5-29: MALSR / SSALR configuration

Medium Intensity Approach Lighting System with Sequenced Flashing Lights (MALSF)

Note: The MALSF consists of a MALS with three (3) sequenced flashing lights located at the last three light bar stations. These flashing lights are added to the MALS at locations where high ambient background lighting, or other reasons, requires these lights to assist pilots in making an earlier identification of the system.

Location

5.3.5.41 A MALSF is installed on the extended centreline of the runway over a distance of 420 m (+ 15 m, – 0 m) and consists of:

(a) seven (7) centreline barrettes, placed at longitudinal intervals of 60 m (±7 m) with the innermost barrette located 60 m (+7 m, –0 m) from the threshold;

(b) a crossbar located at 300 m (±15 m) from the runway threshold, in line with the centreline barrette. The crossbar contains two (2) side barrettes centred 7.5 m from the extended runway centreline;

(c) three (3) sequenced flashing RAIL placed at longitudinal intervals of 60 m (±7 m) with the outermost light located at the outermost centreline barrette; and

(i) when installed on the barrette, no higher than the beam centres of the steady burning lights of the associated centreline barrette, and at the mid-point between the centre steady burning light and the next outward; within a tolerance of ±3 cm.

(ii) when installed in front of the associated barrette, not more than 1.5 m in front of the barrette, not lower than 1.0 m below the plane established by the beam centres of the steady burning lights, and of a height so as to not obscure the output of the adjacent steady burning light.

(d) approach threshold lights specified in section 5.3.6.

Note: See Figure 5-30 for depiction of a MALSF configuration.

5.3.5.42 Subject to 5.3.5.43, the light centres of the elevated MALSF fixtures beyond the strip end lie within ±3 cm of the horizontal plane, which is 35 cm above the threshold.

5.3.5.43 Where it is necessary for the elevated fixtures of the MALSF to deviate from the horizontal plane due to terrain features, to minimize the height of supporting structures, or to achieve clearance over an object, sloping segments are permitted as follows:

(a) the slope starts not less than 90 m outwards from the runway threshold;

(b) only one (1) rising gradient segment is permitted;

(c) only three (3) changes in profile gradient are permitted;

(d) the slope gradient is kept to a minimum and does not exceed a rising gradient of 2.0%, nor a falling gradient of 1.0% to a point 420 m from the threshold, and from this point, the falling gradient does not exceed 2.5%;

(e) the slope segment extends over a minimum of three (3) light units and starts and ends at a light unit; and

(f) the sloping segment continues to the end of the approach light system, reverts to the horizontal, or begins a falling gradient provided that the final segment extends over a distance of three (3) light units.

Note: See Figure 5-27 for depiction of the approach lighting profile and limit of light centres.

5.3.5.44 The transverse tolerance for the installed position of an individual MALSF barrette centre is ±15 cm.

5.3.5.45 The centreline barrettes and crossbar lights of the MALSF are fixed lights showing variable white.

5.3.5.46 The centreline barrettes of the MALSF each contain five (5) lights with centres 1.0 m (±3.0 cm) apart, having an overall width of 4 m (±3 cm).

5.3.5.47 The crossbar barrettes of the MALSF each contain five (5) lights with centres 1.5 m (±3.0 cm) apart, having an overall width of 6 m (±3 cm).

5.3.5.48 The vertical tolerance with respect to an individual MALSF light centre within a barrette is ±3.0 cm.

<u>Characteristics</u>

5.3.5.49 Each light of the RAIL portion of the MALSF flashes twice a second (±25 ms) with a time interval between flashes of adjacent units of 35 ms (±5 ms) beginning with the outermost light and progressing toward the threshold to the innermost light of the system. Any remaining time in each sequence occurs between the flash of the last unit and the flash of the first unit.

The design of the triggering circuit is such that failure of one or more of the RAIL units does not affect operation of the remaining units.

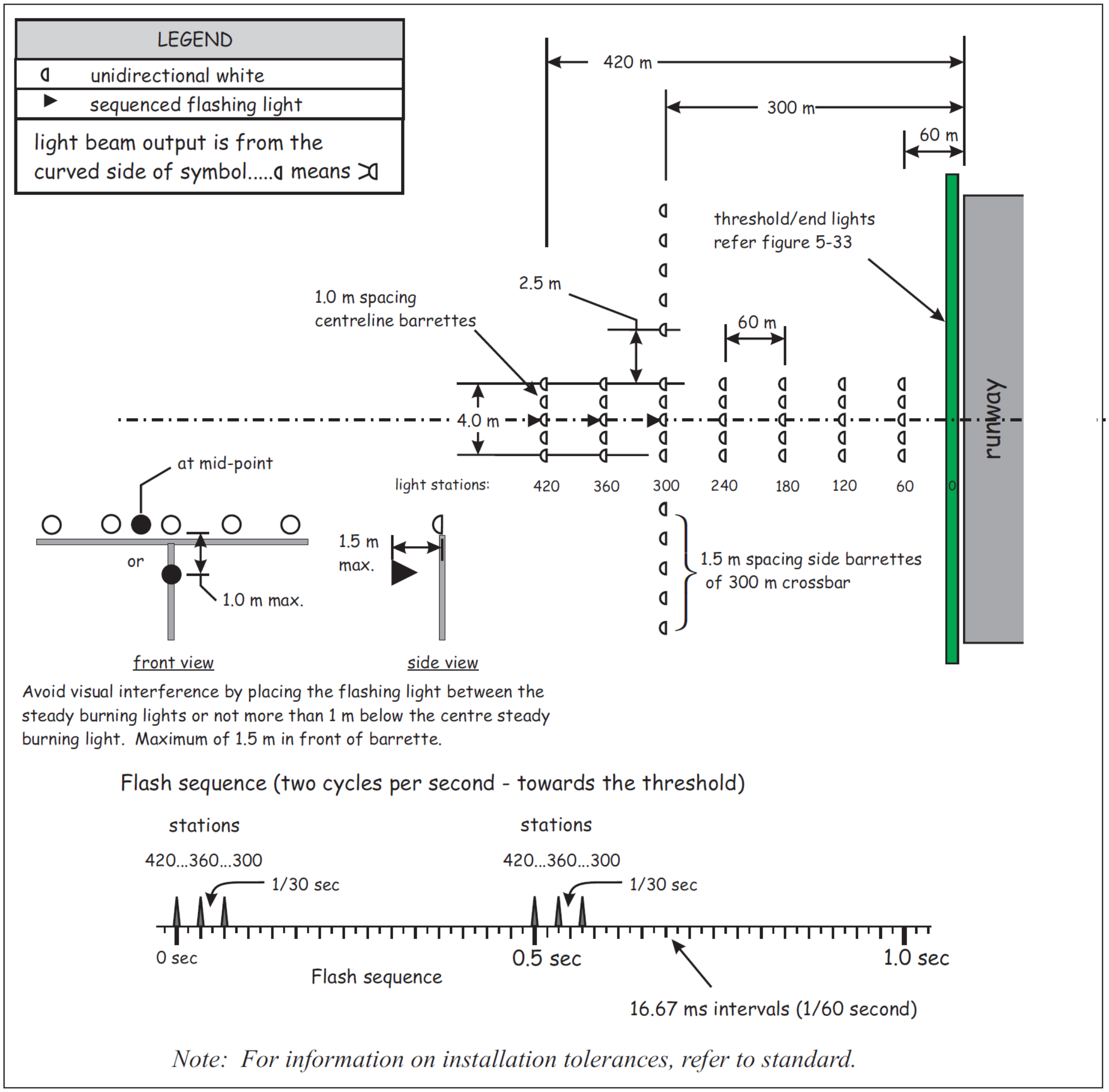
The design of the electrical circuit is such that the RAIL can be operated independently of the other lights of the approach lighting system. The RAIL can be turned off leaving the steady burning lights in operation. The steady burning lights cannot be turned off leaving the RAIL in operation. The RAIL can only be energized when the steady burning lights are operational.

Note: The means of control enables the RAIL to be turned on and off, but only with the steady burning lights on.

5.3.5.50 The lights of the MALSF are in accordance with the specifications of Appendix 5B, Figure B-22 for the steady burning lights and Figure B-23 for the sequenced flasher lights.

5.3.5.51 The MALSF lights are aligned laterally with their beam axis parallel to the extended runway centreline (±1.0°). The vertical alignment of MALSF lights is in accordance with Table 5.3.5.27(±1.0°) and Figure 5-28.

5.3.5.52 The MALSF has a variable intensity control with three (3) intensity settings in accordance with 5.3.1.7.



5-30: MALSF configuration

Simplified Short Approach Lighting System (SSALS)

Note: The SSALS consists of the steady burning lights of a SSALR.

Location

5.3.5.53 The SSALS is installed on the extended centreline of the runway over a distance of 420 m (+15 m, -0 m) and consists of:

(a) seven (7) centreline barrettes, placed at longitudinal intervals of 60 m (±7 m) with the innermost barrette located 60 m (+7 m, -0 m) from the threshold;

(b) a crossbar located at 300 m (±15 m) from the runway threshold, in line with the centreline barrette. The crossbar contains two (2) side barrettes centred 7.5 m from the extended runway centreline; and

(c) approach threshold lights specified in section 5.3.6.

Note: See Figure 5-26 for depiction of SSALS configuration.

5.3.5.54 Subject to 5.3.5.55, the light centres of the elevated SSALS fixtures beyond the strip end lie within ±3 cm of the horizontal plane, which is 35 cm above the threshold.

5.3.5.55 Where it is necessary for the elevated fixtures of the SSALS to deviate from the horizontal plane due to terrain features, to minimize the height of supporting structures, or to achieve clearance over an object, sloping segments are permitted as follows:

(a) the slope starts not less than 90 m outwards from the runway threshold;

(b) only one (1) rising gradient segment is permitted;

(c) only three (3) changes in profile gradient are permitted;

(d) the slope gradient is kept to a minimum and does not exceed a rising gradient of 2%, nor a falling gradient of 1.0% to a point 420 m from the threshold;

(e) the slope segment extends over a minimum of three (3) light units and starts and ends at a light unit; and

(f) the sloping segment continues to the end of the approach light system, reverts to the horizontal, or begins a falling gradient provided that the final segment extends over a distance of three (3) light units.

Note: See Figure 5-27 for depiction of SSALS profile and limit of light centres.

5.3.5.56 The transverse tolerance for the installed position of an individual SSALS barrette centre is ±15 cm.

5.3.5.57 The centreline barrettes and crossbar lights of the SSALS are fixed lights showing variable white.

5.3.5.58 The centreline barrettes of the SSALS each contain five (5) lights with centres 1.0 m (±3.0 cm) apart, having an overall width of 4 m (±3 cm).

5.3.5.59 The crossbar barrettes of the SSALS each contain five (5) lights with centres 1.5 m (±3.0 cm) apart, having an overall width of 6 m (±3 cm).

5.3.5.60 The vertical tolerance with respect to an individual SSALS light centre within a barrette is ±3.0 cm.

Characteristics

5.3.5.61 The steady burning SSALS lights are in accordance with the specifications of Appendix 5B, Figure B-1.

5.3.5.62 The SSALS lights are aligned laterally with their beam axis parallel to the extended runway centreline (±1.0°). The vertical alignment of SSALS lights is in accordance with Table 5.3.5.27 (±1.0°) and Figure 5-28.

5.3.5.63 The SSALS has a variable intensity control with five (5) intensity settings in accordance with 5.3.1.7.

Simplified Short Approach Lighting with Runway Alignment Indicator Lights (SSALR)

Location

5.3.5.64 The SSALR is installed on the extended centreline of the runway over a distance of 720 m (+ 15 m, – 0 m) and consists of:

(a) seven (7) centreline barrettes, placed at longitudinal intervals of 60 m (±7 m) with the innermost barrette located 60 m (+7 m, -0 m) from the threshold;

(b) a crossbar located at 300 m (±15 m) from the runway threshold, in line with the centreline barrette. The crossbar contains two (2) side barrettes centred 7.5 m from the extended runway centreline;

(c) five (5) sequenced flashing RAIL placed at longitudinal intervals of 60 m (±7 m) with the innermost light located 60 m (±7 m) beyond the outermost centreline barrette; and.

(c) approach threshold lights specified in section 5.3.6.

Note: See Figure 5-29 for depiction of a SSALR

5.3.5.65 Subject to 5.3.5.66, the light centres of the elevated SSALR fixtures beyond the strip end lie within ±3 cm of the horizontal plane which is 35 cm above the threshold,

5.3.5.66 Where it is necessary for the elevated fixtures of the SSALR to deviate from the horizontal plane due to terrain features, to minimize the height of supporting structures, or to achieve clearance over an object, sloping segments are permitted as follows:

(a) the slope starts not less than 90 m outwards from the runway threshold;

(b) only one (1) rising gradient segment is permitted;

(c) only three (3) changes in profile gradient are permitted;

(d) the slope gradient is kept to a minimum and does not exceed a rising gradient of 2%, nor a falling gradient of 1.0% to a point 420 m from the threshold, and from this point, the falling gradient does not exceed 2.5%;

(e) the slope segment extends over a minimum of three (3) light units and starts and ends at a light unit; and

(f) the sloping segment continues to the end of the approach light system, reverts to the horizontal, or begins a falling gradient provided that the final segment extends over a distance of three (3) light units.

Note: See Figure 5-27 for depiction of approach lighting profile and limit of light centres.

5.3.5.67 The transverse tolerance for the installed position of an individual SSALR barrette centre is ±15 cm.

5.3.5.68 The centreline barrettes and crossbar lights of the SSALR are fixed lights showing variable white.

5.3.5.69 The centreline barrettes of the SSALR each contain five (5) lights with centres 1.0 m (±3.0 cm) apart, having an overall width of 4 m (±3 cm).

5.3.5.70 The crossbar barrettes of the SSALR each contain five (5) lights with centres 1.5 m (±3.0 cm) apart, having an overall width of 6 m (±3 cm).

5.3.5.71 The vertical tolerance with respect to an individual SSALR light centre within a barrette is ±3.0 cm.

Characteristics

5.3.5.72 Each light of the RAIL portion of the SSALR flashes twice a second (±25 ms) with a time interval between flashes of adjacent units of 35 ms (±5 ms) beginning with the outermost light and progressing toward the threshold to the innermost light of the system. Any remaining time in each sequence occurs between the flash of the last unit and the flash of the first unit.

The design of the triggering circuit is such that failure of one or more of the flash units does not affect operation of the remaining units.

The design of the electrical circuit is such that the RAIL can be operated independently of the other lights of the approach lighting system. The RAIL can be turned off leaving the steady burning lights in operation. The steady burning lights cannot be turned off leaving the RAIL in operation. The RAIL can only be energized when the steady burning lights are operational.

Note: The means of control enables the RAIL to be turned on and off, but only with the steady burning lights on.

5.3.5.73 The lights of the SSALR are in accordance with the specifications of Appendix 5B, Figure B-1 for the steady burning lights and Figure B-23 for the sequenced flasher lights.

5.3.5.74 The SSALR lights are aligned laterally with their beam axis parallel to the extended runway centreline (±1.0°). The vertical alignment of lights is in accordance with Table 5.3.5.27 (±1.0°) and Figure 5-28.

5.3.5.75 The SSALR has a variable intensity control with five (5) intensity settings in accordance with 5.3.1.7.

Approach Lighting System with Flashing Lights for Category II or III Operations (ALSF-2)

Location

5.3.5.76 The ALSF-2 is installed on the extended centreline of the runway over a distance of 720 m (+15 m, -0 m) and consists of:

(a) twenty-four (24) centreline barrettes placed at longitudinal intervals of 30 m (±3 m) with the innermost barrette located 30 m (+3 m, -0 m) from the threshold;

(b) nine (9) side row light barrettes placed on each side of and aligned with the first nine (9) centreline barrettes described in (a). The lateral spacing between the innermost lights of the side row is equal to that of the touchdown zone lighting. The width of the side row barrette matches the width of the touchdown zone lighting;

(c) crossbars located 150 m (±7.5 m) and 300 m (±15 m) from the runway threshold;

(d) fifteen (15) sequenced flashing RAIL located on the extended runway centreline with each one mounted no greater than 1.5 m in front of a centreline barrette as described in (a), and with the innermost located with the barrette 300 m (±15 m) from the threshold; and

(i) when installed on the barrette, no higher than the beam centres of the steady burning lights of the associated centreline barrette, and at the mid-point between the centre steady burning light and the next outward; within a tolerance of ±3 cm.

(ii) when installed in front of the associated barrette, not lower than 1.0 m below the plane established by the beam centres of the steady burning lights, and of a height so as to not obscure the output of the adjacent steady burning light.

(e) approach threshold lights specified in section 5.3.6.

Note: See Figure 5-31 for depiction of ALSF-2 configuration.

5.3.5.77 The ALSF-2 crossbar barrettes provided at 150 m from the threshold are located equidistant between and coincident with the centreline barrettes and side row barrettes.

5.3.5.78 The ALSF-2 crossbar barrettes provided at 300 m extend on both sides of and are coincident with the centreline barrette. They are positioned with their innermost lights centred 4.5 m (±3 cm) from the extended runway centreline.

5.3.5.79 Subject to 5.3.5.80, the light centres of the elevated ALSF-2 fixtures beyond the strip end lie within ±3 cm of the horizontal plane, which is 35 cm above the threshold.

5.3.5.80 Where it is necessary for the elevated fixtures of the ALSF-2 system to deviate from the horizontal plane due to terrain features, to minimize the height of supporting structures, or to achieve clearance over an object, a sloping segment is permitted as follows:

(a) the slope starts not less than 90 m outwards from the runway threshold;

(b) only one (1) sloping segment is permitted;

(c) the slope gradient is kept to a minimum and does not exceed a rising gradient of 2%, nor a falling gradient of 1% except that a falling gradient is not permitted in the inner 450 m;

(d) the slope segment extends over a minimum of four (4) light units and starts and ends at a light unit; and

(e) the sloping segment may continue to the end of the approach light system or may revert to the horizontal provided that the horizontal segment extends over a distance of three (3) light units.

Note: See Figure 5-32 for depiction of the ALSF-2 profile and limit of light centres.

5.3.5.81 The transverse tolerance for the installed position of an individual barrette centre is ±15 cm.

5.3.5.82 Each centreline barrette within an ALSF-2 contains five (5) lights with centres 1.0 m (±3 cm) apart, having an overall width of 4 m (±3 cm).

5.3.5.83 Each side row barrette within an ALSF-2 contains three (3) lights with centres 1.5 m (±3 cm) apart, having an overall width of 3 m (±3 cm).

5.3.5.84 The crossbar barrettes located 150 m from the runway threshold each contain four (4) lights with centres 1.5 m apart, having an overall width of 4.5 m (±3 cm).

5.3.5.85 The crossbar located 300 m from the runway threshold consists of the centreline barrette and two (2) side barrettes. Each side barrette contains eight (8) lights with centres 1.5 m (±3 cm) apart, having an overall width of 12 m (±3 cm).

5.3.5.86 The vertical tolerance with respect to an individual ALSF-2 light centre within a barrette is ±3.0 cm.

Characteristics

5.3.5.87 The centreline barrettes and crossbar lights of an ALSF-2 are fixed white lights showing variable white. The side row lights as described in 5.3.5.84 are fixed lights showing red.

5.3.5.88 Each light of the RAIL portion of the ALSF-2 flashes twice a second in sequence (±2.5%) with a time interval between flashes of adjacent units of 16.67 ms (±2.5%), beginning with the outermost light in the system progressing toward the threshold to the innermost light of the system. Any remaining time in each sequence occurs between the flash of the last unit and the flash of the first unit.

Flash duration for xenon-based flash lamps is not less than 0.25 ms nor more than 5.5 ms at 50% of the peak instantaneous candlepower.

The design of the triggering circuit is such that failure of one or more of the flash units does not affect operation of the remaining units.

The design of the electrical circuit is such that the RAIL can be operated independently of the other lights of the approach lighting system. The RAIL can be turned off leaving the steady burning lights in operation. The steady burning lights cannot be turned off leaving the RAIL in operation. The RAIL can only be energized when the steady burning lights are operational.

5.3.5.89 The lights of the ALSF-2 are in accordance with the specifications of Appendix 5B, Figure B-1 or Figure B2, as appropriate for the steady burning lights, and Figure B-23 for the sequenced flashing lights.

5.3.5.90 The ALSF-2 lights are aligned laterally with their beam axis parallel to the extended runway centreline (±1.0°). The vertical alignment of lights is in accordance with Table 5.3.5.90 (±1.0°) and Figure 5-28.

Table 5.3.5.90—Angle of Elevation Settings for ALSF-2 Lighting Systems

	Vertical Setting Angle (degrees)				Vertical Setting Angle (degrees)	
Station	Approach Centreline and Crossbars (White Light)	Red Side Row Barrettes	Flashing Lamps	Station	Approach Centreline and Crossbars (White Light)	Flashing Lamps
0	5.5	5.5				
30	5.5	5.5		390	6.0	6.0
60	5.5	5.5		420	6.0	6.0
90	5.5	5.5		450	6.0	6.0
120	5.5	6.0		480	7.0	6.0
150	5.5	6.0		510	7.0	6.0
180	5.5	6.0		540	7.0	6.0
210	5.5	6.0		570	7.0	6.0
240	5.5	6.5		600	7.0	6.0
270	5.5	6.5		630	7.0	6.0
300	5.5		6.0	660	8.0	6.0
330	6.0		6.0	690	8.0	6.0
360	6.0		6.0	720	8.0	6.0

Note: These angle settings are for elevated lights installed at the elevation of the horizontal datum as shown in Figure 5-32. Figure 5-28 provides guidance on adjustments to the vertical aiming for lights that are not installed at the elevation of the horizontal datum. Inset approach lights are designed to incorporate the required viewing angles.

5.3.5.91 The ALSF-2 has a variable intensity control with five (5) brightness settings in accordance with 5.3.1.7.

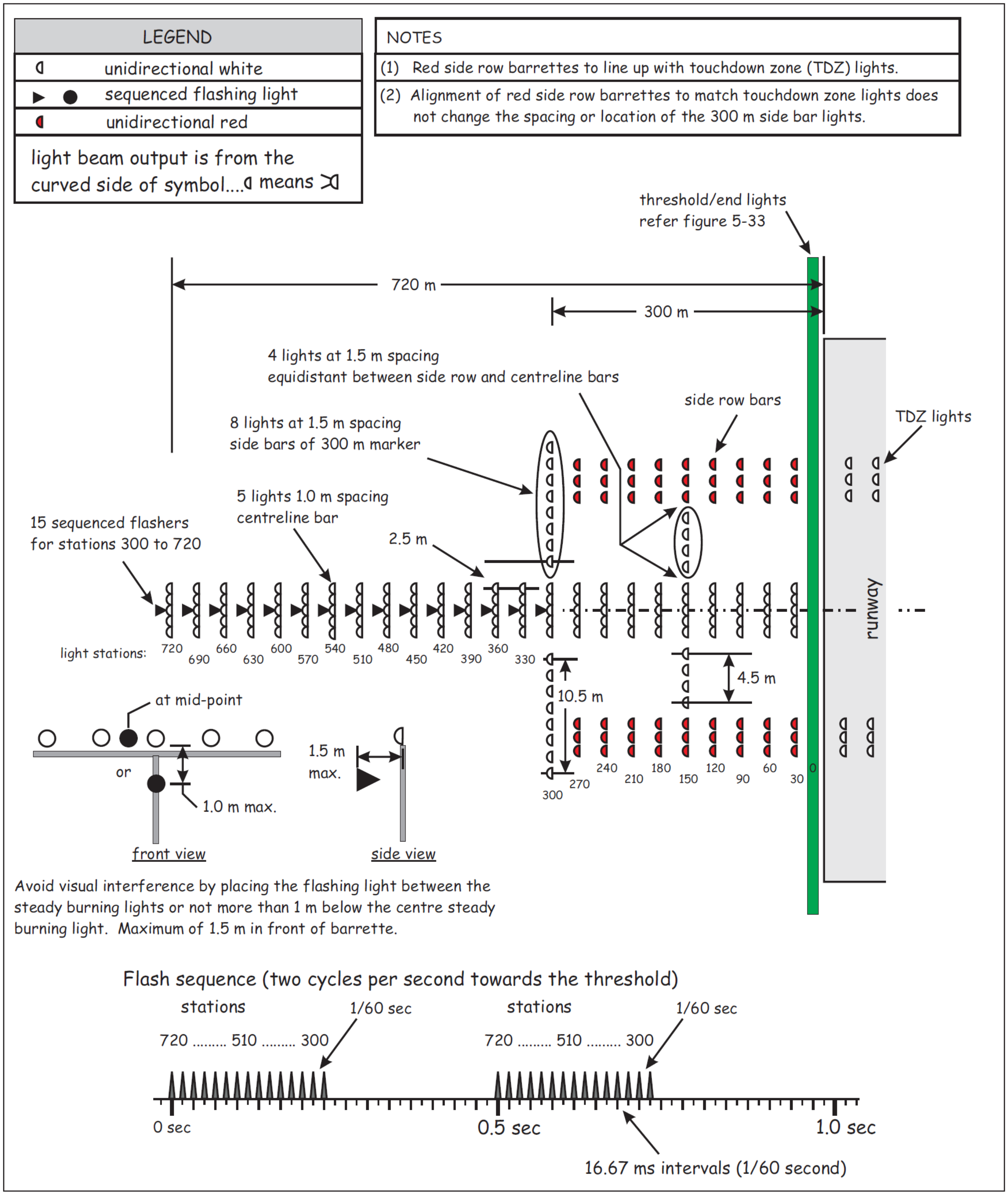


Figure 5-31: ALSF-2 configuration

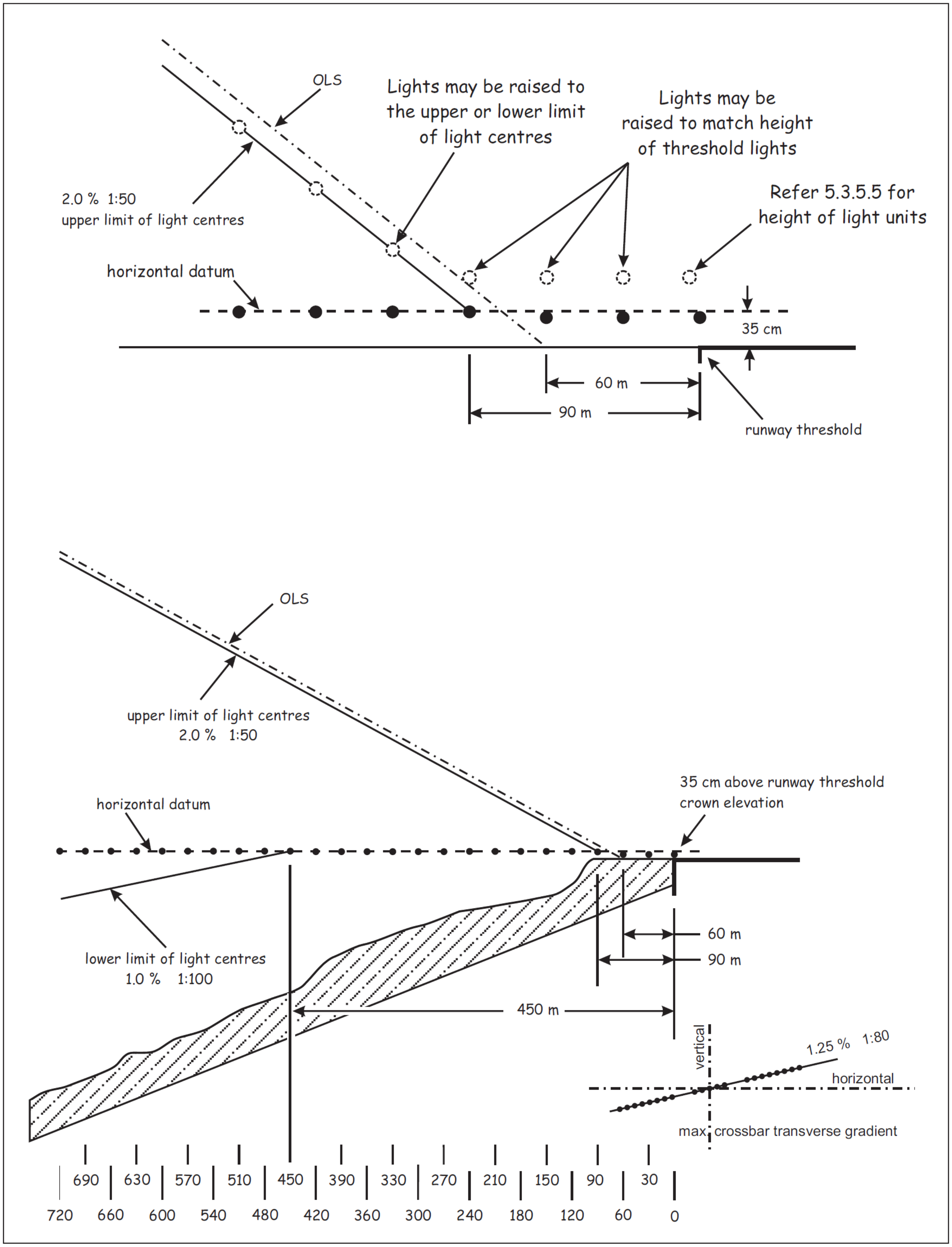


Figure 5-32: ALSF-2, limits of light centres

5.3.6 Approach Threshold Lights

Note: Approach lighting systems, other than ODALS, include a threshold bar. The approach lighting threshold bar is composed of the green lights displaying towards the approach side, which supplements the runway threshold lights. Circuit design should be such that the approach threshold lights operate with the approach light system.

Application

5.3.6.1 Approach threshold lights are provided as part of the installation of MALS, MALSR, MALSF, SSALS, SSALR, or ALSF-2.

Location

5.3.6.2 The approach threshold lights associated with a MALS, MALSR, MALSF, SSALS or SSALR are installed as follows:

(a) the lights are installed with a maximum spacing of 3 m between individual lights, and;

(b) the lights are placed on the same axial orientation as the runway threshold lights.

5.3.6.3 The approach threshold lights associated with an ALSF-2 are installed as follows:

(a) the lights are installed with a maximum spacing of 1.5 m between individual lights;

(b) the lights extend 13.5 m from the runway edge; and

(c) the lights are placed on the same axis as the runway threshold lights.

Note: See Figures 5-33 and 5-34 for depiction of threshold lighting configurations

Characteristics

5.3.6.4 The approach threshold lighting is composed of fixed unidirectional lights showing green in the direction of approach to the runway. The intensity and beam spread of the lights conform to the minimum requirements in Appendix 5-B as follows:

(a) Figure B-3 for high intensity systems;

(b) Figure B-4 for the ALSF-2 lights extending from the runway edge as referenced in 5.3.6.3(b);

(c) Figure B-22 for medium intensity systems.

5.3.6.5 The approach threshold lighting [unidirectional green] is aimed vertically in accordance with the angle prescribed in Table 5.3.5.27 or 5.3.5.90 as appropriate for station 0.

5.3.7 Runway Threshold and Wing Bar Lights

Note: This section applies to threshold lights on a runway without consideration of any associated approach lighting system. Refer to 5.3.6 Approach Threshold Lights for additional threshold lighting requirements associated with approach lighting systems other than ODALS. Where approach threshold lights are installed, circuit design should be such that the threshold lights referred to in this section are operated with the runway edge lights.

<u>Application</u>

5.3.7.1 Subject to 5.3.7.2, runway threshold lights are provided for a runway equipped with runway edge lights.

5.3.7.2 Where the threshold of a non-instrument or non-precision runway is not located at the runway end and inset threshold lights are not provided, wing bar lights are provided to indicate the location of the threshold.

<u>Location</u>

Threshold Lights

5.3.7.3 Runway threshold lights consist of two (2) groups of lights, each group consisting of:

(a) on a runway less than 45 m in width, three (3) lights, and;

(b) on a runway 45 m and greater in width, four (4) lights.

5.3.7.4 The groups of runway threshold lights are 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.

Note: See 5.3.1.5 and Figure 5-21 for height limitation of elevated lights.

5.3.7.6 Each group of runway threshold lights is installed as follows:

(a) the outermost runway threshold light is aligned with the runway edge lights; and

(b) the individual lights are spaced at intervals of 3 m (±0.1 m).

Wing Bar Lights

5.3.7.7 Wing bar lights consist of two (2) groups of lights (i.e. wing bars) each consisting of a minimum of:

(a) three (3) lights when used to mark the location of a threshold for a runway 30 m or less in width;

(b) four (4) lights when used to mark the location of a threshold for a runway greater than 30 m but less than 45 m in width; or

(c) five (5) lights when used to mark the location of a threshold for a runway greater than 45 m.

5.3.7.8 Wing bar lights are installed as follows:

(a) the lights are symmetrically disposed on each side of the runway prior to the imaginary line of the threshold (+3.0 m, -0.0 m);

(b) each wing bar is at a right angle to the line of runway edge lights with the innermost light in line with the runway edge lights; and

(c) the lights are spaced at intervals of 3 m (±0.1 m).

Characteristics

5.3.7.9 Runway threshold and wing bar lights are fixed unidirectional lights showing green in the direction of approach to the runway.

Where the position of the innermost wing bar light coincides with the position of a runway edge light, the runway edge light is bi-directional green/white or green/yellow, as appropriate.

The intensity and beam spread of the runway threshold and wing bar lights conform to the following in Appendix 5B:

(a) Figure B-25 when associated with a medium intensity runway edge light system not requiring approach threshold lights as specified in 5.3.6.1;

(b) Figure B-3 and Figure B-4 where appropriate, when associated with high intensity runway edge light systems.

Note 1: See Figures 5-33 and 5-34 for depiction of threshold lighting configurations.

Note 2: Where wing bar lights are installed to identify a threshold not coincident with the runway end, see section 5.3.8 Runway End Lights for illumination of the runway end. See Figure 5-34 for depiction.

5.3.7.10 Runway threshold and wing bar lights are configured to be illuminated at the same brightness level as the associated runway edge lighting.

5.3.7.11 Runway threshold and wing bar lights (projector style) are aimed vertically as follows:

(a) 3.1° for medium intensity

(b) 5.5° for high intensity

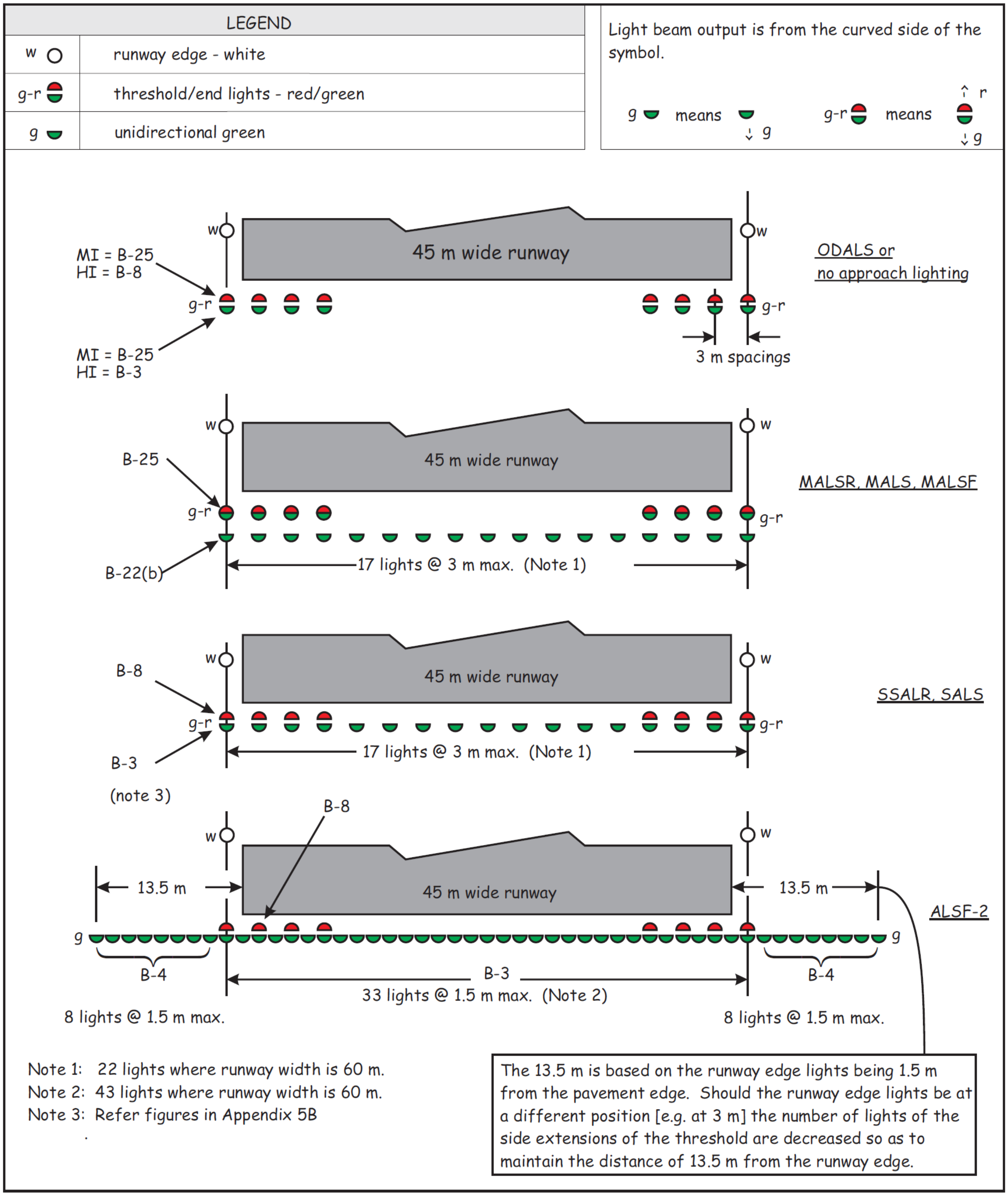
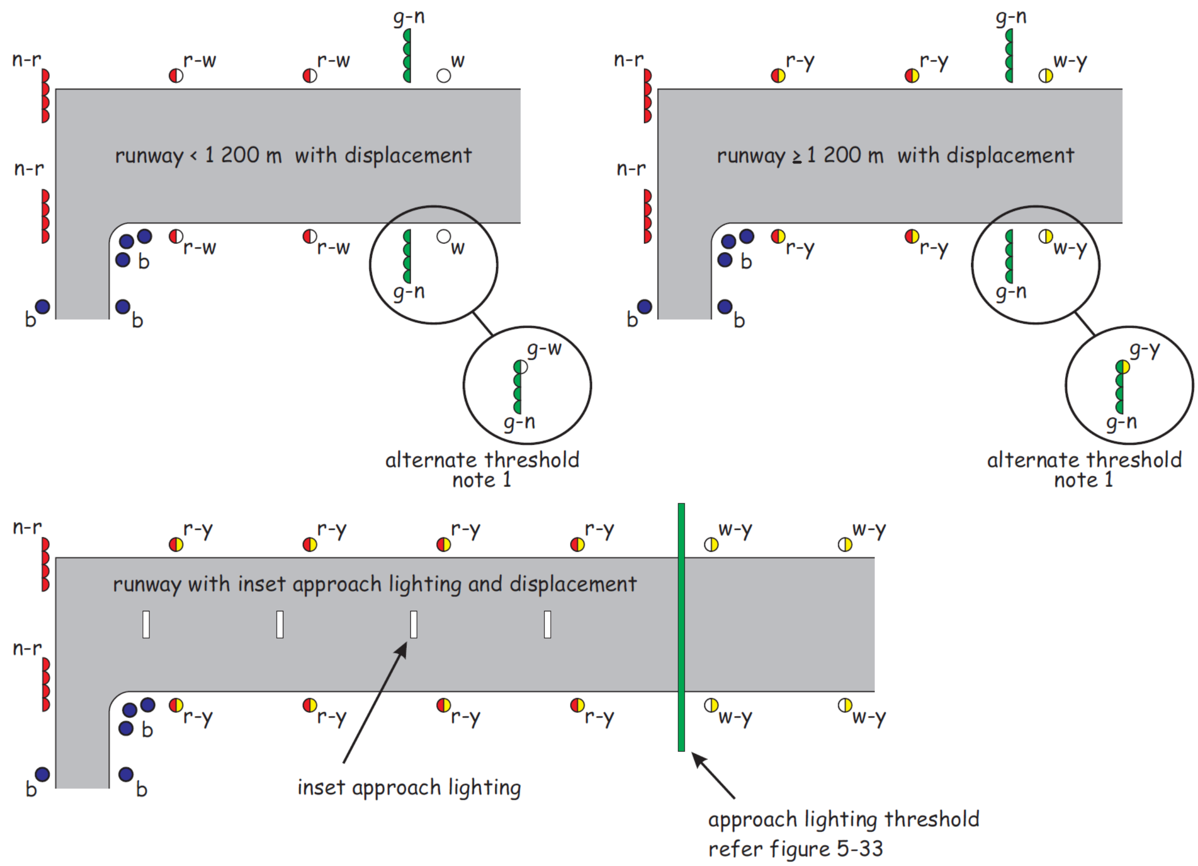


Figure 5-33: Approach threshold, threshold and end light configurations



Note 1: Where the wing bar location coincides with that of the runway edge light, the innermost light is a green-white or green-yellow light as appropriate. This may necessitate a dual fixture to meet intensity requirements.

w	runway edge - white	w-y	runway edge - white/yellow
r-w	displacement edge - red/white	g-r	runway threshold/end - green/red
r-y	displacement edge - red/yellow	n-r	runway end - blank/red
g-n	threshold green/blank	g-y	runway edge - green/yellow
b	taxiway edge - blue	g-w	runway edge - green/white
g-n	means g <--	beam output from the curved side of symbol	
r-y	means r <-- --> y	beam output from the curved sides of symbol	

Figure 5-34: Threshold and end lighting (with displacement)

5.3.8 Runway End Lights

Application

5.3.8.1 Runway end lights are provided for a runway equipped with runway edge lights.

Location

5.3.8.2 Runway end lights consist of two groups of lights, each group consisting of:

(a) on a runway less than 45 m in width, three (3) lights, and;

(b) on a runway 45 m and greater in width, four (4) lights.

5.3.8.3 Runway end lights are 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 beyond the end.

5.3.8.4 The groups of runway end lighting are symmetrically disposed about the runway centreline with the outermost runway end lights positioned to align with the runway edge lights and the remainder spaced at intervals of 3 m (±0.1 m).

Characteristics

5.3.8.5 Runway end lights are fixed unidirectional lights showing red in the direction of the runway.

5.3.8.6 Runway end lights on a runway with high intensity edge lights conform to the specifications of Appendix 5B, Figure B-8.

5.3.8.7 Runway end lights on a runway with medium intensity edge lights conform to the specifications of Appendix 5B, Figure B-25.

Note: See Figure 5-33 and Figure 5-34 for depiction of runway end light configurations

5.3.8.8 Runway end lights are configured to be illuminated at the same brightness level as the associated runway edge lighting.

5.3.9 Stopway Lights

Note: See Figure 5-35 for depiction of stopway lighting configuration.

Application

5.3.9.1 Stopway lights are provided for a stopway used at night.

Location

5.3.9.2 Stopway lights are placed along the full length of the stopway as follows:

(a) in two parallel rows that are equidistant from the centreline and coincident with the rows of the runway edge lights; and

(b) the longitudinal spacing of the lights does not exceed the spacing of the associated runway edge lights.

5.3.9.3 Stopway lights across the end of the stopway are on a line at right angle to the stopway axis as near to the end of the stopway as possible and, in any case, not more than 3 m beyond the end.

5.3.9.4 The number and configuration of the stopway lights across the end of a stopway are the same as for runway end lights specified in 5.3.8.2.

Note: See 5.3.1.5 and Figure 5-21 for height limitation of elevated lights.

__Characteristics__

5.3.9.5 Stopway lights are fixed unidirectional lights showing red in the direction of the runway.

5.3.9.6 Stopway lights are in accordance with the runway end lights characteristics of the associated runway.

Note: See section 5.3.8 for runway end light characteristics.

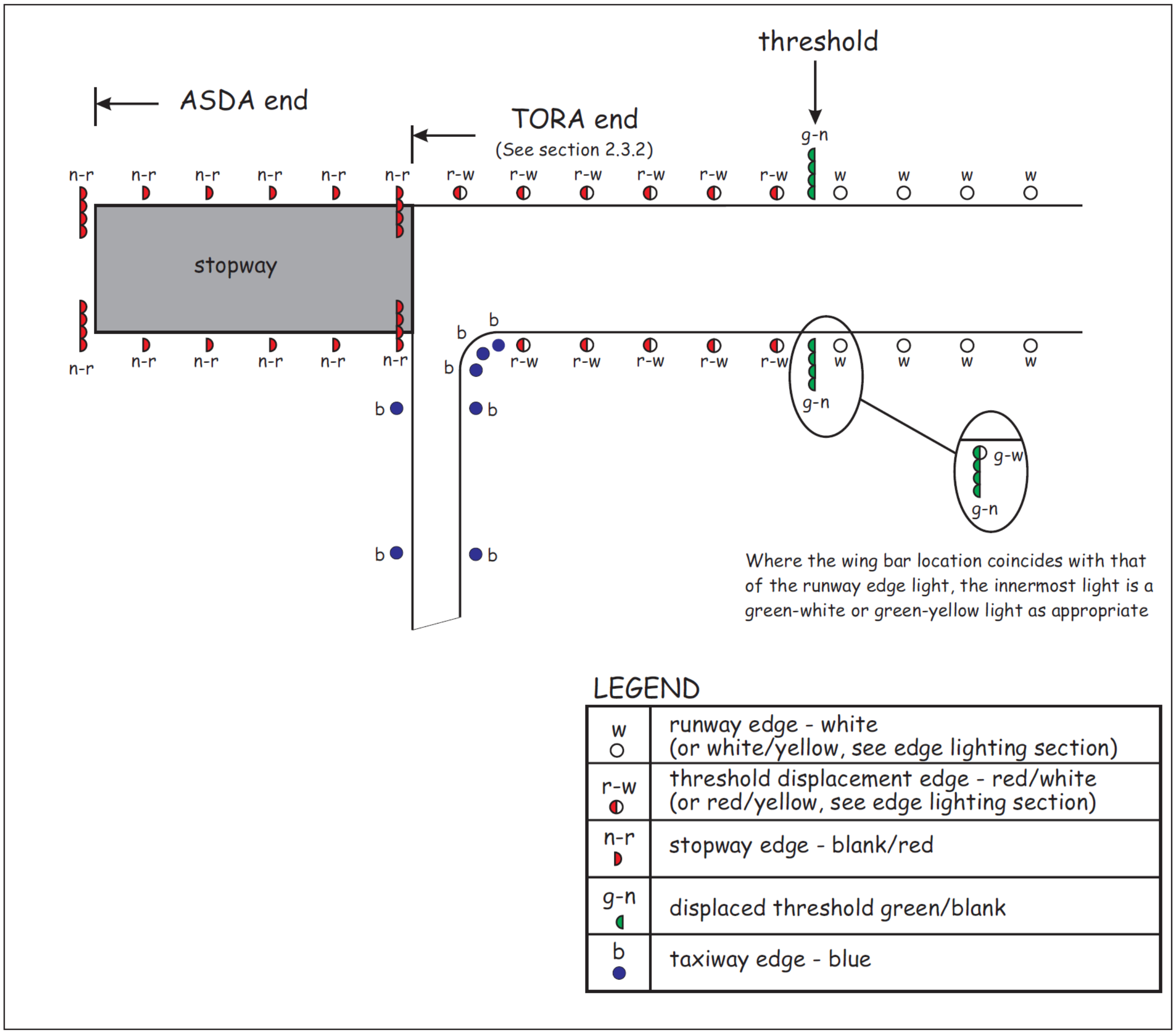


Figure 5-35: Stopway lighting (with displacement)

5.3.10 Runway Threshold Identification Lights (RTIL)

*Note: See Figure 5-36(b) for depiction of runway threshold light configuration***.**

Application

5.3.10.1 Where provided, the runway threshold identification light (RTIL) is as specified in this section.

Location

5.3.10.2 The RTIL are located:

(a) symmetrically about the runway centreline or extended centreline, such that the difference in the distance of the two lights to the runway centreline does not exceed 2 m;

(b) at a lateral distance of 12 m (+10.5 m, -0.0 m) from the runway edge or extended runway edge; and

(c) in a line perpendicular to the extended runway centreline at equidistant positions longitudinally from the threshold (+ 30 m, - 0.0 m).

5.3.10.3 The tops of the light units are installed within a vertical tolerance of +1.0 m/-0.5 m of the runway threshold elevation.

5.3.10.4 The unidirectional type of RTIL are aimed as follows:

(a) 15° outward from a line parallel to the approach centreline, and

(b) inclined at an angle 10° above the horizontal.

Characteristics

5.3.10.5 The RTIL is one of the following styles:

A - Unidirectional, high intensity, one brightness step.
B - Omnidirectional, high intensity, one brightness step.
C - Unidirectional, low intensity, one brightness step.
D - Omnidirectional, low intensity, one brightness step.
E - Unidirectional, three brightness steps.
F - Omnidirectional, three brightness steps.

5.3.10.6 Each light of the RTIL is in accordance with the specifications of Appendix 5B, Figures B-23.

Note: Light output below the vertical cut-off points should be minimized for environmental purposes.

5.3.10.7 Both light units of the RTIL flash simultaneously (no more than a 20 ms separation) at a rate of 90 (±30) flashes per minute.

5.3.11 Visual Alignment Guidance System (VAGS)

Note: A visual alignment guidance system (VAGS) could be provided to serve the visual approach to a runway where concerns exist, such as obstacle clearance, noise abatement or traffic control procedures requiring a particular direction to be flown, or the environment provides few visual surface cues, especially for night operations.

Application

5.3.11.1 Where provided, a visual alignment guidance system (VAGS) is as specified in this section.

Location

5.3.11.2 The VAGS lights are located:

(a) symmetrically about the runway centreline or extended centreline, such that the difference in the distance of the two lights to the runway centreline does not exceed 2m;

(b) at a lateral distance of 10 m (±1.0 m) from the runway edge; and

(c) in a line perpendicular to the extended runway centreline at equidistant positions longitudinally from the threshold (+30 m, -0.0 m).

Note: The optimum location for installation is abeam the threshold.

5.3.11.3 The top of the lights units is a maximum of 1 m above the runway threshold elevation at centreline.

5.3.11.4 The VAGS lights are aligned parallel with the approach centreline.

Characteristics

Signal Format

5.3.11.5 The VAGS signal format includes two light units placed symmetrically to the sides of the runway threshold, as shown below in Figure 5-36. The signal format produces unidirectional beams that flash in such a manner that a pilot making an approach will see one of a minimum of three discrete signal sectors providing "offset to the right", "on track" and "offset to the left" signals:

(a) When inside a ±0.5° width angular sector, centred on the approach axis, the pilot sees the two lights flashing simultaneously.

(b) When the aircraft flies inside a ±15° width angular sector, centred on the approach axis but outside the inner ±0.5° sector, the pilot sees the two lights flashing with a variable delay (60 to 330 ms) according to the position of the aircraft in the sector. The further the aircraft is from the approach axis, the greater the delay. The delay between the two flashes produces a sequence effect, which shows the direction to the axis.

(c) When outside the ±15° angular sector, the pilot will not see any signal.

5.3.11.6 The signal format is such that there is no possibility of confusion between the system and any associated visual approach slope indicator or other visual aids.

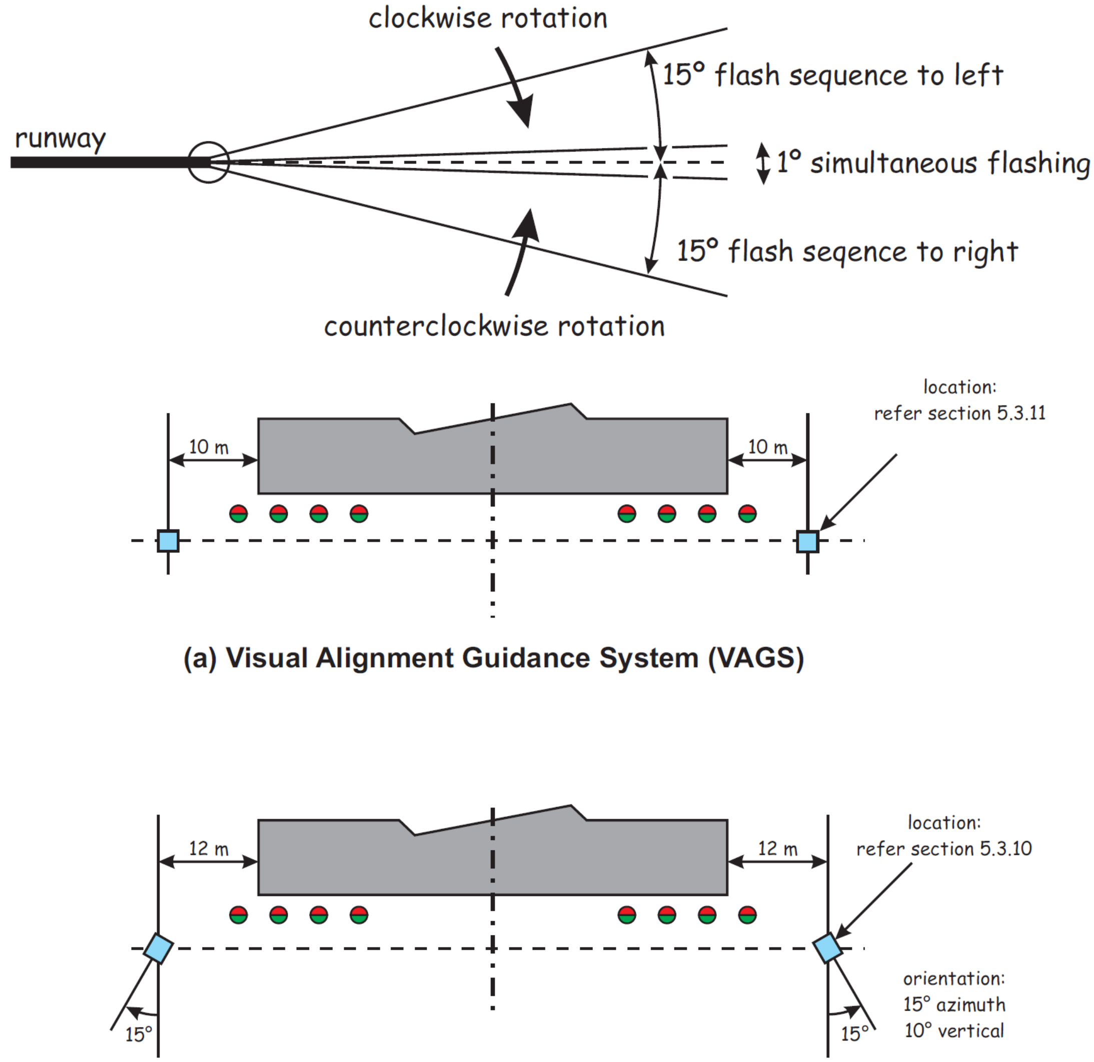


Figure 5-36: Configuration of VAGS and RTIL

5.3.11.7 The light beam of each VAGS unit rotates at a speed of one rotation a second and has the following characteristics:

Colour	Main beam (degrees)		Minimum intensity at a 50 % curve
	horizontal	vertical	cd
white	-0.5 to +0.5	-1.5 to + 7.0	15 000

Angular setting (degrees)	
elevation	toe-in
2.7	0

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

Approach track and azimuth setting

5.3.11.9 The visual alignment guidance system is capable of adjustment in azimuth to within ±5 minutes of arc of the desired approach path.

5.3.11.10 The angle of azimuth guidance system is such that during an approach, the pilot of an aircraft at the boundary of the "on track" signal will clear all objects in the approach area by a safe margin.

5.3.11.11 In the event of the failure of any component affecting the signal format the system is automatically switched off.

5.3.11.12 The light units are so designed that deposits of condensation, ice, dirt, etc., on optically transmitting or reflecting surfaces will interfere to the least possible extent with the light signal and will not cause spurious or false signals to be generated.

5.3.12 Runway Edge Lights

Note: See Figure 5-37 for depiction of runway edge light configuration.

Application

5.3.12.1 Runway edge lights are provided as follows:

(a) Medium intensity runway edge lights for:

(i) a non-instrument runway; or

(ii) non-precision runway used at night.

(b) High intensity runway edge lights for:

(i) a precision runway; or

(ii) a runway used for aircraft take-off in visibility conditions below RVR1200 (¼ SM).

Location

5.3.12.2 Runway edge lights are placed along the full length of the runway, in two (2) parallel rows equidistant from the centreline.

5.3.12.3 Runway edge lights are installed as follows:

(a) With a uniform longitudinal spacing between lights of not more than 60 m [±1 m], except for spacing from the threshold/end light to first/last edge light which may be of a lesser dimension to accommodate for runway length.

(b) The lights are installed within the lateral tolerance stated in 5.3.1.3.

(c) The lights on opposite sides of the runway axis are on lines at right angles to that axis.

(d) Subject to 5.3.12.4, where the spacing of the lights would result in a light being within a runway/runway intersection, the light within the intersection is omitted, irregularly spaced, or inset;

(e) Subject to 5.3.12.4, where the spacing of the lights would result in a light being within a runway/taxiway intersection, the light within the intersection is omitted or replaced with an inset light.

(f) Where a light is omitted, the spacing between:

(i) the adjacent lights on that side does not exceed 122 m, and

(ii) the lights on the opposite side of the intersection maintain the designed spacing.

5.3.12.4 Where the runway is used for operations in visibility conditions below RVR1200 (¼ SM), the runway edge lights within taxiway/runway and runway/runway intersections are inset.

Characteristics

5.3.12.5 Runway edge lights are fixed lights showing variable white, except:

(a) in the case of a threshold not located at the runway end, the lights between the beginning of the runway and the threshold show red towards an aircraft on approach;

(b) on runways 1 200 m or greater in length, a section of the lights 600 m or one-third of the runway length from the runway end whichever is the less, shows yellow towards an aircraft on take-off.

5.3.12.6 High intensity runway edge lights are in accordance with the specifications of Appendix 5B, Figure B-9 or Figure B-10, as appropriate.

5.3.12.7 Medium intensity runway edge lights are in accordance with the specifications of Appendix 5B, Table 5B-1.

5.3.13 Runway Centreline Lights

Note: See Figure 5-37 for depiction of runway centreline light configuration.

Application

5.3.13.1 Runway centreline lights are provided on:

(a) a precision runway category II or III; or

(b) a runway used for take-off in visibility conditions below RVR1200 (¼ SM).

Location

5.3.13.2 Where the threshold of the opposite runway is not co-located with the runway end, the runway centreline lights are extended into the displaced area to indicate the TORA.

Note: Runway centreline lights in the displaced portion of the runway are not displayed to aircraft on approach.

5.3.13.3 Runway centreline lights are located along the centreline of the declared TORA for the runway, except that the lights may be uniformly offset to the same side of the runway centreline by not more than 60 cm where it is not practicable due to pavement joints to locate them along the centreline. The lights are located from the threshold to the end at a longitudinal spacing (±0.6 m) of:

(a) 15 m on a precision approach runway category II or III;

(b) 15 m on runways used for take-off in visibility conditions below RVR 1200 (¼ SM); and

(c) the first or last light is located at 22.5 m (+3.75 m, -7.5 m) from the threshold/runway end**.**

Characteristics

5.3.13.4 Runway centreline lights are fixed lights showing variable white from the threshold to 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. Exception: For runways less than 1800 m in length, the alternate red and variable white lights extend from the midpoint of the LDA to 300 m from the runway end.

Note: Bidirectional fixtures may be used with the appropriate filter in each direction to facilitate the provision of runway centreline lighting on the opposite direction runway.

5.3.13.5 Runway centreline lights are in accordance with the specifications of Appendix 5B, Figure B-7.

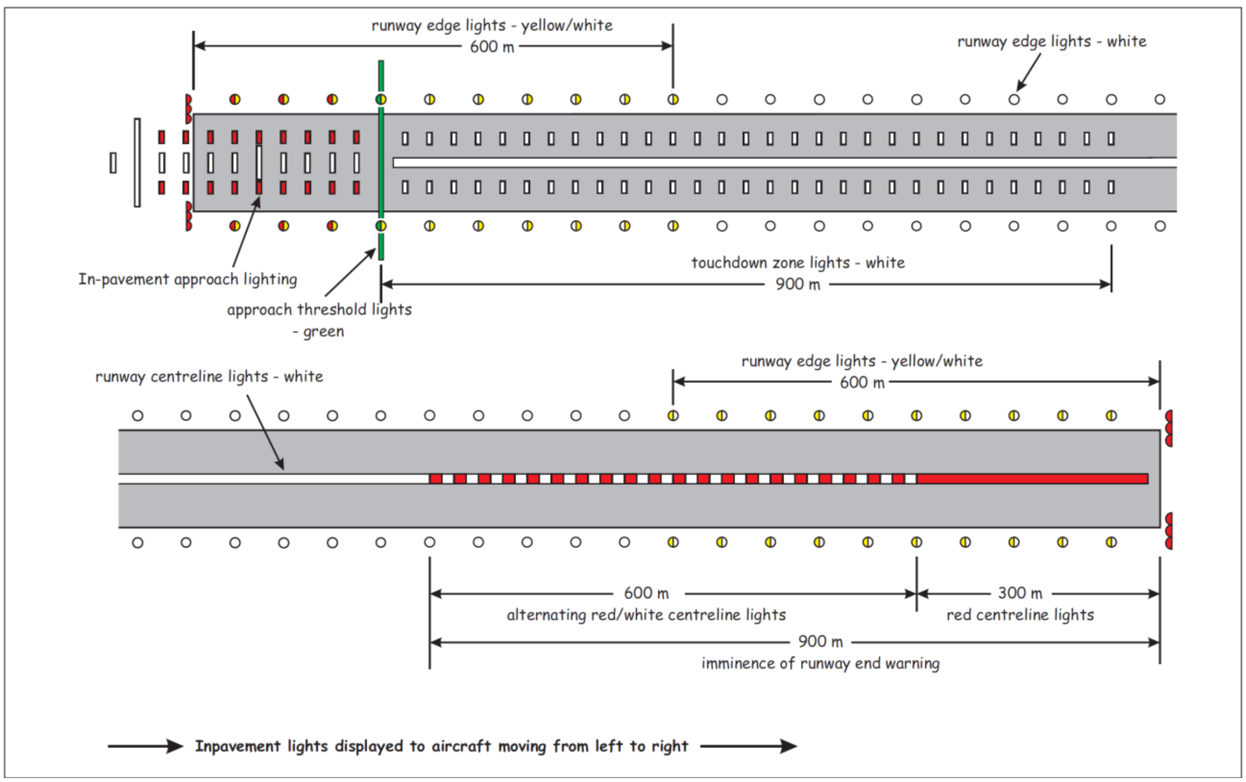


Figure 5-37: Runway edge, centreline and touchdown zone lighting

5.3.14 Runway Touchdown Zone Lights

Note: See Figure 5-37 for depiction of touchdown zone light configuration.

Application

5.3.14.1 Touchdown zone lights are provided on a precision runway category II or III.

Location

5.3.14.2 Touchdown zone lights extend from the threshold for a longitudinal distance of 900 m. On runways less than 1800 m in length, the system is shortened so that it does not extend beyond the midpoint of the runway. Pairs of barrettes symmetrically located about the runway centreline form the pattern.

5.3.14.3 The lateral spacing between the innermost lights of a pair of barrettes is equal to the lateral spacing selected for the aiming point marking.

Note: See 5.2.9 Aiming Point Marking

5.3.14.4 The longitudinal spacing between pairs of barrettes is 30 m (±0.6 m).

5.3.14.5 The barrette is composed of three (3) lights with spacing between the lights of 1.5 m (±3 cm). The overall width of the barrette is 3.0 m (±3 cm). The lateral spacing tolerance from centreline is ±0.15 m.

Characteristics

5.3.14.6 Touchdown zone lights are fixed unidirectional lights showing variable white.

5.3.14.7 Touchdown zone lights conform to the specifications in Appendix 5B, Figure B-5.

5.3.15 Simple Touchdown Zone Lights

Note 1: The purpose of simple touchdown zone lights is to provide pilots with enhanced situational awareness to assist their decision on whether to commence a go-around if the aeroplane has not landed by a certain point on the runway. Simple touchdown zone lights are typically provided at an aerodrome where the approach angle is greater than 3° and/or the landing distance available combined with other factors increases the risk of an overrun. It is essential that pilots operating at aerodromes with simple touchdown zone lights be familiar with the purpose of these lights.

Note 2: See Figure 5-38 for depiction of simple touchdown zone light configuration.

Application

5.3.15.1 Where provided, simple touchdown zone lights conform to the specifications of this section.

Location

5.3.15.2 Simple touchdown zone lights are located on both sides of the runway centreline at the upwind edge of the final touchdown zone marking. The lateral spacing between the pair of lights is equal to the lateral spacing selected for the touchdown zone marking.

5.3.15.2 The lights within each pair are spaced at 1.5 m or one half (½) of the touchdown zone marking width (±0.15 m), whichever is greater.

5.3.15.4 Where provided, on a runway without touchdown zone markings, simple touchdown zone lights are installed in such a position that provides the equivalent touchdown zone information.

Characteristics

5.3.15.5 Simple touchdown zone lights are fixed unidirectional lights showing variable white, aligned so as to be visible to the pilot of a landing aeroplane in the direction of approach to the runway.

5.3.15.6 Simple touchdown zone lights conform to the specifications in Appendix 5B, Figure B-5.

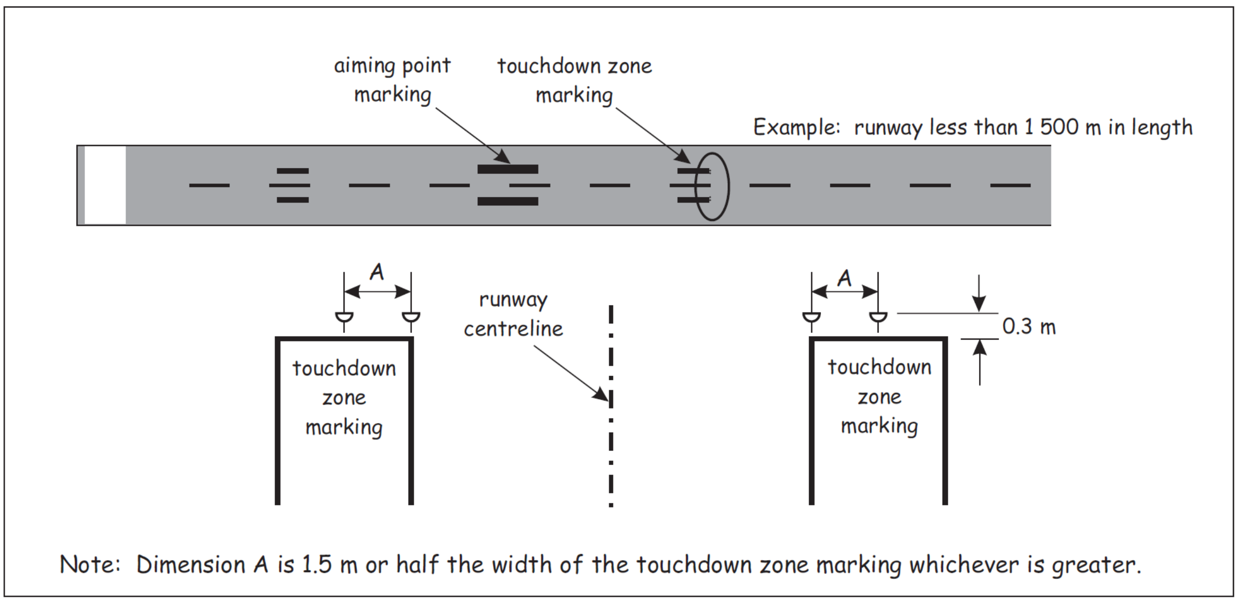


Figure 5-38: Simple touchdown zone lights

5.3.16 PAPI and APAPI Systems

Application

5.3.16.1 PAPI or APAPI is provided on runways where:

(a) the approach slope (OLS) for the runway is steeper than the minimum in Table 4-1(a);

(b) the threshold of a runway without vertical guidance used by CAR 704 or 705 scheduled commercial passenger operations is:

(i) permanently positioned at a point where the start of the LDA is not coincident with the beginning of the runway, or

(ii) temporarily repositioned to a point where the start of the LDA is not coincident with the beginning of the runway for a planned period exceeding 48 hours.

(c) LAHSO operations are conducted;

(d) a risk assessment indicates the need to provide a PAPI or APAPI for reason of one of the following conditions:

(i) the approach is over water or other featureless terrain,

(ii) there is deceptive surrounding terrain or runway slopes,

(iii) there are unlighted obstacles (such as trees) where the danger of descending below a normal flight path cannot be readily ascertained,

(iv) the aircraft is likely to experience significant turbulence due to terrain and prevailing winds, or

(v) where an aircraft undershooting the runway in the immediate vicinity of the aerodrome is likely to cause a hazard to public safety.

Location

5.3.16.2 When one or more of the conditions of 5.3.16.1 are met; a PAPI or APAPI is installed in accordance with the eye to wheel height (EWH) of the critical aircraft, in the normal approach configuration, as in Table 5.3.16.4.

5.3.16.3 The PAPI or APAPI system is located on the left side of the runway unless it is physically impracticable to do so.

5.3.16.4 The light units are located at a distance "D" from the threshold so that:

(a) subject to 8.4.1.4, where the runway is equipped with an ILS, the on course sector is harmonized with the glide slope of the ILS, and

(b) the minimum wheel to threshold height (WTH) specified in Table 5.3.16.4 is provided for all aircraft EWH within the selected system.

Note: Guidance for barometric vertical navigation (BARO-VNAV) approach criteria in Criteria for the Development of Instrument Procedures (*TP 308) should be consulted when installing a PAPI/APAPI system.*

Table 5.3.16.4—Minimum Wheel Clearance over Threshold for PAPI (P) and APAPI (AP)		
System to Be Provided	Eye to Wheel Height (EWH)	Wheel to Threshold Height (WTH)
(1)	(2)	(3)
AP or P1	x < 3 m	3 m *(2)*
P2	3 m ≤ x < 7.5 m	4.5 m
P3	7.5 m ≤ x < 14 m	6 m

(1) The above values of EWH and WTH are entered into the formula of standard 5.3.16.5 to determine the location of the PAPI and APAPI units.

(2) This wheel clearance may be reduced to 1.5m on runways Aircraft Group I and II where the stopping distance beyond the touchdown point is an operational concern.

5.3.16.5 The **horizontal location** of PAPI and APAPI light units from threshold are determined through a two step process, using the values of Table 5.3.16.4, to provide a minimum eye height over threshold, as follows;

(a) The **nominal location** "D" is found through means of the formula:

D = (EWH + WTH) /tan M = MEHT /tan M

Where:

MEHT is minimum eye height over threshold.
For PAPI: M is the angle B minus 2 minutes of arc.
For APAPI: M is the angle A minus 2 minutes of arc.

b) The nominal location of the light units is corrected for difference between the elevation of the runway threshold crown and that of the unit light centres. This second step is an iterative process, since movement of the light units may be into an area of different ground elevation.

The difference in elevation between the lens centre of the installed PAPI light units and the runway threshold crown may be compensated for by moving the PAPI light units towards the threshold by the formula:

Δd = Δh /tan M

where

Δd is distance of movement towards the threshold.
Δh is the difference in elevation between the PAPI lens centre and the runway threshold crown.

Note 1: The movement of the PAPI is away from the threshold if the elevation difference Δh is a negative value.

5.3.16.6 The lateral location is as follows, where:

(a) a PAPI is installed:

(i) subject to (ii), the innermost light unit is 15 m (±1 m) from the runway edge and a spacing of 9 m (±1 m) between units.

(ii) a spacing of 6 m (±1 m) may be used on runway serving AGNs I - IIIA. In this case, the inner light unit is located not less than 10 m (±1 m) from the runway edge.

(b) an APAPI is installed:

(i) subject to (ii), the innermost light unit is 10 m (±1 m) from the runway edge and a spacing of 6 m (±1 m) between the units.

(ii) the lateral spacing between APAPI light 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 later case, the inner APAPI light unit is located 15 m (±1 m) from the runway edge.

5.3.16.7 The height of the units is as follows:

(a) The height of the light units [lens centre] is 0.6 m–1.2 m above grade.

(b) Mounting height tolerances. The beam centers of all light units are within ±3 cm of a horizontal plane. The horizontal plane is defined by the height of the beam centre of light unit B for PAPI and light unit A for APAPI.

Azimuth Aiming

5.3.16.8 Each light unit is aimed outward into the approach zone on a line parallel to the runway centerline within a tolerance of ±1/2°.

Tolerance

5.3.16.9 Installation along a line perpendicular to the runway axis. The front face of each light unit in a bar is located on a line perpendicular to the runway centerline within ±15 cm.

Characteristics

5.3.16.10 The PAPI system consists of four (4) equally spaced light units constructed and arranged in such a manner that a pilot making an approach will:

(a) when on or close to the approach slope, see the two (2) light units nearest the runway edge as red and the two (2) light units farthest from the runway edge as white;

(b) when above the approach slope, see the one (1) light unit nearest the runway edge as red and the three (3) light units farthest from the runway edge as white; and when further above the approach slope, see all light units, as white; and

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

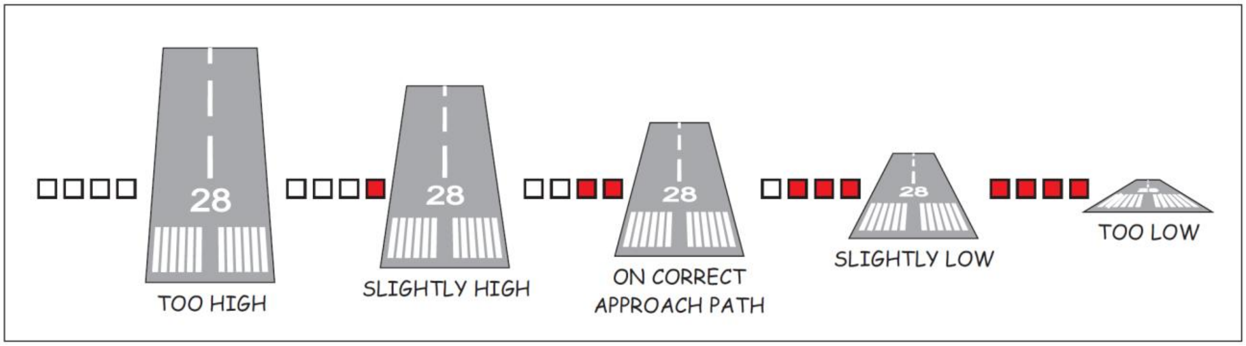


Figure 5-39: PAPI approach slope presentation

5.3.16.11 The APAPI system consists of two (2) light units constructed and arranged in such a manner that a pilot making an approach will:

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

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

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

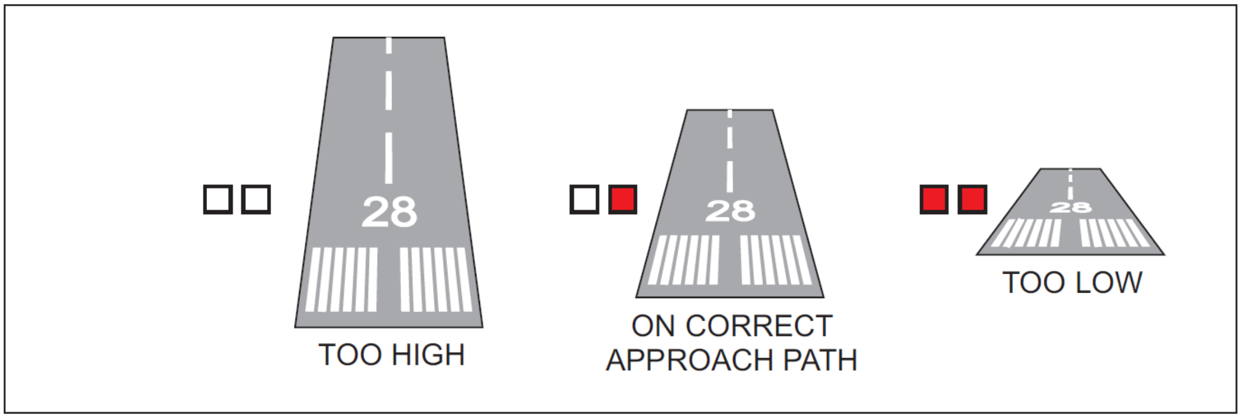


Figure 5-40: APAPI approach slope presentation

5.3.16.12 The light intensity distribution of the light units is as shown in Appendix 5B, Figure B-19.

5.3.16.13 The colour transition from red to white in the vertical plane appears to an observer, at a distance of not less than 300m, to occur within a vertical angle of not more than 3 minutes of arc at the beam centre, increasing to not more than 5 minutes of arc at the beam edges of plus and minus 15° horizontal.

5.3.16.14 The intensity steps of the PAPI/APAPI system is as stated in 5.3.1.7.

5.3.16.15 The light units are designed, operated and maintained such that deposits of condensation, snow, ice, dirt, etc., on optically transmitting or reflecting surfaces do not:

(a) interfere with the light signals; and

(b) adversely affect the required photometric display.

5.3.16.16 The APAPI system is fitted with an automatic shut-off switch, which will extinguish both light units in the event of a misalignment on one or both units.

Note: This is to preclude a misalignment of one or both APAPI units caused by a natural factor (e.g. frost heaves) or by physical interference which could result in a dangerously low on slope indication.

Approach Slope and Elevation Setting of Light Units

5.3.16.17 The standard approach slope is 3.0°, although it can be raised to a maximum of:

(a) 3.1° for runway serving AGNs V and VI;

(b) 3.6° for runways serving AGNs IIIB & IV;

(c) 4.2° for runway serving AGN IIIA;

(d) 5.7° for runway serving AGNs I and II.

5.3.16.18 Subject to 5.3.16.19 and 5.3.16.20, the angle settings of the system for a standard 3° approach are in accordance with Table 5.3.16.18.

Table 5.3.16.18—Setting Angles for 3.0° Approach		
Settings – Degrees	**APAPI**	**PAPI**
Unit A	2° 45'	2° 30'
Unit B	3° 15'	2° 50'
Unit C	N/A	3° 10'
Unit D	N/A	3° 30'
(1) The differential setting for the on-course sector may be increased to 30 minutes where harmonization with electronic glide path is desired.		

Note: See Figure 5-41 and Figure 5-42 for the depiction of PAPI/APAPI setting angles.

5.3.16.19 Where it is necessary to harmonize with an ILS or to raise the approach slope of the PAPI or APAPI units above the standard 3°:

(a) the differential settings of the light units are in accordance with Table 5.3.16.19, and

(b) the approach angle is published in the aeronautical publications.

Table 5.3.16.19—Differential settings for PAPI/APAPI				
	APAPI	PAPI (1)	PAPI with ILS (2)	PAPI
Approach slope	3°	3°–4°	3°–4°	4°–5° 42'
OPS slope	1° 51'	1° 56'–2° 56'	1° 51'–2° 51'	2° 41'–4° 23'
Unit A to OPS	54'	34'	29'	24'
Unit B to A	30'	20'	20'	30'
Unit C to B	N/A	20'	30'	30'
Unit D to C	N/A	20'	20'	30'
(1) Where the angles are raised to address obstacle(s) within the OPS, the specified setting for Unit A is referenced to the highest obstacle height in the PAPI / APAPI OPS. This serves to maintain a 34' clearance between Unit A of a PAPI and the slope of OPS and a 54' clearance between Unit A of an APAPI and the slope of the OPS. (2) The differential setting for the on-course sector may be increased to 30' where harmonization with electronic glide path is required.				

5.3.16.20 The system is installed with the longitudinal axis of the approach slope parallel with the runway centreline and extended centreline, except that the axis may be displaced to a maximum of 5° to match with an offset approach surface where provided.

System Failure

5.3.16.21 The following measures are undertaken when the PAPI or APAPI is unavailable:

(a) Where the approach OLS slope is established in accordance with 5.3.16.1(a), the following operational restrictions apply:

(i) The runway threshold is displaced using the minimum approach OLS in Table 4-1(a) and marked and lighted in accordance with the standards.

(ii) Where the runway threshold cannot be positioned or lighted in accordance to the standards, the runway is closed for arrivals at night in the appropriate direction.

(b) Where the system is provided in accordance with 5.3.16.1(b) and the system failure is greater than 48 hr, the affected runway is not available for scheduled 704/705 commercial passenger operations;

(c) Where the system is provided in support of LAHSO operations in accordance with 5.3.16.1(c), LAHSO operations cease;

(d) Where a PAPI/APAPI is installed as a result of a risk assessment in accordance with 5.3.16.1(d), the assessment includes measures to be taken in event of a PAPI/APAPI failure.

Obstacle Protection Surface (OPS)

Application

5.3.16.22 An obstacle protection surface (OPS) is established where a PAPI or APAPI system is provided.

Characteristics

5.3.16.23 The limits of the OPS comprises:

(a) an inner edge of specified length perpendicular to and located on each side of the extended centreline of the runway, at the specified distance from the threshold;

(b) two sides beginning at the ends of the inner edge, diverging uniformly at a specified rate in the direction of take-off, ending at the outer edge; and

(c) an outer edge parallel to the inner edge at the specified length from the inner edge.

5.3.16.24 The elevation of the inner edge is equal to the elevation of the threshold.

5.3.16.25 The slope of the OPS is measured in the vertical plane containing the extended centreline of the runway.

5.3.16.26 The width and length of the OPS is measured in the horizontal plane.

5.3.16.27 The characteristics of the OPS, i.e. origin, divergence, length and slope are as specified in the relevant column of Table 5.3.16.27.

Table 5.3.16.27—PAPI/APAPI Obstacle Protection Surface

Aircraft Group Number	I	II	IIIA	IIIB	IV	V	VI
Length of inner edge each side of centreline	See Table 4-1(a), Approach: Length of inner edge each side of centreline						
Distance from threshold	See Table 4-1(a), Approach: Distance from threshold						
Divergence (%)	15	15	15	15	15	15	15
Length (m)	7 500	7 500	7 500	7 500	7 500	7 500	7 500
Slope PAPI (3° approach path)	1° 56'	1° 56'	1° 56'	1° 56'	1° 56'	1° 56'	1° 56'
Slope APAPI (3° approach path)	1° 51'	1° 51'	1° 51'				

5.3.16.28 Except as stated in 5.3.16.29, objects, including terrain, do not protrude above the OPS.

5.3.16.29 Terrain in the strip end area may be above the point of origin of the adjoining OPS, provided that:

(a) the terrain beyond the strip end is not higher than the terrain elevation at the strip end until reaching the point of intersection with the OPS, and

(b) thereafter is no higher than the OPS.

Note: See Figure 4-6: Terrain beyond strip end and exceeding approach surface or OPS

5.3.16.30 Where an object or terrain protrudes above the OPS, beyond the length of the approach OLS, one or more of the following measures are taken:

(a) remove the obstacle;

(b) raise the approach slope as permissible in 5.3.16.17 and the OPS of the system;

(c) displace the axis of the system and its associated OPS by no more than 5° and establish the appropriate criteria for an offset approach surface;

(d) displace the system upwind of the threshold to provide an increase in the threshold crossing height equal to the height of the object penetration;

(e) light and mark the obstacle, and publish the reduced operational length; or

(f) displace the threshold;

Note: See Chapter 4—Obstacle Management for standards relating to the establishment of an offset approach surface.

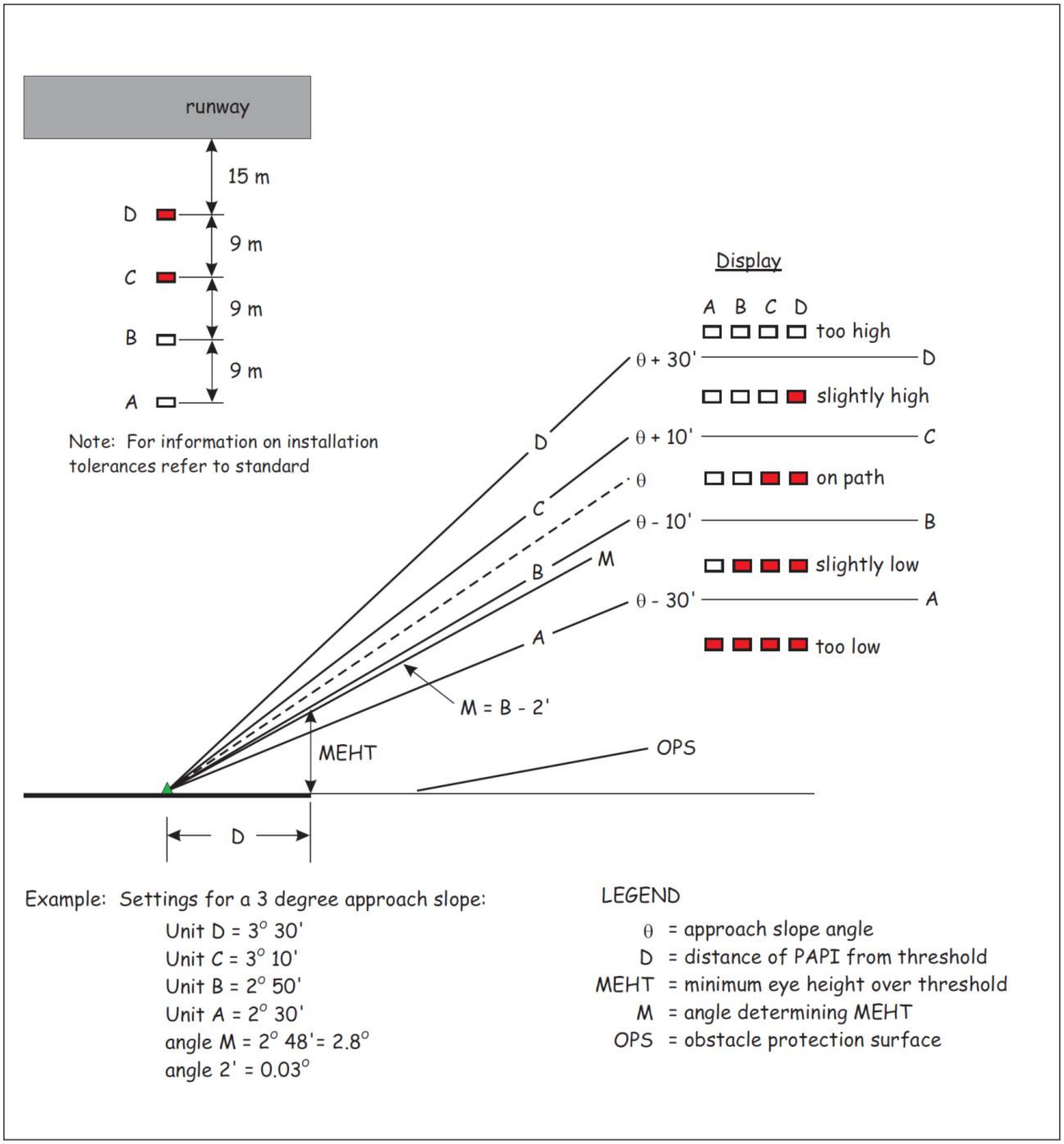


Figure 5-41: PAPI general arrangement

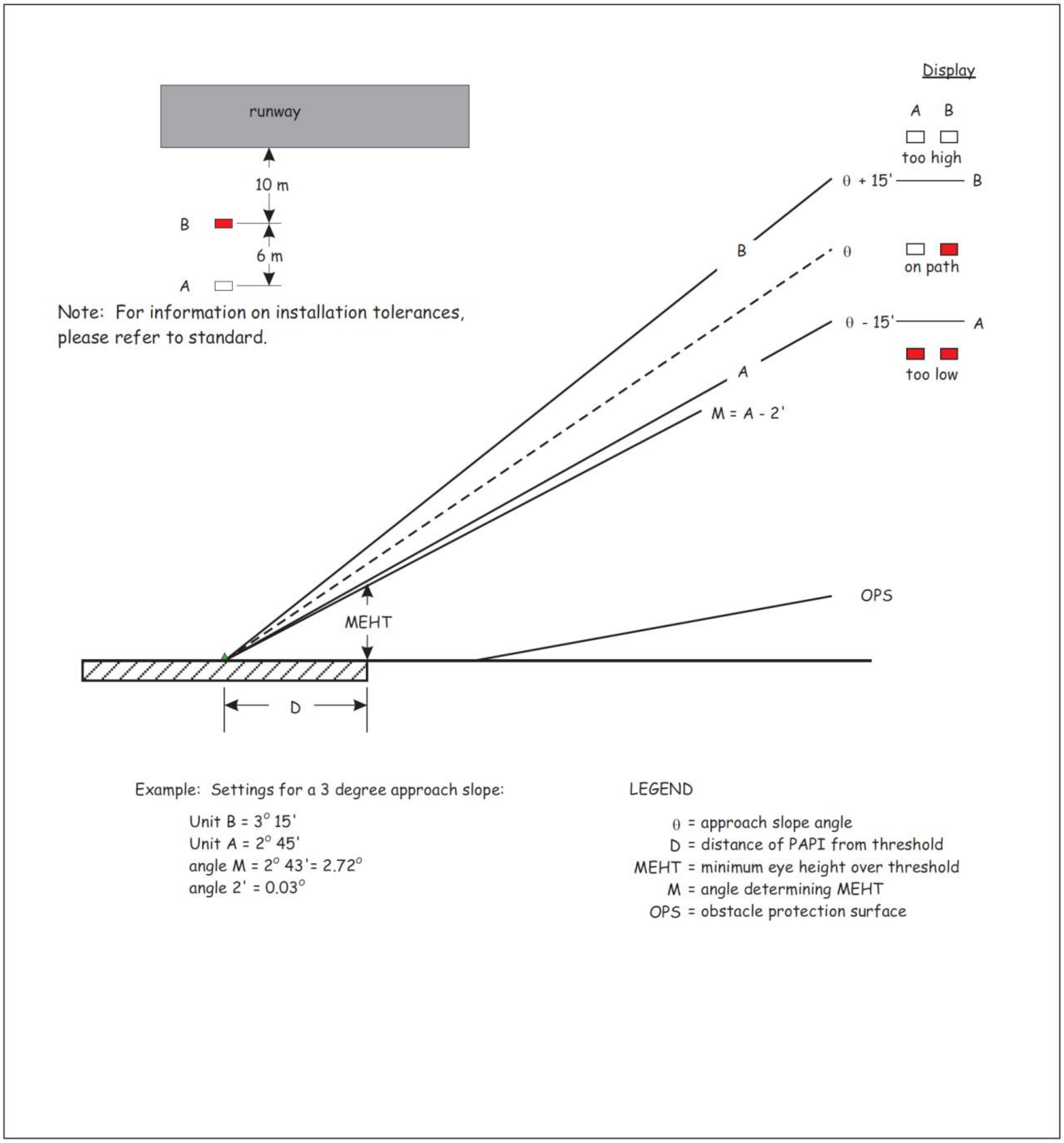


Figure 5-42: APAPI general arrangement

5.3.17 Land and Hold Short Lights

Note: The intent of land and hold short lights is to enhance the holding position on a runway where land and hold short operations are conducted.

Application

5.3.17.1 Where provided, the land and hold short lights are in accordance with the specifications of this section.

Location

5.3.17.2 Land and hold short lights consist of a single row of six (6) fixtures:

(a) located on the holding side of the runway-holding position, at a distance of 0.6 m (+0.9 m, -0.0 m) from the runway-holding position marking.

(b) positioned so that the total width of the row of lights, measured between the centres of the outboard fixtures, is:

(i) 50% (±10%) of the defined runway width; and

(ii) symmetrically disposed about the runway centreline, with an equal distance (±0.05 m) between each light

Note: See Figure 5-43 for depiction of LAHSO visual aids configuration.

Characteristics

5.3.17.3 Land and hold short lights are:

(a) inset fixtures;

(b) unidirectional;

(c) emit a white colour; and

(d) flash simultaneously between “ON” and “OFF” as follows:

(i) 1.35 seconds (±0.1 second) on; and

(ii) 0.8 seconds (±0.1 second) off.

5.3.17.4 The intensity and distribution of the land and hold short lights is in accordance with Appendix 5B, Figure B-7

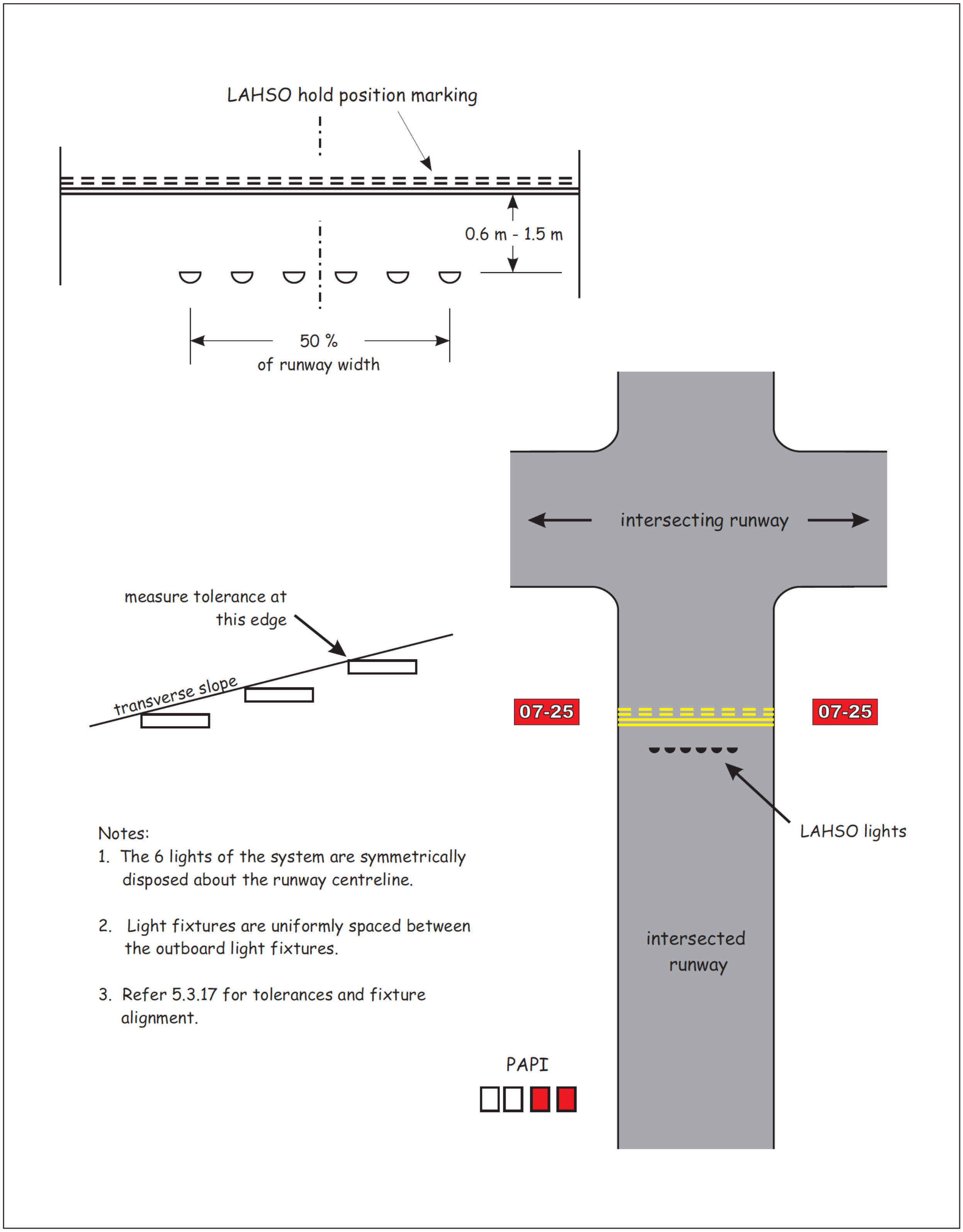


Figure 5-43: LAHSO visual aids configuration

5.3.18 Runway Status Lights (RWSL)

Note 1: Runway status light (RWSL) is an automated system that may be installed in conjunction with enhanced taxiway markings, stop bars or runway guard lights. It functions independently of any other visual system to provide direct warning to a pilot of an incursion danger on the runway ahead. The system comes in three basic forms: runway entrance lights (REL), take-off hold lights (THL) and runway intersection lights (RIL). Either system may be installed by itself, but it is preferred that the systems are installed so as to complement each other.

Note 2: The RWSL processor receives surveillance data of aircraft and vehicles on or near the aerodrome surface from the ground surface surveillance system to determine activation and deactivation of the REL, THL and RIL. The system will automatically adjust light intensity according to the ambient conditions for the time of day.

Note 3: The status of the RWSL lighting is indicated in the ATS control panel. ATS can override automated brightness settings and can disable the system when necessary.

Application

5.3.18.1 Where provided, Runway Status Lights are in accordance with the specifications of this section.

Runway Entrance Light (REL)

Location

5.3.18.2 RELs are offset a maximum of 0.6 m from the taxiway centreline on the opposite side to the taxiway centreline lights, where provided, and begin a maximum of 0.6 m before the runway-holding position marking. An additional single light is placed on the runway 0.6 m (+1.0 m, -0.0 m) from the runway centreline and aligned with the last and next to last light on the taxiway.

Note: See Figure 5-44 for depiction of runway entrance light installation.

5.3.18.3 Subject to 5.3.18.4, the REL consists of at least six (6) light units, with the lights on the taxiway spaced at a minimum of 3.8 m and a maximum of 15.2 m longitudinally, depending upon the taxiway length involved.

5.3.18.4 When the taxiway centreline marking between the holding position marking and the runway is curved, the maximum REL longitudinal spacing conforms to Table 5.3.18.4.

Table 5.3.18.4—REL Longitudinal Spacing on a Curve		
	Longitudinal Spacing	
Radius of Curved Centrelines	**≥ RVR1200 (¼ SM)**	**< RVR1200 (¼ SM)**
less than 120 m	7.5 m	7.5 m
121 m to 364 m	15 m	7.5 m
≥ 365 m	30 m	15 m

5.3.18.5 For angled and highly angled taxiways (e.g. less than 60° from the runway centreline heading), the fixtures used and aiming is determined on a case by case basis to ensure that the RELs are not seen by traffic on the runway.

Characteristics

5.3.18.6 The RELs consist of a single row of fixed in-pavement lights showing red in the direction of aircraft approaching the runway.

5.3.18.7 Intensity and beam spread of REL are in accordance with the specifications of Appendix 5B, Figure B-24.

5.3.18.8 The REL are automated to the extent that the only control over each system will be to disable one or both systems.

Note: ATS personnel do not have operational control over the light array.

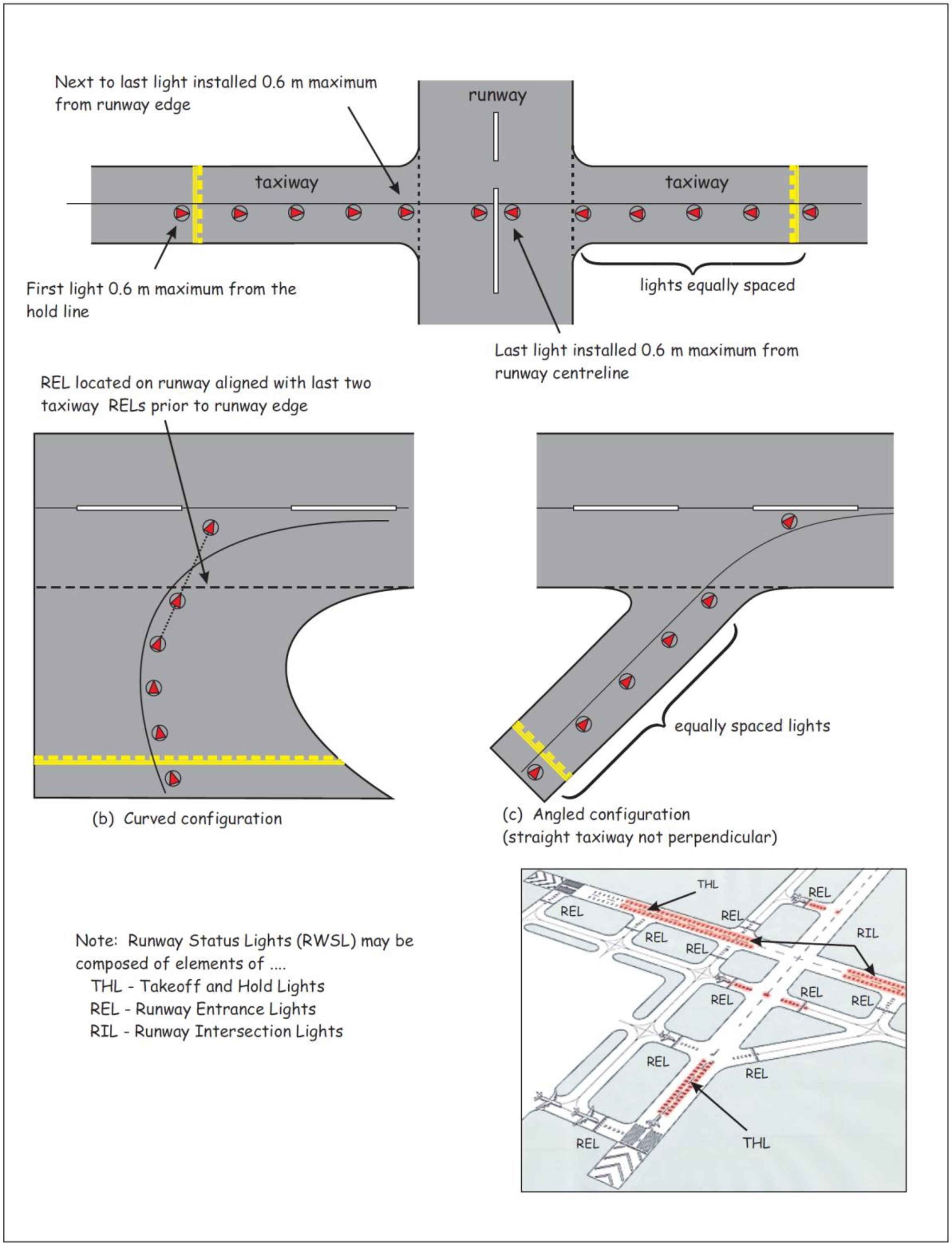


Figure 5-44: Runway status lights—runway entrance lights (REL)

Take-off Hold Light (THL)

Location

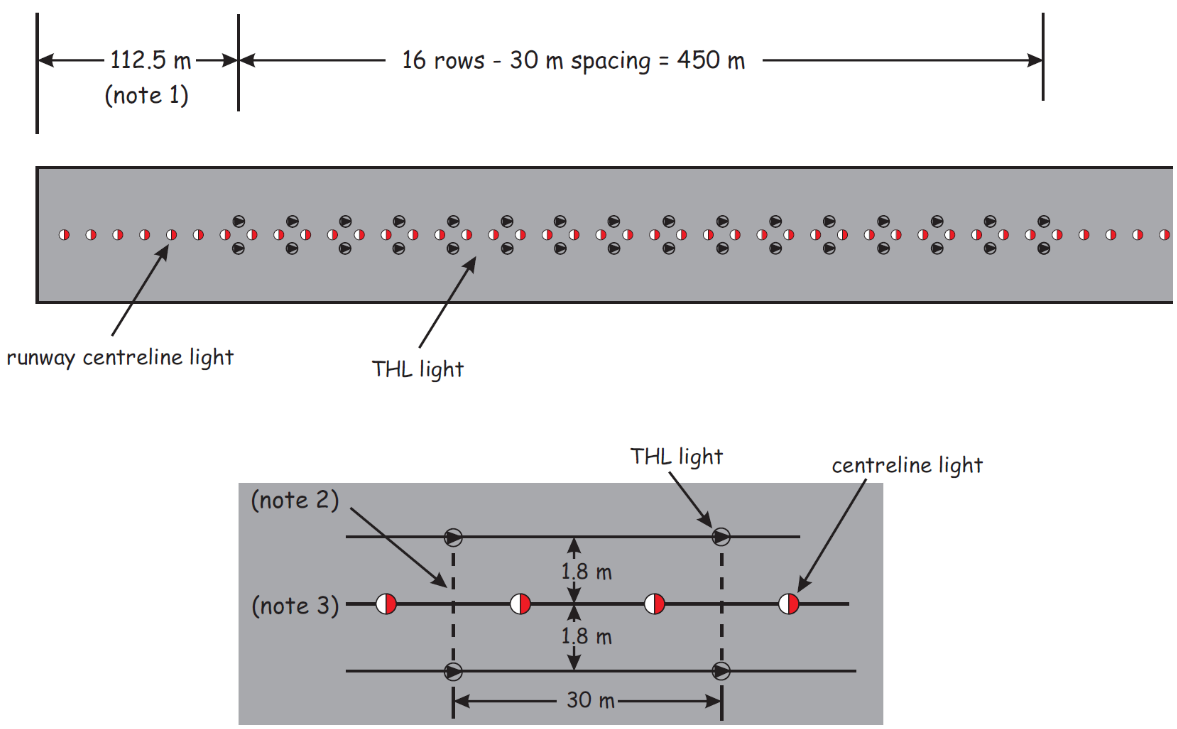
5.3.18.9 THLs are offset 1.8 m on each side of the runway centreline lights, where provided, and extend, in pairs, starting at a point 112.5 m (±7.5 m) from the beginning of the runway and thereafter every 30 m (±0.6 m) for at least 450 m.

Note: See Figure 5-45 for depiction of take-off and hold light installation.

Characteristics

5.3.18.10 The take-off hold light (THL) array consists of two rows of fixed in-pavement lights showing red in the direction of aircraft taking off on the runway.

5.3.18.11 The intensity and beam spread of the THL conforms to the specifications of Appendix 5B, Figure B-24.



Notes:

(1) 7 ½ m centreline light spacings.

(2) Preferably the THL is positioned such that a line formed by two THL lights will be near the mid-point between two centreline lights.

(3) If the runway centreline lights are offset from the physical centreline, the THL lights are similarly offset to maintain the 1.8 m dimension.

Figure 5-45: Runway status lights—take-off hold lights (THL)

Runway Intersection Light (RIL)

Note: See Figure 5-46 for depiction of runway intersection light installation.

Location

5.3.18.12 RILs are a double row (31 pairs) of inset red lights that are aligned with the runway centreline lights and aimed toward an aircraft or vehicle that is approaching an intersecting runway. They begin at the land and hold short inset lights or the runway-holding position marking and extend toward the approach end of the runway for 900 m.

5.3.18.13 The first pair of RIL fixtures is located 1.8 m (+7.5 m, -0.0 m) longitudinally (measured to the centreline of a RIL fixture) from the outer edge of the first solid line of the runway-holding position marking toward the approach end of the runway. If land and hold short in-pavement lights are installed, the first pair of RIL fixtures is located 1.8 m (+7.5 m, -0.0 m) longitudinally, measured to the centre of the RIL fixture, from the centre of a LAHSO light fixture. RILs are installed every 30 m (±0.6 m) and displaced 1.8 m either side of the runway centreline lights in the same manner as THLs.

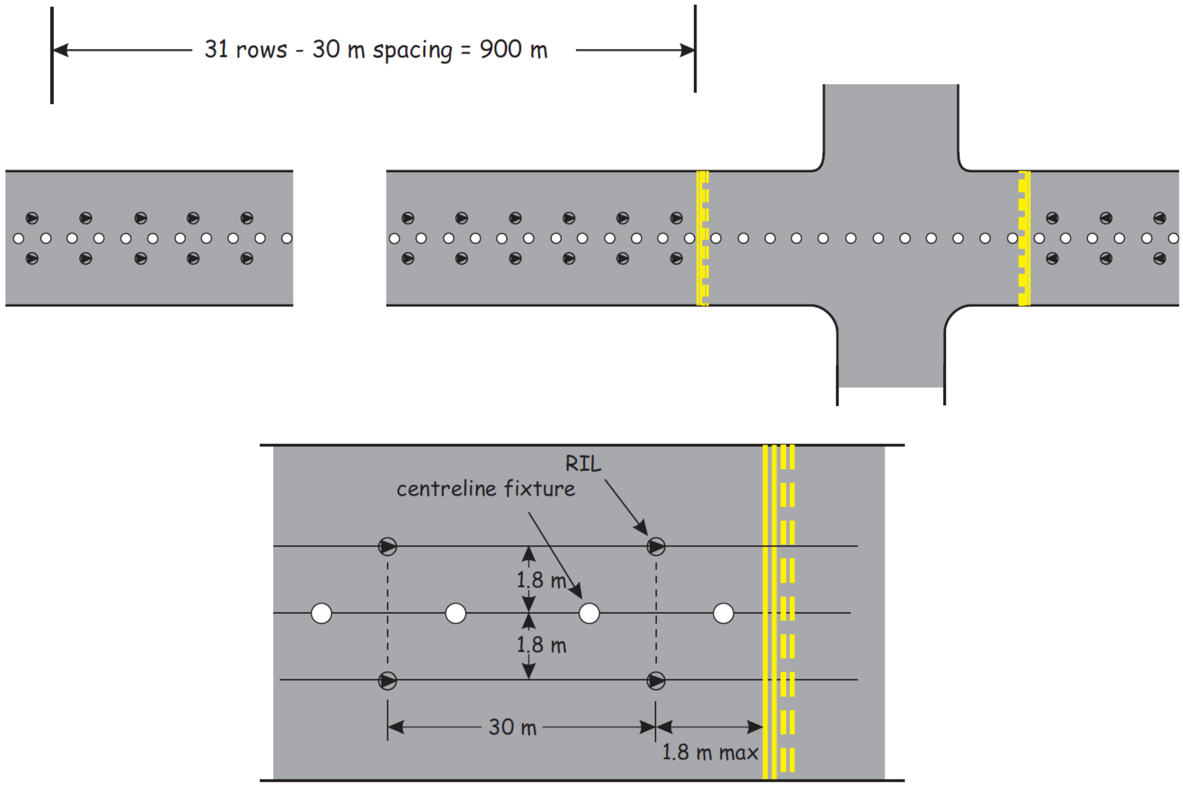
5.3.18.14 Where RILs are to be installed on a runway that does not have runway centreline lights, the RIL array is installed with respect to an imaginary line that represents the location of the runway centreline lights.

Note: In some situations, due to available pavement length, RIL and THL fixtures may overlap.

Characteristics

5.3.18.15 The RIL array consists of two (2) rows of fixed in-pavement lights showing red in the direction of aircraft approaching the intersection.

5.3.18.16 Intensity and beam spread of RILs are in accordance with the specifications of Appendix 5B, Figure B-24.



Notes:

(1) If the centreline lights are offset from the centreline, the RIL lights are similarly offset to maintain the 1.8 m dimension.

(2) If LAHSO lights are installed, the first pair of RIL lights is located at least 0.6 m from the centreline of the LAHSO light bar.

(3) For some installations the RIL may overlap the THL.

Figure 5-46: Runway status lights—runway intersection lights (RIL)

5.3.19 Runway Lead-In Lighting System (LDIN)

Note: A runway lead-in lighting system is provided where it is desirable to provide visual guidance along a specific approach path for reasons such as avoiding hazardous terrain or for the purposes of noise abatement. The system terminates at an approved approach lighting system or at a distance from the threshold, permitting visual reference to the runway environment where no approach lighting system is required under this Chapter. This system is not for use in support of an instrument approach.

Application

5.3.19.1 Where provided, the runway lead-in lighting system (LDIN) is as specified in this section.

Note: See Figure 5-47 for depiction of a runway lead-in light system.

Location

5.3.19.2 The LDIN consists 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 does not exceed 1 600 m.

Note: A LDIN may be curved, straight or a combination thereof.

5.3.19.3 The LDIN extends from a point as determined by an aeronautical evaluation, up to a point where the approach lighting system (if provided), the runway or the runway lighting system is in view.

Characteristics

5.3.19.4 Each LDIN group of lights consists of at least three (3) flashing lights in a linear configuration. The lights within each group are designed to flash in sequence towards the aerodrome. The flash sequencing in a group can be independent of the flash sequencing in a following group.

Note 1: Steady burning lights may augment the system where such lights would assist in identifying the system.

Note 2: The actual number of lights within each group is site dependent.

5.3.19.5 The flashing lights are white in colour.

5.3.19.6 The flashing lights of the LDIN are in accordance with the specifications of Appendix 5B, Figure B-23.

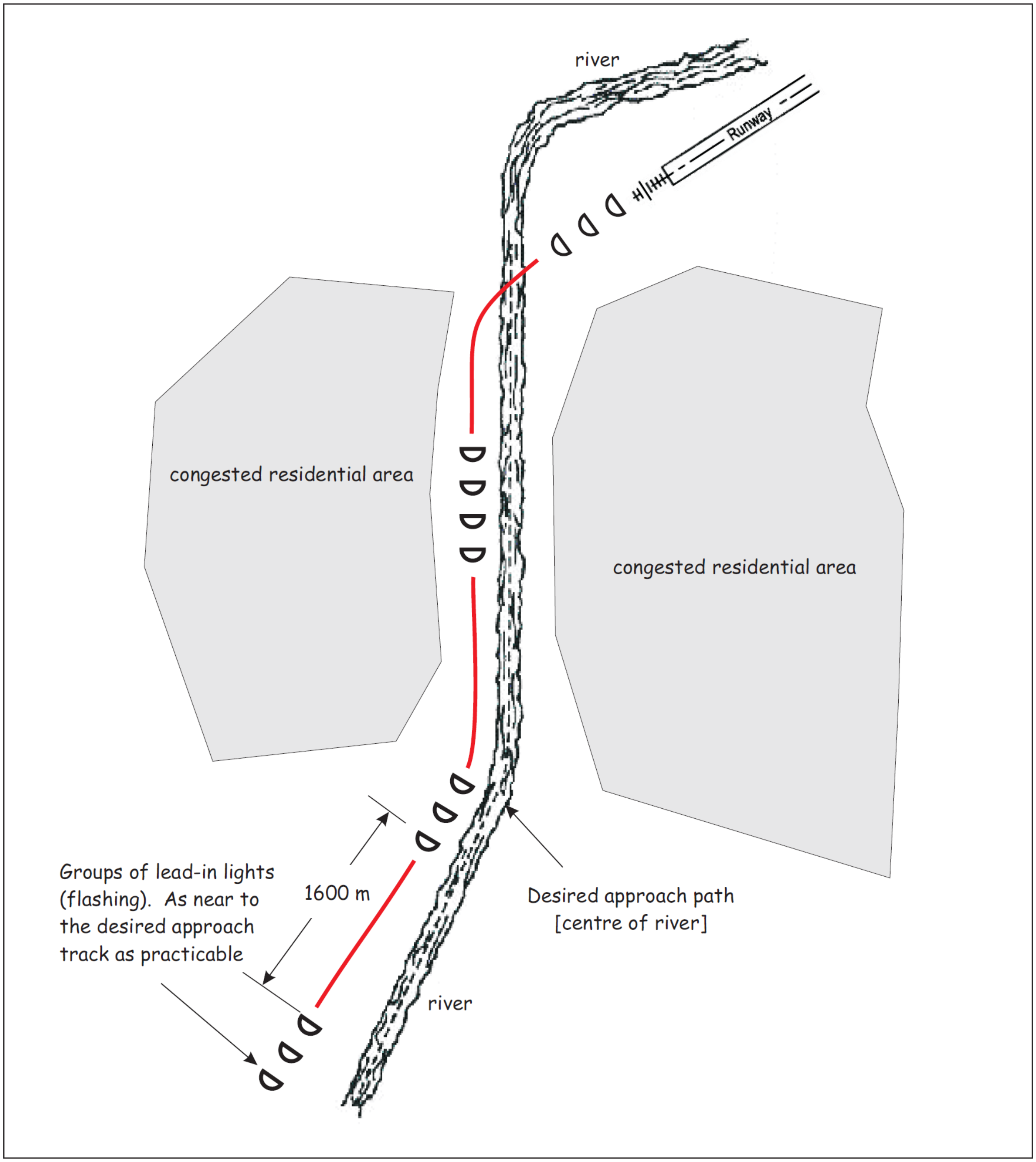


Figure 5-47: Runway lead-in lighting system

5.3.20 Rapid Exit Taxiway Indicator Lights (RETIL)

Note: The purpose of rapid exit taxiway indicator lights (RETIL) is to provide pilots with distance-to-go information to the nearest rapid exit taxiway on the runway, enhance situational awareness in low visibility conditions and enable pilots to apply braking action for more efficient roll-out and runway exit speeds.

Application

5.3.20.1 Where provided, the rapid exit taxiway indicator lights are as specified in this section.

5.3.20.2 Rapid exit taxiway indicator lights are not displayed in the event of any lamp failure or other failure that prevents the display of the full light pattern depicted in Figure 5-48.

Location

5.3.20.3 A set of rapid exit taxiway indicator lights are located on the runway on the same side of the runway centreline as the associated rapid exit taxiway, in the configuration shown in Figure 5-48. In each set, the lights are located 2 m (±0.006 m) apart and the light nearest to the runway centreline is displaced 2 m (±0.012 m) from the runway centreline.

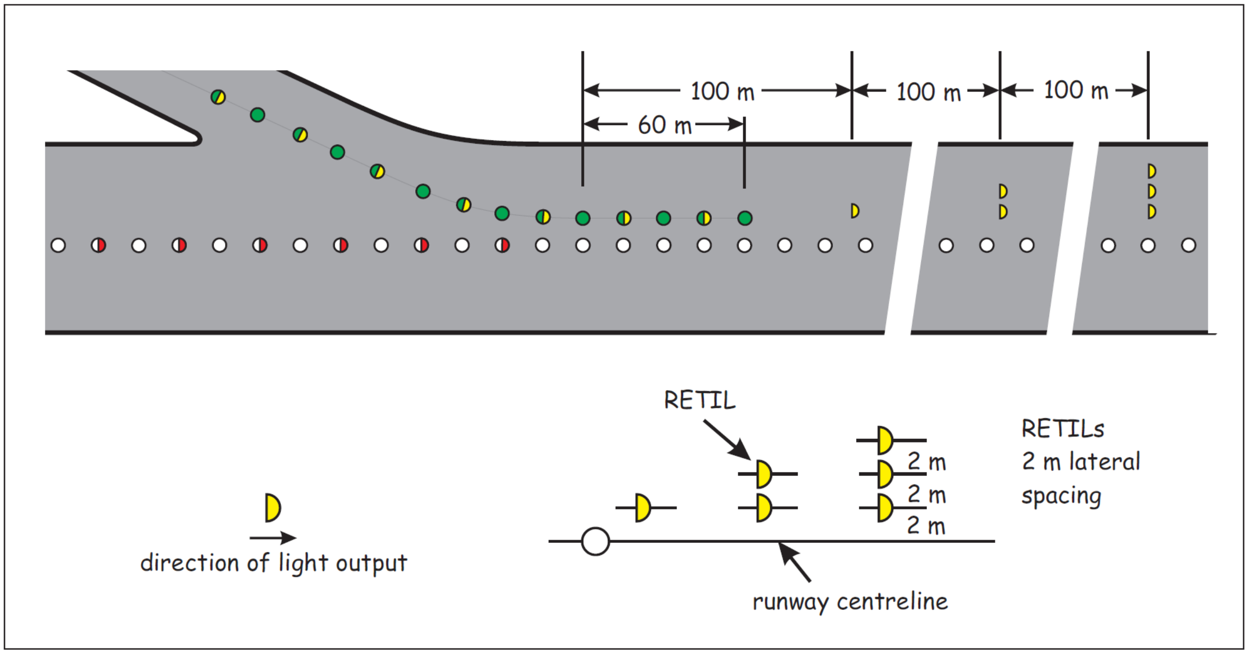
5.3.20.4 Where more than one rapid exit taxiway exists on a runway, the set of rapid exit taxiway indicator lights for each exit does not overlap when displayed.

Characteristics

5.3.20.5 Rapid exit taxiway indicator lights are fixed unidirectional yellow lights, aligned so as to be visible to the pilot of a landing aeroplane in the direction of approach to the runway.

5.3.20.6 Rapid exit taxiway indicator lights are in accordance with the specifications in Appendix 5B, B-7.

5.3.20.7 Rapid exit taxiway indicator lights are displayed only when the associated runway edge and centreline lights are displayed.



5-48: Rapid exit taxiway indicator lights (RETIL)

5.3.21 Taxiway Centreline Lights

Note: See Figure 5-49 for an overview of taxiway lighting system configurations.

Application

5.3.21.1 Taxiway centreline lights are provided on:

(a) an exit taxiway, taxiway, runway turn pad, and aircraft stand taxilane used in visibility conditions below RVR1200 (¼ SM) in such a way as to provide continuous guidance between the runway centreline and the point on the apron where aircraft commence manoeuvring for parking, except for take-off operations in RVR600 ($^{1}/_{8}$ SM) and above, where procedures exist to limit aircraft on the manoeuvring area to one at a time and vehicles on the manoeuvring area to essential minimum; or

(b) a runway forming part of a normal taxi route used in visibility conditions below RVR1200 (¼ SM), except for take-off operations in RVR600 ($^{1}/_{8}$ SM) and above, where procedures exist to limit aircraft on the manoeuvring area to one at a time and vehicles on the manoeuvring area to essential minimum.

Note 1: See sections 5.3.28 to 5.3.30 concerning standards for the provision of aircraft stand manoeuvring guidance lights.

Note 2: See section 8.2 for provisions concerning the interlocking of taxiway lighting systems with other systems.

Location

5.3.21.2 The taxiway centreline lights are located along the centreline of the taxiway or uniformly offset to the same side of the taxiway centreline by no more than 30 cm except for taxiway centreline lights on a runway, which are at least 60 cm from any row of runway centreline lights.

Note: See Figure 5-50 for depiction of taxiway centreline offset.

Taxiway Centreline Lights Spacing

General

5.3.21.3 Taxiway centreline lights on a straight section of a taxiway are spaced at longitudinal intervals of not more than 30 m; on a taxiway intended for use in visibility conditions below RVR1200 (¼ SM), the longitudinal spacing does not exceed 15 m.

5.3.21.4 Taxiway centreline lights on a taxiway curve continue from the straight portion of the taxiway at a constant distance from the outside edge of the taxiway curve. The lights are spaced at intervals such that a clear indication of the curve is provided.

5.3.21.5 The taxiway centreline lights on a curve do not exceed a spacing of:

Curve Radius	Light Spacing
up to 400 m	7.5 m
greater than 400 m	15 m

5.3.21.6 On a taxiway where both taxiway centreline lights and edge lights are installed, the lights of these systems are overlapped for a minimum distance of 90 m to provide transition from one system to another.

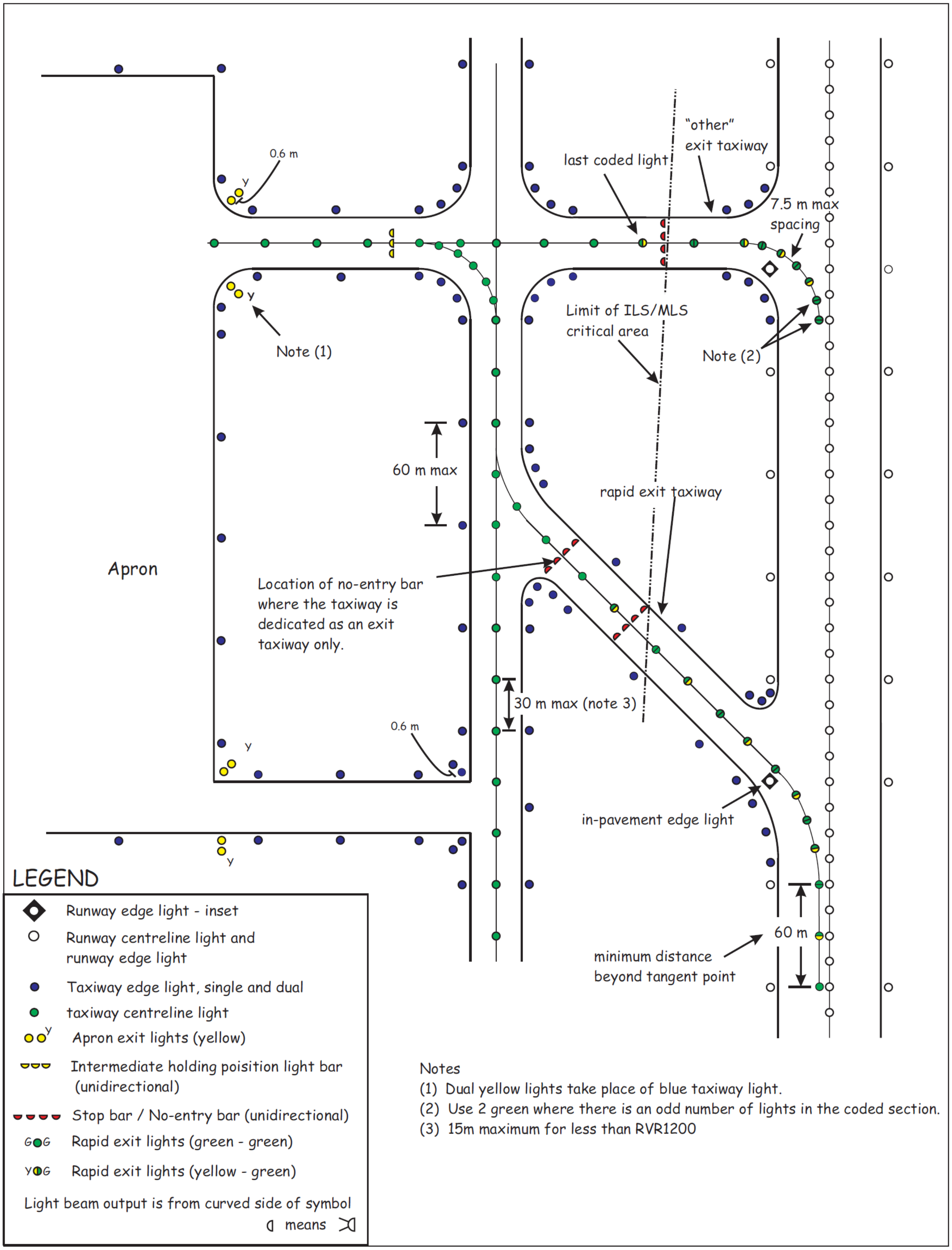


Figure 5-49: Taxiway lighting

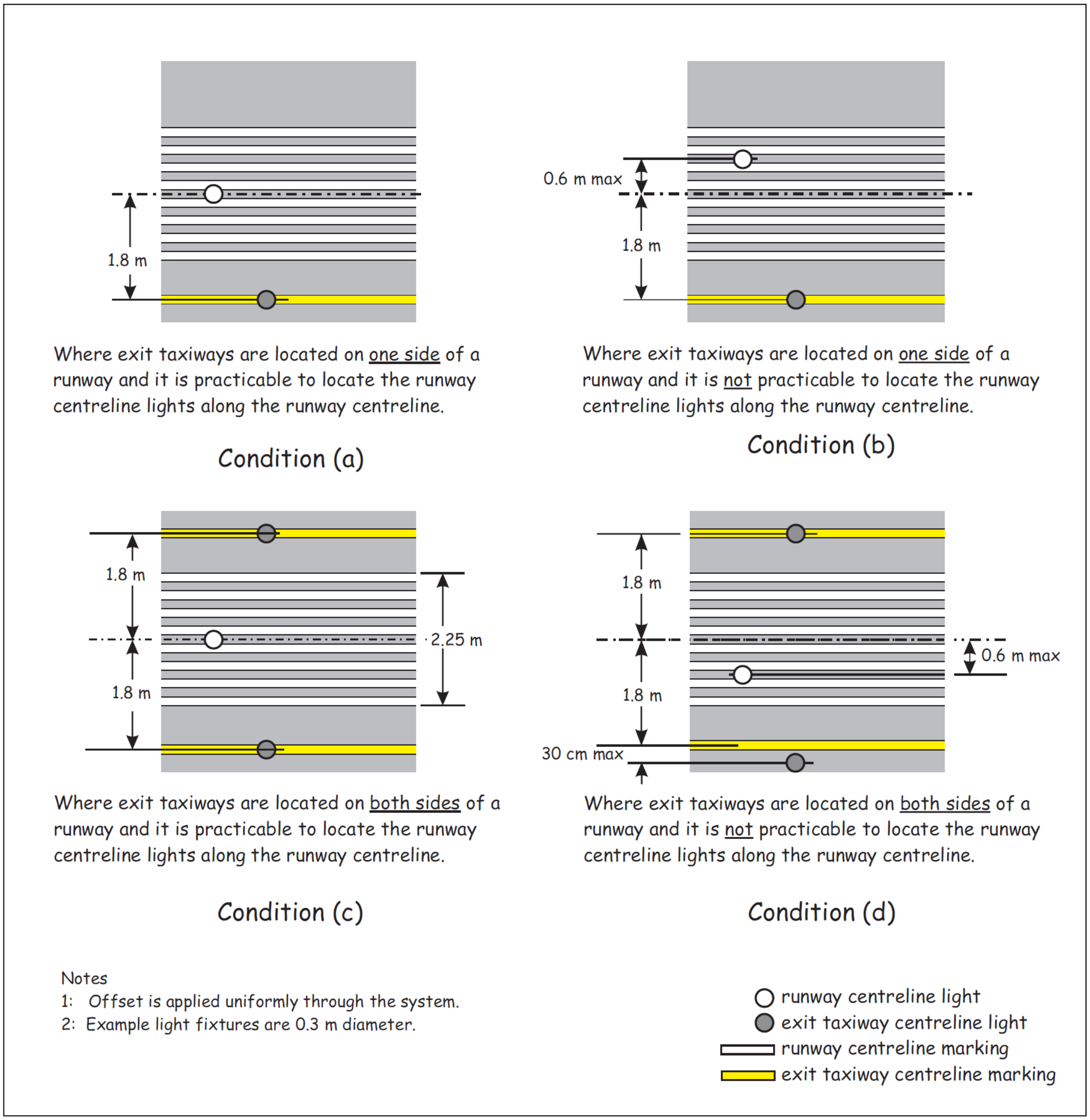


Figure 5-50: Offset runway and taxiway centreline lights

Taxiway Centreline Lights on Rapid Exit Taxiways and Other Exit Taxiways

Note: See Figure 5-51 for depiction of taxiway centreline lighting on exit taxiways.

5.3.21.7 Taxiway centreline lights on a rapid exit taxiway:

(a) commence at a point at least 60 m before the beginning of the taxiway curve or at the start of the taxiway centreline on the runway, whichever is greater;

(b) continue beyond the end of the curve to a point on the centreline of the taxiway where an aircraft can be expected to reach normal taxiing speed or three (3) lights beyond the runway-holding position, whichever is greater; and

(c) are at least 60 cm from any row of runway centreline lights for that portion parallel to the runway centreline.

5.3.21.8 Taxiway centreline lights on exit taxiways other than rapid exit taxiways:

(a) commence at a point of tangency where the taxiway centreline begins to curve from the runway centreline, and

(b) follow the curved taxiway centreline marking to at least the point where the holding position is located.

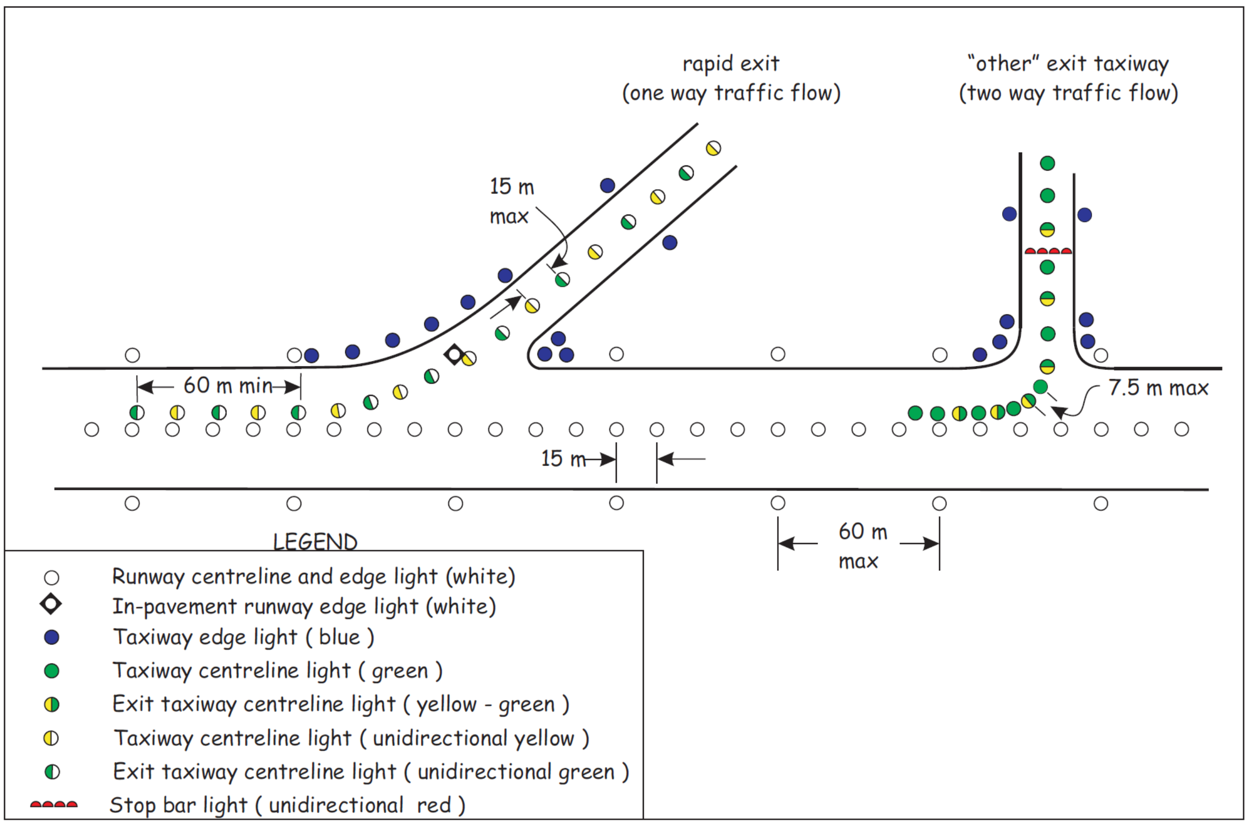


Figure 5-51: Taxiway centreline lighting

Taxiway Centreline Lights on Runway Turn Pads

Note: See Figure 5-52 for depiction of taxiway centreline lights on a runway turn pad.

5.3.21.9 Taxiway centreline lights are provided up to a point where a 180° turn goes at least three lights beyond the runway centreline, as shown in Figure 5-52.

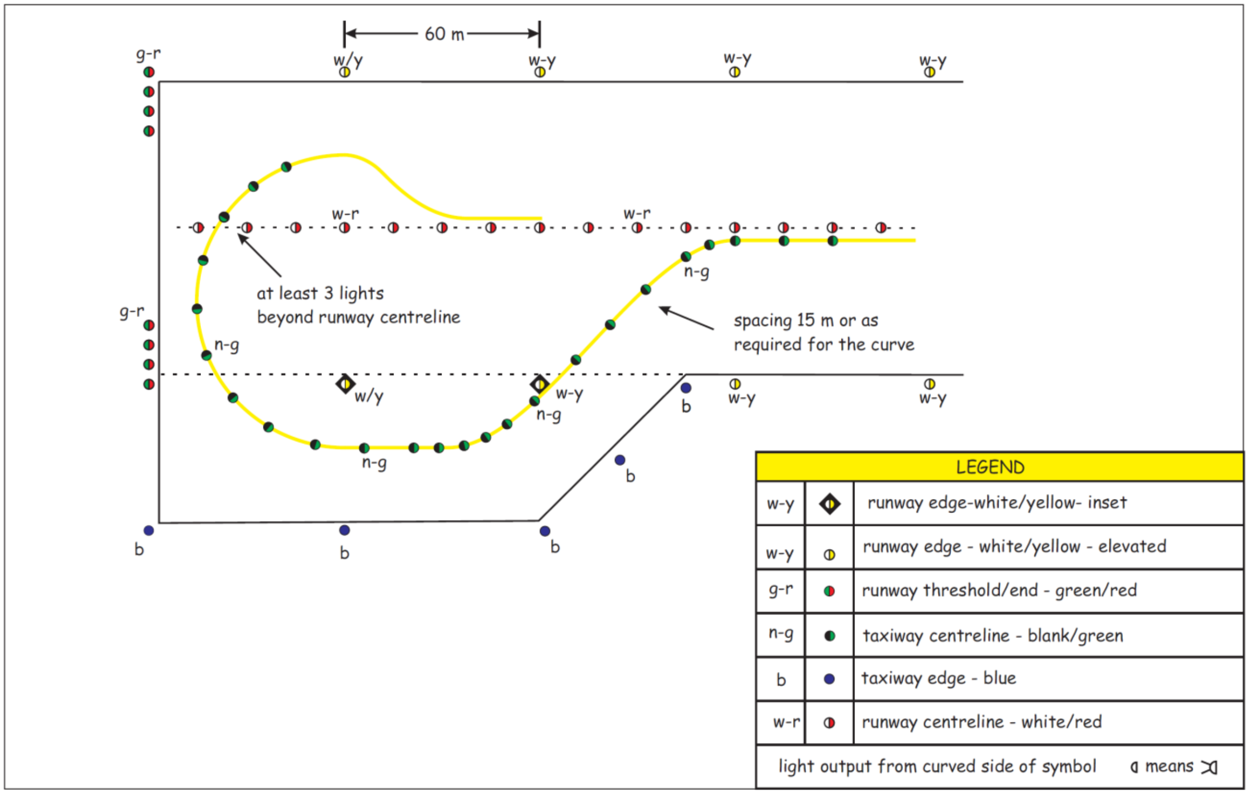


Figure 5-52: Runway turn pad lights

Characteristics

5.3.21.10 Subject to 5.3.21.11, with the exception of an exit taxiway, taxiway centreline lights, on a taxiway and on a runway forming part of a recognized taxi-route, are fixed lights showing green with beam dimensions such that the light is visible only from aircraft on or in the vicinity of the taxiway.

5.3.21.11 The taxiway centreline lights, from a runway-holding position up to the termination point on the runway or between runway-holding positions when crossing a runway, may show alternating green and yellow.

Note: The intent is to increase awareness of the proximity of a runway to reduce runway incursions.

5.3.21.12 Where aircraft follow the same centreline in both directions, the centreline lights are bidirectional.

5.3.21.13 Taxiway centreline lights on an exit taxiway are fixed lights. Alternate taxiway centreline lights show green and yellow from their beginning near the runway centreline to the outer perimeter of the ILS/MLS critical/sensitive area or the taxi-holding position, whichever is farthest from the runway; thereafter, all lights show green. The first light in the exit centreline shows green and the light nearest to the perimeter shows yellow.

Note: The size of the ILS/MLS critical/sensitive area depends on the characteristics of the associated ILS or MLS. Contact the ILS service provider for the specific dimensions of the critical and sensitive areas.

5.3.21.14 Taxiway centreline lights are in accordance with the specifications of:

(a) Appendix 5B, Figures B-12, B-13 or B-14, as appropriate for taxiways used in visibility conditions below RVR1200 (¼ SM); and

(b) Appendix 5B, Figures B-15 or B-16 as appropriate for other taxiways.

5.3.22 Taxiway Edge Lights

Note: See Figure 5-54 for an overview of taxiway edge lighting systems.

Application

5.3.22.1 Taxiway edge lights are provided on:

(a) a holding bay, apron, runway turn pad used at night and on a taxiway not provided with taxiway centreline lights and intended for use at night;

(b) curved portions of taxiways where aircraft operations are being conducted in visibility conditions below RVR600 ($^1/_8$ SM); or

(c) a daytime only runway used for aircraft taxiing at night.

Exceptions:

(i) Retro-reflective markers may be provided in lieu of taxiway edge lighting for aircraft operations in visibility conditions of RVR1200 (¼ SM) and above on private taxiways, and on aprons where, considering the nature of the operations, adequate guidance can be achieved by surface illumination or other means.

(ii) For taxiways on an apron, edge lighting need not be provided on the side adjacent to the apron, provided a taxiway side stripe marking is installed.

Note: See section 5.5.4 for taxiway edge markers.

Location

5.3.22.2 Taxiway edge lights have a uniform designed spacing not exceeding 60 m on straight segments. The installation tolerance is ±1 m of the design spacing.

5.3.22.3 Taxiway light spacing on a curved or fillet section of a taxiway is spaced in accordance with the requirements of Figure 5-53 so that a clear indication of the curve is provided. The installation tolerance is generally ±1 m of the required chord length except chords next to the points of tangency (PT) have a tolerance of (+1m, 0m) to maintain the required spacing of 5.3.22.2.

.

5.3.22.4 Curved or filleted sections of more than 30° of arc have a minimum of three (3) edge lights.

5.3.22.5 The lights on opposite sides of straight portions of the taxiway axis are aligned, at right angles to that axis. Where the spacing of the lights would result in a light being within an intersection, the light(s) is omitted.

5.3.22.6 A taxiway/taxiway or taxiway/runway intersection, where no fillet or curve is provided, is indicated by placing two (2) blue edge lights (double blues) on each side of the intersection. Where the taxiway is situated at the end of the runway, the set of double blues in line with the runway end lights may be omitted.

5.3.22.7 The intersection of a taxiway with an apron is indicated by placing two (2) yellow edge lights (double yellows) on each side of apron exit, adjacent to the taxiway/apron intersection, except where taxiway centreline lights are provided to lead aircraft from the apron to the taxiway these lights may be omitted.

Note: The purpose of the double yellow edge lights is to provide exit guidance from the apron.

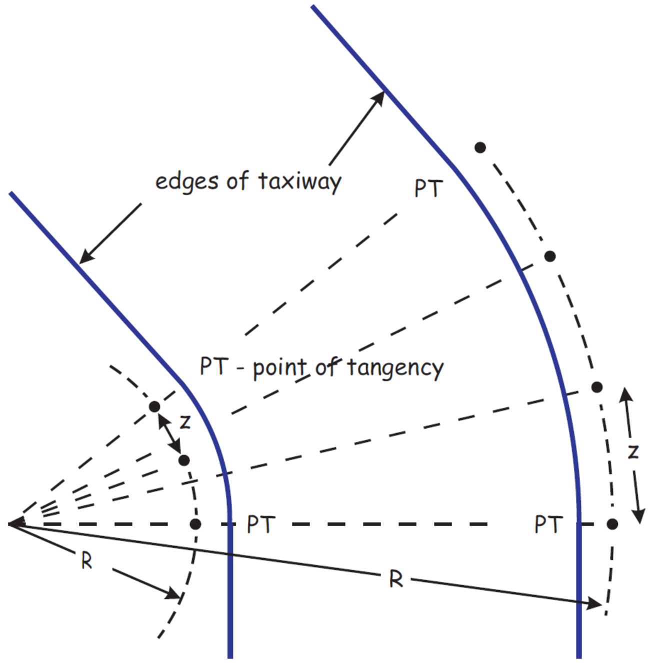
5.3.22.8 The two (2) lights provided in accordance with 5.3.22.6 and 5.3.22.7 are located so that one light is positioned in line with the other edge lights. The second is positioned 0.6 m [±0.05m] from the first and aligned to be equidistant from the edges of the pavement on each side of the first light.

Characteristics

5.3.22.9 Taxiway edge lights are fixed lights showing blue. The lights are visible up to at least 30° above the horizontal and at all angles in azimuth necessary to provide guidance to a pilot taxiing in either direction.

Note: See section 5.5.4 for characteristics of retroreflective taxiway edge markers.

5.3.22.10 The intensity and distribution of taxiway edge lights conform to Appendix 5B, Table 5B-1.



Radius "R" of curve (metres)	Chord "Z" (metres)
5.0	6.0
7.5	7.4
15	10.5
23	12.9
30	14.1
45	16.7
60	19.2
75	21.8
90	24.3
150	34.5
200	43.0
250	51.5
300	60.0

Table: Chord length versus radius

for R = 0 to 23 m, $Z = 2.7 * \sqrt{R}$
for R = 23 m to 300 m, $Z = 0.17R + 9.0$

1. For radii not listed, determine "z" spacing by linear interpolation.
2. "z" is the chord length. "z" is not a segment of the circumference.
3. Uniformly space lights on curved edges.
4. Do not exceed the values listed in the above table.
5. For runway/taxiway intersections the light at the PT may be a runway edge light
6. On curved edges in excess of 30 degrees of arc, do not install less than 3 lights including those at the PTs.

Figure 5-53: Spacing of lights on curved taxiway edges

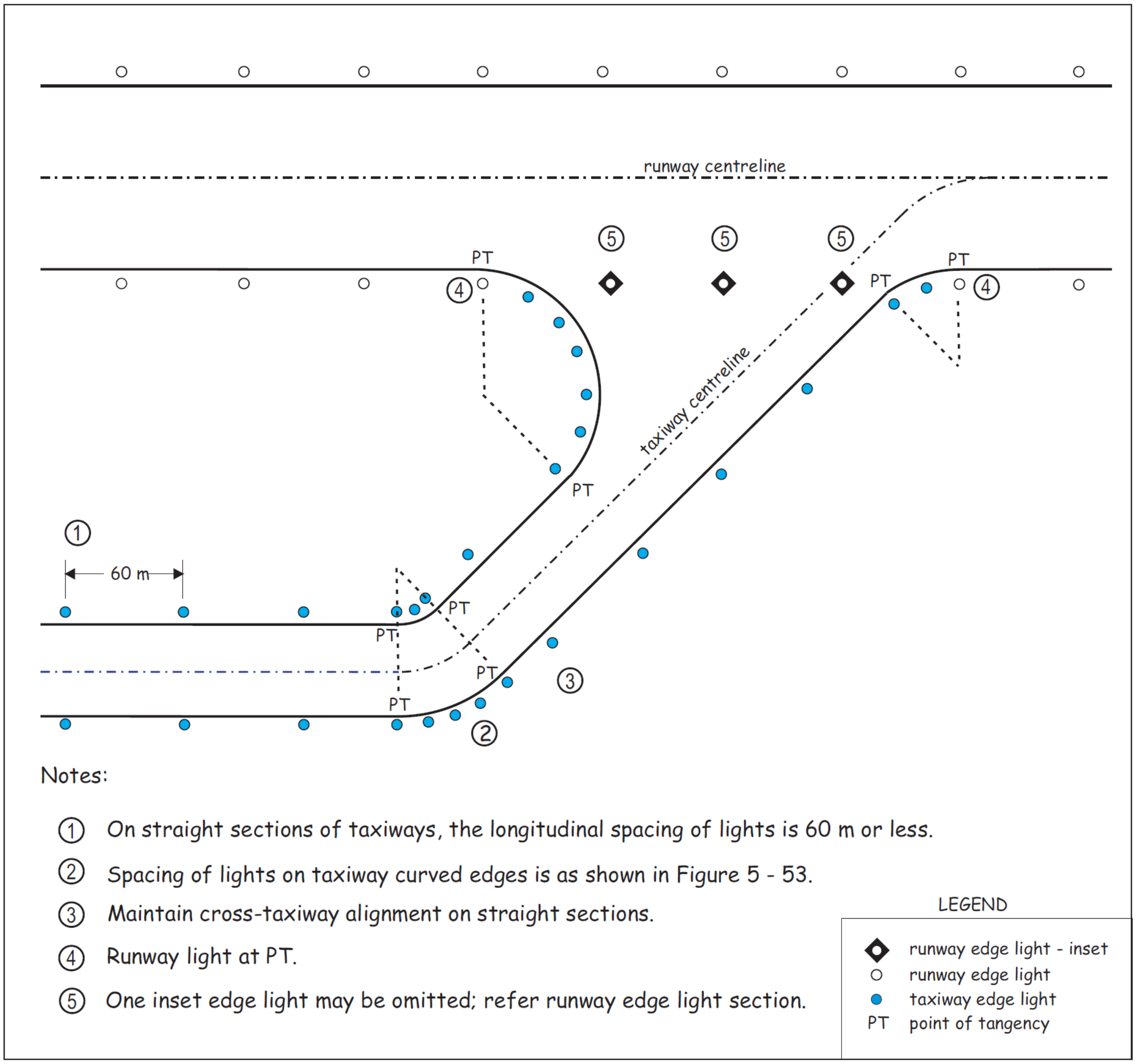


Figure 5-54: Taxiway edge lighting configuration

5.3.23 Stop Bars

Note 1: The provision of dynamic stop bars requires their control by air traffic services. Stop bars may be static or dynamic in operational nature depending on the control requirements of air traffic services under the low visibility operations plan. Dynamic stop bars are commonly located at holding positions used in low visibility operations, while static stop bars are typically used on taxiways not part of the low visibility routing.

See also 5.3.31—Road-Holding Position Light

Note 2: Stop bars are comprised of inset lights across the holding position and supplemental lights (elevated or inset) at the outer edges of the holding position.

<u>Application</u>

5.3.23.1 A stop bar is provided at every runway-holding position serving a runway operating in visibility conditions below RVR1200 (¼ SM), except where operational procedures exist in the reduced or low visibility plan to limit the number of aircraft on the manoeuvring area to one at a time and vehicles on the manoeuvring area to the essential minimum.

Note: An aircraft under tow or escorted by a follow me vehicle constitutes a single movement

<u>Location</u>

5.3.23.2 The stop bar is installed perpendicular to the taxiway centreline on the holding side of the runway-holding position marking, not more than 0.9 m from the marking.

5.3.23.3 For dynamic stop bars, a pair of supplemental stop bar lights is provided on each side of the runway-holding position, in line with the inset stop bar lights and located at a distance of 1.5 to 3 m from the edge of the runway or taxiway.

5.3.23.4 Inset stop bar lights within a runway or taxiway are normally aimed parallel with the taxi centreline. However, for certain applications angular aiming may be necessary depending upon site requirements to facilitate viewing from the aircraft, such as in a curve.

5.3.23.5 Where elevated runway guard lights are installed, the supplemental stop bar lights are installed a minimum of 1 m inboard of the elevated runway guard lights**.**

Note: See Figure 5-55 for depiction of a stop bar and runway guard light installations.

5.3.23.6 The two supplemental stop bar lights are spaced 40 cm (±5 cm) apart.

5.3.23.7 Supplemental stop bar lights are aimed toward the taxi centreline at a distance of between 37 m and 52 m from the runway-holding position.

5.3.23.8 The vertical aiming angle of the supplemental stop bar lights is set between 5° and 10° above the horizontal.

5.3.23.9 Stop bars consist of lights spaced at uniform intervals not exceeding 3 m across the runway-holding position.

Characteristics

5.3.23.10 Stop bars installed at a runway-holding position are unidirectional and show red in the direction of approach to the intersection or the runway-holding position.

5.3.23.11 Selectively switchable *(dynamic)* stop bars at a runway-holding position are installed in conjunction with at least 90 m of taxiway centreline lights extending from the stop bar to the runway centreline.

Note: See section 5.3.21 for standards concerning the spacing of taxiway centreline lights.

5.3.23.12 Where the supplemental stop bar lights are inset fixtures, they are in accordance with Appendix 5B, Figures B-12 to B-16, as appropriate.

5.3.23.13 The intensity in red light and beam spreads of inset stop bar lights conforms to specifications in Appendix 5B, Figures B-12 to B-16, as appropriate.

5.3.23.14 The intensity in red light and beam spreads of elevated stop bar lights conforms to the specifications in Appendix 5B, Figure B-26.

5.3.23.15 The lighting circuit is designed so that:

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

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

(c) when a stop bar is illuminated, taxiway centreline lights installed beyond the stop bar are extinguished for a distance of at least 90 m;

(d) stop bars are interlocked with the taxiway centreline lights so that when the centreline lights beyond the stop bar are illuminated the stop bar is extinguished and vice versa;

(e) when inset runway guard lights are co-located with stop bars, they are interlocked so that when the stop bars are ON, the runway guard lights are OFF and vice-versa; and

(f) when more than one stop bar is associated with a taxiway/runway intersection, only one is illuminated at a time.

5.3.23.16 Where a change in the operational status of a stop bar has occurred, the control system response time is as follows: within two seconds from the time the stop bar button on the ATC airfield lighting control panel is activated, the stop bar lights switch off and the lead-on taxiway centreline lights switch on.

Note: See sections 8.1 and 8.4 for provisions on selective switching of stop bars and taxiway centreline lights

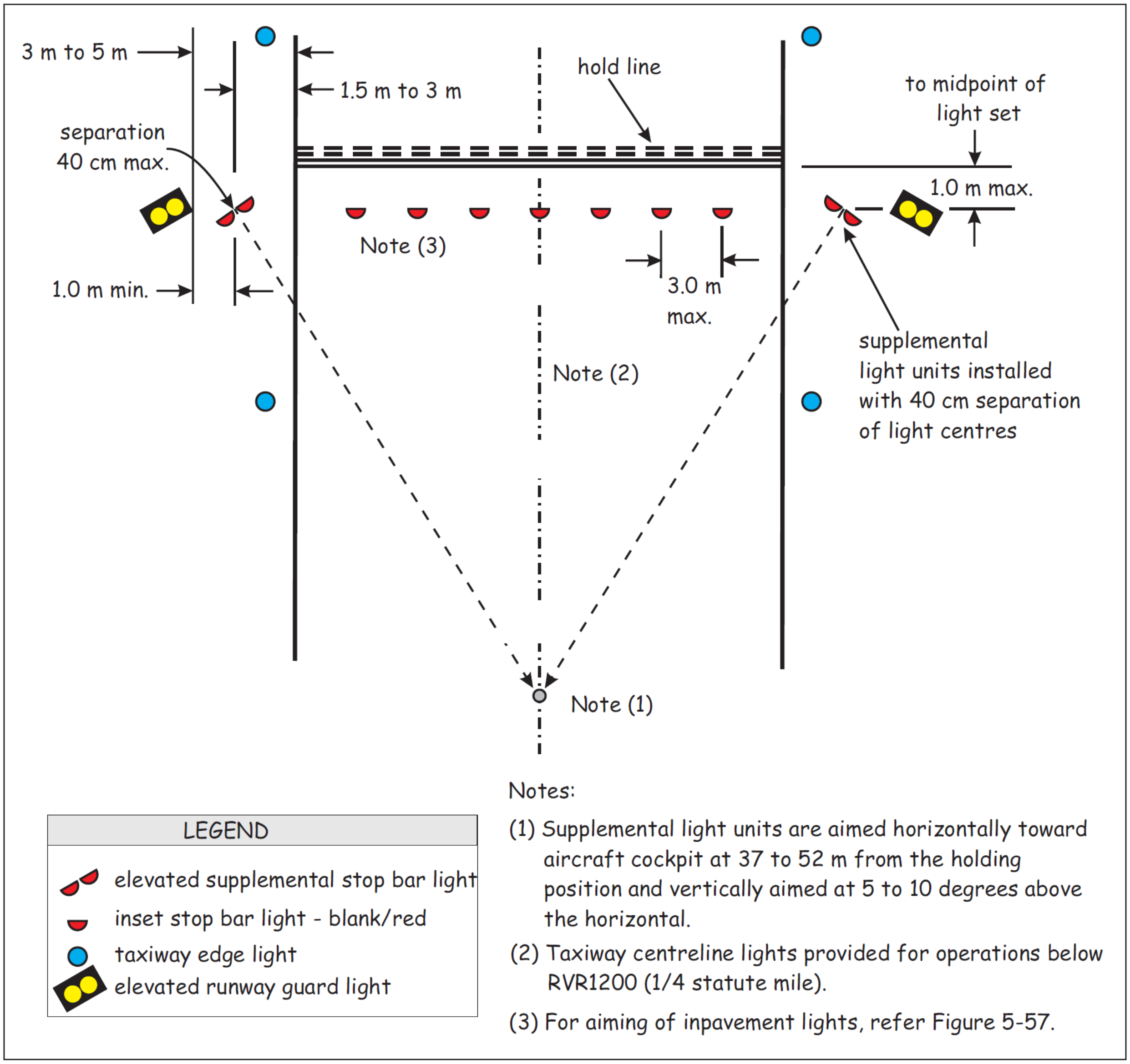


Figure 5-55: Stop bar lighting

5.3.24 No-Entry Bars

Note: No-entry bars are typically used where the entry to a taxiway prohibited. The provision of no-entry requires their control by air traffic services where the exit is intended for aircraft movement in one direction on a temporary basis.

Application

5.3.24.1 Where a no-entry bar is provided, it is as specified in this section.

Location

5.3.24.2 A no-entry bar is located at the entrance of a taxiway to protect the no-entry side.

Note: See Figure 5-49 for depiction of a no-entry bar located on an exit-only taxiway.

5.3.24.3 A no-entry bar is composed of lights which are normally aimed parallel with the taxiway centreline. However, for certain applications, angular aiming may be necessary depending upon site requirements to facilitate viewing from the aircraft, such as just prior to a curve.

5.3.24.4 No-entry bars consist of lights spaced at uniform intervals not exceeding 3 m across the width of the taxiway.

Characteristics

5.3.24.5 No-entry bar lights are inset unidirectional lights showing red in the direction of approach to the intersection.

5.3.24.6 The intensity in red light and beam spreads of no-entry bar lights conforms to the specifications in Appendix 5B, Figures B-12 to B-16, as appropriate.

5.3.24.7 The lighting circuit is designed so that:

(a) no-entry bars located across entrance taxiways are selectively switchable;

(b) no-entry bars are interlocked with the taxiway centreline lights, where provided, so that when the no-entry lights are selected, the centreline lights beyond the no-entry bar are turned off for a minimum distance of 90 m and vice versa; and

(c) when there is a (visible) stop bar beyond the no-entry bar, only one (stop bar or no-entry bar) is illuminated at a time.

5.3.24.8 Where a change in the operational status of a no-entry bar has occurred, an indication is automatically provided to the air traffic control service within 2 seconds of the change.

5.3.25 Intermediate Holding Position Lights

Note: See 5.2.17 for standards on intermediate holding position marking.

Application

5.3.25.1 Intermediate holding position lights are provided where an intermediate holding position marking is established for operations in visibility conditions below RVR1200 (¼ SM).

Location

5.3.25.2 The lights are located no more than 1 m from the intermediate holding position marking on the holding side. The lights are disposed symmetrically and at 90° to the taxiway centreline, with individual lights spaced 1.5 m (±0.3m) apart

5.3.25.3 In order to avoid pavement joints, the intermediate holding position lights may be offset by a maximum of 0.3 m, in the same direction as the taxiway centreline lights, if provided.

5.3.25.4 Where there would be co-location of an intermediate holding position light and a taxiway centreline light, an intermediate holding position light is installed.

Note: See Figure 5-49 for depiction of intermediate holding position lights.

Characteristics

5.3.25.5 Intermediate holding position lights consist of three (3) fixed inset unidirectional lights showing yellow in the direction of approach to the intermediate holding position with a light distribution in accordance with Appendix 5B, Figure B-17.

5.3.26 Runway Guard Lights

Application

5.3.26.1 Runway guard lights, configuration A or configuration B (refer to Figure 5-56), are provided at each taxiway/runway-holding position associated with a runway operating in visibility conditions below RVR2600 (½ SM), except:

(a) where a stop bar is installed and operated below RVR2600 (½ SM); or

(b) where there are procedures in place to manage the vehicular traffic to essential minimum, and limit aircraft movement to one at any time on the manoeuvring area.

.

Location

5.3.26.2 Elevated runway guard lights, configuration A, are located at each side of the taxiway as follows:

(a) on the holding side of the runway-holding position marking, no more than 1 m from the extended edge of the marking,

(b) between 3–5 m from the defined edge of the taxiway; and

(c) a minimum separation of 1 m outboard of the supplementary stop bar, if provided.

5.3.26.3 Elevated runway guard lights are no higher than 75 cm above the edge of the taxiway.

5.3.26.4 Inset runway guard lights, configuration B, are located across the holding side of the runway-holding position marking as follows:

(a) located at a uniform distance from the edge of the runway-holding position marking no more than 1 m from the edge of the marking; and

(b) the lights are uniformly spaced across the full width of the taxiway at intervals of no more than 3 m.

Note: See Figure 5-12 for runway-holding position markings.

Characteristics

5.3.26.5 Elevated runway guard lights, configuration A, consist of two pairs of yellow lights.

5.3.26.6 Inset runway guard lights, configuration B, consist of yellow lights.

5.3.26.7 The light beam is unidirectional and aimed so as to be visible to the pilot of an aircraft taxiing (approaching) to the holding position.

Note: See Figure 5-57 for aiming of inset runway guard lights.

5.3.26.8 Where elevated runway guard lights are provided they are oriented toward the taxiway centreline at a distance of between 45–60 m from the runway-holding position.

Note: The complexity of the taxiway intersection may require the installation of multiple lights to adequately cover the different taxi paths.

5.3.26.9 The vertical aiming angle of configuration A lights is set between 5°–10° above the horizontal plane.

Note: Configuration A runway ground lights are oriented to maximize the visibility of the lights to pilots of aircraft approaching the runway-holding position. The orientation aims the centre of the light beam toward the aircraft cockpit at a specified distance along the predominant taxi path to the holding position. If these criteria cannot be met for all taxi paths to the holding position, consider using multiple fixtures aimed to adequately cover the different taxi paths. Alternatively use in-pavement fixtures, configuration B.

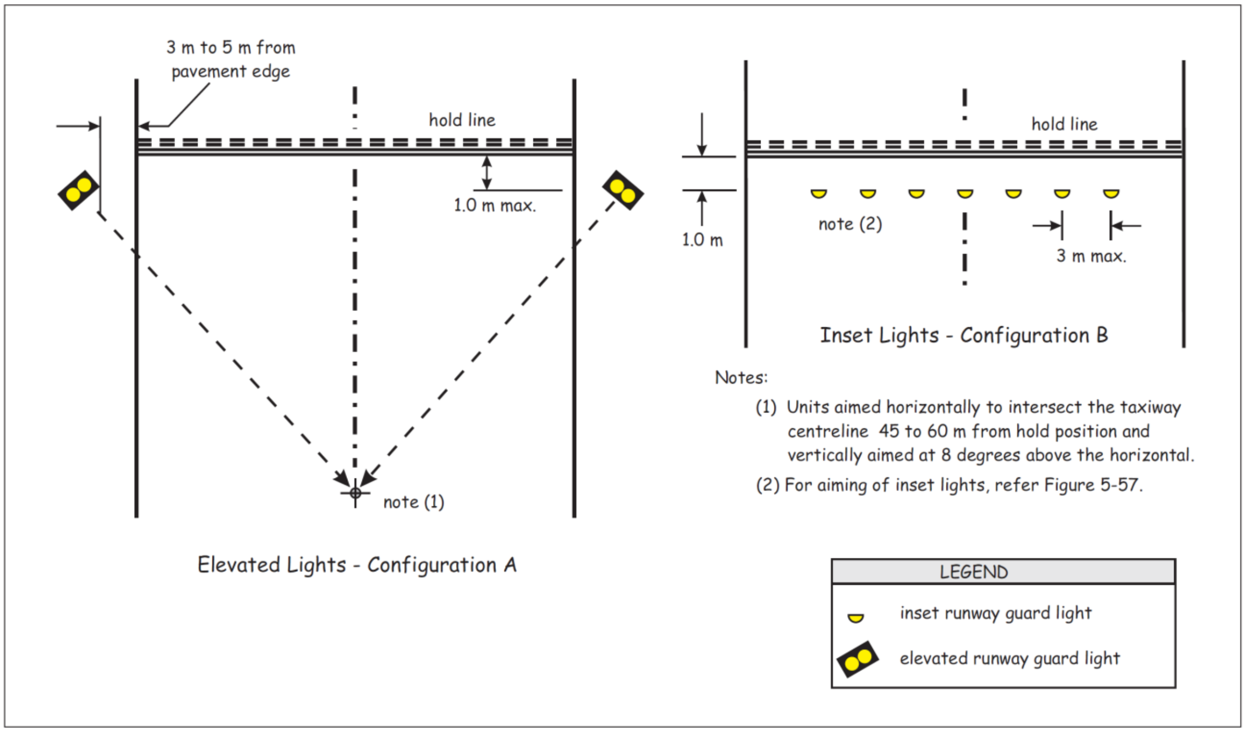


Figure 5-56: Runway guard light configuration

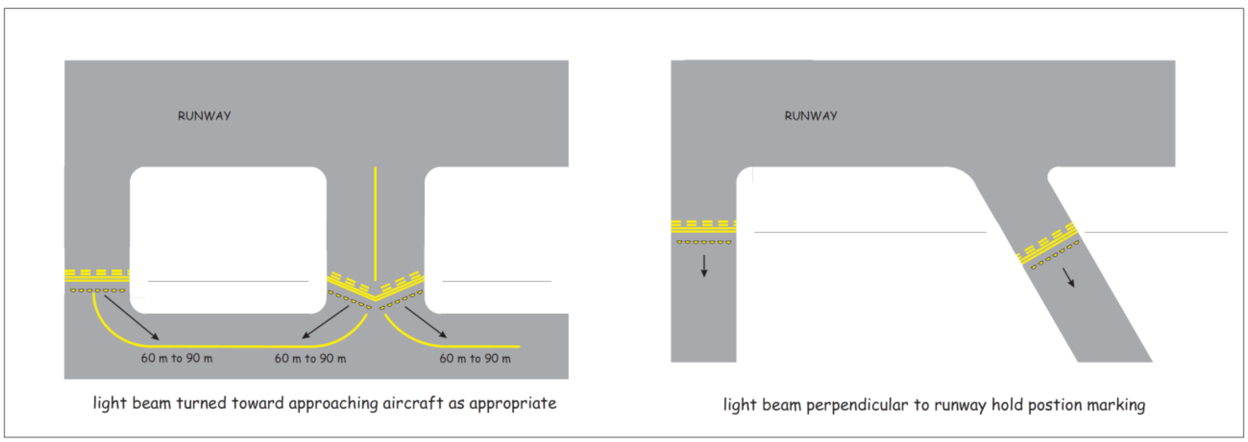


Figure 5-57: Inset runway guard light orientation

5.3.26.10 The intensity in yellow light and beam spreads of elevated runway guard lights conforms to the specifications set out in Appendix 5B, Figure B-20

5.3.26.11 The intensity in yellow light and beam spreads of inset runway guard lights conforms to the specifications set out in Appendix 5B, Figure B-17.

5.3.26.12 The lights in each elevated runway guard light unit are illuminated alternately.

5.3.26.13 For inset runway guard lights, adjacent lights are alternately illuminated and alternate lights are illuminated in unison.

5.3.26.14 The lights are illuminated between 30 and 60 cycles per minute and the light suppression and illumination periods are equal and opposite in each light.

5.3.26.15 Runway guard lights are provided with variable intensity as per 5.3.1.7.

5.3.26.16 Where runway guard lights, configuration B, are co-located with a stop bar at a holding position, an interlock is provided such that both systems are not operated simultaneously.

5.3.26.17 Where runway guard lights, configuration A or B, are installed at a primary holding position and stop bar lights are installed at another holding position further from the runway, an interlock is provided such that the runway guard lights are not operated simultaneously with the stop bar lights.

5.3.27 Apron Floodlighting

Note: Additional information on illumination levels for working areas such as apron areas can be found in external documents, such as the Canada Labour Code.

<u>Application</u>

5.3.27.1 Where provided, apron floodlighting is in accordance with the specifications of this section.

<u>Location</u>

5.3.27.2 Apron floodlights are configured so as to provide minimum glare to pilots of aircraft in flight and on the ground, and to aerodrome and apron controllers.

<u>Characteristics</u>

5.3.27.3 The colour rendition of light emitted from apron floodlights is such that the colours used for surface and/or obstacle marking can be correctly identified.

5.3.28 Visual Docking Guidance System (VDGS)

Application

5.3.28.1 A visual docking guidance system is provided when precise positioning of an aircraft is required and other means, such as marshallers, are not practical.

Characteristics

5.3.28.2 The visual docking guidance system provides both azimuth and stopping guidance.

5.3.28.3 The azimuth guidance unit and the stopping position indicator are adequate for use in all weather, visibility, background lighting and pavement conditions for which the system is intended, both by day and night, but do not dazzle the pilot.

Note: Care is required in both the design and on-site installation of the system to ensure that reflection of sunlight, or other light in the vicinity does not degrade the clarity and conspicuity of the visual cues provided by the system.

5.3.28.4 The azimuth guidance unit and the stopping position indicator (where installed) are of a design such that:

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

(b) they can be turned off.

5.3.28.5 The azimuth guidance unit and the stopping position indicator are located in such a way that there is continuity of guidance between the aircraft stand markings, the aircraft stand manoeuvring guidance lights, if present, and the visual docking guidance system.

5.3.28.6 The accuracy of the system is adequate for the type of loading bridge and fixed aircraft servicing installations with which it is to be used.

5.3.28.7 If selective operation is required to prepare the system for use by a particular type of aircraft, then the system provides an identification of the selected aircraft type to both the pilot and the system operator as a means of ensuring that the system has been set properly.

Azimuth Guidance Unit

Location

5.3.28.8 The azimuth guidance unit is located on or close to the extension of the stand centreline ahead of the aircraft so that its signals are visible from the cockpit of an aircraft throughout the docking manoeuvre and aligned for use by at least the pilot occupying the left seat.

Characteristics

5.3.28.9 The azimuth guidance unit provides unambiguous left/right guidance, which enables the pilot to acquire and maintain the lead-in line without over-controlling.

5.3.28.10 When azimuth guidance is indicated by colour change, green is used to identify the centreline and red for deviations from the centreline.

Stopping Position Indicator

Location

5.3.28.11 The stopping position indicator is 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 his/her head.

5.3.28.12 The stopping position indicator is usable at least by the pilot occupying the left seat.

Characteristics

5.3.28.13 The stopping position information provided by the indicator for a particular aircraft type accounts for the anticipated range of variations in pilot eye height and/or viewing angle.

5.3.28.14 The stopping position indicator shows the stopping position for the aircraft for which guidance is being provided and, in the case of an electronic system, provides closing rate information to enable the pilot to gradually decelerate the aircraft to a full stop at the intended stopping position.

5.3.28.15 When stopping guidance is indicated by colour change, green is used to show that the aircraft can proceed and red to show that the stop point has been reached. For a short distance prior to the stop point, a third colour may be used to warn that the stopping point is close.

5.3.29 Advanced Visual Docking Guidance System (A-VDGS)

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, 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.

Application

5.3.29.1 Where provided the A-VDGS is as specified in this section.

Location

5.3.29.2 The A-VDGS location is 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

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 the vehicle that is towing the aircraft.

Characteristics

5.3.29.3 The A-VDGS is suitable for use by all types of aircraft for which the aircraft stand is intended.

5.3.29.4 The A-VDGS is used only in conditions in which its operational performance is specified.

Note 1: The use of the A-VDGS in conditions such as weather, visibility and background lighting, both by day and night, should 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.

5.3.29.5 The docking guidance information provided by an A-VDGS does 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 is provided.

5.3.29.6 The A-VDGS provides, at minimum, the following guidance information at the appropriate stage of the docking manoeuvre:

(a) an emergency stop indication;

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

(c) an indication of the lateral displacement of the aircraft relative to the stand centreline;

(d) the direction of azimuth correction needed to correct a displacement from the stand centreline;

(e) an indication of the distance to the stop position;

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

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

5.3.29.7 The A-VDGS is capable of providing docking guidance information for all aircraft taxi speeds encountered during the docking manoeuvre.

Note: See the ICAO Aerodrome Design Manual, Part 4 (Doc 9157) *for an indication of the maximum aircraft speeds relative to distance to the stopping position.*

5.3.29.8 Symbols and graphics used to depict guidance information are intuitively representative of the type of information provided.

Note: The use of colour should follow signal convention, i.e. red, yellow and green mean hazard, caution and normal/correct conditions, respectively. The effects of colour contrasts should also need to be considered.

5.3.29.9 Information on the lateral displacement of the aircraft relative to the stand centreline is provided at least 25 m prior to the stop position.

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 position.

5.3.29.10 Continuous closure distance and rate is provided at least 15 m prior to the stop position.

5.3.29.11 Throughout the docking manoeuvre, an appropriate means is 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 is displayed.

5.3.29.12 Provision to initiate an immediate halt to the docking procedure is made available to personnel responsible for the operational safety of the stand.

5.3.30 Aircraft Stand Manoeuvring Guidance Lights

Application

5.3.30.1 Where provided, aircraft stand manoeuvring guidance lights conform to the specifications of this section.

Location

5.3.30.2 Aircraft stand manoeuvring guidance lights are co-located with the aircraft stand markings; lights may be uniformly offset by not more than 30 cm where it is not practical to locate them along the centreline.

Characteristics

5.3.30.3 Aircraft stand manoeuvring guidance lights are yellow lights and are visible throughout the segments within which they are intended to provide guidance.

5.3.31 Road-Holding Position Lights

Application

5.3.31.1 A road-holding position light is provided at each road-holding position serving a runway when it is intended that the runway will be used in conditions below RVR1200 (1/4 SM).

Note: See Chapter 8 for low and reduced visibility operations plans.

Location

5.3.31.2 A road-holding position light is located adjacent to the holding position marking 1.5 m (±15 cm) from the right hand edge of the road (when facing the holding position marking), or on the left hand edge of the road should the former be impractical.

Characteristics

5.3.31.3 The road-holding position light is comprised of:

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

(b) a flashing red light.

5.3.31.4 The road-holding position light beam is unidirectional and aligned so as to be visible to the driver of a vehicle approaching the road-holding position.

5.3.31.5 The intensity of the light beam is adequate for the conditions of visibility and ambient light in which the use of the holding position is intended.

5.3.31.6 The flash frequency of the flashing red light is between 30 and 60 flashes per minute with the light illuminated approximately 50% of the time.

5.3.32 Unserviceability/Closed Lights

Application

5.3.32.1 Unserviceability lights are provided on a taxiway bridge or runway bridge.

5.3.32.2 In addition to closed markers, unserviceability lights are provided for a temporary closure at night where:

(a) a closed taxiway is intercepted by a usable runway or taxiway,

(b) a portion of a taxiway, taxiway safety area or apron used at night is unusable but it is still possible for aircraft to bypass the area safely, or

(c) any portion of an apron is unusable and there is insufficient ambient lighting to delineate the area with the use of retroreflective markers alone.

Note 1: Where unserviceable lights are used to delineate a portion of the taxiway or taxiway safety area that has become temporarily unserviceable, movements may need to be restricted to aircraft of lesser AGN to maintain the taxiway width standards.

Note 2: See unserviceability markers in section 5.5.6.

Location

5.3.32.3 Unserviceability lights are spaced at maximum intervals of 3 m except on taxiway or runway bridges per 5.3.32.5.

5.3.32.4 When a runway, taxiway or portion thereof is closed and is intersected by a usable runway or taxiway which is used at night, unserviceability lights are placed across the entrances to the closed area at intervals not exceeding 3 m in addition to closed markings, as per 5.3.24.

5.3.32.5 Subject to 5.3.32.6, on a taxiway bridge or runway bridge, three (3) uniformly spaced unserviceability lights are located on each outer edge, across the full length of the bridge.

Note: See Figure 5-11 Taxiway safety area marking for depiction of unserviceability lights on a bridge.

5.3.32.6 On a taxiway bridge with a positive aircraft restraint system installed as per 3.5.3.2, unserviceability lights are positioned as follows:

(a) a maximum of 15 m intervals; and

(b) extending four (4) lights before and after the bridge surface.

Characteristics

5.3.32.7 An unserviceability light:

(a) is fixed red; and

(b) has an intensity not less than 10 cd.

5.3.33 Lighted “X” Closed Area Marker

Application

5.3.33.1 A lighted “X” closed area marker can be used as an alternate to painted Xs on a runway or painted Xs and unserviceable lights on a taxiway if the closure is for a specified period, normally associated with maintenance or construction except for:

(a) permanent closures of a runway, taxiway or portion thereof, or

(b) temporary closure of the displaced portion of a runway.

Location

5.3.33.2 The lighted “X” closed area marker on a runway is positioned on the runway centreline or extended centreline within 75 m of the runway threshold.

5.3.33.3 The lighted “X” closed area marker at a taxiway/taxiway intersection is positioned on the centreline of the closed taxiway at the taxiway to object distance in Table 3.5.1.4.

5.3.33.4 A lighted “X” closed area marker is not used to indicate a taxiway closure as viewed from the runway.

Note: Lighted “X” closed area markers are not considered frangible and are positioned in a manner to ensure the required clearances from operational areas are maintained as stated in Chapters 3 and 4.

Characteristics

5.3.33.5 A lighted “X” closed area marker used for runway closure:

(a) is of a form and proportion displayed in Figure 5-58;

(b) contains a minimum of 9 evenly spaced white lights with maximum intervals of 1 m between centres having the minimum intensity specified in Figure 5-58;

(c) has adjustable aiming and levelling to allow tilting to an optimum angle of 3° from vertical; and

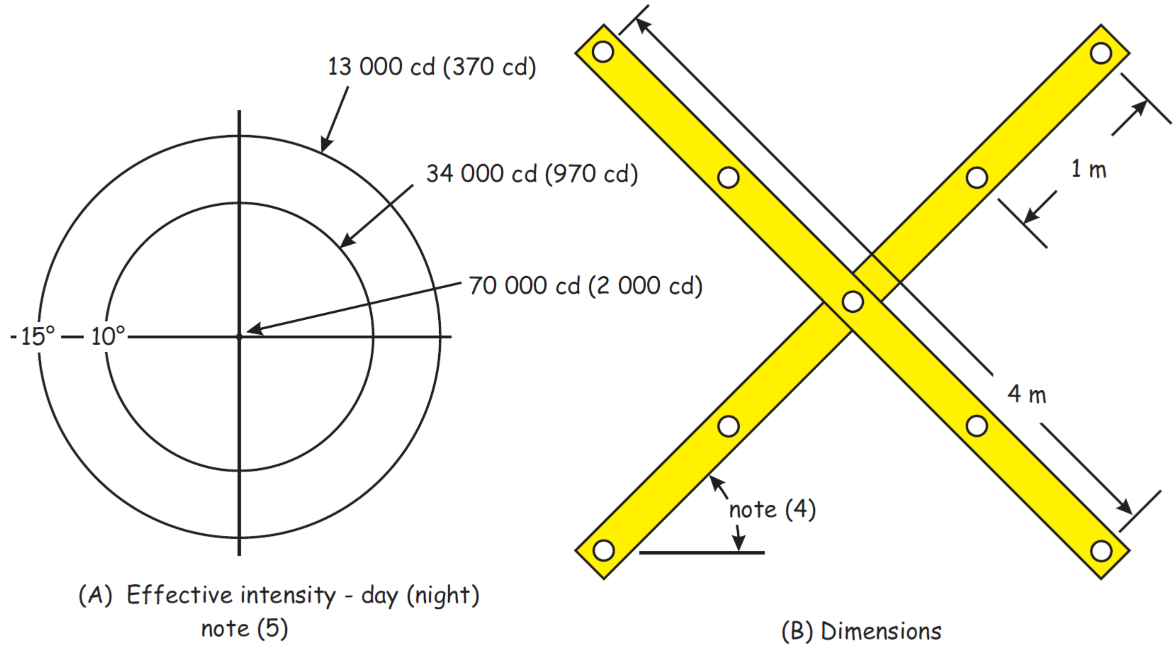
(d) provides the following daytime visual reference during clear conditions when placed on centreline and within 75 m of the runway threshold:

(i) visible to the pilot at a range of at least 5 NM [9.25 km];

(ii) recognizable as a letter "X" from a range of at least 1.5 NM [2.78 km].

Note 1: A runway lighted “X” closed area marker with suitable dimming capability would be usable for both runway and taxiway closures.

Note 2: See Figure 5-58 for depiction of a lighted “X” closed area marker.



Notes:

(1) Lamps to flash simultaneously with a cycle of 2.5 seconds on and 2.5 seconds off (± 20 %).

(2) Provide means for photocell selection of day and night intensity.

(3) Provide lamps with photometric distribution as indicated in (A).

(4) The light sources are arranged and arms crossed at an appropriate angle to make the "X" readily discernible.

(5) The minimum intensity for each light source is determined by dividing the specified minimum intensity by the number of light sources.

Figure 5-58: Lighted “X” closed area marker

5.4 SIGNS

5.4.1 General

Note 1: See section 5.4.7 for design characteristics of signs.

Note 2: See section 5.2.21 for the standards relating to painted sign pavement markings.

Application

5.4.1.1 Signs are as specified in this section.

Location

5.4.1.2 Except for road-holding signs, signs are installed in accordance with the criteria outlined in Table 5.4.1.2.

Table 5.4.1.2—Sign Sizes and Installation Criteria		
Installation Criteria:	**AGN** I - IIIA	**AGN** IIIB and above
Maximum installed height above grade to top of sign	180 cm	200 cm
Perpendicular distance from defined *taxiway* edge to near side of sign	5–11 m	11–21 m
Perpendicular distance from defined *runway* edge to near side of sign	3–11 m	8–21 m

Note: The actual installation height of the sign should take into consideration the clearance requirements to any overhanging aircraft parts, such as engine pods. See 5.4.1.6.

5.4.1.3 Signs associated with holding positions are co-located within 1 m before or after the imaginary extension of the holding position marking.

Characteristics

5.4.1.4 Signs are:

(a) frangible and have a frangible break point located 0 to 5 cm above grade; and

(b) constructed of light weight non-ferrous materials.

Note: See 5.4.7.24 for frangibility criteria.

5.4.1.5 Signs with metallic face and back panels do not interfere with surface radar or electronic navigation aids.

5.4.1.6 Signs near a runway or taxiway are sufficiently low to preserve a minimum of 15 cm clearance for propellers and the engine pods of jet aircraft.

5.4.1.7 Where signs are rectangular, the longer side is horizontal.

5.4.1.8 The only signs on the movement area using red are mandatory instruction signs.

5.4.1.9 The inscriptions on a sign are in accordance with section 5.4.7.

5.4.1.10 Subject to 5.4.1.11 and 5.4.5.5, signs are illuminated when used in support of operations:

(a) at night; or

(b) in visibility conditions below RVR1200 (¼ SM).

5.4.1.11 Signs positioned on private taxiways or taxiways serving non-instrument runways of AGNs I and II may be retroreflective and non-illuminated.

5.4.1.12 The luminance values over the face of internally and externally illuminated signs are within the ratios specified in 5.4.7.18.

Note: See 5.4.7.14 for sign luminance values.

5.4.1.13 The characters on a sign lighted using embedded fibre-optic elements are illuminated such that:

(a) the characters on mandatory instruction signs show red;

(b) the characters on information signs show white except that the characters on a location sign show yellow;

(c) the sign is legible when viewed from angles up to 80° from the optical axis; and

(d) a single lamp failure does not result in the character or any portion of the character being extinguished.

5.4.1.14 The colours on the sign are in accordance with Appendix 5A.

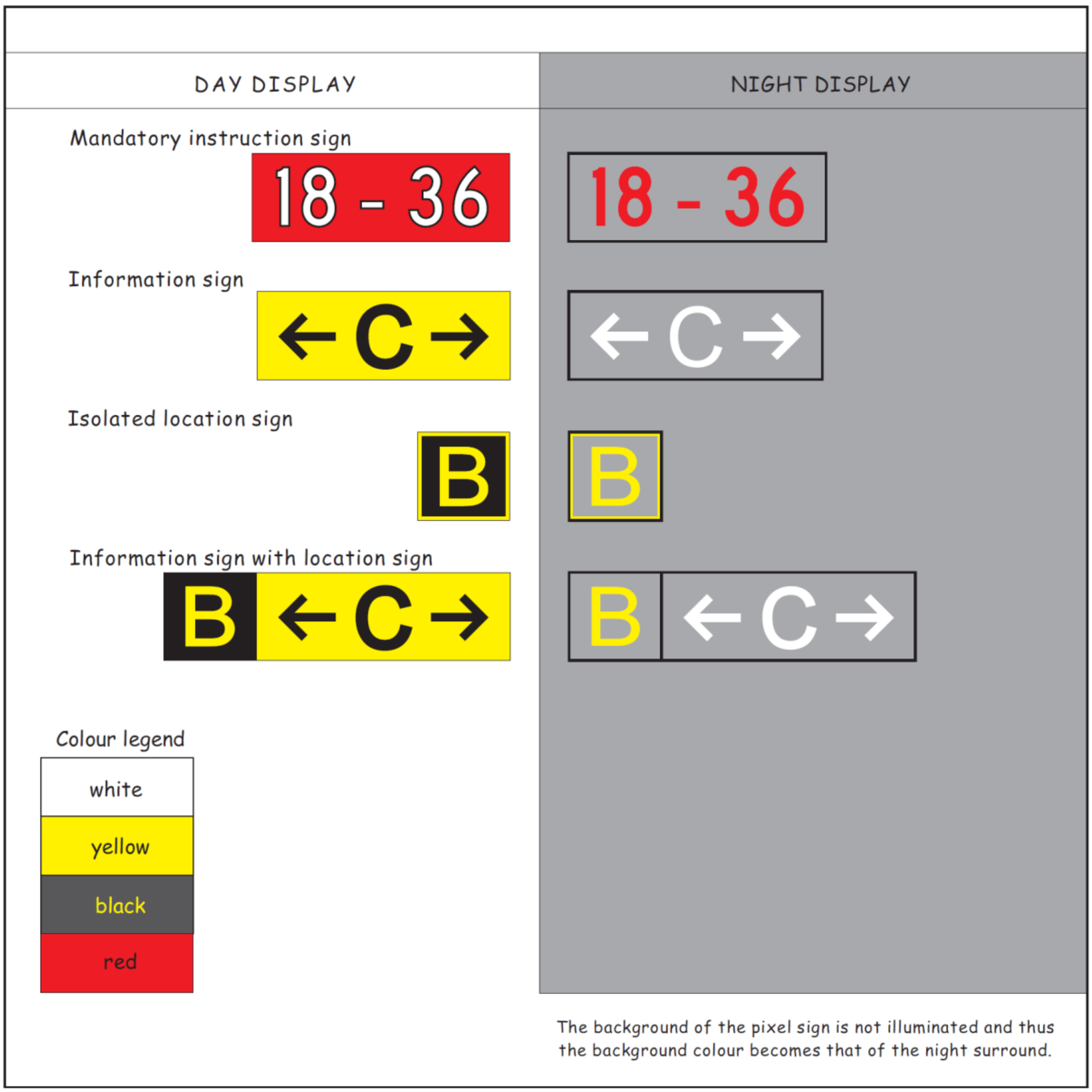


Figure 5-59: Colour display for pixel (fibre-optic) signs

5.4.2 Mandatory Instruction Signs

Note: See Figure 5-61 for pictorial representation of mandatory instruction signs and Figure 5-60 for examples of locating signs at taxiway/runway intersections.

General

5.4.2.1 Mandatory instruction signs include:

(a) runway designation signs;

(b) Category I, Category II, Category III or Category II/III runway-holding position signs;

(c) NO-ENTRY signs; and

(d) obstacle free zone signs such as APCH.

Note: See section 5.4.5 for specifications on road-holding position signs.

Application

5.4.2.2 A mandatory instruction sign is provided at a location beyond which an aircraft taxiing or vehicle does not proceed unless:

(a) authorized by the aerodrome control tower, where provided; or

(b) the pilot in command or vehicle operator has ascertained that the runway is clear.

5.4.2.3 A runway designation sign, or runway APCH sign supplements a pattern A runway-holding position marking, as described in section 5.2.16.

5.4.2.4 A Category I, Category II, Category III, Category II/III holding position sign;

(a) supplements a pattern B runway-holding position marking as described in section 5.2.16; and

(b) is only installed where ATC is provided.

Note 1: See Figure 5-60 for examples of runway designation, obstacle free zones, and CAT I, II and III signs.

Note 2: See Figure 5-12 for pattern A and pattern B holding position markings.

5.4.2.5 Where there is more than one (1) taxiway intersecting the runway, a runway designation sign at a taxiway/runway intersection is supplemented with a location sign in the outboard (furthest from the taxiway centreline) position.

Note: See section 5.4.3 for characteristics of location signs.

5.4.2.6 A NO-ENTRY sign is provided when entry into an area is prohibited.

Location

5.4.2.7 Subject to 5.4.2.8, mandatory instruction signs face the direction of approaching aircraft and are located equidistantly (±2.0m) on each side of a taxiway or runway, within the installation criteria stated in 5.4.1.2.

5.4.2.8 Where it is physically impossible to install both signs at a taxiway/runway intersection, one of the two signs may be omitted provided that a painted sign marking (mandatory instruction) is provided.

Note: See section 5.2.21 painted sign pavement markings.

5.4.2.9 A NO-ENTRY sign is located at the beginning of the area to which entrance is prohibited.

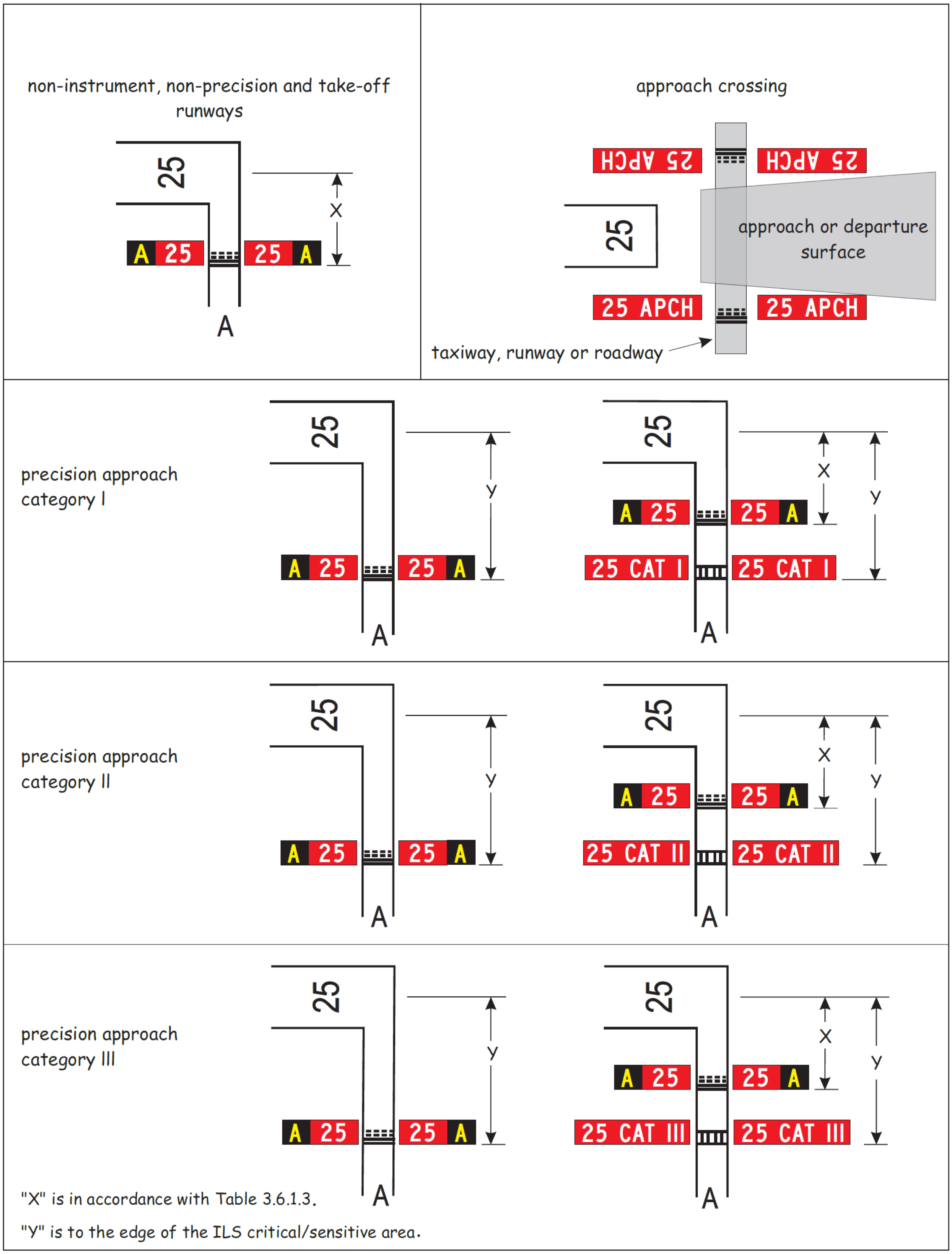


Figure 5-60: Examples of locating mandatory instruction signs at taxiway/runway intersections

Characteristics

5.4.2.10 Subject to 5.4.2.12, a mandatory instruction sign consists of an inscription (characters, arrows and symbols) in white on a red background.

5.4.2.11 Subject to 5.4.2.12, the inscription on a runway designation sign consists of the runway designation number 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. In cases of aerodromes located within the area of compass unreliability, the inscription on a runway designation sign consists of the exact runway azimuth as a three-digit number in degrees TRUE, properly oriented with respect to the viewing position of the sign (i.e., 258T - 078T).

5.4.2.12 A runway designation sign does not contain arrows except at:

(a) taxiway/runway/runway intersections or;

(b) runway/runway/runway intersections.

5.4.2.13 The inscription on a Category I, II or III holding position sign consists of the runway designation followed by CAT I, CAT II, CAT III or CAT II/III, as applicable.

5.4.2.14 The inscription on a NO-ENTRY sign is in accordance with Figure 5-61 and section 5.4.7.

5.4.2.15 As appropriate, the inscription on a mandatory instruction sign is as shown in Figure 5-61.

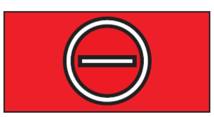
Runway designation of a runway extremity	25	Indicates a runway-holding position at a runway extremity. Note: For single runway designators, the width of the sign is increased to make the red background more conspicuous.
Runway designation of both extremities of a runway	25-07	Indicates runway-holding position located at other than a runway extremity. A runway holding position sign at a runway/runway intersection does not include a location sign.
	↙ 27-09 | 33-15 ↘	Indicates a runway holding position at runway/runway/taxiway, or runway/runway/runway intersection.
ILS/MLS Category I hold position	25 CAT I	Indicates a Category I runway-holding position at the threshold of a runway (e.g. rwy 25).
ILS/MLS Category II hold position	25 CAT II	Indicates a Category II runway-holding position at the threshold of a runway (e.g. rwy 25).
ILS/MLS Category III hold position	25 CAT III	Indicates a Category III runway-holding position at the threshold of a runway (e.g. rwy 25).
ILS/MLS Category II and II hold position	25 CAT II/III	Indicates a joint Category II and III runway-holding position at the threshold of a runway (e.g. rwy 25).
NO ENTRY		Indicates that entry to an area is prohibited.
Approach or departure surface holding position	25 APCH	Indicates a runway holding position that has been established for the protection of an approach or departure surface OLS to a runway

Figure 5-61: Mandatory instruction signs

5.4.3 Information Signs

Note: See Figures 5-62, 5-63, 5-64 and 5-65 for pictorial representations of information signs.

Application

5.4.3.1 An information sign is provided where:

(a) an intermediate holding position marking is established,

(b) there is an operational need to identify a specific destination, location, frequency or routing information.

5.4.3.2 Information signs include direction signs, location signs, destination signs, frequency signs, runway exit signs, runway vacated signs, and runway distance remaining signs.

5.4.3.3 A runway exit sign is provided where there is an operational need to identify the runway exit.

5.4.3.4 A runway-vacated sign is provided where the exit taxiway is not provided with taxiway centreline lights and there is a regular need for a pilot to report clearing the obstacle free zone.

Location

5.4.3.5 Subject to 5.4.3.7, information signs are, wherever practicable, located on the left-hand side of the taxiway

5.4.3.6 Subject to 5.4.3.7, at a taxiway intersection, information signs are located:

(a) prior to the intersection, and

(b) in line with the intermediate holding position marking, where provided.

Note: See section 5.2.17 for information on intermediate holding position markings.

5.4.3.7 Where a direction sign is provided at a “T” intersection the sign may be installed on the opposite side (top of the “T”) of the intersection facing the taxiway.

Note: See Figure 5-62 for depiction.

5.4.3.8 The runway exit sign is located on the same side of the runway (left or right) as the exit.

5.4.3.9 Runway exit signs are located prior to the runway exit at a minimum distance, from the point of tangency of the taxiway centreline with the runway centreline, of:

(a) 30 m where the AGN is I–IIIA; and

(b) 60 m where the AGN is IIIB and above,

Exception: Runway exit signs may be installed prior to the point of intersection of the taxiway centreline extended perpendicular to the runway centreline where multiple/complex exits present an installation or operational issue.

5.4.3.10 The location sign installed in conjunction with a runway designation sign is positioned outboard of the runway designation sign.

5.4.3.11 An information sign other than a location sign is not co-located with a mandatory instruction sign.

5.4.3.12 The runway-vacated sign is located on the backside of the holding position sign.

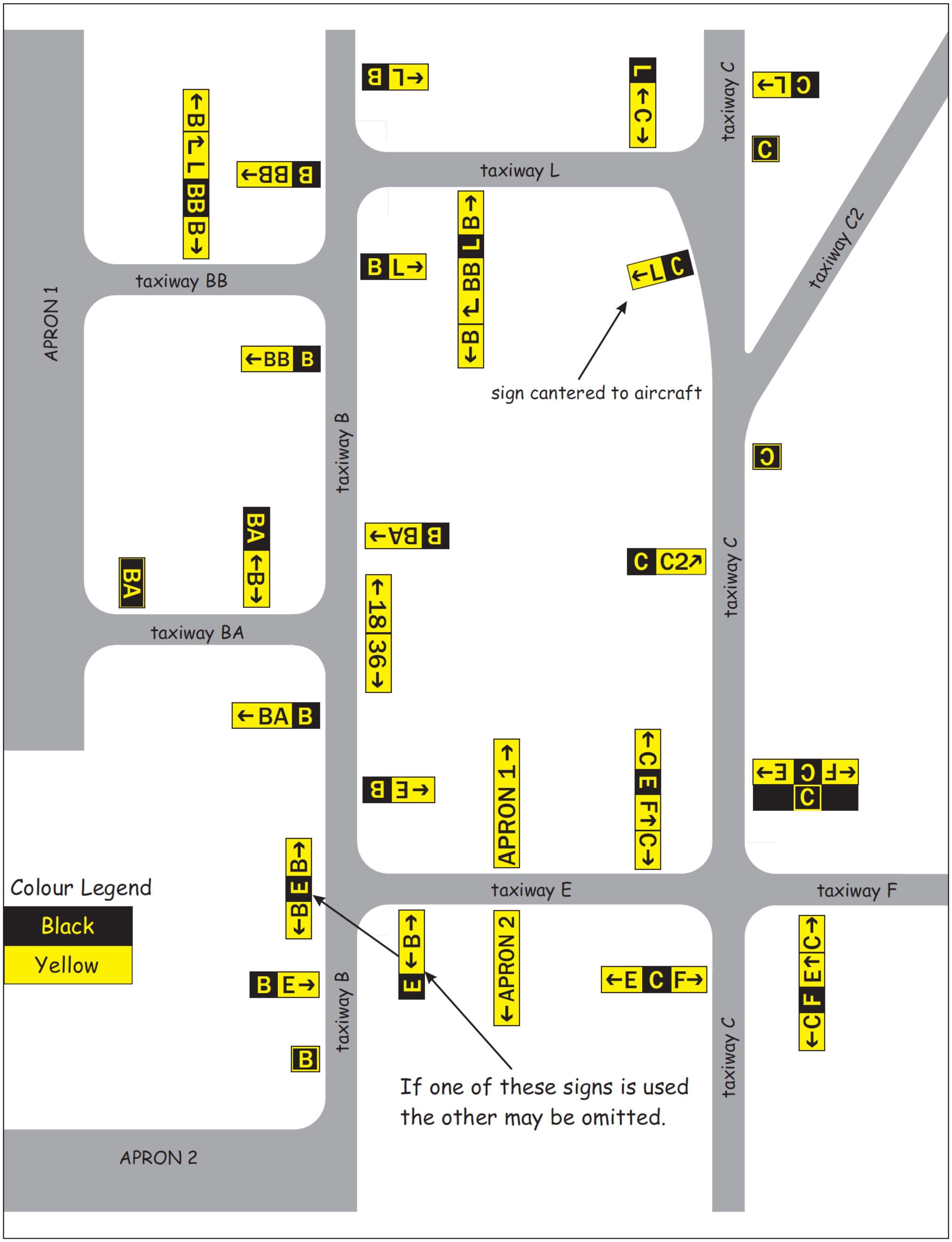


Figure 5-62: Examples of locating information signs

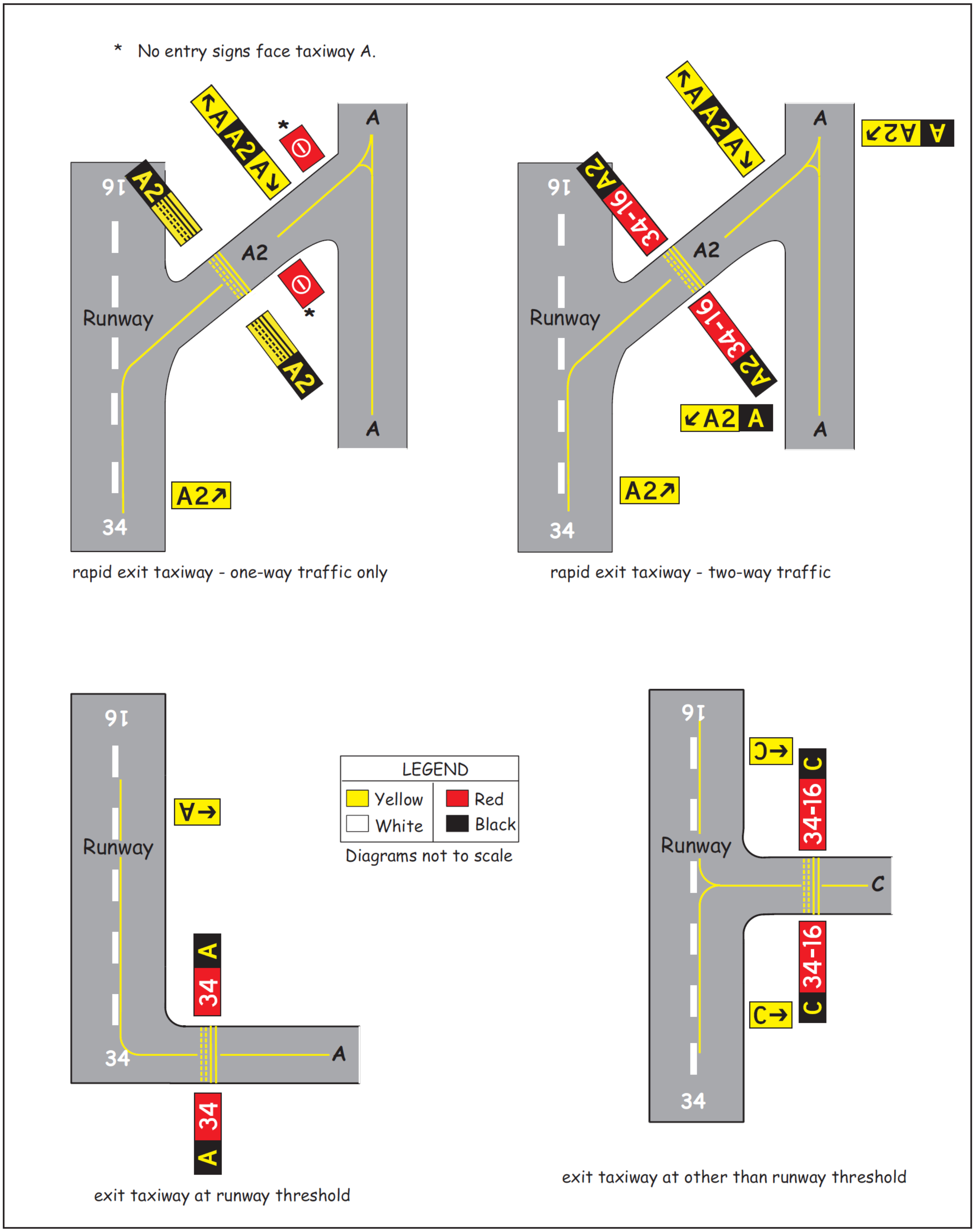


Figure 5-63: Examples of locating runway exit and vacated signs

Characteristics

5.4.3.13 The direction sign is combined with a location sign, except that a sign installed at the top of a "T" intersection may omit the location sign.

5.4.3.14 At an intersection of a taxiway and runway, a location sign is combined with a runway designation sign, except with a CAT I, II or III mandatory instruction sign.

5.4.3.15 Subject to 5.4.3.16, an information sign consists of an inscription in black on a yellow background.

5.4.3.16 A location sign:

(a) consists of an inscription in yellow on a black background; and

(b) has a yellow border where it is a stand-alone sign.

5.4.3.17 A runway-vacated sign is as depicted in Figure 5-64.

5.4.3.18 The inscription on a runway exit sign consists of the designator of the exit taxiway and an arrow indicating the direction to follow.

5.4.3.19 The inscription on a destination sign comprises an alpha, alphanumeric or numeric message identifying the destination plus an arrow indicating the direction to follow.

5.4.3.20 The inscription on a direction sign comprises an alpha or alphanumeric message identifying the route plus an arrow or arrows indicating the route to follow.

5.4.3.21 The inscription on a location sign comprises the designation of the location, taxiway, or other pavement the aircraft is on or is entering and is without arrows.

5.4.3.22 Where a location sign and direction signs are used in combination to provide routing guidance:

(a) all left turn direction signs are located to the left of the location sign and all right turn direction signs are located to the right of the location sign except that where the junction consists of one intersecting taxiway, the location sign may alternatively be placed in the outboard position;

(b) the direction signs are placed such that the direction of the arrows departs increasingly from the vertical with increasing deviation of the corresponding taxiway;

(c) an appropriate direction sign is placed next to the location sign where the change in direction of the location taxiway beyond the intersection, exceeds 25°; and

(d) adjacent direction signs are delineated by a vertical black line.

Note: See Figure 5-64 for examples of location/direction signs used in combination.

5.4.3.23 A taxiway is identified by a unique designator comprising one or more alpha characters or alphanumeric characters and has a designated start and end point.

5.4.3.24 The use of numbers alone on the manoeuvring area is reserved for the designation of runways.

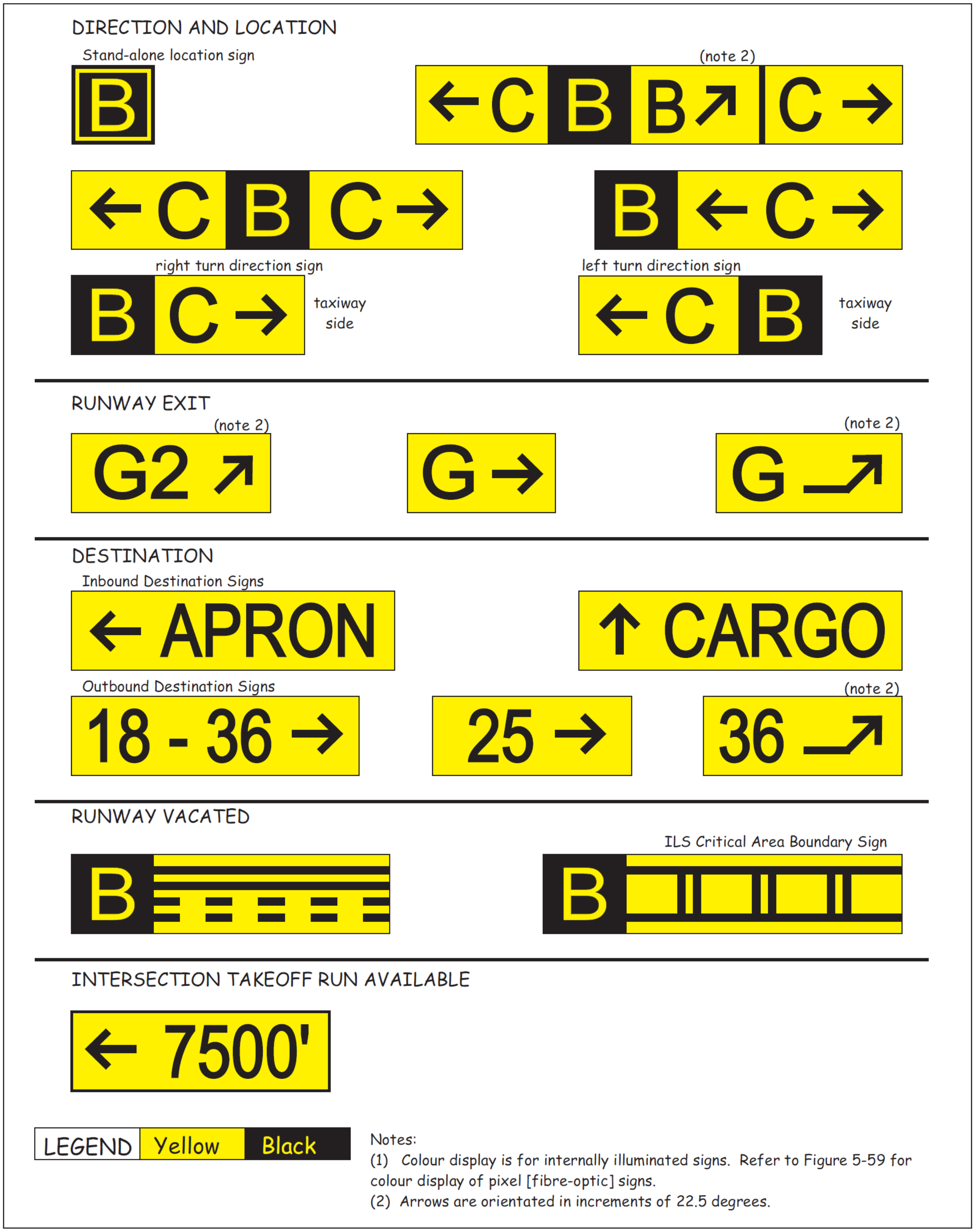


Figure 5-64: Examples of information signs

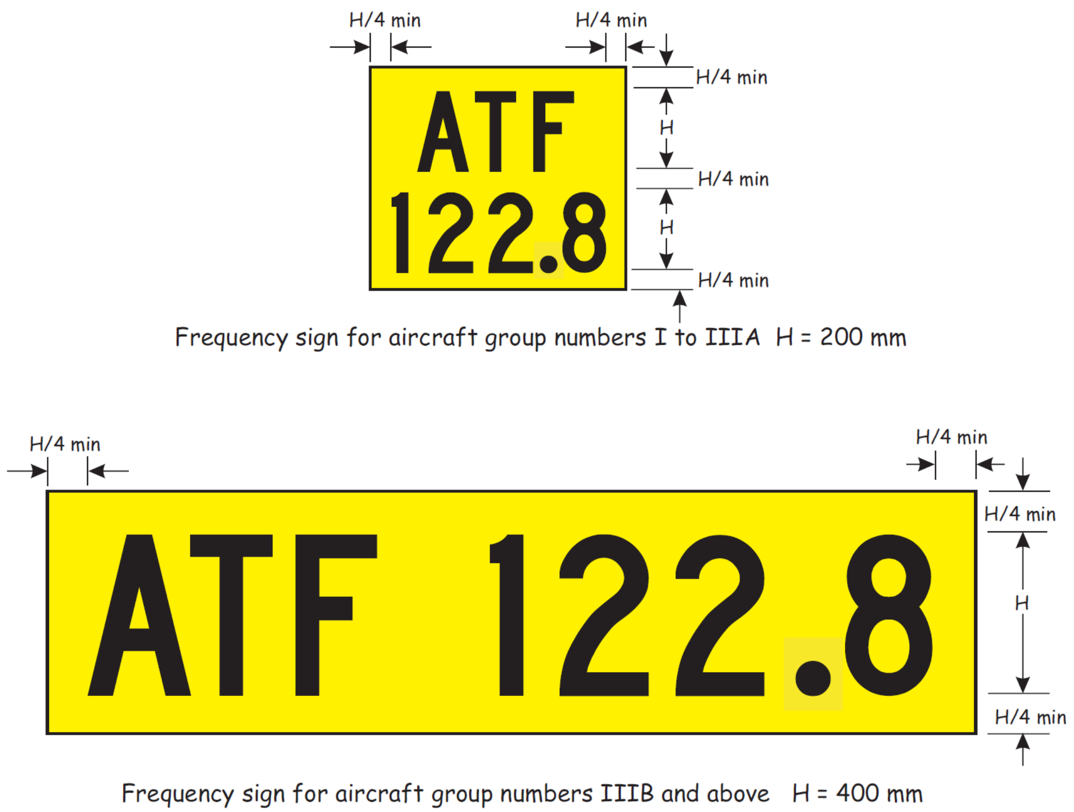


Figure 5-65: Examples of frequency signs

5.4.4 Aircraft Stand Identification Signs

5.4.4.1 Where provided, an aircraft stand identification sign consists of an inscription in black on a yellow background.

5.4.5 Road-Holding Position Sign

Note: See Figure 5-66 for examples of road-holding position signs.

Application

5.4.5.1 A road-holding position sign is provided at all road-holding positions of runway and taxiways.

Note: See 5.2.18 for specification on road-holding position markings.

Location

5.4.5.2 The road-holding position sign is located 1.0 m to 3.0 m from the edge of the road at the holding position.

Characteristics

5.4.5.3 The road holding position sign:

(a) is of octagonal shape;

(b) includes a requirement to stop;

(c) has white characters and border on a red background; and

(d) is at least 60 cm wide by 60 cm high.

5.4.5.4 The road-holding position sign installation comprises an instruction sign with the following information:

(a) where ATC/on-site FSS is provided, the contact information to obtain clearance to proceed;

(b) where no ATC/on-site FSS is provided, a requirement to broadcast intention on the MF or aerodrome traffic frequency (ATF), and

(c) a location designator.

5.4.5.5 A road-holding position sign intended for night use is retroreflective or illuminated.

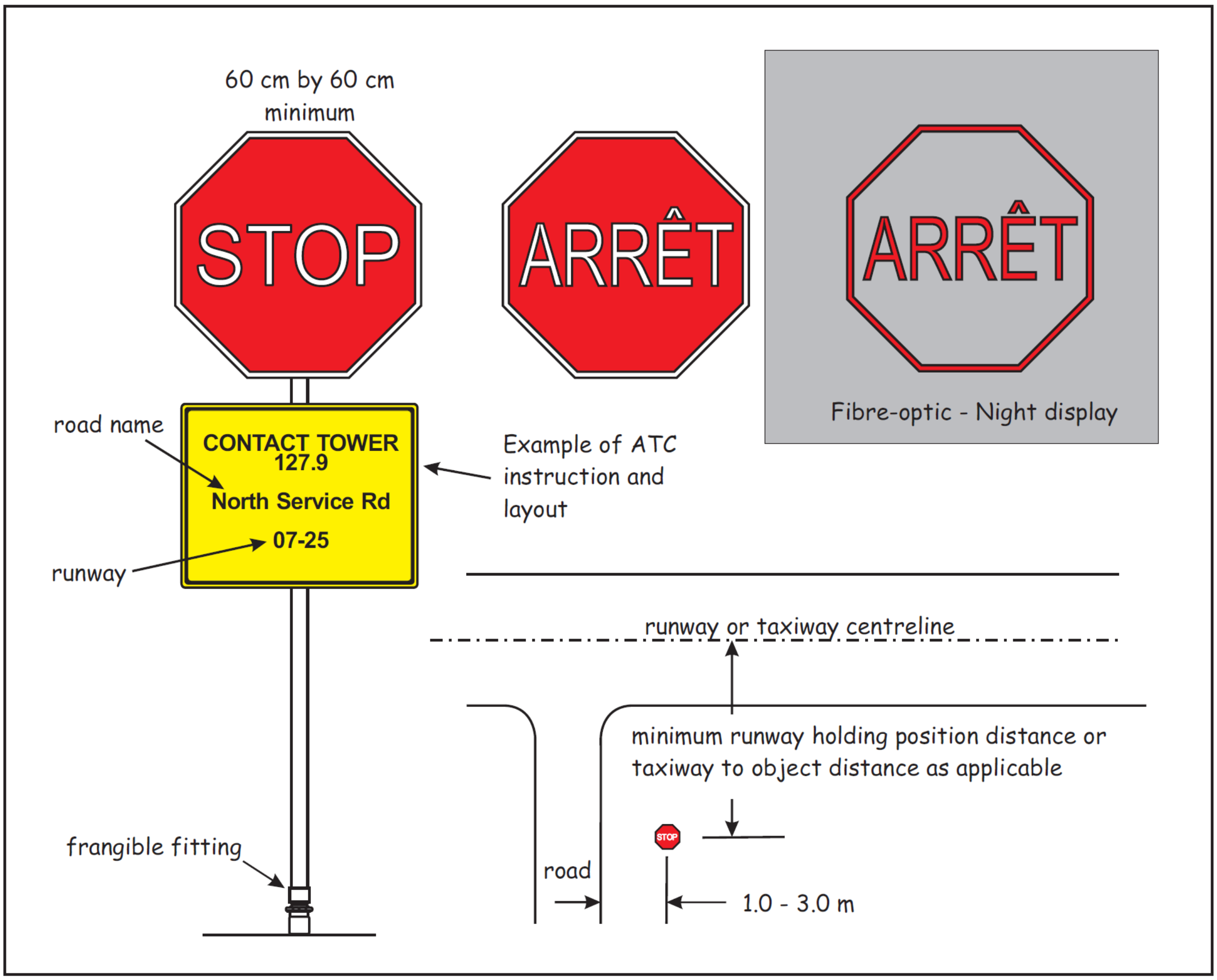


Figure 5-66: Road-holding position sign

5.4.6 Runway Distance Remaining Signs

Application

5.4.6.1 Where provided, runway distance remaining signs are installed in accordance with the specifications in this section.

Location

5.4.6.2 Distance remaining signs are installed as per one of the following methods:

(a) Method #1 consists of double-faced signs installed along the left side of the runway as viewed in the take-off direction, preferably the most used direction. For runway lengths, which are not exact multiples of 1 000 ft, one half of the remaining distance is added to distance of each sign on each runway end;

(b) Method #2 consists of single-faced signs on both sides of the runway;

(c) Method #3 consists of a single double-faced sign installed along the left side of the runway as viewed in the take-off direction, preferably the most used direction, depicting a “½” symbol. This method is only permissible for use on a runway that is less than 3 000 ft in length.

Note: See Figure 5-67 for depiction of runway distance remaining sign configuration.

5.4.6.3 Displaced areas, which are to be used for take-offs and/or rollout, are treated as part of the runway for locating the signs.

5.4.6.4 Subject to 5.4.6.5, signs are located as follows:

(a) methods # 1 and # 2—1 000 ft (±50 ft) intervals, along the full length of the runway;

(b) method # 3—at midpoint, (±50 ft), of the runway length.

5.4.6.5 Where the sign cannot be installed within the 50 ft tolerance, it is omitted

Characteristics

5.4.6.6 The runway distance remaining sign consists of an inscription in white on a black background.

5.4.6.7 The form of characters on the runway distance remaining sign conforms to Figures 5-69 (g) and (h), as appropriate.

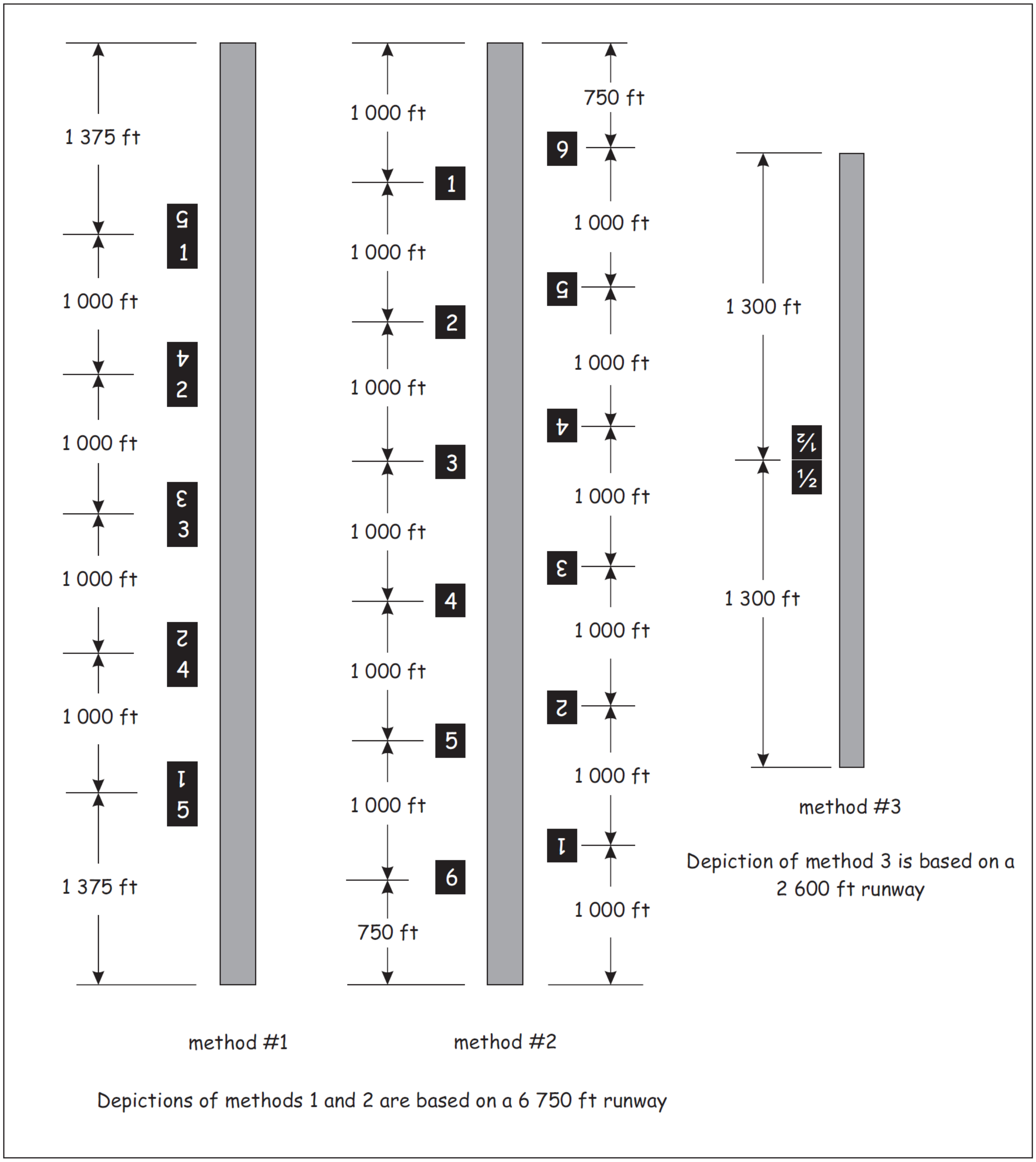


Figure 5-67: Runway distance remaining signs

5.4.7 Design Requirements

Note: The following design requirements are applicable to mandatory instruction and information signs (collectively known as guidance signs) to be located on the movement area of an aerodrome.

Sign Face and Character Dimensions

5.4.7.1 The characters on a sign are of uniform height (±2 mm) in accordance with Table 5.4.7.1.

Table 5.4.7.1—Sign Face Height and Character Dimensions (millimetres)						
	Mandatory instruction, and runway exit information signs		Location, direction, destination, etc. information signs		Runway distance remaining signs	
Aircraft Group Number	**I - IIIA**	**IIIB and above**	**I - IIIA**	**IIIB and above**	**I - IIIA**	**IIIB and above**
Vertical Dimensions:						
Minimum character height (H)	300	400	200	400	600	1 000
Minimum face height (H + 2*H/4)	450	600	300	600		
Minimum face height (H + 2*H/10)					720	1 200

5.4.7.2 Where signs of differing minimum character heights are located together to form an array, the signs are of uniform dimensions, conforming to the larger of the character heights (e.g. location sign co-located with a runway designation sign).

5.4.7.3 Subject to 5.4.7.4, the face size, legend dimensions and character spacings are in proportion to the given character height, in accordance with Figure 5-68(a) and (b).

5.4.7.4 The face size and character dimensions on a runway vacated sign are in accordance with Figure 5–69 (e); on a NO-ENTRY sign, they are in accordance with Figure 5–69 (f).

Borders

5.4.7.5 Where a location sign is not used to form part of an array, it has a yellow border surrounding the sign. The width of the border is 50% [±3mm] of the width of the stroke used to make the location sign inscription.

Delineator

5.4.7.6 Where signs have been combined together to form an array, the individual signs are separated by a vertical black stripe [delineator] between sign inscriptions. The width of the delineator is 70% [±3mm] of the width of the stroke used to make the sign inscription.

Sign Character Size and Spacing

5.4.7.7 The size, form, and proportion of sign characters used to form the inscriptions on signs is in accordance with Sub-tables 1 to 4 of Table 5.4.7.7, and Figure 5-69 (a) to (d).

Note: The character form in Figures 5-69 (a) to (d) is based upon Series D of the Federal Highways Administration (FHWA) Standard Alphabets 1977, while Figure 5-69 (g) is based on Series C. The grid size is 5 mm such that the character height is 50 mm. The characters may be enlarged to the desired letter height by any conventional enlarging process and the characters will remain proportional. For example to obtain a 300 mm letter or numeral height, the character is enlarged by a factor of 6.

5.4.7.8 The spacing between words, or a word and character or numeral, is in accordance with code 2 in Sub-table 4 of Table 5.4.7.7. Dimensional tolerance is ±6 mm.

5.4.7.9 Signs made in multiple sections appear to the viewer as displaying a single message element.

5.4.7.10 The space between multiple signs forming an array is 7.5 cm to 30 cm.

Black Outline

5.4.7.11 The characters of mandatory Instruction signs are outlined in black. The width of the outline is:

(a) 10 mm (±3 mm) for a sign with a character height not exceeding 300 mm;

(b) 20 mm (±3 mm) for a sign with a character height greater than 300 mm.

Note: See Figure 5-68(b) for information on black outlining.

Table 5.4.7.7—Character Widths and Spacings

Note: To determine the proper space between characters (letters or numerals), obtain the code number from sub-table 1 and look for that code number in sub-table 4 with reference to the desired character height. Dimensional tolerance is ±2 mm, except sub-table 4 is ±6 mm.

Sub-table 1 CHARACTER TO CHARACTER CODE NUMBER

Preceding Character	Following Character: B, D, E, F, H, I, K, L, M, N, P, R, U, 1, 5	Following Character: C, G, O, Q, S, X, Z, 2, 3, 6, 8, 9, 0	Following Character: A, J, T, V, W,Y, 4, 7
A	2	2	4
B	1	2	2
C	2	2	3
D	1	2	2
E	2	2	3
F	2	3	3
G	1	2	2
H	1	1	2
I	1	1	2
J	1	1	2
K	2	2	3
L	2	2	4
M	1	1	2
N	1	1	2
O	1	2	2
P	1	2	2
Q	1	2	2
R	1	2	2
S	1	2	2
T	2	2	4
U	1	1	2
V	2	2	4
W	2	2	3
X	2	2	3
Y	2	2	4
Z	2	2	3
1	1	1	2
2	1	2	2
3	1	2	2
4	2	2	4
5	1	2	2
6	1	2	2
7	2	2	4
8	1	2	2
9	1	2	2
0	1	2	2

Sub-table 2 WIDTH OF CHARACTER (mm)

	Letter Height (mm): 200	300	400
A	170	255	340
B	137	205	274
C	137	205	274
D	137	205	274
E	124	186	248
F	124	186	248
G	137	205	274
H	137	205	274
I	32	48	64
J	127	190	254
K	140	210	280
L	124	186	248
M	157	236	314
N	137	205	274
O	143	214	286
P	137	205	274
Q	143	214	286
R	137	205	274
S	137	205	274
T	124	186	248
U	137	205	274
V	152	229	304
W	178	267	356
X	137	205	274
Y	171	257	342
Z	137	205	274

	Numeral height (mm): 200	300	400	600*(2)*	1000*(2)*
1	50	74	98	148	208
2	137	205	274	210	556
3	137	205	274	210	556
4	149	224	298	448	620
5	137	205	274	210	556
6	137	205	274	210	556
7	137	205	274	210	556
8	137	205	274	210	556
9	137	205	274	210	556
0	143	214	286	428	588
½				605	

Sub-table 3 WIDTH OF STROKE

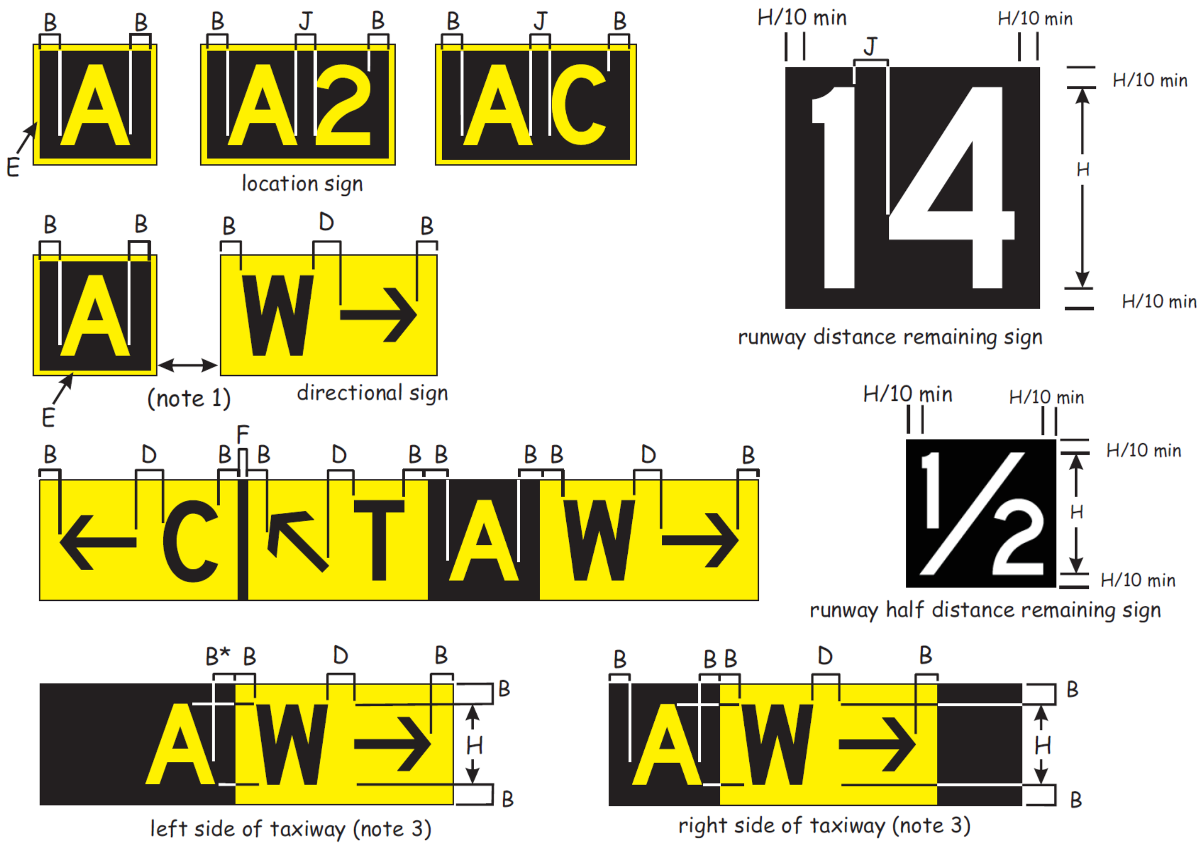
Character Height (mm)	Stroke Width (mm)
200	32
300	48
400	64
600 *(Note 2)*	84
1000 *(Note 2)*	140

Sub-table 4 SPACE BETWEEN CHARACTERS (mm) ***Note 1***

Code #	Character Height (mm): 200	300	400	600*(2)*	1000*(2)*
1	48	71	96	129	213
2	38	57	76	102	172
3	25	38	50	69	113
4	13	19	26	33	57

Note 1: For sub-table 4, the space is measured horizontally from the extreme right edge of the preceding character to the extreme left edge of the following character.

Note 2: The 600 and 1 000 mm numeral heights in this table are based on FHWA Series C for use with Figure 5-69(g) and limited for use on the runway distance remaining signs. Stroke width for the characters and diagonal of the half distance remaining sign is shown in Figure 5-69(h) and based on FHWA Series D.



(1) Where multiple signs are used in an array, the separation is 75 to 300 mm.

(2) Where the location sign is physically separate, it is provided with a rectangular border.

(3) Any left-over panel area that is not used by a legend is coloured black and the legend justified towards the adjacent taxiway/runway. * The location sign character is positioned at distance B [± 6 mm].

(4) Dimensions are for the exposed panel and do not include the sign frame, with exception of runway distance remaining signs.

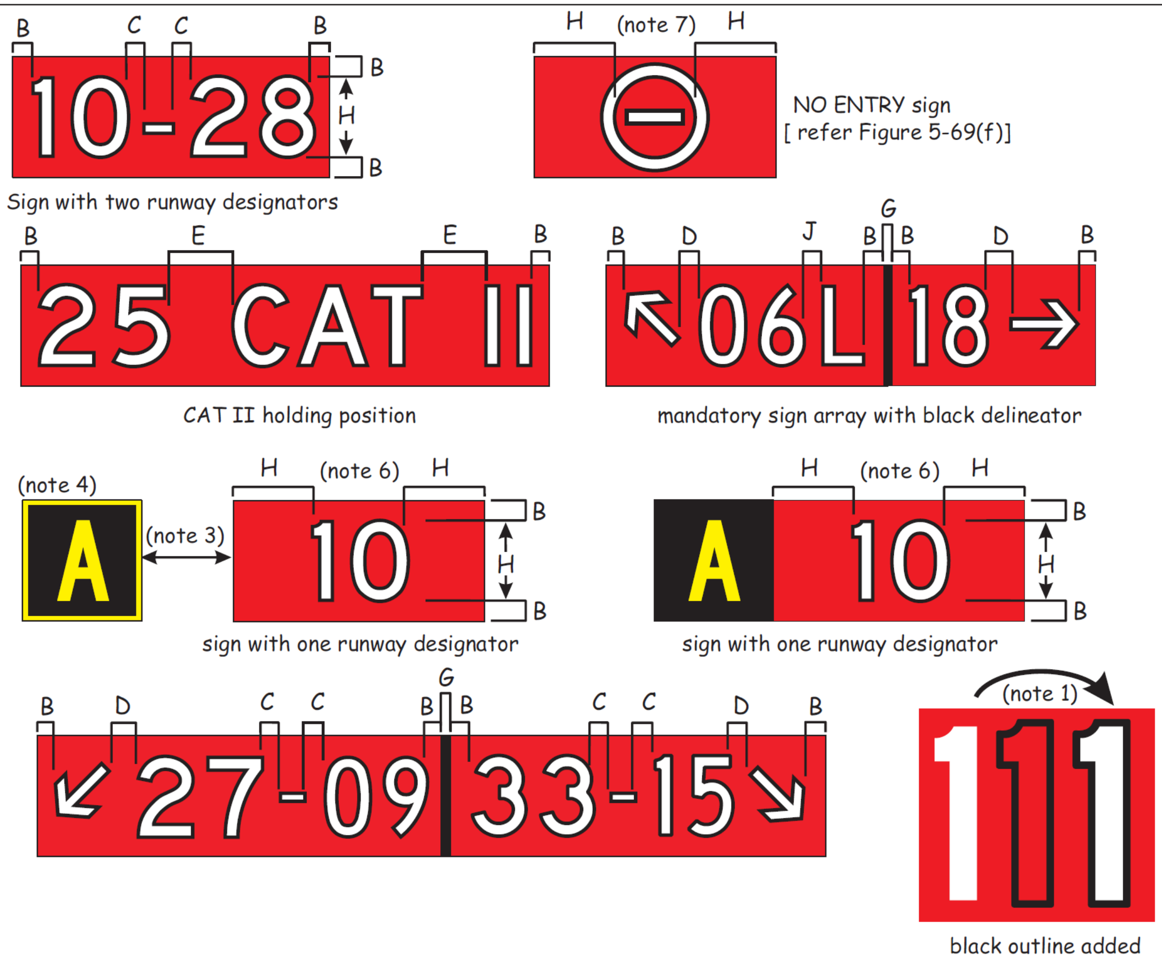
(5) The space between words or groups of characters forming an abbreviation or symbol should be equal to 0.5 to 0.75 of the height of the characters used except that where an arrow is located with a single character such as 'A ->', the space may be reduced to not less than one quarter of the height of the character in order to provide a good visual balance.

SPACING FOR BORDERS, MESSAGE DIVIDERS & ARROWS (millimetres)

H	200	300	400	600	1000	Character height
B	50	75	100	---	---	Minimum spacing between LEGEND and border or EDGE of exposed sign face [H/4]
	---	---	---	96	160	[H/10 for runway distance remaining signs]
E	16	24	32	---	---	Border of Location sign [width is 0.5 of the stroke width = H/12.5]
D	0.5 - 0.75 H			---	---	Spacing range between ARROW and letter, numeral or symbol [refer note 5]
F	22	34	45	---	---	Black delineator between directional signs [0.7 of stroke width]
J	Character to character spacing. Refer Table 5.4.7.7, subtable 4					
S	32	48	64	84	140	Stroke width

Legends heights of 200, 300 and 400 mm are FHWA Style D. Runway distance remaing signs are 600 and 1000 mm in FHWA Style C. Runway half distance remaining sign has proportioned numbers and are FHWA Style D.

Figure 5-68 (a): Legend dimensions (signs)



(1) A black outline is applied to the outside of the letter/numeral character of mandatory signs such that the required stroke width (white) is not reduced. The outline is 10mm in width for a sign with a character height up to 300mm and 20mm in width for a sign with a character height of 400mm.

(2) Character separation of mandatory signs is measured to the white character, not to the black outline.

(3) Where multiple signs are used in an array, the separation is 75 to 300 mm.

(4) Where the location sign is physically separate, it is provided with a yellow border.

(5) Dimensions are for the exposed panel and do not include the sign frame.

(6) Stand-alone runway designator sign and NO ENTRY have H spacing to the edge to provide more red.

(7) Dimension H is measured from the inside diameter of the white symbol.

SPACING FOR BORDERS, MESSAGE DIVIDERS & ARROWS (millimetres)

H	200	300	400	Character Height
S	32	48	64	Stroke width
B	50	75	100	Minimum spacing between LEGEND and EDGE of exposed sign face [H/4]
C	48	71	96	Spacing between dash or dot and letter or numeral [code 1]
D	0.5 - 0.75 H			Spacing range between ARROW and letter, numeral or symbol.
E	0.5 - 0.75 H			Character GROUP SPACE (spacing between "CAT" and any legend or symbol).
G	22	34	45	Black delineator [0.7 of stroke width]
J	Character to character spacing. Refer Table 5.4.7.7, subtable 4			

Figure 5-68 (b): Legend dimensions (signs)

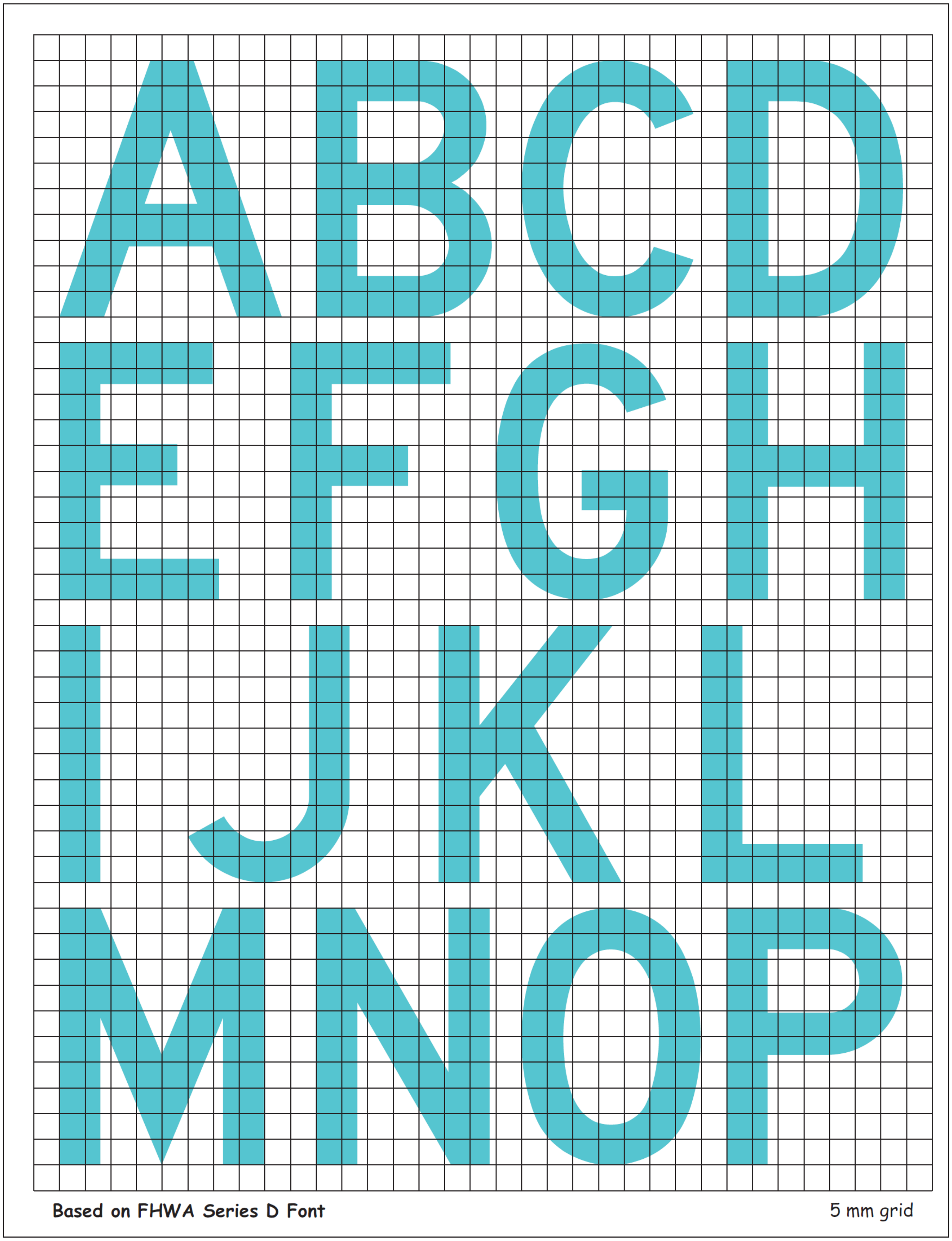


Figure 5-69 (a): Forms of characters (signs)

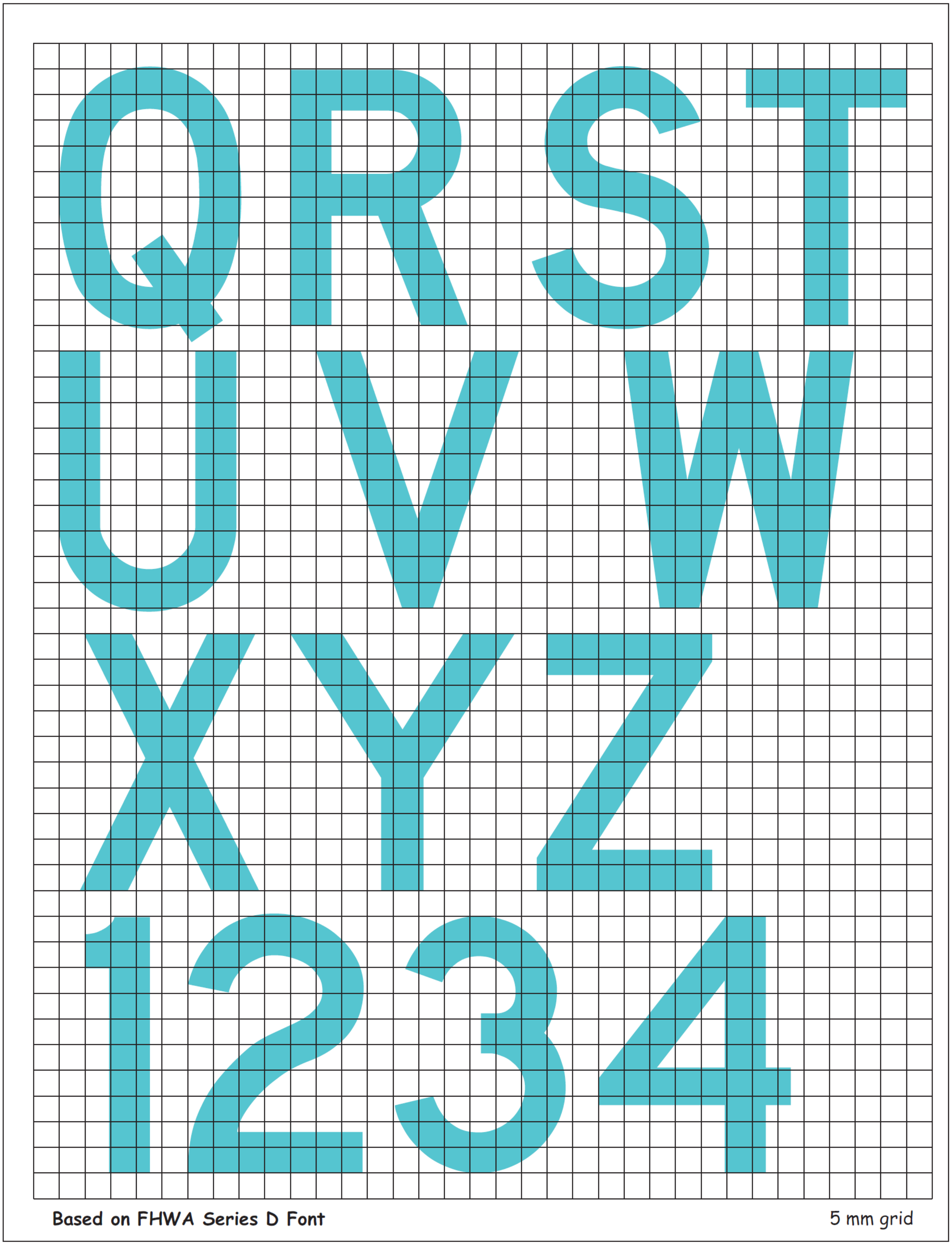


Figure 5-69 (b): Forms of characters (signs)

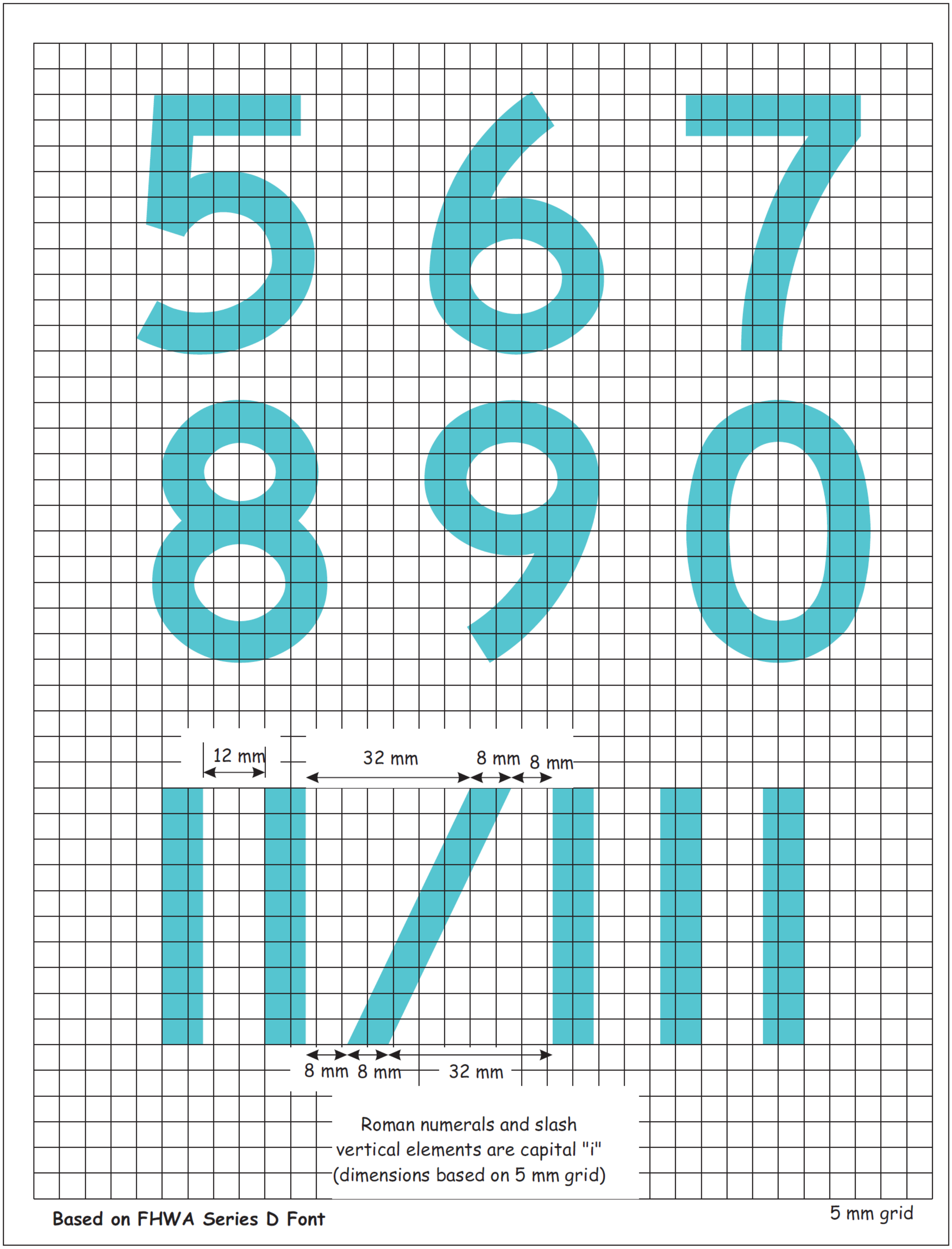
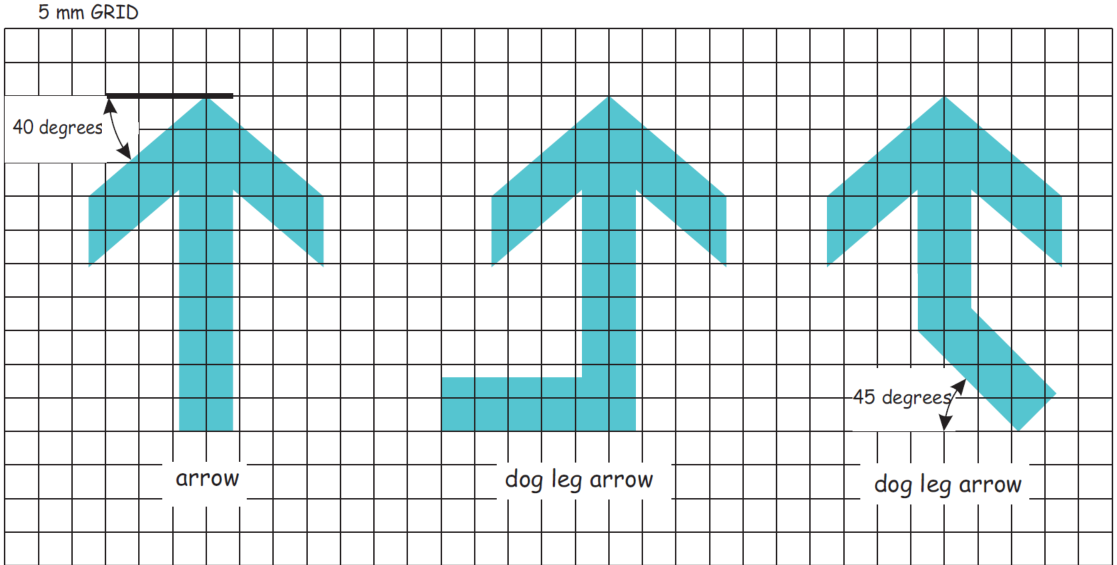
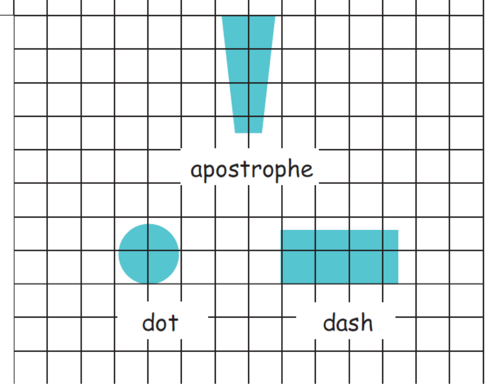


Figure 5-69 (c): Forms of characters (signs)



Character height(mm)	50	200	300	400
stroke width	8	32	48	64
dot diameter	8	32	48	64
dash length	17.5	70	105	140
arrow width	35	140	210	280
arrow height	50	200	300	400
apostrophe height	17.5	70	105	140
apostrophe top	8	32	48	64
apostrophe bottom	4	16	24	32

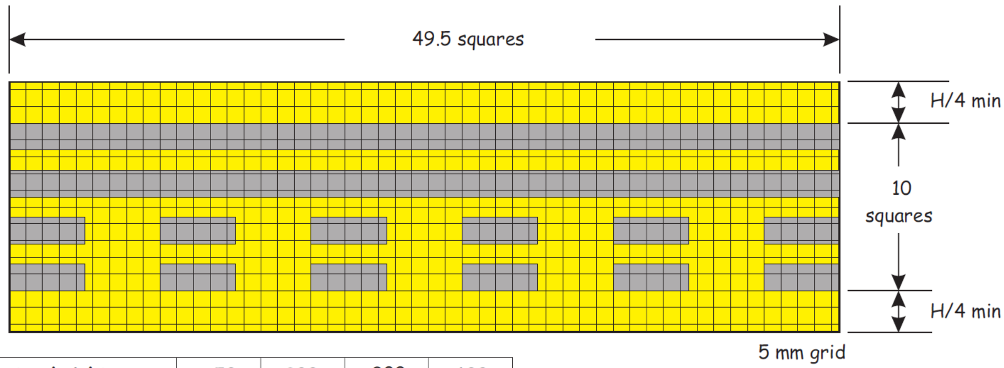


Based on FHWA Series D Font

(a) The arrow angles are in increments of 22.5 degrees.

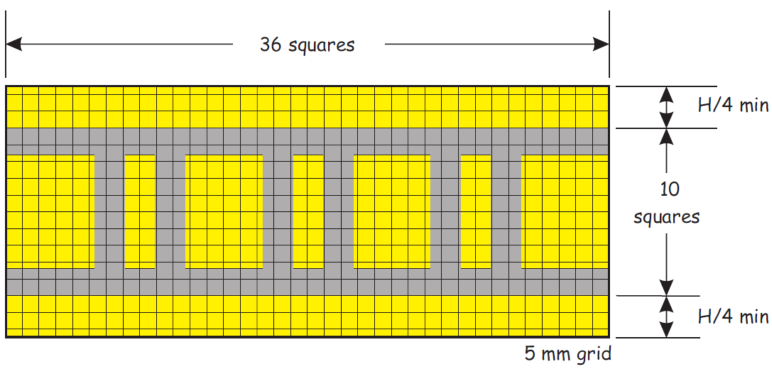
(b) The dot dash and arrow are centred within the vertical viewable panel area. The dog leg arrow is positioned so that the arrow portion is centred.

Figure 5-69 (d): Forms of characters (signs)



Character height	50	200	300	400
overall length	247.5	990	1485	1980
dash length	22.5	90	135	180
dash spacing	22.5	90	135	180
stroke width	8	32	48	64
vertical space	6	24	36	48

(a) Runway Vacated Sign - CAT I

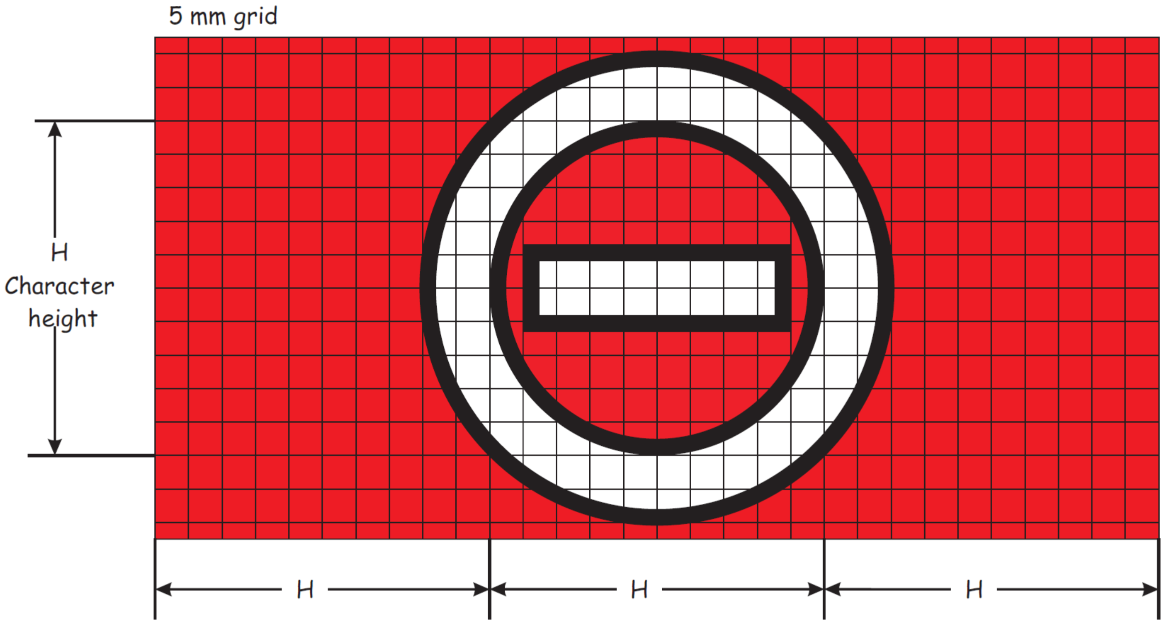


Character height	50	200	300	400
overall length	180	720	1080	1440
stroke width	8	32	48	64

(b) Runway Vacated Sign - CAT II or III

Note: Dimensions are in millimeters

Figure 5-69 (e): Forms of characters—runway vacated signs



Character Height	50 mm	200 mm	300 mm	400 mm
outside diameter	66 mm	264 mm	396 mm	528 mm
inside diameter	50 mm	200 mm	300 mm	400 mm
dash length	35 mm	140 mm	210 mm	280 mm
stroke width	8 mm	32 mm	48 mm	64 mm
outline width	2.5 mm	----	10 mm	20 mm

Note : The outline widths for 300 mm and 400 mm signs are not proportional. The 200 mm size is not used for mandatory signs. For purpose of illustration the outline in the 50 mm sign is proportional to the 400 mm sign.

Figure 5-69 (f): Forms of characters—NO ENTRY sign

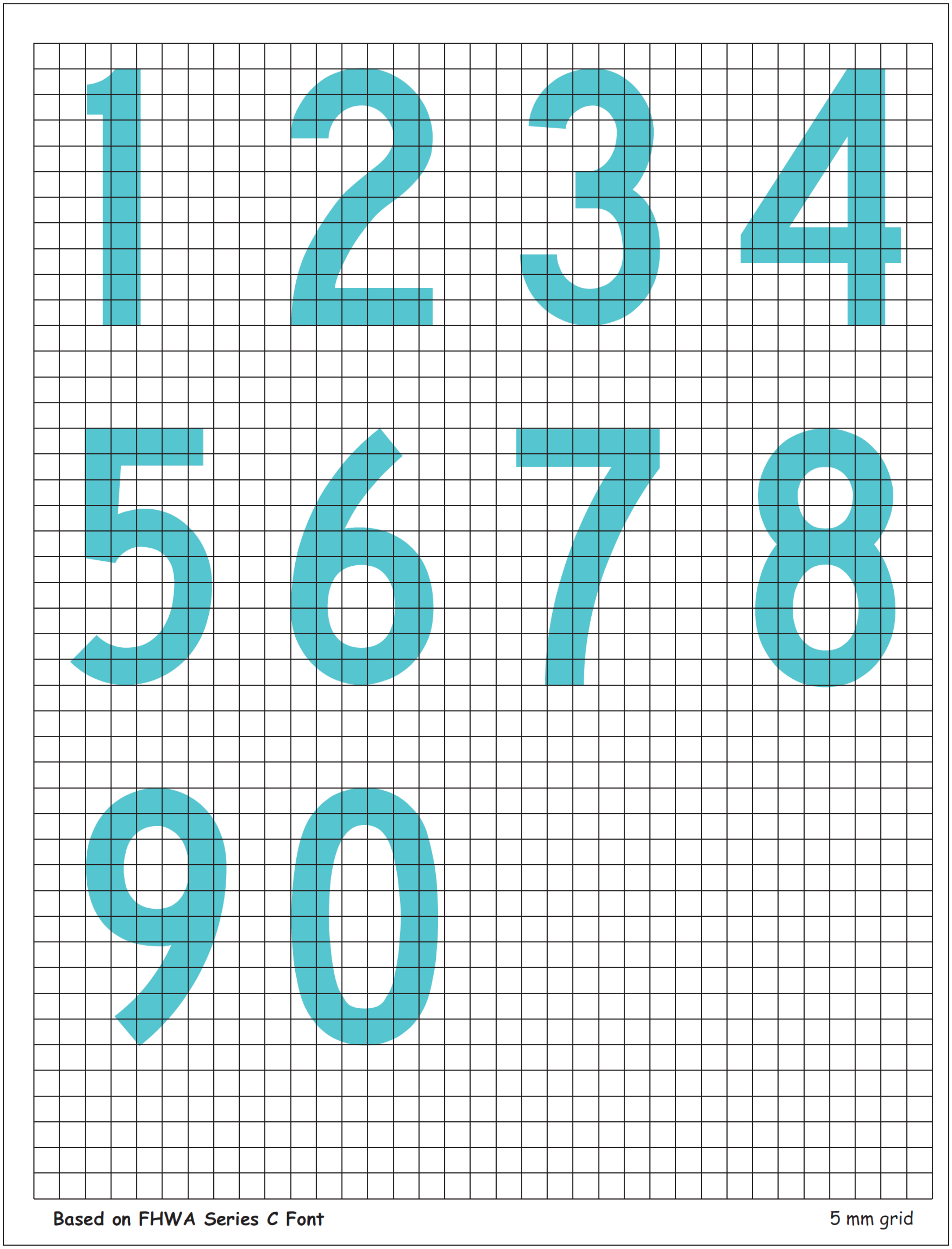
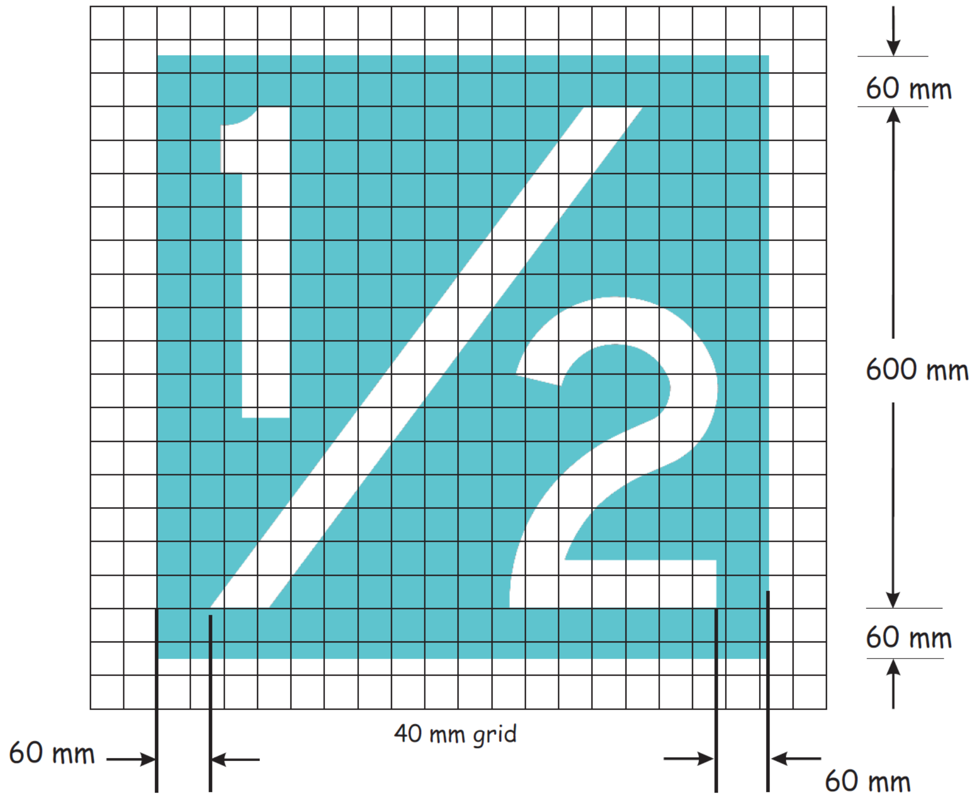


Figure 5-69 (g): Forms of characters—runway distance remaining sign



Note 1: Numerals are based on FHWA Series D 1977.
Note 2: Stroke width is 60 mm.

Figure 5-69 (h): Forms of characters—runway distance remaining sign

Retroreflective Signs

5.4.7.12 Retroreflective materials for non-illuminated signs comply with the reflectivity criteria of ASTM D4956 Standard Specification for Retroreflective Sheeting for Traffic Control, Type III or IV sheeting.

Illuminated Signs

5.4.7.13 Signs made in multiple sections appear to the viewer as displaying a single message element and illuminated area. The transition between sections does not present a noticeable darkened area to the pilot. The letters/numerals of the legend may be applied across this point of transition.

5.4.7.14 Sign face luminance (average sign luminance) is as follows:

(a) Where operations are conducted at night, the average sign luminance is at least:

Red	10 cd/m^2
Yellow	50 cd/m^2
White	100 cd/m^2

(b) Where operations are conducted in visibility conditions less than RVR2600 (½ SM), the average luminance is at least:

Red	30 cd/m^2
Yellow	150 cd/m^2
White	300 cd/m^2

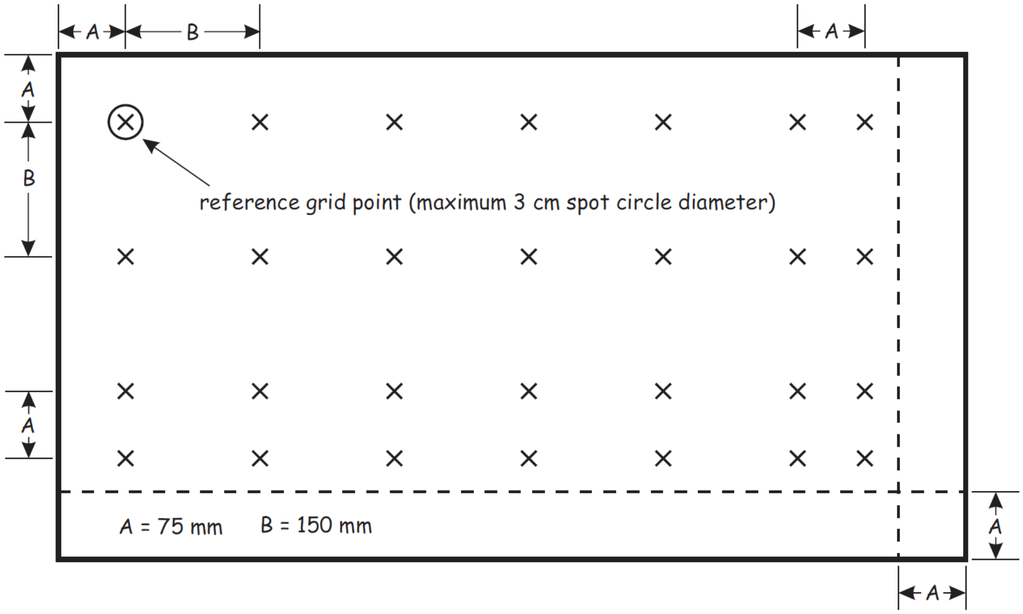
5.4.7.15 With all lamps operating, the luminance ratio between red and white elements of a mandatory instruction sign is between 1:5 and 1:10.

5.4.7.16 The average luminance of the sign is calculated by establishing grid points as shown in Figure 5-70 and using the luminance values measured at all grid points located within the rectangle representing the sign.

5.4.7.17 The average value is the arithmetic average of the luminance values measured at all considered grid points.

5.4.7.18 With all lamps operating, the ratio between luminance values of adjacent grid points does not exceed a ratio of 1.5:1. For areas of the sign face where the grid spacing is 7.5 cm, the ratio between luminance values of adjacent grid points does not exceed 1.25:1. The ratio between the maximum and minimum luminance value over the whole sign face does not exceed 5:1

5.4.7.19 Lamp failure does not reduce luminance by more than 50% of that initially provided with all lamps operating for the area of the sign face applicable to the failed lamp.



Note 1: The average luminance of a sign is calculated by establishing grid points on a sign face showing typical inscriptions and a background of the appropriate colour (red for mandatory instruction signs and yellow for direction and destination signs) as follows:

(a) Starting at the top left corner of the sign face, establish a reference grid point at 7.5 cm from the left edge and the top of the sign face.
(b) Create a grid of 15 cm spacing horizontally and vertically from the reference grid point. Grid points within 7.5 cm of the edge of the sign face are excluded.
(c) Where the last point in a row/column of grid points is located between 22.5 cm and 15 cm from the edge of the sign face (but not inclusive), an additional point is added 7.5 cm from this point.
(d) Where a grid point falls on the boundary of a character and the background, the grid point is slightly shifted so that the spotmeter circle is completely outside the character.
(e) Where the measurement spotmeter circle falls on a black outline of a mandatory sign the circle is moved off the black area horizontally adjacent to the red background or white portion of the legend.

Note 2: To assess a letter/numeral, select equally spaced points along the centre of the character stroke. The average luminance is the arithmetic average of the measurements at these points.

Note 3: Where one unit includes two types of signs, a separate grid is established for each type.

Figure 5-70: Grid points for calculating avereage luminance of a signs

Fibre-Optic Signs

5.4.7.20 The fibre-optic points that illuminate a character have a spacing of not more than 20 mm.

5.4.7.21 The line of fibre-optic points follow the centre of the character, except that the line is shifted to the left edge of the vertical member of letters "B", "D", "E", "F", "K", "L", "P", and "R", and the numeral "5". In addition, the line of fibre-optic points follows the lower edge of the horizontal member of letters "A", "E", "F", and "H".

5.4.7.22 The fibre-optic sign has the photometric distribution as shown in Appendix 5B, Figure B-21.

5.4.7.23 Lamp failure does not reduce:

(a) intensity by more than 50% for each fibre-optic point; and

(b) the number of illuminated fibre-optic points.

Sign Construction

General

5.4.7.24 The frangibility of the sign is proven based on the following conditions:

(a) the overall sign height is 1200 mm;

(b) the representative panel height is 600 mm and of a suitable length for the message “07-25”;

(c) the sign withstands a wind speed of 320 km/h; and

(d) the frangible device breaks before reaching a wind speed of 480 km/h.

Note: The withstand and frangibility strengths are specified in terms of wind loading (pressure) using the following formula: $P=K*V^2$ *where: P = pressure in kPa, V = wind speed in km/hr, K = 0.00005.*

5.5 MARKERS

5.5.1 General

5.5.1.1 Markers are lightweight and if mounted have a frangible point no higher than 5 cm above grade.

5.5.1.2 The marker colours comply with Appendix 5A.

Mounting Height

5.5.1.3 Markers are mounted to a maximum height of 35 cm above the edge of the operational surface (runway, taxiway, apron, etc…), subject to the following;

(a) the marker may be raised to a maximum height of 75 cm when located 3 m from the edge of the operational surface using a ratio of 1 cm per 3.75 cm as the marker is moved out from the 1.5 m to the 3 m position; and

(b) a minimum clearance of 15 cm is provided between the top of the marker and any overhanging part of the aircraft expected to operate on the surface when it's main gear is located at the edge of the operational surface.

5.5.2 Manoeuvring Area Markers

Note: See Figure 5-71 for depiction of gable and conical markers.

Application

5.5.2.1 Markers are provided when the extent of a runway, stopway or taxiway is not clearly delineated from that of the surrounding ground.

Location

5.5.2.2 Subject to in 5.5.2.3, conical shaped or flat rectangular [to the ground] markers are provided at intervals of 90 m or less.

5.5.2.3 Where there are no lights, gable markers may be provided to delimit the runway clearly, at intervals of 200 m or less.

Characteristics

5.5.2.4 The flat rectangular markers are:

(a) at least 1 m by 3 m; and

(b) installed with their long axis parallel to the runway centreline, except at the threshold where the long axis is perpendicular to the runway centreline as shown in Figure 5-71(b).

5.5.2.5 The conical markers have a height of 50 cm or less.

5.5.2.6 The gable markers are:

(a) a minimum of 2.4 m in length;

(b) a maximum of 0.5 m in height;

(c) a minimum of 1 m across the base; and

(d) installed with their long axis perpendicular to the runway centreline.

5.5.2.7 The stopway edge markers are sufficiently different from any runway edge markers to avoid any confusion.

5.5.3 Retroreflective Markers

General

5.5.3.1 The reflective material on retroreflective markers complies with the minimum reflectivity requirements of ASTM D4956 Standard Specification for Retroreflective Sheeting for Traffic Control, Type III sheeting

5.5.4 Taxiway Edge Markers

Note: See Figure 5-72 for depiction of taxiway edge markers.

Application

5.5.4.1 Where provided, the taxiway edge markers are as specified in this section.

Note: Taxiway edge markers may be required pursuant to 5.3.22.1.

Location

5.5.4.2 The taxiway edge marker is located in the manner as would be a taxiway edge light for the location.

Characteristics

5.5.4.3 The taxiway edge marker is retroreflective, cylindrical in shape and of the same colour, height and frangibility as the applicable light for the location.

5.5.4.4 The taxiway edge marker has a viewing area to the pilot of 150 cm^2 or more.

5.5.5 Taxiway Centreline Markers

Note: See Figure 5-72 for depiction of taxiway centreline markers.

Application

5.5.5.1 Where provided, taxiway centreline markers are as specified in this section.

Location

5.5.5.2 The taxiway centreline marker is located as the applicable taxiway centreline light for the location.

Note: See section 5.3.21 Taxiway Centreline Lights.

Characteristics

5.5.5.3 The taxiway centreline marker is retroreflective, in-pavement and has a viewing area to the pilot of 9.7 cm^2 or more.

5.5.5.4 The taxiway centreline marker is of the same colour as the applicable taxiway centreline light for the location.

5.5.5.5 The taxiway centreline marker is 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.

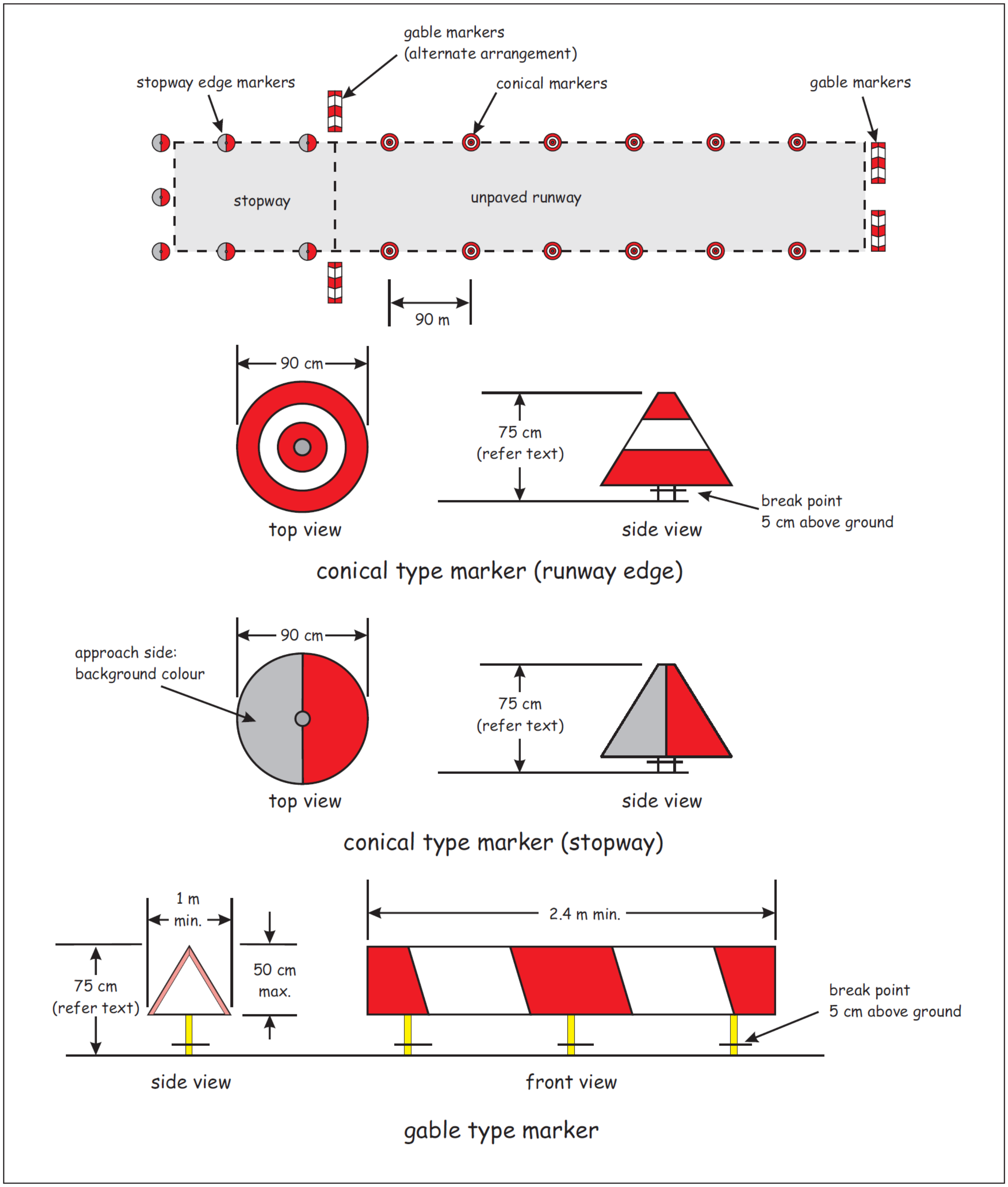


Figure 5-71(a): Example of conical and gable markers

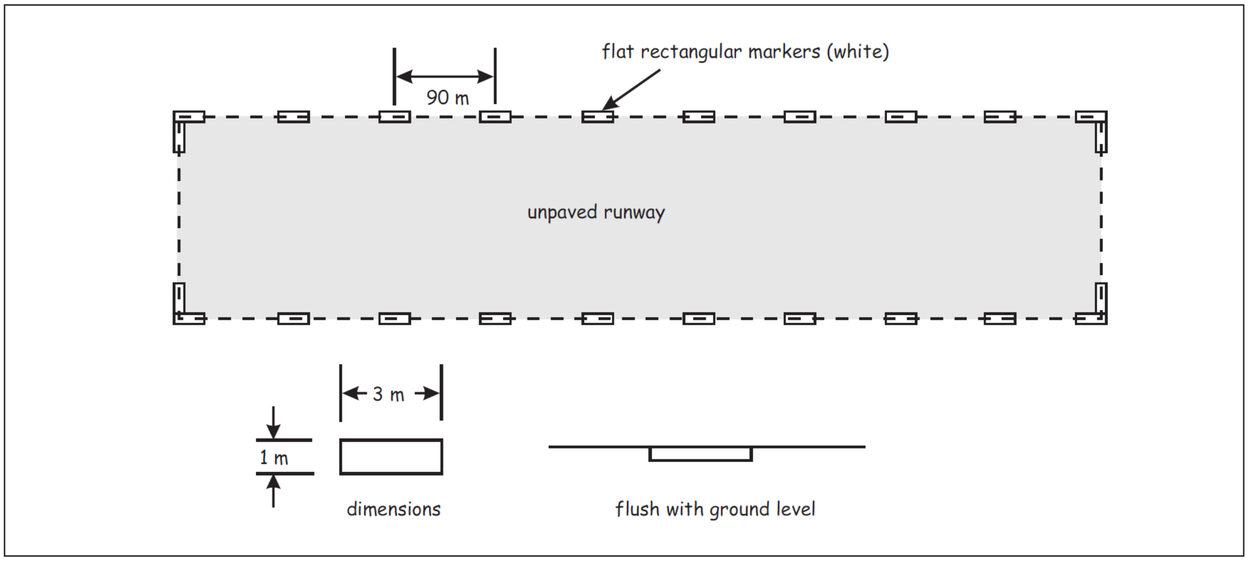


Figure 5-71(b): Example of flat rectangular markers

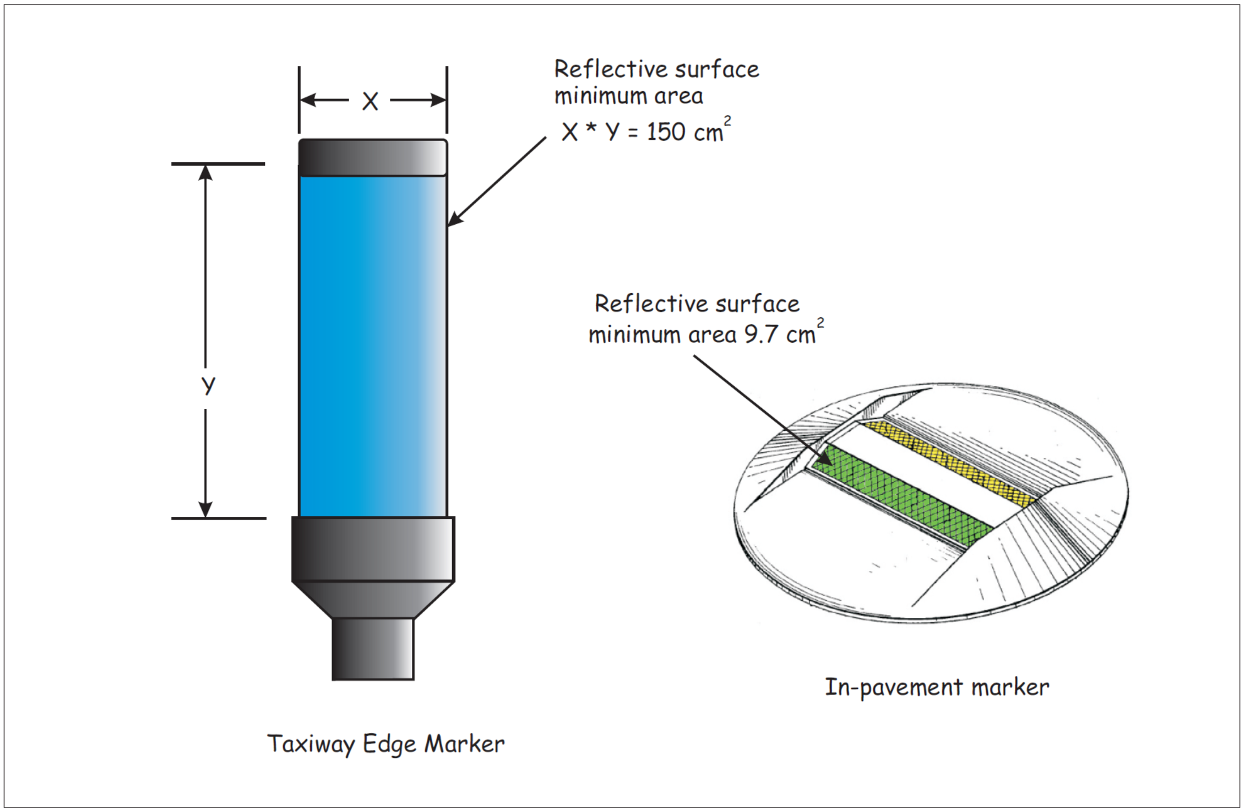


Figure 5-72: Example of taxiway edge and centreline markers

5.5.6 Unserviceability/Closed Markers

Note: Unserviceability markers are used to warn pilots of a hole in a taxiway or apron pavement or to outline a portion of pavement, such as an apron, that is under repair. They are not suitable when a portion of a runway becomes unserviceable, nor are they suitable on a taxiway when the remaining taxiway width does not allow for aircraft operations. In such instances, the runway or taxiway is normally closed.

Application

5.5.6.1 Unserviceability markers are provided for a temporary closure during the day where:

(a) a closed taxiway is intercepted by a usable runway or taxiway, or

(b) a portion of a taxiway, taxiway safety area or apron is unusable but it is still possible for aircraft to bypass the area safely.

Location

5.5.6.2 Unserviceability markers are placed at intervals sufficiently close so as to delineate the unserviceable area and not allow the passage of an aircraft between the markers.

Characteristics

5.5.6.3 Unserviceability markers consist of conspicuous upstanding devices such as flags, cones or marker boards.

5.5.6.4 An unserviceability marker is red or international orange or any combination of these with white.

Appendix 5A
Colours for Aeronautical Ground Lights, Markings, Signs and Markers

APPENDIX 5A—COLOURS FOR AERONAUTICAL GROUND LIGHTS, MARKINGS, SIGNS AND MARKERS

Introductory Note: The following standards define the chromaticity limits of colours to be used for aeronautical ground lights and for the marking of surfaces, as required in this manual. The specifications are in accordance with the 1983 specifications of the International Commission on Illumination (CIE), except for the colour orange in Figure A-2 for ordinary colours for markings and externally illuminated signs and panels.

It is not possible to establish standards for colours such that there is no possibility of confusion. For reasonably certain recognition, it is important that the eye illumination be well above the threshold of perception, that the colour not be greatly modified by selective atmospheric attenuations and that the observer's colour vision be adequate. There is also a risk of confusion of colour at an extremely high level of eye illumination such as may be obtained from a high-intensity source at very close range. Experience indicates that satisfactory recognition can be achieved if due attention is given to these factors.

The chromaticities are expressed in terms of the standard observer and coordinate system adopted at the CIE's eighth session (1931) in Cambridge, England.

The chromaticities for solid state lighting [e.g. LED] are based upon the boundaries set in CIE standard S004 (2001), except for the blue boundary of white.

For more information, refer to CIE, Publication No. 15, Colourimetry *(1971).*

1. Colours for Aeronautical Ground Lights

1.1 Chromaticities for lights having filament-type light sources:

1.1.1 The chromaticities of aeronautical ground lights with filament-type light sources are within the following boundaries:

CIE Equations [see Figure A-1(a)]

Colour	Boundary	Equation 1	Equation 2
Red	Purple Yellow Yellow	y = 0.980 -x y = 0.335 (except PAPI) y = 0.320 (for PAPI)	
Yellow	Red White Green	y = 0.382 y = 0.790 - 0.667x y = x - 0.120	
ITE Yellow *(Note 1)*	Red White Green	y = 0.411 y = 0.995 - x y = 0.452	
White	Yellow Blue Green Purple	x = 0.500 x = 0.285 y = 0.440 y = 0.050 + 0.750x	 y = 0.150 + 0.640x y = 0.382
Variable White	Yellow Blue Green Purple	x = 0.255 + 0.750y x = 0.285 y = 0.440 y = 0.050 + 0.750x	y = 0.790 - 0.667x y = 0.150 + 0.640x y = 0.382
Blue	Green White Purple	y = 0.805x + 0.065 y = 0.400 - x x = 0.600y + 0.133	
Green	Yellow White Blue	x = 0.360 - 0.080y x = 0.650y x = 0.390 - 0.171x	

Note 1: The yellow boundary is extended to include ITE yellow in accordance with Institute of Transportation Engineers (ITE) Standard ST-017, Vehicle Traffic Control Signal Heads

Note 2: Guidance on chromaticity changes resulting from the effect of temperature on filtering elements is given in the ICAO Aerodrome Design Manual, Part 4 (Doc 9157).

1.2 Discrimination between lights having filament type sources.

1.2.1 If there is a requirement to discriminate yellow and white from each other, they are displayed in close proximity of time or space as, for example, being flashed successively from the same beacon.

1.2.2 If there is a requirement to discriminate yellow from green and/or white as, for example, on exit taxiway centreline lights, the "y" coordinates of the yellow light does not exceed a value of 0.40.

Note: The limits of white have been based on the assumption that they will be used in situations in which the characteristics (colour temperature) of the light source will be substantially constant.

1.2.3 The colour variable white is intended to be used only for lights that are to be varied in intensity to avoid dazzling. If this colour is to be discriminated from yellow, the lights are so designed and operated that:

(a) the x coordinate of the yellow is at least 0.05 greater than the x coordinate of the white, and

(b) the disposition of the lights is such that the yellow chromaticity and luminance lights are displayed simultaneously and in close proximity to the white lights.

1.3 Chromaticities for lights having a solid state light source:

1.3.1 The chromaticities of aeronautical ground lights with solid state light sources [e.g. LEDs] is within the following boundaries:

CIE Equations [see Figure A-1(b)]

Colour	Boundary	Equation
Red	Purple Yellow Yellow	y = 0.980 - x y = 0.335 (except PAPI) y = 0.320 (for PAPI)
Yellow	Red White Green	y = 0.387 y = 0.980 - x y = 0.727x + 0.054
White	Yellow Blue Green Purple	x = 0.440 x = 0.320 y = 0.150 + 0.643x y = 0.050 + 0.757x
Blue	Green White Purple	y = 1.141x - 0.037 x = 0.400 - y x = 0.134 + 0.590y
Green	Yellow White Blue	x = 0.310 x = 0.625y - 0.041 y = 0.400

1.4 Colour measurement for filament-type and solid state-type light sources:

1.4.1 The colour of aeronautical ground lights is verified as being within the boundaries specified in Figure A-1(a) or Figure A-1(b) as appropriate, by measurement at five points within the area limited by the innermost isocandela curve (see isocandela diagrams in Appendix 5A), with operation at rated current or voltage. In the case of elliptical or circular isocandela curves, the colour measurements are taken at the centre and at the horizontal and vertical limits. In the case of rectangular isocandela curves, the colour measurements are taken at the centre and the limits of the diagonals (corners). In addition, the colour of the light is checked at the outermost isocandela curve to ensure that there is no colour shift that might cause signal confusion to the pilot.

Note 1: For the outermost isocandela curve, a measurement of colour coordinates should be made and recorded for review and judgement of acceptability by the appropriate authority.

Note 2: Certain light units may have applications so that they may be viewed and used by pilots from directions beyond that of the outermost isocandela curve (e.g. stop bar lights at significantly wide runway-holding positions). In such instances, the appropriate authority should assess the actual application and, if necessary, require a check of colour shift at angular ranges beyond the outermost curve.

1.4.2 In the case of visual approach slope indicators and other light units having a colour transition sector, the colour is measured at points in accordance with 1.4.1, except that the colour areas are treated separately and no point is within 0.5° of the transition sector.

2. Colours for Markings, Signs and Markers

Note 1: The specifications of surface colours given below apply only to freshly coloured surfaces. Colours used for surface markings usually change with time and therefore require renewal.

Note 2: Guidance on surface colours is contained in the CIE document entitled Recommendations for Surface Colours for Visual Signalling, *Publication No. 39-2 (TC-1.6), 1983.*

Note 3: The standards recommended in 3.4 below for transilluminated panels are interim in nature and are based on the CIE specifications for transilluminated signs. It is intended that these specifications will be reviewed and updated as and when CIE develops specifications for transilluminated panels.

2.1 Chromaticities and luminance

2.1.1 The chromaticities and luminance factors of ordinary colours, colours of retroreflective materials and colours of transilluminated (internally illuminated) signs and panels are determined under the following standard conditions:

(a) angle of illumination: 45°;

(b) direction of view: perpendicular to surface; and

(c) illuminant: CIE standard illuminant D_{65}.

2.1.2 The chromaticity and luminance factors of ordinary colours for surface markings and externally illuminated signs, panels and non-reflective markers are within the following boundaries, when determined under standard conditions.

CIE Equations (see Figure A-2)

Colour	Boundary	Equation	Luminance Factor ß
Red	Purple White Orange	y = 0.345 - 0.05lx y = 0.910 - x y = 0.314 + 0.047x	0.07 (min)
Orange	Red White Yellow	y = 0.285 + 0.100x y = 0.940 - x y = 0.250 + 0.220x	0.20 (min)
Yellow	Orange White Green	y = 0.108 + 0.707x y = 0.910 - x y = 1.35x - 0.093	0.45 (min)
White	Purple Blue Green Yellow	y = 0.010 + x y = 0.610 - x y = 0.030 + x y = 0.710 - x	0.75 (min)
Black	Purple Blue Green Yellow	y = x - 0.030 y = 0.570 - x y = 0.050 + x y = 0.740 - x	0.03 (max)
Green	Yellow White Blue	x = 0.313 y = 0.243 + 0.670x y = 0.493 - 0.524x	0.10 (min)

Note: The small separation between surface red and surface orange is not sufficient to ensure the distinction of these colours when seen separately.

2.1.3 The chromaticity and luminance factors of colours of retroreflective materials for markings, signs, panels and markers are within the following boundaries, when determined under standard conditions.

CIE Equations (see Figure A-3)

Colour	Boundary	Equation	Luminance Factor ß
Red	Purple White Orange	y = 0.345-0.051x y = 0.910 - x y = 0.314+ 0.047x	0.03 (min)
Orange	Red White Yellow	y = 0.265 + 0.205x y = 0.910 – x y = 0.207 + 0.390x	0.14 (min)
Yellow	Orange White Green	y = 0.160 + 0.540x y = 0.910 - x y = 1.35x - 0.093	0.16 (min)
White	Purple Blue Green Yellow	y = x y = 0.610 - x y = 0.040 + x y = 0.710 - x	0.27 (min)
Blue	Green White Purple	y = 0.118 + 0.675x y = 0.370 - x y = 0.165x - 0.187	0.01 (min)
Green	Yellow White Blue	y = 0.711 - 1.22x y = 0.243 + 0.670x y = 0.405 - 0.243x	0.03 (min)

2.1.4 The chromaticity and luminance factors of colours for transilluminated (internally illuminated) signs and panels are within the following boundaries, when determined under standard conditions.

CIE Equations (see Figure A-4)

Colour	Boundary	Equation	Luminance Factor (day condition)	Relative Illuminance to White (night condition)
Red	Purple White Orange	y = 0.345 - 0.051x y = 0.910 - x y = 0.314 + 0.047x	ß = 0.07 (min)	5–20%
Yellow	Orange White Green	y = 0.108 + 0.707x y = 0.910 - x y = 1.35x - 0.093	ß = 0.45 (min)	30–80%
White	Purple Blue Green Yellow	y = 0.010 + x y = 0.610 - x y = 0.030 + x y = 0.710 - x	ß = 0. 75(min)	100%
Black	Purple Blue Green Yellow	y = x - 0.030 y = 0.570 - x y = 0.050 + x y = 0.740 - x	ß = 0.03 (min)	0–2%

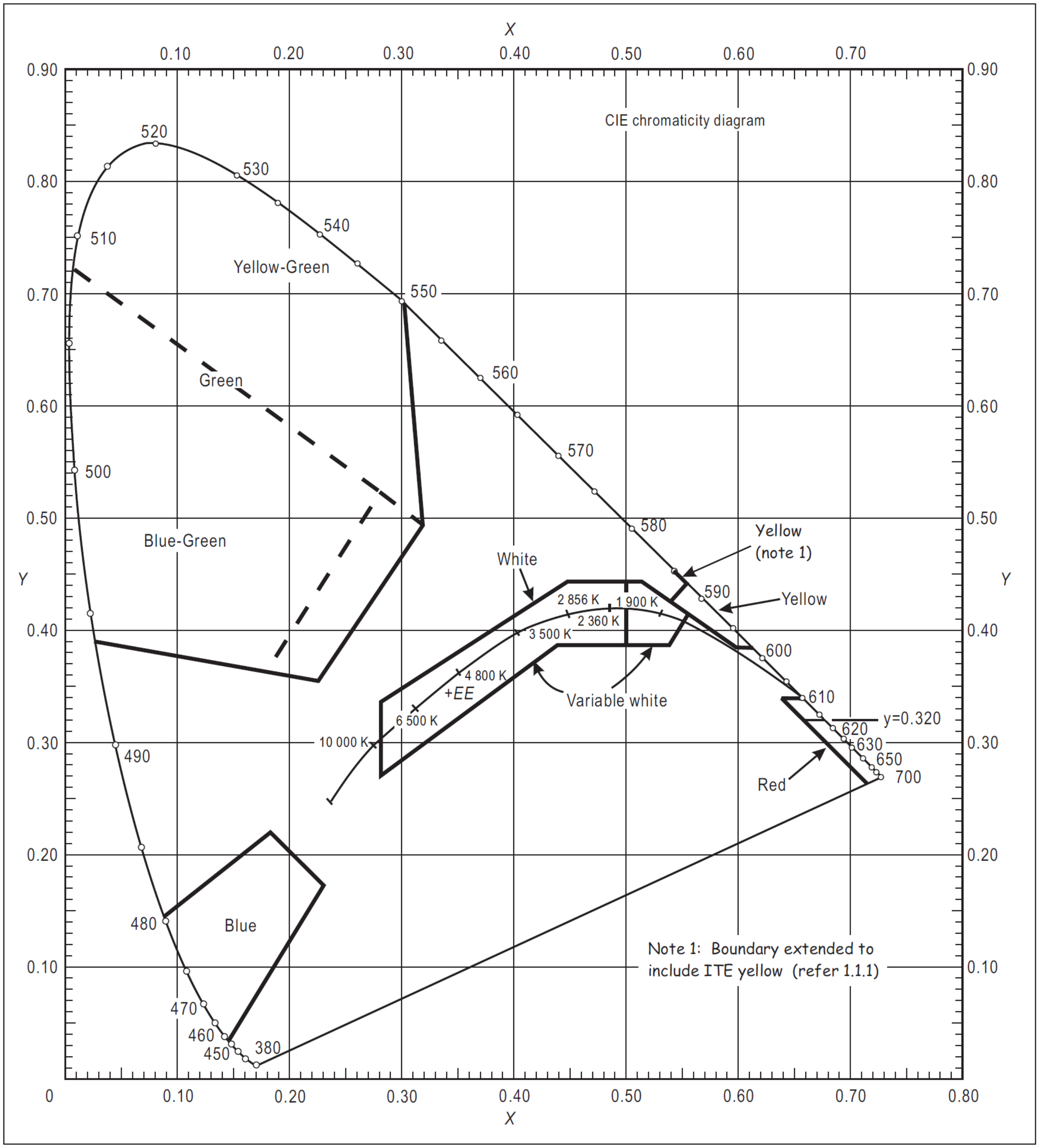


Figure A-1(a): Colours for aeronautical ground light (filament type lamps)

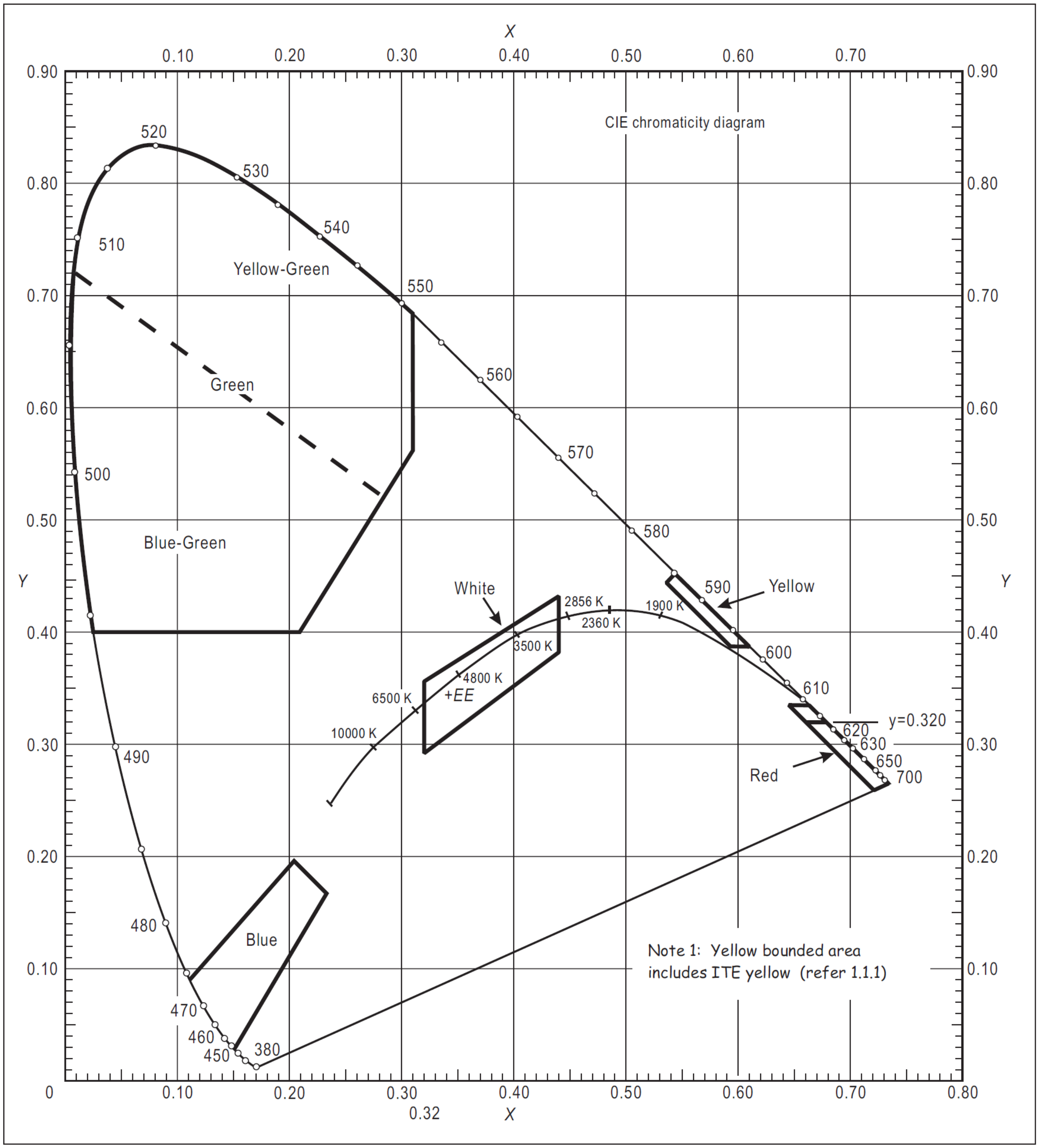


Figure A-1(b): Colours for aeronautical ground light (solid state lighting)

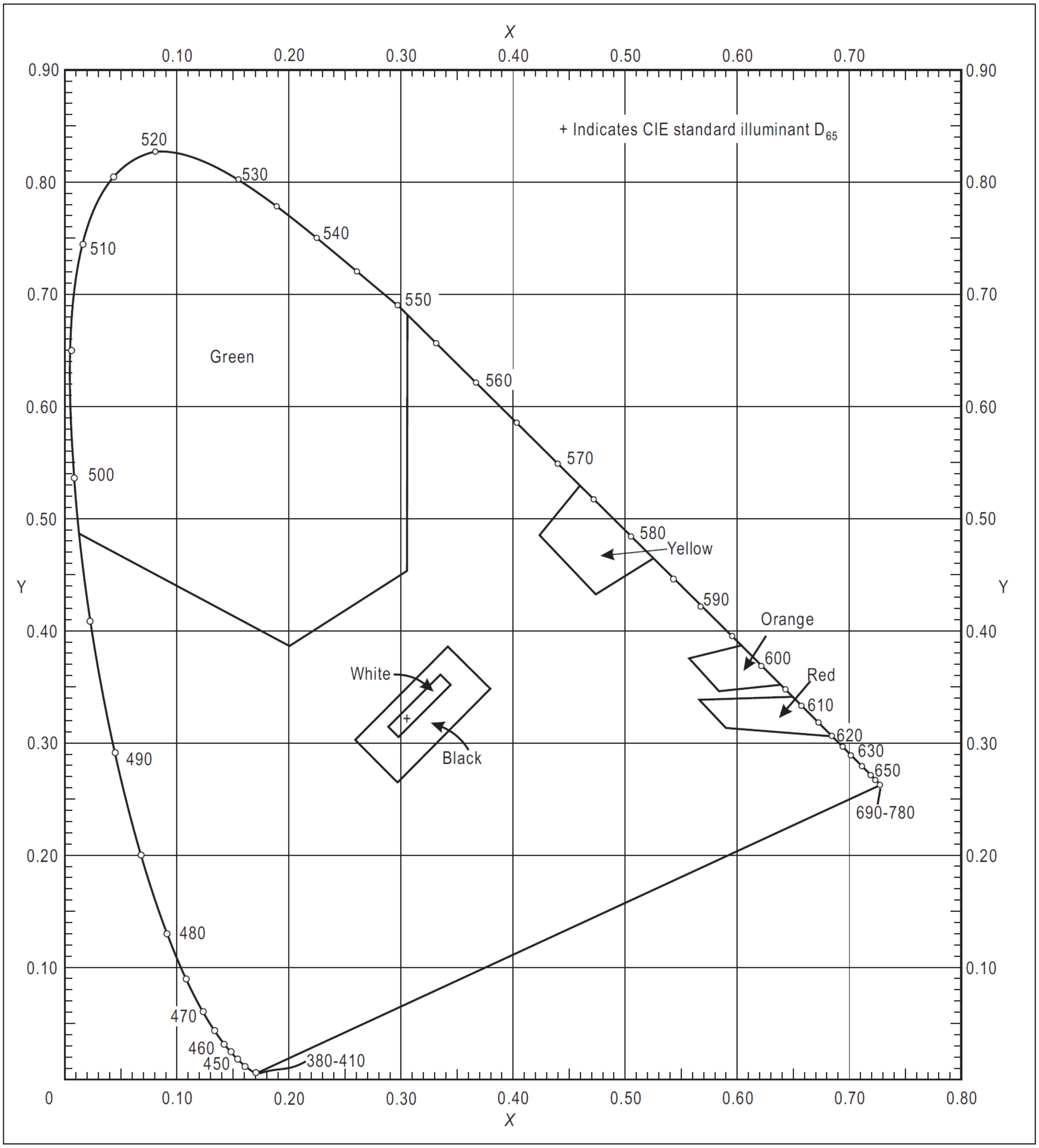


Figure A-2: Ordinary colours for markings, externally illuminated signs and non-reflective markers

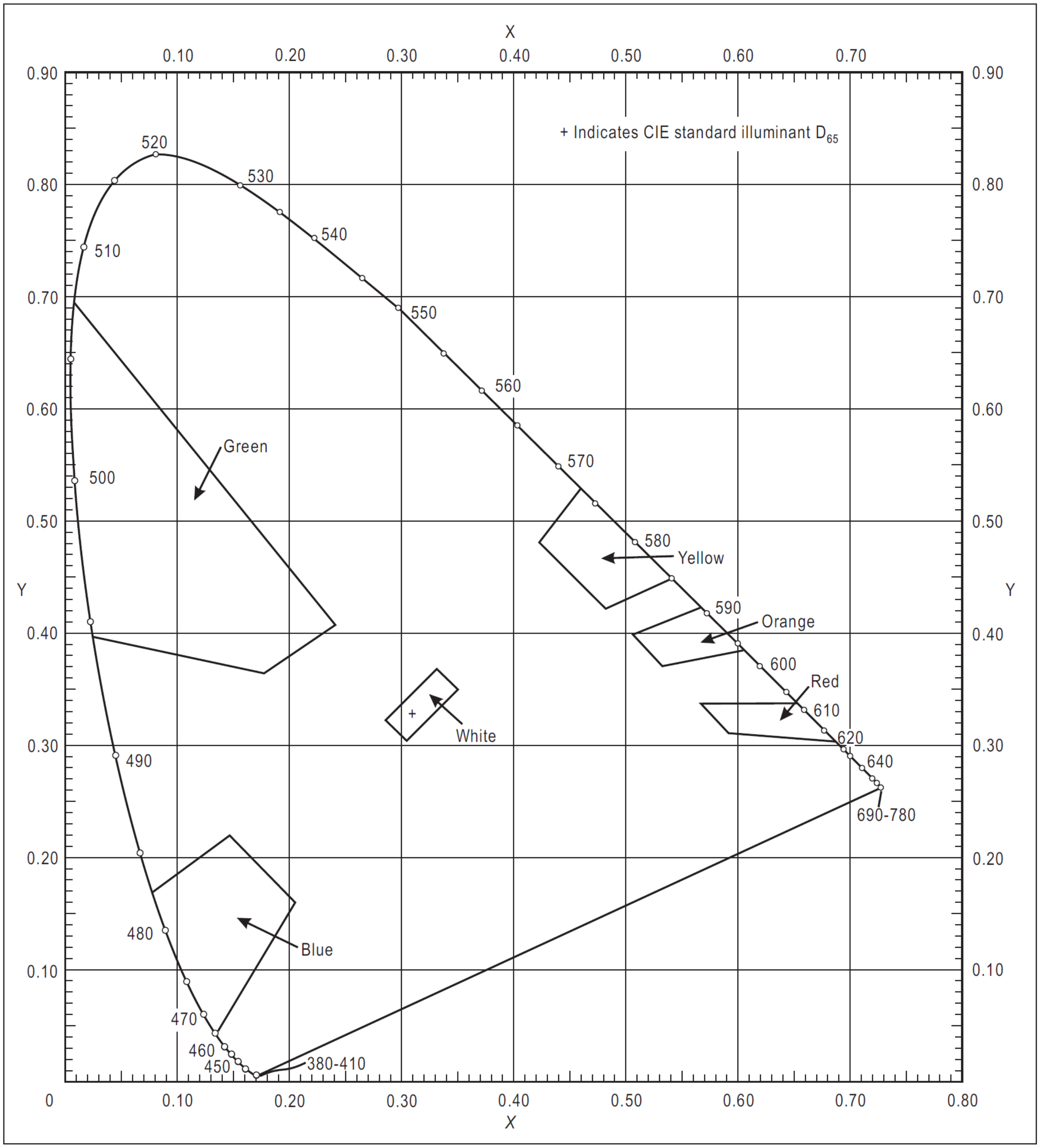


Figure A-3: Colours for retroreflective materials for markings, signs and markers

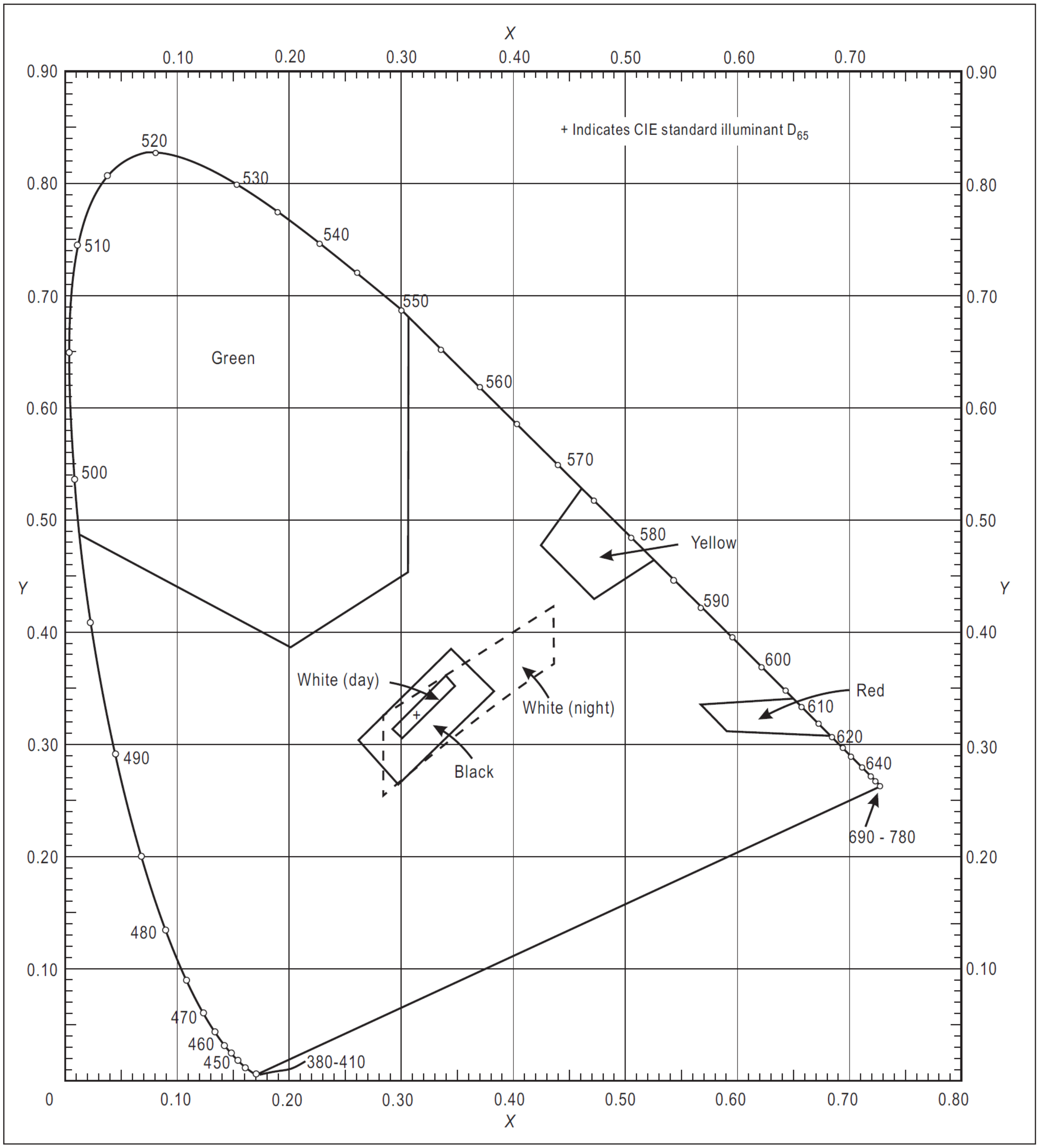


Figure A-4: Colours for transilluminated [internally illuminated] signs

Appendix 5B
Aeronautical Ground Light Characteristics

1 Photometric Requirements for Medium Intensity Lights and Taxiway Edge Lights

Table 5B-1.
Photometric Requirements for Medium Intensity (MI) Omnidirectional Elevated Lights (d)

Type	Colour	Intensity (candelas) (a) 2°–10° minimum	2°–10° average	10°–15° minimum
MI runway edge	White	75	125	40
	Yellow	37	67	20
	Red (c)	3	5	1

Note: See Figure B25 for MI threshold/end photometric requirements.

Photometric Requirements for Taxiway Edge Omnidirectional Elevated Lights (d)

Type	Colour	Intensity (candelas) (a) 2°–10° minimum	2°–10° average	10°–15° minimum
Taxiway edge	Blue	2	(b)	(b)

Photometric Requirements for In-pavement Runway Edge Lights (e)

Minimum beam coverage (degrees) Main beam Horizontal	Main beam Vertical	10 % Horizontal+	10 % Vertical	Intensity (candelas) White	Intensity (candelas) Yellow
±30	1 to 10	±30	0 to15	150	100

Notes:
(a) Angles are measured in vertical plane.
(b) Coverage is 2 candelas from ***0°–6°*** *vertically and 0.2 candela at other vertical angles up to 75°.*
(c) Red is only 180° of horizontal coverage for unidirectional and bidirectional.
(d) Measurement:

- *(i) For fixtures with a specified horizontal beam width greater than 180°, vertical "cuts" are taken for at least every 30° of the horizontal beam width.*
- *(ii) Each reading meets the minimum intensity requirement, and the average of each vertical "cut" meets the minimum average intensity requirement.*
- *(iii) Additionally, each of the intensity readings taken in a vertical cut is not less than one-half the specified value for the minimum average intensity requirement.*

(e) Where a medium intensity runway edge light is to be installed at an intersection in accordance with 5.3.12.3(c) use an in-pavement light having the following photometrics. Also refer 3.0 Collective notes.

2 Collective Notes to Figures B-1 to B-11, B-20, B-24(a) and B-25

2.1 The ellipses in each figure are symmetrical about the common vertical and horizontal axes.

2.2 Figures B-1 to B-10 show the minimum allowable light intensities. The average intensity of the main beam is calculated by establishing grid points as shown in Figure B-11 and using the intensity values measures at all grid points located within and on the perimeter of the ellipse representing the main beam. The average value is the arithmetic average of light intensities measured at all considered grid points.

2.3 No deviations are acceptable in the main beam pattern when the lighting fixture is properly aimed.

2.4 **Average intensity ratio**—The ratio between the average intensity within the ellipse defining the main beam of lights for the indicated system in comparison to the average intensity of lights within a runway edge lighting system [given a value of 1.0] is as shown in the Table 5B-2 below.

Table 5B-2. Intensity Ratios

Figure	System	Ratio with Respect to Runway Edge Lighting
B-1	ALSF-2, SSALR and SSALS approach centreline and crossbars	1.5 to 2.0 (white light)
B-2	ALSF-2 approach side row	0.5 to 1.0 (red light)
B-3	High intensity threshold	1.0 to 1.5 (green light)
B-4	High intensity threshold wing bar	1.0 to 1.5 (green light)
B-5	Touchdown zone	0.5 to 1.0 (white light)
B-7	Runway centreline(15 m spacing) and land and hold short	0.5 to 1.0 for CAT III (white light) 0.25 to 0.5 for CAT I, II (white light)
B-8	High intensity runway end	0.25 to 0.5 (red light)
B-9	High intensity runway edge 45 m or less runway width	1.0 (white light) 0.4 (yellow light)
B-10	High intensity runway edge greater than 45 m runway width	1.0 (white light) 0.4 (yellow light)
		Ratio with respect to runway edge lighting
Table 5B-1	Medium intensity runway edge	1.0 (white light)
B-25	Medium intensity runway threshold/end	4.8 to 7.6 (green light) 4.8 to 7.6 (red light)
		Ratio with respect to approach centreline lighting
B-22	MALS, MALSF, MALSR approach centreline and crossbars	1.0 (white light)
B-22	MALS, MALSF, MALSR threshold	0.5 to 1.0 (green light)

Note: The purpose of Table 5B-2 is to ensure a balance in the visual display amongst the lighting systems and is referenced to the runway edge lighting with all systems operating at 100% intensity. For example, if the runway edge lighting has an intensity of 10 000 candela, then the approach centreline and crossbars are to have an intensity [at 100%] of between 15 000 and 20 000 candelas.

2.5 The beam coverages in the figures provide the necessary guidance for approaches down to RVR 600 and take-offs down to RVR 300.

2.6 Horizontal angles are measured with respect to the vertical plane through the runway centreline. For lights other than centreline lights, the direction towards the runway centreline is considered positive. Vertical angles are measured with respect to the horizontal plane.

2.7 For approach centreline lights, crossbars and approach side row lights, where inset lights are used in lieu of elevated lights, e.g. in the displaced portion of a runway, the intensity requirements can be met by installing two or three light units (lower intensity) at each position.

2.8 The importance of adequate maintenance cannot be over-emphasized. The average intensity never falls to a value less than 50% of the installed performance, in accordance with 9.1.3.2.

2.9 The light unit is installed so that the main beam is aligned within ±0.5° of the specified requirement.

3 Collective Notes to Figures B-12 to B-18, B-24(b) and B-26

3.1 The intensities specified in Figures B-12 to B-17 are in green and yellow light for taxiway centreline lights, yellow light for runway guard lights and red light for stop bar lights.

3.2 Figures B-12 to B-17, B-24(b) and B-26 show the minimum allowable light intensities. The average intensity of the main beam is calculated by establishing grid points as shown in Figure B-18 and using the intensity values measured at all grid points located within and on the perimeter of the rectangle representing the main beam. The average value is the arithmetic average of the light intensities measured at all considered grid points.

3.3 No deviations are acceptable in the main beam, as applicable, when the lighting fixture is properly aimed.

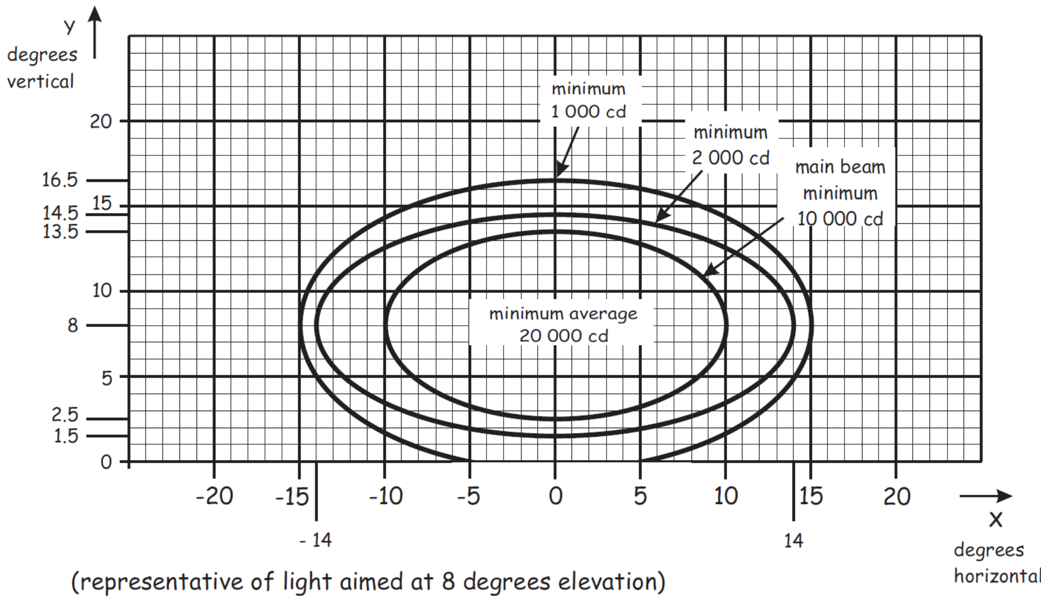
3.4 Horizontal angles are measured with respect to the vertical plane through the taxiway centreline except on curves where they are measured with respect to the tangent to the curve.

3.5 Vertical angles are measured from the longitudinal slope of the taxiway surface.

3.6 The importance of adequate maintenance cannot be over-emphasized. The average intensity never falls to a value less than 50% of the installed performance in accordance with 9.1.3.2.

3.7 The light unit is installed so that the main beam or the innermost beam, as applicable, is aligned within ±0.5° of the specified requirement.

Index of Photometric Figures



(representative of light aimed at 8 degrees elevation)

Notes

1. Curves are calculated on the formula $x^2/a^2 + y^2/b^2 = 1$.

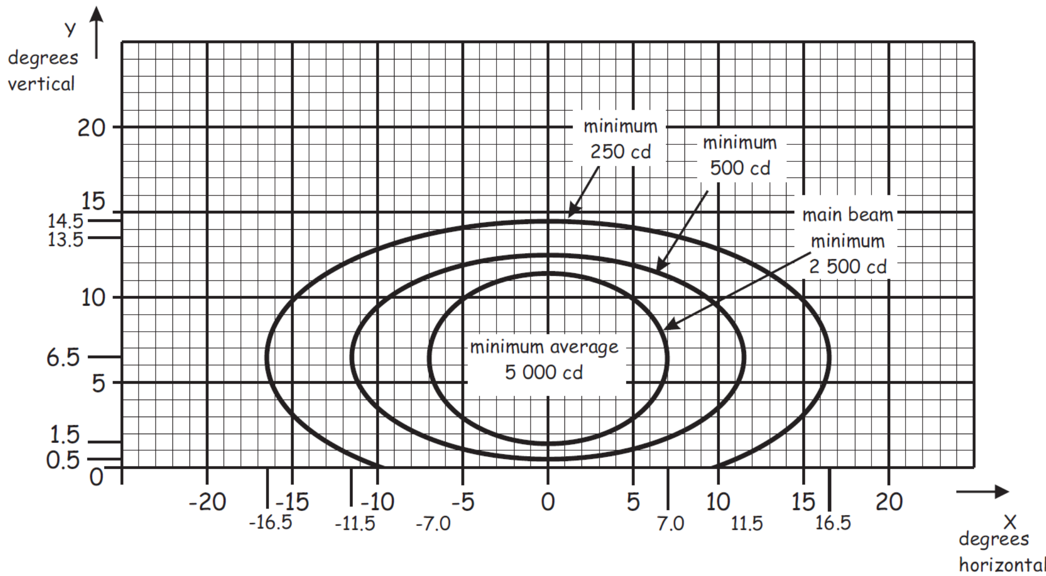
a	10	14	15
b	5.5	6.5	8.5

2. Vertical setting angles for steady burning lights:

light station	vertical main beam coverage
0 to 300	0 to 11 degrees
330 to 450	0.5 to 11.5 degrees
480 to 630	1.5 to 12.5 degrees
660 to end	2.5 to 13.5 degrees

3. See collective notes B-1 to B-11

Figure B-1: Isocandela diagram for ALSF-2, SSALR and SSALS approach centreline lights and crossbars (white light)



(representative of light aimed at 6.5 degrees elevation)

a	7.0	11.5	16.5
b	5.0	6.0	8.0

Notes:

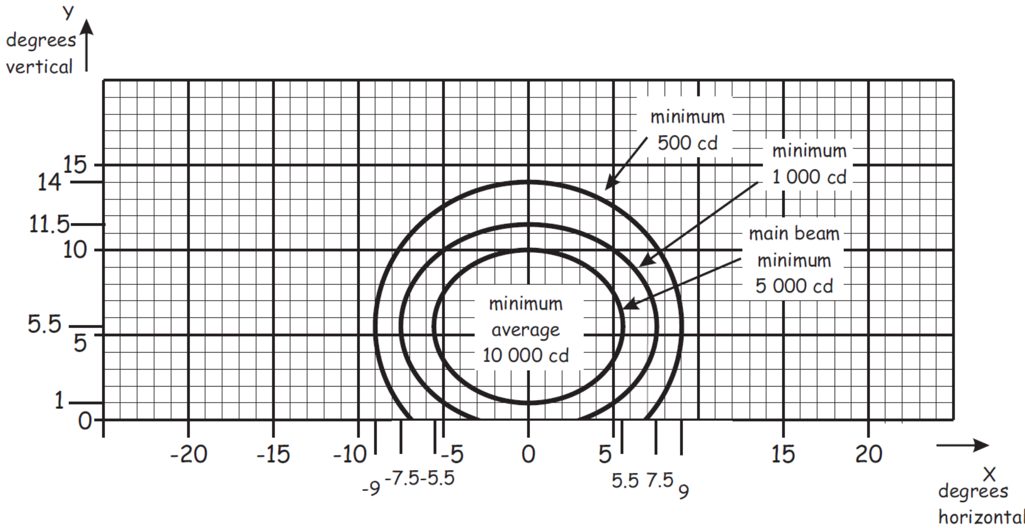
1. Curves are calculated on the formula $x^2/a^2 + y^2/b^2 = 1$.

2. Vertical setting angles for steady burning lights:

light station	vertical main beam coverage
0 to 90	0.5 to 11.5 degrees
120 to 210	1.0 to 11.0 degrees
240 and 270	1.5 to 11.5 degree

3. See collective notes for Figures B-1 to B-11.

Figure B-2: Isocandela diagram for ALSF-2 approach side row light (red light)



a	5.5	7.5	9.0
b	4.5	6.0	8.5

Notes:

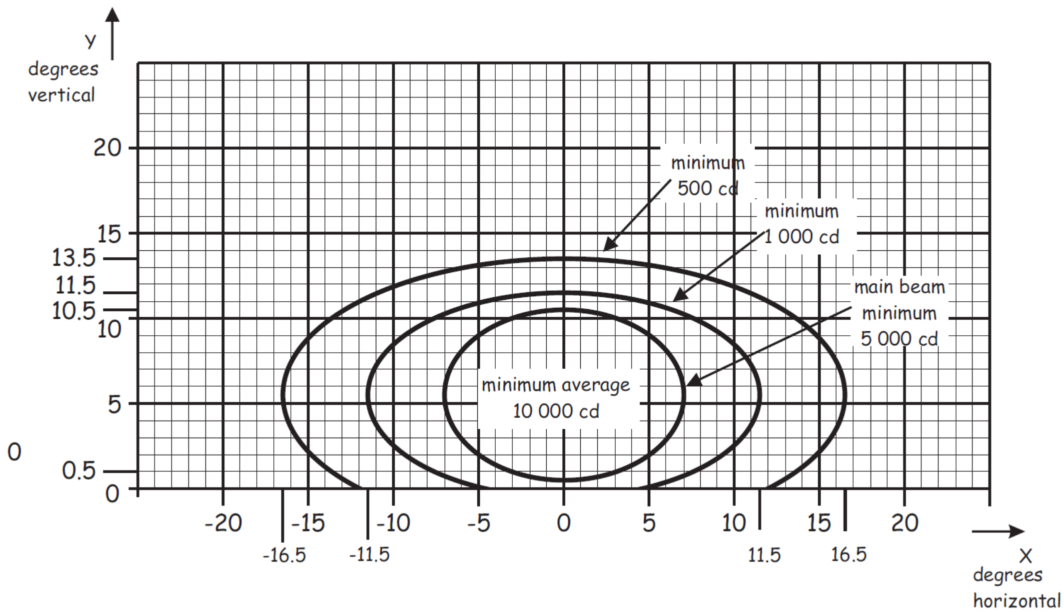
1. Curves are calculated on the formula $x^2/a^2 + y^2/b^2 = 1$.

2. Toe-in angle = 3.5 degrees

3. Elevation angle = 5.5 degrees

4. See collective notes for Figures B-1 to B-11.

Figure B-3: Isocandela diagram for high intensity threshold light (green light)



Notes:

1. Curves are calculated on the formula $x^2/a^2 + y^2/b^2 = 1$.

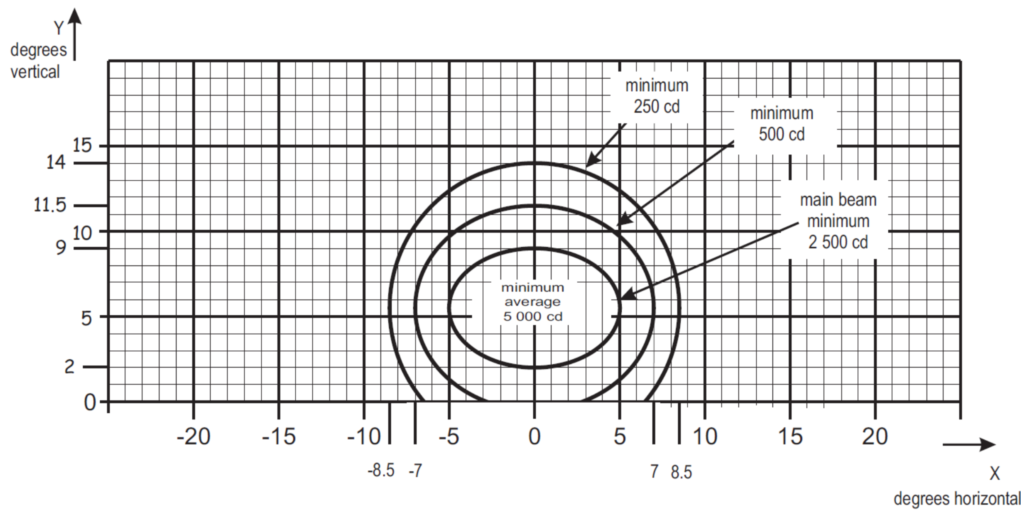
a	7.0	11.5	16.5
b	5.0	6.0	8.0

2. Toe-in angle = 2 degrees

3. See collective notes for Figures 1 to 11.

4. Elevation angle = 5.5 degrees

Figure B-4: Isocandela diagram for high intensity threshold wing bar light (green light)



Notes:

1. Curves are calculated on the formula $x^2/a^2 + y^2/b^2 = 1$.

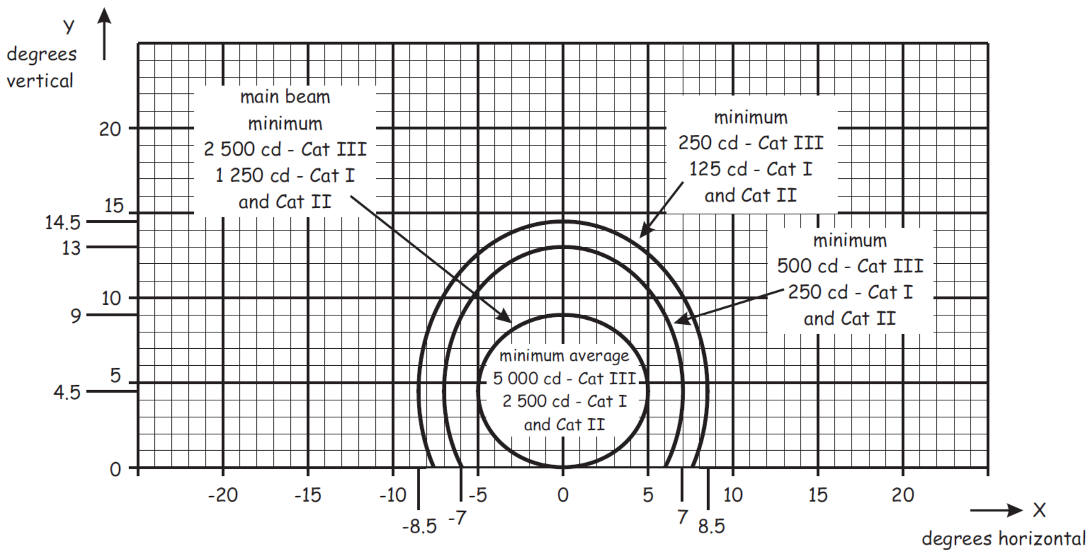
a	5.0	7.0	8.5
b	3.5	6.0	8.5

2. Elevation angle = 5.5 degrees

3. Toe-in angle = 4 degrees

4. See collective notes for Figures B-1 to B-11.

Figure B-5: Isocandela diagram for touchdown zone light (white light)



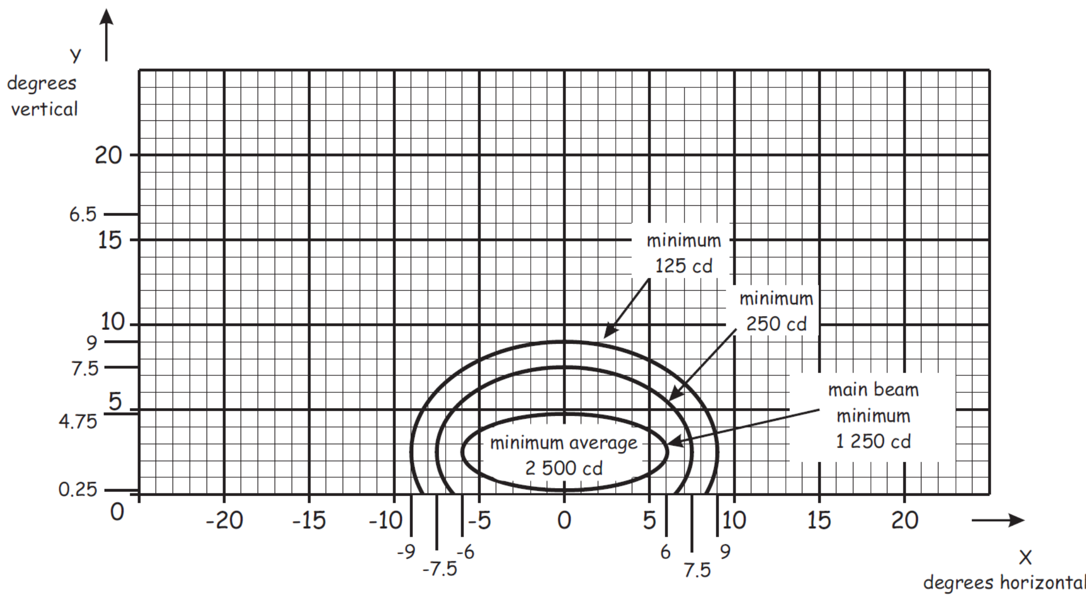
Notes:

1. Curves are calculated on the formula $x^2/a^2 + y^2/b^2 = 1$.

a	5.0	7.0	8.5
b	4.5	8.5	10.0

2. Elevation angle = 4.5 degrees
3. For **red** light multiply values by 0.15.
4. For **yellow** light multiply values by 0.40.
5. See collective notes for Figures B-1 to B-11.

Figure B-7: Isocandela diagram for runway centreline light with 15 m longitudinal spacing (white and red light), land and hold short light (white light), and RETIL (yellow light)



Notes:

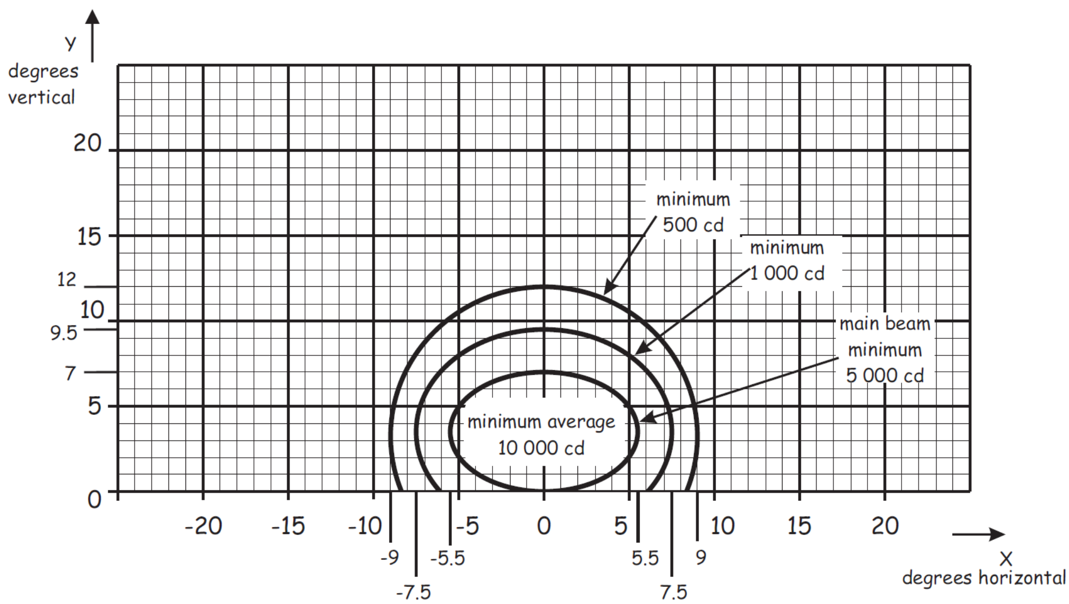
1. Curves are calculated on the formula $x^2/a^2 + y^2/b^2 = 1$.

a	6.0	7.5	9.0
b	2.25	5.0	6.5

2. Elevation angle = 2.5 degrees

2. See collective notes for Figures B-1 to B-11.

Figure B-8: Isocandela diagram for high intensity runway end light (red light)



Notes:

1. Curves are calculated on the formula: $x^2/a^2 + y^2/b^2 = 1$

a	5.5	7.5	9.0
b	3.5	6.0	8.5

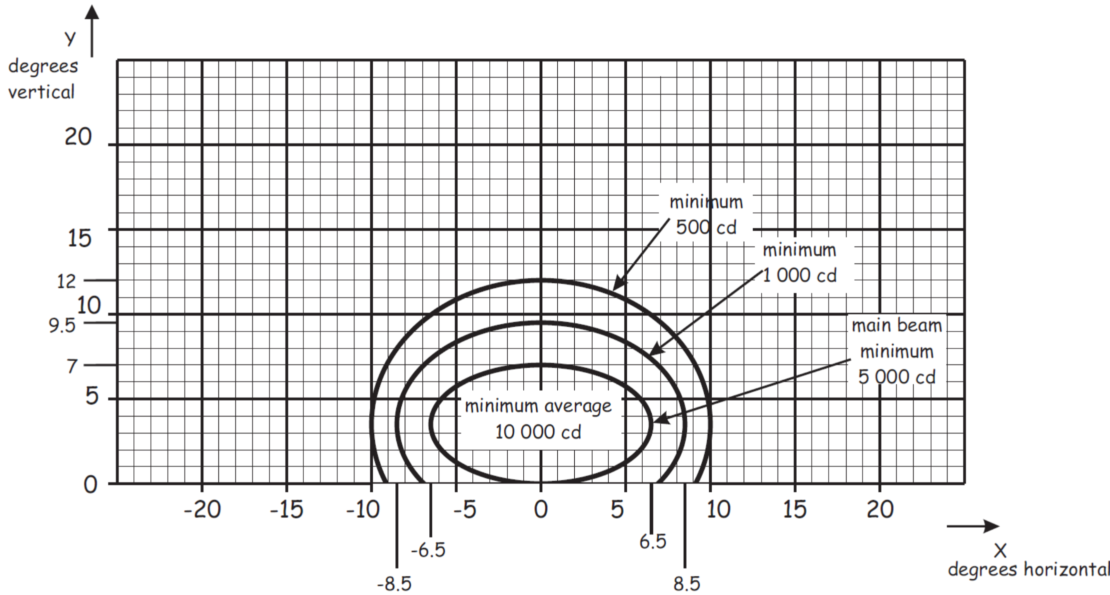
2. Elevation angle = 3.5 degrees

3. Toe-in angle = 3.5 degrees

4. For **yellow** light multiply values by 0.4.

5. See collective notes for Figures B-1 to B-11.

Figure B-9: Isocandela diagram for high intensity runway edge light where width of runway is 45 m or less (white and yellow light)



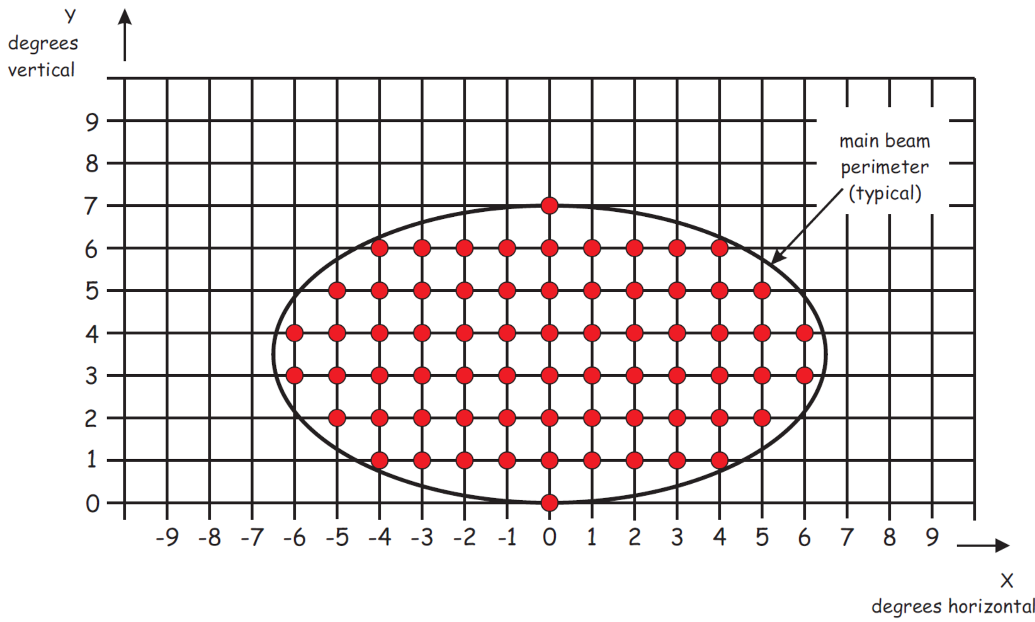
Notes:

1. Curves are calculated on the formula: $x^2/a^2 + y^2/b^2 = 1$.

a	6.5	8.5	10.0
b	3.5	6.0	8.5

2. Elevation angle = 3.5 degrees
3. Toe-in angle = 4.5 degrees
4. For **yellow** light multiply values by 0.4.
5. See collective notes for Figures B-1 to B-11.

Figure B-10: Isocandela diagram for high intensity runway edge light where width of runway is greater than 45 m (white and yellow light)



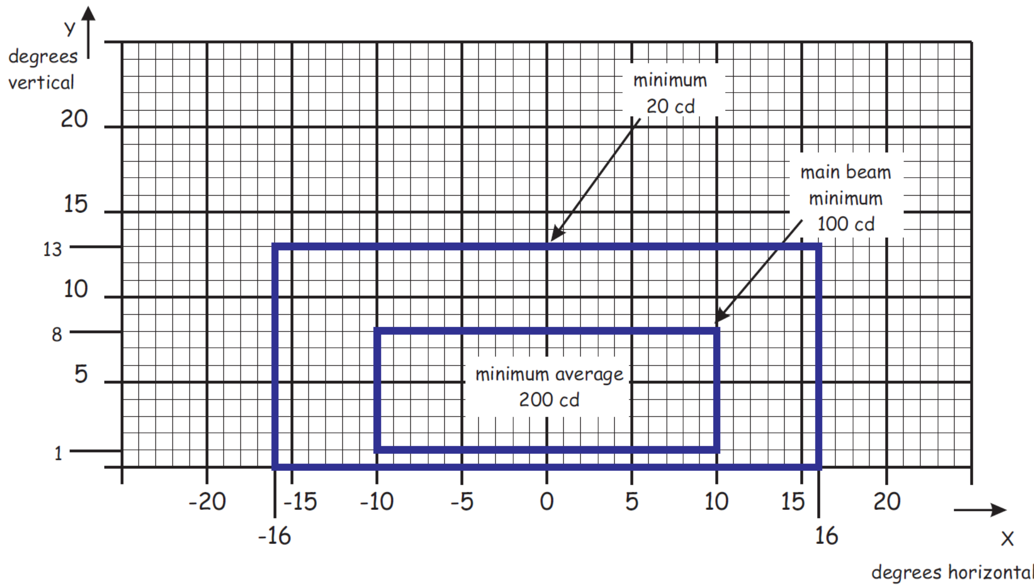
Notes:

1. The average intensity of the main beam is calculated by establishing grid points as shown above and using the intensity value measures at all grid points located within and on the perimeter of the ellipse representing the main beam. The average value is the arithmetic average of light intensities measured at all considered grid points.

2. On the perimeter of and within the ellipse defining the main beam, the measured intensity shall not be less than 0.5 times the specified average intensity.

3. On the perimeter of and within the ellipse defining the main beam, the maximum light intensity value shall not be greater than 1.5 times the average intensity value calculated in accordance with note 1.

Figure B-11: Grid points to be used for the calculation of average intensity of approach and runway lights



Notes

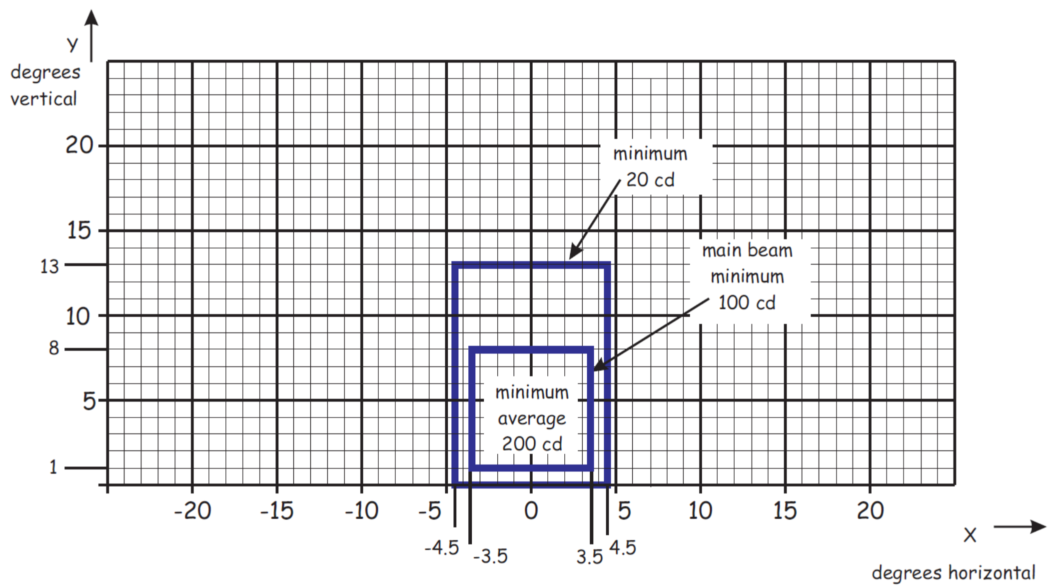
(1) These beam coverages allow for displacement of the cockpit from the distances of the order of 12 m and are intended for use before and after curves.

(2) Elevation angle = 4.5 degrees

(3) **Green**, **yellow** and **red** are in the indicated intensities.

(4) See collective notes for Figures B-12 to B-18.

Figure B-12: Isocandela diagram for taxiway centreline light with 15 m longitudinal spacing and stop bar light in straight sections used in visibility conditions less than RVR1200 (¼ SM), where large offsets can occur (green, yellow and red light)



Notes:

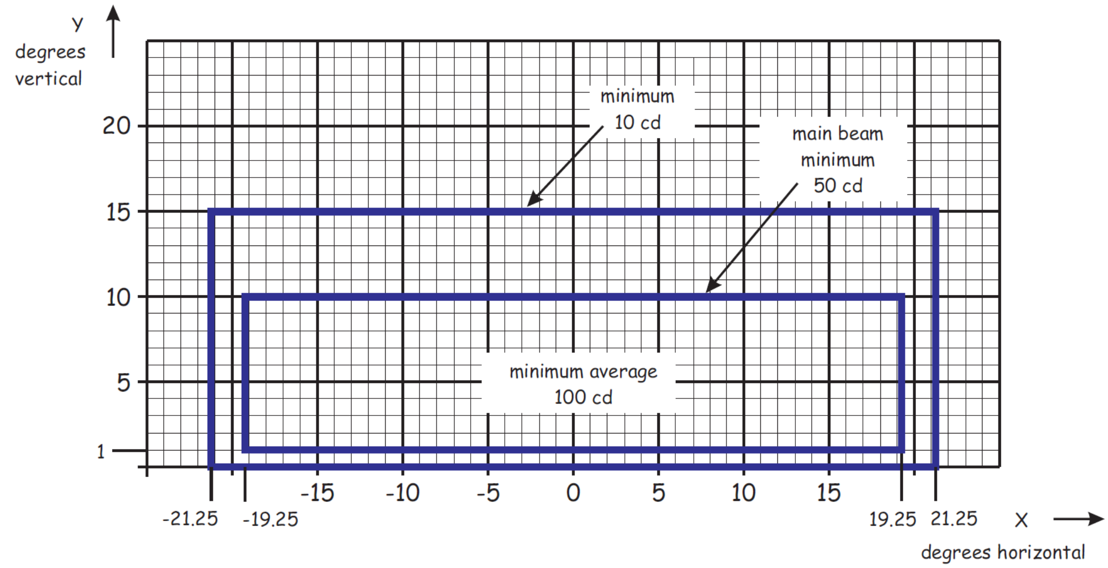
(1) These beam coverages are generally satisfactory and cater for a normal displacement of the cockpit from the centre line of approximately 3 m.

(2) Elevation angle = 4.5 degrees

(3) **Green**, **yellow** and **red** are in the indicated intensities

(4) See collective notes for Figures B-12 to B-18.

Figure B-13: Isocandela diagram for taxiway centreline light with 15 m longitudinal spacing and stop bar light in straight sections used in visibility conditions less than RVR1200 (¼ SM) (green, yellow and red light)



Notes:

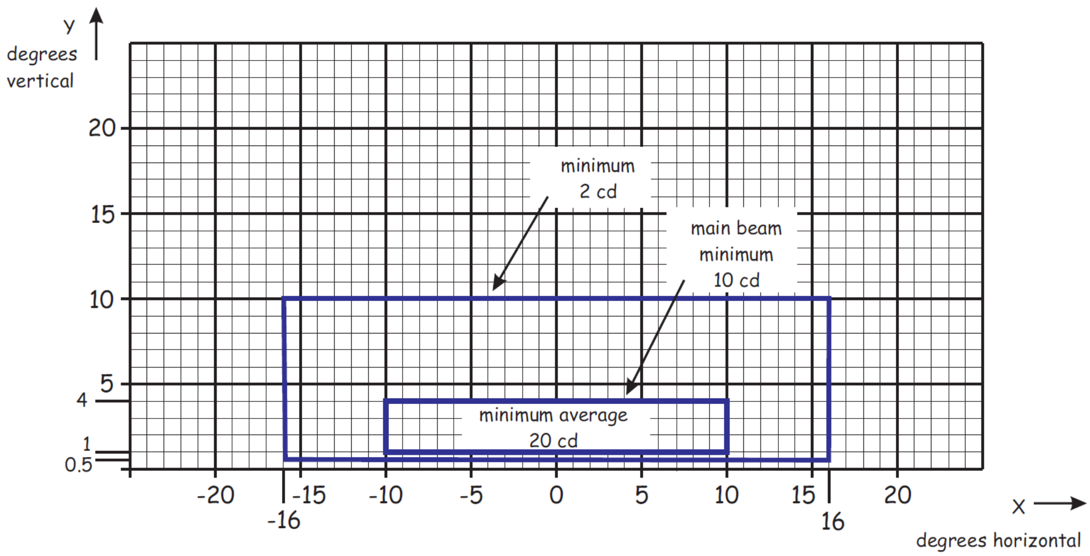
(1) Lights on curves to be toed-in 15.75 degrees with respect to the tangent of the curve.

(2) Elevation angle = 5.5 degrees

(3) **Green**, **yellow** and **red** are in the indicated intensities.

(4) See collective notes for Figures B-12 to B-18.

Figure B-14: Isocandela diagram for taxiway centreline light with 7.5 m longitudinal spacing and stop bar light in curved sections utilized used in visibility conditions less than RVR1200 (¼ SM) (green, yellow and red light)



Notes:

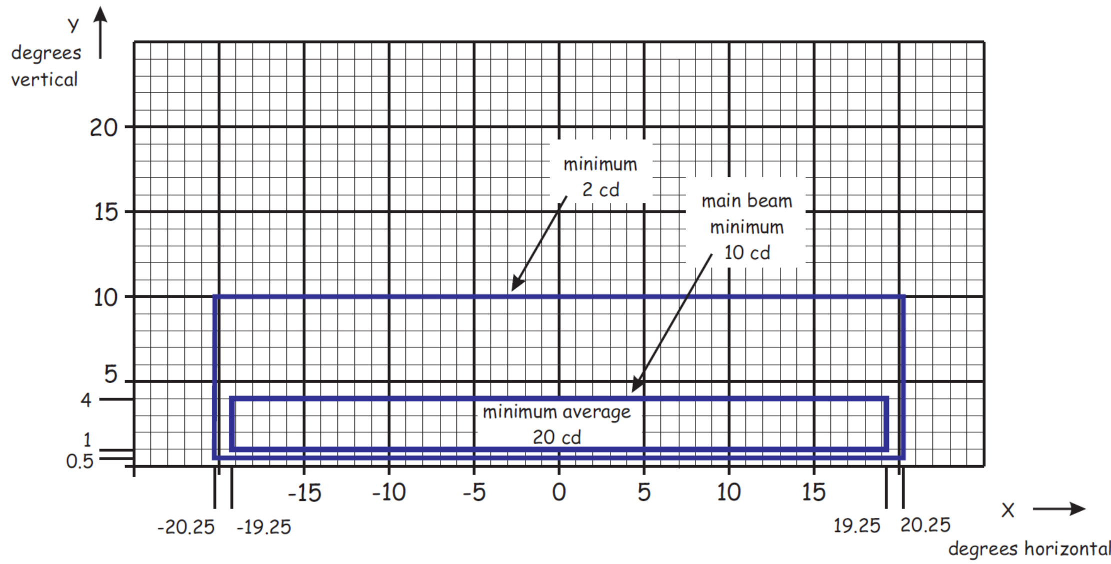
(1) Elevation angle = 2.5 degrees

(2) Where omnidirectional lights are used, they shall comply with the vertical beam requirements in this figure.

(3) **Green**, **yellow** and **red** are in the indicated intensities.

(4) See collective notes for Figures B-12 to B-18.

Figure B-15: Isocandela diagram for taxiway centreline light with 30 m or 60 m longitudinal spacing and stop bar light in straight sections used in visibility conditions of RVR1200 (¼ SM) or greater (green, yellow and red light)



Notes:

(1) Lights on curves to be toed-in 15.75 degrees with respect to the tangent of the curve.

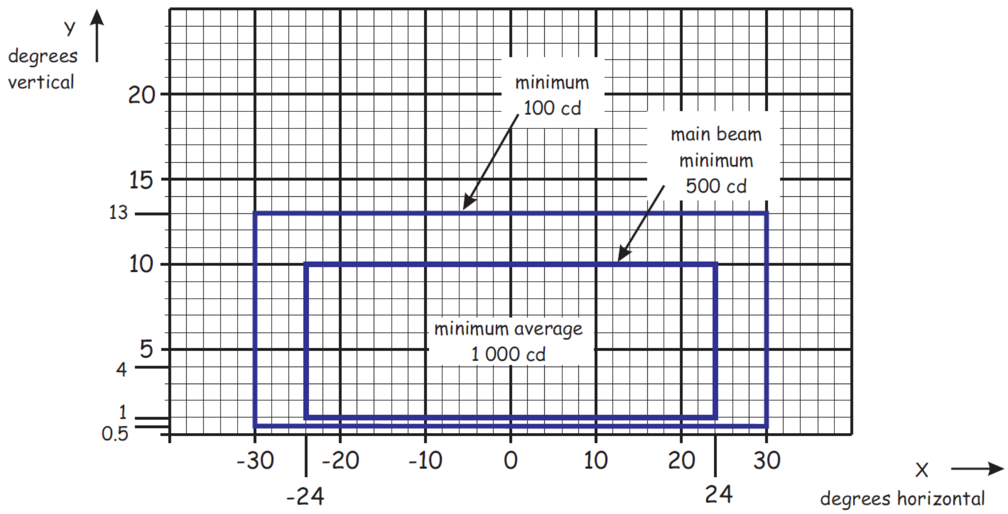
(2) Elevation angle = 2.5 degrees.

(3) These beam coverages allow for displacement of the cockpit from the centreline up to distances of the order of 12 m as could occur at the end of curves.

(4) **Green**, **yellow** and **red** are in the indicated intensities

(5) See collective notes for Figures B-12 to B-18.

Figure B-16: Isocandela diagram for taxiway centreline light with 7.5 m, 15 m, or 30 m longitudinal spacing and stop bar light in curved sections used in visibility conditions of RVR1200 (¼ SM) or greater (green, yellow and red light)



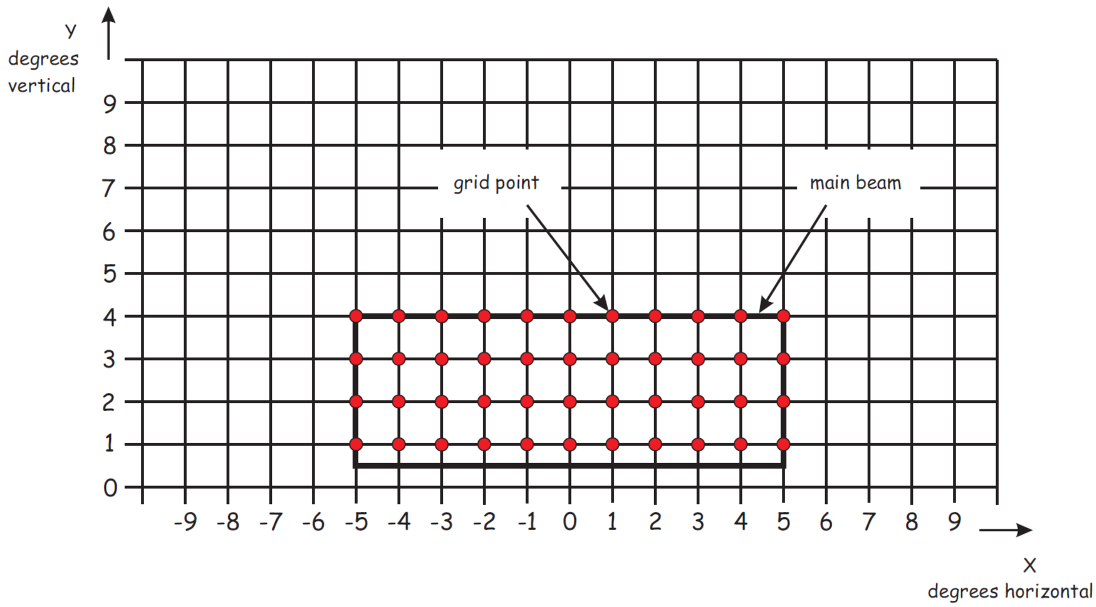
Notes:

(1) Although the lights flash in normal operation, the light intensity is specified as if the lights were fixed for incandescent lamps.

(2) Elevation angle = 5.5 degrees.

(3) See collective notes for Figures B-12 to B-18.

Figure B-17: Isocandela diagram for inset runway guard light (yellow light)



Notes:

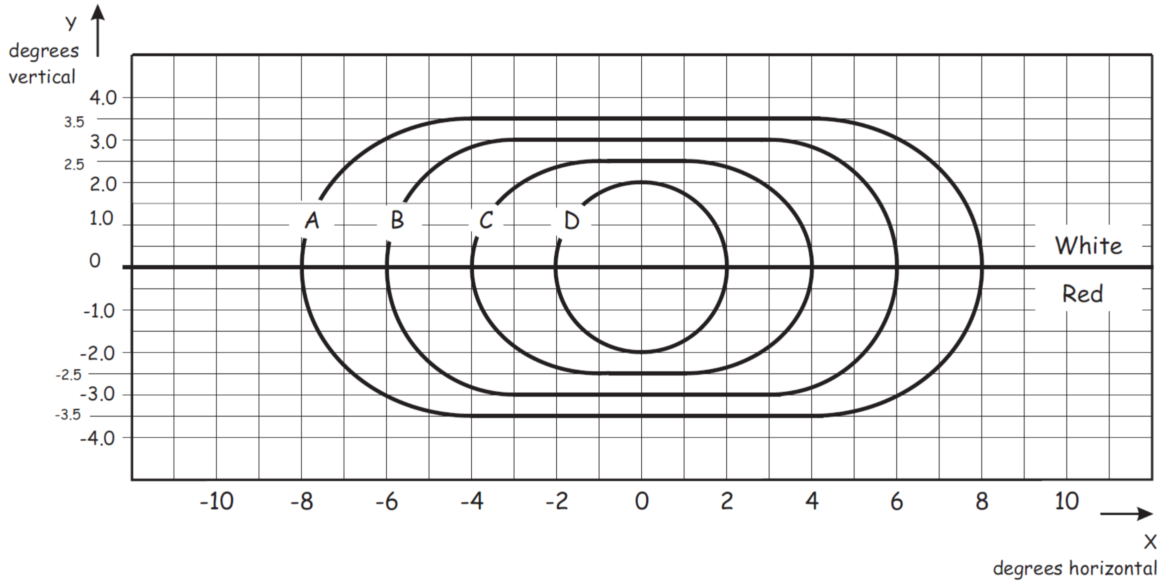
1. The above figure illustrates grid points for typical main beam curve. The angular dimensions of various light units will differ.

2. The average intensity of the main beam is calculated by establishing grid points as shown above and using the intensity value measures at all grid points located within and on the perimeter of the rectangle representing the main beam. The average value is the arithmetic average of light intensities measured at all considered grid points.

3. On the perimeter of and within the rectangle defining the main beam, the measured intensity shall not be less than 0.5 times the specified average intensity.

4. On the perimeter of and within the rectangle defining the main beam, the maximum light intensity value shall not be greater than 1.5 times the average intensity value calculated in accordance with note 1.

Figure B-18: Illustration of how to establish grid points for calculation of average intensity of taxiway centreline, stop bar and runway guard lights



Notes:

(1) The curves are for minimum intensities in red light.

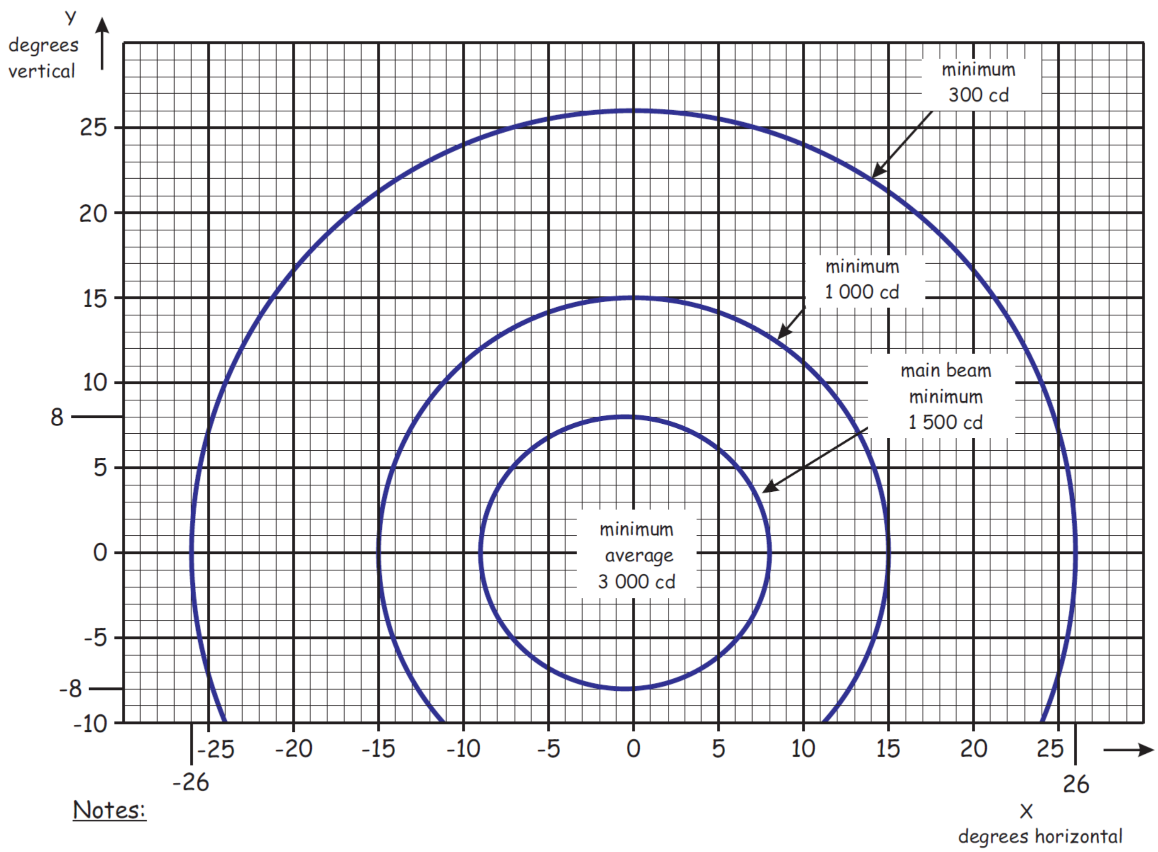
A = 4 000 cd
B = 7 000 cd
C = 10 000 cd
D = 15 000 cd

(2) The intensity value in the white sector of the beam shall be not less than 2 and may be as high as 6.5 times the corresponding intensity in the red sector.

(3) Conformance to the minimum intensity values for each curve is determined by measurement at grid points of 0.5 degree increments in the vertical and 1 degree increments in the horizontal. Each measurement is compared to the specified minimums.

(4) The transition band shall be flat within 3 minutes of arc.

Figure B-19: Light intensity distribution of PAPI and APAPI



Notes:

(1) Curves are calculated on the formula $x^2/a^2 + y^2/b^2 = 1$.

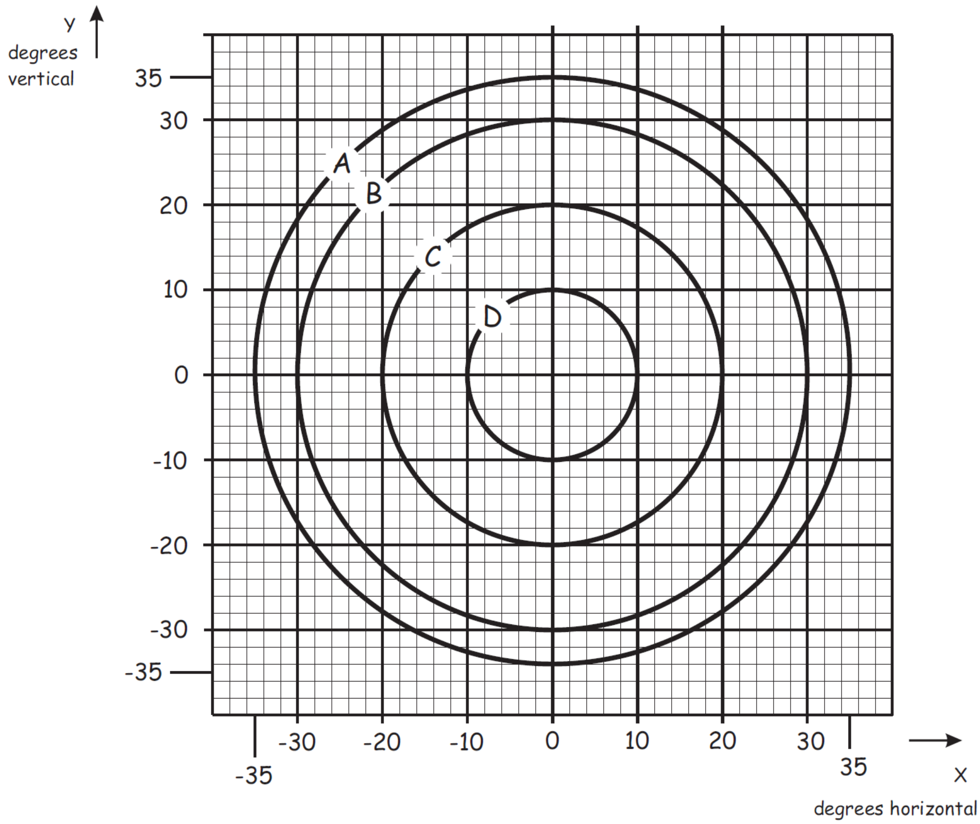
a	8	15	26
b	8	15	26

(2) Although the lights flash in normal operation, the light intensity is specified as if the lights were fixed for incandescent lamps.

(3) The intensities are in yellow light.

(4) For testing refer to B-11.

Figure B-20: Isocandela diagram for elevated runway guard light (yellow light)



Notes:

(1) Minimum intensity measured for 8 combined fibre-optic points:

A = 0.2 cd
B = 0.4 cd
C = 1.0 cd
D = 2.0 cd

(2) Colour: Identification Lunar White to MIL-C-25050A

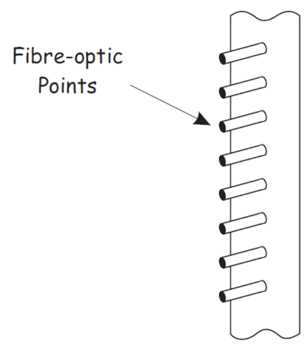


Figure B-21: Isocandela diagram for fibre-optic signs

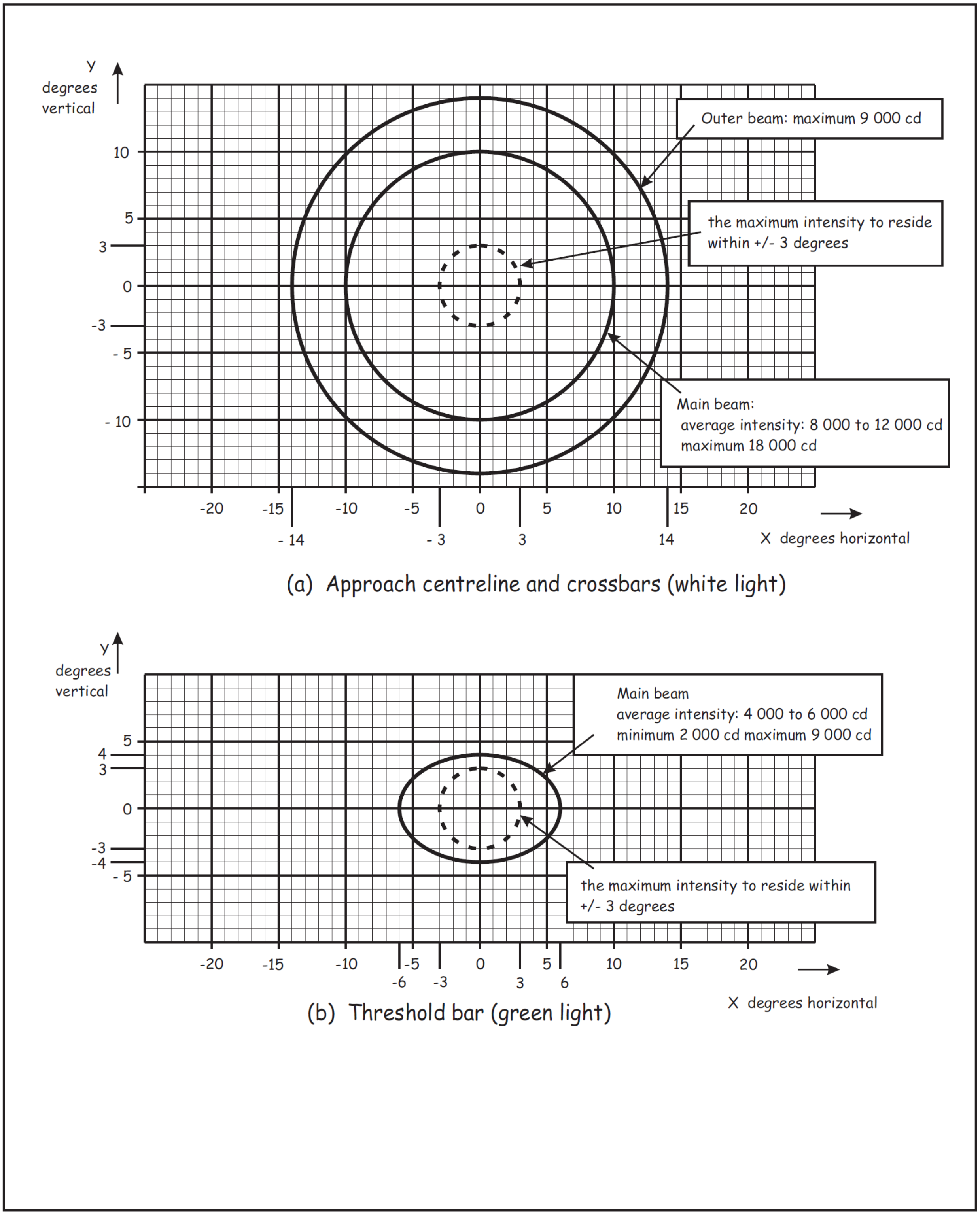
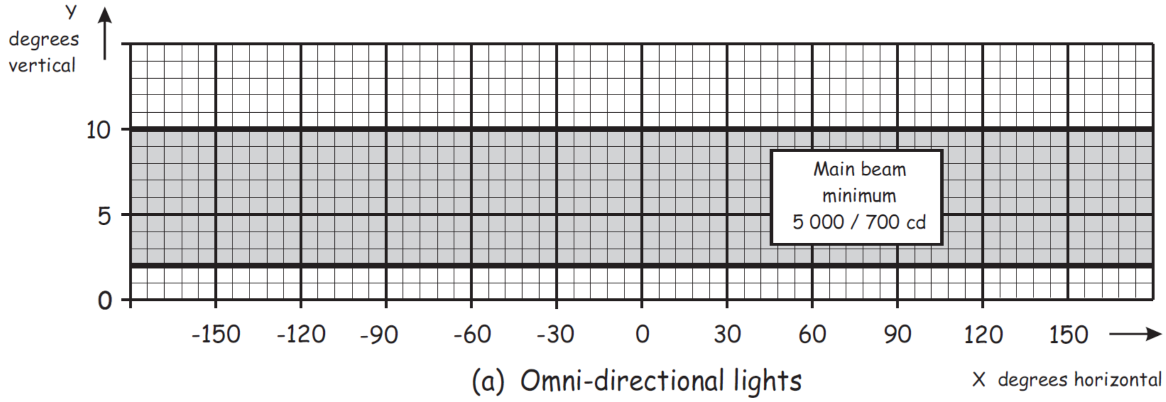
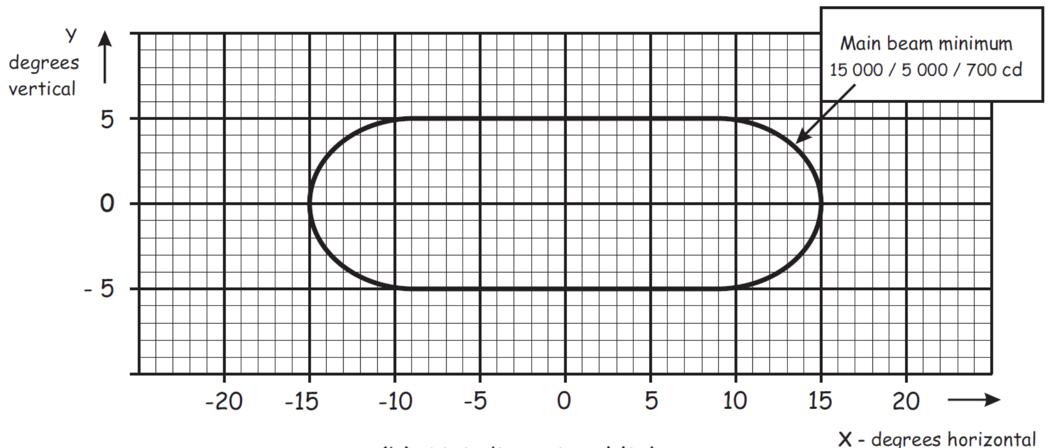


Figure B-22: Isocandela diagram for elevated MALSR, MALSF, and MALS approach centreline and crossbar light (white light) and threshold light (green light)



(a) Omni-directional lights



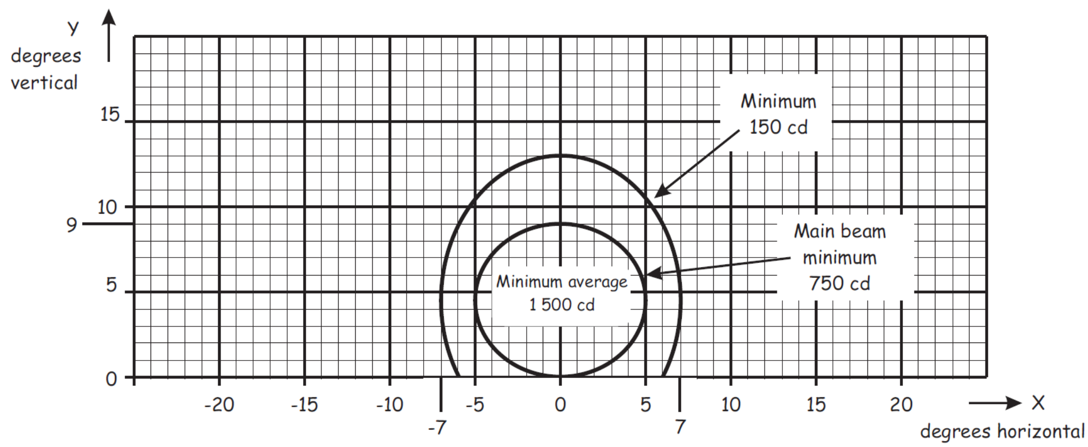
(b) Uni-directional lights

Table: Effective Intensity* (candelas) per Brightness Step

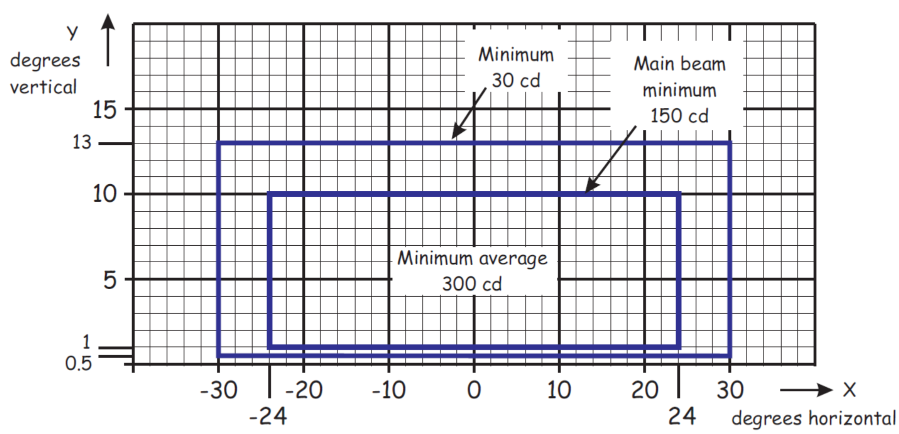
Style	Form	High	Medium	Low
A	uni-directional	15 000	---	---
B	omni-directional	5 000	---	---
C	uni-directional	---	---	700
D	omni-directional	---	---	700
E	uni-directional	15 000	1 500	300
F	omni-directional	5 000	1 500	300

* Measured intensity values are to the values in above table within a tolerance of +/- 50%.

Figure B-23: Isocandela diagram for (a) RTIL and ODALS; and (b) RTIL, LDIN, ALSF-2, SSALR, MALSR, MALSF flashing light (white light)

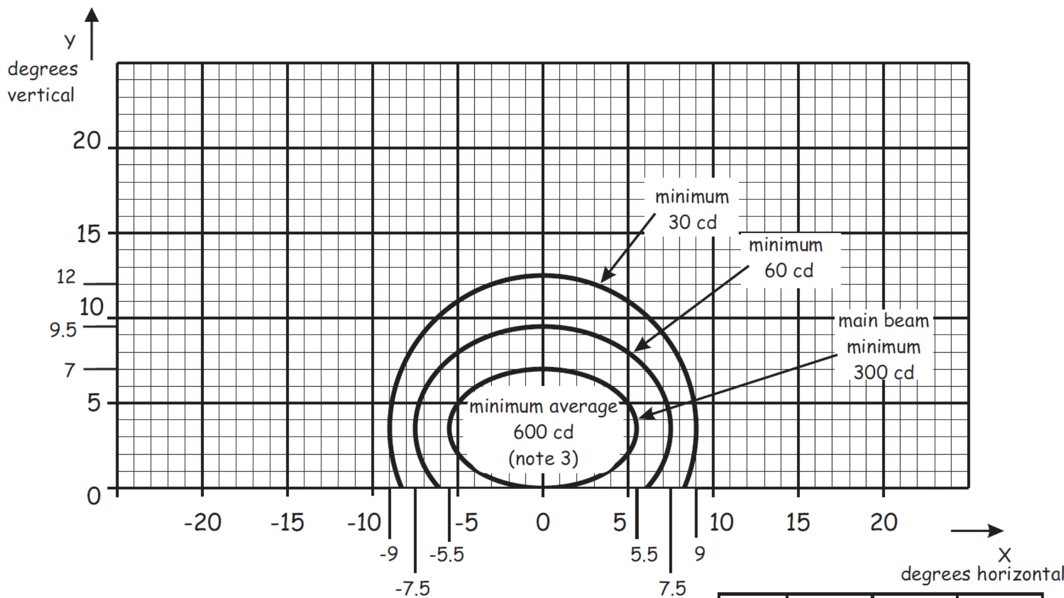


(a) Takeoff and Hold Lights (THL) and
Runway Intersection Lights (RIL) (red light)



(b) Runway Entrance Lights (REL) (red light)

Figure B-24: Isocandela diagram for runway status light (RWSL) (red light)

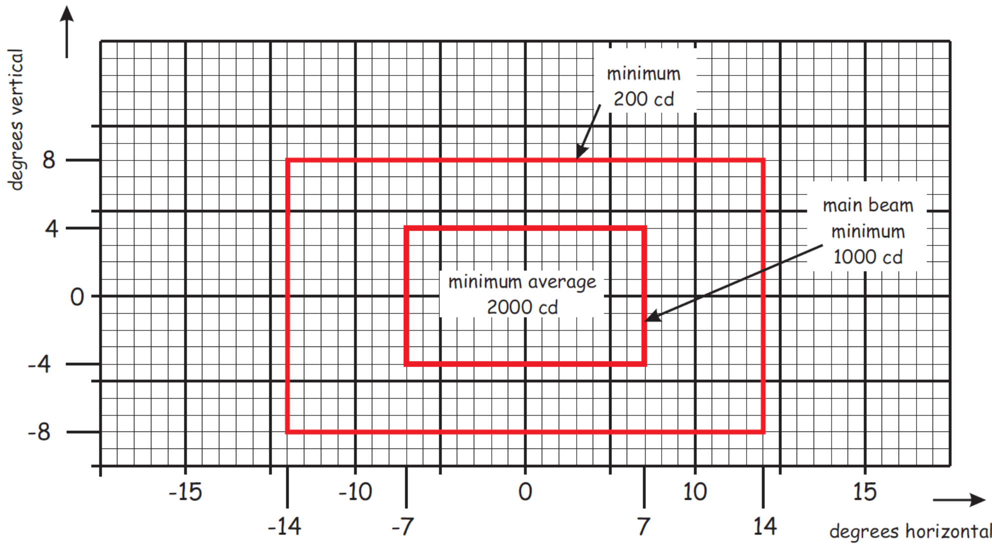


a	5.5	7.5	9.0
b	3.5	6.0	8.5

Notes:

1. Curves calculated on formula: $x^2/a^2 + y^2/b^2 = 1$
2. See collective notes for Figures B-1 to B-11.
3. Photometrics apply to both the end light [red] and threshold light [green].

Figure B-25: Isocandela diagram for medium intensity threshold and end light (green and red light)



Notes:

(1) Supplemental light units are aimed horizontally toward aircraft cockpit at 37 to 52 m from the holding position and vertically aimed at 5 to 10 degrees above the horizontal. [refer figure 5-55]

(2) See collective notes to Figures B-12 to B-21 and B-25B-12 to B-18.

(3) Colour is Aviation Red or Traffic Signal Red.

Figure B-26: Isocandela diagram for supplemental elevated stop bar light (red light)

CHAPTER 6.
MARKING AND LIGHTING OF OBJECTS

CHAPTER 6. MARKING AND LIGHTING OF OBJECTS

6.1 APPLICATION

Note: Marking and lighting is intended to facilitate the pilot's visual acquisition of objects that may pose a hazard to aircraft movement. It does not necessarily reduce operating limitations that may be imposed by an obstacle. The characteristics for the marking and lighting of objects off aerodrome are found in CAR Standard 621.

6.1.1 Objects on Movement Areas

6.1.1.1 Vehicles and other mobile objects, excluding aircraft, on the manoeuvring area of an aerodrome are deemed obstacles. They are marked and, if the mobile object and aerodrome are used at night or in visibility conditions below RVR1200 (1/4SM), lighted.

6.1.1.2 Elevated aeronautical ground lights within the movement area are marked so as to be conspicuous by day.

6.1.2 Objects on Runway Strips

6.1.2.1 A fixed object located on a runway strip is marked and, if the aerodrome is used at night, lighted. Exception: visual aids that are by their nature visually conspicuous.

6.1.3 Other Objects

6.1.3.1 All elevated objects within the distance specified in Table 3.5.1.4 are marked and, if the taxiway is used at night, lighted.

6.2 MARKING OF OBJECTS

6.2.1 Fixed Objects

General

6.2.1.1 All fixed objects to be marked are, whenever possible, coloured; if this is not possible, markers or flags are displayed on or above them. Objects that are conspicuous by their shape, size, or colour need not otherwise be marked.

Use of markers

6.2.1.2 Markers displayed on or adjacent to objects are located in conspicuous positions so as to retain the general profile of the object. They are recognizable in clear weather from a distance of at least 1000 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 are distinctive to the extent necessary to ensure that they are not mistaken for markers employed to convey other information, and they are displayed such that the hazard presented by the object they mark is not increased.

Note: See section 5.5 for markers used to delineate operational areas.

Use of flags

6.2.1.3 Flags used to mark fixed objects are displayed around, on top of, or around the highest edge of, an object. When flags are used to mark large objects or groups of closely spaced objects, they are displayed at least every 15 m and do not increase the hazard presented by the object they mark.

6.2.2 Mobile Objects

General

6.2.2.1 All mobile objects to be marked are coloured or display flags.

Use of colours

6.2.2.2 Flags used to mark mobile objects are rectangular and not less than 0.9 m on a side.

6.2.2.3 Flags used to mark mobile objects consist of a chequered pattern, each square having sides of not less than 0.3 m. The colours of the pattern contrast each with the other and with the background against which they will be seen. Orange and white, or alternately, red and white are used.

6.3 LIGHTING OF OBJECTS

6.3.1 Fixed Objects

6.3.1.1 The lighting characteristics of fixed objects in 6.1.2.1 and 6.1.3.1 are as follows:

(a) with fixed red light(s);

(b) of an intensity not less than 32 cd and in accordance with Standard 621; and

(c) located at or near the highest point(s) on the object.

6.3.2 Mobile Objects

6.3.2.1 Subject to 6.3.2.2, mobile objects, excluding aircraft, on the manoeuvring area are lighted to display flashing yellow lights except for vehicles associated with an emergency situation, which display flashing red light, or flashing red and flashing yellow lights. The characteristics are as follows:

(a) an effective intensity of the flash ranging between 40 and 400 candelas;

(b) 360° azimuth (horizontal) coverage;

(c) peak intensity from 0° to 10° above the horizontal and reduced intensity to 1/10 of peak intensity from 10° to 15° above the horizontal;

(d) a flash rate of 75 (±15) flashes per minute; and

(e) the colour of a mobile object light is within the appropriate boundaries identified in Appendix 5A.

Note: It is desirable to use lights of higher intensity for mobile objects routinely operating on the manoeuvring area for easy acquisition from the control tower, yet not in excess of 400 candelas for reason of glare.

6.3.2.2 For the strobe type light, the flash display includes a multiple flash burst within each cycle. The multiple flashes are sequential and separated by an interval of 250 ms.

CHAPTER 7. RESERVED

CHAPTER 8. AERODROME LIGHTING SYSTEM DESIGN AND OPERATIONS

CHAPTER 8. AERODROME LIGHTING SYSTEM DESIGN AND OPERATIONS

8.1 SECONDARY POWER SUPPLY

Note: Aerodrome facilities, as identified below are provided with a primary and a secondary power supply. In the case of visual aids lighting for precision approach CAT 1 operations, the primary is designated the normal supply and the secondary is designated the standby supply. Typically, in order to meet the maximum switchover time requirements of 1 second (see Table 8.1.1.2), the secondary supply is designated the normal supply and the primary supply is designated the standby.

Application

8.1.1.1 A secondary power supply is provided for:

(a) a precision runway, or

(b) a take-off runway operating in visibility conditions less than RVR1200 (¼ SM).

Characteristics

8.1.1.2 The secondary power supply is capable of supplying the power requirements of the aerodrome facilities listed below:

(a) all fixed obstacle lights which, in the opinion of the TCCA, are essential to ensure the safe operation of aircraft;

(b) essential equipment and facilities for onsite emergency agencies; and

(c) items listed in Table 8.1.1.2—Requirements for Secondary Power Supply.

Note: Other essential lighting may be required to meet other federal or provincial/territorial legislation such as, but not limited to, security and occupational health and safety.

8.1.1.3 The switchover time between failure of the normal power supply and the complete restoration of the services through means of the secondary power supply is not more than that specified in Table 8.1.1.2.

8.1.1.4 Requirements for a secondary power supply are met by either of the following:

(a) local engine-generator(s); or

(b) a duplicate feeder that supplies power to the aerodrome's field electric centre(s) from a grid substation other than the primary substation through a transmission line following a route different from the primary power supply route, such that the possibility of a simultaneous failure of the primary and secondary power supplies is extremely remote.

Note 1: Guidance on secondary power supply is given in the ICAO Aerodrome Design Manual, Part 5.

Note 2: The possibility of simultaneous failure of the power supplies is remote due to their physical and electrical separation, thereby ensuring the required level of power availability and independence.

8.2 CIRCUIT DESIGN

8.2.1.1 For a precision runway or for take-off operations in visibility conditions below RVR1800 ($^{3}/_{8}$ SM), the electrical circuits for the power supply, lighting and control of the lighting systems included in Table 8.1.1.2 are so designed that the failure of one circuit will not leave the pilot without visual guidance nor will it result in a misleading or inadequate pattern.

8.2.1.2 Where a runway forming part of a normal taxi route is provided with runway lighting and taxiway lighting, the lighting systems are interlocked to preclude the possibility of simultaneous operation of both lighting systems.

Table 8.1.1.2—Requirements for Secondary Power Supply

Runway type operation	Visual aids (lighting) requiring power	Maximum switchover time (seconds)
Precision approach category I	Approach lighting system	15
	Runway edge	15
	PAPI	15
	Runway threshold	15
	Runway end	15
	Essential taxiway	15
Precision approach category II & III	Inner 300 m of approach lighting system	1
	Other portions of approach lighting system	15
	Runway edge	15
	Runway threshold	1
	Runway end	1
	Runway centreline	1
	Runway touchdown zone	1
	All stop bars	1
	Essential taxiway	15
Take-off runway operations in visibility conditions below RVR1200 (¼ SM) day or night	Runway edge	15
	Runway end	1
	Runway centreline	1
	All stop bars	1
	Essential taxiway	1

8.2.1.3 Where a surface movement guidance and control system is provided by selective switching of stop bars and taxiway centreline lights, the following requirements are met:

(a) taxiway routes which are indicated by illuminated taxiway centreline lights are capable of being terminated by an illuminated stop bar;

(b) the control circuits are so arranged that when a dynamic stop bar is illuminated , the section of taxiway centreline lights extending for a minimum distance of 90 m beyond is suppressed; and

(c) the taxiway centreline lights beyond the stop bar are activated in the intended direction of aircraft movement when the stop bar is suppressed.

Note: Taxiway centreline lighting on rapid exit taxiways should have independent on/off control and an intensity setting, which is that of the associated runway centreline lighting.

8.2.1.4 Stop bars, which are to be actively used for aircraft control purposes, are provided with an automatic ON function in the event of a control system failure.

8.3 CONTROL AND MONITORING

8.3.1 Visual Aids

Automatic Monitoring

8.3.1.1 Where lighting systems are used for aircraft control purposes (e.g. stop bars), within 5 seconds of pressing the stop bar button on the ATC airfield lighting control panel, the actual status of the lights is displayed on the lighting control panel.

8.4 OPERATION AND CONTROL OF AERODROME LIGHTING SYSTEMS

8.4.1 General

Application

8.4.1.1 Except for aerodromes using the ARCAL system as specified in section 8.4.2, aerodrome lighting is operated as specified in 8.4.1.2 to 8.4.1.9.

Continuous or Automatic Operation

8.4.1.2 Where aerodrome lighting systems are controlled automatically by means of a photoelectric device, the ON and OFF settings are between 300 lux and 500 lux of northern sky illuminance.

8.4.1.3 Where provided, aerodrome flight manoeuvring area hazard lights operate continuously at night.

Non-Continuous Operation

8.4.1.4 Where the PAPI or APAPI system has not been harmonized with the ILS glide slope signal, the system is not operated when:

(a) the runway in use is provided with vertical guidance capability; and

(b) weather conditions are less than a ceiling of 500 ft or the visibility is less than 1 SM.

8.4.1.5 Where provided, stop bars are activated whenever an aircraft, vehicle or other mobile object is operating on the manoeuvring area in visibility conditions below:

(a) RVR1200 (¼ SM); or

(b) RVR2600 (½ SM), where the runway guard lights have been omitted in accordance with 5.3.26.1.

8.4.1.6 Where provided, runway guard lights are activated when visibility conditions are below RVR2600 (½ SM) and a vehicle, aircraft or other mobile object is operating on the manoeuvring area.

8.4.1.7 Where provided, obstruction lights are activated continuously at night.

8.4.1.8 Where provided, road-holding position lights are activated in visibility conditions below RVR1200 (¼ SM) whenever a vehicle, aircraft or other mobile object is operating on the manoeuvring area.

Selection of Lighting System Intensity

8.4.1.9 Where a light system has been provided with intensity control functions, the default selection of intensity is in accordance with Table 8.4.1.9—Intensity Settings for Medium and High Intensity Light Systems, except that any selection may be made at the request of a pilot using the visual aid or as required to facilitate aerodrome operations.

Table 8.4.1.9—Intensity Settings for Medium and High Intensity Light Systems

Visibility Less Than	Night					Day			
	½ SM (RVR 2600)	1 SM (RVR 5000)	2 SM	3 SM	> 3 SM	1 SM (RVR 5000)	2 SM	3 SM	> 3 SM
5 settings system									
ALSF2*(1)*, SSALR*(1)*, SSALS	4	3	2	2	1	5	4	4	3
Runway edge, threshold and end	4	3	2	2	1	5	4	4	3
Runway centreline	4	3	2	2	1	5	4	4	3
Rapid exit centreline	4	3	2	2	1	5	4	4	3
Rapid exit taxiway indicator lights	4	3	2	2	1	5	4	4	3
Stop bar	4	3	2	2	1	5	4	4	3
Touchdown zone lighting	4	3	2	2	1	5	4	4	3
PAPI/APAPI	3	3	3	3	3	4-5	4-5	4-5	4-5
Taxiway centreline	4	3	2	2	1	5	4	4	3
Taxiway edge *(2)*	4	3	2	2	1	5	4	4	3
Land and hold short lights	4	3	2	2	1	5	4	4	3
3 settings system									
ODALS*(1)*, MALSR*(1)*, MALSF*(1)*, MALS	3	3	2	1	1	3	3	2	2
Runway edge, threshold and end	3	3	2	1	1	3	3	2	2
Runway threshold identification lights	3	3	2	2	1	3	3	2	2
PAPI/APAPI	1	1	1	1	1	2-3	2-3	2-3	2-3
Taxiway edge *(2)*	3	3	2	1	1	3	3	2	2
Runway guard lights *(1)*	3	3	2	1	1	3	3	2	2
Visual alignment guidance system	3	3	2	1	1	3	3	2	2

(1) ODALS, RGLs and the RAIL portion of other systems, although connected to a 5 setting system, operate as a low/medium/high system as depicted in the 3 setting system. For approach lighting systems equipped with RAIL, the control system is such that the RAIL portion can be turned off leaving the steady burning portion of the system. However, the steady burning portion of the system cannot be turned off leaving only the RAIL

(2) Where variable intensity control function is available for taxiway edge lights.

8.4.2 Aircraft Radio Control of Aerodrome Lighting (ARCAL)

Application

8.4.2.1 Where provided, the ARCAL is as specified in this section.

General

8.4.2.2 An ARCAL system is only installed at an aerodrome having runway operating minima [height above threshold] of 200 ft or higher.

Characteristics

8.4.2.3 The ARCAL system controls the following visual aid components, where provided:

(a) approach lighting systems;

(b) runway lighting;

(c) taxiway lighting;

(d) visual approach slope indicator (PAPI, APAPI);

(e) runway identification lights;

(f) visual alignment guidance lights;

(g) wind direction indicator light; and

(h) aerodrome beacon.

8.4.2.4 Where the ARCAL system is activated in both daytime and night time operations and incorporates a photocell device to increase the settings established in Table 8.4.1.9, the photocell device has the settings in Tables 8.4.2.4(a) or (b) as appropriate.

Table 8.4.2.4(a)—Two Intensity Steps

Mode Change	Intensity Change	Photocell Setting (*)
Day to Night	High to Low	600 to 350 lux
Night to Day	Low to High	350 to 600 lux

Table 8.4.2.4(b)—Three Intensity Steps

Mode Change	Intensity Change	Photocell Setting (*)
Day to Twilight	High to Medium	600 to 350 lux
Twilight to Night	Medium to Low	50 to 20 lux
Night to Twilight	Low to Medium	20 to 50 lux
Twilight to Day	Medium to High	350 to 600 lux

(*) north sky illuminance

8.4.2.5 Aerodrome flight manoeuvring area hazard lights are not activated by an ARCAL system or a remote facility.

8.4.2.6 The ARCAL system functions 24 hr per day except at aerodromes where air traffic services are provided. ARCAL does not function during the hours when such services are provided.

8.4.2.7 Where the ARCAL system is to activate a variable intensity lighting system, it is capable of selection of at least three intensity settings.

Selection of Operating Frequency

8.4.2.8 At aerodromes where there is a mandatory frequency (MF), the ARCAL system operates on the published MF.

8.4.2.9 Where there is an aerodrome traffic frequency, the ARCAL is activated by selecting the aerodrome traffic frequency (ATF).

System Operation

8.4.2.10 The ARCAL system controls the aerodrome visual aid components by decoding a series of radio transmissions that are generated by keying the aircraft transmitter microphone a specified number of times within a 5 second period.

8.4.2.11 Once activated, the ARCAL remains on for a minimum of 15 minutes after which period the ARCAL and associated selected lighting are automatically turned off. The 15-minute time period resumes every time an operation or brightness selection is made.

8.4.2.12 The selection of visual aid components controlled by the ARCAL system is in accordance with Table 8.4.2.12—Intensity Settings for Lighting Systems Activated by ARCAL.

Table 8.4.2.12—Intensity Settings for Lighting Systems Activated by ARCAL				
		Selected Intensity Setting		
		Type K		
Visual Aid System	Intensity Settings	* 3 Clicks	5 Clicks	7 Clicks
Approach Lighting				
-- SSALR / SSALS	5	1	3	4 **
-- MALSR / MALSF / MALS	3	1	2	3
-- ODALS	3	OFF or 1	2	3
Runway Edge Lighting:				
-- High Intensity	5	1	3	4 **
-- Medium Intensity	3	1	2	3
Taxiway Edge Lighting:				
-- 3 setting	3	1	2	3
-- 1 setting	1	1	1	1
PAPI and APAPI:				
-- 5 settings	5	3	4	5
-- 3 settings	3	1	2	3
Runway Threshold Identification Lights (RTILs), RAIL and MALSF Flashing Lights				
-- 3 settings	3	OFF	OFF or 2	3
-- 1 setting	1	OFF	OFF or 1	1
Miscellaneous Lighting				
---- Wind Direction Indicator	1	1	1	1
---- Signs	1	1	1	1
---- Aerodrome Beacon	1	1	1	1
---- Visual Alignment Guidance System	3	OFF or 1	2	3
---- Runway Guard Lights	3	1	2	3

** A photocell may be installed on the system to disable the intensity 3 setting during daytime operations.*

*** A photocell may be installed on the system to allow the intensity 5 setting during daytime operations.*

8.5 AERODROME VEHICLE OPERATION

8.5.1 General

8.5.1.1 The driver of a vehicle operates:

(a) on the manoeuvring area, only as authorized by the air traffic services unit, aerodrome operator or designate; and

(b) on the apron, only as authorized by the appropriate designated authority.

8.5.1.2 At aerodromes where air traffic services, an approach Unicom, or community aerodrome radio station (CARS) are provided, the driver of a vehicle operating on the manoeuvring area is equipped with suitable two-way radio communication or is accompanied by a vehicle or person equipped with appropriate radio communication equipment.

Note 1: At aerodromes where air traffic services or an approach Unicom is not provided, the decision to equip vehicles with radio equipment is determined by the aerodrome operator after taking into account the air traffic density, visibility conditions under which operations are conducted, complexity of the aerodrome layout, ground traffic density, and the obligation to convey runway status information to pilots conducting instrument approaches.

8.5.1.3 The driver of a vehicle operating on the movement area complies with all mandatory instructions conveyed by marking and signs unless:

(a) otherwise authorized by the air traffic services unit personnel, aerodrome operator or designate when on the manoeuvring area;

(b) otherwise authorized by the appropriate designated authority when on the apron; or

(c) giving way to aircraft.

8.5.1.4 The driver of a vehicle operating on the movement area complies with all mandatory instructions conveyed by lights.

8.5.1.5 The driver of a vehicle operating on the movement area is appropriately trained for the tasks to be performed and complies with the instructions issued by:

(a) the air traffic services unit personnel, aerodrome operator or designate when operating on the manoeuvring area; and

(b) the appropriate designated authority, when operating on the apron.

8.5.1.6 Where air traffic services, an approach Unicom, or a community aerodrome radio station (CARS) is provided, the driver of a vehicle establishes satisfactory two-way radio communication with the unit personnel on the MF or ATF, as applicable, before entering the manoeuvring area.

8.5.1.7 Where the services specified in 8.5.1.6 are not provided, or during any period that the services specified in 8.5.1.6 are not available (e.g. less than 24 hour operation), the driver of a vehicle:

(a) broadcasts prior to entering, exiting or changing location on the manoeuvring area, stating the vehicle position and intentions on the MF or ATF, as applicable;

(b) broadcasts when on the manoeuvring area to advise pilots of vehicle position and intentions;

(c) broadcasts when requested, to provide runway condition reports and the location of other known ground traffic present on the manoeuvring area; and

(d) gives way to aircraft at all times.

8.5.1.8 The driver of a vehicle subject to 8.5.1.2 maintains a continuous listening watch on the appropriate frequency when operating on the movement area.

8.5.1.9 The driver of a vehicle operating on an apron gives way to:

(a) an emergency vehicle responding to an emergency displaying flashing red light or flashing red and flashing yellow lights;

(b) an aircraft taxiing, about to taxi or being pushed or towed; and

(c) other vehicles in accordance with local air traffic directives.

8.6 LOW/REDUCED VISIBILITY OPERATIONS PLANS

8.6.1 General

Application

8.6.1.1 A low visibility operations plan is provided at an aerodrome operating in visibility conditions below RVR1200 (¼ SM).

8.6.1.2 A reduced visibility operations plan is provided at an aerodrome operating in visibility conditions below RVR2600 (½ SM) down to RVR1200 (¼ SM).

Characteristics

8.6.1.3 The low visibility operations plan is documented and comprises:

- (a) the management of aircraft movements on the apron either procedurally or by positive control;
- (b) the identification of low visibility taxi routes;
- (c) the limitations of vehicle operations on the movement area, including:
  - (i) maintenance activity not required for low visibility operations,
  - (ii) construction;
- (d) the use and operation of visual aids;
- (e) a monitoring system to:
  - (i) detect lighting outages,
  - (ii) confirm proper operation of interlocking systems,
  - (iii) detect electrical circuits failures,
  - (iv) relay appropriate information to ATC personnel as required;
- (f) an annual review of the low visibility operations plan;
- (g) initial and recurrent training;
- (h) a summary of the emergency response equipment and procedures in use;
- (i) standby power, including**:**
  - (i) type,
  - (ii) system facilities,
  - (iii) switchover time,
  - (iv) the ongoing operation,
- (j) low visibility operations activation procedures;
- (k) ongoing operational procedures, including but not limited to:
  - (i) the periodic inspection of the manoeuvring area surfaces,
  - (ii) the periodic inspection of visual aids,
  - (iii) system failures; and
- (l) low visibility operations termination procedures.

8.6.1.4 The reduced visibility operations plan is documented and includes:

(a) identification of reduced visibility taxi routes, where provided;

(b) limitations of vehicle operations on the manoeuvring area, such as:

(i) non-operationally required maintenance activity,

(ii) construction;

(c) the use and operation of visual aids;

(d) an annual review of the reduced visibility operations plan;

(e) standby power, including:

(i) type,

(ii) system facilities,

(iii) switchover time,

(iv) the ongoing operation;

(f) ongoing operational procedures, including but not limited to:

(i) the periodic inspection of the manoeuvring area surfaces,

(ii) the periodic inspection of visual aids; and

(g) any other operational procedures unique to the site.

CHAPTER 9. AERODROME MAINTENANCE

CHAPTER 9. AERODROME MAINTENANCE

9.1 MAINTENANCE

9.1.1 General

9.1.1.1 A maintenance program is established to maintain the aerodrome components in a condition of compliance with standards.

Note: Preventive maintenance is programmed maintenance work done in order to prevent a failure or degradation of` facilities and systems.

9.1.2 Pavements

9.1.2.1 For a runway serving turbojet aircraft, measurements of the friction characteristics of a runway surface are made periodically with a continuous friction-measuring device using self-wetting features.

Note: New, reconstructed or resurfaced paved runways would typically have friction characteristics measured prior to or as soon as possible following the return to service to establish a baseline for trend measurements of friction characteristics.

9.1.2.2 Corrective maintenance action is taken when:

(a) the average coefficient of friction (COF) for the entire runway is below 0.50; or

(b) any portions of a runway surface that are 100 m or greater in length have an average COF less than 0.30.

Note 1: A NOTAM advising pilots that the runway may be slippery when wet is common practice when the measured coefficient of friction is below the values in 9.1.2.2. See 2.5.1.3.

Note 2: The COF levels specified in 9.1.2.2 apply to the COF measurements made with the surface friction tester (SFT) and to the following test conditions:

(a) the friction test tire is manufactured to meet the requirements of ASTM E1551 Standard Specification for Special Purpose, Smooth–Tread Tire, Operated on Fixed Braking Slip Continuous Friction Measuring Equipment ;

(b) the friction test tire is inflated to a tire pressure of 207kPa (±3kPa);

(c) the test speed is held constant at 65 km/h (±5 km/h); and

(d) the depth of water placed in front of the friction test tire by the self-wetting system is 1.0 mm.

Winter maintenance

9.1.2.3 Chemicals that may have harmful effects on aircraft or pavements are not used on the movement area.

9.1.3 Visual Aids

Application

9.1.3.1 The serviceability of a lighting system is in accordance with the requirements of Table 9.1.3.1—Lighting Serviceability Table (Maximum Light Failures) and associated notes for the continued operation of the system.

Note: Guidance on preventive maintenance of visual aids is given in ICAO Airport Services Manual, Part 9.

9.1.3.2 A light is deemed to have failed (light failure) when the main beam average intensity is less than 50% of the value specified in the appropriate figure in Appendix 5B. For light units where the design value of the main beam average intensity is above the values shown, the 50% value is of the design value.

9.1.3.3 Subject to 9.1.3.4, where the light failures for a required lighting system exceeds that in the Table 9.1.3.1—Lighting Serviceability Table (Maximum Light Failures), the aerodrome operator, pending rectification of the problem, reduces the level of service of the aerodrome to the appropriate level for compliance with the maximum permissible light failures.

9.1.3.4 Where the light failures for a runway edge, end or threshold lighting system exceeds that indicated under Arrival Non-Instrument Runway the Table 9.1.3.1, the system and all associated lighting systems for that runway are deemed unserviceable for night operations and are extinguished.

Table 9.1.3.1—Lighting Serviceability Table (Maximum Light Failures)				
Runway Level of Service →→→	**Arrival Non-Instrument Runway**	**Arrival Non-Precision Runway**	**Arrival Precision CAT I Runway**	**Arrival Precision CAT II/III Runway**
Runway Edge Lights	15% of the total No 4 in a row	15% of the total No 3 in a row	15% of the total No 2 in a row	5% of the total No 2 in a row
Runway Threshold Lights	2 out, no 2 adjacent	2 out, no 2 adjacent, except for threshold lights on SSALS, MALS, MALSR, MALSF which is addressed as part of steady burning approach lights	Addressed as part of steady burning approach lights	Addressed as part of steady burning approach lights
Runway End Lights	2 out, no 2 adjacent	2 out, no 2 adjacent	2 out, no 2 adjacent	2 out, no 2 adjacent
Runway Centreline Lights	N/A	N/A	N/A	5% of the total No 2 adjacent
Touchdown Zone Lights	N/A	N/A	N/A	10% of the total No 3 adjacent in any direction
ALSF-2 / SSALR Approach Lights (steady burning lights) (Note 6)	N/A	N/A	15% of the total No 3 adjacent in any direction, except for threshold bar which has no 2 adjacent failures	5% of the total No 3 adjacent in any direction, except for threshold bar which has no 2 adjacent failures
SALS/MALS/MALSR/MALSF Approach Lights (steady burning lights) *(Notes 1 and 6)*	NA	15% of the total No 3 adjacent failures	NA	NA
ALSF-2 / SSALR Approach Lights (flashing lights)	N/A	N/A	1 centreline (SSALR)	2 out, no 2 adjacent (ALSF2)
MALSR/MALSF/ODALS Approach Lights (flashing lights) *(Note 1)*	NA	1 centreline, 1 bedpost (ODALS)	NA	NA
Taxiway Edge Lights *(Note 3) (per individual taxiway) Note: Where a portion of taxiway exceeds the maximum outages, that portion may be closed and the remaining portions may continue operations.*	15% of the total No 2 adjacent	15% of the total No 2 adjacent	15% of the total No 2 adjacent	15% of the total No 2 adjacent
Apron Edge Lights *(Note 2)*	25% of the total	25% of the total	25% of the total	25% of the total

Table 9.1.3.1—Lighting Serviceability Table (continued)		
Runway Level of Service →→→	**Departure RVR < 1200 (¼ SM) (Day/Night)**	**Departure RVR ≥ 1200 (¼ SM) (Night Only)**
Runway Edge Lights	5% of the total No 2 in a row	15% of the total No 2 in a row
Runway Threshold Lights	N/A	N/A
Runway End Lights	2 out, no 2 adjacent	2 out, no 2 adjacent
Runway Centreline Lights	5% of the total, no 2 adjacent	N/A
Touchdown Zone Lights	N/A	N/A
Approach Lights (steady burning lights)	N/A	N/A
Approach Lights (flashing lights)	N/A	N/A
Taxiway Edge Lights *(Note 3)*	15% of the total No 2 adjacent	15% of the total No 2 adjacent
Apron Edge Lights *(Note 2)*	25% of the total	25% of the total

Other Lighting Systems
Apron exit (Dual yellow corner lights): Upon loss of both lights of a corner dual fixture, a NOTAM would be provided advising aircrews of the location of the failure.
Runway threshold identification lights: 1 lamp may be out within a set.
Stop bars: No more than 2 lights are unserviceable per stop bar. No two adjacent lights are unserviceable.
Runway guard lights (elevated): One lamp may be unserviceable on one side only.
Runway guard lights (inset): No more than 2 lights are unserviceable. No two adjacent lights are unserviceable.
PAPI/APAPI - 2 lamp units: All lights are serviceable.
PAPI/APAPI - 3 lamp units: 2 of 3 lamps in each unit are serviceable.
Taxiway centreline lights RVR1200 (¼ SM) and above: 15 %, no more than 90 m adjacent light failures.
Taxiway centreline lights below RVR1200(¼ SM) to RVR600: 15 %, no more than 45 m adjacent light failures (no more than 2 adjacent light failures based on spacing of 15m) on straight sections, no more than 2 adjacent lights in curved sections (spacing less than 15m).
Taxiway centreline lights below RVR600: 10 %, no more than 30 m adjacent light failures on straight sections, no two adjacent light failures on curved sections.

(1) When the number of light failures exceeds the number permissible, a NOTAM is issued advising aircrews of the situation and duration. Where the overall presentation of the system is significantly changed due to light failures within, the system should be turned off pending repairs.
(2) Where the number of light failures exceeds the number permissible for apron edge lights, a NOTAM is issued advising aircrews of the situation and duration.
(3) Double blues are considered as one fixture. Light failures are limited to one side only.
(4) A light that is obscured in its intended direction(s) of use by snow, grass or other is deemed to be a failed light.
(5) When calculating the number permitted light unit failures, based on the percentages in this table, rounding up to the next highest unit is acceptable.
(6) When calculating number of light failures permitted for ALSF-2, SSALR, and SSALS, MALS, MALSR, MALSF, the lights in the threshold bar are considered part of the steady burning approach lights.
(7) With respect to runway edge lights, lights are considered to be adjacent if located sequentially in the same row of edge lights.
(8) With respect to barrettes, crossbars and runway edge lights, lights are considered to be adjacent if located consecutively and:
    (i) laterally, in the same barrette or crossbar; or
    (ii) longitudinally, in the same row of edge lights or barrettes.