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Revision history

Twelfth edition **January 2022**

This is a significant corrective amendment.

- Changes to a number of Chapters to include the requirements published in Amendments 13A – 15 of Annex 14 Volume I

  These include:

  - Enhanced global reporting format for assessing and reporting runway surface condition described in Appendix 6D.
  - Definitions of arresting system, autonomous runway incursion warning system (ARIWS); reduced taxiway and taxilane separation distances; clearance distances on aircraft stands; taxiway design guidance for prevention of runway incursions; flashing characteristics and colour specifications for LEDs; clarification on light intensity distribution; marking and lighting of wind turbines over 150 m height; location criteria for PAPI obstacle protection surface; Revised aerodrome reference code in Table 3.1
  - Figure 6B.1 (PAPI General Arrangement) a correction to the PAPI angle, where associated with an ILS, Unit 1, to 2°.25'.
  - Pavement monitoring and maintenance including the introduction of ACR/PCR.

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Edition 12 was re-issued to correct formatting errors.

Amendment to Figure 6A.19 Light intensity distribution of PAPI and (A)PAPI **January 2023**

Introduction

This document is published in support of the discretionary powers relating to the grant of an aerodrome licence contained in the Air Navigation Order (ANO). The Civil Aviation Authority (Chicago Convention) Directions 2007 require the Civil Aviation Authority (CAA) to ensure that it acts consistently with the obligations placed on the United Kingdom under the Convention on International Civil Aviation, enacted in Chicago on 7 December 1944 (the Chicago Convention). Not all ICAO (International Civil Aviation Organisation) Standards and Recommended Practices (SARPs) and procedures have been fully implemented directly in the ANO. Therefore, where the CAA has discretionary powers to grant a licence, certificate or approval provided it is satisfied as to the suitability of the applicant, the CAA is expected to implement such SARPs through its policy documents such as CAP 168. Where the UK has formally notified ICAO of differences to any of the SARPs in Annex 14, these differences are also published in the UK Aeronautical Information Publication (AIP) at GEN 1.7.

The ANO requires that, in the United Kingdom, most flights for the public transport of passengers take place at a licensed aerodrome, or at a government aerodrome. The Order also makes provision for an applicant to be granted an aerodrome licence subject to such conditions as the CAA thinks fit.

The purpose of this document is to give guidance to applicants and licence holders on the procedure for the issue and continuation of or variation to an aerodrome licence issued under Article 212 of the ANO 2016, and to indicate the licensing requirements that are used for assessing a variation or an application. The document also describes the CAA’s aerodrome licensing requirements relating to operational management and the planning of aerodrome development. This document represents the minimum standards necessary to meet the licensing requirement.

Prior to the grant of a licence and for continued licensing, the CAA’s Inspectors will visit the aerodrome and determine the extent to which the aerodrome, its facilities and its operational procedures meet the licensing requirements. In making its assessment of an application for or continuation of a licence the CAA will adopt as flexible an approach as is consistent with the achievement and maintenance of a satisfactory level of safety. All aerodromes differ, and to allow the CAA flexibility to deal with the different situations encountered, some specifications are phrased using the word ‘should’. This does not mean that compliance is optional but rather that, where insurmountable difficulties exist, the CAA may accept an alternative means of compliance, provided that an acceptable safety assurance from the applicant or licence holder shows that the safety requirements will not be reduced below that intended by the requirement.

Any limiting conditions or mitigating measures, described in the safety assurance, that compensate for any increased risk will take account of the anticipated flying activity and any other non-compliances, including those documented as variations, from licensing requirements that may already exist. Thereafter, the conditions or mitigating measures, and any other non-compliances, including variations, will be reviewed by the licence holder and the CAA periodically, in particular when any significant changes in activity or aerodrome development are proposed.

Significant changes in the nature and the scale of flying activity at a licensed aerodrome shall be notified to the CAA as soon as is practicable and be reflected in the pre-audit aerodrome safety report sent to the CAA. Where development work, including changes to the physical characteristics, aerodrome lighting and other visual aids is proposed, the CAA shall be consulted beforehand in accordance with the conditions of the licence and relevant legislation or both.

The CAA places emphasis on the adoption, by licence holders, of safety management systems that describe the safety policy of the aerodrome licence holder, and its application, and operational management, in addition to the physical design and operating standards of aerodromes. Aerodromes will be audited regularly by the CAA.

During an aerodrome audit inspectors from the CAA shall assess the aerodrome's compliance with requirements, audit the aerodrome's management of safety and assess the competence of those responsible for safety. The aerodrome manual and aerodrome safety report are key documents in this process, as is CAP 700, Operational Safety Competences. The inspectors will also appraise the aerodrome's current level of flying, or any anticipated change in activity against the facilities provided, in order to be satisfied that the aerodrome and the airspace, within which its visual traffic pattern is normally contained, are safe for use by aircraft. The inspectors will, as a result of their inspection, produce a report to the licence holder which will list non-compliance items with agreed actions and timescales for rectification. The report will also detail other issues which may affect safety at the aerodrome.

An aerodrome licensed in accordance with aerodrome licensing requirements will normally be suitable for use by Short Take-Off and Landing (STOL) aircraft; there are currently no specific criteria published for aerodromes to be used only by aircraft with a STOL capability. Proposals for the licensing of STOL or helicopter aerodromes should be discussed with the CAA, from which guidance is available.

From time to time the CAA will wish to supplement the guidance or requirements given in this publication, and this shall be in the form of either a safety directive, safety notice, or an information notice. Where applicable, such information will subsequently be included in this publication by amendment.

References in this publication to the Air Navigation Order, regulations and rules of the air are to the Order, Regulations and Rules then in force.

Where a definition is not provided in the Glossary of Terms, the definition provided in ICAO annex 14, volume 1, Aerodrome Design and Operations, will apply unless otherwise stated. Where a requirement is not provided in CAP 168, the relevant SARP in ICAO annex 14, volume 1, Aerodrome Design and Operations, will normally apply. Where an aerodrome licence holder believes that this SARP should not be applied, then this shall be assessed on a case-by-case basis. The relevant annex 14 SARP will form the basis of this assessment. The need for any subsequent amendment to CAP 168 to include the relevant SARP shall also be considered and actioned as appropriate.

An amendment service is provided for this publication, contact details are given on the inside cover of this publication.

Glossary of terms

Accelerate – Stop Distance Available (ASDA): The distance from the point on the surface of the aerodrome at which the aeroplane can commence its take-off run to the nearest point in the direction of take-off at which the aeroplane cannot roll over the surface of the aerodrome and be brought to rest in an emergency without the risk of accident.

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

Aerodrome beacon: An aeronautical beacon used to indicate the location of an aerodrome from the air.

Aerodrome elevation: The elevation of the highest point of the landing area. This is the highest point of that part of the runway used for both landing and take-off. See also 'Landing Area'.

Aerodrome Mapping Data (AMD): Data collected for the purpose of compiling aerodrome mapping information for aeronautical uses.

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

Aerodrome Mapping Database (AMDB): A collection of aerodrome mapping data organised and arranged as a structured dataset.

Aerodrome Reference Point (ARP): The aerodrome reference point is the geographical location of the aerodrome and the centre of its traffic zone where an ATZ is established.

Aerodrome Traffic Zone (ATZ): The airspace specified in Article 258 of the ANO 2016 as being airspace in the vicinity of an aerodrome notified for the purposes of Rule 45 of the Rules of the Air Regulations.

Aeronautical ground light: Any light specifically provided as an aid to air navigation other than a light displayed on an aircraft including lights specifically provided at an aerodrome as an aid to the movement and control of aircraft and of those vehicles which operate on the movement area.

Aeroplane: A power-driven heavier-than-air aircraft, deriving its lift in flight chiefly from aerodynamic reactions on surfaces which remain fixed under given conditions of flight.

Aeroplane reference field length (ARFL): The minimum field length required for take-off at maximum take-off weight, calculated at MSL, in standard atmosphere conditions and still air, and with zero runway slope. The precise distance will be given in the Flight manual or equivalent data-sheets from the manufacturer.

Aircraft: Any machine that can derive support in the atmosphere from the reactions of air other than by the reactions of air against the earth's surface.

Aircraft classification number (ACN)[1]. A number expressing the relative effect of an aircraft on a pavement for a specified standard subgrade category.

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

Aircraft classification rating (ACR)[2]. A number expressing the relative effect of an aircraft on a pavement for a specified standard subgrade category.

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

Aircraft stand: A designated area on an aerodrome to be used for parking an aircraft.

Apron: A defined area on a land aerodrome provided for the stationing of aircraft for the embarkation and disembarkation of passengers, the loading and unloading of cargo, fuelling, and for parking.

Arresting system: A system designed to decelerate an aeroplane overrunning the runway.

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

Balanced field length: A runway for which the Accelerate Stop Distance Available is equal to the Take-off Distance Available is considered to have a balanced field length.

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

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

Cleared and Graded Area (CGA): That part of the Runway Strip cleared of all obstacles except for minor specified items and graded, intended to reduce the risk of damage to an aircraft running off the runway.

Clearway: An area at the end of the take-off run available and under the control of the aerodrome licence holder, selected or prepared as a suitable area over which an aircraft may make a portion of its initial climb to a specified height.

[1] Applicable until 27 November 2024
[2] Applicable from 28 November 2024

Cloud ceiling: In relation to an aerodrome, cloud ceiling means the vertical distance from the elevation of the aerodrome to the lowest part of any cloud visible from the aerodrome which is sufficient to obscure more than one half of the sky so visible.

Critical area: An area of defined dimensions extending about the ground antennae of a precision instrument approach equipment within which the presence of vehicles or aircraft will cause unacceptable disturbance of the guidance signals.

Declared distances: The distances declared by the aerodrome authority for the purpose of application of the requirement of the Air Navigation (General) Regulations in respect of aeroplanes flying for the purpose of public transport.

Delethalisation: Below ground ramping to buried vertical face of construction designed to reduce risk of damage to aircraft running on cleared and graded area of strip.

Displaced threshold. A threshold not located at the extremity of a runway.

Effective intensity. The effective intensity of a flashing light is equal to the intensity of a fixed light of the same colour which will produce the same visual range under identical conditions of observation.

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

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

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

Frangibility: The ability of an object to retain its structural integrity and stiffness up to a specified maximum load but when subject to a load greater than specified or struck by an aircraft will break, distort or yield presenting minimum hazard to an aircraft.

Heavier-than-air aircraft: Any aircraft deriving its lift in flight chiefly from aerodynamic forces.

Helicopter: A heavier-than-air aircraft supported in flight by the reactions of the air on one or more power-driven rotors on substantially vertical axes.

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

Holding bay: A defined area where aircraft can be held or bypassed in order to facilitate the efficient movement of aircraft.

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

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

Instrument approach operations: An approach and landing using instruments for navigation guidance based on an instrument approach procedure.

There are two methods for executing instrument approach operations:

1. a two-dimensional (2D) instrument approach operation, using lateral navigation guidance only; and
2. a three-dimensional (3D) instrument approach operation, using both lateral and vertical navigation guidance.

Note: Lateral and vertical navigation guidance refers to the guidance provided either by:

1. *a ground-based radio navigation aid; or*
2. *computer-generated navigation data from ground-based, space-based, self-contained navigation aids or a combination of these*.

Instrument approach operations shall be classified based on the designed lowest operating minima below which an approach operation shall only be continued with the required visual reference as follows:

1. Type A: a minimum descent height or decision height at or above 75 m (250 ft); and
2. Type B: a decision height below 75 m (250 ft).

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

a) Non-precision approach runway.

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

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

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

d) Precision approach runway Category III (cat 3) operation. A runway served by visual aids and non-visual aid(s) intended for landing operations following an instrument approach operation type B with a decision height (DH) lower than

30 m (100 ft), or no decision height and a runway visual range less than 300 m or no visual range limitations.

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;

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; and

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.

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

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

Landing Distance Available (LDA): The distance from the point on the surface of the aerodrome above which the aeroplane can commence its landing, having regard to the obstructions in its approach path, to the nearest point in the direction of landing at which the surface of the aerodrome is incapable of bearing the weight of the aeroplane under normal operating conditions or at which there is an obstacle capable of affecting the safety of the aeroplane.

Lower than standard category I operation: A Category I Instrument Approach and Landing Operation using a Category I decision height, with an RVR lower than would normally be associated with the applicable decision height.

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

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

Note: Maneuvering Area and Movement Area are generic terms intended to describe the ‘airside’ part of an aerodrome, rather than just those pavements or surfaces on which aircraft movements take place.

Non-instrument runway: A runway intended for the operation of aircraft using visual approach procedures or an instrument approach procedure to a point beyond which the approach may continue in visual meteorological conditions (VMC).

Obstacle: All fixed (whether temporary or permanent) and mobile objects, or parts thereof, that are located on an area intended for the surface movement of aircraft or that extend above a defined surface intended to protect aircraft in flight, or that stand outside those defined surfaces and that have been assessed as being a hazard to air navigation.

Obstacle free zone: A volume of airspace extending upwards and outwards from an inner portion of the Runway Strip to specified upper limits which is kept clear of all obstructions except for minor specified items required for air navigation purposes, of low mass and of a frangible mount.

Other than standard category II operation: A Category II Instrument Approach and Landing Operation to a runway where some or all of the elements of the ICAO annex 14 Precision Approach Category II lighting system are not available.

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

Pavement classification number (PCN)[3]. A number expressing the bearing strength of a pavement for unrestricted operations.

Pavement classification rating (PCR)[4]. A number expressing the bearing strength of a pavement.

Precision approach runway: See Instrument Runway: A defined rectangular area, on a land aerodrome prepared for the landing and take-off run of aircraft along its length.

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

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

Note. — The purpose of the runway condition code is to permit an operational aeroplane performance calculation by the flight crew. Procedures for the determination of the runway condition code are described in the PANS-Aerodromes (Doc 9981).

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

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

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

[3] Applicable until 27 November 2024
[4] Applicable as of 28 November 2024

Runway incursion: Any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and take-off of aircraft.

Runway strip: An area of specified dimensions enclosing a runway intended to reduce
the risk of damage to an aircraft running off the runway and to protect aircraft flying over it when taking off or landing.

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

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

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

Note 3.— Procedures on determining runway surface conditions are available in the PANS-Aerodromes (Doc 9981).

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

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

c) **Slippery wet runway**. A wet runway where the surface friction characteristics of a significant portion of the runway have been determined to be degraded.

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

   Note. — Procedures on determination of contaminant coverage on runway are available in the PANS-Aerodromes (Doc 9981).

e) **Runway surface condition descriptors**. One of the following elements on the surface of the runway:

   Note. — The descriptions for e) i) to viii) are used solely in the context of the runway condition report and are not intended to supersede or replace any existing WMO definitions.

   i) ***Compacted snow***. Snow that has been compacted into a solid mass such that aeroplane tires, at operating pressures and loadings, will run on the surface without significant further compaction or rutting of the surface.

ii) ***Dry snow.*** Snow from which a snowball cannot readily be made.

iii) ***Frost.*** Frost consists of ice crystals formed from airborne moisture on a surface whose temperature is below freezing. Frost differs from ice in that the frost crystals grow independently and therefore have a more granular texture.

Note 1.— Below freezing refers to air temperature equal to or less than the freezing point of water (0 degree Celsius).

Note 2. — Under certain conditions frost can cause the surface to become very slippery and it is then reported appropriately as reduced braking action.

iv) ***Ice.*** Water that has frozen or compacted snow that has transitioned into ice, in cold and dry conditions.

v) ***Slush.*** Snow that is so water-saturated that water will drain from it when a handful is picked up or will splatter if stepped on forcefully.

vi) ***Standing water.*** Water of depth greater than 3 mm.

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

vii) ***Wet ice.*** Ice with water on top of it or ice that is melting.

Note. — Freezing precipitation can lead to runway conditions associated with wet ice from an aeroplane performance point of view. Wet ice can cause the surface to become very slippery. It is then reported appropriately as reduced braking action in line with procedures in the PANS-Aerodromes (Doc 9981).

viii) ***Wet snow.*** Snow that contains enough water content to be able to make a well-compacted, solid snowball, but water will not squeeze out.

Runway threshold: The beginning of that portion of the runway usable for landing.

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

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

Safety Management System (SMS): A systematic approach to managing safety including the necessary organisational structure, accountabilities, policies and procedures.

Sensitive area: An area extending beyond the Critical Area where the parking and/or movement of aircraft or vehicles will affect the guidance signal to the extent that it may be rendered unacceptable to aircraft using the signal.

Shoulder: An area adjacent to the edge of a paved surface so prepared as to provide a transition between the pavement and the adjacent surface for aircraft running off the pavement.

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

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

Snow (on the ground):

a) ***Dry snow***. Snow which can be blown if loose or, if compacted by hand, will fall apart again upon release; specific gravity: up to but not including 0.35.

b) ***Wet snow***. Snow which, if compacted by hand, will stick together and tend to or form a snowball; specific gravity: 0.35 up to but not including 0.5.

c) ***Compacted snow***. Snow which has been compressed into a solid mass that resists further compression and will hold together or break up into lumps if picked up; specific gravity: 0.5 and over.

Stand: See Aircraft Stand.

Stopway: A defined rectangular area beyond the end of the TORA, suitably prepared and designated as an area in which an aeroplane can be safely brought to a stop in the event of an abandoned take-off.

Take-off Distance Available (TODA): Either the distance from the point on the surface of the aerodrome at which the aeroplane can commence its take-off run to the nearest obstacle in the direction of take-off projecting above the surface of the aerodrome and capable of affecting the safety of the aeroplane, or one and one half times the take-off run available, whichever is the less.

Take-off Run Available (TORA): The distance from the point on the surface of the aerodrome at which the aeroplane can commence its take-off run to the nearest point in the direction of take-off at which the surface of the aerodrome is incapable of bearing the weight of the aeroplane under normal operating conditions.

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

1. Aircraft stand taxilane. A portion of an apron designated as a taxi route intended to
2. provide access to aircraft stands only.
3. Apron taxiway. A portion of a taxiway system located on an apron and intended to provide a through taxi route across the apron.
4. Rapid exit taxiway. A taxiway connected to a runway at an acute angle and designed to allow landing aeroplanes to turn off at higher speeds than are

achieved on other exit taxiways thereby minimising runway occupancy times.

Taxiway strip: An area of specified dimension enclosing a taxiway and intended to protect aircraft operating on the taxiway and to reduce the risk of damage to an aircraft running off the taxiway.

Taxiway holding position: A designated position at which taxying aircraft and vehicles may be required to hold in order to provide adequate clearance from a runway or another taxiway.

1. Runway Taxi Holding Position. A Taxi Holding Position intended to protect a runway.
2. Intermediate Taxi Holding Position. A Taxi Holding Position intended to protect a priority route.

Taxiway intersection: A junction of two or more taxiways.

Threshold: The beginning of that portion of the runway available for landing.

CHAPTER 1

The licensing process

In this chapter the Air Navigation Order and references to Articles of that Order mean the Air Navigation Order 2016. Should that Order be amended or replaced, any reference to the Order or any Article of that Order shall be taken as references to the Order currently in force.

The legal background to aerodrome licensing

1.1 In addition to annex 14, ICAO has published the manual on Certification of Aerodromes, Document 9774, the purpose of which is to provide guidance to States in establishing their regulatory regime so that compliance with the specifications in annex 14 can be effectively enforced. In the UK the term 'licensing' is used rather than 'certification'. Document 9774 is implemented in the Air Navigation Order and CAP 168.

1.2 The Air Navigation Order (ANO) Article 208 requires that, in the UK, specified flights for the purpose of public transport or for the purpose of instruction in flying, take place only at a licensed aerodrome or a Government aerodrome. The grant of an aerodrome licence is governed by Article 212.

1.3 The aerodrome manual required under ANO Article 212 shall include information and instructions as specified in Schedule 12 to that Article. Guidance on aerodrome manual production is given in chapter 2 of this CAP.

1.4 The CAA may, if it thinks fit, provisionally suspend or vary any licence pending enquiry into or consideration of the case, and may, on sufficient ground being shown to its satisfaction after due enquiry, revoke, suspend or vary a licence in accordance with ANO Article 228.

1.5 The Civil Aviation Authority Regulations 1991 provide that, where it is proposed to revoke, suspend, or vary a licence otherwise than on the application of the holder, notice of the proposal, together with the reasons for it, will be served on the holder who may within 14 days serve on the CAA a request that the case be decided by the CAA and not by any other person on its behalf.

1.6 Where an application for the grant or variation of an aerodrome licence is refused, or is granted in terms other than those requested by the applicant, a notice will be served stating the reasons for the decision, and the applicant may request within 14 days from the date of service of the notice that CAA review the case.

Charges

1.7 Details of the Civil Aviation Authority's Scheme of Charges (Aerodrome Licensing) made pursuant to section 11 of the Civil Aviation Act 1982 may be obtained from the Aerodrome Standards Department and also at www.caa. co.uk/ors5.

Type of licence

1.8 An applicant may be granted a Public Use aerodrome licence or an Ordinary aerodrome licence. In the case of the former, the hours of availability of the aerodrome must be notified in the United Kingdom Aeronautical Information Publication (UK AIP) and the aerodrome must be available on equal terms and conditions to all persons permitted to use the aerodrome. An Ordinary licence relates only to use of the aerodrome by the holder of the licence and persons specifically authorised by the licence holder. The holder of an Ordinary licence is not obliged to notify the hours of availability in the UK AIP but, if he does so, the aerodrome must remain open throughout the notified hours irrespective of traffic requirements. If the hours are not notified, the availability of the aerodrome and its facilities can be shown in the UK AIP as 'by arrangement', but if this is the case then the protection of an Aerodrome Traffic Zone (ATZ) may not be provided.

Application for a licence

1.9 The applicant should either be the owner of the land or have obtained the landowner's permission for the use of the site as an aerodrome. A proposal to use land as an aerodrome may be subject to the requirements of the Town and Country Planning Acts and applicants are advised to consult the Local Planning Authority before embarking on any such project. The application for planning permission and the request for the aerodrome licence are not interdependent and are made separately. A similar constraint will almost certainly apply to any proposals for aerodrome development. The granting of an aerodrome licence does not absolve the holder from observing other statutory requirements.

1.10 The initial application for an aerodrome licence must be made on form SRG 2002. The completed form should be returned to the CAA together with the appropriate fee, a map showing the aerodrome location and boundaries and a copy of the aerodrome manual (see chapter 2). Additionally, survey data in the form of charts, profiles, sections, evidence of pavement strengths and surface textures etc., relating to the site and its environs, must be provided by the applicant as required by the CAA.

1.11 An application for the variation of a licence must be made in writing by the licence holder, and be accompanied by the appropriate fee, and by the relevant survey and other information where there are any changes in the characteristics of the aerodrome or its environs. A variation to the licence can be requested for a change to the licence holder's details, a change to the licence conditions, or to Schedule 1 the aerodrome boundary map. A variation in this context means a change or amendment to an existing aerodrome licence.

1.12 A licence will normally remain in force until suspended or revoked but may be issued for a limited period. In the case of a licence for a period exceeding 12 days but not exceeding 12 months, i.e., a seasonal licence, application must be made on form SRG 2002. In the case of a temporary licence, for a period not exceeding 12 consecutive days, application must be made on form SRG 2003.

1.13 Applications should be submitted in sufficient time to allow for detailed consideration and inspection of the aerodrome before the issue of a licence. The minimum notice required is 60 days from the date a completed aerodrome manual is accepted by the CAA. The interval between application and grant of a licence (or a variation thereto) may depend upon matters within the control of the applicant and no undertaking can be given that the CAA will be able to reach a decision within a particular period.

1.14 A prospective applicant should, in their own interest, consult the CAA before committing themselves to expenditure on developing or equipping an aerodrome.

1.15 Application forms are obtainable from the CAA and also in electronic format at www.caa.co.uk/aerodromelicensingforms.

Aerodrome boundaries

1.16 As part of the aerodrome licensing process, the holder of (or applicant for) an aerodrome licence is required to provide a map on a scale not larger than A4 size showing the exact location of the aerodrome, and to delineate on the map the boundary of the aerodrome land. If a licence is granted, this map will form a schedule to the aerodrome licence.

1.17 The aerodrome boundary for licensing purposes should not be confused with boundaries established for other purposes such as the operational boundaries used by local planning authorities, or those used to designate security restricted zones. These other boundaries may be coincident either in whole or in part with the aerodrome licence boundary, but there is no requirement for them to be so.

1.18 The map forming Schedule 1 to the aerodrome licence should show the boundary of the area of the aerodrome set aside for the movement of aircraft requiring the use of a licensed aerodrome, so should include runways, taxiways, aprons and, in most cases, the area adjacent to the terminal building. This is the area that will be audited by CAA Inspectors and is also the boundary of the area referred to in Condition 3 of the aerodrome licence.

General requirements for the grant of a licence

1.19 Before a licence is granted the CAA will require to be satisfied that the physical conditions on the maneuvering area, apron and in the environs of the aerodrome are acceptable, and that the scale of equipment and facilities provided are adequate for the flying activities which are expected to take place. The criteria which will be applied in making this assessment are given in the chapters which follow. The CAA also will require to be satisfied that the applicant for the licence is able to ensure an effective safety management system and, in those activities which are related to the safe operation of the aerodrome, to provide staff who are competent and where necessary, suitably qualified.

1.20 For these purposes the CAA's Inspectors will visit the aerodrome and determine the extent to which the aerodrome, its facilities, equipment and operational organisation meet the licensing requirements. Following the initial grant of a licence, the CAA's Inspectors will visit each aerodrome periodically as part of their audit/inspection programme. The Inspectors will assess compliance with requirements, audit the management of safety, and assess the competence of those responsible for safety. Normally, prior notice will be given to the holder of the licence, but inspections may take place without such prior notice. Inspectors will be 'authorised persons' as defined in the Air Navigation Order and normally will be allocated responsibility for certain aerodromes so that a helpful continuity will develop and improve the value of contacts between them and the management of the aerodrome.

Conditions of licence

1.21 The Air Navigation Order provides that the CAA may grant a licence 'subject to such conditions as the CAA thinks fit'. The standard Conditions are shown in the specimen licenses at appendix 1A Aerodrome Licence 'Public Use', appendix 1B Aerodrome Licence 'Ordinary' and appendix 1C Temporary Aerodrome Licence ''Ordinary'. Additional conditions may be added to a particular licence to take account of the conditions or circumstances at that aerodrome, and when appropriate this method will be considered by the CAA as a means of achieving a satisfactory level of safety by, for example, limiting the type of flying activity which may take place when one or more of the criteria cannot be met.

1.22 It is also a standard Condition of licenses that the holder must inform the CAA of changes to data concerning the aerodrome so that appropriate promulgation of the change, and amendment to the UK AIP can be made. Guidance on the aeronautical information to be provided in respect of a licensed aerodrome, and the procedures for promulgating such information is given in chapter 10.

1.23 Aerodrome licence holders should develop procedures that describe the processes by which changes to the physical characteristics, including the erection of new buildings and alterations to existing buildings or to visual aids, are managed. Such procedures should be contained within the aerodrome manual and cross-referenced to other formally accepted or recognised publications, for example CAP 791, Procedures for Changes to Aerodrome Infrastructure.

Change of aerodrome licence holder

1.24 An aerodrome licence is granted to a named 'legal person' (an individual or a company or any other legally constituted authority or body – e.g., local authority, limited liability partnership) who satisfies the CAA that the criteria for licence issue have been met. Once a licence is granted the CAA is obliged to satisfy itself that a licence holder continues to meet licensing requirements. An aerodrome licence is not a saleable asset and cannot be transferred from one person to another.

1.25 If the identity of a licence holder is to change, application for grant of a new licence should be made to the CAA by the prospective licence holder. (Please note: A change in the name only of a licence holding company does not constitute a change of identity;

the licence holder should apply to the CAA for a variation of the licence to reflect the name change and provide a copy of the 'Certificate of Incorporation on Change of Name'.)

1.26 If licensed aerodrome operations are to continue during the change, the outgoing licence holder must be in a position to retain responsibility for the operation of the aerodrome until the grant of an aerodrome licence to the new licence holder. In all cases a new aerodrome licence must be obtained from the CAA and the existing licence must be revoked by the CAA, before operations under the new licence holder can begin.

1.27 An application for an aerodrome licence in the name of the prospective licence holder should be completed and returned to the CAA together with the appropriate fee for licence issue. Documentation should be submitted in sufficient time to allow for consideration of the application by the CAA (recommended minimum is 60 days from the date a completed aerodrome manual is accepted by the CAA), and for the provision by the applicant of such further information and documentation as the CAA may require. An aerodrome manual acceptable to the CAA will be required in all cases.

1.28 When it is proposed to make other changes at the time of a change of licence holder (for example changes to personnel in key operational posts) it is prudent to provide the CAA with as much prior notice as possible. The CAA recommends a minimum of 60 days' notice to process the change. However, the interval between application for and grant of a licence may depend on factors outside the control of the CAA (for example matters within the control of the applicant, the outgoing licence holder, or other persons or organisations); therefore, no undertaking can be given that the CAA will be able to reach a decision within a particular timescale or by a specific date.

1.29 As with any new application, grant of an aerodrome licence will be subject to the applicant satisfying the CAA on the requirements of Article 212 and Schedule 12 of the Air Navigation Order 2016; and of CAP 168, Licensing of Aerodromes. In addition to the aerodrome characteristics these requirements will include the demonstration of competence by the applicant to secure that the aerodrome and its airspace are safe for use by aircraft. In assessing an applicant's competence, matters taken into account by the CAA will include:

1. the previous conduct and experience of the applicant;
2. the organisation, staffing and equipment to be provided;
3. the arrangements for the maintenance of the aerodrome and its facilities and equipment;
4. the adequacy of the aerodrome manual; and
5. any other arrangements made including the adequacy of safety management systems.

Change of provider of an air traffic service

1.30 At some licensed aerodromes the Air Traffic Services (ATS) are provided by contracted organisations. Occasionally the contracted organisations will change, and the aerodrome licence holder will wish the transition to be as seamless as possible, while maintaining high levels of safety, particularly if continuous operations are to be provided. Aerodrome licence holders are reminded of their responsibilities under ANO Article 212 to secure the aerodrome and airspace especially during the change- over of providers of ATS. Licence holders must be aware of the importance of the initial contract with their chosen ATS provider to ensure that the arrangements for transfer of an ATS contract to another provider is addressed. These arrangements should include processes for the implementation, at the time of transfer, of a Manual of Air Traffic Services (MATS) Part 2 acceptable to the CAA. In this respect and to ensure that there is no immediate negative impact on aerodrome operations, licence holders should consider retaining ownership of the existing, approved, MATS Part 2. Further guidance on how to achieve a seamless transition from one provider of ATS to another may be found in CAP 670, ATS Safety Requirements (available on the CAA website at www.caa.co.uk/CAP670).

Naming of aerodromes

1.31 Aerodrome operational information and other relevant data are notified by the Aeronautical Information Services (AIS) in accordance with international standards and recommended practices specified in ICAO annex 15, European Commission Regulation and any applicable Aeronautical Data Requirements concerning data integrity and assurance specifications.

1.32 In guidance Document 8126 Aeronautical Information Services manual, ICAO requires to be shown in the Aeronautical Information Publication (AIP) of a State, a list of aerodrome and heliport names and ICAO location indicators. The aerodrome name should indicate the name in capitals of the city or town served by the aerodrome, followed by an oblique strike and the name given to the aerodrome by the State concerned, thus LIVERPOOL/John Lennon.

1.33 In aviation safety terms the name of an aerodrome is directly connected with aeronautical communications and flight safety information. Furthermore, certain aerodromes, recognised for their international importance, are notified to ICAO, which in turn publishes details of existing and planned facilities available at the aerodrome in the regional Air Navigation Plan (FACID). It is therefore important for flight planning purposes, including international flights, that the aerodrome name is consistently recognisable, relevant, unambiguous, and promulgated accordingly.

1.34 The aerodrome name used in aeronautical information should therefore include the name used in the callsign for air traffic communications (for licensed aerodromes and where applicable, as specified in AD 2.17 or AD 2.18 of the AIP), be representative of its location (the nearest city or town) and should not have the potential to be confused with another aerodrome.

Oversight and licence action

1.35 There may be occasions where aerodromes require greater regulatory oversight by the CAA, for instance where large or complex aerodrome developments are being undertaken, where significant operational changes are taking place or in order to achieve a satisfactory standard of regulatory compliance. Additionally, there may be occasions where the CAA has identified concerns about the safety of aircraft operations at an aerodrome, the maintenance of its facilities, equipment or the aerodrome's organisational structure in meeting CAA licensing requirements. In these circumstances the aerodrome may be identified as requiring 'special attention'.

1.36 In such cases the CAA may provide additional resource, which could involve additional visits by Inspectors, to support the aerodrome so as to achieve the required safety standards and other objectives. The CAA will write to the aerodrome licence holder to explain the reasons for special attention being necessary and will agree the steps needed to return the aerodrome to normal oversight.

1.37 However, there are also occasions when this additional oversight fails to produce the improvements or changes necessary to maintain safety standards. Additionally, there are occasions when the CAA detects unchecked trends in some operations that indicate safety standards are deteriorating. If left unchecked this could lead to a situation whereby the CAA is no longer satisfied as to a licence holder's competence to secure that the aerodrome is safe for use by aircraft.

1.38 With such aerodromes the CAA will take action in a consistent manner that makes it clear to the licence holder what it must do to recover the situation. The CAA will also make clear what the consequences are, should the aerodrome fail to adhere to an agreed recovery plan. In the event that the CAA has observed an adverse trend, which, if unchecked, would lead it to cease to be satisfied as to the competence of the licence holder, the CAA will contact the licence holder to set out the CAA's concerns. This may result in the aerodrome being placed 'on notice'.

1.39 It is important to recognise that every case needs to be judged on the individual circumstances. Examples of what could prompt action include:

1. Level 1 Audit Findings;
2. repetitive Level 2 audit findings, including a failure to identify root causes of audit findings or a 'sticking plaster' approach to findings;
3. significant incidents, together with a failure to investigate properly and deal with the root causes;
4. an increasing number of incidents, indicating an underlying systemic failure;
5. poor management attitude to compliance;

6. a management that prefers solutions that simply address the detail of the audit finding and that is unwilling or unable to put measures in place that address the root cause of non-compliances;
7. unstable/ineffective management. Instability can be caused by changes in structure, personnel, or both.

1.40 The CAA will set out its concerns and request a recovery plan from the licence holder to address the causes of the adverse trend. The recovery plan should provide deliverables that can be measured, including specific timescales. The recovery plan should set out clearly the 'who, what, where and how'. The need for, and adherence to, agreed timescales is particularly important.

1.41 The licence holder will be informed that a failure to deliver, either in terms of quality and/or time, will result in firm regulatory action. This action may include the suspension of the aerodrome licence.

1.42 Where the licence holder completes, to the satisfaction of the CAA, the agreed actions in the recovery plan relating to the adverse trend(s) observed by the CAA, the licence holder will be informed in writing that they are no longer 'on notice'. In most cases the aerodrome will revert to 'special attention' for a period to ensure that the improvements or changes are maintained and then return to normal levels of oversight.

APPENDIX 1A

Aerodrome licence 'public use'

The Civil Aviation Authority (in this licence referred to as 'the CAA') in exercise of its powers under Article 212 of the Air Navigation Order hereby licenses the above-named aerodrome as an aerodrome to be used as a place of take-off and landing of aircraft engaged in flights for the purpose of the public transport of passengers or for the purpose of instruction in flying, subject to the following conditions:

1. The aerodrome is licensed for public use and shall at all times when it is available for the take-off or landing of aircraft be so available to all persons on equal terms and conditions.
2. No aircraft shall take-off or land at the aerodrome unless such fire-fighting and rescue services and such medical services and equipment as are required in respect of such an aircraft in the CAA's publication CAP 168 (Licensing of Aerodromes) are provided there. Such services and equipment shall at all times when the aerodrome is available for the take-off or landing of aircraft be kept fit and ready for immediate turnout.
3. Changes in the physical characteristics of the aerodrome including the erection of new buildings and alterations to existing buildings or to visual aids shall not be made without prior approval of the CAA.
4. The licence holder shall, by the quickest means available, notify the CAA of any material change in the surface of the landing area, or in the obstruction characteristics of the approach, take-off or circuit in relation to the aerodrome.
5. Any public right of way crossing or bordering the landing area shall be adequately sign-posted with notices warning the public of danger from aircraft.
6. The aerodrome is licensed for the take-off and landing of aircraft at night. Such systems of lighting appropriate to the category of runway in use as described in the CAA's publication CAP 168 (Licensing of Aerodromes) shall be in operation at all times when aircraft are taking-off or landing at the aerodrome at night, provided that minor temporary unserviceability, not of a character likely to affect the safety of operations, shall not preclude the take-off or landing of aircraft.
7. The licence holder shall inform the CAA of the times during which the aerodrome is to be generally available for the take-off or landing of aircraft, and of any changes in those times, and whether the aerodrome is to be available by arrangement with the licence holder outside those times. The aerodrome shall be kept available for the take-off or landing of aircraft at all times when, in accordance with the information furnished by the licence holder to the CAA it is notified as being generally available and shall not be used for the take-off or landing of aircraft at any other time, unless it has been notified in accordance with such information as being available for use by arrangement with the licence holder outside the times when it is generally available

and is used pursuant to such arrangement.

8. Without prejudice to condition 1, nothing in this licence shall be taken to confer on any person the right to use the aerodrome without the consent of the licence holder.

9. Expressions used in this licence shall have the same respective meanings as in the Air Navigation Order.

10. 'The Air Navigation Order' in this licence means the Air Navigation Order 2016 and any reference to the Order or to any Article of the Order shall, if that Order be amended or replaced, be taken to be a reference to the Air Navigation Order for the time being in force or the corresponding Article of that Order.

11. This licence shall remain in force until it is varied, suspended or revoked.

APPENDIX 1B

Aerodrome licence 'ordinary'

The Civil Aviation Authority (in this licence referred to as 'the CAA') in exercise of its powers under Article 212 of the Air Navigation Order hereby licenses the above-named aerodrome as an aerodrome to be used as a place of take-off and landing of aircraft engaged in flights for the purpose of the public transport of passengers or for the purpose of instruction in flying, subject to the following conditions:

1. The aerodrome is licensed for use only by the licence holder and by persons specifically authorised by the licence holder.
2. No aircraft shall take-off or land at the aerodrome unless such fire-fighting and rescue services and such medical services and equipment as are required in respect of such an aircraft in the CAA's publication CAP 168 (Licensing of Aerodromes) are provided there. Such services and equipment shall at all times when the aerodrome is available for the take-off or landing of aircraft be kept fit and ready for immediate turnout.
3. Changes in the physical characteristics of the aerodrome including the erection of new buildings and alterations to existing buildings or to visual aids shall not be made without prior approval of the CAA.
4. The licence holder shall, by the quickest means available, notify the CAA of any material change in the surface of the landing area, or in the obstruction characteristics of the approach, take-off or circuit in relation to the aerodrome.

   Night use: The aerodrome is licensed for the take-off and landing of aircraft at night. Such systems of lighting appropriate to the Category of runway in use as described in the CAA's publication CAP 168 (Licensing of Aerodromes), shall be in operation at all times when aircraft are taking-off or landing at the aerodrome at night, provided that minor temporary unserviceability, not of a character likely to affect the safety of operations, shall not preclude the take-off or landing of aircraft.

   Or

   Day use only: The aerodrome is not licensed for the take-off or landing of aircraft at night.
5. Any public right of way crossing or bordering the landing area shall be adequately sign-posted with notices warning the public of danger from aircraft.
6. Expressions used in this licence shall have the same respective meanings as in the Air Navigation Order.
7. The 'Air Navigation Order' in this licence means the Air Navigation Order 2016 and any reference to the Order or to any Article of the Order shall, if that Order be amended or replaced, be taken to be a reference to the Air Navigation Order for the time being in force or the corresponding Article of that Order. This licence shall remain in force until it is varied, suspended or revoked.

APPENDIX 1C

Temporary aerodrome licence 'ordinary'

The Civil Aviation Authority (in this licence referred to as 'the CAA') in exercise of its powers under Article 212 of the Air Navigation Order hereby licenses the above-named aerodrome (on/from dates) inclusive for the take-off and landing of aircraft engaged in flights for the purpose of the public transport of passengers or for the purpose of instruction in flying, subject to the following conditions:

1. The aerodrome is licensed for use only by the licence holder and by persons specifically authorised by the licence holder.
2. No aircraft shall take-off or land at the aerodrome unless such emergency services and equipment as specified in the CAA's publication CAP 168 Licensing of Aerodromes are provided there. Such services and equipment shall at all times when the aerodrome is available for the take-off or landing of aircraft be kept fit and ready for immediate turn-out.
3. Except in an emergency no aircraft shall take-off or land at the aerodrome when any obstruction, vehicle or person is on the part of the aerodrome shown with hatching on the map at schedule 1 .
4. Changes in the physical characteristics of the aerodrome including the erection of new buildings and alterations to existing buildings or to visual aids shall not be made without the prior approval of the CAA.
5. The licence holder shall, by the quickest means available, notify the CAA of any material change in the surface of the landing area, or in the obstruction characteristics of the approach, take-off or circuit in relation to the aerodrome.
6. The aerodrome is not licensed for the take-off or landing of aircraft at night.
7. Expressions used in this licence shall have the same respective meanings as in the Air Navigation Order.
8. The 'Air Navigation Order' in this licence means the Air Navigation Order 2016 and any reference to the Order or to any Article of the Order shall, if that Order be amended or replaced, be taken to be a reference to the Air Navigation Order for the time being in force or the corresponding Article of that Order.
9. This licence is only valid while an air traffic control service, or such other air traffic service, as the CAA may have agreed in writing for the purposes of this condition, is being provided at the aerodrome.

CHAPTER 2

The aerodrome manual

Introduction

2.1 Article 212 of the Air Navigation Order (ANO) governs the grant of aerodrome licenses by the Civil Aviation Authority. The Article, together with Schedule 12, sets out the requirements for the aerodrome manual within the licensing process. The CAA uses the manual to assess the suitability of aerodrome licence holders and their organisations against the safety-related requirements set out in Article 212(1)(a), (b) and (c) of the Order. The assessment is a continuous process; this is particularly relevant when changes likely to affect safety are proposed or made.

2.2 An application for an aerodrome licence should be accompanied by an aerodrome manual produced in accordance with CAP 168. Once granted a licence, the licence holder is required to maintain the manual in conformity with chapter 2 of CAP 168, and all aerodrome operating staff must have access to the relevant parts of the manual. The term 'operating staff' means all persons, whether or not the aerodrome licence holder and whether or not employed by the aerodrome licence holder, whose duties are concerned either with ensuring that the aerodrome and airspace within which its visual traffic pattern is normally contained are safe for use by aircraft, or whose duties require them to have access to the aerodrome maneuvering area or apron. The manual will be regarded by the CAA as the primary indication of the standards likely to be achieved by the aerodrome operator. A copy is to be lodged with the CAA. The process for submission of an aerodrome manual is contained in paragraphs 2.22 onwards.

Purpose and scope of the manual

2.3 An efficient management structure and a systematic approach to aerodrome operation are essential. The manual should contain all the relevant information to describe this structure satisfactorily. It is the means by which all aerodrome operating staff are fully informed as to their duties and responsibilities with regard to safety. It should describe the aerodrome services and facilities, all operating procedures, and any restrictions on aerodrome availability.

2.4 Accountability for safety must start at the very top of any organisation. One of the key elements in establishing safe working practices is for all staff to understand the safety aims of the organisation, the chain of command, and their own responsibilities and accountabilities. As safety management principles are applied, the manual should be expanded to describe clearly how the safety of operations is to be managed at all times. To a reader or user of the manual there should never be any doubt about who is responsible, who has the authority, who has the expertise and who actually carries out the tasks described in any section.

2.5 The principal objective of an aerodrome manual should be to show how management will discharge its safety responsibilities. The manual will set out the policy and expected standards of performance and the procedures by which they will be achieved.

Ownership of an aerodrome manual

2.6 The licence holder is responsible for providing the aerodrome manual. It should reflect the requirements and guidance material contained in Civil Aviation Publications and other documents.

2.7 It is the responsibility of the licence holder to be satisfied as to the appropriateness of each provision of the manual to the particular operation, and to make amendments and additions as necessary.

2.8 The safety aim and objectives of the manual and how it is to be used by employees, tenants etc. should be stated in a preface by the licence holder.

2.9 In this format and under the signature of the person with overall responsibility for safety in the company, the manual demonstrates, from the highest level, a commitment to the way in which safety will be managed.

Amendment of the manual

2.10 Responsibility for maintaining the accuracy of the manual should be clearly defined.

2.11 Each copy of the manual should be numbered and a list of holders maintained by the person responsible for the issue of amendments. In the front of each volume there should be an amendment page available for recording the amendment numbers, date of incorporation, signature of the persons amending, and the page or paragraph affected.

2.12 Manuscript amendments are not acceptable. Changes or additions should always be the subject of an additional or replacement page on which the amended material is clearly identified.

2.13 Amendments to the manual will be needed either because the document requires to be brought up to date or in response to a request by the CAA. Any amendments or additions must be furnished to the CAA by the licence holder before or immediately after they come into effect.

Form of the manual

2.14 The aerodrome manual is a key document both for the licence holder and the CAA.

2.15 Supported by the Safety Report, it is the safety assurance document for the CAA's licensing process, and a management tool for industry. The manual is the source document describing how operational procedures and their safe management will be delivered. It should contain all such information and instructions as may be necessary to enable the aerodrome operating staff to perform their duties. This must include information and instructions relating to those matters specified in Schedule 12 to the ANO. The CAA will expect the aerodrome manual to be an accurate reflection of the aerodrome's visible safety management system and safety culture. It should show how the aerodrome intends to measure its performance against safety targets and objectives. An aerodrome manual should not just satisfy the CAA's requirements. One of the principal objectives should be to create a medium for promulgating all procedures and information relating to the safe management of the aerodrome. The reader of a manual should be given a clear and unambiguous statement of how safety is developed, managed and maintained on the aerodrome. All safety policies, operational procedures and instructions should be contained in detail or cross-referenced to other formally accepted or recognised publications.

2.16 At larger aerodromes the size and complexity of operations and related procedures may dictate that these procedures could not easily be included in a single document. In such circumstances it is acceptable to identify and reference within the manual the procedures which are not included within it. If this system is to be successful it is essential that any referenced information, documentation, and procedures are subjected to exactly the same systems of consultation and promulgation as the manual itself. For many small aerodromes the manual can be both simple and brief as long as it covers procedures essential for satisfactory day-to-day operations. Nevertheless, it is possible to adopt a common format embracing the essential elements that define a safety management system.

2.17 The numbering of pages and paragraphs should be orderly and systematic to facilitate reference. The standard of printing, duplication and binding should allow the manual to be read without difficulty and ensure it remains intact and legible during normal use.

Contents of the manual

2.18 As a general guide the following paragraphs set out the items which should be included in the manual, although it is recognised that the need to include all items will vary between aerodromes depending on the nature and scale of operations. It is not necessary for all operational procedures to be included in the manual. However, when these are relevant to achievement of policy their location should be clearly referenced within the manual.

Introduction

1. Purposes of the manual.
2. Legal position regarding aerodrome licensing as contained in the ANO.
3. Distribution of the manual.
4. Procedures for distributing and amending the manual and the circumstances in which amendments may be needed.
5. Checklist of Pages.
6. Preface by licence holder.

7. Content Page.
8. Glossary of Terms (other than those included in CAP 168).

Note: *This section will contain a short explanation of the general terms used in the manual including job titles and abbreviations.*

Technical administration

1. Name and address of aerodrome.
2. Name and address of licence holder.
3. Name and status of the accountable manager.
4. Named Persons:
   a) the name, status and responsibilities of the official in charge of day-to-day operation;
   b) the name, status and responsibility of other senior operating staff;
   c) instructions as to the order and circumstances in which the above-named staff may be required to act as the official in charge;
   d) the name, status and responsibility of staff authorised by the CAA under Article 232 of the Air Navigation Order 2016;
   e) the name, status and responsibilities of the accountable manager.
5. Details of the Aerodrome Safety Management System (see appendix 2C).

Note: *This should include an organisation chart supporting the commitment to the safe operation of the aerodrome as well as simply showing the hierarchy of responsibility for safety management*.

6. Safety related committees.

Aerodrome characteristics

1. Details of the following:
   a) latitude and longitude of the aerodrome reference point in WGS 84 format;
   b) elevations of:
      - aerodrome;
      - apron.
2. Plans to a scale of 1:2500 showing the position of the aerodrome reference point, layout of the runways, taxiways, and aprons; the aerodrome markings and lighting (including PAPI, VASIS or LITAS and obstruction lighting); the siting of navigational aids within the runway strips, and their degree of frangibility. It will not be necessary for these plans or the information called for in the following sub-paragraphs 3. to 6. to accompany all copies of the manual, but they must be appended to the licence holder's master copy and to the copy lodged with the

CAA. In the case of copies or extracts provided or made available to operating staff, plans of a scale reasonably appropriate to the relevant duties of the said staff should be provided.

3. Description, height and location of obstacles which infringe the standard protection surfaces, and whether they are lighted.
4. Location, reference number and date of the survey plans from which the data at sub-paragraphs 1. and 2. were derived, and details of the procedures for ensuring they are maintained and updated.
5. Data for, and the method of, calculation of declared distances and elevations at the beginning and end of each Declared Distance.
6. Method of calculating reduced declared distances when there are temporary objects infringing the runway strip, or the approach and take-off surfaces.
7. Details of the surfaces, dimensions, and classification or bearing strengths of runways, taxiways and aprons.

Operational procedures

1. The system of Aeronautical Information Service available and the system that the licence holder uses to promulgate Aeronautical Information Publication (AIP) requirements.
2. Routine aerodrome inspections, including lighting inspections, and reporting including the nature and frequency of these inspections (chapter 3, appendix 3F).
3. Inspecting the apron, the runways and taxiways following a report of debris on the movement area, an abandoned take-off due to engine, tyre or wheel failure, or any incident likely to result in debris being left in a hazardous position.
4. Sweeping runways, taxiways and aprons.
5. Obtaining and disseminating meteorological information, including Runway Visual Range (RVR) and meteorological visibility and local area forecasts (detailed specifications and procedures for RVR assessment in Category I weather conditions using human observers are given in appendix 2A).
6. Protection of runways during low visibility procedures (LVPs) if such operations are permitted (appendix 2B).
7. Measurement and promulgation of water and slush depths on runways and taxiways.
8. Measurement and/or assessment, and promulgation of runway surface friction conditions.
9. Promulgation of information on the aerodrome operational state, temporary withdrawals of facilities, runway closures etc.
10. The safe integration of other aviation activities such as gliding, parachuting and banner towing, operations from unlicensed runways on licensed aerodromes

and unmanned aerial systems (UAS).

11. Recording aircraft movements.
12. The control of works, including trenching and agricultural activity, which may affect the safety of aircraft (appendix 2F).
13. The control of access to the aerodrome and its operational areas, including the location of notice boards, and the control of vehicles on the operational areas.
14. Maintaining apron control, including marshaller's instructions.
15. The availability of aviation fuel and its storage, handling and quality control (ANO Article 217).
16. Complying with regulatory requirements relating to accidents, incidents and Mandatory Occurrence Reporting (MOR). Mandatory Occurrence Reporting in the UK is outlined in UK Regulation 376/2014 with additional guidance presented in implementing regulation 1018/2015.
17. The removal of disabled aircraft.
18. The aerodrome snow plan.
19. The wildlife hazard control plan.
20. Aerodrome Safeguarding (chapter 4).
21. Runway incursion prevention (appendix 2D).
22. Responsibility for monitoring the third parties operating on the aerodrome (appendix 2E).
23. Procedures for the management of on-aerodrome development and changes to physical characteristics.

Visual aids (reference should be made to chapters 6 and 7)

1. Responsibilities with respect to the aeronautical ground lighting (AGL) system.
2. A full description of all visual aids available on each approach, runway, taxiway and apron. This shall include AGL signs, markings and signals.
3. Procedures for operational use and brilliancy settings of the AGL system.
4. Standby and emergency power arrangements, including operating procedures both in LVPs and during mains failure.
5. Procedures for routine flight inspection of approach lights, runway lights and PAPIs.
6. The location of and responsibility for obstacle lighting on and off the aerodrome.
7. Procedures for recording inspection and maintenance of visual aids and actions to be taken in the event of failures.

Rescue and Fire Fighting Services (RFFS)

1. Policy statement of the RFF category or categories to be provided.

2. Where the Senior Airport Fire Officer (SAFO) or designated watch officers have specific safety accountabilities, these should be included in the relevant chapter of the manual.
3. Policy and procedures indicating how depletion of the RFFS is to be managed. This should include the extent to which operations are to be restricted, how pilots are to be notified and the maximum duration of any depletion.
4. At aerodromes where a higher category is available by prior arrangement, the manual should clearly state the actions necessary to upgrade the facility. Where necessary this should include actions to be taken by other departments.
5. The licence holders' objectives for each RFF category provided should be defined. This should include a brief description of:
   - amounts of media provided;
   - discharge rates;
   - number of foam-producing appliances;
   - manning levels;
   - levels of supervision.

   Note: *When the objectives are higher than those set out in CAP 168, chapters 8 and 9, licence holders may also wish to indicate the minimum levels acceptable under their safety policies.*
6. Procedures for:
   - monitoring the movement areas for the purpose of alerting RFF personnel;
   - showing how RFF personnel are alerted throughout the range of functions (training, extraneous duties, etc.) and geographical locations from where they may be expected to respond;
   - indicating how the adequacy of the response time capability throughout their functions and locations is monitored and maintained;
   - indicating how RFF personnel engaged in extraneous duties are managed to ensure that response capability is not affected.
7. Where the aerodrome provides specialist equipment such as rescue craft, emergency tenders, hose layers, appliances with aerial capability, etc., details should be included in the manual. Procedures to be followed if these facilities are temporarily unavailable should also be included.
8. Where the aerodrome is reliant upon other organisations to provide equipment which is essential for ensuring safe operation of the aerodrome (perhaps water rescue), policies or letters of agreement should be included in the manual. Where necessary contingency plans in the event of non- availability should be described.
9. A statement describing the processes by which licence holders ensure the initial and continued competence of their RFF personnel. This should include the

following:

- realistic fuel fire training;
- breathing apparatus training in heat and smoke;
- First Aid;
- LGV driving;
- Low Visibility Procedures, CAP 168, chapter 8, appendix 8B;
- Health and Safety policy with regard to training of personnel in RPE and PPE.

10. Additional guidance may be found in CAP 168, chapter 8, and CAP 699, Standards for Competence of Rescue and Fire Fighting Service Personnel Employed at UK Licensed Aerodromes;
11. Procedures indicating how accidents within 1000 m of the threshold of each runway are to be accessed. Where other difficult environs exist, the manual should indicate how these are to be accessed.
12. Where licence holders expect the RFF facility to respond to domestic fires or special services, procedures for managing the impact of this upon the normal aircraft RFF response should be included.
13. Where licence holders expect the RFF facility to respond to aircraft accidents landside, the policy should be clearly described. This should include procedures to manage the effects on continued aircraft operations.
14. The availability of additional water supplies following an aircraft accident should be described. Details of the policy to be followed in the event of contractual work which requires isolation or depletion of supplies should be included (work in progress).
15. Where an aerodrome accepts freight aircraft, ambulance flights or movements not required to use a licensed facility, company objectives regarding RFF category should be included.
16. The licence holder's arrangements for ensuring the adequacy of responses in abnormal conditions i.e., low visibility procedures.
17. A policy statement indicating how the licence holder ensures the training and competence of first aid personnel.
18. An indication of the scale of the medical equipment carried. Where medical equipment is held other than on the RFF vehicles a statement indicating its location and how it is to be transported to an incident should be included.

Integrated emergency planning

2.19 The licence holder's arrangements for determining and implementing plans that ensure the integrated management of response to an aircraft incident/accident. These arrangements should take account of the complexity and size of the aircraft operations.

Air traffic services

2.20 Details of the following:

1. the system for the safe management of air traffic operating on the aerodrome or in the airspace associated with it;
2. procedures for the selection of the runway in use and the circuit direction;
3. procedures for noise abatement;
4. procedures for evaluating the suitability for use and availability of the runway(s);
5. procedures for alerting emergency services;
6. except where these are included in documentation associated with an ATSU established at the aerodrome and approved by the CAA.

Communications and navaids

1. Description of and instructions for the use of air/ground and operational ground radio communications where these are not covered in ATC or AFIS manuals.
2. Description of and operating procedures for navigation aids.

Bibliography

2.21 Cross-referenced documentation.

Submission of the aerodrome manual and other required documents

Introduction

2.22 The development, transmission, storage, dissemination and change control of documents is far more efficient and easier by electronic means than with paper copies.

2.23 The aerodrome manual, emergency orders and details of the safety management system, if contained in a separate document(s), should be submitted in electronic form. In order to facilitate assessments of aerodrome developments and the treatment of obstacles, the aerodrome plan may be provided in paper form.

Procedures

2.24 The aerodrome manual and other documents should be submitted in either portable document format[1] (.pdf) or a format that can be viewed using an application within the Microsoft Office software suite (e.g. Microsoft Word).

2.25 Documents must be saved to allow opening, printing, extracting (copy) and commenting without the need to enter a password. Documents received in an unsuitable format may not be accepted.

2.26 The number of pictures and graphics within a document should be kept to a minimum. Every effort should be made to provide large graphics and maps in electronic form;

however, if they cannot be viewed clearly on a computer display with a resolution of 800x600 pixels the graphic or map only should be submitted in paper copy form to the address in paragraph 2.33. Electronic signatures are acceptable.

2.27 Submitted documentation must be complete and, if an amendment, not just the amended pages. An amendment should be clearly indicated, for example, using a line in the margin adjacent to the line containing the amendment, underlining new text, and strikethrough of deleted text. Substantial amounts of amended text, e.g. completely new paragraphs or chapters, may be annotated just using a margin line.

2.28 Every document should be controlled according to the version and date of issue/ applicability. All files should be named according to the following convention:

2.29 (Date as YYYYMMDD)(Aerodrome name)(Document name)(Version number)

2.30 For example: 20070122ManpoolAeroManPart1V1.0.pdf

2.31 Do not insert spaces or symbols but intuitive abbreviations may be used. An amendment record and list of effective pages should be included in the document and, where applicable, the saved filename of a previously submitted document that is to be replaced should be notified.

2.32 Documents must not contain hyperlinks to other documents or internet/intranet addresses. Large documents may, however, be split into different parts and individual files. The part number should also be indicated in the saved filename, for example: 20070122ManpoolAeroManPart1V1.0.pdf If a required document is split into parts, a list of the parts and, where appropriate, their relationship to each other, should be provided.

2.33 Documentation should be submitted, with suitable notification of the nature of the submission, by email only to the following address: asddocs@caa.co.uk

2.34 The size of individual emails, including file attachments, must not exceed 10Mb. A series of emails may be sent to submit multiple attachments less than this limit. However, where the size of an individual file exceeds 10Mb, the document should be submitted on a CD by post. DVD format is not acceptable. Notification of the content of the CD and any information specified in paragraph 2.30 should be provided in a separate document. A CD should be posted only to the following address:

Airspace, ATM and Aerodromes, Safety and Airspace Regulation Group,

Civil Aviation Authority, Aviation House, Gatwick Airport South,

West Sussex RH6 0YR

2.35 Electronic versions or paper copies of required documents should not be submitted directly to an Aerodrome Inspector or CAA Regional Office. The identity of the aerodrome, the sender and his/her position and contact details should be clearly stated in each submission.

2.36 Attachment A provides an example checklist for the submission process, which could be used to accompany each email/CD submission.

2.37 Notification of receipt of a submitted document, its acceptance by the CAA or any deficiencies in the document, will be provided.

2.38 Exemption from this requirement will be considered by the CAA on request.

Attachment A

	Action	Approved By	Date
1	Document completed		
2	Amendments marked; list of effective pages updated		
3	Saved as File name (s):		
4	Where applicable – list of documents (file names and titles), relationships and amendment details:		
5	Document supersedes which document (file name)?		
6	Document submitted to the CAA via: Email (<4Mb only) Post (CD)		
7	Identity and contact details of sender	N/A	
8	Response received from the CAA	N/A	
9	Further action/amendment required? Yes – Go to 1 No – End		

For CAA use only

Email/CD received, content and source verified		
Format checked, amendments marked, file name checked		
Paper attached (YES/NO)		
Document rejected, response sent, and reason included		
Document accepted/saved; response sent		

APPENDIX 2A

Runway Visual Range (RVR) assessed by human observers

Foreword

1. Where Instrumented RVR is not available, RVR for the purposes of category I and non-precision instrument approach operations may be assessed by human observer. However, the human observer assessment of RVR is not permitted for category II or category III operations.

2. This appendix sets out the CAA's specifications for establishing and operating RVR reporting systems using human observers.

3. It should be read in conjunction with CAP 746, Requirements for Meteorological Observations at Aerodromes.

Method

4. Where human observer assessment is employed, the observer counts the number of runway lights he can see from a Runway Observation Position (ROP) near the runway and this number is converted to runway visual range. An allowance is made for the differences in light intensity, background, etc., observed from the different viewing positions of the observer and the pilot. Where it is difficult to count runway lights, observations are made on a special row of runway or other lights, set up near the runway.

The Runway Observation Position (ROP)

Siting and number of runway observation positions

5. For RVR observations made in connection with Category I operations, one ROP giving an assessment of the RVR on the runway in the touchdown zone will generally be sufficient.

6. An ROP may be either a structure or vehicle and its location should be determined by the aerodrome operator in consultation with the CAA using the guidance material set out in this appendix.

Lateral position

7. Ideally the ROP should be sited not more than 120 m laterally from the runway centreline. However, for safety reasons it must not be located:
   1. within the runway cleared and graded area;
   2. within taxiway strips;
   3. such that a profile of 1 in 10 slope originating at the runway centreline is infringed by the height of the structure or vehicle, including the observer in his

observation position.

8. However, as an exception to 2 above it is acceptable to locate the ROP on a taxiway that is inactive when measurements are being taken. Reference should be made to CAP 168, chapter 3, for details of the relevant specifications and criteria.

Longitudinal position

9. The touchdown zone ROP should be located approximately 300 m upwind of the runway threshold. On short runways it is preferable for the ROP to be sited abeam or downwind of the threshold so as to be able to increase the maximum reportable RVR. Care should be taken to ensure that the ROP does not constitute an obstacle infringing the relevant instrument approach surfaces specified in CAP 168.

Position of ROP relative to lights/marker boards

10. The ROP should be sited so as to enable the lights used for assessing RVR to be clearly visible to the observer. The observer eye height should be 5 m above the runway level, this being the maximum practical height for a human observer. The most representative assessment of RVR will be made when counting lights on the opposite side of the runway to that of the ROP, but it is recognised that although this should be the aim, it will not be possible on some runways, for example on undulating runways or where there are many flush edge light fittings on the opposite side. In such cases the order of preference for the selection of lights to be used is shown in paragraphs 20 to 27 below.

11. The ROP should be located so that the vehicle or structure does not obscure a pilot's view of visual aids.

12. In order to ensure that the ROP does not affect the performance of electronic navigation aids, advice on the siting should be sought from the aerodrome telecommunications officer.

Marking and lighting

13. Whether the ROP is a fixed structure or parked vehicle it should be marked and lighted as an obstacle as laid down in CAP 168, chapter 4.

14. In order to ensure that the observer makes his observation from the calibrated position where the ROP is a parked vehicle, the parking position should be clearly and unambiguously marked, so that the vehicle may be correctly positioned each time it is deployed.

Equipment and facilities

15. **Communications:**
The ROP should have direct and preferably discrete communication with ATC in order to facilitate the rapid reporting of RVR changes. It is a requirement that the report reaches the pilot within 30 seconds of an observation being made.

16. **Comfort:**
The ROP, whether permanent or mobile, should have a sufficient degree of comfort so that

personnel are not affected by fatigue or poor working conditions.

17. **Transparency of glass surfaces**
Glass surfaces through which observations are made should be kept clear of precipitation and condensation.

18. **Internal lighting**:
Sufficient light should be available for reporting and recording the observations. Lighting within the ROP should be such that the taking of observations and the visual night acclimatisation of the observer are not adversely affected.

19. **ROP construction**:
Where the ROP is a fixed structure, it should be of minimum dimensions and maximum frangibility consistent with its function.

Lights

Selection of lights to be used for observations

20. The order of preference for selecting lights to be used for observations is, in descending order:

    1. opposite side runway edge lights
    2. opposite side special reference lights
    3. same side runway edge lights
    4. same side special reference lights

21. The CAA will advise the aerodrome operator which lights are to be used for each runway and only that set of lights should be used for observations. Some runway edge light fittings may not be clearly visible to an observer at the side of the runway and a row of special reference lights of similar characteristics to the runway lights but beamed towards the ROP, may be needed. The intensity setting of these reference lights should be automatically set to the same intensity as the runway lights. Reference lights are to be arranged so as not to present a confusing or dangerous appearance to pilots.

22. So as to ensure the accuracy of the assessment it is necessary for the positions of the lights to be used to be accurately determined. Accordingly, they require to be included in the aerodrome survey, the requirements for which are contained in CAP 232, Aerodrome Survey Information, chapter 5.

Creation of RVR conversion table

23. There are two methods available for creating the RVR conversion table, details for both are provided in CAP 746, requirements for meteorological observations at Aerodromes, appendix C:

    1. use of the Gold Visibility Meter;
    2. use of a distance-based methodology.

24. A new conversion table is required to be produced following any alterations or changes to the system, for example when lights have been realigned or relocated, or changes made to supply voltages, or when the ROP has been changed. Any such change invalidates the previous conversion table and RVR reports are not to be passed until a new table is available.

Calibration of runway lights

25. High intensity runway lights with a beamed element, directed along the runway towards the pilot, will result in the intensity of light directed towards the ROP being less than the intensity directed towards the pilot. Consequently, a calibration of the lights used will be necessary. This will be carried out from the ROP and from the runway centreline in order to prepare a conversion table. From this table an assessment of the RVR to be experienced by the pilot can be read against the number of lights observed from the ROP. The aerodrome operator should ensure that re-calibrations are carried out at the agreed intervals and that a new table is issued. A re-calibration is to be carried out immediately following any alterations or changes to the system, for example when lights have been realigned, or changes made to supply voltages, or when the ROP site has been changed. Any such change invalidates the previous conversion table and RVR reports are not to be passed until a new table is available.

Maintenance of RVR reference lights

26. Where special reference lights are used, they should be maintained to the same standard as the corresponding runway lights so that RVR observers and pilots are viewing lights which have a comparable performance.

Inspection of lights

27. The lights used for RVR observations should be regularly inspected from the ROP, at the correct eye height, through binoculars in clear daylight with the lights set at maximum intensity. This visual inspection should check for subsidence, damage, misalignment, ageing of bulbs/lenses and obscuration by grass. It is recommended that this inspection is carried out at least monthly.

The observer

Selection and function of the observer

28. The function of the observer needs no particular skill since it consists of identifying and counting lights and reporting this count to ATC. However, since assessment of RVR has a direct bearing on safety and regularity of aircraft operations, observers should be suitably trained and competent to undertake the task. The aerodrome operator should ensure that observers understand the importance of correct RVR observations and appreciate that extra vigilance is required when fog is forming or dissipating so that changes are detected and reported as they occur.

Time on duty

29. Duty periods for RVR observers should be arranged so that long periods without an adequate break are avoided. Periodic visits should be made by supervisors to an active ROP to check that the correct procedures are being used and the log is being correctly maintained when this is required of the observer.

Eyesight and hearing requirements

30. Personnel selected for RVR observer duties should have the necessary eyesight (visual acuity and colour perception) and hearing requirements for them to operate on the maneuvering area. Correcting spectacles or contact lenses should be worn when required.

Operating procedures

Periods when RVR reporting is required

31. The ROP should be manned in accordance with an alerting procedure based on meteorological reports and forecasts which will ensure that a continuous service can be given throughout any operational period during which the meteorological visibility is reported to be 1500 m or less. Assessment and reporting may cease when meteorological visibility is greater than 1500 m and the RVR is greater than the maximum value that can be reported. At some less busy aerodromes it may be sufficient to report RVR only during those periods commencing 15 minutes prior to and during aircraft movements. However, consideration should be given to the need for pilots intending to depart from another aerodrome to have a recent destination RVR report available to them. Under no circumstances should an RVR report be used or passed after the standing down of the observer except when that report is quoted as part of a full meteorological report which includes a time of origin.

Reporting procedures

32. **Standardisation**

The UK standard for reporting RVR extends from 0 to 1500 m in the following steps:

- 0 to 400 m in 25 m steps
- 400 to 800 m in 50 m steps
- 800 to 1500 m in 100 m steps

Where a system is unable to report the full range of RVR as outlined above, the limitations of the system should be published in the AIP at GEN 3.5.3.

33. **The count**

The number of lights that can be seen (the count) should be reported to ATC, for example ‘four lights’. The report should be read back to the observer by ATC. The count is converted to RVR using the relevant conversion table. An immediate report is to be made whenever there is a change in the count, but if there are no changes, confirmatory reports should be made at 30-minute intervals, or when requested. Similar reports and read backs should be made if the count is converted to RVR at the ROP.

34. **Low/high RVR values**

If the RVR is so low that no lights are visible to the observer, he should report this. The RVR in these circumstances should be reported to a pilot as 'less than .... metres', the actual RVR value quoted being the equivalent of one light. If the visibility is sufficient to enable the observer to see an object at ground level at a distance greater than the light which defines the maximum reportable RVR value, a report of 'RVR greater than .... metres' should be given.

35. **Effect of light intensity on reporting**

RVR observations, including those for transmission in meteorological reports, should be made with the lights set at the intensity appropriate to the prevailing conditions. RVR should not be assessed with the lights set at an intensity for which there is no conversion table. If a pilot requests that the lights be reduced in intensity and this results in a setting for which there is no conversion table, the pilot should be advised that RVR is not available at this requested setting.

36. **ATS functions**

ATS aspects of RVR are described in general terms in Part 1 of the Manual of Air Traffic Services (MATS). Air Traffic Service Units should ensure that aspects specific to their aerodromes are described in their Part 2 of MATS or local instructions.

37. **Changes to procedures**

RVR should be observed and reported strictly in accordance with the laid down procedures. However, where local conditions require a departure from the standard procedures, the proposed change should be cleared with the CAA before operational use.

Operating instructions

38. A comprehensive set of operating instructions should be drawn up for the aerodrome and included in the aerodrome manual. The instructions should state clearly who is to be responsible for the various procedures, for example, who will be required to maintain the RVR log. It may be desirable for instructions to be issued to RVR observers in a separate document.

39. The minimum content of the instructions is shown at annex A.

The RVR log

40. RVR and meteorological visibility values that are observed or measured shall be recorded such that the reported RVR and visibility reported at any particular time can be determined. Records shall be made available to the CAA on request.

41. Logs and any other required records are to be collected on the termination of a period of observation and are to be kept by the unit concerned for at least 12 months from their completion, after which time they may be destroyed.

42. Associated records (system calibration; system maintenance; observer medicals etc.) shall still be kept according to their audit requirements.

43. The RVR log shall include the following:

- aerodrome;
- date;
- runway;
- start and finish time for the period of observations;
- the time each observation is logged, expressed in UTC to the nearest minute;
- the actual count expressed as the number of lights observed e.g. ‘Four lights’, and the corresponding RVR value.

ANNEX A TO APPENDIX 2A

Guidance notes on the contents of the aerodrome operations manual relating to RVR observations

1. The following material should be included:

    1. The reason for RVR reports, with emphasis on the contribution to operational safety.
    2. The alerting procedure and meteorological conditions for manning the ROPs.
    3. The positions of the ROPs and, if applicable, which vehicle is to be used at the ROPs, the orientation of the vehicle and the precise position of the observer in relation to the vehicle, for example, sitting in the cab or on the roof.
    4. The routes to be used to reach the ROPs and details of any authorisation or clearance required.
    5. A comprehensive diagram of the runway environment is to be available at the ROP to enable the lights to be positively and individually identified.
    6. The manner in which reports are to be passed to ATS together with an instruction that reports are to be passed immediately.
    7. The method of use of the conversion table.
    8. Specification of UTC as the time to be used and the need to synchronise the ROP clock or observer's watch with ATS.
    9. The action to be taken in the event of partial electrical failure extinguishing certain lights (if appropriate to the aerodrome).
    10. The method of reporting an RVR value greater than, or less than the calibrated values.
    11. An instruction to observers that they should immediately report to ATS anything they see that might affect operational safety. Examples should be given, such as unauthorised persons on the movement area, an airfield lighting fault (particularly those lights used in RVR observations), or something on an aircraft appearing to be unsafe.
    12. Responsibility and instructions for maintaining and preserving the RVR log.
    13. Arrangements for initial and renewal eye tests for observers. A reminder that spectacles or contact lenses must be worn for observation if worn for the test.
    14. The frequency of re-calibration of the RVR lights.
    15. Arrangements for inspection and cleaning of the lights.

APPENDIX 2B

Low visibility operations

Low visibility operations

1. Aircraft operations at aerodromes during reduced visibility or low cloud conditions present additional hazards to aircraft and to other aerodrome users. As visibility reduces, the ability of ATC, pilots, vehicle drivers and other personnel to identify hazards and to take remedial action in a timely manner becomes limited. In conditions of low cloud, the time available for the pilot of an approaching aircraft to visually assess the aerodrome environment is reduced.

2. Low Visibility Operations (LVOs) is a general term used for airside operations in conditions of reduced visibility or low cloud conditions and consists of low visibility safeguarding and low visibility procedures (LVPs).

3. Low visibility safeguarding is the process carried out which prepares the aerodrome for low visibility procedures.

4. Low visibility procedures are the actions carried out by ATC and the aerodrome operator in respect of aircraft operations and vehicle movements. This may include restricted access to the maneuvering area, the protection of the ILS critical and sensitive areas and a reduced aircraft movement rate.

5. LVPs are required for the following types of operation:

- Lower than standard category I;
- Category II;
- Other than standard category II;
- Category III;
- Take-offs below 550 m RVR;
- Approaches utilising an Enhanced Vision System (EVS) where the actual RVR is below 550 m.

Low visibility safeguarding

6. The point at which LVPs are implemented will vary from one aerodrome to another and will depend on local conditions and facilities available. However, a period of time is required to prepare the aerodrome and, in particular, the maneuvering area, in readiness for LVPs. The safeguarding measures must ensure that at the point when LVPs are declared to be in force, all actions to protect aircraft operations have been put in place.

7. When the visibility deteriorates to approximately 1000 m RVR and is expected to fall further below 550 m RVR, or the cloud ceiling reduces to 300 ft and is expected to fall further below 200 ft, safeguarding should be initiated. The withdrawal of vehicles and personnel involved in non-essential activities on the maneuvering area should be initiated. Any temporary work in progress on the movement area should normally cease and the work areas should be vacated and returned to operational condition or clearly marked/lit and notified as unavailable for use. Routine maintenance on visual and non-visual aids should be suspended and the ILS localiser and glide path critical and sensitive areas should be cleared of all traffic.

8. Aerodrome operators, in conjunction with ATC, should develop actions that ensure that, in good time prior to the introduction of LVPs, all airlines and other organisations with maneuvering area access are notified. This is particularly important where companies exercise control over their own apron areas and maintenance facilities adjacent to the maneuvering area.

9. Particular attention should be given to the protection of the runway and radio navigational aids. Access to the maneuvering area should be restricted to essential operational safety vehicles and personnel.

10. The decision to commence or continue work, especially involving construction, when a significant probability for the need to invoke LVPs exists, should take account of the time it will take to cease the work, remove all persons and equipment, and prepare the site for LVPs. Alternatively, the planning process employed in the development of major construction projects should detail the control measures that would be implemented should it be deemed necessary to continue both WIP and aircraft operations during LVPs.

Responsibilities with respect to low visibility procedures

11. It is the responsibility of the aerodrome operator to develop and maintain the LVPs used at their aerodrome.

12. Whilst ATC are responsible for advising pilots of the status of LVPs at an aerodrome, it is the responsibility of the aerodrome operator to ensure that all measures required to protect aircraft operations in poor weather conditions are in place.

Declaration of low visibility procedures in force

13. It is essential that the aerodrome operator verifies to ATC that all safeguarding measures are in place before LVPs are declared to be in force by ATC. Similarly, LVPs should be declared as cancelled before the aerodrome operator withdraws any measures. It should be remembered that aircraft established on an approach may have commenced that approach believing that LVPs are in force. All measures taken to protect the approach aids and runway should remain in place until all such aircraft have completed their approach.

14. At aerodromes that support operations listed in paragraph 5 and in conditions that preclude Category I operations, under no circumstances should LVPs be declared to be in force if the appropriate safeguards for these operations are not fully in

place to protect the landing aids and runway.

15. Misunderstandings about the status of LVPs can easily arise during periods when the procedures are being introduced or withdrawn. This is particularly true at aerodromes where LVPs include a phase where preparatory actions are taken prior to the full implementation and declaration of LVPs in force, or where some measures may be left in place during what may be a temporary improvement in the weather conditions so that full LVPs can be re-instituted at short notice should the weather deteriorate again. Procedures should ensure that the status of LVPs is clearly understood by all those that are involved in aerodrome operations. There should be a single point from which definitive information about the current status of LVPs can be confirmed wherever possible.

Low visibility procedures

16. As the RVR deteriorates to lower than 550 m, or the cloud ceiling reduces below 200 ft, low visibility procedures should be fully implemented. (The cloud ceiling criteria of below 200 ft is not required for aerodromes conducting take-offs below 550 m RVR but limited to Category I operations only). The withdrawal of non-essential vehicles and personnel from the maneuvering area should be completed. Where possible free ranging should have ceased and all activities on the maneuvering area should be under the direct control of ATC. ATC should apply increased spacing between aircraft to allow additional time for the preceding arriving aircraft to vacate the Localiser Sensitive Area (LSA) or the previous departing aircraft to have overflown the localiser. Interference with the localiser and glide path signal can cause a deviation to an aircraft’s flight path requiring a go-around to be flown.

17. The point at which LVPs are to be implemented must be clearly defined in terms of a specific RVR, expressed in metres, or cloud ceiling measurement, expressed as a height in feet, and must be promulgated in relevant notices and documentation to all those persons involved.

18. In order that flying operations may be safely conducted at aerodromes in low visibility conditions, aerodrome operators, in consultation with ATC, should determine the movement rate that they wish to sustain and develop LVPs that will support the desired movement rate. The aircraft movement rate will be dependent on the aerodrome infrastructure including the ground markings and lighting.

19. LVPs will vary with each aerodrome and are subject to acceptance by the CAA prior to inclusion in the aerodrome manual and the Manual of Air Traffic Services Part 2 and their subsequent implementation.

20. In order to protect aircraft operating on the ground in low visibilities, it is essential to prevent unauthorised vehicular traffic from entering the movement area. The area should, where practicable, be fenced and provided with manned controlled

entry points. Where unguarded gates are provided, they should be kept locked and inspected regularly to ensure that they remain secure. Where physical closure is not practicable, for example between aircraft maintenance areas and maneuvering areas, entry points should be manned and where the opening is too wide for visual surveillance, then it should be fitted with intruder detection equipment suitable for operation in low visibility conditions. By protecting the movement area in this manner, it should be possible to exclude unauthorised personnel who will not be aware of aerodrome traffic control procedures.

21. Complete protection can be expensive and is sometimes difficult to achieve, particularly on large aerodromes where taxiways cross vehicular traffic routes, and where maintenance areas compete with parking aprons for space. Where it is not practicable to secure the area in the manner recommended, the aerodrome operator shall satisfy the CAA as to the security of the aerodrome's operations in low visibility conditions.

22. When LVPs are in force, only vehicles essential to the aerodrome operation and driven by formally tested and authorised drivers should be allowed onto the maneuvering area. All such vehicles should be equipped with an aerodrome chart available in the driver's cab clearly showing all taxiways, runways, holding points and vehicle routes marked with their appropriate designation. All drivers should be aware of the action to take in the event that the vehicle should break down or that the driver should become unsure of his position on the aerodrome.

23. In addition, all vehicles operating on the maneuvering area should be equipped with R/T and the driver required to maintain contact with ATC at all times unless escorted by an operations vehicle equipped with R/T and in contact with ATC at all times. Authorised drivers should be thoroughly briefed and familiar with the aerodrome layout including closed taxiway junctions and runway access points,the meaning of all markings, signs and aerodrome lighting, and where appropriate, standard R/T phraseology. Drivers that are restricted to certain areas of operation should be familiar with the limits of those areas, particularly if they cannot be clearly marked, for example, on the aerodrome surface. Authorised drivers should be checked periodically for competence and knowledge of local instructions.

24. In order to continue unrestricted operations for as long as possible while weather conditions deteriorate, many of the low visibility safeguarding measures are implemented in good time and in certain circumstances before they are absolutely necessary. The reduction in the aircraft movement rate, which is activated by ATC, should be implemented only when the weather conditions demand it.

25. Rescue and Fire Fighting Service (RFFS) vehicles are essential to aerodrome operations at all times and response and deployment times are of vital concern to aerodrome operators. Although it is unlikely that the RFFS response time will be significantly affected in visibilities down to 200 m, temporary relocation of vehicles to strategic points may be necessary for a very large or complicated aerodrome. In

visibilities below 200 m there is greater probability that response times will be affected. Operational instructions and training should be developed in accordance with the guidance in chapter 8.

26. Similarly, because congregations of wildlife are difficult for both ATC or pilots to observe in poor weather conditions, wildlife hazard control operations should not be restricted during LVPs. Processes should ensure that adequate time between movements is afforded to permit wildlife hazard control measures to be implemented. The importance of maintaining a runway inspection regime in sustained periods of LVP implementation is also highlighted. This too should be accounted for when determining the declared movement rate.

27. The risk of an inadvertent runway incursion by an aircraft or vehicle, or aircraft mis-routeing, is increased in low visibility conditions. Wherever possible this risk should be minimised by keeping taxiway routeings as simple as is practicable. This can be best achieved by restricting the available taxiway system wherever possible to a single route from the apron to the runway, with intermediate junctions closed, a clearly defined runway entry point, holding point and a separate exit taxiway and return route for landings or rejected take-offs. All other runway access or crossing points should be closed.

28. This can be achieved by the use of red stop-bars or by a physical barrier as described in chapter 7. Markers used in this manner should either be retro-reflective or augmented by lights of the type described in chapter 4. In this way the procedural control of aircraft and vehicles at complex aerodromes can be simplified. On major aerodromes where traffic is such that several routes are operated simultaneously, a Surface Movement Guidance and Control System (SMGCS) is likely to be required in order to achieve the declared movement rate.

29. ICAO annex 14 currently recommends the provision of Surface Movement Radar (SMR) at aerodromes where operations in RVR less than 400 m take place. However, unless the CAA has approved specific procedures, SMR is a monitoring tool only; SMR enhances existing ATC procedures, and its use should not be regarded as the prime method by which collision avoidance can be effected.

Visibility conditions and associated actions

Visibility condition 1:

30. Visibility sufficient for the pilot to taxi and to avoid collision with other traffic on taxiways and at intersections by visual reference, and for ATC to exercise control over all traffic on the basis of visual surveillance.

31. No additional requirements for the protection of ground operations by aircraft are required during visibility condition 1.

Visibility condition 2:

32. Visibility sufficient for a pilot to taxi and to avoid collision with other traffic on taxiways and at intersections by visual reference, but insufficient for ATC to exercise control over all traffic on the basis of visual surveillance.

33. Actions required in visibility condition 2 are dependent on the dimensions of the maneuvering area and the position of the control tower. Procedures and visual aids will allow the pilot to determine his position and follow the required route.

34. In the lower ranges of visibility condition 2, the necessary measures might limit the movement rate unless some additional aids are available, such as SMGCS, which may enable a greater movement rate to be achieved safely. Adequate safeguards against runway incursions should be in place, such as limited taxi routeing, surface movement radar and stop-bars or physical barriers at runway access points.

Visibility condition 3:

35. Visibility sufficient for the pilot to taxi but insufficient for the pilot to avoid collision with other traffic on taxiways and at intersections by visual reference, and insufficient for ATC to exercise control over all traffic on the basis of visual surveillance. For taxying, this is normally taken as visibilities equivalent to an RVR of less than 400 m but more than 75 m.

36. In such visibility conditions it is likely further ATC measures, such as block control, to assist aircraft and vehicle movement including RFF vehicles, should be considered.

Visibility condition 4:

37. Visibility insufficient for the pilot to taxi by visual guidance only. This is normally taken as an RVR of 75 m or less.

38. During visibility conditions 3 and 4, Advanced Surface Movement Guidance Control Systems (A-SMGCS), where available, may be used to determine the position of aircraft and vehicles on the maneuvering area.

Precision instrument approach operations

39. Pilots will expect a precision instrument runway to be fully safeguarded and available for the operations listed in paragraph 5. and any guided take-off, if LVPs are declared to be in force by ATC at the aerodrome.

Review of low visibility procedures

40. The aerodrome operator, in co-operation with ATC and other agencies involved in LVP operations, should regularly review the effectiveness of LVPs. Any need for change should be agreed with the CAA prior to inclusion in the aerodrome manual

and the Manual of Air Traffic Services Part 2 and subsequent implementation.

41. LVP table-top exercises should be completed on a regular basis to ensure all stakeholders are familiar with the procedures. They should also be considered for any forthcoming operational changes and development works that may significantly impact on LVPs.

EU-OPS approach operations

42. EU OPS and other national authority regulations may allow approved operators to carry out lower than standard category I or other than standard category II approach operations if certain conditions (specified in EU OPS) are met.

43. Lower than standard category I operations allow operators to carry out a Category I approach but with a lower RVR limit than previously available. The actual RVR limit will depend on a number of factors including the:

- lowest decision height available;
- level of aeronautical ground lighting available including approach lighting;
- ILS specification.

44. Aerodromes which are suitable for lower than standard category I operations should ensure that their LVPs are suitable for the lowest RVR limit possible. Further details of lower than standard category I or other than standard category II approach operations can be found on the CAA website.

45. EU OPS and other national authority regulations may allow approved operators to carry out specified approach operations utilising Enhanced Vision Systems (EVS) which reduce the traditional RVR minima required. Aerodromes that are suitable for the specified approach operations should review their LVPs to ensure they are adequate for aircraft and vehicle operations in such visibilities. Further details of EVS operations can be found on the CAA website.

Additional information

46. Low visibility operations are discussed in greater detail in ICAO Doc 9476 manual of Surface Movement and Guidance Control Systems chapter 5 and ICAO European Doc 013 European Guidance Material on All Weather Operations at Aerodromes.

47. Systems designed to enable movement rates to be sustained are discussed in ICAO Doc 9830 A-SMGCS manual.

Conversion of reported meteorological visibility to RVR

48. At aerodromes where RVR measurements are not made, or in case of unserviceability of RVR measuring equipment, LVPs should include criteria for implementation and withdrawal based on the reported meteorological visibility.

49. Pilots, when converting meteorological visibility to an equivalent RVR, may apply the factors table 2B.1 provides. This method of obtaining RVR is not intended or direct application by aerodrome operators but is included in order to provide assistance for aerodromes at which RVR is not available. The conversion method is not to be applied by aerodrome operators and then provided to aircrew as an RVR.

Table 2B.1

Lighting elements available	RVR = Reported Met Visibility	
	Day	Night
High intensity approach and runway lighting	1.5	2.0
Any type of lighting installation other than above	1.0	1.5
No lighting	1.0	-

APPENDIX 2C

Aerodrome safety management system

Introduction

1. An effective Safety Management System (SMS) is an organised approach to managing safety, including the necessary organisational structures, accountabilities, policies and procedures, and forms the primary safety oversight covering the way an aerodrome manages safety. It also provides an identifiable and easily audited systematic control of the management of safety at an aerodrome. By applying lessons learned, an SMS should aim to make measurable improvements to the overall level of safety.
2. An aerodrome SMS should be commensurate with the size of the aerodrome and the level of complexity of the services provided.
3. Guidance on SMS can be found on the CAA website: www.caa.co.uk/sms.
4. The ICAO SMS framework consists of four components and twelve elements, and where possible, aerodrome licence holders should include or refer to the ICAO SMS elements below. ICAO publishes SMS guidance in Document 9859 Safety Management manual (SMM).

SMS framework

Safety policy and objectives

5. **Management commitment and responsibility**:

An effective safety policy, endorsed by the accountable manager, sets a clear direction for the aerodrome to follow and contributes to all aspects of business and safety performance. The safety policy should include a statement about the provision of adequate resources and show the commitment of senior management to manage safety effectively.:

6. Safety accountability

The aerodrome licence holder should identify an accountable manager who is accountable for ensuring that all operational activities can be financed and carried out to the standard required.

7. **Appointment of key personnel**:

The aerodrome licence holder should identify a manager to be the focal point for the implementation and day-to-day maintenance of an effective SMS.

8. Co-ordination of emergency response planning:

The aerodrome licence holder should ensure that an emergency response plan provides for the orderly and efficient transition from normal to emergency operations and the return to normal operations. The plan should be properly coordinated with the emergency response plans of those organisations it must interface with during the provision of its services. (CAP 168, chapter 9 gives further guidance on emergency planning.)

9. SMS documentation:

The aerodrome licence holder should develop and maintain documentation describing the safety policy and objectives, the safety accountabilities and responsibilities of senior managers, the SMS processes and procedures and any outputs from the SMS. SMS documentation may be integrated in the existing aerodrome manual or a separate safety management system manual may be developed.

Safety risk management

10. Hazard identification:

The aerodrome licence holder should develop and maintain an effective process to identify safety hazards affecting the operation. Hazard identification should be based on a combination of reactive (using safety data from an event that has happened), proactive (using safety data from a near-miss report) and predictive (actively looking at normal day-to-day operations to see where potential problems could occur) methods of safety data collection.

11. Safety risk assessment and mitigation:

The aerodrome licence holder should develop and maintain an effective process that ensures analysis and assessment of the safety risks in aerodrome operations and should implement any remedial action necessary to maintain risks at a level as low as reasonably practicable. Risk assessments should be reviewed regularly, and when changes occur that may affect the safety hazards or the associated risks.

Safety assurance

12. Safety performance monitoring and measurement:

The aerodrome licence holder should ensure that safety performance is measured to determine whether safety measures are effective and to identify where improvement is needed. Self-monitoring such as incident investigation, safety inspections and safety audits is a part of this process.

13. **Management of change**:

The aerodrome licence holder should assess the safety impact of any safety- significant changes upon other procedures and processes, individuals and the operation and organisation as a whole. This should be done in the planning stages of any project and updated as required.

14. Continuous improvement of the SMS:

The aerodrome licence holder should identify and determine the implications of sub-standard performance of the SMS in operation and eliminate or mitigate such causes.

Safety promotion

15. Training and education:

The aerodrome licence holder should ensure all aerodrome personnel and third- party contractors receive safety training as appropriate to their role to ensure they understand their safety responsibilities within the aerodrome's SMS.

16. Safety communication:

The aerodrome licence holder should develop and maintain safety communication mechanisms which ensure safety critical information is conveyed effectively and explain why particular safety actions are taken and why safety procedures are introduced or changed.

Accountable manager

17. Schedule 12 of the ANO requires an aerodrome to nominate an accountable manager and include the name and status of the accountable manager in the aerodrome manual.

18. The nominee will often be the chief executive, chief operating officer, board chairman, president, managing director, general manager or similar title; it is not necessary for the person to be the 'controlling mind' of the organisation. It is possible for an accountable manager to be answerable to and directed by another person or persons, and still retain the appropriate level of authority to ensure that activities are financed and carried out to the standard required. The organisational title of this post is at the licence holder's discretion; however, the person named to the post must be advised to the CAA as the accountable manager.

19. The accountable manager should:

- ensure that all necessary resources are available to operate the aerodrome in accordance with the aerodrome manual. Where a reduction in the level of resources or abnormal circumstances which may affect aircraft safety occurs, the accountable manager should ensure that a corresponding reduction in the level of operations at the aerodrome is implemented as required;
- establish, implement and promote the safety policy; and
- ensure compliance with relevant regulations, licensing criteria and the organisation's Safety Management System.

20. The accountable manager should have:

- appropriate seniority within the organisation;
- an appropriate level of authority to ensure that activities are financed and carried out to the standard required;
- knowledge and understanding of the documents that prescribe relevant aerodrome safety standards;
- understanding of the requirements for competence of aerodrome

- management personnel so as to ensure that competent persons are in place;
- knowledge and understanding of SMS related principles and practices, and how these are applied within the organisation;
- knowledge of the role of the accountable manager; and
- knowledge and understanding of the key issues of risk management within the aerodrome.

21. The level of technical knowledge and understanding expected of an accountable manager is essentially high level, with particular reference to their own role in ensuring that standards are maintained.

22. During periods of absence, the day-to-day responsibilities of the accountable manager may be delegated; however, the accountability ultimately remains with the accountable manager.

APPENDIX 2D

Runway incursion awareness

Introduction

1. Several fatal accidents involving runway incursions have occurred, resulting in significant loss of life. Aerodrome licence holders need to be aware of the potentially catastrophic hazard presented to aircraft by runway incursions and to focus on preventive measures. These include the necessity for effective low visibility procedures and runway taxiway holding position signage to be compliant with CAP 168, which upholds the international standards.

2. Proactive measures should be taken by aerodrome licence holders to reduce the likelihood of a runway incursion occurring and to raise awareness of the hazards associated with runway incursions to all aerodrome users.

3. Runway incursions commonly have multiple causal factors generally involving flight crew, air traffic controllers and airfield operations. Errors that may contribute to runway incursions include:

   - failure to follow a clearance or instruction
   - failure to follow procedures
   - issue of an incorrect clearance, instruction or procedure
   - following an incorrect clearance, instruction or procedure
   - loss of situational awareness
   - use of poor communication techniques
   - poor knowledge of the aerodrome
   - use of inadequate or inappropriate procedures
   - confusing or inadequate aerodrome signage
   - taxiway layout

4. In November 2004, the International Civil Aviation Organisation (ICAO) published a new definition of a runway incursion for use by member states. The ICAO definition has been adopted by EUROCONTROL and the European Action Plan for the Prevention of Runway Incursions (EAPPRI) has been amended to reflect this change. The CAA has also adopted this definition, which is:

   - Any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and take-off of aircraft.

Action to be taken by aerodrome licence holders

5. Aerodrome licence holders should regularly review those areas of their aerodrome SMS relevant to the effectiveness and adequacy of the prevention measures in place at their aerodrome. In doing so, they should ensure that suitable measures are in place, particularly in areas of vulnerability, to minimise the risk of runway incursion. In this review, aerodrome licence holders should consider:

- to what extent aerodrome visual aids, i.e., aeronautical ground lighting, signs and markings, contribute towards reinforcing situational awareness;
- whether the aerodrome's visual aids, in conjunction with ATC clearances and instructions, in the vicinity of a runway could mislead pilots and vehicle drivers;
- whether the layout of any movement areas on the aerodrome could cause confusion 'hot-spots', and how such confusion could be eliminated;
- whether airside driver training is sufficiently robust, reassessing vital topics such as aerodrome operations; radio communication procedures
- and phraseology; the use and meaning of visual aids; and familiarisation of aerodrome layout; and
- how runway safety is maintained during periods of 'work in progress', particularly when contractors who are not familiar with the aerodrome or with aerodrome operations are involved.

6. Aerodrome licence holders should conduct regular 'table-top' exercises attended by representatives of all relevant aerodrome functional areas, whereby runway incursion scenarios can be developed and the effectiveness of potential prevention measures may be assessed. A review of these assessments and other SMS actions may be included in the aerodrome audit process.

7. As a continuing part of this approach, aerodrome licence holders should continue to review the effectiveness and adequacy of the prevention measures in place at their aerodrome and take particular note of the proportion of runway incursions attributed to vehicles.

8. Attention is drawn to the EAPRRI[2]. The action plan suggests certain initiatives and recommendations to mitigate the level of operational risk related to runway incursions, including the establishment of a permanent Local Runway Safety Team (LRST), improved operational procedures and training, together with the development of awareness campaigns. It is likely that a runway safety committee, or similarly named group, may perform the same role as the LRST.

2 Available for download from the EUROCONTROL website at: http://www.eurocontrol.int/runwaysafety/ public/standard page/EuropeanAction.html

9. Aerodrome licence holders, air traffic services providers and other key stakeholders should be especially aware of locations on an aerodrome with a history of, or potential risk for, collisions or runway incursions. These locations have been given the name 'hot spots', their definition being' a location on an aerodrome movement area with a history or potential risk of collision or runway incursion, and where heightened attention by pilots/drivers is necessary'. A hot spot is equally likely to result from:

- poor infrastructure design
- a confusing pavement layout
- inadequate surface navigational facilities
- a deficiency of visual aids; or

10. Additionally, hot spots may be locations that, although fully compliant, are potentially difficult to navigate due to awkward geometry, or where additional awareness is required, such as at runway crossing locations.

11. Hot spots should be notified on the aerodrome chart published in the Aeronautical Information Publication (AIP), and examples of both local and AIP charts are provided. annex 4 will specify that the location of a hot spot is circled on the AIP aerodrome chart and that 'properly annotated' additional information is provided to describe the nature of the potential risk at the hot spot. Publication on the aerodrome chart, supported by explanatory notes if considered helpful, is intended to facilitate pilot awareness.

12. Ideally, an effective LRST will ensure that hot spots do not exist. To achieve this aim, aerodrome licence holders, in conjunction with the LRST, should conduct an assessment to determine whether any hot spots exist currently on the aerodrome. The assessment should also address the potential for air traffic procedures (particularly acknowledged runway incursion causal factors such as the use of conditional clearances and non-standard communications) and other aerodrome operating procedures to create any hot spots. Human factors should be given due consideration in any assessment of hot spots.

13. If hot spots are identified, suitable strategies should be implemented to remove the hazard and, where this is not immediately possible, manage and mitigate risk. These strategies may include:

- awareness campaigns;
- additional visual aids (signs, markings, lights);
- use of alternative routeings;
- construction of new taxiways;
- mitigating against blind spots in the aerodrome control tower;
- publishing the hot spot in the AIP.

14. Some hot spot causal factors can be addressed swiftly but others may take much longer to remove, or it may be impracticable to remove them altogether. Hence, plans for the permanent removal of a hot spot or suitable immediate mitigation measures must be developed and implemented.

15. A new hot spot is most likely to be established as a result of change to the movement area or an operating procedure. An assessment should be conducted before the start of any new work, such as new pavement layout, or the introduction of a new or revised operating procedure, to prevent new hot spots being created inadvertently. Ceasing operations in the affected areas should be considered as mitigation in the case of work in progress.

16. The assessment described above should be repeated periodically to ensure that it remains valid and takes into account current aerodrome operating practice and design.

17. Where the measures to mitigate or remove an identified hot spot will take some time to complete, or it is considered that the publication of a hot spot would benefit pilot awareness, the hot spot should be notified by an appropriate means to air traffic service personnel and pilots using the aerodrome. The NOTAM process should be used for the notification of the short term (i.e. less than 3 months) existence of a hot spot. However, if a hot spot is likely to exist for more than one AIP Air Regulation and Control (AIRAC) publication cycle, it should be notified on the aerodrome chart in the UK AIP as specified in Amendment 54 to ICAO annex 4 and as a warning in the specific aerodrome local traffic regulations section (AD 2.20). The warning should include details of ongoing work to remove, or measures to mitigate, the hot spot, or other information that will help situational awareness.

18. Attention is also drawn to ICAO Doc 9870 manual on the Prevention of Runway Incursions.

19. When reviewing visual aids additional measures should be considered whenever it has been shown that further runway incursion prevention mitigation measures are required. The use of additional measures will depend on the specific circumstances but could include the following:

- the use of enhanced stop-bars where the light fittings making up a stop-bar are spaced equally across the taxiway in a line perpendicular to the taxiway centreline at reduced intervals;
- the use of stop-bars 24 hours a day in all lighting conditions should be considered as runway incursions are not limited to low visibility conditions;
- the use of inset runway guard lights (chapter 6);
- the use of runway guard lights 24 hours a day in all lighting conditions;
- the use of a runway ahead marking (as shown in figures 2D.1 and 2D.2) in addition to the mandatory instruction marking (chapter 7). Where possible the runway ahead marking should be located before the mandatory marking

as illustrated below and collocated with the CAT II/ III holding position marking (pattern B) where applicable. The actual position of the runway ahead marking will depend on the aerodrome's particular circumstances and layout, and should be decided in consultation with the LRST where appropriate;

- runway ahead surface markings, size and proportions, should be as described in chapter 7, appendix 7B.

Figure 2D.1 Runway ahead marking for pattern A holding position and enhanced taxiway centreline marking

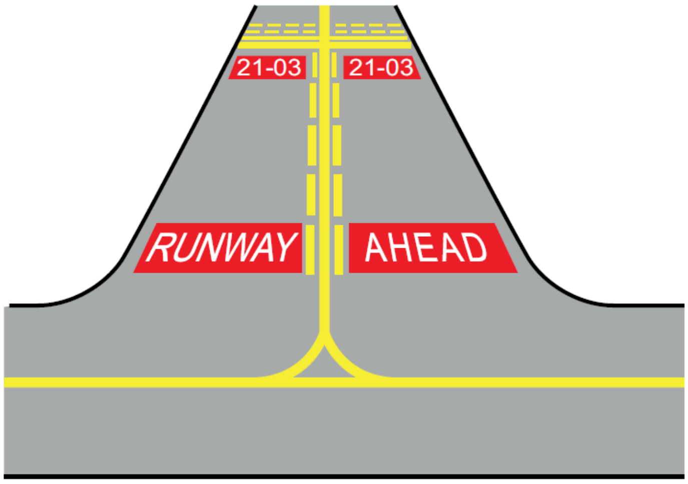


Figure 2D.2 Runway ahead marking – for pattern B (Cat II/III) holding position

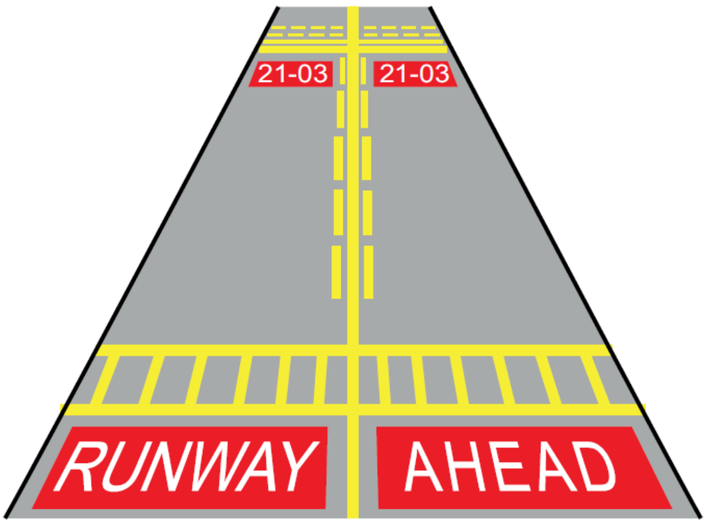
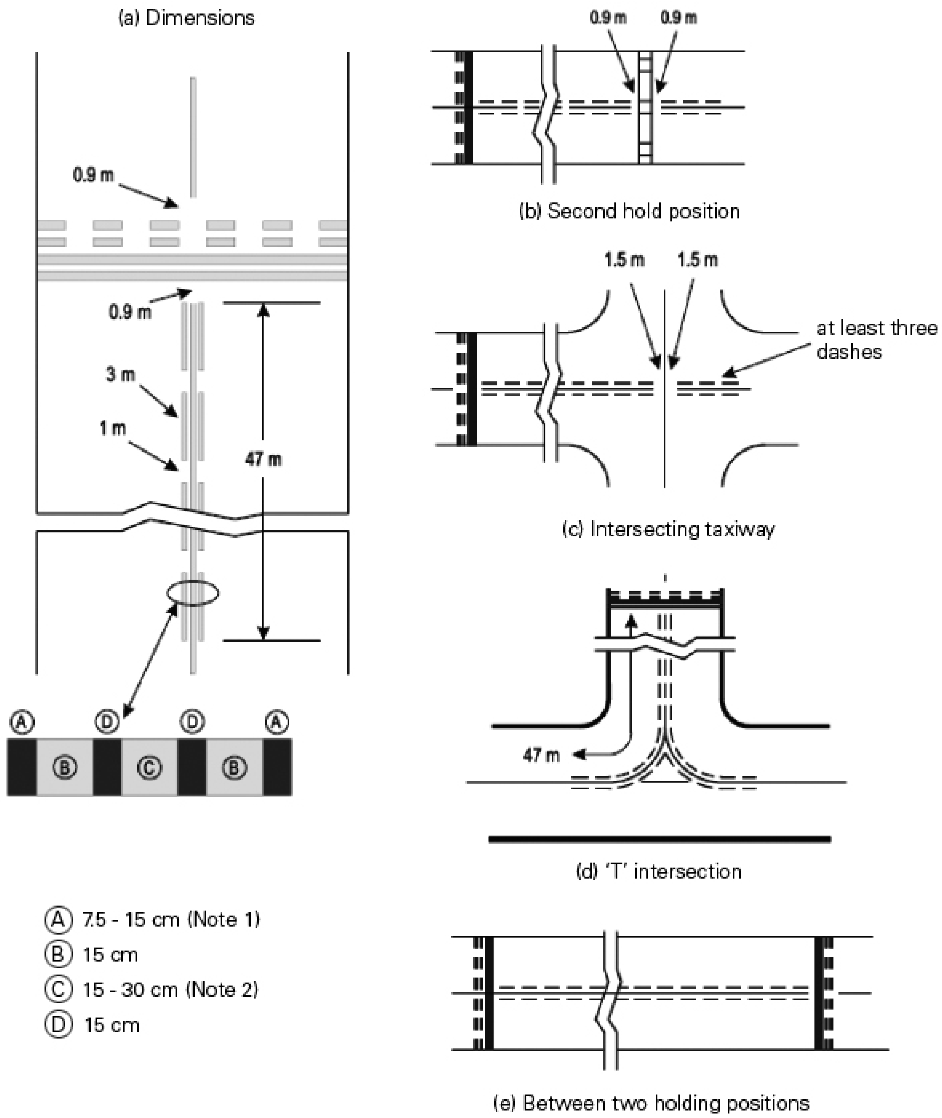


Figure 2D.3 Enhanced taxiway centreline marking



Notes:

1. Black background for contrast on light-coloured pavements.

2. Continuous yellow centre line.

APPENDIX 2E

Responsibility for monitoring third parties operating within the boundaries of licensed aerodromes

Introduction

1. The ANO, article 212, requires that an aerodrome be safe for use by aircraft. As part of this, aerodrome licence holders have responsibility for control of those areas, including leased areas within the aerodrome boundary, that are available for aircraft movements requiring the use of a licensed aerodrome. In addition to having responsibilities for areas or services under their direct control, they have responsibilities under the aerodrome licence for areas used or operated by third parties. Examples include tenants and concessionaries under lease or other use agreements, fuel farms sited within the aerodrome boundary and operated by fuel companies, and the provision of Rescue and Fire Fighting Services (RFFS) where the licence holder contracts this to another party.

2. If the operations of third parties give the CAA cause for concern, it would have to take action with the party that it regulates, namely the licence holder. Therefore, licence holders have a responsibility to ensure that contractors and others operate correctly on their aerodromes. This is particularly important in areas that could affect the licence holders' ability to discharge their responsibility for securing the safety of aircraft on their aerodromes and to demonstrate that ability to the CAA.

3. The last reference to responsibilities is not meant to indicate that licence holders have total responsibility; many of these areas have shared responsibilities. The purpose should be to achieve sensible and comprehensive measures for monitoring any activity that could have a negative effect on aircraft safety. The best way to achieve this is to manage safety in a systematic way. It is accepted that aerodrome licence holders, in addition to airlines and aircraft ground handling companies, all share the responsibility for aircraft safety on the aerodrome ramp or apron.

APPENDIX 2F

Work in progress

Introduction

1. Wherever major work affecting operational areas is planned, aerodrome licence holders must be satisfied that unacceptable risks generated by Works in Progress (WIP) have been identified and removed, and that procedures are provided and followed which ensure no adverse impact upon levels of safety.

2. Part of effective safety management in connection with major development or other works lies in timely and comprehensive planning, conducted in consultation with all involved parties, including ATC and users. The aims of such consultation should be the identification of all those measures necessary for the work to be undertaken safely and the early notification to all who need to know of resulting operational changes.

Licensing condition

3. Aerodrome licence holders are required to comply with licence conditions (and the relevant air navigation legislation) concerning changes to, or work in progress, on their aerodrome. These include:

Licence conditions

- Condition 3 – prior approval of CAA is required before any changes are made in the physical characteristics of the aerodrome.
- Condition 4 – the licence holder must notify CAA by the quickest means available of any material change in the surface of the landing area or in the obstruction characteristics of the relevant obstacle limitation surfaces.

Article 212 and schedule 12 of the Air Navigation Order 2016

- Article 212 (5) places a direct legal obligation on the holder of an aerodrome licence to take all reasonable steps to ensure that the aerodrome and its airspace are safe at all times for use by aircraft.
- Article 212 and Schedule 12 require that the aerodrome manual contains procedures for promulgating information concerning the aerodrome's state, and for the control of access, vehicles and work in relation to the aerodrome's maneuvering area and aprons.

Procedures

4. All parties involved with:

- WIP;
- the movement of aircraft and vehicles;
- the availability of aircraft ground routes;
- the promulgation of declared distances;
- the notification and availability of navigation aids and procedures, for example, must work to an agreed programme of works authorisation and management, if the safety of the aerodrome is to be maintained. This programme should set out clearly where responsibilities for the authorisation and implementation of any proposed change to operational facilities lie, the point at which the facilities will be withdrawn or changed and the methods by which such changes will be promulgated.

5. This programme should be formulated only after an assessment of the risks to aircraft safety have been undertaken by the aerodrome licence holder in co-operation with interested parties, and appropriate mitigation measures introduced to keep risks to an acceptable level. Human factors issues should be taken into account in the risk assessment. There will be risks associated with the maintenance task itself, e.g. shift working, length of shift, time pressure etc. as well as those connected to the specific changes, e.g. possible perceptual effects induced by changes to lighting and so on.

6. Before promulgation, practical checks of proposed arrangements must be made by personnel having a comprehensive grasp of the programme and its operational implications, normally the aerodrome operations unit. Where significant changes to markings or lighting are being made, it may be necessary for the aerodrome to conduct a preliminary flight check in order to make sure that the proposals have been correctly implemented and are functioning as intended. It should also be borne in mind that changes to marking or lighting may give different perceptual effects at different times of day or in different weather conditions. Small, apparently insignificant changes can sometimes have unanticipated results.

7. Processes, developed procedures, actions and decisions made should be documented, and relevant documentation must be made available to and, when appropriate, be provided to agencies affected by the change in operations and WIP. Particular consideration should be given to ensuring that all personnel and agencies involved in the operation of aircraft that might be affected by the revised information are aware of the type and extent of WIP and of any operational changes and restrictions that result. All documentation should be retained and made available for audit purposes.

8. Where shift working is in operation it will be necessary to ensure that each shift is properly and fully briefed. The safety management system should ensure a procedure

for feedback from the parties involved and the swift implementation of corrective measures if they are necessary. Regular monitoring of contractors is essential to ensure continued safety. Operators should ensure that contractors have made support available outside normal working hours. Particular attention should be paid to the transfer of adequate information at shift or work handover. Ideally, any transfer of information should have a degree of redundancy, e.g., both verbal and written, preferably on a standard document retained for later checking and verification, if necessary.

9. Before implementation, draft operational instructions or other promulgation information should be discussed with those most directly affected and subjected to checks to ensure that their meaning is clear to potential users.

10. Where work is already in progress, aerodrome licence holders should satisfy themselves that, as far as possible, the above issues are being addressed.

11. Procedures for the control of works should include any or all of the following tasks (this list is not exhaustive):

    1. works permit procedures
    2. relevant safety procedures
    3. restrictions during low visibility conditions
    4. R/T communications
    5. staff briefing
    6. site marking, by day or night, or in low visibility
    7. work on an ‘on-off’ basis
    8. hot works where relevant
    9. aerodrome operating procedures during the works
    10. emergency procedures
    11. supervisory and contact information
    12. plans and diagrams

Reduced runway length operations

12. Additional hazards may arise when WIP involving a reduction in the available runway distances takes place. In such circumstances, where the runway length available is less than declared in the AIP, it is essential that:

    1. the potential hazards before, during, and on ceasing operations with reduced runway length available and/or WIP are identified and mitigated as necessary in order to assure the safety of aircraft operations;

Note: Hazards may include inappropriate or potentially misleading display of visual aids; inappropriate or potentially misleading availability of navigational aids; adverse environmental impact; risks resulting from adverse or unusual meteorological conditions; and restricted obstacle clearance and wingtip separation distances. It is important to recognise that the hazards that may be identified can cover a wide range of areas, including those that do not pose a risk only to aircraft, for example the potential risk from interaction with jet blast.

2. a revised runway strip, Runway End Safety Area (RESA) and obstacle limitation surfaces, such as the approach and take-off climb surfaces, are implemented, where necessary;
3. a safety zone is established between that area of the runway that is to be used by aircraft and the WIP or unusable runway;

   Note: *The location, size and shape of the safety zone are dependent upon the circumstances described above, to provide for items such as runway end safety areas, blast protection and abbreviated or simple approach light systems.*

4. markings are provided to clearly indicate the extent of the safety zone, the WIP area and any movement area or roadways that are to be used by persons involved in the WIP and not to be used by aircraft;
5. the presence, activities and movement on or around a runway or taxiway of contracted staff, who may not be as familiar with the aerodrome and aviation practices as expected, are properly managed and controlled;
6. the impact on the ability of the rescue and fire fighting and emergency services to perform their functions is considered and addressed;
7. all operational information is correct, available and promulgated in a timely manner to all relevant parties;
8. roles and responsibilities for operations and tasks associated with the reduction of the runway length available and the WIP are clearly understood and complied with; and
9. wherever practicable, the suitability of a procedure is tested prior to implementation.

13. The aerodrome licence holder is responsible for the co-ordination and management of the opening and closing of the runway (and other movement areas, as necessary) and the WIP. Management of aircraft operations may be contracted out to an independent organisation (e.g., an ANSP) but a tactical decision concerning aircraft operations made by that organisation outside, or that deviate from, the agreed operational procedures, unless of an urgent safety nature, must be adopted only in co-operation with the aerodrome licence holder.

14. The aerodrome licence holder should put in place measures to monitor closely the safety of the aerodrome and aircraft operations during runway WIP such that timely corrective action is taken when necessary to assure continued safe operations.

This is particularly important when operational change or unprecedented or unpredicted events occur. Wherever practicable the stakeholders should agree any strategic decisions that might need to be made after operations with reduced runway length available and/or WIP have commenced.

15. Aerodrome licence holders are reminded that they are not permitted to declare a distance exceeding that notified in the AIP without the prior approval of the CAA, see CAP 168 chapter 10.

CHAPTER 3

Aerodrome physical characteristics

Introduction

3.1 This chapter describes the physical characteristics that are taken into account when an aerodrome is to be licensed or when developments are considered. The related safety surfaces which afford protection to aeroplanes taking off, landing or flying in the vicinity of an aerodrome are described in chapter 4 .

3.2 The specifications for the individual requirements are interrelated by a two-element reference code, described in paragraph 3.5 below.

3.3 In addition, specifications will vary with the designation of a runway as an instrument runway if it is served by one or more non-visual aids to approach and landing or as a non-instrument runway, if it is not so served.

3.4 The use of this system ensures that the facilities and characteristics of an aerodrome are effectively related and match the needs of the aeroplanes for which the aerodrome intends to cater.

Aerodrome (runway) reference code

3.5 To determine the extent of the lateral, longitudinal, and sloping planes of the airspace and ground surfaces surrounding each runway that should be kept free of obstacles, a reference code is established from table 3.1. This code comprises of two elements:

1. A number determined by selecting the higher value of declared TODA or ASDA;
2. A letter which corresponds to the wingspan or main gear outer-wheel span, whichever is the more demanding, of the largest aircraft likely to be operating at the aerodrome.

3.6 The determination of a runway's reference code is for the identification of the horizontal and vertical parameters of the surfaces associated with that runway and is not intended to influence the pavement strength. The CAA will determine the runway reference code in consultation with the aerodrome licence holder.

Table 3.1 Aerodrome reference code

Code element 1	
Code number	**The greater of TODA or ASDA**
1	Less than 800 m
2	800 m up to but not including 1200 m
3	1200 m up to but not including 1800 m
4	1800 m and over
Code element 2	
Code letter	**Wingspan**
A	Up to but not including 15 m
B	15 m up to but not including 24 m
C	24 m up to but not including 36 m
D	36 m up to but not including 52 m
E	52 m up to but not including 65 m
F	65 m up to but not including 80 m

Runways

Introduction

3.7 A runway is a rectangular area on a land aerodrome prepared for the landing and taking-off of aeroplanes. Separate criteria apply to a runway serving as a non- instrument runway and to a runway serving as an instrument runway. The ability to meet the criteria will determine what length of runway may be declared for what purpose. The length of runway provided is not directly determined by the code. The aerodrome authority should declare distances for each runway direction. The declared distances are to be approved and promulgated by the CAA.

Width

3.8 Runways both paved and unpaved should have the following minimum widths:

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

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

3.9 Where additional runway distances are required for take-off, these may be achieved by adding a starter extension to the beginning of the runway. Provided this extension is not more than 150 m in length, its width shall be reduced to not less than two-thirds of the normal requirement.

3.10 It may be necessary to provide extra width at the end of a runway or starter extension to enable aeroplanes to turn around.

Longitudinal slopes

3.11 The overall longitudinal slope, calculated by dividing the difference in elevation between the runway ends by the length of the runway, should not exceed 1% (1:100) for runways where the code number is 3 or 4 and 2% (1:50) for runways where the code number is 1 or 2.

3.12 Local longitudinal slopes on runways should not exceed:

1. 1.25% (1:80) where the code number is 4;
2. 1.5% (1:66) where the code number is 3;
3. 2.0% (1:50) where the code number is 1 or 2.

3.13 The first and last quarters of runways where the code number is 3 or 4 should not exceed a slope of 0.8% (1:125).

3.14 Longitudinal slope changes along a runway have an effect on the operation of aeroplanes which is in direct ratio to the slope change and inverse ratio to the length of transition between successive slopes. Slope changes should be minimised on new construction and wherever possible on existing runways
during the course of major runway maintenance. Slope changes allowable during resurfacing are detailed at appendix 3A.

3.15 Where a slope cannot be avoided, the change between two consecutive slopes should not exceed:

1. 1.5% where the code number is 3 or 4;
2. 2.0% where the code number is 1 or 2.

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

1. 0.1% per 30 m (minimum radius of curvature of 30 000 m) where the code number is 4;
2. 0.2% per 30 m (minimum radius of curvature of 15 000 m) where the code number is 3;
3. 0.4% per 30 m (minimum radius of curvature of 7500 m) where the code number is 1 or 2.

Sight distance

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

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

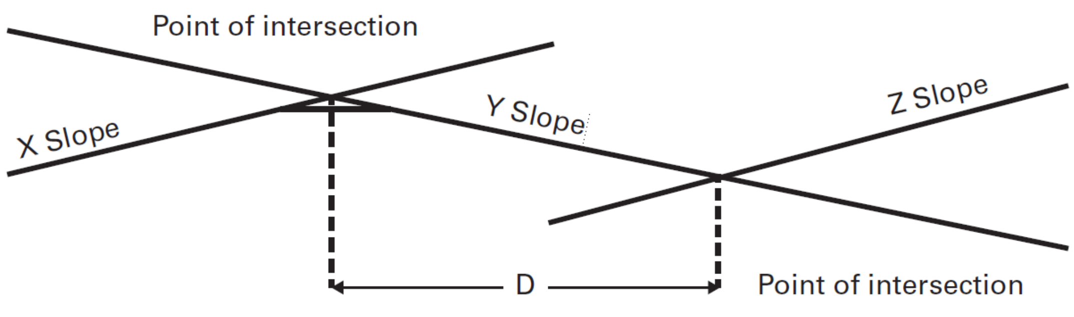
Distance between slope changes

3.18 Undulations or appreciable changes in slopes located close together along a runway should be avoided. The distance in metres between the points of intersection of two successive slope changes should not be less than the sum of the two slope changes in absolute terms multiplied by:

1. 300 where the code number is 4;
2. 150 where the code number is 3;
3. 50 where the code number is 1 or 2.

3.19 The minimum distance between two successive slope changes should never be less than 45 m.

Example: Figure 3.1



3.20 When the code number is 4 then D should be at least 300 [(X–Y) + (Y–Z)] m where (X–Y) is the absolute numerical percentage value of X–Y, and (Y–Z) of Y–Z.

Assuming	X Y	=	+1%
		=	-0.5%
	Z	=	+0.5%
Then	X–Y	=	1.5%
	Z–Y	=	1.0%

D should not be less than 300 (1.5 + 1.0) m = 750 m.

Transverse slopes on paved runways

3.21 Rapid drainage of water from a paved runway is assisted by a cambered surface. The surface of a new runway should be cambered. However, a single cross-fall from high to low in the direction of the wind flow most frequently associated with rain may ensure a more rapid drainage of water.

3.22 The transverse slope on either side of the crown should be symmetrical and ideally should be 1.5% (1:66) where the code letter is C, D, E or F, and 2% (1:50) where the code letter is A or B, but in any event should not exceed 1.5% or 2% as applicable, nor be less than 1% except at runway or taxiway intersections where flatter slopes may be necessary. A 1.5% slope should be provided on a straight cross-fall. In the case of a cambered runway when a transverse slope of only 1% exists, the transverse slope on either side of the crown should be symmetrical and ideally should be 1.5% (1:66) where the code letter is C, D, E or F, and 2% (1:50) where the code letter is A or B, but in any event should not exceed 1.5% or 2% as applicable, nor be less than 1% except at runway or taxiway intersections where flatter slopes may be necessary. A 1.5% slope should be provided on a straight cross-fall. In the case of a cambered runway when a transverse slope of only 1% exists, it is recommended that the surface of that runway demonstrates an ability to drain water effectively.

Runway shoulders

3.23 Strong crosswinds may result in significant deviation from the runway centreline. With some large aircraft the wing-mounted engines may overhang the runway edge and there is then a risk of jet blast eroding the surface adjacent to the runway. This can cause dust and the possible ingestion of debris by the engines.

3.24 To overcome the potential problems runway shoulders should be provided for runways where the code letter is D or E, except that this is not necessary where the runway width is 60 m or more. Runway shoulders should be provided for a runway where the code letter is F.

3.25 Runway shoulders should extend symmetrically on both sides of the runway so that the overall width of runway plus shoulders is not less than 60 m where the code letter is D or E, and 75 m where the code letter is F. Shoulders for runways where the code letter is E or F normally should be paved.

3.26 However, for runways where the code letter is F, there may be circumstances where a lesser paved width may be acceptable; for example, where an aerodrome is nominated as an alternate, or where the frequency of operations is very low; in all circumstances the minimum paved width should be 60 m. Where a reduced paved width of 60 m is accepted:

1. the outer unpaved 7.5 m of runway shoulder should be stabilised; the ground is prepared so that there is full grass coverage with no loose gravel or other material. This may include additional materials if the bearing strength and surface of the ground are not sufficient;
2. a programme of inspections of the shoulders and runway should be implemented to confirm its continuing serviceability and ensure that there is no deterioration that could create a risk of FOD or otherwise hazard aircraft operations;
3. as movements of code letter F aircraft increase, the need for full paved width shoulders should be assessed by local hazard analysis;
4. the bearing strength of the shoulders, whether paved or not, should comply with the requirements in chapter 3; paved surfaces should be of an approved PCN classification and unpaved surfaces should be regularly assessed in accordance with chapter 3, paragraphs 3.180 to 3.181.

3.27 The surface of the shoulder that abuts the runway should be flush with the runway surface, and its transverse slope should not exceed 2.5% (1:40).

3.28 Runway shoulders should be so prepared as to be capable of supporting the aeroplanes using the runway without causing structural damage to those aeroplanes. They should also be capable of supporting vehicles such as fire fighting appliances. In some cases, while the bearing strength of the natural ground may be sufficient, special preparation may be necessary to avoid erosion or the ingestion of debris into aircraft engines.

Blast pads and runway ends

3.29 Along with the runway shoulders, the areas at the ends of runways, such as blast pads, stopways and runway turn pads, may be subject to significant blast forces and jet engine vortex effects. Additional paved surface may be used to mitigate the effects of these factors. Aerodrome licence holders should assess such paved surfaces which, if provided, should be able to accommodate the occasional passage of the critical aircraft for runway pavement design. Pavement strength should subsequently take account of the taxying loads of the most critical aircraft and/or the critical axle load of emergency or maintenance vehicles. Where additional paved surface is provided at runway ends, it should have a width equal to the width of the runway plus shoulders.

3.30 Irrespective of whether it is fit for the normal movement of aircraft, the surface should be such that it can withstand the extended blast from aircraft engines that may overhang and the effects of engine inlet forces.

Runway turn pads

3.31 Where the end of a runway is not served by a taxiway or a taxiway turnaround a runway turn pad should be provided, if necessary, to facilitate a 180° turn of aeroplanes.

3.32 Such areas may also be useful if provided along a runway to reduce taxying time and distance for aeroplanes that may not require the full length of the runway.

3.33 The runway turn pad may be located on either the left or the right side of the runway and adjoining the runway pavement at both ends of the runway, and at some intermediate locations where deemed necessary. However, the initiation of the turn would be facilitated by locating the turn pad on the left side of the runway, since the left hand seat is the normal position of the pilot-in-command.

3.34 Where the use of runway turn pads is deemed necessary, they should have the characteristics below:

1. The intersection angle of the runway turn pad should not exceed 30° and the nose wheel steering angle to be used should not exceed 45°.
2. The design of a runway turn pad should be such that, with the cockpit of the most critical aeroplane for which the turn pad is intended over the turn pad marking, the minimum distance between the outer edge of the main wheels of the aeroplane and the edge of the turn pad should be:
   a) 4.5 m where the code letter is D, E, F or C and the turn pad is intended to be used by aeroplanes with a wheel of 18 m or greater;
   b) 3 m where the code letter is C and the turn pad is intended to be used by aeroplanes with a wheelbase of less than 18 m;
   c) 2.25 m where the code letter is B;
   d) 1.5 m where the code letter is A; or
   e) where severe weather conditions and resultant lowering of surface friction characteristics prevail, a larger wheel-to-edge clearance of 6 m should be provided where the code letter is E or F.
3. The longitudinal and transverse slopes on a runway turn pad should be sufficient to prevent the accumulation of water on the surface and facilitate rapid drainage of surface water. The slopes should be the same as those on the adjacent runway surface.
4. The strength of a runway turn pad should be at least equal to that of the adjoining runway which it serves, due consideration being given to the fact that the turn pad will be subjected to slow-moving traffic making hard turns and consequent higher stresses on the pavement. Where a turn pad is provided with flexible pavement, the surface would need to be capable of withstanding the horizontal shear forces exerted by the main landing gear during turning maneuvers.
5. The surface of a runway turn pad should not have surface irregularities that may cause damage to an aeroplane using the turn pad and should be so constructed or

resurfaced so as to provide good surface friction characteristics at least equal to that of the adjoining runway.

6. Runway turn pads should be provided with shoulders of such width as is necessary to prevent surface erosion by the jet blast of the most demanding aeroplane for which the turn pad is intended, and any possible foreign object damage to the aeroplane engines. As a minimum, the width of the shoulders would need to cover the outer engine of the most demanding aeroplane and thus may be wider than the associated runway shoulders.
7. The strength of the runway turn pad shoulders should be capable of withstanding the occasional passage of the aeroplane it is designed to serve without inducing structural damage to the aeroplane and to the supporting ground vehicles that may operate on the shoulder.
8. The characteristics of runway turn pad lights are detailed in chapter 6 and runway turn pad markings in chapter 7.

Runway strips

Introduction

3.35 A runway strip is an area enclosing a runway and any associated stopway. Its purpose is to:

1. reduce the risk of damage to an aeroplane running off the runway by providing a graded area which meets specified longitudinal and transverse slopes, and bearing strength requirements; and
2. protect aeroplanes flying over it during landing, balked landing or take-off by providing an area which is cleared of obstacles except permitted aids to air navigation.

3.36 Ideally the whole of a runway strip should be clear of obstacles, but in practice it is recognised that the strip facilitates the installation of visual, surface movement, radio and radar aids, and some of these cannot perform their function if they are sited outside the runway strip. Equipment essential to an approach, landing or balked landing, or equipment required for aircraft safety purposes, is permitted within the runway strip subject to the conditions detailed in paragraphs 3.80 to 3.82.

3.37 Drainage channels, catchpits and other essential design features at aerodromes should not constitute hazards to aeroplanes. Whenever possible, items which are not required to be at ground level should be buried to a depth of not less than 0.45 m.

3.38 Within the graded area of the runway strip, constructions such as plinths, runway ends, paved taxiway edges, etc. should be delethalised, that is, so constructed as to avoid presenting a buried vertical face to aircraft wheels in soft ground conditions in any direction from which an aircraft is likely to approach. To eliminate a buried vertical surface, a slope should be provided which extends from the top of the construction to not less than 0.3 m below ground level. The slope should be no greater than 1:10. Newly constructed features complying with paragraph 3.37 are not required to be delethalised.

3.39 Agricultural crops other than long grass should not be grown within the runway strip since they would either conflict with the requirements of paragraph 3.35 1, provide a wildlife-attractive environment or be a fire hazard. See paragraphs 3.158 to 3.159.

3.40 The total area within the runway strip should be capable of supporting unrestricted access for emergency service vehicles.

Length

3.41 A runway strip should extend beyond each end of a runway and of any associated stopway for a distance of at least 60 m where the code number is 2, 3 or 4, and where the code number is 1 and the runway is an instrument runway. When the code number is 1 and the runway is a non-instrument runway, the distance should be 30 m.

3.42 When a starter extension is provided, the runway strip before the starter extension need only provide for wing overhang plus a safety margin of 7.5 m or 20% of wingspan, whichever is the greater. This distance may need to be increased for other factors, e.g. blast (see figure 3.2).

Width

3.43 The runway strip which encloses a non-instrument runway should extend each side of the centreline and extended centreline of the runway and any associated stopway for a distance of at least:

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

3.44 Where there is a non-instrument runway of 10% or greater than the minimum width, the overall width of the runway strip should be increased to provide a distance measured from each edge of the runway of at least:

1. 28 m where the code number is 2;
2. 21 m where the code number is 1.

3.45 The runway strip which encloses an instrument runway should extend each side of the centreline and extended centreline of the runway from 60 m before threshold to 60 m beyond the end of the declared landing distance for a distance of at least:

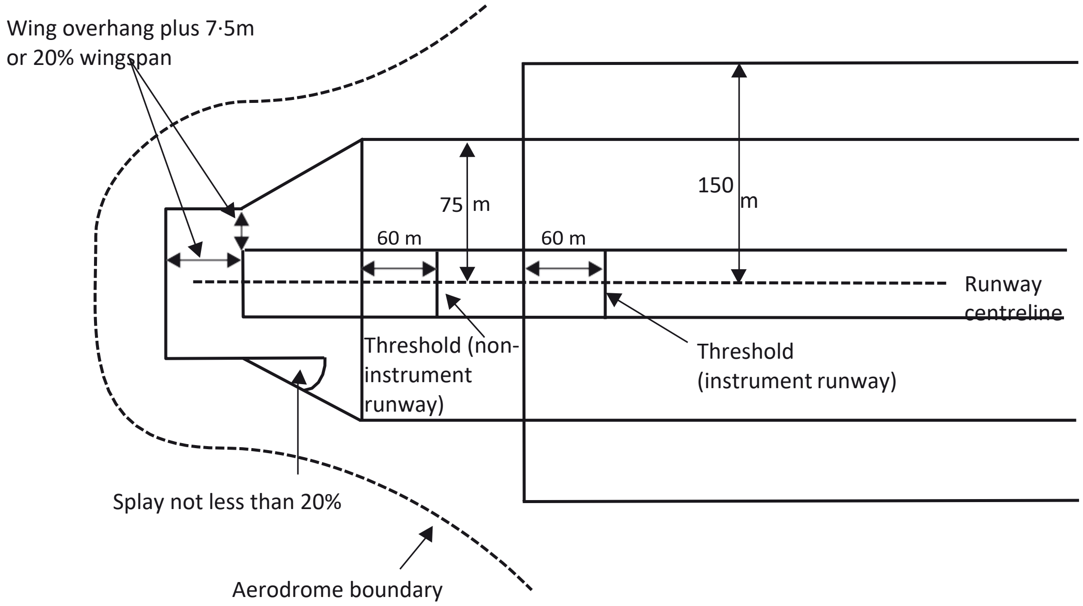
1. 140 m where the code number is 3 or 4;
2. 70 m where the code number is 1 or 2.

3.46 When the threshold or end of landing distance do not coincide with the ends of a runway, the runway strip enclosing the runway and any associated stopway should extend to the lengths specified in paragraph 3.41 at the widths specified in paragraph 3.43, based on the threshold end of Take-Off Run Available, end of Landing Distance Available or end of stopway as appropriate.

3.47 Near the start of its take-off run an aeroplane will be moving slowly; consequently, the runway strip width up to the beginning of a starter extension may be reduced to provide a distance from each edge of the extension for wing overhang plus 7.5 m or 20% of wingspan of the largest aeroplane, whichever is the greater.

3.48 Thereafter, the width of the runway strip should increase at a splay of not less than 20% each side in the direction of take-off until the full visual strip width is achieved relevant to the runway code number.

Figure 3.2

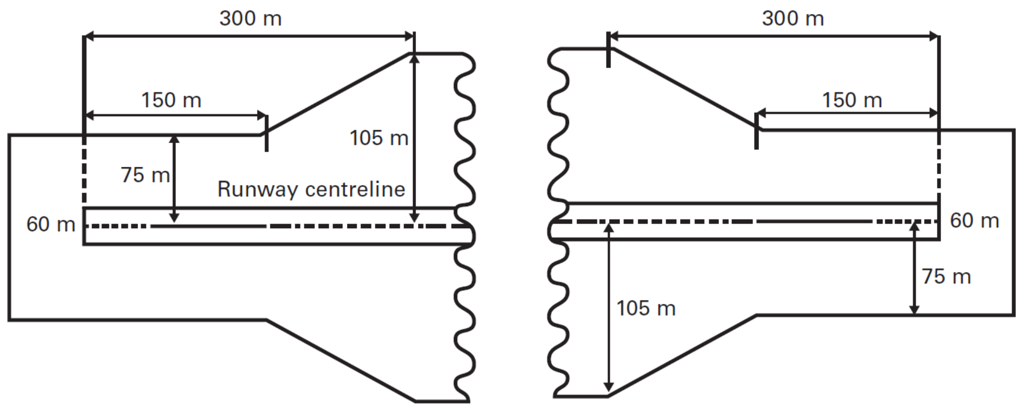


NB: Figure 3.2 does not reflect the reduction of strip width from 75 m to 70 m either side of the runway centre-line, for a Code 3 or 4 runway (in accordance with EASA CS-ADR-DSN Issue 4 effective 8/12/17.

Cleared and Graded Area (CGA)

3.49 The runway strip which encloses a precision instrument runway where the code number is 3 or 4 should be cleared of obstacles and graded for a distance of at least 75 m each side of the centre line of the runway and its extended centre line to provide a graded area for aeroplanes which the runway is intended to serve in the event of an aeroplane running off the runway. Subject to a satisfactory safety assessment, this distance may be increased to 105 m each side of the centreline and extended centreline at each strip end, starting at a width of 75 m at the start of operational direction and continuing at this width for the first 150 m of runway available, then increasing uniformly to 105 m from centreline by 300 m.

Figure 3.3



3.50 The runway strip which encloses a precision instrument approach runway where the code number is 1 or 2 should be cleared of obstacles and graded for a distance of at least 40 m each side of the centreline and extended centreline.

3.51 The runway strip which encloses a non-instrument, or a non-precision instrument approach runway, should be cleared of obstacles and graded on each side of the centreline and extended centreline of the runway and any associated stopway for a distance of at least:

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

3.52 Guidance on temporary obstacles within runway strips is in appendix 3B.

Bearing strength

3.53 The runway strip should be flush with the runway, runway shoulder and stopway along their common edges. That part which is required to be graded should be so prepared as to be capable of supporting any aeroplane at maximum certificated weight that the runway is intended to serve, without the aeroplane suffering significant damage. The area before the runway threshold should be prepared against blast erosion to at least 30 m, in order to protect a landing aircraft from the exposed edge, and to eliminate the effects of jet blast and inlet forces. Where such areas have paved surfaces, they should be able to withstand the occasional passage of the critical aeroplane for runway pavement design.

3.54 The bearing strength may decrease gradually in a transverse direction away from the runway to assist arresting an aeroplane, but rapid transverse changes in bearing strength should be avoided.

Longitudinal slopes

3.55 The longitudinal slope along any portion of a runway strip which is required to be graded should not exceed:

1. 1.5% (1:66) where the code number is 4;
2. 1.75% (1:57) where the code number is 3;
3. 2.0% (1:50) where the code number is 1 or 2.

3.56 Longitudinal slope changes on that portion of a strip to be graded should be gradual. Abrupt changes of slope should be removed.

Transverse slopes

3.57 The transverse slopes on that portion of the runway strip to be graded should avoid the accumulation of water but should not exceed:

1. 2.5% (1:40) where the code number is 3 or 4;
2. 3.0% (1:33) where the code number is 1 or 2;

3.58 Except that to facilitate drainage, the transverse slope for the first 3 m outwards from the edge of the runway, runway shoulder or stopway should be negative as measured in the direction away from the runway but should not exceed 5% (1:20).

3.59 The transverse slopes on those portions of the runway strip outside the area to be graded should not exceed an upward slope of 5% (1:20) measured in the direction away from the runway.

Runway End Safety Areas (RESA)

3.60 RESAs are designated areas at each end of the runway intended to minimise risk of damage to an aeroplane where an aeroplane overruns or undershoots a runway. The RESA is beyond and in addition to the runway strip, as shown in CAP 168, figure 3.11.

3.61 RESAs are required at each end of the runway strip enclosing all runways where the code number is 3 or 4, and instrument runways where the code number is 1 or 2.

3.62 Additionally, RESAs should be considered for non-instrument runways where the code number is 1 or 2, particularly where there are movements by jet aircraft not using public transport performance factors, or a high proportion of runway-limited movements at the higher weights.

3.63 A runway end safety area should extend from the end of a runway strip to a distance of at least 90 m and, as far as practicable, extend to a distance of:

(i) 240 m where the code number is 3 or 4 and

(ii) 120 m where the code number is 1 or 2 and the runway is an instrument one;

3.64 A runway end safety area should extend from the end of a runway strip, as far as practicable, to a distance of 30 m where the code number is 1 or 2 and the runway is a non-instrument one.

3.65 Notwithstanding the provisions in 3.63 above, the length of the runway end safety area may be reduced where an arresting system is installed, based on the design specifications of the system.

3.66 The width of a runway end safety area should be at least twice that of the associated runway and, wherever practicable, be equal to that of the graded portion of the associated runway strip.

3.67 For applicable runways where the RESA does not extend to the recommended distance, as part of their SMS, licence holders should assess the risk of a runway excursion on a regular basis as circumstances change and implement appropriate and suitable mitigation measures as necessary.

3.68 Further guidance on RESA risk assessments and potential mitigating measures can be found in CAP 168, appendix 3I.

3.69 The surface of a runway end safety area need not be prepared to the same standard as that of the graded area of the associated runway strip. It should enhance the deceleration of aeroplanes in the event of an overrun, but it should not:

1. hinder the movement of rescue and fire fighting vehicles, the effectiveness of the rescue and fire fighting provision; or
2. endanger aircraft in the event of an aeroplane undershooting or overrunning.

3.70 The overall longitudinal slope in a runway end safety area should not exceed a downslope of 5% (1:20) and should be such that no part of the safety area penetrates the approach or take-off climb surfaces. Where the ground in a runway end safety area exceeds a downslope of 5% (1:20), it may be acceptable in the case of an overrun RESA to increase the length of the area beyond that considered to be adequate for the particular circumstances in order to compensate for steeper slopes, up to a maximum of 10% (1:10) gradient.

3.71 Transverse slopes should not exceed 5% (1:20).

3.72 Slope changes and transitions between slopes should be gradual and abrupt changes or sudden reversals of slopes should be avoided.

3.73 Aids to navigation, which because of their function must be placed within a runway end safety area to meet air navigation requirements, should be constructed and sited to reduce the potential hazards (delethalised and frangible) to a minimum and consequential risks to an acceptable level.

Arresting systems

3.74 Research programmes, as well as evaluation of actual aircraft overruns into arresting systems, have demonstrated that the performance of some arresting systems using engineered material is predictable and effective in arresting aircraft overruns. Engineered Material Arresting System (EMAS) may be installed at UK licensed aerodromes as an alternative where a 240 m RESA cannot be achieved.

3.75 The CAA accepts the US Federal Aviation Administration (FAA) performance specification and guidance material as suitable for use in EMAS design in the UK, subject to a suitable safety assessment by each aerodrome on their own circumstances (i.e., where to site the system, dimensions, operating conditions etc.).

3.76 EMAS may be located within the runway strip or RESA as determined by the design assessment.

3.77 The CAA will permit an increase in runway declared distances that can be achieved from the installation of EMAS only where installation of EMAS has provided the equivalent to a 240 m RESA and 60 m strip end (a full length EMAS for the design size aircraft).

3.78 Should arresting systems other than EMAS be considered the licence holder needs to be aware of the risks to aircraft and possible increase in rescue and fire fighting provision that their establishment may introduce. Arresting systems may be sited inside the RESA only where their performance and frangibility has been demonstrated. Aerodrome licence holders evaluating such systems should contact the CAA for further advice.

3.79 Soft ground arrester beds are not intended to replace RESA and, therefore, should not be located within the minimum RESA distance.

The siting of aids to navigation within runway strips

3.80 Any aids to air navigation to be sited within a runway strip should be made as light and as frangible as design and function will permit. In this context a frangible object is one which retains its structural integrity and stiffness up to a desired maximum load, but when subjected to a greater load than desired will break, distort or yield in such a manner as to present the minimum hazard to an aeroplane.

3.81 The height of any object which is permitted within a runway strip should be kept to the minimum for the particular site and function of the equipment.

3.82 Objects which are unlikely to aggravate the consequences of a ground swing may be located within the cleared and graded area provided they are frangible, not more than 0.9 m above local ground level, and not closer than 15m from the edge of the runway. All other permitted objects are to be sited outside this area and should be so positioned that they do not penetrate a limiting surface sloping upward and outward from the runway centreline at a slope of 1:10.

3.83 The limiting surface at 1:10 referred to in paragraph 3.82 above extends beyond the edge of the runway strip, until either it intersects the inclined plane of the transitional surface rising outwards from the edge of the strip, or until it meets the plane of the inner horizontal surface and continues at that height until it reaches the point where the transitional surface meets the inner horizontal surface.

Taxiways

3.84 Taxiways should be provided when they are necessary for the safe and orderly movement of aircraft on the ground, or when it is necessary for aircraft to follow a certain path to avoid protected areas or surfaces. When the end of a paved runway is not wide enough to allow an aeroplane to turn around, either the runway should be widened, or an entrance/exit taxiway provided at the runway end.

Width

3.85 The width of a taxiway should be such that with the cockpit of the most critical aeroplane for which the taxiway is intended over the centreline, the minimum distance between the outer edge of the main wheels of the aeroplane and the edge of the pavement should be not less than that given by the following tabulation

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

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

Note: Wheelbase means the distance from the nose gear to the geometric centre of the main gear.

3.86 While the changes in direction of taxiways should be as few as possible, where curves are necessary, they should be compatible with the maneuvering capability at normal taxying speed of the most critical aeroplane for which the taxiway is intended. to provide the clearance distances it may be necessary to widen taxiways on the inside of curves to provide a fillet, the amount of widening depending on the wheelbase and track of the critical aeroplane and the radius of curvature of the taxiway centreline. The design of the curve should be such that the intent of paragraph 3.84 is met at all points on the curve. Fillets should be provided as required at junctions and intersections of taxiways with runways, aprons and other taxiways.

3.87 A straight portion of a taxiway should have a width of not less than that given by the following tabulation:

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

Longitudinal slopes and slope changes

3.88 The longitudinal slopes of taxiways should be kept to a minimum to avoid tracking or handling problems. The longitudinal slopes should not exceed:

1. 1.5% (1:66) where the code letter is C, D, E or F;
2. 3.0% (1:33) where the code letter is A or B.

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

1. 1% per 30 m where the code letter is C, D, E or F;
2. 1% per 25 m where the code letter is A or B

Sight distance

3.90 Where slope changes in 3.88 and 3.89 cannot be achieved and slopes on a taxiway cannot be avoided, the transition from one slope to another slope should be accomplished by a curved surface which should allow the safe operation of all aircraft in all weather conditions.

Transverse slopes

3.91 The transverse slope of a taxiway should be sufficient to prevent the accumulation of water but should not exceed:

1. 1.5% (1:66) where the code letter is C, D, E or F;
2. 2.0% (1:50) where the code letter is A or B.

Taxiway strips

3.92 A taxiway should be enclosed by a strip providing an area clear of objects which may endanger taxying aeroplanes and to reduce the risk of damage to an aircraft running off the taxiway. The strip should extend on each side of the taxiway centreline throughout the length of the taxiway for a distance of:

1. 51 m where the code letter is F;
2. 43.5 m where the code letter is E;
3. 37 m where the code letter is D;
4. 26 m where the code letter is C;
5. 20 m where the code letter is B;
6. 15.5 m where the code letter is A.

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

1. 22 m where the OMGWS is 9 m up to but not including 15 m, where the code letter is F.
2. 19 m where the OMGWS is 9 m up to but not including 15 m, where the code letter is E;
3. 18.50 m where the OMGWS is 9 m up to but not including 15 m, where the code letter is D;
4. 12.50 m where the OMGWS is 6 m up to but not including 9 m;
5. 11 m where the OMGWS is 4.5 m up to but not including 6 m;
6. 10.25 m where the OMGWS is up to but not including 4.5 m;

3.94 On taxiway curves, junctions and intersections where extra pavement is provided, a corresponding increase should be made in the width of the taxiway strip and graded area.

3.95 The taxiway graded area should be flush with the taxiway along their common edges and should be maintained free from holes, ditches and debris that could damage an aeroplane or its engines. Special preparation of the graded area such as surfacing will help to avoid erosion by overhanging engines.

3.96 The transverse slope on the graded area of a taxiway strip, taken in conjunction with the transverse slope on the adjacent taxiway, should not be such as to cause a hazard to aircraft and should not exceed an upward slope of:

1. 2.5% (1:40) where the code letter is C, D, E or F;
2. 3.0% (1:33) where the code letter is A or B; measured relative to the transverse slope on the adjacent taxiway.

3.101 The downward transverse slope of the graded portion of a taxiway strip should not exceed 5% (1:20) measured relative to the horizontal.

3.102 The transverse slope of a taxiway strip beyond that part to be graded should not exceed an upward slope of 5% (1:20) measured in the direction away from the taxiway and relative to the horizontal.

Taxiway holding bays and holding positions

3.103 A taxi-holding position or positions should be established on the taxiway, at the intersection of a taxiway and a runway. At grass aerodromes where taxiways are not provided, aircraft should hold no closer to the runway than the runway holding position sign.

3.104 A taxiway holding position, holding bay, or road-holding position is not to be located closer to the runway centreline than the edge of the relative cleared and graded area of the runway. On precision instrument approach runways this distance may need to be increased to avoid:

1. interference with radio aids;

2. penetration of the obstacle free zone by a holding aeroplane; or
3. a holding aeroplane being accountable in the calculation of Obstacle Clearance Altitude/Height (OCA/H).

Table 3.3 Minimum distance from runway centreline to holding bay, taxi-holding position or road-holding position

Type of runway	Code number			
	1	2	3	4
Non-instrument	30 m	40 m	75 m	75 m
Instrument and take-off	30 m	40 m	75 m	75 m
Precision instrument approach Category I	60 m b	60 m b	90 m a,b	90 m a,b,c
Category II & III			90 m a, b	90 m a,b,c
Take-off runway	30 m	40 m	75 mm	75 m m

Notes:

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

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

Information on critical and sensitive areas of ILS and MLS is contained in Annex 10, Volume I, Attachments C and G, respectively (see also 3.12.6).

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

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

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

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

Taxiway separation distances

3.105 The minimum distance between a taxiway and other aerodrome features should be as listed in table 3.4 if operational restrictions are to be avoided.

3.106 At aerodromes where these separation distances are not achieved, operational restrictions may include a limitation on the size of aeroplane using a particular taxiway, or the sterilisation of a taxiway when the runway is in use.

Table 3.4 Taxiway minimum separation distances (metres)

Code letter	Distance between taxiway centreline and runway centreline								Taxiway centreline to taxiway centreline	Taxiway and apron taxiway centreline to object (see note)	Aircraft stand taxi-lane centreline to aircraft stand taxi-lane centreline (see note)	Aircraft stand taxi-lane centreline to object (see note)
	Instrument runway code number				Non-instrument runway code number							
	1	2	3	4	1	2	3	4				
(1)	(2)				(3)				(4)	(5)	(6)	(7)
A	77.5	77.5	—	—	37.5	47.5	—	—	23	15.5	19.5	12
B	82	82	152	—	42	52	87	—	32	20	28.5	16.5
C	88	88	158	158	48	58	93	93	44	26	40.5	22.5
D	—	—	166	166	—	—	101	101	63	37	59.5	33.5
E	—	—	172.5	172.	—	—	107.5	107.	76	43.5	72.5	40
F	—	—	180	180	—	—	115	115	91	51	87.5	47.5

Note: *These distances may have to be increased on taxiway curves to accommodate the wing sweep of the critical aeroplane.*

3.107 Objects essential to the use of a taxiway system which require to be sited closer than shown in table 3.4, column 5, should be kept at such a distance from the edge and at such a height, allowing for taxiway and strip transverse slopes, that the most critical aeroplane cannot strike them while keeping all wheels on the taxiway. Restrictions may be placed on the types of aeroplanes which may use a particular taxiway if an object exceeds 0.36 m above the taxiway level within the following distances of the edge of the taxiway:

1. 22 m where the code letter is F;
2. 18 m where the code letter is D or E;
3. 11 m where the code letter is C;
4. 7.5 m where the code letter is A or B.

3.108 Between the distances in paragraph 3.107 and those in column 5 of table 3.4, objects should not exceed 1.5 m in height above taxiway level.

3.109 Acceptance of temporary obstacles near a taxiway will depend on the types of aeroplanes using the taxiway. Clearance between an aeroplane wing tip and the temporary obstacle should be not less than 20% of aeroplane wingspan when the aeroplane is in the centre of the taxiway.

Rapid exit taxiways

3.110 Where rapid exit taxiways are provided, they should have the specifications detailed in paragraphs 3.111 to 3.115.

3.111 Rapid exit taxiways should be designed with a radius of turn-off curve of at least:

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

To enable exit speeds under wet conditions of:

3. 93 km/h where the code number is 3 or 4;
4. 65 km/h where the code number is 1 or 2.

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

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

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

3.115 The locations of rapid exit taxiways along a runway and their speed criteria, along with other guidance on the provision and design of rapid exit taxiways, is given in the ICAO Aerodrome Design manual, Part 2.

Taxiways on bridges

3.116 Where taxiways on bridges are provided, the width of that portion of a taxiway bridge capable of supporting aircraft should be at least the width of the graded area of the taxiway strip, unless a proven method of lateral restraint is provided which is not hazardous to aircraft.

3.117 Access should be provided to allow rescue and fire fighting vehicles to intervene in both directions within the specified response time to the largest aircraft for which the taxiway is intended. If aircraft engines overhang the bridge structure, protection of adjacent areas below the bridge from engine blast should be taken into consideration.

3.118 A taxiway bridge should be constructed on a straight section of taxiway, with a straight section at both ends of the bridge, to facilitate the alignment of aircraft approaching the bridge. As bridge deck temperatures fall faster than pavements, licence holders should be alert to the presence of ice.

Stopways

Introduction

3.119 A stopway is an area on the ground beyond the end of the Take-Off Run Available (TORA) which is prepared and designated as a suitable area in which an aeroplane can be stopped in the event of an abandoned take-off. TORA plus stopway makes up the Accelerate – Stop Distance Available (ASDA) (previously Emergency Distance (ED)).

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

Bearing strength

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

3.122 A stopway should be so prepared or constructed as to allow unimpeded passage by rescue and fire fighting vehicles.

Width

3.123 A stopway should have the same width as its associated runway.

Slopes

3.124 Slopes and slope changes on a stopway, and the transition from runway to stopway, should meet the requirements for the associated runway, except that the limitation of a 0.8% slope for the first and last quarters of a runway where the code number is 3 or 4 need not be applied. The rate of change of slope on a stopway should not exceed 0.3% per 30 m where the code number is 3 or 4, or 0.5% per 30 m where the code number is 1 or 2.

Clearways

Introduction

3.125 A clearway is an area which may be provided beyond the end of the TORA which is free from objects which may cause a hazard to aeroplanes in flight. In conjunction with the runway, it provides an area over which an aeroplane can safely transit from lift-off to the required screen height. In certain circumstances it may be an alternative to an increase in runway length (see appendix 3C).

3.126 A clearway need not have bearing strength and may be land or water. It may extend outside the aerodrome boundary only if the aerodrome authority establishes such control that will ensure that the clearway will be kept free from obstacles or that the clearway plane will not be infringed.

3.127 **Width**

The width of clearway at the end of TORA should be not less than 75 m each side of the extended centreline of the runway, or, in the case of a non-instrument runway, the width of the runway strip. The width should expand linearly in the direction of take-off so that at the end of the Take-Off Distance Available (TODA) it equals the width at origin of the area within which obstacles are to be accounted for in the calculation of regulated take-off weight. This width is taken to be 180 m where the code number is 3 or 4 and 150 m where it is 1 or 2.

3.128 **Length**

The length of a clearway will be the least of either the distance to the first upstanding obstacle, excluding lightweight, frangible objects of 0.9 m or less in height, or the distance resulting from the application of the criteria in the following paragraphs, subject to an overall limit of 50% of the TORA.

3.129 **Slopes on clearways**

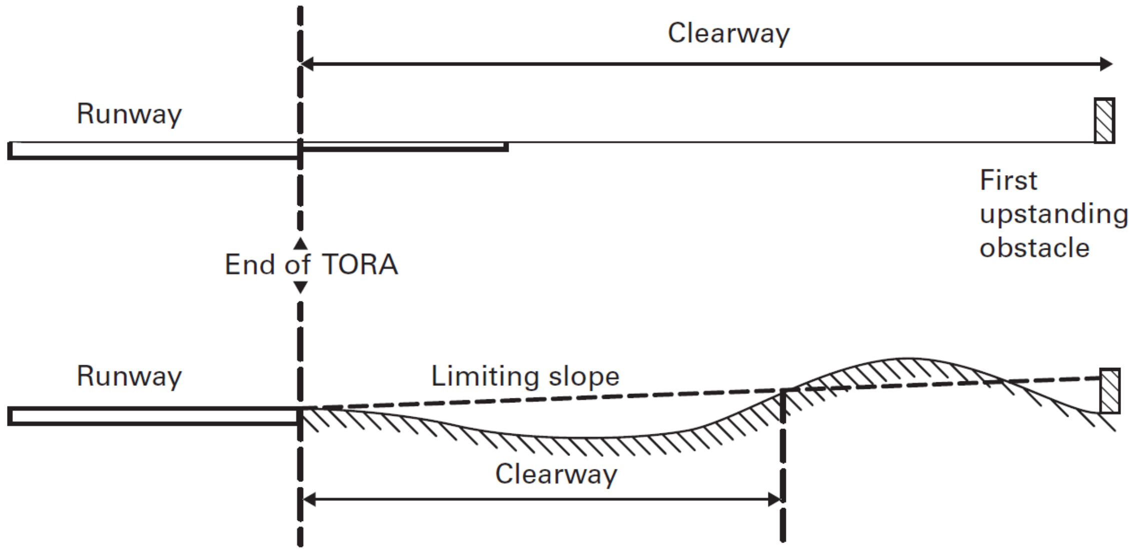
The ground in a clearway should not project above a plane having an upward slope of:

- % (1;80) for runways where the code number is 3 or 4; or
- 2.0% (1:50) for runways where the code number is 1 or 2, the lower limit of this plane being a horizontal line which:

a) is perpendicular to the vertical plane containing the runway centre line; and

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

Figure 3.4



Aprons and stands

Introduction

3.130 An apron is a defined area on a land aerodrome which is intended to accommodate aircraft for the purpose of loading or unloading passengers, mail or cargo, refueling, parking or maintenance.

3.131 An apron may be divided into stands in order to facilitate the safe parking and movement of aircraft and people.

3.132 Separate aprons for long-term parking or maintenance may be necessary to reduce congestion in the main terminal area.

3.133 When an aerodrome is used extensively by helicopters which have skid undercarriages and are therefore obliged to hover-taxi between the apron and the operating areas, provision of a discrete helicopter apron is recommended.

Size

3.134 There should be room enough on the apron to provide for the number and types of aircraft expected to use it with adequate safety margins from obstructions including parked aircraft. The design of the apron should aim at facilitating the movement of aircraft and avoiding difficult maneuvers which might require undesirable use of excessive amounts of engine thrust or impose abnormal stress on tyres.

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

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

Slopes

3.136 Slopes on an aircraft stand should not exceed 1% in any direction.

3.137 Aprons or stands should not slope down towards the terminal buildings. Where such slopes are unavoidable, special measures should be taken to reduce the fire hazard resulting from fuel spillage.

Aerodrome surface conditions

Introduction

3.138 In conjunction with the specifications for longitudinal and transverse slopes of runways, taxiways and strips, the type of construction and surface characteristics of the runway itself are probably the most important factors in maintaining safe aircraft operations and in alleviating the operational effect of surface contaminants. In particular, aircraft operations can be affected adversely when the movement area has a low surface friction or is contaminated by ice, snow, slush, water, mud, oil or rubber deposits.

3.139 The aim should be to provide in the first instance a runway surface that is clean and has a uniform longitudinal profile and friction levels that will give satisfactory braking action in wet conditions. These issues should be addressed at the time of the design of runways, pavements or subsequent resurfacing. Thereafter it is important to ensure that the surface qualities do not deteriorate below an acceptable level by undertaking periodic inspection and maintenance. Details of the minimum requirement for periodic monitoring of airfield pavements are given in appendix 3F. Advice on airfield pavement design and maintenance, and runway surface evenness, is given in appendix 3A.

3.140 When the surface is affected by winter contaminants, ICAO's Global Reporting Format (GRF) detailed in CAP2174 Assessment, Measurement and Reporting of Runway Surface Conditions for Licensed Aerodromes should be followed.

3.141 The reporting of runway surface conditions to pilots by an ATS unit must follow the ICAO's Global Reporting Format, see MATS Pt 1, section 2, chapter 7 for further details. Also refer to CAP 2174.

Paved surfaces

3.142 It has been found that, after an initial period, the wet friction characteristics of a runway surface generally remain relatively constant and deteriorate only slowly over a period of time, depending on frequency of use. However, the friction level of a wet runway and thus the braking action available can vary significantly over a short period depending on the actual depth of water on the runway and the characteristics of the surfacing materials. Although there is no meaningful operational benefit to be derived from continually measuring the friction level of a runway in wet conditions, it is essential to monitor the friction level on a regular basis.

3.143 The surface of a new runway or a newly resurfaced runway should be designed and constructed to enable good braking action to be achieved by aeroplanes in wet runway conditions. When a new runway is built or an existing runway resurfaced, the wet surface friction characteristics shall be assessed in order to classify the friction level. Thereafter, the runway should be subject to periodic assessment in order to ensure that the friction level does not fall below an acceptable level. The procedures for runway surface friction assessment along with the friction criteria are given in CAP 683, The Assessment of Runway Surface Friction Characteristics.

3.144 The surface of a new runway or a resurfaced runway should be designed and constructed without irregularities or surface characteristics which would adversely affect the directional control, braking efficiency of anti-skid systems or ride characteristics of an aeroplane. Therefore, in addition to complying with the slope criteria of paragraphs 3.11 to 3.22 and friction criteria in CAP 683, the finished surface should be checked for such irregularities. In particular, the surface should be such that when a 3 m straight edge is placed anywhere in any direction across the surface, there is no deviation greater than 3 mm between the bottom of the straight edge and the surface of the pavement other than when the straight edge crosses the crown of a camber or a drainage channel. Further information can be found in ICAO annex 14 Volume 1, attachment A, paragraph 5.

3.145 Day-to-day operations of aeroplanes may lead to deformation of pavement layers or differential settlement of the pavement foundation, either of which will result in an increase in surface irregularity. Apart from increasing the possibility of control or braking difficulties, a greater depth of standing water can result which may initiate aquaplaning and, if sufficiently deep, can lead to engine water ingestion. Runway surfaces should be maintained so that standing water is avoided and no pool of water deeper than 13 mm can form or be retained on any part of the runway declared as available for take-off or landing. (The significant water depth for engine water ingestion for aeroplanes certified to the requirements of Performance Group A is 13 mm.)

3.146 Brief technical details of various runway surfaces which have been shown to provide the required good wet runway braking action are described in appendix 3A, together with criteria for ‘feathering’ during runway resurfacing.

Taxiways and Aprons

3.147 The surface of taxiways and aprons should have adequate draining characteristics and should provide good surface friction for aeroplanes using them. The surface of a taxiway should not have irregularities that could cause damage to aircraft.

Stopway

3.148 The surface of a paved stopway should have friction characteristics not substantially less than those of the associated runway and above the minimum friction level stated in CAP 683. It should be kept free from debris and loose material which could damage aeroplanes (see appendix 3E).

Movement area cleanliness

3.149 The surface of the movement area should be inspected at least twice on each day the aerodrome is available for operations, and adequate measures taken to ensure its cleanliness (see appendix 3F).

3.150 The surfaces should be kept free from loose stones, chippings, grit and other debris which might damage an aeroplane or its engines (see appendix 3E).

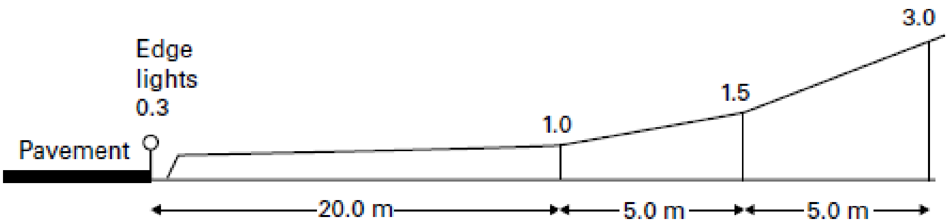
3.151 Contaminants such as mud, oil and rubber deposits lead to a deterioration in the friction value of a surface which could adversely affect aircraft and ground vehicles. The contaminants should be removed as completely as possible particularly from apron stands.

Winter conditions

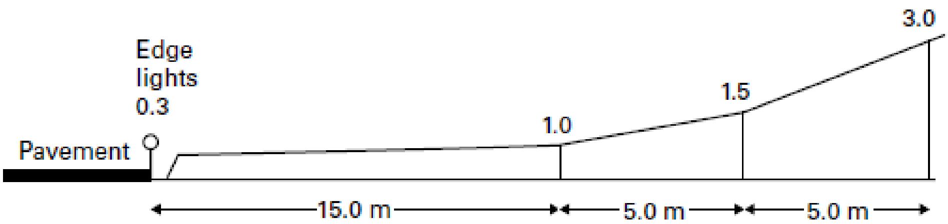
3.152 To allow aircraft movements to take place, snow, slush and ice should be removed from as much of the movement area as is required for safe operations (see appendix 3G). When snowbanks remain at the edge of a cleared section of the movement area they should not exceed the profiles given in figures 3.8 and 3.9.

3.153 Aerodromes and airports listed as either a 'regular' or an 'alternate' in the current edition of ICAO Air Navigation Plan – European Region are required to draw up a snow plan in accordance with the National Snow Plan. Other aerodromes can be included in the National Snow Plan on request to the CAA.

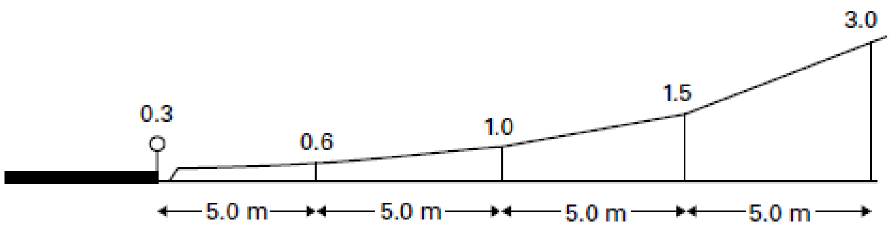
Figure 3.8 Acceptable profile of snowbanks showing maximum height in metres



(i) Runways used by A380

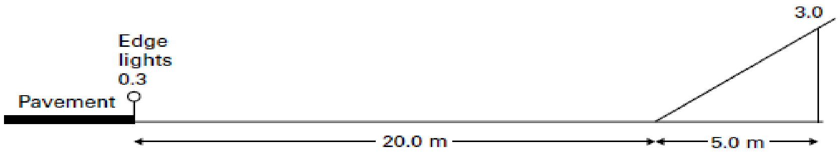


(ii) Runways used by B747, DC10 and L1011

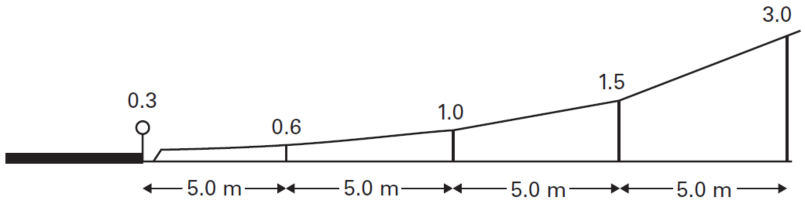


(iii) Runways used by other aeroplanes

Figure 3.9 Acceptable profile of fully cleared snowbanks showing maximum height in metres



(i) Runways used by B747, A380



(ii) Runways used by other aeroplanes

Unpaved surfaces

Runways

3.154 Natural surfaces of unpaved runways should be prepared or treated to remove irregularities which might adversely affect the directional control, braking or riding characteristics of an aeroplane. There should be no irregularities which would allow the collection of surface water or the discontinuity of bearing strength in wet conditions.

3.155 A simple method of assessing the evenness of a natural surface is to drive over it in a suitable vehicle. The surface should not display undue signs (e.g. wheel ruts) of the vehicle's passage and, if the surface is acceptably even, this test should be accomplished without discomfort to the vehicle occupants.

Stopways

3.156 An unpaved stopway should be prepared or constructed so that the braking action is not substantially less than that of the associated runway.

3.157 An unpaved stopway should be made resistant to erosion where it abuts a paved surface, and so prepared or treated as to minimise the hazard to an aeroplane running onto the stopway.

Length of grass

3.158 Within the maneuvering area on a grass aerodrome the length of grass should not exceed the limits described in CAP 772, Aerodrome Wildlife Strike Hazard Management and Reduction.

3.159 Grass should be grown in accordance with the grass management regime as described in CAP 772 within RESAs, unpaved stopways and the graded area of runway and taxiway strips. To ensure adequate visibility of installed lights and signs, grass in their immediate vicinity should be closely mown. No more grass than is necessary should be closely mown.

Movement area cleanliness

3.160 The surface of the movement area should be inspected at least once on each day the aerodrome is available for operations, and adequate measures taken to ensure its cleanliness.

3.161 The surface should be kept free from loose stones, chippings, grit and other debris which might damage an aeroplane or its engines (see appendix 3E).

Movement area bearing strength (*Applicable until 27 November 2024*.)

3.162 Pavement forming part of the movement area needs to be of sufficient strength to allow aircraft to operate without risk of damage either to the pavement or to the aircraft. Pavements subject to overload conditions will deteriorate at an increasing rate depending upon the degree of overload. To control this, it is necessary to classify both pavement and aircraft under a system whereby the

3.163 load-bearing capacity of the pavement and the loads imposed by the aircraft can be compared. The method used in the UK is the Aircraft Classification Number – Pavement Classification Number (ACN/PCN) method.

Operational requirements

3.164 All pavements forming part of the movement area should be of adequate bearing strength for the types of aircraft expected to use the aerodrome.

3.165 All pavements should be regularly examined by a suitably qualified person. For further details see appendix 3F. Any pavements which have been subjected to overload conditions should be closely monitored by suitably qualified staff for a period of several weeks or until it is clear that no rapid deterioration of the pavement has been triggered.

Reporting pavement bearing strength

3.166 The ACN/PCN method has been developed by ICAO as an international method of reporting the bearing strength of pavements which leaves States the option to use national methods for design and evaluation. Accordingly, the UK will continue to use criteria developed from the Load Classification Group (LCG) system for pavement design and evaluation, but the results will be converted into units of the ACN/PCN method.

3.167 The ACN/PCN method of classifying the bearing strength of pavements differs from the LCG method in that emphasis is shifted from direct evaluation of the pavement itself to the load imposed on the pavement by the aircraft. In this respect, the load rating of the aircraft is most significantly affected by the sub- grade support strength of the pavement. ACNs are therefore numbers giving a relative load rating of the aircraft on pavements for certain specified sub-grade strengths. ACN values for most aeroplanes have been calculated by ICAO and are published in Aeronautical Information Publications. The PCN is also a number which represents the load-bearing strength of the pavement in terms of the highest ACN which can be accepted on the pavement for unrestricted use.

3.168 In order to calculate a PCN using the current UK criteria for design and evaluation, the normal method is to identify the aircraft which has the highest Load Classification Number (LCN) which can be accepted on the pavement for unrestricted use. This aircraft is designated as the critical aircraft for the pavement. To convert to the ACN/ PCN method, the ACN of the critical aircraft is notified as the PCN. This PCN value indicates that aircraft with ACNs appropriate to the pavement type and specified sub-grade that are equal to or less than the reported PCN can use the pavement without restriction.

3.169 As an alternative, a PCN can be identified and reported without a technical evaluation of the pavement by means of an assessment of the results of aircraft using the pavement. Providing the type and sub-grade support strength of the pavement are known, the ACN of the most critical aircraft successfully using the pavement can be reported as the PCN.

3.170 A PCN is reported in a five-part format. Apart from the numerical value, notification of the pavement type (rigid or flexible) and the sub-grade support category is also required. Additionally, provision is made for the aerodrome authority to limit the maximum allowable tyre pressure. A final indication is whether the assessment has been made by a technical evaluation or from past experience of aircraft using the pavement.

Overload operations

3.171 Individual aerodrome authorities are free to decide their own criteria for permitting overload operations as long as pavements remain safe for use by aircraft. The PCN value does include a safety factor so that a 10% increase of ACN over PCN is generally acceptable for pavements that are well consolidated and in good condition.

Unpaved surfaces

3.172 The bearing strength of unpaved surfaces cannot usefully be classified. The basic material, its degree of compaction, the quality of the sub-grade, and the drainage characteristics are examples of factors that can cause considerable daily variation in bearing strength.

3.173 After prolonged rain, the condition of an unpaved surface may become such that either further use by aircraft would result in serious damage to the surface or, due to the difficulty of assessing bearing strength, the surface can no longer be considered suitable for take-off and landing. Where such conditions are likely to occur, a close watch should be kept on the surface and, if in the judgement of the aerodrome operator such action appears necessary, use of the aerodrome should be restricted or the aerodrome closed altogether.

Published details

3.174 Details of individual aerodrome ACN or PCN values are published in the AD 2 section of the UK AIP. See AD 2.12 - Runway Physical Characteristics, Column 4 .

3.175 Details of the five elements of the code and an example are shown b e l o w :

Example [Letters in brackets refer to explanations]

56 (a)	F (b)	B (c)	X (d)	T (e)

1. The PCN number. Refer to aircraft manufacturer for individual aircraft equivalents.
2. Pavement type for ACN-PCN determination: Code
   - R Rigid pavement
   - F Flexible pavement
3. Sub-grade strength category: Code
   - A High strength: characterised by K

150 Nm/m^3 [3] and representing all K values above 120 Nm/m^3 for rigid pavements, and by CBR[4] = 15 and representing all CBR values above 13 for flexible pavements.

   - B Medium strength: characterised by K

80 Nm/m^3 and representing a range in K of 60 to 120 Nm/m3 for rigid pavements, and by CBR = 10 and representing a range in CBR of 8 to 13 for flexible pavements.

   - C Low strength: characterised by K

40 Nm/m^3 and representing a range in K of 25 to 60 Nm/m^3 for rigid pavements, and by CBR = 6 and representing a range in CBR of 4 to 8 for flexible pavements.

   - D Ultra low strength: characterised by K

20 Nm/m^3 and representing all K values below 25 Nm/m^3 for rigid pavements, and by CBR = 3 and representing all CBR values below 4 for flexible pavements.

4. Maximum allowable tyre pressure category: Code
   - W Unlimited: no pressure limit
   - X High: pressure limited to 1.50 MPa
   - Y Low: pressure limited to 1.00 MPa
   - Z Very low: pressure limited to 0.50 MPa
5. Evaluation method: Code
   - T Technical evaluation: Representing a specific study of the pavement characteristics and application of pavement behaviour technology.
   - U Using aircraft experience: Representing knowledge of the specific type and mass of aircraft satisfactorily being supported under regular use

4 Nm/m^3 means Newton metres per cubic metre which = 1 pascal, a unit of pressure.

5 CBR means California Bearing Ratio: a simple penetration test developed to evaluate the strength of road subgrades.

The use of block pavers on aerodrome movement areas

3.176 It is recommended that pavers should normally only be used to surface the following categories of aircraft pavements:

1. aircraft stands;
2. low speed taxiways not subject to significant jet blast or propeller wash;
3. aircraft maintenance areas not subject to significant jet blast or propeller wash;
4. helicopter pads.

3.177 Block pavers should normally not be used to surface the following categories of aircraft pavements:

1. runways;
2. areas where aircraft engines are run at high thrust values;
3. high speed taxiways.

3.178 Should aerodrome management wish to depart from these recommendations, they should first discuss this with their aerodrome inspector.

Movement area bearing strength (*Applicable as of 28 November 2024*.)

3.179 The following paragraphs introduce the ACR-PCR method, which will be applicable as of 28 November 2024 and will replace the ACN-PCN method, which is currently in use. The new system will be no longer based on a 'critical aircraft' but will consider all aircraft, which are intended to serve on a given pavement with their real offset from pavement centreline. By doing so, the reported PCR will address, in a more accurate manner, the amount of damage that each aircraft produces within a mix, as a function of their operating weight, full landing gear geometry, individual tyre load and pressure. The new pavement reporting system will provide several benefits to the aerodrome operators: optimised usage of their pavements, consistency between pavement design and aircraft admissibility parameters, better pavement management (inspections and maintenance), and improved predictability of pavement life. It will also benefit aircraft operators by allowing optimised operating weights and frequencies. By adopting the layered elastic analysis (LEA) within the pavement rating system, the subgrade strength categories have to be designated with the modulus of elasticity (E modulus). The CBR for flexible pavement and the k-value (modulus of subgrade reaction) for rigid pavement are no longer applicable. However, the four subgrade strength categories will still be designated with the same letters.

3.180 Pavement forming part of the movement area needs to be of sufficient strength to allow aircraft to operate without risk of damage either to the pavement or to the aircraft. Pavements subject to overload conditions will deteriorate at an increasing rate depending upon the degree of overload. To control this, it is necessary to classify both pavement and aircraft under a system whereby the load-bearing capacity of the pavement and the loads imposed by the aircraft can be compared. The method used in the UK is the Aircraft Classification Reference – Pavement Classification Reference (ACR/PCR) method. The bearing strength of a pavement shall be determined.

Operational requirements

3.181 The bearing strength of all pavements forming part of the movement area shall be determined and should be of adequate bearing strength for the types of aircraft expected to use the aerodrome.

3.182 All pavements should be regularly examined by a suitably qualified person. For further details see appendix 3F. Any pavements which have been subjected to overload conditions should be closely monitored by suitably qualified staff for a period of several weeks or until it is clear that no rapid deterioration of the pavement has been triggered.

Reporting pavement bearing strength

3.183 The ACR/PCR method has been developed by ICAO as an international method of reporting the bearing strength of pavements which leaves States the option to use national methods for design and evaluation. Accordingly, the UK recommends the use of the new airfield pavement design and evaluation method in the revised DMG 27 Guide (2022) and DEAP2022 software, which incorporates the ACR/PCR load classification system.

3.184 The new Guide combines the use of multi-layer elastic analysis with the long-term experience of performance of the various pavement types. The purpose being to facilitate enhanced modeling of the pavements with particular regard to the legacy of complex composite pavements, the trend towards bound recycled bases, the need especially in the case of pavements subject to high frequency trafficking by very heavy aircraft for more accurate analysis of cumulative damage and also to be able to set more than one failure criteria commensurate with maintenance strategies at different airports. Alternatively, other equivalent/national guides may be used for the determination of pavement designs, evaluations, and PCR values.

3.185 The transition from ACN/PCN to ACR/PCR will require the replacement of Airport promulgated PCNs with new PCR values. For existing pavements which have been the subject of a comprehensive design and construction regime, or technical evaluation, with all relevant data/site investigations/material test records currently available, consideration may be given to changing from a PCN value equal to the highest of all the ACN values of the aircraft mix using the pavement, to a PCR that is equal to the highest of all the ACR values in the same aircraft mix.

3.186 Much will depend on the efficacy of the existing pavement designs or technical evaluations, whether there has been any significant change to aircraft usage and future traffic projections since the previous design/technical evaluation was carried out, and that pavement performance to date has been consistent with the design/technical evaluation. It should also be noted that the ranges of the subgrade categories in the new ACR/PCR system are slightly offset from those of the ACN/PCN system, which particularly in respect of Flexible pavements, could result in subgrade category changes in transitioning from current PCN values to new PCR values.

3.187 A further technical consideration is that the calculation models for Flexible and Rigid pavements used to derive ACR values are different to those used to derive the ACN values. Hence, apart from the factor of 10 introduced in the ACR calculation to clearly distinguish between ACNs and ACRs and hence PCNs and PCRs, the new ACR scales (i.e., Rigid and Flexible) of relative aircraft loading severity results in some changes from that determined by the ACN system. This can in certain circumstances, result in the aircraft with the maximum ACR value using a pavement, being a different aircraft to the one previously determined by the ACN scale. For guidance on the design and evaluation of airfield pavements including the above considerations in transitioning from PCN values to PCR values, refer to DMG 27 or other equivalent national guide.

3.188 The bearing strength of a pavement intended for aircraft of apron mass greater than 5700 kg shall be made available using the aircraft classification rating-pavement classification rating (ACR-PCR) method by reporting all of the following information:

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

b) pavement type for ACR-PCR determination;

c) subgrade strength category;

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

e) evaluation method.

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

3.190 For the purpose of determining the ACR, the behaviour of a pavement shall be classified as equivalent to a rigid or flexible construction.

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

1. Pavement type for ACR-PCR determination:

	Code
Rigid pavement	R
Flexible pavement	F

Note.*— If the actual construction is composite or non-standard, include a note to that effect (see example 2 below).*

2. Sub-grade strength category:

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

3. Maximum allowable tyre pressure category:

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

Note. — *The following examples illustrate how pavement strength data are reported under the ACR-PCR method. Further guidance on this topic is contained in the Aerodrome Design Manual (Doc 9157), Part 3.*

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

PCR 760 / R / B / W / T

Example 2.— If the bearing strength of a composite pavement, behaving like a flexible pavement and resting on a high strength subgrade, has been assessed by using aircraft experience to be PCR 550 and the maximum allowable tire pressure is 1.25 MPa, then the reported information would be:

PCR 550 / F / A / Y / U

***Note**. — Composite construction.*

3.192 Criteria should be established to regulate the use of a pavement by an aircraft with an ACR higher than the PCR reported for that pavement in accordance with 3.198 and 3.199

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

a) maximum allowable aircraft mass; and

b) maximum allowable tire pressure.

Example: 4800 kg/0.60 MPa.

Overload operations

3.194 For those operations in which the magnitude of overload and/or the frequency of use do not justify a detailed analysis, the aerodrome operator should use the following criteria, in order not to adversely affect the pavement:

a) for flexible and rigid pavements, occasional movements by aircraft with ACR not exceeding 10 % above the reported PCR may be allowed; and

b) the annual number of overload movements should not exceed approximately 5 % of the total annual movements excluding light aircraft.

3.195 The aerodrome operator should not permit overload operations on pavements exhibiting signs of distress or failure. Furthermore, overload operations should be avoided during any periods of thaw following frost penetration, or when the strength of the pavement or its subgrade could be weakened by water. Where overload operations are conducted, the aerodrome operator should review the relevant pavement condition regularly, and should review the criteria for overload operations periodically, since repetition of overloads can cause severe shortening of pavement life or require major rehabilitation of pavement.

Unpaved surfaces

3.196 The bearing strength of unpaved surfaces cannot usefully be classified. The basic material, its degree of compaction, the quality of the sub-grade, and the drainage characteristics are examples of factors that can cause considerable daily variation in bearing strength.

3.197 After prolonged rain, the condition of an unpaved surface may become such that either further use by aircraft would result in serious damage to the surface or, due to the difficulty of assessing bearing strength, the surface can no longer be considered suitable for take-off and landing. Where such conditions are likely to occur, a close watch should be kept on the surface and, if in the judgement of the aerodrome operator such action appears necessary, use of the aerodrome should be restricted or the aerodrome closed altogether.

Published details

3.198 Details of individual aerodrome ACR or PCR values are published in the AD 2 section of the UK AIP. See AD 2.12 - Runway Physical Characteristics, Column 4 .

The use of block pavers on aerodrome movement areas

3.199 It is recommended that pavers should normally only be used to surface the following categories of aircraft pavements:

1. aircraft stands;
2. low speed taxiways not subject to significant jet blast or propeller wash.
3. aircraft maintenance areas not subject to significant jet blast or propeller wash;
4. helicopter pads.

3.200 Block pavers should normally not be used to surface the following categories of aircraft pavements:

1. runways;
2. areas where aircraft engines are run at high thrust values;
3. high speed taxiways.

3.201 Should aerodrome management wish to depart from these recommendations, they should first discuss this with their aerodrome inspector.

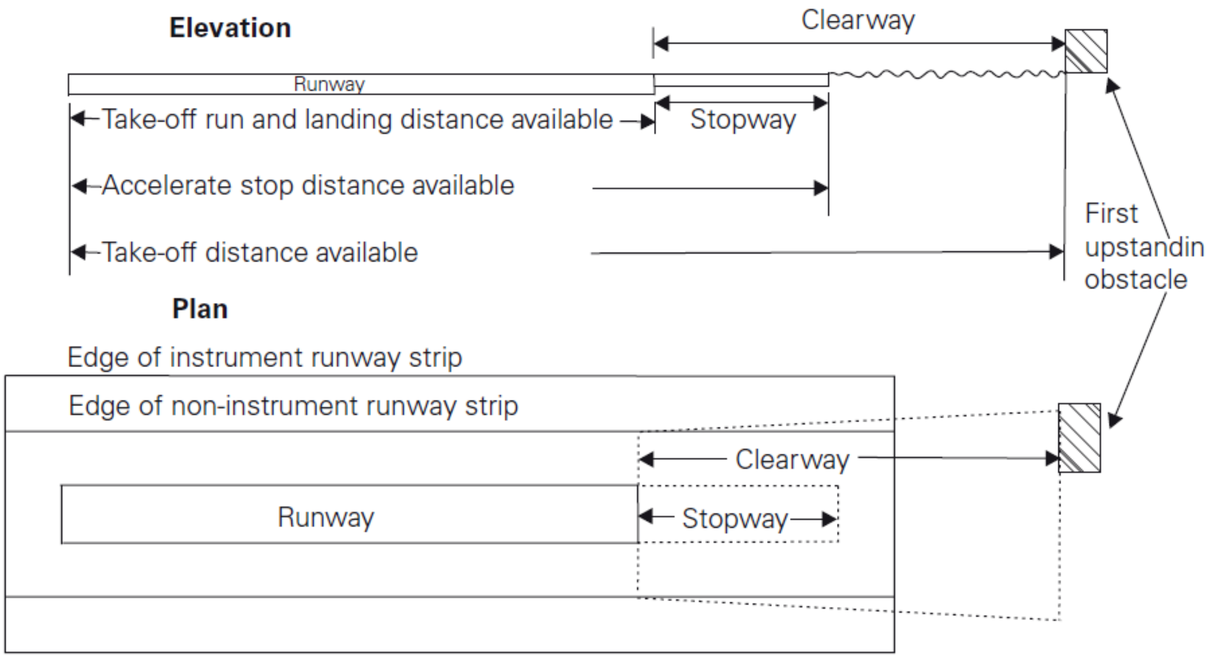
Declared distances

3.202 Aerodrome declared distances constitute the relevant distances for the application of the weight and performance requirements of the Air Navigation (General) Regulations in respect of aeroplanes flying for the purpose of public transport. The distances are illustrated in figure 3.10 and are:

1. TORA. This is the length of runway available and suitable for the ground run of an aeroplane taking-off;
2. ASDA. This is the length of TORA plus the length of any associated stopway;
3. TODA. This is the length of TORA plus the length of any associated clearway;
4. LDA. This is the length of runway available and suitable for the ground landing run of an aeroplane.

3.203 The significance and application of the runway/stopway/clearway concept in relation to aircraft performance is given in appendix 3C.

Figure 3.10



3.204 The TORA, ASDA, TODA and LDA should be measured to the nearest metre for each paved and unpaved runway direction. For this purpose, unpaved runways are to be marked. The distances are measured along the centreline of the runway and of any associated stopway and clearway and should be declared by publication in the UK AIP or in a NOTAM. declared distances may be reduced as outlined in appendix 3B. They may only be increased with the prior agreement of the CAA.

3.205 The intended use of a runway or part thereof for take-off or for landing using either visual or instrument approach procedures will determine the criteria to be applied in measuring the distances which may be declared. Alternatively, the ability to meet the criteria will decide what length of runway may be declared for what purpose. For example, a runway strip should extend beyond the end of a runway or stopway where the code number is 3 or 4 for a distance of 60 m at an overall width of 150 m. However, such a runway should also have a runway end safety area extending beyond the end of the strip for a distance of at least 90 m at a minimum width of twice that of the associated runway. The end of the declared TORA, ASDA and LDA should be adjusted so that the runway end safety area is provided as well as the required strip length and width. If the particular runway is served by an instrument approach procedure, the strip width to be applied when determining LDA will differ from that required for TORA and ASDA. Examples of the application of the various criteria are illustrated in figures 3.11, 3.12 and 3.13.

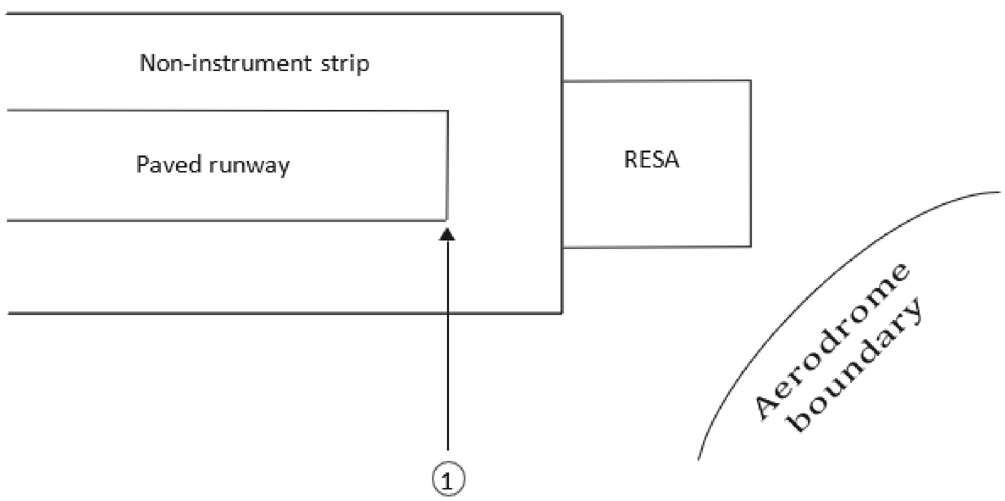
Threshold displacement

3.206 The threshold is the start of that part of a runway that is declared as available for landing. When the individual requirements for strip width and length, and runway end safety area are met the threshold will normally be located at the start of the runway. However, it may be necessary to account for any of these physical characteristics or an obstacle which cannot be removed and extends above the approach surface (see chapter 4) by displacement of the threshold from the runway end. The amount by which the threshold is displaced will vary with the individual circumstances of each situation, regard being given to:

1. the nature, type and level of traffic;
2. whether the runway is an instrument runway or a non-instrument runway, and if it is an instrument runway whether it is a precision instrument approach runway or non-precision instrument approach runway;
3. the position of any obstacle that either affects the RESA or infringes the approach surface, in relation to the threshold and extended centreline of the runway;
4. the amount by which the obstacle penetrates the approach surface, and its significance in the calculation of the obstacle clearance height;
5. the angle of the glidepath or nominal glidepath for an instrument approach procedure and the calculated obstacle clearance height;
6. the limiting visibility and cloud base conditions under which the runway will be used.

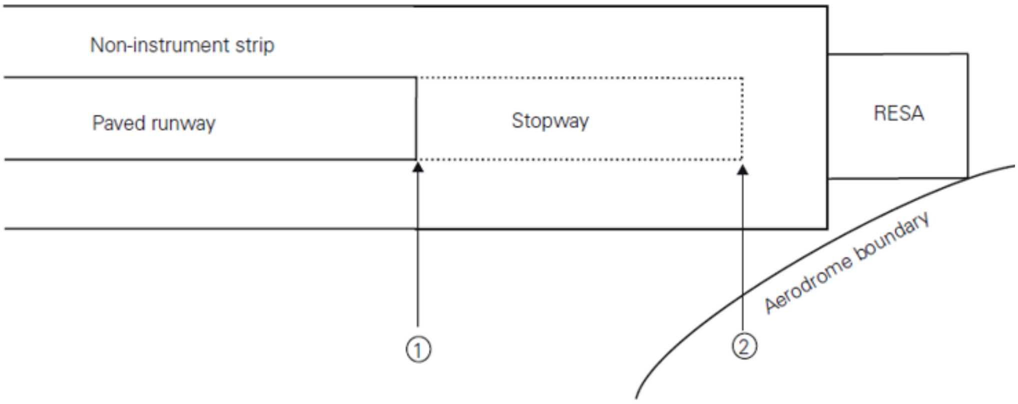
Figure 3.11

=



1. would be the end of TORA and ASDA (no stopway), and the end of LDA for a non-instrument runway. It would be the start of TORA, ASDA and TODA in the reciprocal direction, and also LDA unless the threshold were displaced because of obstacles in the approach area.

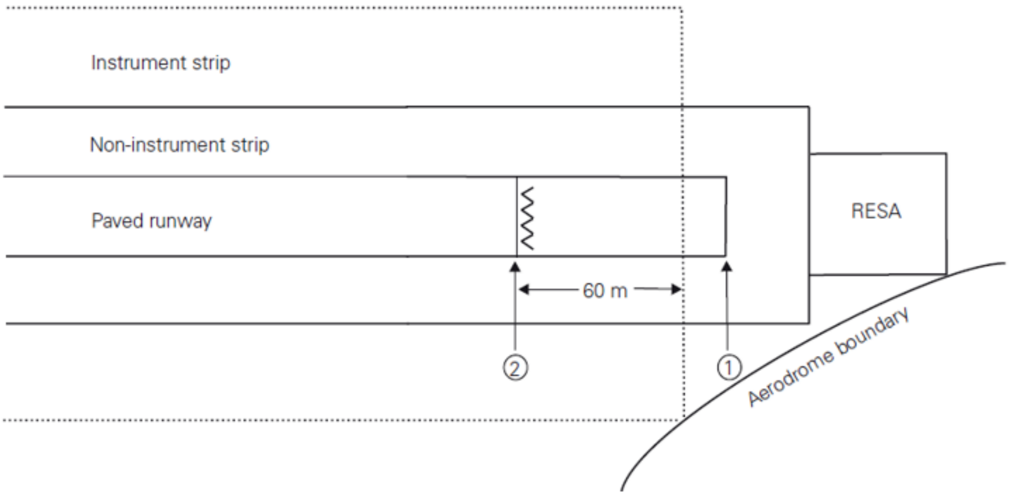
Figure 3.12



Here, in figure 3.12, the runway depicted in figure 3.11 has been supplemented by the provision of stopway.

1. would be the end of TORA and LDA for a non-instrument runway. It would be the start of TORA, ASDA and TODA in the reciprocal direction, and also the start of LDA unless the threshold were displaced because of obstacles in the approach area.
2. would be the end of ASDA, limited by the RESA short of the aerodrome boundary not by the strip width.

Figure 3.13



The runway of figures 3.11 and 3.12 has been extended by paving the declared stopway of figure 3.12 to full runway strength.

3. would be the end of TORA and LDA for a non-instrument runway. It would be the start of TORA, ASDA and TODA in the reciprocal direction, also LDA unless the threshold were displaced because of obstacles in the approach area.
4. would be the end of LDA for an instrument runway, the provision of the required instrument strip becoming the limiting factor, and the start of LDA in the reciprocal direction, subject to the availability of an acceptable obstacle free approach surface.

Declared distances from runway intersections

Aerodromes make use of intersection take-offs to maintain runway capacity and efficiency. declared distances from a runway intersection shall be calculated from the downwind edge of the taxiway. When defining the downwind edge, note should be taken of possible redundant paved areas at the side of a taxiway. The edge of the taxiway should be used as the start of the projection to the runway for the origin, excluding the redundant area.

The origin of full-length declared distances is, in most cases, the end of concrete; therefore, following aircraft line-up, the origin is behind the aircraft. An allowance for the length of the aircraft is taken into account when calculating the remaining distance. ICAO publishes the following in annex 6 Part I, chapter 5, paragraph 5.2.8.1: 'In determining the length of the runway available, account shall be taken of the loss, if any, of runway length due to alignment of the aeroplane prior to take-off.' Aircraft performance manuals make the same calculation for line-up allowance irrespective of where that line-up occurs along the runway. Therefore, flight crews would expect to calculate a similar correction distance at an intersection departure as for a full-length departure, regardless of where the origin is located. The use of the downwind origin as the basis for calculating declared distances from a runway intersection provides consistency with the full-length calculation.

Figures 3.14–3.16 illustrate how to determine the origin of intersection departures. Aerodrome licence holders should use this method to determine the origin of the TORA, in order to measure the distances for intersection departures accurately. Licence holders should liaise with their Aerodrome Inspector in order to notify intersection take-off distances in the AGA section of the UK Aeronautical Information Publication (AIP). A NOTAM should be issued to cover the period up to publication of the revised AIP entry.

Figure 3.14 Perpendicular runway entrance

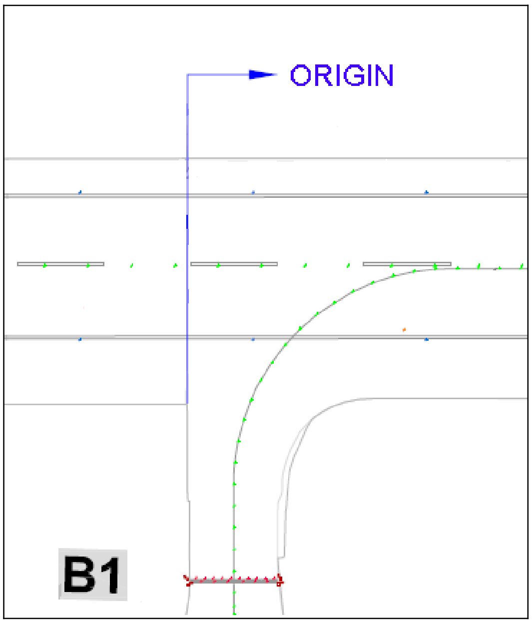


Figure 3.15 Redundant concrete at edge of entrance

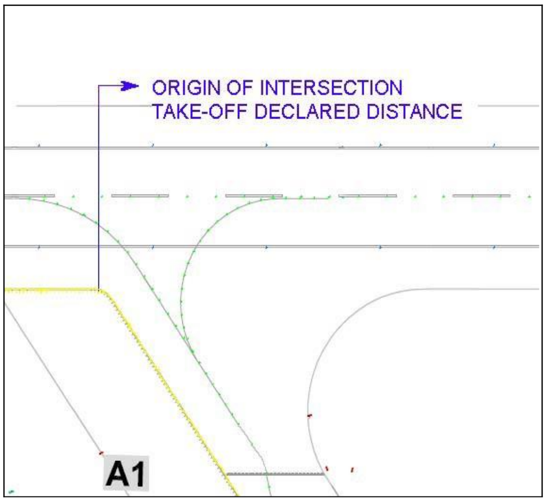
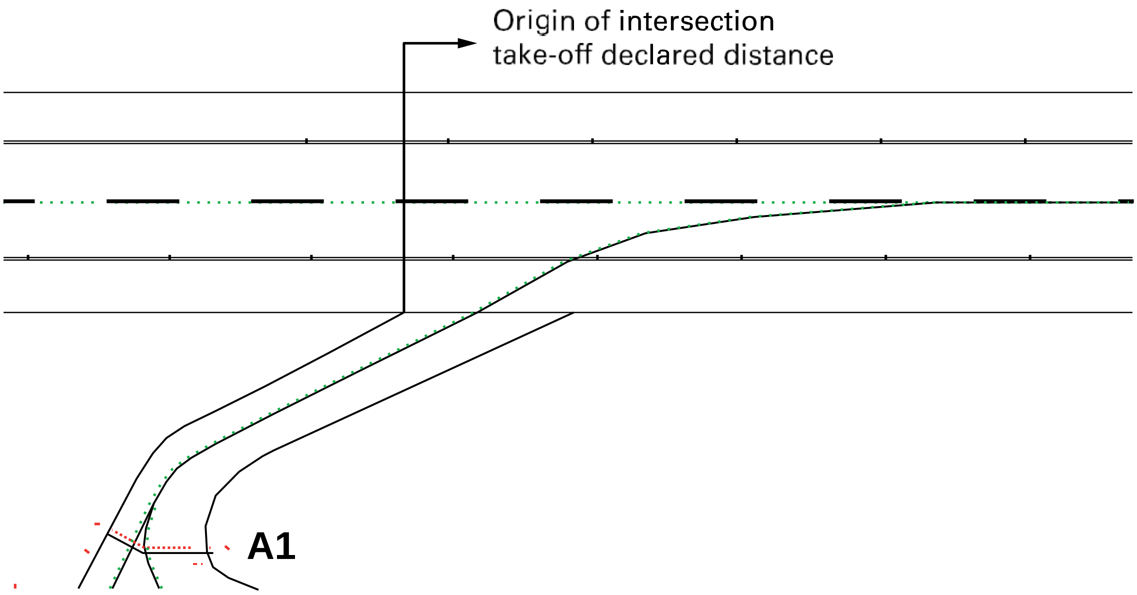


Figure 3.16 Rapid-access taxiway



APPENDIX 3A

Runway surfaces – technical details

Introduction

1. It is essential to ensure that a runway surface is sufficiently well constructed and maintained to stand up to the particular demands of aircraft take-off and landing operations. The principal requirements of a new or resurfaced runway may be summarised as follows:
    1. provide a surface friction level at or above the design objective level defined in CAP 683, The Assessment of Runway Surface Friction Characteristics;
    2. provide an average texture depth of not less than 1 mm;
    3. provide a hard durable surface that will not generate loose materials or contaminants;
    4. provide good rideability;
    5. provide good surface water drainage;
    6. avoid excessive tyre wear;
    7. avoid damage to the surface by aircraft maneuvering;
    8. provide a stable surface that will not be damaged or removed by jet engine exhaust efflux;
    9. provide a suitable PCN for aircraft operations;
    10. provide an acceptable design life;
    11. meet the geometric criteria defined in chapter 3.
2. Further information can be found in ICAO Doc 9157 Aerodrome Design manual Part 3 Pavements and Doc 9137 Aerodrome Services manual Part 2 Pavement Surface Conditions or FAA Advisory Circular 150/5320-12C Change 8 Measurement, Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces.

Surfacing materials

3. Brief details are given below of runway surfaces and treatments which have normally been found to provide good friction performance

Porous friction course

4. Porous friction course is open-graded asphalt laid to a uniform thickness of typically 20 mm with a high void ratio making it pervious. This allows the free penetration of surface water to the underlying layer which must be a densely graded impervious bituminous surfacing shaped to ensure drainage to the sides of the runway.
5. Porous friction course has good riding qualities, due to the close tolerances to which it

is laid. Ice formation is retarded on a porous friction course and the thawing of both snow and ice is accelerated. In addition, reverted rubber tends to crumble from, rather than stick to, the surface of the friction course.

6. It should be noted that, due to the use of a relatively soft bitumen binder, this can lead to softening of the surface during the first summer after laying. It is also important that the pavement joints are sufficiently porous to allow cross- flow of water.

Pavement Quality Concrete (PQC)

Coarse directional texturing by wire broom or comb

7. This surface texturing is formed in the plastic concrete by drawing a wire broom or purpose-made comb transversely across the surface of the plastic concrete surface at right angles to the runway centreline. During the laying of the concrete, regular measurements of texture depth are made on the coarse- textured slabs.

8. Provided the concrete is sound, grooving treatment wears well. However, when the concrete is old, and the surface seal is broken, exposing the aggregate, some deterioration of the concrete may then occur.

Grooving

9. The transverse grooving of hardened concrete is undertaken by a specialised machine to saw a groove in the surface of the concrete at regular intervals.

Asphalt

10. New or resurfaced runways with an asphalt surface normally do not provide adequate friction levels for aircraft operations immediately after the new surface has been placed. This is because it takes some period of time for the surface film of oils to be removed by traffic and weathering so as to expose the microtexture of the aggregate. For a number of years hot rolled marshall asphalt has been employed to surface runways in the UK where a flexible pavement is required.

11. A design requirement for a new runway surface may include new materials that provide the necessary friction characteristics[5] and offer at least 1 mm macro texture depth without the need for grooving. Such materials as Stone Mastic Asphalt (SMA), Béton Bitumineux Aéronautique (BBA) and Béton Bitumineux à Module Elevé (BBME) are all examples of this type of material. Aerodrome licence holders should satisfy themselves that the performance of any such materials can be demonstrated to meet the requirements set out in paragraph 1.

Coarse textured slurry seal

12. This method involves the application of a coarse-textured bitumen emulsion slurry seal with a graded crush rock aggregate from 3.35 mm down; however, care must be taken to ensure good adhesion of the slurry seal to any surface to which it is applied.

Grooving

13. The asphalt surface course is grooved transversely by a machine incorporating diamond saw blades. Grooving effectively adds macrotexture and there is a mathematical relationship between the width/depth of each groove plus the spacing at which they are cut and the amount of texture this adds. As an average texture depth of 1 mm is recommended by ICAO, a sufficient ungrooved texture depth for a new asphalt surface course should be achieved prior to grooving.

It is the responsibility of the aerodrome licence holder to ensure that, should grooving be required, it is specified so that the additional benefit when added to the measured asphalt macrotexture exceeds the recommended minimum and takes local climatic characteristics into account.

Runway ramping during resurfacing

14. In order that operations may continue between periods of runway resurfacing or maintenance, the new surface and temporary ramps should be constructed across the full width of the runway. Before operations recommence, after a period of runway closure, the surface should be inspected to ensure that temporary ramps have been constructed as follows:

1. the gradient of temporary ramps should not be steeper than 1:100 where the depth of overlay is not greater than 50 mm otherwise the gradient shall not be steeper than 1:200;
2. the depth of ramp should not exceed 100 mm;
3. the minimum spacing between successive ramps should be 150 m;
4. all ramps should be constructed so as to remain stable and durable under aircraft operations;
5. wherever possible ramps should be constructed with regard to the prevailing landing and take-off direction. It is undesirable for an aircraft to encounter an up gradient during take-off or landing, particularly in the touchdown zone.

Runway surface evenness and roughness

15. Information regarding runway surface evenness and roughness criteria may be found in ICAO annex 14, Attachment A and the Aerodrome Design manual Part 4 Pavements.

5 See CAP 683 Assessment of Runway Surface Friction Characteristics and CAP 781 Runway Rehabilitation.

APPENDIX 3B

Temporary obstacles within runway strips

1. It is the responsibility of the aerodrome authority to notify pilots of the existence of all temporary obstacles within a runway strip either through the medium of ATC or by NOTAM. The following paragraphs give guidance on the operational implications of temporary obstacles within runway strips and the limitations which should govern the continued use of the runway.

2. A runway should be withdrawn from service or its length and declared distances restricted if there is an obstacle which cannot be removed within the area which is to be cleared and graded.

3. The amended distances declared as available will have regard for the differences in the area to be cleared for an instrument runway compared with a take-off runway. Thus, with an obstacle say 80 m laterally from the runway centreline it may be feasible to reduce the landing distance available on an instrument runway but leave the take-off field lengths unchanged. Alternatively, the instrument procedure might be withdrawn. When the landing distance for an instrument runway is amended, the CAA shall be consulted in order to determine whether consequential amendments are necessary to the instrument approach procedure.

4. Declared distances have a statutory application and it is important that amendments are promulgated as they arise. The CAA may require to verify amended distances. The revised distances must be included in a NOTAM issued to advise pilots of temporary aerodrome conditions. It cannot be assumed that inbound pilots will have had access to the NOTAM and therefore the information should also be passed by R/T.

5. When there is a temporary obstacle within the runway strip but outside the area to be cleared and graded, the continued use of the runway may be permitted subject to the pilots being notified of the obstacle. Every effort should be made to remove the obstacle as soon as possible.

6. Temporary ditches or depressions are acceptable on only one side of the runway within the graded area at any given time. They should not exceed a surface area of 10 m^2 or exceptionally for narrow trenches a surface area of 30 m^2. There should be no earth banks or equipment above the original ground level of the area.

APPENDIX 3C

The use of runway, stopway and clearway – performance aspects

1. The decision to provide stopway or clearway as an alternative to an increased length of runway will depend on the physical characteristics of the site, and the performance requirements of the aeroplane expected to use the runway.
Take-off performance is normally the critical factor, but landing requirements are occasionally overriding.

Rules on the amount of stopway or clearway which may be used vary according to the aircraft performance classification

2. The weight and performance requirements of the Air Navigation (General) Regulations require an aerodrome large enough to ensure that, taking account of ambient conditions, i.e. runway slope, surface wind, temperature, aerodrome pressure and altitude, the aeroplane can either be brought to rest or complete the take-off safely in the event of one engine failing during take-off. For the purpose of these notes it has been assumed that the lengths provided at an aerodrome are just adequate for the aeroplane at its proposed operating weight. Under these circumstances there is for each take-off a speed, called the decision speed, at which, if engine failure occurs, the aeroplane may be stopped within the ASDA or continue a take-off with equal safety. If an engine fails below this speed the take-off must be abandoned, while above it the take-off must be continued.

3. The decision speed is not a fixed speed for each aeroplane but can be selected by the pilot within certain limits to suit the field lengths available at the aerodrome. For example, when the TODA is long and the ASDA is short, a low decision speed may be chosen. As ASDA increases or take-off distance decreases, so the decision speed may be increased. A variety of combinations of ASDA and take-off distance can accommodate a particular aeroplane at a particular weight. Each combination requires its particular length of take-off run which must consist of runway alone.

4. The most familiar case is where the TODA is equal to the ASDA: this is referred to as the balanced field length. When only runway is available, these distances will always be equal to the runway length. It is not essential that a balanced field length should consist of runway alone. Where it does not consist of runway alone, the take-off run required will be less than the ASDA as the balanced field length is then provided as runway plus stopway. If stopway is to be used and the runway is level and can be used for take-off in both directions as is normally the case, an equal length of stopway would need to be provided at each end. The saving in runway is, therefore, bought at the cost of greater total strip length. If the runway is not level, or take-offs with a tail wind are acceptable, varying lengths of stopway will be required.

5. A decision speed other than that associated with the balanced field length conditions is selected when ASDA and take-off distances are unequal. Normally, only lower values are of interest since higher speeds will always increase the requirement for stopway although reducing take-off distance requirements. By using lower decision speeds, the ASDA distance required will be reduced, i.e. less stopway required. However, additional clearway will be needed to provide for the increase in the take-off distance required. Exceptionally, the use of higher speeds would be an advantage when obstacles in the take-off area make it necessary to reduce to a minimum the take-off distance required.

6. At some aerodromes it may be expedient to provide both stopway and clearway.

7. Where the nature of the ground is such that stopway can be economically provided, there will be little gain in the substitution of clearway since this will result in a greater total field length requirement. Where stopway cannot be economically provided and only runway and clearway are practicable, the take- off run available and ASDA will equal the runway length, while clearway will constitute the remainder of the take-off distance available.

8. If field length requirements at a particular aerodrome are critical for an aeroplane in Class 'A', the minimum runway, stopway and/or clearway lengths which can be used may be determined from flight manual performance data, as follows:

1. If stopway is economically possible, the ASDA lengths to be provided are preferably those for the balanced field length. The runway length is the take- off run required or the landing distance required, whichever is the greater.
   If the take-off distance/ASDA required is greater than the runway length so determined, the excess may be provided as stopway, usually at each end of the runway (see chapter 3);
2. If stopway is not to be provided, the runway length required will be the greater of the landing distance required and the ASDA required corresponding to the lowest usable value of the decision speed. The lowest practical value is the speed at which the ASDA required and take-off run required are equal, unless the minimum of the permissible range of decision speeds is higher. The difference between the take-off distance required and the runway length may be provided as clearway, usually at each end of the runway.

General

9. The paragraphs above provide guidance on how the proportions of runway, stopway and clearway may be determined to meet the needs of flight performance. Further information on aircraft flight performance can be obtained from ICAO annex 6 'Operation of Aircraft'.

10. The decision to provide stopway and clearway rests with the aerodrome licence holder; proposals should be developed as part of the aerodrome SMS, in co- operation with relevant airline partners.

APPENDIX 3D

Runway Surface Condition Assessment and Reporting for Licensed Aerodromes

(Applicable 4 November 2021)

Introduction

1. The global reporting system for assessing and reporting runway surface conditions (commonly known as the Global Reporting Format (GRF)) involves all stakeholders involved in collecting data, converting the data into structured operational information and bringing the structured information to the end users, and the end users using the structured information.
2. A fundamental change in the new reporting system is the introduction of a runway condition code (RWYCC).
3. The assessment process of assigning a RWYCC is a deterministic process, starting with the identification of the various contaminants, that determines what initial RWYCC must be reported. Based on all other information available, this initial RWYCC can be downgraded or upgraded using procedures detailed Paragraph 41.
4. The revised scale GOOD, GOOD TO MEDIUM, MEDIUM, MEDIUM TO POOR, POOR and LESS THAN POOR is used by the flight crew to characterize perceived braking action and lateral control of the aeroplane during landing roll. RWYCCs 0 through 5 are mapped to this terminology in the runway condition assessment matrix (RCAM) and describe a consistent runway surface condition in relation to its effect on aircraft braking performance and lateral control.
5. Another fundamental change is that WET runway conditions are included in the runway condition report (RCR) on a regular basis.
6. The concept of the RCR is premised on:

a) an agreed set of criteria used in a consistent manner for runway surface condition assessment, aeroplane (performance) certification and operational performance calculation;

b) a unique runway condition code (RWYCC) linking the agreed set of criteria with the aircraft landing and takeoff performance table, and related to the braking action experienced and eventually reported by flight crews;

c) reporting of contaminant type and depth that is relevant to take-off performance;

d) a standardized common terminology and phraseology for the description of runway surface conditions that can be used by aerodrome operator inspection personnel, air traffic controllers, aircraft operators and flight crew; and

e) globally harmonized procedures for the establishment of the RWYCC with a built-in flexibility to allow for local variations to match the specific weather, infrastructure and other particular conditions.

7. These harmonised procedures are reflected in a runway condition assessment matrix (RCAM) which correlates the RWYCC, the agreed set of criteria and the aircraft braking action which the flight crew should expect for each value of the RWYCC.

8. It is recognized that information provided by the aerodrome's personnel assessing and reporting runway surface condition is crucial to the effectiveness of the runway condition report. However, a misreported runway condition alone should not lead to an accident or incident. Operational margins should cover for a reasonable error in the assessment, including unreported changes in the runway condition. But a misreported runway condition can mean that the margins are no longer available to cover for other operational variance (such as unexpected tailwind, high and fast approach above threshold or long flare).

9. This is further amplified by the need for providing the assessed information in the proper format for dissemination, which requires insight into the limitations set by the syntax for dissemination. This in turn restricts the wording of plain text remarks that can be provided.

10. It is important to follow standard procedures when providing assessed information on the runway surface conditions to ensure that safety is not compromised when aeroplanes use wet or contaminated runways. Personnel should be trained in the relevant fields of competence and their competence verified to ensure confidence in their assessments.

Reporting of Surface Contaminants

11. The aerodrome operator shall report to the aeronautical information services and air traffic services units on matters of operational significance affecting aircraft and aerodrome operations on the movement area, particularly in respect of the presence of the following:

    a) water;

    b) snow;

    c) slush;

    d) ice;

    e) frost;

    f) anti-icing or de-icing liquid chemicals or other contaminants; and

    g) snowbanks or drifts.

12. The aerodrome operator shall report the runway surface condition over each third of the runway using a runway condition report (RCR). The report shall include a runway condition code (RWYCC) using numbers 0 to 6, the contaminant coverage and depth, and a description to be reported in capital letters using the following terms:

a) COMPACTED SNOW; (snow that has been compacted into a solid mass such that aeroplane tyres, at operating pressures and loadings, will run on the surface without significant further compaction or rutting of the surface)

b) DRY;

c) DRY SNOW; (snow from which a snowball cannot readily be made)

d) DRY SNOW ON TOP OF COMPACTED SNOW;

e) DRY SNOW ON TOP OF ICE;

f) FROST; (ice crystals formed from airborne moisture on a surface whose temperature is at or below freezing; frost differs from ice in that frost crystals grow independently and therefore, have a more granular texture)

g) ICE; (water that has frozen or compacted snow that has transitioned into ice in cold and dry conditions)

h) SLUSH; (snow that is so water-saturated that water will drain from it when a handful is picked up or will splatter if stepped on forcefully)

i) STANDING WATER; (water of depth greater than 3 mm)

j) WATER ON TOP OF COMPACTED SNOW;

k) WET;

l) WET ICE; (ice with water on top of it or ice that is melting)

m) WET SNOW; (snow that contains enough water to be able to make a well-compacted, solid snowball, but water will not squeeze out)

n) WET SNOW ON TOP OF COMPACTED SNOW;

o) WET SNOW ON TOP OF ICE;

13. Reporting shall commence when a significant change in runway surface condition occurs due to water, snow, slush, ice or frost.

14. Reporting of the runway surface condition shall continue to reflect significant changes until the runway is no longer contaminated. When this situation occurs, the aerodrome operator shall issue an RCR that states that the runway is wet or dry as appropriate.

> Significant changes in the runway surface condition used in the runway condition report are described in Paragraph 28.

15. Friction measurements shall not be reported (see Para. 29).

16. When a paved runway or portion thereof is slippery wet, the aerodrome operator shall make such information available to the relevant aerodrome users. This shall be done by issuing a NOTAM and shall describe the location of the affected portion.

Runway Condition Report

17. Assessing and reporting the condition of the movement area and related facilities is necessary in order to provide the flight crew with the information needed for safe operation

of the aeroplane. The RCR is used for reporting assessed conditions through the issuance of SNOWTAM, when necessary.

18. Generally, movement areas are exposed to a multitude of climatic conditions and consequently there is a significant difference in the conditions to be reported. The RCR describes a basic structure applicable for all these climatic variations. Assessing the runway surface condition relies on a great variety of techniques and no single solution can apply to every situation.

19. The RCR should consist of the:

    a) aeroplane performance calculation section; and

    b) situational awareness section.

20. The information should be included in an information string in the following order:

    a) **aeroplane performance calculation section**:

    (i) aerodrome location indicator;

    (ii) date and time of assessment;

    (iii) lower runway designation number;

    (iv) RWYCC for each runway third;

    (v) per cent coverage contaminant for each runway third;

    (vi) depth of loose contaminant for each runway third;

    (vii) condition description for each runway third; and

    (viii) width of runway to which the RWYCCs apply if less than the published width.

    b) **Situational awareness section**:

    (i) reduced runway length;

    (ii) drifting snow on the runway;

    (iii) loose sand on the runway;

    (iv) chemical treatment on the runway;

    (v) snowbanks on the runway;

    (vi) snowbanks on the taxiway;

    (vii) snowbanks adjacent to the runway;

    (viii) taxiway conditions;

    (ix) apron conditions; and

    (x) plain-language remarks.

21. The philosophy of the RCR is that the aerodrome operator assesses the runway surface condition whenever water, snow, slush, ice or frost are present on an operational runway. From this assessment, a RWYCC and a description of the runway surface are reported,

which can be used by the flight crew for aeroplane performance calculations. This format, based on the type, depth and coverage of contaminants, is the best assessment of the runway surface condition by the aerodrome operator; however, all other pertinent information is taken into consideration and kept up to date, and changes in conditions are reported without delay.

22. The RWYCC reflects the runway braking capability as a function of the surface conditions. With this information, the flight crew can derive from the performance information provided by the aeroplane manufacturer, the necessary stopping distance of an aircraft on the approach under the prevailing conditions.

Aeroplane Performance Calculation Section

23. The aeroplane performance calculation section is a string of grouped information, separated by a space ‘ ’ ending with a return and a two-line feed ‘<<≡’, in order to distinguish the aeroplane performance calculation section from the following situational awareness section or the following aeroplane performance calculation section of another runway.

24. The information to be included in this section consists of the following:

    a) **Aerodrome location indicator:** a four-letter ICAO location indicator in accordance with ICAO Doc 7910, *Location Indicators.*

       This information is mandatory.
       Format: nnnn

    b) **Date and time of the assessment:** date and time (UTC) when the assessment was performed.

       This information is mandatory.
       Format: MMDDhhmm

    c) **Lower runway designation number:** a two- or three-character number identifying the runway for which the assessment is carried out and reported.

       This information is mandatory.
       Format: nn[L] or nn[C] or nn[R]

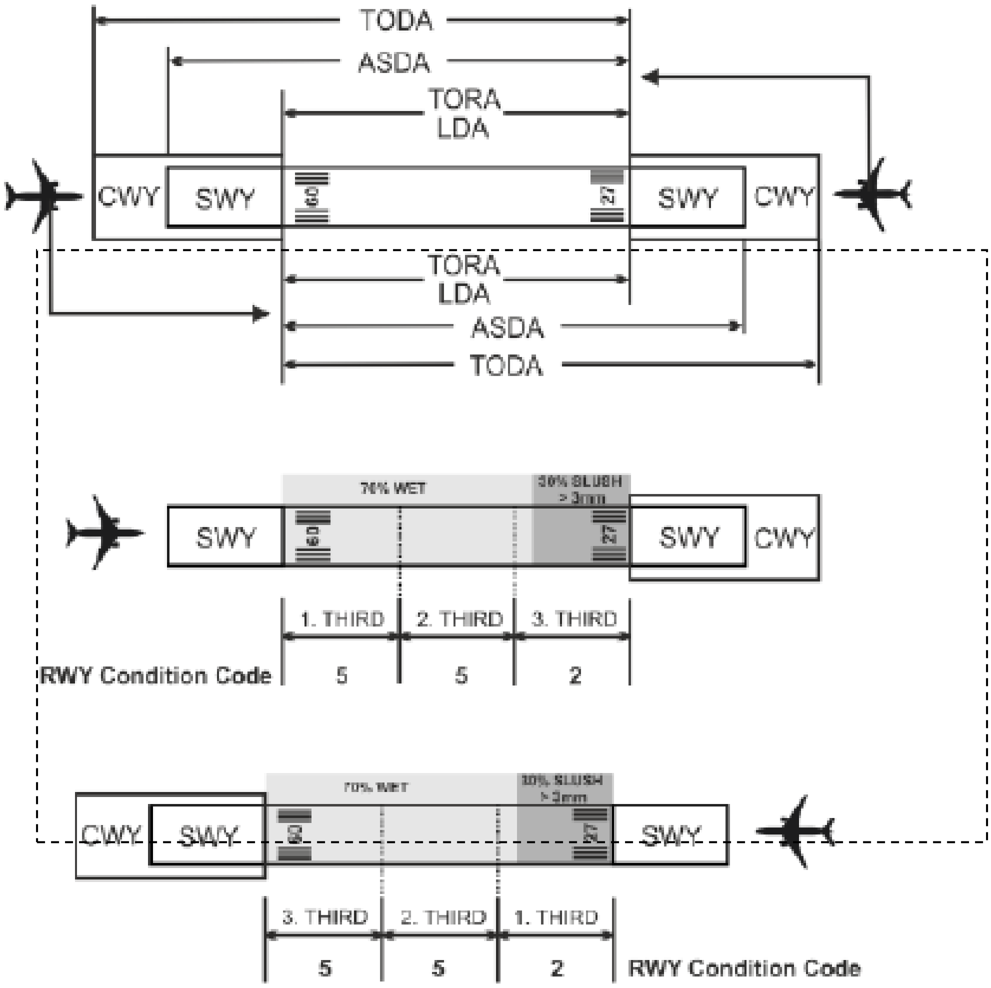
    d) **Runway condition code for each runway third:** a one-digit number identifying the RWYCC assessed for each runway third. The codes are reported in a three-character group separated by a ‘/’ for each third. The direction for listing the runway thirds is the direction as seen from the lower designation number.

       This information is mandatory.

       > When transmitting information on the runway surface condition by air traffic services to flight crews, the sections are, however, referred to as the first, second or third part of the runway. The first part always means the first third of the runway as seen in the direction of landing or take-off as illustrated in Figures 1 and 2.

       Format: n/n/n
       Example: 5/5/2

Figure 1 — Reporting of RWYCC (from air traffic services to flight crew for runway thirds)



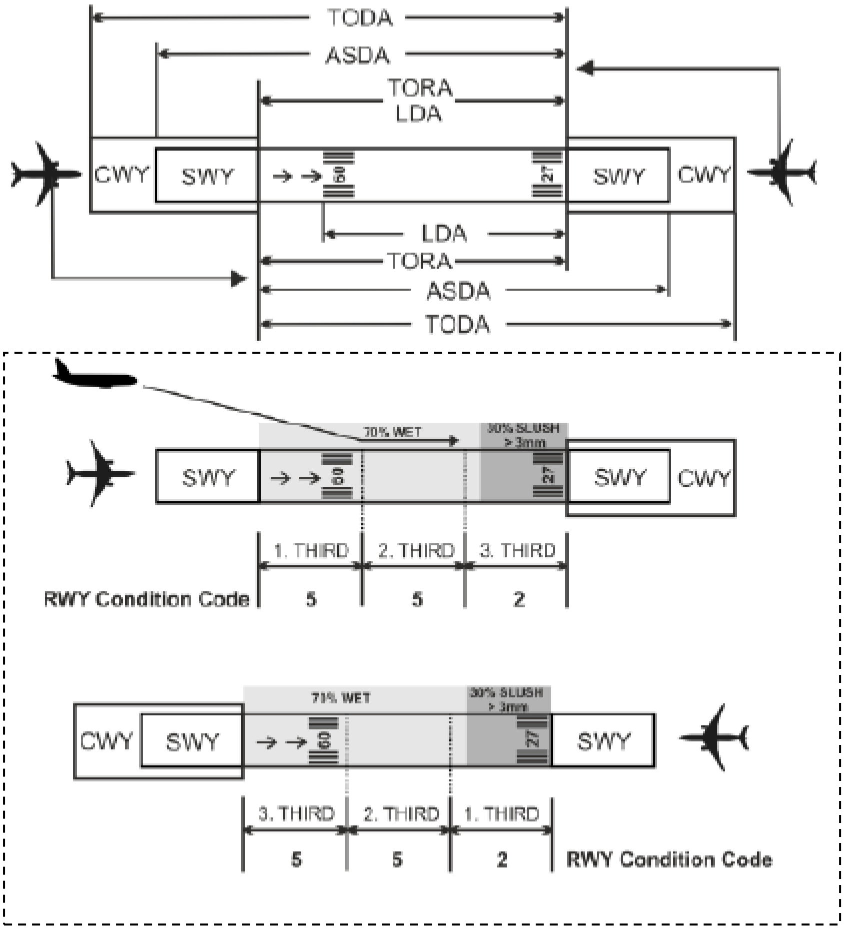


Figure 2 — Reporting of RWYCC (for runway thirds from air traffic services to flight crew on a runway with displaced threshold)

e) **Per cent coverage contaminant for each runway third:** a number identifying the percentage coverage. The percentages are to be reported in an up-to-nine character group separated by a '/' for each runway third. The assessment is based upon an even distribution within the runway thirds using Table 1.

This information is conditional. (It is not reported for any runway third that is dry or covered with less than 10 per cent).
Format: [n]nn/[n]nn/[n]nn
Example: 25/50/100

In case of uneven distribution of the contaminants, additional information is given in the plain-language remark part of the situational awareness section of the RCR. Where possible, a standardised text is used.

When no information is to be reported, 'NR' is inserted at the relevant position of the message to indicate to the user that no information exists.

f) **Depth of loose contaminant: dry snow, wet snow, slush or standing water for each runway third:** a two- or three-digit number representing the assessed depth (mm) of the contaminant for each runway third. The depth is reported in a six- to nine-character group separated by a '/' for each runway third as defined in Table YYY. The assessment is based upon an even distribution within the runway thirds following an assessment. If measurements are included as part of the assessment process, the reported values are still reported as assessed depths.

This information is conditional. It is reported only for DRY SNOW, WET SNOW, SLUSH and STANDING WATER.
Format: [n]nn/[n]nn/[n]nn

g) **Condition description for each runway third:** to be reported in capital letters using the terms specified in Para 8. The condition types are separated by an oblique stroke '/'.

This information is mandatory.
Format: nnnn/nnnn/nnnn

h) **Width of runway to which the RWYCCs apply if less than the published width:** two-digit number representing the width of cleared runway in metres.

This information is mandatory.
Format: nn

If the cleared runway width is not symmetrical along the centre line, additional information is given in the plain-language remark part of the situational awareness section of the RCR.

SITUATIONAL AWARENESS SECTION

25. All individual messages in the situational awareness section end with a full-stop sign, in order to distinguish the message from subsequent message(s).

26. The information to be included in this section consists of the following:

a) **Reduced runway length:**

The information is conditional when a NOTAM has been published with a new set of declared distances affecting the landing distance available (LDA).
Format: Standardised fixed text – RWY nn [L] *or* nn [C] *or* nn [R] LDA REDUCED TO [n]nnn

b) **Drifting snow on the runway:**

This information is conditional.
Format: Standardised fixed text – RWY nn [L] or nn [C] or nn[R] DRIFTING SNOW

c) **Loose sand on the runway**

This information is conditional.
Format: RWY nn[L] or nn[C] *or* nn[R] LOOSE SAND

d) **Chemical treatment on the runway**

This information is conditional.
Format: RWY nn[L] *or* nn[C] *or* nn[R] CHEMICALLY TREATED

e) **Snowbanks on the runway**

This information is conditional.
Left or right distance in metres from centre line.
Format: RWY nn[L] *or* nn[C] *or* nn[R] SNOWBANK Lnn *or* Rnn *or* LRnn FM CL

f) **Snowbanks on taxiway**

This information is conditional.
Format: TWY [nn]n or TWYS [nn]n/[nn]n/[nn]n/… or ALL TWYS SNOWBANKS

g) **Snowbanks adjacent to the runway penetrating level/profile set in the aerodrome snow plan.**

This information is conditional.
Format: RWY nn[L] *or* nn[C] *or* nn[R] ADJ SNOWBANKS

h) **Taxiway conditions**

This information is optional.
Format: TWY [nn]n POOR

i) **Apron conditions**

This information is conditional.
Format: APRON [nnnn] POOR

j) **Plain-language remarks using only allowable characters in capital letters**

> Where possible, standardised text is used. 'UPGRADED' or 'DOWNGRADED' is used whenever assessed RWYCC differs from what follows directly from RCAM.

This information is optional.
Format: Combination of allowable characters where use of full stop '.' marks the end of the message.

> Allowable characters:
> A B C D E F G H I J K LM N O P Q R S T U V W X Y Z
> 0 1 2 3 4 5 6 7 8 9
> / [oblique stroke] '.' [period]' ' [space]
>
> If ICE, SNOW or SNOW ON ICE affects only the runway edge, the following text may be used:
> RWY nn[L] or nn[C] or nn[R] ICE or SNOW or SNOW ON ICE Lnn or Rnn or LRnn FM EDGE

An example of a complete information string prepared for dissemination is as follows:

COM header and abbreviated header] (Completed by AIS)

GG EADBZQZX EADNZQZX EADSZQZX

070645 EADDYNYX

SWEA0151 EADD 02170055

SNOWTAM 0151

[Aeroplane performance calculation section]

EADD 02170055 09L 5/5/5 100/100/100 NR/NR/NR WET/WET/WET

EADD 02170135 09R 5/2/2 100/50/75 NR/06/06 WET/SLUSH/SLUSH

EADD 02170225 09C 2/3/3 75/100/100 06/12/12 SLUSH/WET SNOW/WET SNOW

[Situational awareness section]

RWY 09L SNOWBANK R20 FM CL. RWY 09R ADJ SNOWBANKS. TWY B POOR. APRON NORTH POOR.

REPORTING BY AERODROMES WITH MULTIPLE RUNWAYS

27. On aerodromes with multiple runways, SNOWTAM should include all the runways, in case that at least one runway is contaminated. This improves pilots' situational awareness and support their decision on the selection of the landing/take-off runway.

SIGNIFICANT CHANGES

28. A change in the runway surface condition used in the RCR is considered significant whenever there is any:

a) change in the RWYCC;

b) change in the contaminant type;

c) change in reportable contaminant coverage according to Table 1;

d) change in contaminant depth according to Table 2; and

e) other information, for example a SPECIAL AIR-REPORT of runway braking action, which according to assessment techniques used, is known to be significant.

Table 1 — Percentage of coverage for contaminants

Assessed per cent	Reported per cent
10-25	25
26-50	50
51-75	75
76-100	100

Table 2 – Depth assessments for contaminants

Contaminant	Valid values to be reported	Significant change
STANDING WATER	04, then assessed value	3 mm
SLUSH	03, then assessed value	3 mm
WET SNOW	03, then assessed value	5 mm
DRY SNOW	03, then assessed value	20 mm

Note 1 — For STANDING WATER, 04 (4 mm) is the minimum depth value at and above which the depth should be reported. From 3 mm and below, the runway third should be considered WET.

Note 2 — For SLUSH, WET SNOW and DRY SNOW, depths up to and including 3 mm should be reported as 03 (3 mm).

Note 3 — Above 4 mm for STANDING WATER and above 3 mm for SLUSH, WET SNOW and DRY SNOW, an assessed value should be reported and a significant change relates to the observed change from this assessed value.

An example of reporting depth of contaminant whenever there is a significant change is as follows.

After the first assessment of runway condition, a **first Runway Condition Report** is generated. The initial report is:

5/5/5 100/100/100 02/02/02 SLUSH/SLUSH/SLUSH

Note — The full information string is not used in this example.

With continuing precipitation, a new Runway Condition Report is required to be generated as a subsequent assessment reveals a change in the RWYCC is needed. A **second Runway Condition Report** is therefore created as:

2/2/2 100/100/100 03/03/03 SLUSH/SLUSH/SLUSH

With even more precipitation, a further assessment reveals the depth of contamination has increased from 3 mm to 5 mm along the entire length of the runway. However, a new Runway Condition Report **is not** required because the RWYCC has not changed (change in depth is less than the significant change threshold of 3 mm).

A final assessment of the contamination reveals that the depth has increased to 7 mm. A new RWYCC is required because the change in depth from the last RCR (**second RWYCC**), i.e. from 3 mm to 7 mm is greater than the significant change threshold of 3 mm. A **third Runway Condition Report** is thus created as below:

2/2/2 100/100/100 7/7/7 SLUSH/SLUSH/SLUSH

Note: For contaminants other than STANDING WATER, SLUSH, WET SNOW or DRY SNOW, the depth is not reported. The position of this type of information in the information string is then identified by /NR/.

When the depth of the contaminants varies significantly within a runway third, additional information is to be given in the plain-language remark part of the situational awareness section of the Runway Condition Report.

USE OF FRICTION MEASUREMENTS

29. Friction measurements cannot be used by flight crews to determine landing performance requirements, because there is no correlation between the measurements and aeroplane performance data. Nevertheless, continuous friction measuring devices may be used, together with all other available means, to support upgrade or downgrade of the RWYCC, by using friction measurements in a comparative way and not as absolute values.

Runway Condition Assessment

RUNWAY CONDITION ASSESSMENT MATRIX (RCAM)

30. The aerodrome operator should use the following RCAM in order to assign the RWYCC:

Runway Condition Assessment Matrix (RCAM)			
Assessment criteria		**Downgrade assessment criteria**	
Runway condition code	Runway surface description	Aeroplane deceleration or directional control observation	Pilot report of runway braking action
6	• DRY	—	—
5	• FROST • WET (The runway surface is covered by any visible dampness or water up to and including 3 mm depth) **Up to and including 3 mm depth:** • SLUSH • DRY SNOW • WET SNOW	Braking deceleration is normal for the wheel braking effort applied AND directional control is normal.	GOOD
4	***−15ºC and Lower outside air temperature***: • COMPACTED SNOW	Braking deceleration OR directional control is between Good and Medium.	GOOD TO MEDIUM
3	• WET (“slippery wet” runway) • DRY SNOW or WET SNOW (any depth) ON TOP OF COMPACTED SNOW ***More* than *3 mm depth:*** • DRY SNOW • WET SNOW ***Higher* than *−15ºC outside air temperature[5]:*** • COMPACTED SNOW	Braking deceleration is noticeably reduced for the wheel braking effort applied OR directional control is noticeably reduced.	MEDIUM
2	***More* than *3 mm depth:*** • STANDING WATER • SLUSH	Braking deceleration OR directional control is between Medium and Poor.	MEDIUM TO POOR

[5] Runway surface temperature should preferably be used where available.

1	• ICE	Braking deceleration is significantly reduced for the wheel braking effort applied OR directional control is significantly reduced.	POOR
0	• WET ICE • WATER ON TOP OF COMPACTED SNOW • DRY SNOW or WET SNOW ON TOP OF ICE	Braking deceleration is minimal to non-existent for the wheel braking effort applied OR directional control is uncertain.	LESS THAN POOR

31. The RCAM is a tool to be used when assessing runway surface conditions. It is not a standalone document and should be used in compliance with the associated procedures of which there are two main parts:

    a) assessment criteria; and

    b) downgrade assessment criteria.

AVAILABLE MEANS USED TO DETERMINE THE RWYCC

32. The visual inspection of the movement area to assess the surface condition is the core method to determine the RWYCC. An overall assessment however implies more than that. The continuous monitoring of the development of the situation and the prevailing weather conditions is essential to ensure safe flight operations. Other aspects to be considered in the assessment result are the outside air temperature, the surface temperature, the dew point, the wind speed and direction, the effect of surface treatment, control and deceleration of the inspection vehicle, the special-air-reports of braking action, the output from friction measuring devices, the weather forecast, etc. Due to interaction between them, a deterministic method on how these factors affect the RWYCC to be reported cannot be precisely defined.

33. The RCAM supports the classification of runway surface conditions by their effect on aeroplane braking performance using a set of criteria identified and quantified based on the best industry knowledge, built upon dedicated flight testing and in-service experience. The thresholds at which a criterion changes the classification of a surface condition are intended to be reasonably conservative, without being excessively pessimistic.

34. The following describes why the primary classification criteria in the RCAM have been set this way, and why it is important for aerodrome personnel to monitor and accurately report conditions when operating close to the boundaries of each RWYCC:

    a) Percentage of coverage with contamination in each runway third

    A runway is considered contaminated whenever the extent of the coverage is more than a quarter of the surface of at least one third of the runway. It is important to note that whenever coverage is assessed to be below the 25 per cent threshold in each third, the computation assumption made by flight crew will be a dry runway (uniformly bare of moisture, water and contamination). It has been demonstrated that in conditions of contamination just below the reporting threshold but concentrated in the most unfavourable location, this assumption of dry runway still provides positive stop margins.

b) Type of contaminant

Different contaminants affect the contact area between tyre and runway surface, where the stopping force is generated, in different ways. A water film of any depth leads to the partial (viscous aquaplaning) or total separation (dynamic aquaplaning) of the tyre from the surface. The smaller the surface, the smaller the force of adhesion, the less braking is available. This is why the maximum braking force decreases at higher speed and depends on contaminant depth. Other fluid contaminants have a similar effect. Hard contaminants, such as ice or compacted snow, prevent the contact between tyre and runway surface completely and at any speed, effectively providing a new surface that the tyre rolls on. A deterministic classification of the stopping performance can be made only for the contaminants listed in the RCAM. For other reportable contaminants (oil, mud, ash, etc.), a large variance in the aeroplane performance effect exists, or insufficient data is available to permit a deterministic classification. An exception is rubber contamination, for which in-service data indicates that an assumption of RWYCC 3 provides a satisfactory performance margin. Runway surface treatments with sand, grit or chemicals may be very effective or even detrimental depending on the conditions of the application, and no credit can be attributed to such treatment without verification and validation.

c) Depth of the contamination

The industry accepts that the threshold for the effect of depth of fluid contaminants on aeroplane performance is at 3 mm. Below this threshold, any type of fluid contaminant can be removed from the tyre/runway contact zone either by forced drainage or by compressing it into the macrotexture of the surface, thus allowing adhesion between tyre and surface to exist, albeit on less than the full footprint surface area. This is the reason that contamination depths up to 3 mm are expected to provide similar stopping performance as a wet runway. It should be noted that the physical effects causing reduced friction forces begin to take effect from very small film thickness, therefore damp conditions are considered to provide no better braking action than a wet runway. Aerodrome personnel should be aware of the fact that the capability to generate friction in wet (or with thin layers of fluid contaminants) conditions is very dependent upon the inherent qualities of the runway surface (friction characteristics) and may be less than normally expected on poorly drained, polished or rubber contaminated surfaces. Above the 3 mm threshold, the impact on friction forces is more significant, leading to classification in lower RWYCCs. Above this depth, and depending on the density of the fluid, additional drag effects start to apply, due to displacement or compression of the fluid and impingement on the airframe of the aeroplane. These latter effects depend on the depth of the fluid and affect the ability of the aeroplane to accelerate for take-off.

d) Surface or air temperature

It is self-evident that close to the freezing point significant changes in surface conditions can occur very quickly. Surface temperature is more significant for the relevant physical effects, and surface and air temperature may be significantly different due to latency and radiation. However, surface temperature may not be readily available and it is acceptable to use air temperature as a criterion for the contaminant classification. The threshold for the classification of compacted snow in RWYCC 4 (below OAT -15 degrees) or RWYCC 3 (above this temperature) is based on historical North American operational practice and may be very conservative, therefore other assessment means should be used to support the classification. Such assessment means should be based upon specific rationale, specific procedures and substantiating aeroplane data.

ICE is considered to be untreated ice that covers the runway macrotexture.

ASSIGNMENT OF RUNWAY CONDITION CODE

35. The aerodrome operator should:

a) assign a RWYCC 6, if 25 per cent or less area of a runway third is wet or covered by contaminant;

b) describe in the plain-language remarks part of the situational awareness section of the RCR the location of the area that is wet or covered by the contaminant, if the distribution of the contaminant is not uniform;

c) assign a RWYCC based on the contaminant that will most likely affect the aeroplane's performance, if multiple contaminants are present and the total coverage is more than 25 per cent but no single contaminant covers more than 25 per cent of any runway third;

d) not upgrade an assigned RWYCC 5, 4, 3, or 2; and

e) not upgrade beyond RWYCC 3 an assigned RWYCC 1 or 0.

36. The aerodrome operator may upgrade an assigned RWYCC 1 or 0 when all available means of assessing runway slipperiness, including properly operated and calibrated measuring devices, if available, have been used to support the decision.

37. The aerodrome operator, when RWYCC 1 or 0 is upgraded, should assess the runway surface frequently during the period the higher RWYCC is in effect, to ensure that the runway surface condition does not deteriorate below the assigned code.

38. The aerodrome operator, if sand or other runway treatments are used to support upgrading of the RWYCC, should assess the runway surface frequently to ensure the continued effectiveness of the treatment.

39. The aerodrome operator should appropriately downgrade the RWYCC taking into consideration all available means of assessing runway slipperiness, including special air-reports.

SINGLE AND MULTIPLE CONTAMINANTS

40. When single or multiple contaminants are present, the RWYCC for any third of the runway is determined as follows:

a) When the runway third contains a single contaminant, the RWYCC for that third is based directly on that contaminant in the RCAM as follows:

   (i) If the contaminant coverage for that third is less than 10 per cent, a RWYCC 6 is to be generated for that third, and no contaminant is to be reported. If all thirds have less than 10 per cent contaminant coverage, no report is generated; or

   (ii) If the contaminant coverage for that third is greater than or equal to 10 per cent and less than or equal to 25 per cent, a RWYCC 6 is to be generated for that third and the contaminant reported at 25 per cent coverage; or

   (iii) If the contaminant coverage for that third is greater than 25 per cent, the RWYCC for that third is based on the contaminant present.

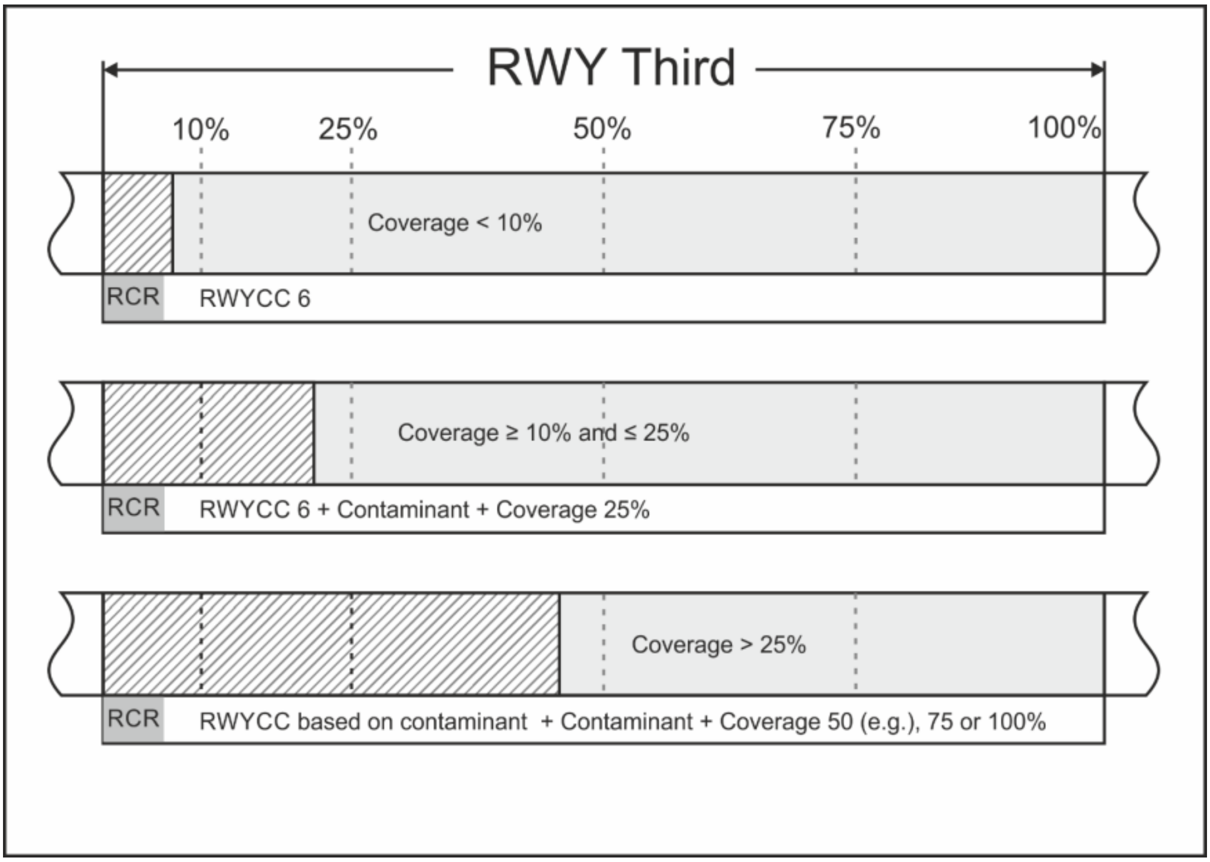


Figure 1 — Single contaminant

b) If multiple contaminants are present where the total coverage is more than 25 per cent but no single contaminant covers more than 25 per cent of any runway third, the RWYCC is based upon the judgement of the runway inspector, considering what contaminant will most likely be encountered by the aeroplane and its likely effect on the aeroplane's performance. Typically, this would be the most widespread contaminant, but this is not an absolute.

c) The structure of the RCAM is ranking the contaminants in the column 'Runway surface description' from top to bottom and is having the most slippery contaminants at the bottom. However, this ranking is not an absolute, as the RCAM by design is landing oriented and if judged in a take-off scenario, the ranking could be different due to drag effects of loose contaminants.

DOWNGRADING AND UPGRADING

41. The RCAM allows making an initial assessment based on visual observation of contaminants on the runway surface: their type depth and coverage, as well as the outside air temperature. Downgrading and upgrading is an integral part of the assessment process and essential to developing relevant reports of the prevailing runway surface condition. When all other observations, experience and local knowledge indicate that the primary assignment of the RWYCC does not reflect the prevailing conditions accurately, a downgrade or upgrade should be made.

> Examples of aspects to be considered in assessing the runway slipperiness for the downgrade process:
>
> a) Prevailing weather conditions
>
> (i) stable sub-freezing temperature
>
> (ii) dynamic conditions
>
> (iii) active precipitation
>
> b) Observations
>
> c) Measurements
>
> (i) friction measurements
>
> (ii) vehicle behaviour
>
> (iii) shoe scraping
>
> c) Experience (local knowledge)
>
> d) Special air-reports

42. An assigned RWYCC 5, 4, 3 or 2 shall not be upgraded.

43. When the complete removal of contaminants cannot be achieved, but the RWYCC initially assigned does not reflect the real surface condition, the aerodrome personnel may apply the upgrade procedures. Upgrading is applicable only when the initial RWYCC is 0 or 1. Upgrading can only occur up to RWYCC 3.

44. An assigned RWYCC 1 or 0 can be upgraded using the following procedures:

    a) if a properly operated and calibrated State-approved measuring device and all other observations support a higher RWYCC as judged by trained personnel;

    b) the decision to upgrade RWYCC 1 or 0 cannot be based upon one assessment method alone. All available means of assessing runway slipperiness are to be used to support the decision;

    c) when RWYCC 1 or 0 is upgraded, the runway surface is assessed frequently during the period the higher RWYCC is in effect to ensure that the runway surface condition does not deteriorate below the assigned code; and

    d) variables that may be considered in the assessment that may affect the runway surface condition, include but are not limited to:

i) any precipitation conditions;

ii) changing temperatures;

iii) effects of wind;

iv) frequency of runway in use; and

v) type of aeroplane using the runway.

45. When a friction measuring device is used for upgrading purposes, a preponderance of evidence should exist. In order to upgrade a RWYCC 0 or 1 to no higher than RWYCC 3, the friction measuring device should demonstrate an equivalent friction to that of a wet runway (RWYCC 5) or higher.

USE OF SPECIAL AIR-REPORTS

46. Where available, the pilot reports of runway braking action should be taken into consideration as part of the ongoing monitoring process, using the following principle:

a) a pilot report of runway braking action is taken into consideration for downgrading purposes; and

b) a pilot report of runway braking action can be used for upgrading purposes only if it is used in combination with other information qualifying for upgrading.

47. The aerodrome operator should:

a) re-assess the runway surface condition if RWYCC 2 or better has been reported and two consecutive pilot reports of POOR runway braking action are received; and

b) re-assess the runway surface condition and consider the suspension of operations on that runway when one pilot has reported a LESS THAN POOR runway braking action.

48. The aerodrome operator may use a special air-report of runway braking action for upgrading purposes only if it is used in combination with other information qualifying for upgrading.

Special air-reports typically provide aerodrome personnel and other pilots with an observation that can confirm the ground-based assessment of or alert to degraded conditions experienced in terms of braking capability and/or lateral control during the landing roll. The braking action observed is dependent on the type of aircraft, aircraft weight, runway portion used for braking, and other factors. Pilots will use the terms GOOD, GOOD TO MEDIUM, MEDIUM, MEDIUM TO POOR, POOR and LESS THAN POOR. When receiving a special air-report, the recipient should consider that it rarely applies to the full length of the runway and is limited to the specific sections of the runway surface in which sufficient wheel braking was applied to reach friction limitation. As special air-reports are subjective and contaminated runways may affect the performance of different aeroplane types in a different way, the reported braking action may not be directly applicable to another aeroplane.

SNOWTAM FORMAT

(COM heading)	(PRIORITY INDICATOR)	(ADDRESSES)		<≡
	(DATE AND TIME OF FILING)	(ORIGINATOR'S INDICATOR)		<≡
(Abbreviated heading)	(SWAA* SERIAL NUMBER) S W * *	(LOCATION INDICATOR)	DATE/TIME OF ASSESMENT	(OPTIONAL GROUP) <≡(

SNOWTAM →	(Serial number) <≡

Aeroplane performance calculation section			
(AERODROME LOCATION INDICATOR)	M	A)	<≡
(DATE/TIME OF ASSESSMENT *(Time of completion of assessment in UTC)*)	M	B)	→
(LOWER RUNWAY DESIGNATION NUMBER)	M	C)	→
(RUNWAY CONDITION CODE (RWYCC) ON EACH RUNWAY THIRD) *(From Runway Condition Assessment Matrix (RCAM) 0, 1, 2, 3, 4, 5 or 6)*	M	D)	/ / →
(PER CENT COVERAGE CONTAMINANT FOR EACH RUNWAY THIRD)	C	E)	/ / →
(DEPTH *(mm)* OF LOOSE CONTAMINANT FOR EACH RUNWAY THIRD)	C	F)	/ / →
(CONDITION DESCRIPTION OVER TOTAL RUNWAY LENGTH) *(Observed on each runway third, starting from threshold having the lower runway designation number)* COMPACTED SNOW DRY DRY SNOW DRY SNOW ON TOP OF COMPACTED SNOW DRY SNOW ON TOP OF ICE FROST ICE SLUSH STANDING WATER WATER ON TOP OF COMPACTED SNOW WET WET ICE WET SNOW WET SNOW ON TOP OF COMPACTED SNOW WET SNOW ON TOP OF ICE	M	G)	/ / →
(WIDTH OF RUNWAY TO WHICH THE RUNWAY CONDITION CODES APPLY, IF LESS THAN PUBLISHED WIDTH)	O	H)	<≡≡
Situational awareness section			
(REDUCED RUNWAY LENGTH, IF LESS THAN PUBLISHED LENGTH *(m)*)	O	I)	→
(DRIFTING SNOW ON THE RUNWAY)	O	J)	→
(LOOSE SAND ON THE RUNWAY)	O	K)	→
(CHEMICAL TREATMENT ON THE RUNWAY)	O	L)	→
(SNOWBANKS ON THE RUNWAY) *(If present, distance from runway centre line (m) followed by "L", "R" or "LR" as applicable)*	O	M)	→
(SNOWBANKS ON A TAXIWAY)	O	N)	→
(SNOWBANKS ADJACENT TO THE RUNWAY)	O	O)	→
(TAXIWAY CONDITIONS)	O	P)	→
(APRON CONDITIONS)	O	R)	→
(MEASURED FRICTION COEFFICIENT)	O	S)	→
(PLAIN-LANGUAGE REMARKS)	O	T)	)

NOTES:
1. *Enter ICAO nationality letters as given in ICAO Doc 7910, Part 2 or otherwise applicable aerodrome identifier.
2. Information on other runways, repeat from B to H.
3. Information in the situational awareness section repeated for each runway, taxiway and apron. Repeat as applicable when reported.
4. Words in brackets ( ) not to be transmitted.
5. For letters A) to T) refer to the *Instructions for the completion of the SNOWTAM Format,* paragraph 1, item b).

SIGNATURE OF ORIGINATOR *(not for transmission)*

APPENDIX 3E

Aerodrome movement areas – clearance of Foreign Objects and Debris (FOD)

General

1. It is important in the interests of safety and economy to keep runways, taxiways and aprons clear of loose stones or other objects and debris that could cause damage to aircraft or engines or impair the operation of aircraft systems. Turbine engines are extremely susceptible to damage as a result of foreign object ingestion. Propellers, aircraft skin and tyres have all been damaged as a result of loose stones or debris becoming dislodged by jet blast, slipstream or tyre action. Serious accidents have resulted from tyres being punctured by a metal object on a runway. Grit used on icy runways has led to control surface jamming and wet tar ingestion has led to engine failure. At all times, debris on the movement area of an aerodrome is a potential hazard to aircraft safety. An aborted take-off brought about by an engine failure or a wheel/tyre failure is particularly likely to result in debris being left on the runway.

2. Apart from the safety aspect, unscheduled replacement of parts or components damaged by debris will result in economic penalties for an aircraft operator. Damage to tyres resulting from contact with sharp objects, untreated joints or deteriorating pavement edges are responsible for reduced tyre life. The cleanliness of the surface of the movement area should be a matter of continuous concern and attention to an aerodrome authority.

3. FOD typically falls into two main categories:

    1. that on the runway consists largely of aircraft parts, typically small metal panels or metallic honeycomb structures, and tools, torches and equipment, including wheel chocks;
    2. that on the taxiways and aprons is usually associated with vehicles and smaller items associated with passenger baggage, catering and cargo handling equipment or is from adjacent WIP.

4. All personnel involved in operations on the aerodrome movement area, maintenance hangars and aircraft turnrounds have equal responsibility to ensure that their particular operation does not give rise to FOD. Likewise, every member of staff should act when they detect FOD, either by removing it, should that be safe so to do, or reporting it immediately to the appropriate authority. Above all, FOD should be prevented.

5. Aerodrome and aircraft operators, maintenance and ground handling organisations should include FOD prevention in their induction and continuation training programmes, for all airside, maintenance and hangar staff. Specific procedures for the elimination of the risk of FOD should be implemented and working practices that pose a high risk of providing FOD should be reviewed.

6. Closer co-operation between aerodrome licence holders, aircraft operators and their service partners should be fostered. The topic of FOD should be a standing agenda item for all aerodrome users' committee meetings and internal safety meetings.

7. No proprietary system has yet been proven to be fully effective in the detection and identification of FOD on runways. However, while future developments of such systems should not be discounted, the use of advanced technology should only supplement current methods of inspection.

8. Aerodrome licence holders should regularly review their FOD policy and assure themselves that it remains effective. They should also ensure that any third-party operation on the aerodrome can demonstrate a satisfactory level of FOD awareness and that their working procedures do not increase the likelihood of FOD.

Pavement surfaces

9. Particular care is needed in the maintenance of the surfaces of maneuvering areas, especially where the pavement shows any signs of deterioration or damage. All joint sealants, crack repairs, patching and maintenance works should be stable and permanent even under the influence of aircraft movements, slipstream or jet efflux.

10. Pavements should be adequately sealed and joints properly filled to permit effective sweeping without forming a trap for debris. Runway and taxiway shoulders should also be adequately sealed and care exercised to minimise the risk of ingestion into turbine engines of vegetation, grass cuttings, and debris that can result from erosion of the surface by overhanging turbine engines. It is possible for stones to be thrown onto runways and taxiways during grass cutting or other work on areas adjacent to paved surfaces, and the potential hazard to aircraft that this presents should be minimised by frequent inspections during such activities, sweeping as necessary.

11. Newly surfaced areas can also be sources of hazard from engine ingestion. These areas should not be used by aircraft until the material is no longer susceptible to being picked up by the aircraft wheels or spattered on any part of the aircraft.

Grit and spoil

12. Sand used to clean fuel and oil spillage from aprons is a potential cause of turbine engine and propeller damage and should be removed immediately after use.

13. Where construction is in progress on aerodromes, authorities should, if practicable, prohibit use of the movement area by contractors' vehicles or at least minimise such use by restricting them to marked lanes, particularly when the vehicles are engaged in transporting the types of load from which spillage frequently occurs, e.g. building waste, gravel and fill. Earth and stones adhering to the wheels of such vehicles can also become dislodged and subsequently create a hazard to aircraft using the same areas. Where building construction is in close proximity to the movement area, it is important that some form of screening be provided to prevent sand and small stones being blown onto the movement area by high winds or jet blast. Following the completion of construction, the contractor should be required to remove all debris from the surrounding areas and not leave piles of dirt, or rubble, on the aerodrome surface.

Packages and wrappings

14. The widespread use of polythene bags and sheets on aprons is another potential source of damage to engines through ingestion. Suitably covered receptacles for such litter should be provided in sufficient numbers by aerodrome authorities. Similar receptacles should also be provided on all vehicles which use the movement areas on a routine basis.

15. Cargo areas are particularly liable to contamination from loose strappings, nails, wire, paper and wood etc. from crates or containers discarded in the course of handling, in addition to the polythene sheets mentioned above.

Inspection and standards of cleanliness

16. For details of inspection procedures see appendix 3F.

17. Aerodrome authorities should impress the need for apron cleanliness upon those in control of such staff as airline ground handlers, aircraft caterers, fuel suppliers, cleaners and freight agents who have access to the movement area in the course of their duties.

18. Analysis of any debris on the movement area should be undertaken to determine its origin, and the frequency of cleaning operations increased in those areas where contamination is highest. Remedial measures should be taken with those responsible.

Aircraft debris

19. Flight crews are expected to report at once to ATS any incident during take-off or landing which might result in a part of the aircraft's structure becoming detached and left behind on runways or taxiways. Ground engineering staff should also be asked to collaborate by reporting to ATS minor damage to aircraft which may have left debris on runways. Failure to make these reports to ATS could mean that debris remains on the runway for longer than would otherwise be the case, and thus, particularly at night, constitute an avoidable hazard to other aircraft taking off and landing.

20. Whenever debris is reported on the movement area, whenever a take-off is abandoned due to engine, tyre or wheel failure, or whenever an incident occurs that is likely to result in debris being left in a hazardous position, the runway, taxiway or apron as appropriate should be inspected and any debris removed before any other aircraft is allowed to use it.

Equipment for the removal of debris

21. Guidance on suitable equipment for providing clean aerodrome pavement is given in the ICAO Airport Services manual Part 2 .

APPENDIX 3F

Aerodrome pavement maintenance and inspection procedures

Introduction

1. Aerodrome pavements to runways, taxiways and aprons are critical to ensure that hazards to aircraft are minimised and to the safe, efficient and economic operation of an aerodrome. As such they represent a significant capital investment that must be preserved in a suitable condition for the particular demands of aircraft operations.

2. Aerodrome pavements are complex structural systems, and their performance depends on a large number of variables relating to the unique mix of aircraft operations, pavement materials and environmental conditions at each aerodrome. As with all aerodrome assets, the most effective means of preserving these pavements in a suitable condition is to implement appropriate inspection and maintenance procedures.

3. Aerodrome licence holders should be aware of the importance of timely and disciplined core runway inspections and have suitable procedures to ensure that such inspections are undertaken effectively. Regular inspections should be planned so as to ensure that an appropriate level of vigilance is maintained at all times. These will also improve the level of understanding of the changes
under local conditions and allow for maintenance activities to be proactive. The inspections should address the following related items:

    1. inspection of the runway surface condition, including water drainage characteristics;
    2. FOD detection and removal;
    3. aeronautical ground lighting fittings within the pavement including the structural integrity of the fittings;
    4. signage, markings and other visual aids;
    5. cleared and graded areas;
    6. wildlife control and the removal of remains.

4. A runway inspection involves the deliberate entry of an active runway. It is therefore essential that any hazards associated with this activity are identified and addressed so that each agency with an inspection duty has a clear understanding of what is involved and how the task is carried out safely.

5. All personnel with a task that involves entering a runway should clearly understand their responsibilities and the identified hazards. This training should be recorded, and a system of review should be established so that new hazards can be identified and new training needs satisfied.

6. The aerodrome licence holder should ensure that the development and use of runway

7. inspection procedures are addressed in the safety management system employed at the aerodrome.

Documentation

8. All aerodrome inspections, maintenance activities and matters arising from such should be formally documented by the aerodrome licence holder and records maintained for future reference.

9. Each inspection should include a reporting mechanism to ensure that appropriate action is taken. Reports should include details of the task(s); any remedial action(s) necessary or taken; should identify the person/agency responsible for undertaking the task and/or further action; and should identify the timescale by which it should be completed.

Daily inspections

10. The movement area should be inspected by aerodrome operations staff at least twice a day, although this may be increased dependent upon the movement rate and duration of operations, but the inspections should be spread over the main times of operational activity.

11. Inspections planned to take place during the hours of darkness may need to be done in a different manner from those undertaken during the daytime, with consideration being given to the presence of vehicles, people, lighting etc. The inspection should check the current suitability for aerodrome operations and the presence of FOD. Inspections may be undertaken from a vehicle travelling at a speed suitable to the task.

Weekly inspections

12. All aerodrome pavements within the movement area should be inspected in more detail at least once a week.

13. The inspection should check the integrity of the aerodrome pavements and should give particular attention to those areas subject to high loads such as departure taxiways, thresholds and high-speed operations. High levels of jet blast are known to be a cause for concern. Inspections should be undertaken preferably on foot but may be made from a slow-moving vehicle.

Annual inspections

14. All pavements within the movement area should be subject to inspection by a professional qualified engineer at least once a year. Inspections should be undertaken on foot and should cover the whole of the movement area or a statistically significant sample.

Optional inspections

15. Specific additional on-runway inspections, for example, wildlife hazard control or FOD detection, might be undertaken by a single vehicle and should be carried out at an appropriate speed for effective monitoring.

16. Off-runway observations may be taken from various vantage points, such as the edge of the clear and graded area, holding points, taxiways or tracks. Observations should be carried out from a stationary vehicle, with binoculars. These types of inspections may only be possible during daylight hours and, if utilised, should be integrated with the core 'on runway' inspections.

17. Daily runway lighting checks are normally undertaken in order to identify unserviceable lamps and possible failures of light fittings. It might be possible to incorporate inspections of particular areas of the runway at the same time. These inspections will need to integrate with the other on-runway inspections and be flexible in timing to cater for the variability of the onset of night.

18. Runway walking inspections can provide a more thorough examination of the runway. The number of full walking inspections planned for each year will depend upon the age and use of the runway surface, and the level of operations undertaken at each aerodrome. Suitable opportunities for this type of inspection may include during and after periods of maintenance, when engineering staff are working on the runway.

19. A runway inspection should be conducted in the vicinity of the working area after completion of the works to ensure that tools, machinery and other forms of FOD are not present. This is particularly important after works at night where there is a greater risk of the misplacement of work items.

Detailed pavement inspection and evaluation

20. The inspection procedures described address the functional condition of the surface of the aerodrome pavement but do not consider the structural condition of the pavement construction as a whole. In order to monitor the change in the condition of aerodrome pavements over time, it is recommended that aerodrome authorities establish a formal index to define pavement condition.

21. The pavement structure has a limited operational life that will be related in part to the declared PCN (PCR). The ACN/PCN (ACR/PCR) method is described in chapter 3. The aerodrome should review declared PCN (PCR) values in the light of the functional condition.

22. A detailed pavement inspection of functional condition should normally be undertaken every 2-4 years and a detailed pavement structural evaluation every 5-10 years. However, the frequency will depend on the age, condition and usage of each area.

23. The regular inspection and evaluation of aerodrome pavements can be the first step in establishing a formal management system that will provide significant advantages to aerodromes by improving the ability to predict, plan and budget for future maintenance work. A number of computerised systems are available.

APPENDIX 3G

Care of pavements during winter conditions – improving surface friction by removal of contaminants

(See also ICAO Airport Services manual Part 2 'Pavement Surface Conditions')

Chemical methods

1. Many chemicals that might be used to improve the friction coefficient of a movement area contaminated with ice, snow, slush or associated water are corrosive and harmful to aircraft components. It is, therefore, essential to confirm before using any chemical for this purpose that it has been tested and found harmless to aircraft components and light fittings and that it is acceptable ecologically.

2. Chemicals are best used as anti-icers. They may be in pellet or liquid form, but neither is universally satisfactory. Liquids used on a bare pavement can cause a loss of traction; and the pellet form is unsuitable for use on a porous friction course as it results in an uneven spread of anti-icing liquid and pockets of water in the surface layer.

3. When chemicals are used as deicers the result can be an icy surface covered by melt water, one of the most slippery of surfaces. This can be avoided by using pellet chemicals on a dry icy surface to loosen the ice which should then be removed mechanically.

4. Following the severe winter of 1978–79 considerable frost and ice damage was experienced, mainly to concrete pavements which had hitherto been satisfactory for a number of years. Investigations revealed a link between the use of liquid chemicals for pavement de-icing and the damage reported. Concrete when hardened contains a series of pores or voids which, depending upon the local weather conditions, may be partially or completely filled with water. This water, if it freezes, expands by approximately 9% but is usually safely accommodated by adjacent voids or by relief to the surface. The slower the rate of refrigeration the more safely this process can evolve. If the refrigeration rate is fast, or the surface is already frozen, there is a risk of damage to the pavement.

5. If ice forms on the concrete before a de-icing chemical is applied, it is quite probable that there will be water-filled voids below the surface. The deicer is subjected to very rapid cooling and the latent heat required to melt the ice is quickly drawn from the nearest available source, which in this case is the pavement. The more concentrated the chemical the more rapid is the refrigeration of the concrete, and the water in the voids may be turned to ice. If the resultant expansion cannot be relieved safely, the concrete surface will be damaged.

6. To reduce the risk of damage, the concrete used in modern pavements is air-entrained. Minute air bubbles are dispersed through the matrix and tend to act as cushions to absorb expansion. This process does not make the surface completely damage proof, so even comparatively new concrete pavements should be treated

with care.

7. It is always better to apply chemicals in advance to prevent ice forming. In the event that this cannot be done, the minimum amount of chemical should be used so as to reduce the risk of damage, even if it takes a little longer to remove the ice. As a guide, the maximum rate of spread for undiluted fluids should be 0.35 fluid ozs per square yard, equivalent to 1 kilo per 75 square metres. Records should be kept to determine the actual rate of spread achieved.

8. Whilst the above recommendations are for concrete pavements, bituminous surfaces should also be treated cautiously, especially if they are old. Though surfaces which are in good condition will not be liable to disruption, with age the thermoplastic binder can become brittle and porous, making the pavement vulnerable. Often, a new bituminous surface is laid over an old surface which contained extensive cracks. As time passes, these cracks tend to widen, the cracking is propagated upwards through the new surface and continued frosts aggravate the condition.

Mechanical methods

9. Mechanical methods of clearance should commence as soon as the snow begins to accumulate on the surface. The machinery employed will depend upon the type of snow, whether wet or dry, and the direction and strength of the wind. Normally, runway sweepers should be used first and for as long as they remain effective. Snow ploughs and blowers should supplement the sweepers only when the sweeper cannot efficiently remove the accumulation. The use of vehicles with chains, high speed snow drags, and underbody metal scrapers should be forbidden.

Sand/grit

10. Engine turbines will suffer erosion damage if even the finest grain sand is ingested. For this reason, sand should only be used on runways as a last resort. However, if it is necessary to use sand or grit to increase friction on the movement area, it needs to be carefully selected and the supply should be rigidly controlled to ensure that the material meets the specification at paragraph 12. below and is free from soluble salts. Loads containing oversized particles should be rejected, as should any flint-type material.

11. Normally runways should be swept clean of grit as soon as ice has melted but if they are gritted because of the imminent return of freezing conditions, pilots should be warned of the presence of 'dry' grit on the runway. It is particularly important to clear away any slush that is contaminated by grit. Such a combination thrown up by the wheels increases the risk of damage by ingestion.

12. Sand/grit should have an aggregate crushing value of less than 20 when tested in accordance with British Standards BS 812, 1973, Part 3 and be of the following sizes:

Metric	BS 410 sieve	US	% By weight passing
3 mm	1/8 inch	No. 6	100
1 mm	No. 14	No. 16	0 – 20
0.25 mm	No. 52	No. 50	0

13. The use of limestone chippings is not recommended as they do not provide good runway friction qualities and are wasteful in providing a high percentage of fines.

Porous friction course

14. A porous friction course presents a specific problem because of the nature of its construction. If water should be present in the pores of the friction course when freezing takes place, damage may be caused by expansion of the water within the pores, or ice protrusions may form on the surface of the runway as water is forced back onto the surface. To prevent these two possibilities, the principle of anti-icing should be followed using liquid chemicals to provide an even distribution of anti-icing fluid to infiltrate the whole structure. Aerodrome licence holders should satisfy themselves that the use of such chemicals does not breach environmental protection laws.

Ice detectors

15. Ice detectors can provide an accurate assessment of surface conditions and lead to the efficient and cost-effective use of anti-icing or de-icing materials.

APPENDIX 3H

Starter extensions

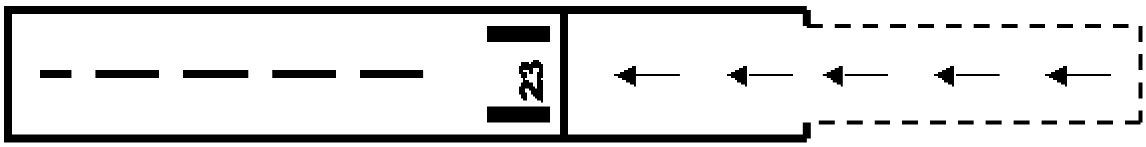
1. There are circumstances where additional declared distances may be provided at the start of the runway. Consequently, the term' starter extension' was introduced to permit additional runway distances to be utilised for take-off. For the requirements for these additional distances see chapter 3.

2. Starter extensions may be utilised to provide additional runway declared distances. So as to ensure that its purpose cannot be mistakenly interpreted as pre-threshold runway, stopway or clearway, the length of a starter extension is limited to a maximum of 150 m and the width to two-thirds of the normal runway requirement. The starter extension is not considered as a part of the runway dimensions.

   Note: *It may be necessary to provide extra width at the end of a starter extension to enable aeroplanes to turn around.*

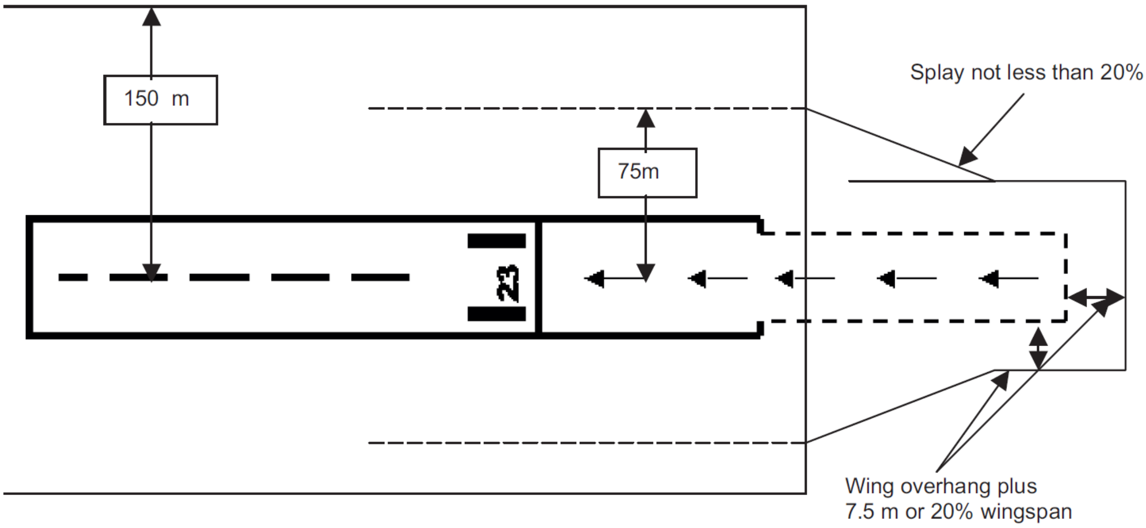
3. To differentiate further between a starter extension and pre-threshold runway, runway edge markings for the pre-threshold runway are to be consistent with those of the post-threshold runway, i.e., solid white lines, while those of the starter extension should be dashed white lines of 15 m length with 15 m spacing between each line. The width of the dashed white lines should be half the width of the centreline marking.

Figure 3H.1 Starter extension and pre-threshold markings



4. Starter extensions should be lit in accordance with the requirements given in chapter 6 with runway strip requirements as shown in chapter 3

Figure 3H.2 Starter extension safeguarding



5. Aerodrome licence holders should ensure runway declared distances published in the AIP are amended to include starter extensions at the earliest opportunity. To get a full picture of the effect the starter extension has on declared distances, TORA, TODA and ASDA should include the length of any starter extension. Promulgation should follow the example shown below:

AD2.12 – RUNWAY PHYSICAL CHARACTERISTICS

This section should indicate length of full-width runway only. The remarks column could include the description of any starter extensions in use and which runways are affected, e.g. 'Runway 10 has a starter extension of 150 x 30 m. Hard shoulder width at starter extension is 15 m'. AD2.13 – declared distances. Should a starter extension be utilised, the published TORA, TODA and ASDA should include the starter extension distance. The remarks column should then include a statement along the lines of: 'Runway 10 declared distances include a starter extension of 150 x 30 m'.

APPENDIX 3I

Runway end safety areas (assessment)

Introduction

1. Aerodromes are required to provide Runway End Safety Areas (RESA) for runways as specified in chapter 3. For applicable runways where the RESA does not extend to the recommended distance, as part of their safety management system, licence holders should assess the risk of both a runway excursion and a runway undershoot and implement appropriate and suitable mitigation measures as necessary

2. For the purpose of this guidance, runway excursions include an overrun or veer off on landing or during an aborted take-off. An aerodrome's assessment of RESA should consider each of these scenarios.

3. The aim of this guidance is to assist licence holders in assessing the level of risk of an aeroplane undershooting or overrunning a runway at their aerodrome and suggest mitigation measures that may be appropriate, both to reduce the likelihood and to reduce the potential effects of an event.

Aeroplane performance

4. In general pilots must calculate the take-off and landing distance required using performance charts/tables provided for each type of aeroplane by the manufacturer. These calculations must take into account the mass and configuration of the aeroplane and operational variables such as the physical characteristics of the runway, the obstacle environment surrounding the runway and environmental conditions such as temperature, pressure, precipitation and the head or tail wind component.

5. For public transport or commercial air transport operations, there is a legal requirement to include a safety margin in the calculations to allow for unforeseen variations in conditions and to provide an assured level of safety. These include an additional safety margin for wet or contaminated runway conditions. It is important to note that non-public transport or non-commercial air transport operations are not legally required to add these additional safety margins.

6. The likelihood of an aeroplane actually undershooting or overrunning a runway and needing the use of a RESA is very low and generally only happens in extreme circumstances.

Risk assessment

7. The risk of an aeroplane undershooting or overrunning a runway involves a large number of variable factors. These factors include prevailing weather conditions, the type of aeroplane (e.g. large jet aircraft, business jet, turboprop), the landing aids available, frequency of use, runway characteristics, the surrounding environment and pilot performance. Many of these factors are completely outside the control of the aerodrome but each of them can make a significant contribution to the overall level of risk. The nature of the hazard and level of risk will be different for each aerodrome and even for each runway direction at any one aerodrome.

8. The risk assessment should be able to:

   1. show that the risk of an undershoot or overrun has been assessed in terms of severity and likelihood;
   2. show that the risk has been mitigated as much as is reasonable and practicable;
   3. show that the level of remaining risk meets the safety standards of the aerodrome licence holder;
   4. provide the aerodrome management with a means of assessing the impact on the undershoot and overrun risk of any future changes to the aerodrome environment or the number or type of aeroplanes using the aerodrome.

9. Licence holders should take into account in their risk assessments, factors such as:

   1. the nature and location of any hazard beyond the runway end, including the topography and obstruction environment beyond the RESA and outside the runway strip;
   2. the types of aeroplane and level of traffic at the aerodrome, and actual or proposed changes to either;
   3. aircraft performance limitations arising from runway length and slope;
   4. aerodrome overrun history;
   5. the percentage of operations not using public transport performance safety factors;
   6. runway surface texture depth, transverse slope and drainage, irregularities that would result in a loss of friction, and the general friction characteristics when the runway is wet;
   7. degradation of runway surface friction which may affect aeroplane braking action due to the presence of contaminants or the accumulation of rubber deposits;
   8. ATC procedural risk mitigation measures to avoid creating conditions that increase the chance of a rushed/unstabilised approach.
   9. actual RESA provision and options for enhancement;
   10. the type and level of use of navigation aids, such as ILS/RNAV (GNSS) and/or PAPI.

Level of risk

10. There are different methods available to try to assess the overall level of risk. CAP 760, Guidance on the Conduct of Hazard Identification, Risk Assessment and the Production of Safety Cases details a suitable risk assessment process. In general, the level of risk should be assessed in terms of severity and likelihood so that an overall level of risk can be identified using a suitable risk tolerability matrix. Once the level of risk has been identified, where necessary, suitable risk mitigation measures can be used to reduce the level of risk to an acceptable level either by reducing the severity if the risk actually occurs or reducing the likelihood of the risk occurring.

Severity

11. In most scenarios the level of severity of an aeroplane undershooting or overrunning will depend on the area surrounding the runway. Any improvements to the area surrounding the runway, such as increasing the RESA distance, removing any obstacles, delethalising buried objects, removal of or improvement to the infrastructure surrounding the runway will decrease the severity if an undershoot or overrun actually occurs. The severity of an undershoot or overrun should be assessed in terms of the most realistic scenario and will depend on the hazards surrounding the runway end.

Likelihood

12. Determining the likelihood of an aeroplane undershooting or overrunning a runway is more difficult to assess. Some aerodromes have accumulated data over many years and use this to work out a reasonable likelihood of an undershoot or overrun by comparing the number of events with the number of total movements. However, most aerodromes will not have had previous experience of an event and may choose to use UK or worldwide statistical data from various sources to identify an appropriate level of likelihood.

13. Use of this type of data alone does not take into account the increased risk of an undershoot or overrun from an increase in traffic, new and larger types of aeroplanes using the runway, or changes to the infrastructure or physical characteristics of the runway.

Even though there may be a safety margin built into the performance calculations used by operators, the likelihood of an overrun increases as the proportion of the declared distance required for take-off or landing increases. Aeroplanes that do not require the full distance available for either takeoff or landing effectively have a built-in additional distance that could be used for stopping the aeroplane in addition to any RESA provided. Although the distances required will depend on the actual mass of the aeroplane and the weather conditions on the day, it should be possible to identify aeroplanes that could be described as being more likely to be performance-limited for a particular runway.

14. Depending on the actual conditions (aeroplane mass, temperature, pressure altitude, wind component, runway surface condition and obstacle environment) it may sometimes be necessary for an aircraft operator to reduce or limit the take- off mass of the aeroplane in order to use a particular runway due to the length of the runway. Similarly, the mass of the aeroplane on landing will affect the landing distance required and sometimes an aeroplane will not be able to land on a particular runway until the mass is reduced below a specified figure.

15. Under these conditions the aeroplane is performance-limited and needs all the available runway length (taking into account any safety margins added) in order to take off or land. Even though this is acceptable from a performance perspective it does mean the aeroplane is operating at the limit for that runway and there is no excess runway available beyond the included safety margins.

16. To help assess the likelihood of an aeroplane overrunning a runway, licence holders should assess the traffic using their aerodrome to identify what percentage of operations is likely to be performance limited.

17. An objective assessment of the severity, likelihood and overall level of risk of an aeroplane undershooting, veering off or overrunning a runway will have to be made using all the information available. Depending on the level of risk further mitigation measures to reduce either the severity and/or likelihood of an event happening may need to be considered.

Possible mitigation measures to consider

18. If the risk assessment reveals that the level of risk of an undershoot or overrun is of concern, mitigation measures will be required to reduce the level of risk to As Low As Reasonably Practicable (ALARP). It may be that the cost of a particular mitigation measure is beyond the scope of an aerodrome and will not be feasible; however, it is likely that many mitigation measures will be reasonably practicable and should therefore be considered.

19. The following list outlines some of the measures that may be considered, singly or in combination, to reduce the risks (in terms of severity or likelihood) of an undershoot, veer off and/or an overrun occurring. Mitigation measures that reduce the likelihood of either an undershoot, veer off or overrun include:

    1. Improve the friction characteristics of runway surfaces and/or limit the lowest friction values allowed. CAP 683, The Assessment of Runway Surface Friction Characteristics, specifies the requirements for runway friction. Resurface and if needed reshape the runway to improve runway surface texture depth, increase transverse slope for rapid drainage and remove any irregularities that would result in a loss of friction. Any surface should be constructed to provide good friction characteristics when the runway is wet and this would include grooving or providing a specific surface friction layer.

    2. Improve the friction characteristics of runway surfaces either by maintenance or the removal of contamination or rubber deposits to increase the chances of an

aeroplane stopping on the paved surface especially when wet or contaminated.

3. Ensure that a regular assessment and maintenance programme is in place to maintain adequate levels of grip at all times.
4. Ensure that accurate and up-to-date information on weather and the runway state is available to pilots.
5. Upgrade visual and instrument landing aids to improve the accuracy of aeroplane delivery at the correct landing position on runways (including the provision of Instrument Landing Systems and/or PAPIs).
6. Consider RNAV (GNSS) approaches for runways with non-precision approaches.
7. Ensure that touchdown zone markings are correctly located and clearly visible.
8. Install touchdown zone lighting.
9. Install coded runway centreline lights or yellow caution zone edge lights to indicate that the end of the runway is near.
10. In consultation with aeroplane operators and air navigation service providers formulate procedures to help ensure stabilised approaches.
11. In consultation with aeroplane operators and air navigation service providers consider operating procedures or restrictions for severe weather conditions.
12. Ensure the accuracy of any AIP entries with regard to the obstacle environment and declared distances.
13. Ensure an open dialogue between the aerodrome, air navigation service provider and aeroplane operators to raise awareness of the factors that could lead to a runway excursion.
14. Where possible reduce the number of tail wind landings and review any limitations in the use of reverse thrust due to noise abatement requirements.
15. Implement/promote a go-around policy for aircraft that have not touched down by the end of the touchdown zone.
16. During work in progress ensure that any temporarily reduced declared distances are clearly communicated to pilots and that any lighting, signs and markings correspond to the actual declared distances available.
17. During runway rehabilitation projects ensure that accurate information regarding the condition of the runway surface is effectively promulgated to pilots.
18. Mitigation measures that reduce the severity of either an undershoot, veer off or overrun include:
    a. Reduce the declared runway distances in order to provide an increased length of RESA. Aerodrome licence holders should consult with their operators to determine what effect a reduction in declared distances would have on their operations. Any increase in the length of a RESA provided will help to reduce the severity of an aeroplane actually undershooting or overrunning a runway and

should be considered a high priority wherever possible.

b. Install suitably positioned and designed arresting systems to supplement a RESA where appropriate. Further guidance on suitable arresting systems is available on the CAA website.

c. Minimise the obstruction environment surrounding the runway and in the area beyond the RESA. A reduction in obstructions surrounding the runway should decrease the severity if an aeroplane departs the runway unintentionally. This includes making obstructions frangible wherever possible and making the surrounding areas safe appropriately.

19. The above list is not exhaustive or in any particular order and should complement action by aeroplane operators, designers and aviation regulators. Aerodrome licence holders are reminded of the need to advise the CAA about changes to the physical characteristics of the aerodrome, in accordance with the licence conditions.

Optimising the available RESA

20. It is recognised that improving RESA distance is often difficult. However, it is important to note that incremental gains should be obtained wherever possible, as any gain is valuable. Therefore, whenever a runway project involves construction consideration should also be given to improving the RESA further. This includes:

a. Relocation or realignment of the runway - it may be possible to construct additional pavement at the start of take-off end to make more pavement available to retain the declared distances. The start and end of declared distances can be moved towards the downwind (start of take-off) end, thereby retaining the declared distance and creating space for a longer RESA.

b. In the case where landing RESA is limited and the runway has a displaced landing threshold, examine whether the threshold can be moved (downwind) to increase the RESA.

c. Increasing the RESA provision including land acquisition, improvements to the grading and realigning fences or roads to provide additional area.

d. Improving the slopes in the RESA to minimise or remove downward slopes.

e. Providing paved RESA with known friction characteristics.

Reviewing the risk assessment

21. As part of the aerodrome's SMS, licence holders should review the risk of a runway excursion whenever significant changes occur that would affect either the likelihood or severity of a runway excursion.

22. Changes affecting the level of risk include:

a. changes to the declared distances;

b. new aircraft types;

c. changes to the number of movements;

d. changes to the traffic mix;
e. runway rehabilitation projects;
f. proposed changes or projects involving the surrounding infrastructure;
g. changes to ATC procedures.

CHAPTER 4

The assessment and treatment of obstacles

Introduction

4.1 The effective utilisation of an aerodrome may be considerably influenced by natural features and man-made constructions inside and outside its boundary. These may result in limitations on the distance available for take-off and landing and on the range of meteorological conditions in which take-off and landing can be undertaken. For these reasons, certain areas of the local airspace must be regarded as integral parts of the aerodrome environment. The degree of freedom from obstacles in these areas is as important in the granting and retention of an aerodrome licence as the more obvious physical requirements of the runways and their associated runway strips and is determined by survey in accordance with CAP 1732, Aerodrome Survey Guidance and CAP 232, Aerodrome Survey Information.

4.2 The method of assessing the significance of any existing or proposed object within the aerodrome boundary or in the vicinity of the aerodrome is to establish defined obstacle limitation surfaces particular to a runway and its intended use. The purpose of this chapter is to define these obstacle limitation surfaces and their characteristics and describe the action to be taken in respect of objects which infringe them. These surfaces are illustrated at figure 4.11. In ideal circumstances all the surfaces will be free from obstacles but when a surface is infringed, any safety measures required by the CAA will have regard to:

1. the nature of the obstacle and its location relative to the surface origin, to the extended centreline of the runway or normal approach and departure paths and to existing obstructions;
2. the amount by which the surface is infringed;
3. the gradient presented by the obstacle to the surface origin;
4. the type of air traffic at the aerodrome; and
5. the instrument approach procedures published for the aerodrome.

4.3 Safety measures could be as follows:

1. promulgation in the UK AIP of appropriate information
2. marking and/or lighting of the obstacle
3. variation of the runway distances declared as available
4. limitation of the use of the runway to visual approaches only
5. restrictions on the type of traffic

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

4.5 Particular attention should also be given to the security of the movement area and access denied to unauthorised persons and/or vehicles.

4.6 Paragraphs 4.8 to 4.49 illustrate how to determine what constitutes an obstacle.

4.7 Paragraphs 4.50 onwards relate to the treatment of obstacles.

Obstacle limitation surfaces

The take-off climb surface

4.8 A take-off climb surface is an inclined plane located beyond the end of the take-off run available or the end of the clearway where one is provided.

4.9 A take-off climb surface is established for each runway direction intended to be used for take-off.

4.10 The limits of a take-off climb surface comprise:

1. an inner edge of specified length, perpendicular to the extended centreline of the runway, at the end of the clearway, when such is provided, but in no case less than:
   a) a distance of 60 m measured horizontally in the direction of take-off beyond the end of the declared take-off run available, where the code number is 2, 3 or 4; or
   b) a distance of 30 m measured horizontally in the direction of take-off beyond the end of the declared take-off run available where the code number is 1.
2. two sides originating at the ends of the inner edge, diverging uniformly at a specified rate from the vertical projection of the take-off flight path to a specified final width and continuing thereafter at that width for the remainder (if any) of the length of the take-off climb area;
3. an outer edge parallel to the inner edge.

4.11 The dimensions of the take-off climb surface are specified in table 4.1 and illustrated in figures 4.1 to 4.4. A reduced length may be adopted where this length would be consistent with procedures for the control of departing aeroplanes.

4.12 The elevation of the inner edge is equal to that of the end of the clearway, or clearway plane, on the extended centreline of the runway. Where a clearway is not provided, the elevation is that of the point of intersection of the centreline of the runway and the inner edge.

4.13 In the case of a straight take-off flight path, the slope of the take-off climb surface is measured in the vertical plane containing the extended centreline of the runway. The slope should not be steeper than is specified in table 4.1. Where no object reaches the 2% (1:50) surface slope specified for runways where the code number is 3 or 4, the slope should be reduced until it touches the first immovable object or reaches 1.6% (1:62.5), whichever is the steeper. If the slope is reduced, the length of the surface should be increased to afford protection on the climb to a height of 1000 ft.

4.14 In the case of a take-off flight path involving a turn, the take-off climb surface is a complex surface such that the normal at any point on the flight path centreline is a horizontal line at the same height above surface origin as would have resulted from the application of a straight flight path. The edge of a TOCS may be slewed in the direction of a turn away from the extended runway centreline up to a maximum of 15° splay. The portion of TOCS encompassing the new departure track should be the same shape and dimensions as the original TOCS measured relative to the new departure track. The opposite edge of the TOCS should remain unchanged unless there is another turning departure towards that side also, in which case, the edge may be slewed in that direction too.

4.15 Where a runway is 10% or more than the minimum width, the length of the inner edge of the take-off climb surface is extended so that it is not less than the appropriate strip width. The initial part of the surface is formed by sides drawn from the strip edges parallel to the extended centreline until they intersect the diverging sides of the normal take-off climb surface (see figure 4 . 4).

Table 4.1 Dimensions and slopes of take-off climb surfaces

Code number	3 or 4	2	1
Length of inner edge	180m	80m[1]	[2]60m
Distance of inner edge from end of take-off run[3]	60 m	60 m	30m
Divergence (each side)	12.5%	10%	10%
Final width	1200m [4]180 m	580m	380m
Length	15000m	2500m	1600m
Slope	2% (1:50)	4% (1:25)	5% (1:20)

1 and 2. Where clearway is provided, the length of the inner edge should be 150m.
3. Where clearway is provided, the inner edge is at the end of the clearway.
4. When the intended track includes changes of heading greater than 15°, the final width of the take-off climb surface for runways where the code number is 3 or 4 is increased to 1800m.

Figure 4.1 Take-off climb surface associated with a runway where the code number is 3 or 4, also showing slewed TOCS

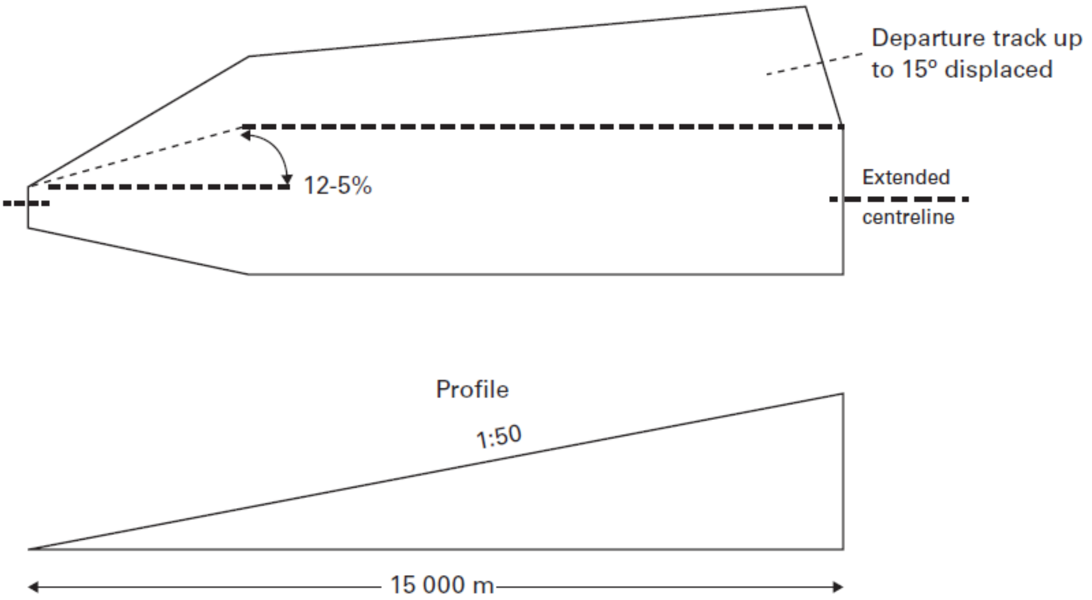


Figure 4.2 Take-off climb surface associated with a runway where the code number is 2

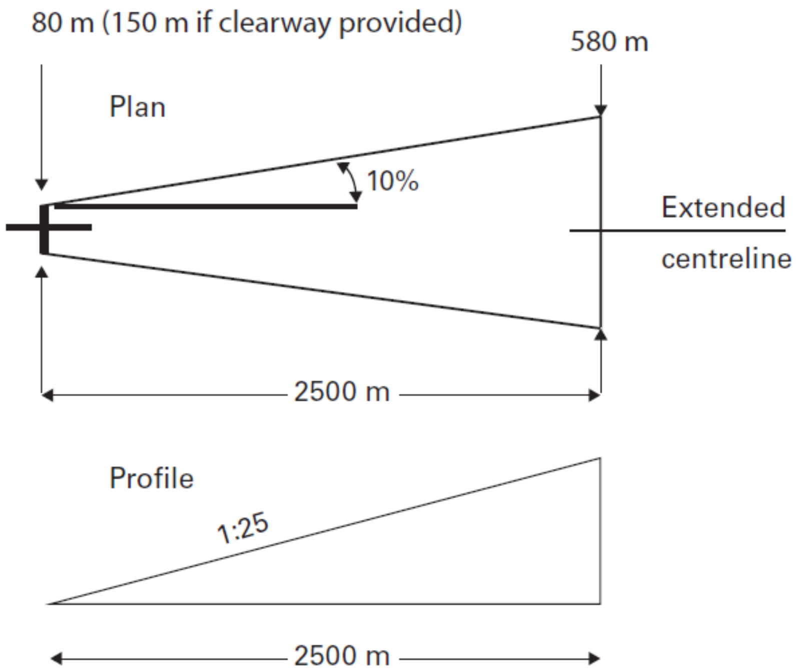


Figure 4.3 Take-off climb surface associated with a runway where the code number is 1

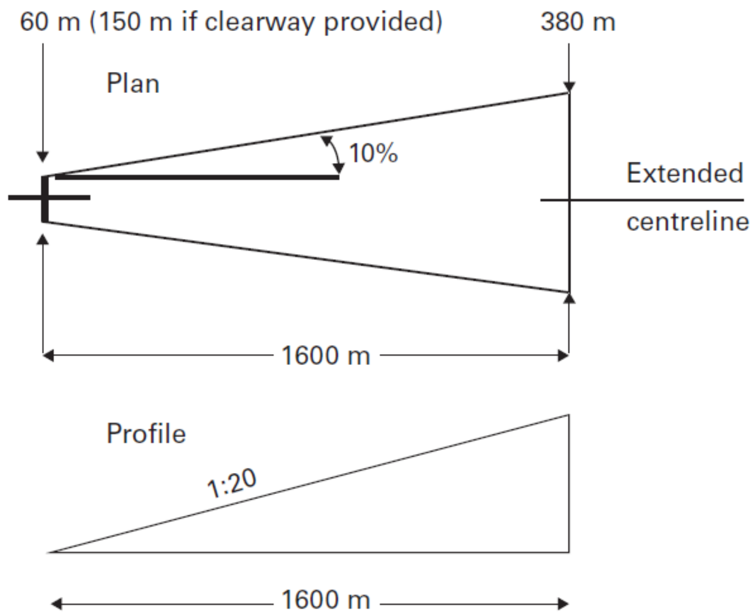
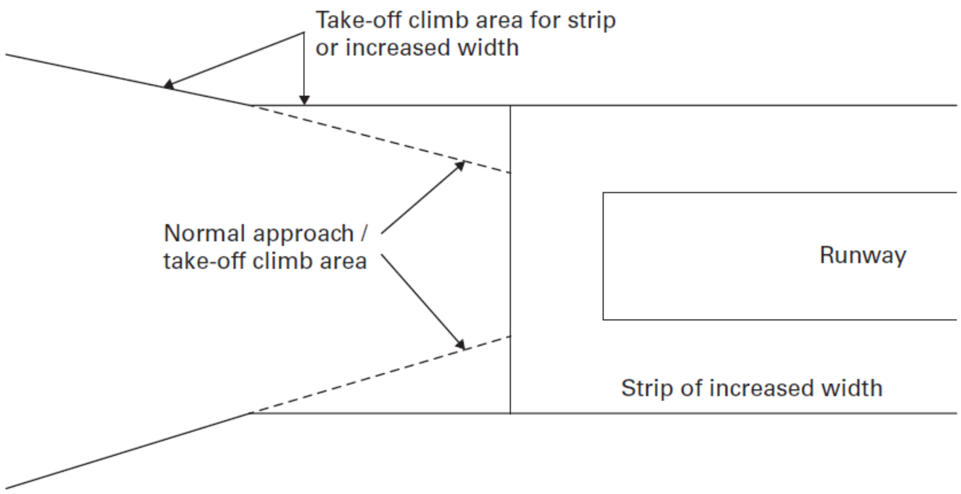


Figure 4.4 Approach/take-off climb surface associated with a runway of substantially more than minimum width



The approach surface

4.16 An approach surface is an inclined plane or combination of planes preceding the threshold.

4.17 An approach surface is established for each runway direction intended to be used for the landing of aircraft.

4.18 The limits of the approach surface comprise:

1. a horizontal inner edge of specified length perpendicular to the centreline of the runway located at a distance of 60 m before the landing threshold, except in the case of non-instrument runways where the code number is 1 and where the distance is 30 m;

2. two sides originating at the ends of the inner edge and diverging uniformly at a
3. specified rate from a line drawn parallel to the extended centreline of the runway;
4. an outer edge parallel to the inner edge.

4.19 The dimensions and slope of the approach surface are specified in table 4.2 and illustrated in figures 4.5 to 4.10.

4.20 The elevation of the inner edge is equal to the elevation of the mid-point of the landing threshold.

4.21 The slope of the approach surface is measured in the vertical plane containing the centreline of the runway. An approach surface for an instrument runway is horizontal beyond the point at which it intersects a horizontal plane 150 m above the threshold elevation.

4.22 Where there is a runway of 10% or more than the minimum width, the length of the inner edge of the approach surface is extended so that it is not less than the appropriate strip width. The initial part of the surface is formed by sides drawn from the strip edges parallel to the extended centreline until they intersect the diverging sides of the normal approach surface. This principle is illustrated at figure 4.4.

Table 4.2 Approach surface slopes and dimensions

	Precision instrument approach runways		Non-precision instrument approach runways		Non-instrument runways			
	Code number		Code number		Code number			
	3 or 4	1 or 2	3 or 4	1 or 2	4	3	2	1
Length of inner edge	280m	140m	280m	140m	150m	150m	80m	60m
Distance before threshold	6 m	60m	60m	60m	60m	60m	60 m	30m
Divergence each side	15%	15%	15%	15%	10%	10%	10%	10%
Length of first section	3000m	3000m	3000m	2500m	3000m	3000m	2500m	1600m
Slope of first section	2% (1:50)	2.5% (1:40)	2% (1:50)	3.33% (1:30)	2.5% (1:40)	3.33% (1:30)	4% (1:25)	5% (1:20)
Length of second section	360 m	2500m	3600m					
Slope of second section	2.5% (1:40)	3% (1:33.3)	2.5% (1:40)					
Length of horizontal section	8400m	9500m	8400m					

.

Figure 4.5 Approach surface associated with an instrument runway where the code number is 3 or 4

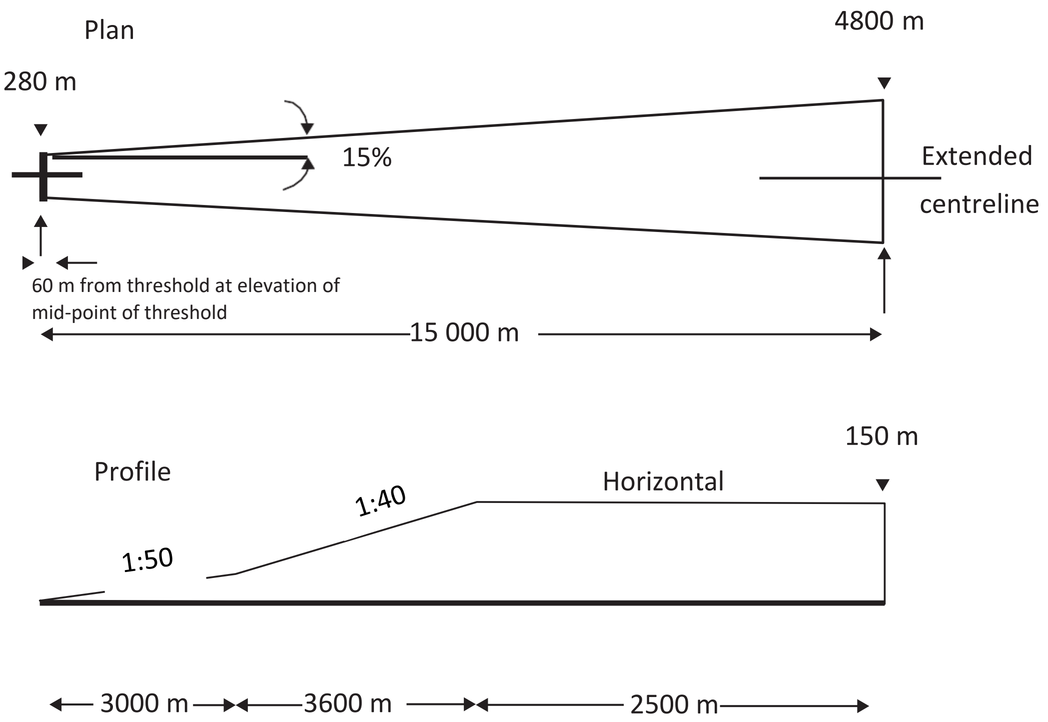


Figure 4.6 Precision instrument approach where the code number is 1 or 2

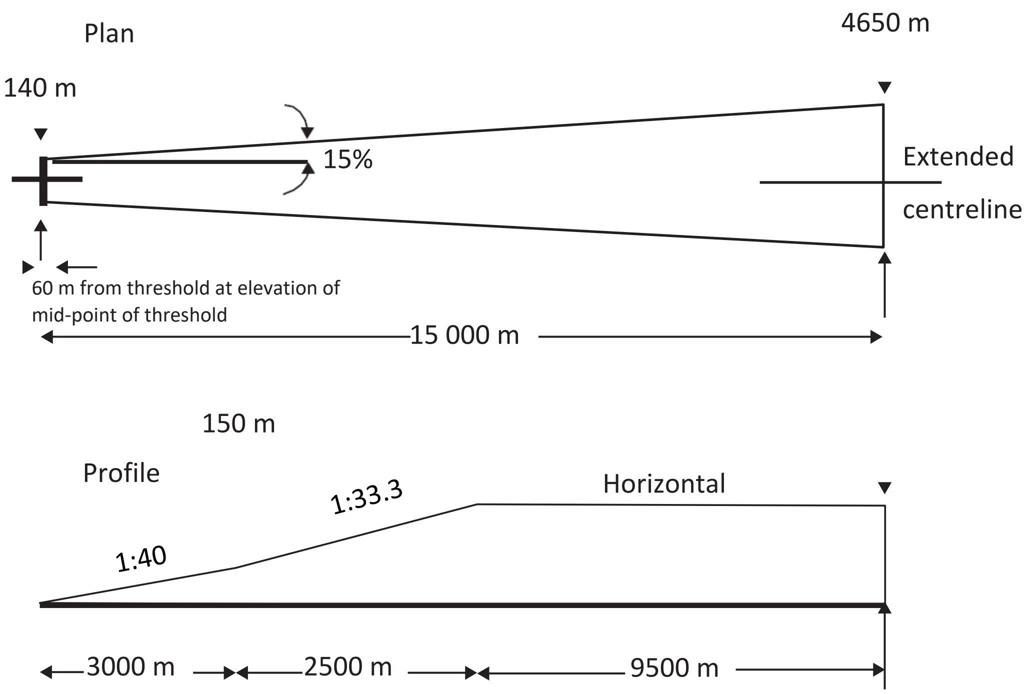


Figure 4.7 Non-precision instrument approach where the code number is 1 or 2

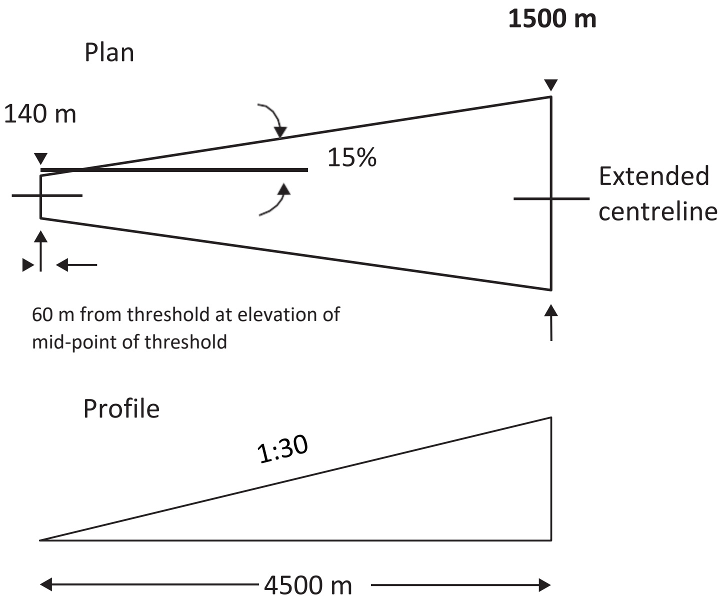


Figure 4.8 Approach surface associated with a non-instrument runway where the code number is 3 or 4

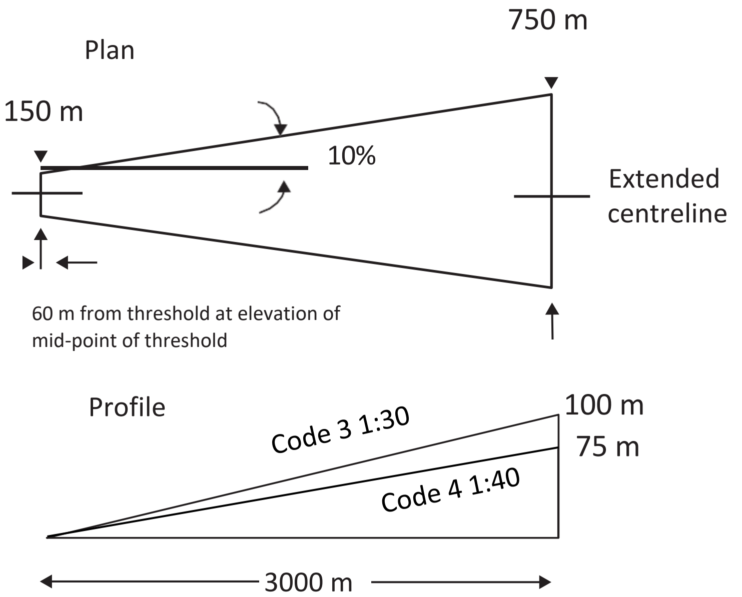


Figure 4.9 Approach surface associated with a non-instrument runway where the code number is 2

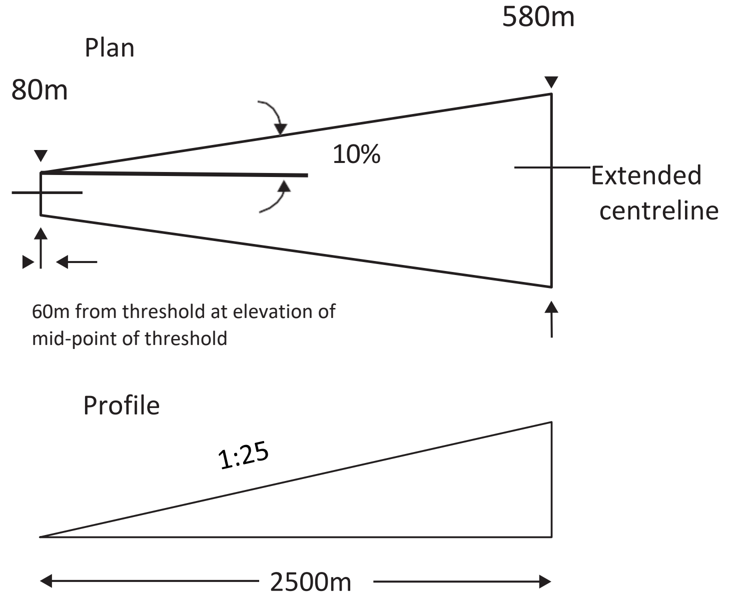


Figure 4.10 Approach surface associated with a non-instrument runway where the code number is 1

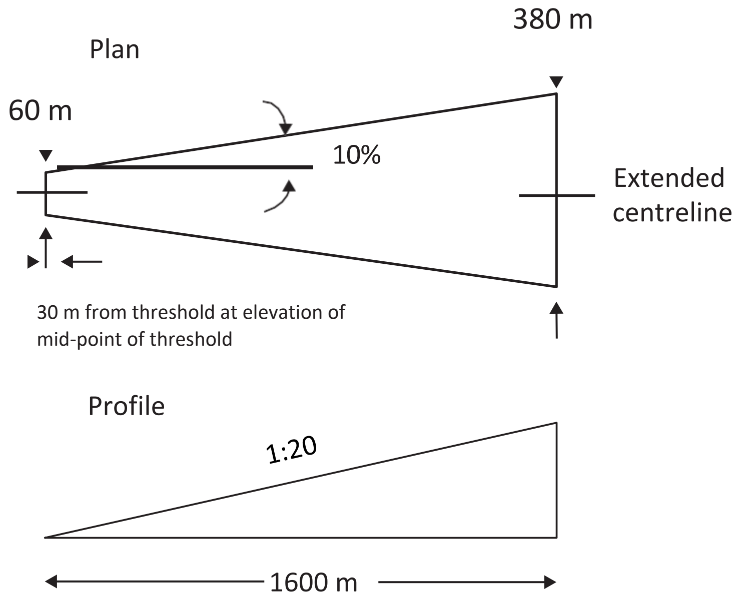
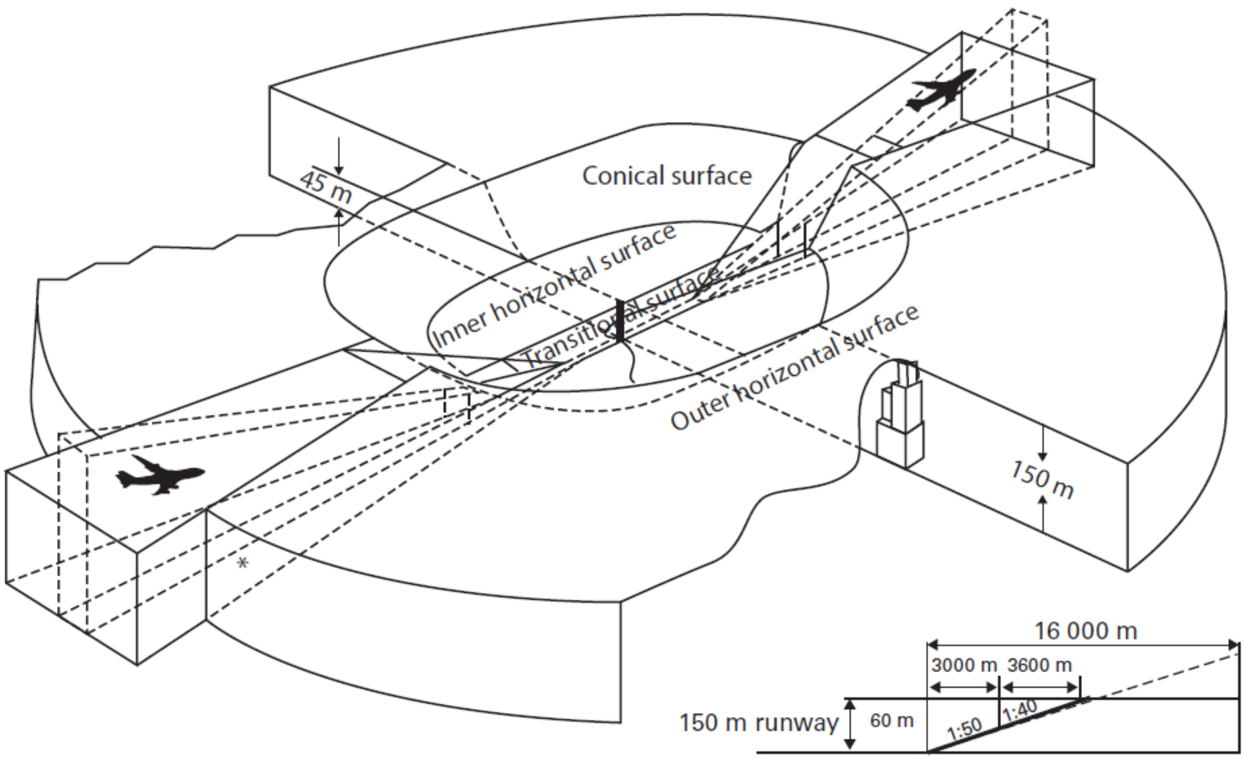


Figure 4.11

Obstacle limitation surfaces for an instrument runway where the main runway is 1800 m or more in length



Note: The take-off funnels are shown in chain-dot line in both views. To assess clarification the vertical scale on this chart is 20 times that of the horizontal scale.

The transitional surface

4.23 A transitional surface is a complex surface sloping up to the inner horizontal surface from the side of the runway strip and from part of the side of the approach surface.

4.24 Transitional surfaces are established for every runway intended to be used for landing.

4.25 The slope of the transitional surface is measured in the vertical plane above the horizontal, and normal to, the centreline of each runway. Where the runway code is 1 or 2 and has a non-instrument or non-precision instrument approach, the slope is 20% (1:5). For all other runways the slope is 14.3% (1:7).

4.26 The elevation of any point on the lower edge of the surface is:

1. along the side of the approach surface, equal to the elevation of the approach surface at that point;
2. along the strip, equal to the elevation of the centreline of the runway opposite that point.

4.27 The outer limit of a transitional surface is determined by its intersection with the plane of the inner horizontal surface.

4.28 An obstacle may be sited in a position that would cause it to infringe the transitional surface only if:

1. it is an aid to navigation;
2. the entire structure complies with the frangibility requirements of obstacles sited within runway strips (chapter 3 refers); and
3. it does not penetrate a surface sloping upward and outward from the centreline of the runway at a slope of 1:10. The elevation of the lower edge of this 1:10 slope is that of the runway centreline at a point where a line drawn to the obstacle is normal to the centreline. The elevation of the upper edge is where the 1:10 surface:
    a) meets the transitional surface, or where no such intersection occurs;
    b) is equal to the elevation of the inner horizontal surface and continues at this height until it meets the point where the transitional surface intercepts the inner horizontal surface.

The inner horizontal surface

4.29 An inner horizontal surface is a horizontal plane located above an aerodrome and its vicinity. It represents the level above which consideration needs to be given to the control of new obstacles and the removal or marking of existing obstacles to ensure safe visual maneuvering of aeroplanes in the vicinity of the aerodrome.

4.30 An inner horizontal surface is established for every aerodrome.

4.31 The inner horizontal surface is contained in a horizontal plane located 45 m above the elevation of the lowest runway threshold existing or proposed for the aerodrome.

4.32 The limits of the inner horizontal surface are established as follows:

4.33 Where the main runway is 1800m or more in length, circles of radius 4000m are described centred on the strip ends of the runway. These circles are joined by common tangents parallel to the runway centreline to form a racetrack pattern. The boundary of this pattern is the boundary of the inner horizontal surface.

4.34 Where a main runway is less than 1800 m in length, the inner horizontal surface is circular and is centred on the mid-point of the runway. The radius is 4000m except in the case of non-instrument runways where the code number is 1 or 2. For these runways the radii are 2000m and 250 m respectively.

4.35 Where an end of a subsidiary runway more than 1800 m long is less than 3000m from any point on the periphery of the surface constructed in accordance with paragraph 4.33 or 4.34, the dimensions of the surface are modified. A circle of radius 3000 m is described centred on the strip end of the subsidiary runway, and this is joined by common tangents to the pattern already established.

4.36 Where the inner horizontal surface is at any point lower than an approach surface or take-off climb surface, the inner horizontal surface is the obstacle limitation surface at that point.

The conical surface

4.37 A conical surface is a surface sloping upwards and outwards from the periphery of the inner horizontal surface. It represents the level above which consideration needs to be given to the control of new obstructions and the removal or marking of existing obstructions so as to ensure safe visual maneuvering in the vicinity of an aerodrome.

4.38 A conical surface is established for every aerodrome.

4.39 The slope of the conical surface measured in the vertical plane above the horizontal is 5% (1:20).

4.40 The outer limits of the conical surface are contained in a horizontal plane located 105 m above the inner horizontal surface except where the code number of a non-instrument runway is 2 or 1. In these cases the plane is located 55 m above the inner horizontal surface where the code number is 2 and 35 m above the inner horizontal surface where the code number is 1.

The outer horizontal surface

4.41 An outer horizontal surface is a specified portion of a horizontal plane around an aerodrome beyond the limits of the conical surface. It represents the level above which consideration needs to be given to the control of new obstacles in order to facilitate practicable and efficient instrument approach procedures, and together with the conical and inner horizontal surfaces to ensure safe visual maneuvering in the vicinity of an aerodrome.

4.42 An outer horizontal surface is established for every aerodrome where the main runway is 1100 m or more in length.

4.43 The outer horizontal surface extends from the periphery of the conical surface to a minimum radius of 15000m from the aerodrome reference point when the main runway is 1860m or more in length and to a minimum radius of 10000m where the main runway is 1100m or more but less than 1860m in length.

The Obstacle Free Zone (OFZ)

4.44 An OFZ is intended to protect aeroplanes from fixed and mobile obstacles during Category I, II or III operations when approaches are continued below decision height and during any subsequent missed approach or balked landing with all engines operating normally. It is not intended to supplant the requirement of other surfaces or areas where these are more demanding.

4.45 The limits of the OFZ where the code number is 3 or 4 are described below and illustrated at figure 4.12. It is designed to protect an aeroplane with a wingspan of up to 60m which has descended below a height of 100 ft and has been correctly aligned with the runway at that height by visual reference to the runway or approach lighting. The length of runway enclosed is based on an assumption that a go-around is initiated not later than the end of the touchdown zone and that a further 900m distance is sufficient for the pilot to make any necessary changes of the aircraft configuration and to achieve a positive rate of climb of at least 3.33% with a deviation from track contained within a 10% splay either side of centreline. When an aeroplane's wingspan is greater than 60m or its performance is worse than the basis used in defining the surfaces, the OFZ will need to be redesigned or operations for the particular aeroplane restricted. Conversely a narrower OFZ may be acceptable if the wingspan of the aeroplanes at a particular aerodrome is limited to less than 60 m.

4.46 The limits of the OFZ where the code number is 1 or 2 are described in paragraph 4.49 and illustrated in figure 4.13. The rationale is similar to that detailed in paragraph 4.45 except that the maximum wingspan is reduced to 30m, the rate of climb on missed approach increased to 4%, and the origin of the balked landing surface is at the upwind end of the runway strip.

4.47 An OFZ is established for each precision instrument approach Category II or III runway and shall be maintained during operations conforming to those categories. An OFZ should be established for precision instrument approach Category I runways and should be maintained during operations conforming to this category.

4.48 The limits of the OFZ where the code number is 3 or 4 comprise:

1. a portion of the instrument approach surface commencing at its inner edge at a width of 60m on each side of the extended centreline of the runway and extending at this width for a distance of 1500m away from the direction of landing, and with an outer edge parallel to the inner edge. This distance shall increase to 70.0m for code F runways;
2. a portion of the runway strip extending to 60m on each side of the runway centreline from a distance of 60 m before threshold to a distance of 1800m beyond threshold. This distance shall increase to 70.0m for code F runways;
3. a balked landing surface with:
   a) an inner edge coincident with the upwind edge of the area described at 2 above, with an elevation of the centreline of the runway at that point;
   b) two sides originating at the outer extremities of the inner edge and diverging uniformly at 10% each side from the extended centreline of the runway;
   c) an outer edge parallel to the inner edge and located in the plane of the Inner Horizontal Surface;
   d) a slope of 3.33% (1:30) measured in the vertical plane containing the centreline of the runway.
4. side surfaces which slope upwards at 33.3% (1:3) measured in a vertical plane normal to the centreline of the runway:
   a) from the sides of that portion of the approach surface described at paragraph 4.48 1. to a height equal to the plane of the inner horizontal surface, with the elevation of any point on the lower edge equal to the elevation of the approach surface at that point;
   b) from the sides of the area described at paragraph 4.48 2 to a height equal to the plane of the inner horizontal surface, with the elevation of

any point along the lower edge equal to the elevation of the centreline of the runway opposite that point;

c) from the sides of the balked landing surface described at paragraph 4.48 3 to a height equal to the plane of the inner horizontal surface with the elevation of any point on the lower edge equal to the elevation of the balked landing surface at that point.

4.49 The limits of the OFZ where the code number is 1 or 2 comprise:

1. a portion of the instrument approach surface commencing at its inner edge at a width of 45 m on each side of the runway centreline and extending at this width for a distance of 1500m away from the direction of landing, and with an outer edge parallel to the inner edge;
2. a portion of the runway strip extending to 45 m on each side of the runway centreline from a distance of 60m before threshold to a distance of 60 m beyond the end of the landing distance available;
3. a balked landing surface with:
   a) an inner edge coincident with the upwind edge of the area described at paragraph 4.49 2, with an elevation equal to that of the centreline of the runway at that point;
   b) two sides originating at the outer extremities of the inner edge and diverging uniformly at 10% each side from the extended centreline of the runway;
   c) an outer edge parallel to the inner edge and located in the plane of the inner horizontal surface;
   d) a slope of 4% (1:25) measured in the vertical plane containing the centreline of the runway.
4. side surfaces which slope upwards at 40% (1:2.5) in a vertical plane perpendicular to the centreline of the runway:
   a) from the sides of that portion of the approach surfaces described in paragraph 4.49 1 to a height equal to that of the plane of the inner horizontal surface, with the elevation of any point on the lower edge equal to the elevation of the approach surface at that point;
   b) from the sides of the area described at paragraph 4.49 2 to a height equal to that of the plane of the inner horizontal surface, with the elevation of any point along the lower edge equal to the elevation of the centreline of the runway opposite that point;
   c) from the sides of the balked landing surface described at paragraph 4.49 3 to a height equal to that of the plane of the inner horizontal surface with the elevation of any point on the lower edge equal to the elevation of the balked landing surface at that point.

Figure 4.12 OFZ for category I, II and III operations where the code number is 3 or 4 (not to scale)

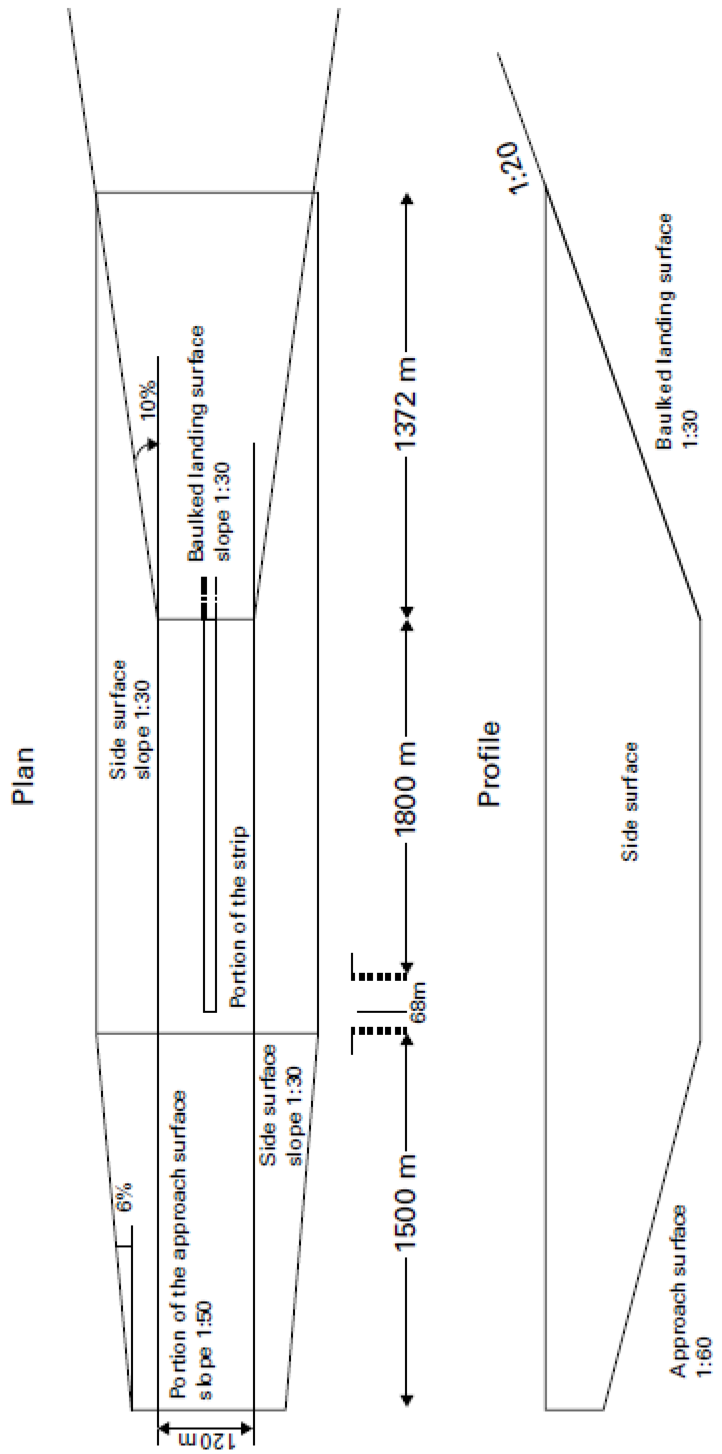
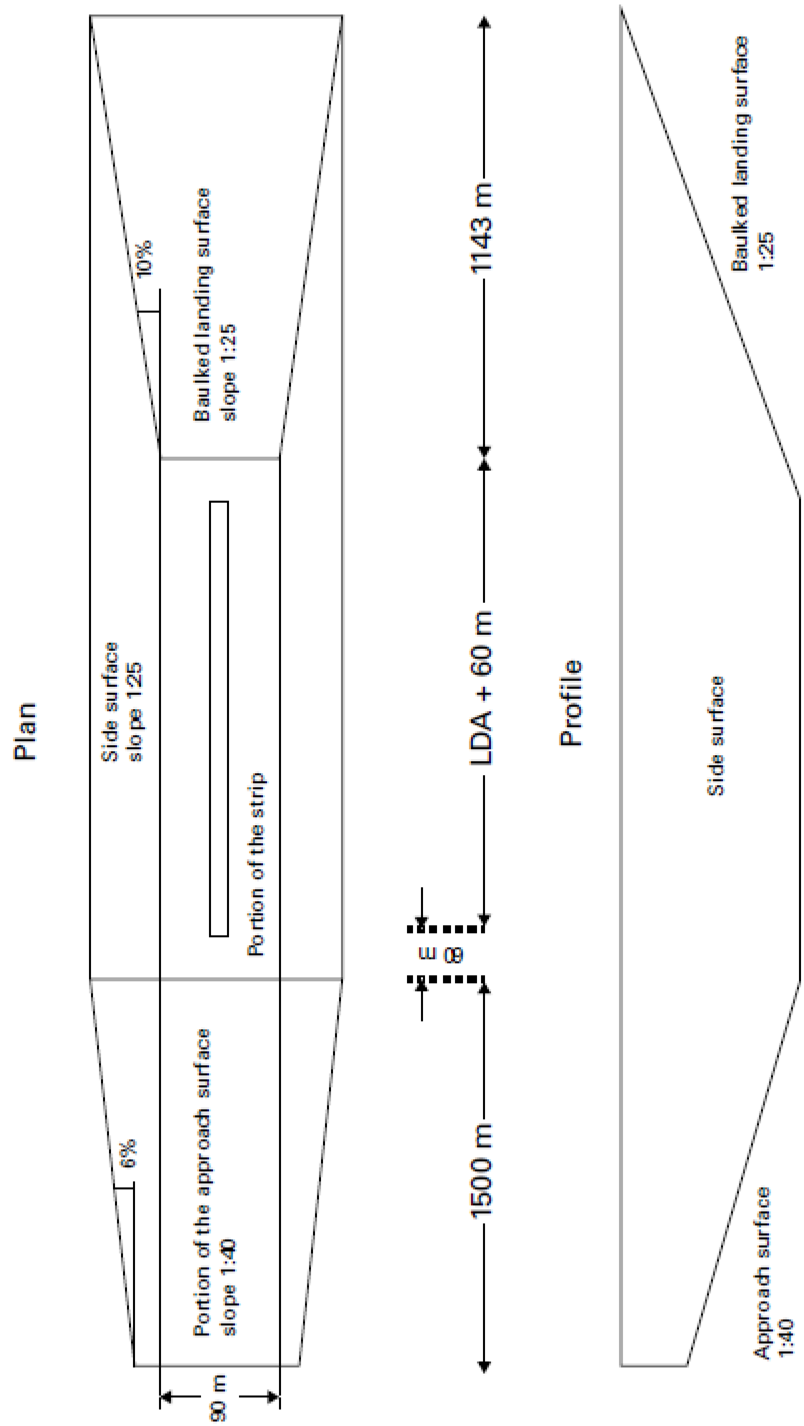


Figure 4.13 OFZ for category I operations where the code number is 1 or 2 (not to scale



Restriction and removal of obstacles

4.50 New objects or additions to existing objects should not extend above an approach surface, above a transitional surface or above a take-off climb surface, except when in the opinion of the CAA the new object or addition would be shielded by an existing immovable object or if after a safety assessment, it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

4.51 New objects or additions to existing objects should not extend above an inner horizontal surface, a conical surface or an outer horizontal surface, except when in the opinion of the CAA the object would be shielded by an existing immovable object or it is determined that the object would not adversely affect the safety or significantly affect the regularity of aircraft operations.

4.52 Existing objects above an approach surface, transitional surface, take-off climb surface, inner horizontal surface or conical surface should as far as practicable be removed, except when in the opinion of the CAA the object is shielded by an existing immovable object or if after a safety assessment, it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

4.53 In guidance material in ICAO annex 14 Volume 1, all roads are considered to be obstacles extending to 4.8 m above the crown of the road. Similarly, railways, regardless of the amount of traffic, are considered to be obstacles extending 5.4 m above the top of the rails. On receipt of an acceptable safety assessment that considers the maximum possible height of the obstacle and has assessed, as far as practicable, future development of the surrounding infrastructure, the CAA may use its discretion in accepting lower values for mobile and fixed obstacles.

4.54 Objects which do not penetrate an approach surface to a new runway or a proposed runway extension but which would nevertheless adversely affect the optimum performance of visual or non-visual aids should be removed.

4.55 Anything which may, in the opinion of the CAA, endanger aircraft on the movement area must be removed. Except for those objects or vehicles on essential aerodrome duties which, because of their function, must be positioned within the runway strip (but outside the cleared and graded area) to meet air navigation requirements, any object or vehicle situated on a runway strip which may endanger aircraft must be removed.

4.56 No object, whether fixed or mobile, is to be permitted to penetrate the OFZ during the use of a runway for landing in Category I, II or III operational conditions, except essential visual aids which are frangibly mounted.

4.57 No object, whether fixed or mobile, is to be permitted to penetrate the balked landing surface of an OFZ established for Category II or III operations. Where this surface intercepts the Basic ILS missed approach obstacle clearance surface, the latter becomes limiting. The Basic ILS missed approach surface is a 2.5% (1:40) slope commencing 900 m after the landing threshold, at the same elevation as the threshold.

4.58 Confirmation that the extended OFZ balked landing surface is obstacle free up to the height where it intersects with the Category I ILS missed approach surface will normally be necessary only when the OFZ is initially established. Thereafter, the normal safeguarding procedures, as well as observance of the conditions of the aerodrome licence, will ensure that either the extended OFZ missed approach surface will remain obstacle free or that proposed constructions which might infringe the surface are referred to the CAA for consideration.

4.59 Objects which would endanger aircraft in the air are not permitted in a clearway.

4.60 Essential aids to navigation, providing they are frangible and do not exceed 0.9 m above ground level or the clearway plane, as appropriate, are acceptable.

4.61 Objects which would endanger aircraft on the ground are not permitted in a stopway or runway end safety area. When it is essential for approach light fittings to be situated in a stopway, they must be frangible and not exceed 0.46m in height.

4.62 Where there are transverse or longitudinal slopes on a strip or clearway the inner edge of a take-off climb surface or an approach surface may lie partly or wholly below the level of the ground in the strip or clearway. It is not necessary that the strip or clearway should, in such cases, be graded to conform with the inner edge of the take-off climb or approach surface.

4.63 Because of the difficulty of recognition, special restrictions must be applied to elevated wires and their supports. Where no other object penetrates a given obstacle limitation surface, overhead wires and their supports should not penetrate a surface passing through the top of the highest existing object and parallel to the established surface for a distance of 1500m from the runway threshold. The shielding criteria at paragraphs 4.64 to 4.67 do not apply to the shielding of overhead wires.

Shielding of obstacles

4.64 The principle of shielding is employed when a substantial and permanent object or natural terrain already penetrates an obstacle limitation surface. When it is considered that such an obstacle is permanent, objects of equal or lesser height around it may, at the CAA's discretion, be permitted to penetrate the surface.

4.65 Acceptance by the CAA of obstacle limitation surface penetrations using the shielding principle will always be subject to close scrutiny of the operational implications. Existing obstacles will be regarded as shields only when there is no prospect of their removal or destruction.

4.66 An object, building, structure or terrain which is accepted as a shielding obstacle and which penetrates an approach or take-off climb surface will create two shielding planes (see figure 4.14). The first plane is horizontal at the elevation of the top of the obstacle and extends from the obstacle in the direction away from the runway. The second plane extends from the top of the shielding obstacle, towards the runway with a negative slope of 10%.

4.67 planes will be the width of the obstacle (measured in the plane normal to the extended centreline of the runway at the obstacle), decreasing with sides parallel to the sides of the relevant protecting surface (see figure 4.15), until the point where these projected lines converge, or intersect the take-off climb surface or the approach surface. Thus, either the profile or plan view may take the form of a truncated triangle (see figures 4.14 and 4.15). Where the take-off climb surface and the approach surface are not coincident it may be necessary to adopt a different angle of convergence, between the two surfaces.

Figure 4.14

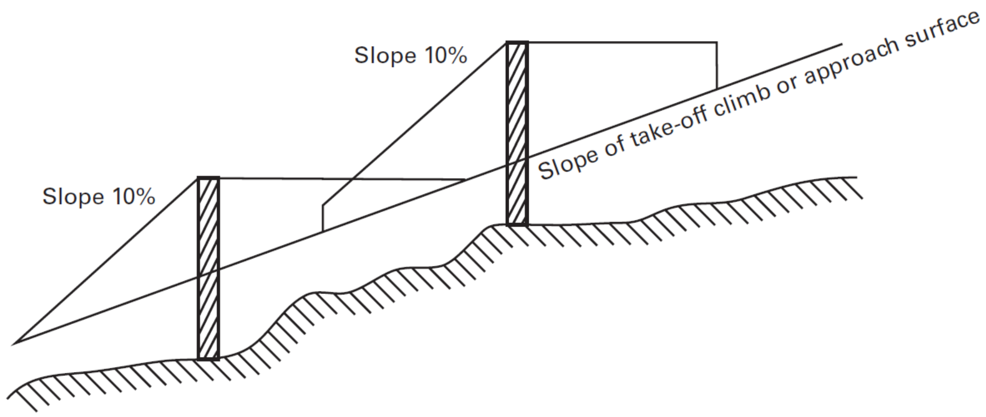
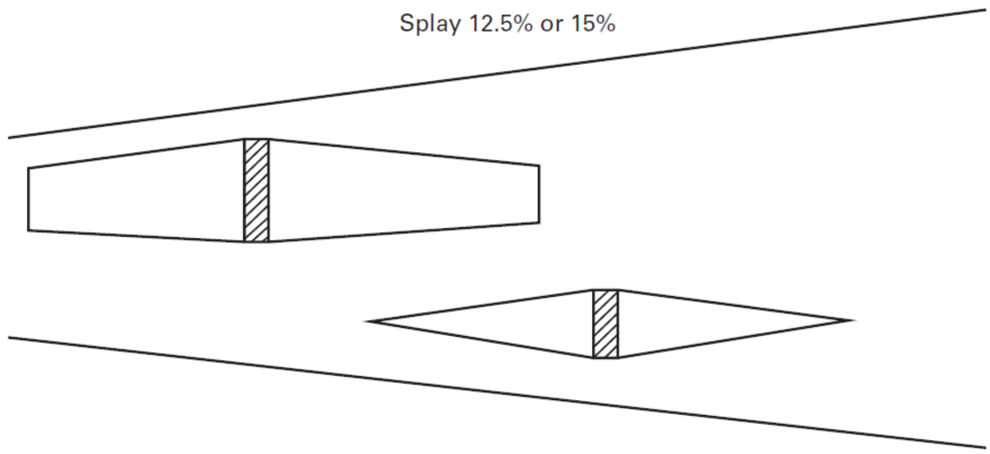
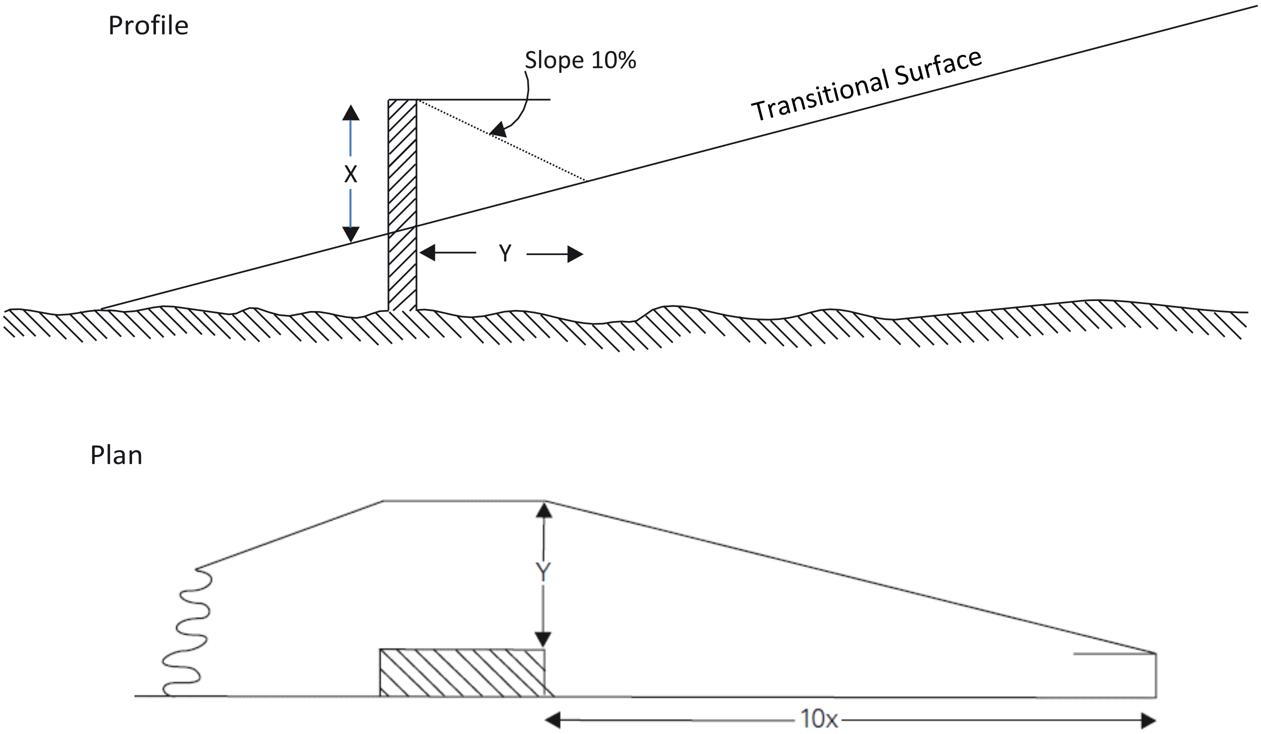


Figure 4.15



4.67 A permanent obstacle which penetrates a transitional surface may be regarded as shielding any other obstacles which lie beneath a negative slope of 10% extending from the top of the obstacle except that no obstacle can be considered as shielded that is situated closer to the runway than the shielding obstacle (see figure 4.16).

Figure 4.16



Aerodrome safeguarding

4.68 Detailed guidance is incorporated in CAP 738, Safeguarding of Aerodromes.

4.69 Aerodrome licence holders should take all reasonable steps to ensure that, through safeguarding, the aerodrome and its airspace are safe at all times for use by aircraft. To enable this, procedures should be established to manage the safeguarding process. Details of the following should be included in the aerodrome manual:

1. accountability with regard to safeguarding and a system for recording consultations, including a method for seeking advice on issues of OLS infringements and, if officially safeguarded, call-in procedures;
2. procedures for notifying planning authorities of objections;
3. procedures for consulting the aerodrome's ATC provider to ensure development has no electromagnetic/line of sight issues, either temporary or permanent;
4. procedures for assessing and monitoring the wildlife hazard risk;
5. procedures for evaluating potential impacts on instrument approach procedures;
6. procedures for promulgating infringements in the UK Aeronautical Information Publication (AIP), if appropriate.

4.70 It is recognised that the need to include all items will vary between aerodromes depending on the nature and scale of operations.

Marking and lighting of obstacles and unserviceable surface areas

General

4.71 The following paragraphs contain details of the requirements for the marking and lighting of obstacles on and near aerodromes and for the standards applicable to enroute obstacles. The latter is provided for the information of licence holders and to assist them should they be consulted, or their advice sought, on the lighting and marking of obstacles in the vicinity of the aerodromes but beyond the obstacle limitation surface boundaries.

4.72 The responsibility for marking and lighting obstacles on or near aerodromes must be determined between the aerodrome licence holder and the owners of the structures. The CAA is not concerned with the allocation of responsibility but may withhold, suspend, vary or withdraw a licence if the following requirements for lighting and/or marking are not met.

4.73 Licence holders are responsible for ensuring that all obstacles on the movement area are lit and/or marked as required, irrespective of ownership.

4.74 All objects which extend to a height of 150 m or more above ground elevation are regarded as obstacles and shall be lit in accordance with ANO Article 222. Other objects of a lesser height may be assessed as hazards to aviation and also treated as obstacles. They should be marked and/or lit as detailed in the following paragraphs.

Objects to be marked or lit

4.75 Indicating the presence of obstacles by marking or lighting is intended to reduce the hazards to aircraft operating at low level or moving on the surface.

4.76 Objects which are deemed by the CAA to be enroute obstacles should be marked and/or lit.

4.77 Other objects inside (and outside) the obstacle limitation surfaces should be marked and/or lighted if an aeronautical study indicates that they could constitute a hazard to aircraft (this includes adjacent to visual routes, e.g., waterways, or highways). Wind turbines, whether on, near or away from the immediate vicinity of an aerodrome, which are deemed to be obstacles, should be marked and/or lit accordingly.

Wind turbines

4.78 The rotor blades, nacelle and upper 2/3 of the supporting mast of wind turbines should be painted white, unless otherwise indicated by an aeronautical study.

4.79 When lighting is deemed necessary, medium intensity obstacle lights should be used. In the case of a wind farm, i.e., group of two or more wind turbines, it should be regarded as an extensive object and the lights should be installed:

1. to identify the perimeter of the wind farm;
2. respecting the maximum spacing between the lights along the perimeter, unless a

dedicated assessment shows that a greater spacing can be used;

3. so that, where flashing lights are used, they flash simultaneously; a n d
4. so that, within a wind farm, any wind turbines of significantly higher elevation are also identified wherever they are located.
5. at locations prescribed in 1, 2 and 4, respecting the following criteria:
   i) for wind turbines of less than 150 m in overall height (hub height plus vertical blade height), medium-intensity lighting on the nacelle should be provided;
   ii) for wind turbines from 150 m to 315 m in overall height, in addition to the medium-intensity light installed on the nacelle, a second light serving as an alternate should be provided in case of failure of the operating light. The lights should be installed to assure that the output of either light is not blocked by the other; and
   iii) in addition, for wind turbines from 150 m to 315 m in overall height, an intermediate level at half the nacelle height of at least three low-intensity Type E lights should be provided. If an aeronautical study shows that low-intensity Type E lights are not suitable, low-intensity Type A or B lights may be used.

Note.— The above 5 (iii) does not address wind turbines of more than 315 m of overall height. For such wind turbines, additional marking and lighting may be required as determined by an aeronautical study.

4.80 The obstacle lights should be installed on the nacelle in such a manner as to provide an unobstructed view for aircraft approaching from any direction. Where lighting is deemed necessary for a single wind turbine or short line of wind turbines, the installation should be in accordance with 4.79 (5) above or as determined by an aeronautical study.

4.81 Further information is available in CAP 764, CAA Policy and Guidance on Wind Turbines and ICAO annex 14 Volume 1, chapter 6, Paragraph 6.4.

4.82 Objects which are deemed by the CAA to be aerodrome obstacles should, if not removed, be marked and if the aerodrome is used at night, lit except that:

1. obstacles that are sufficiently conspicuous by their shape, size or colour need not be marked;
2. objects which technically are aerodrome obstacles, but which are deemed to be shielded by other obstacles, need not be marked or lit;
3. immovable obstacles or terrain which extensively obstruct an aerodrome circuit area need not be marked or lit providing appropriate terrain avoidance procedures have been established;
4. an obstacle which the CAA considers to be of no operational significance need not be marked or lit.

4.83 Vehicles and other mobile objects, excluding aircraft, on the movement area of an aerodrome are obstacles and should be marked and, if the vehicles and aerodrome are used at night or in conditions of low visibility, be lit. Aerodrome licence holders may exempt aircraft servicing equipment and vehicles used only on aprons from this provision provided that they are adequately conspicuous.

4.84 Elevated aeronautical ground lights on aerodromes should be made conspicuous by day by a suitable form of marking.

Marking of obstacles

4.85 Fixed obstacles that are sufficiently conspicuous by their shape, size or colour need not be otherwise marked.

4.86 Fixed obstacles that require marking should be conspicuously coloured. If this is not practicable, markers or flags should be displayed on or above them.

4.87 No fixed obstacle need be marked if it is lit.

4.88 A fixed obstacle should be coloured to show a chequered pattern if it has essentially unbroken surfaces and its projection on any vertical plane equals or exceeds 4.5m in both directions. The pattern should consist of rectangles with sides of not less than 1.5 m and not greater than 3m.

4.89 A fixed obstacle should be coloured to show alternating contrasting bands if:

1. it has essentially unbroken surfaces and has one dimension, horizontal or vertical, greater than 1.5m, and the other dimension, horizontal or vertical, less than 4.5 m; or
2. it is of skeletal type with either a vertical or horizontal dimension greater than 1.5 m.

4.90 The bands should be perpendicular to the longest dimension and have a width the dimensions of which are in accordance with table 4.3 (see figure 4.17).

4.91 A fixed obstacle should be coloured in a single conspicuous colour if its projection on any vertical plane has both dimensions less than 1.5m.

Table 4.3 Marking band widths

Longest dimension			
Greater than	**Not exceeding**	**Band width**	
1.5 m	210 m	1/7 of longest dimension)	or 30 m whichever is less
210 m	270 m	1/9 of longest dimension)	
270 m	330 m	1/11 of longest dimension)	
330 m	390 m	1/13 of longest dimension)	
390 m	450 m	1/15 of longest dimension)	
450 m	510 m	1/17 of longest dimension)	
510 m	570 m	1/19 of longest dimension)	
570 m	630 m	1/21 of longest dimension)	

Figure 4.17(a) Basic marking patterns

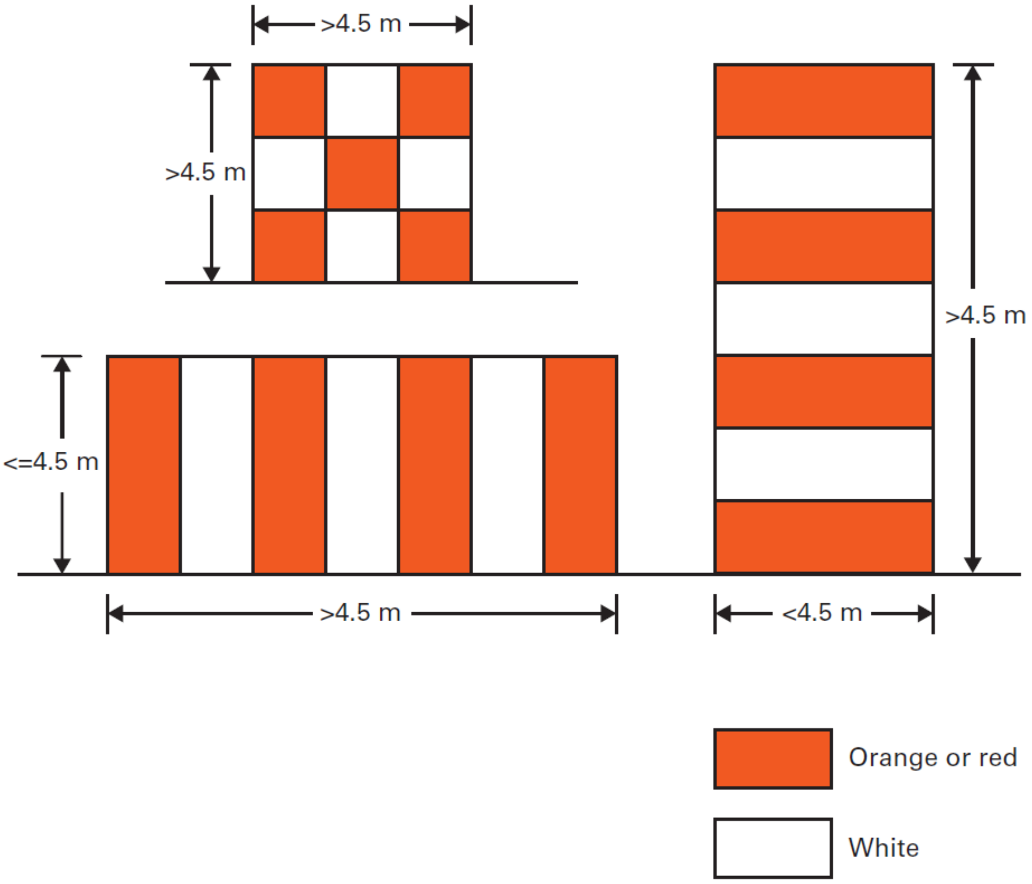
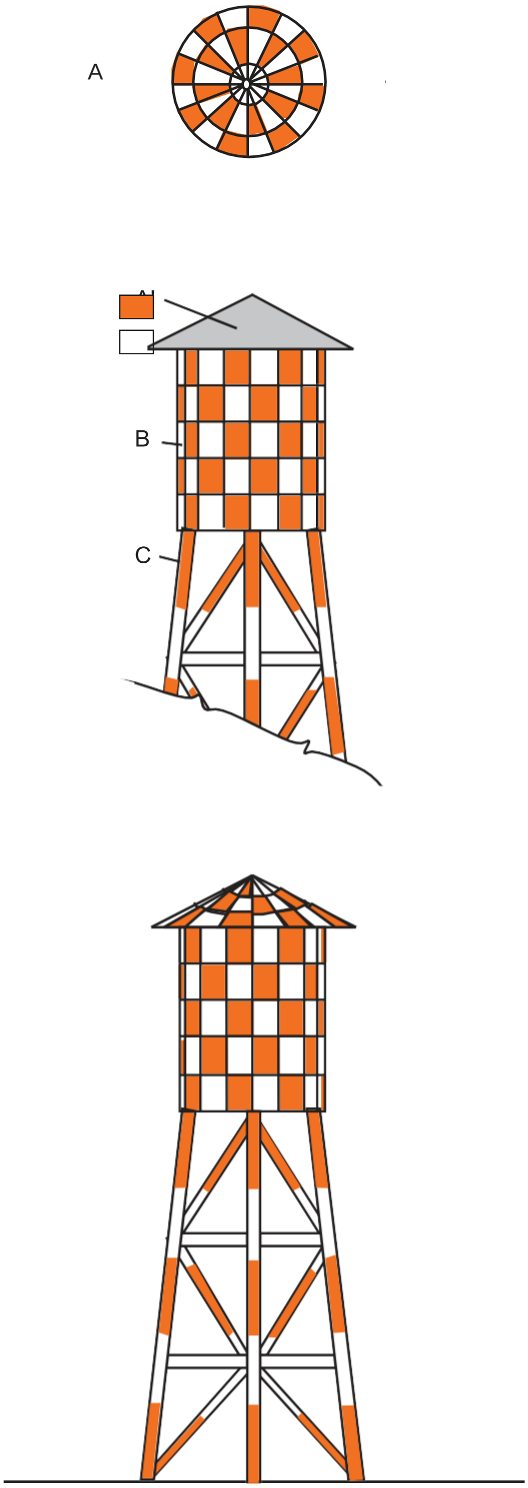


Figure 4.17(b) Marking of tall structures



A Rooftop pattern	Orange or red
A' Plain roof pattern	White
B Curved surface	
C Skeleton structure	

4.92 All mobile obstacles that require marking should be conspicuously coloured or carry markers or flags (see also paragraph 4.95).

4.93 Enroute obstacles are not normally marked but may be marked in accordance with the preceding sub-paragraphs if local authorities so wish.

Colouring

4.94 The colours used for marking fixed obstacles should contrast with the background against which they will be seen. Where practicable, orange and white or red and white should be used for chequers and bands, and red or orange used for small objects as defined at paragraph 4.91. The chequers/bands on the extremities of the obstacle should be of the darker colour (see figure 4.17).

4.95 When mobile obstacles are marked by colour, a single distinctive conspicuous colour should be used.

Use of markers

4.96 Markers displayed on or adjacent to obstacles should be located in conspicuous positions so as to retain the general definition of the object without increasing the hazard it presents. The markers should be coloured either orange and white or red and white to contrast with the background.

Use of flags

4.97 Flags used to mark obstacles, including temporary obstacles to taxying aircraft, should be displayed around, on top of, or along the highest edge of an object, but must not increase the hazard presented by the object they mark. Flags should be displayed at least every 15 m and:

1. for fixed obstacles, flags should be not less than 0.6 m on each side and be orange in colour or a combination of two triangular sections, one orange or red and the other white, in order to give the maximum contrast;
2. for mobile obstacles, flags should be not less than 0.9 m on each side, consisting of a chequered pattern of squares in the manner illustrated in figure 4.17 and having sides not less than 0.3 m. The chequers should be coloured orange and white, or red and white except where such colours merge with the background.

Marking of unserviceable surface areas

4.98 Markers as described in chapter 7 should be used to delineate an unserviceable portion of the paved movement area. Unfit areas on paved taxiways and runways should be marked with white crosses as described in chapter 7.

4.99 When the portion is sufficiently small as to be bypassed safely by aircraft, flags or traffic cones may be used to outline its limits.

4.100 Marker boards alternating with flags or cones, as described in paragraph 4.9.3 of chapter 7, should be used to delineate an unserviceable portion of a grass aerodrome.

Lighting of obstacles

4.101 Obstacle lights should be used to indicate the existence of objects which are to be lit as follows:

1. Low intensity steady red obstacle lights should be used on obstacles less than 45 m high, except that medium intensity steady red lights should be used to light such obstacles as an elongated structure, an obstacle in the outer area of the approach or high ground adjacent to the aerodrome circuit. There are two types of low intensity obstacle lights for fixed obstacles:

   Group A and Group B (see table 6A.1).

   a) Low intensity Group A lights should be used for obstacles on the movement area where Group B lights may cause dazzle.

   b) Low intensity Group B lights should be used away from the movement area or in areas on the movement area with high levels of background illuminance.

2. Medium intensity red steady obstacle lights should be used on obstacles between 45 m and less than 150 m in height.

3. Medium intensity steady red obstacle lights should be used to indicate the presence of:

   a) an obstacle if its height is 150 m or more; or

   b) a tower supporting overhead wires, cables etc. of any height where an aeronautical study indicates such lights to be essential for recognition of the presence of the obstacle.

4.102 However, where an aeronautical study conducted by the CAA concludes that greater conspicuity of the obstacle through the use of a higher specification light is required, the use of a high intensity flashing white obstacle light will be considered by the CAA.

4.103 The combination of white and red obstacle lights should not be used at the same time to light an obstacle.

Location of obstacle lights (figure 4.18)

4.104 The top light

1. Except in the case of a chimney or other similar structure, one or more lights should be located at the top of the obstacle. The lights should be so arranged as to indicate the highest points or edges of the obstacle relative to the obstacle limitation surface. If two or more edges are of the same height, the edge nearest the flight path should be lit. On facing sides of groups of obstacles, lights may be omitted with the approval of the CAA, and the group treated as one solid obstacle

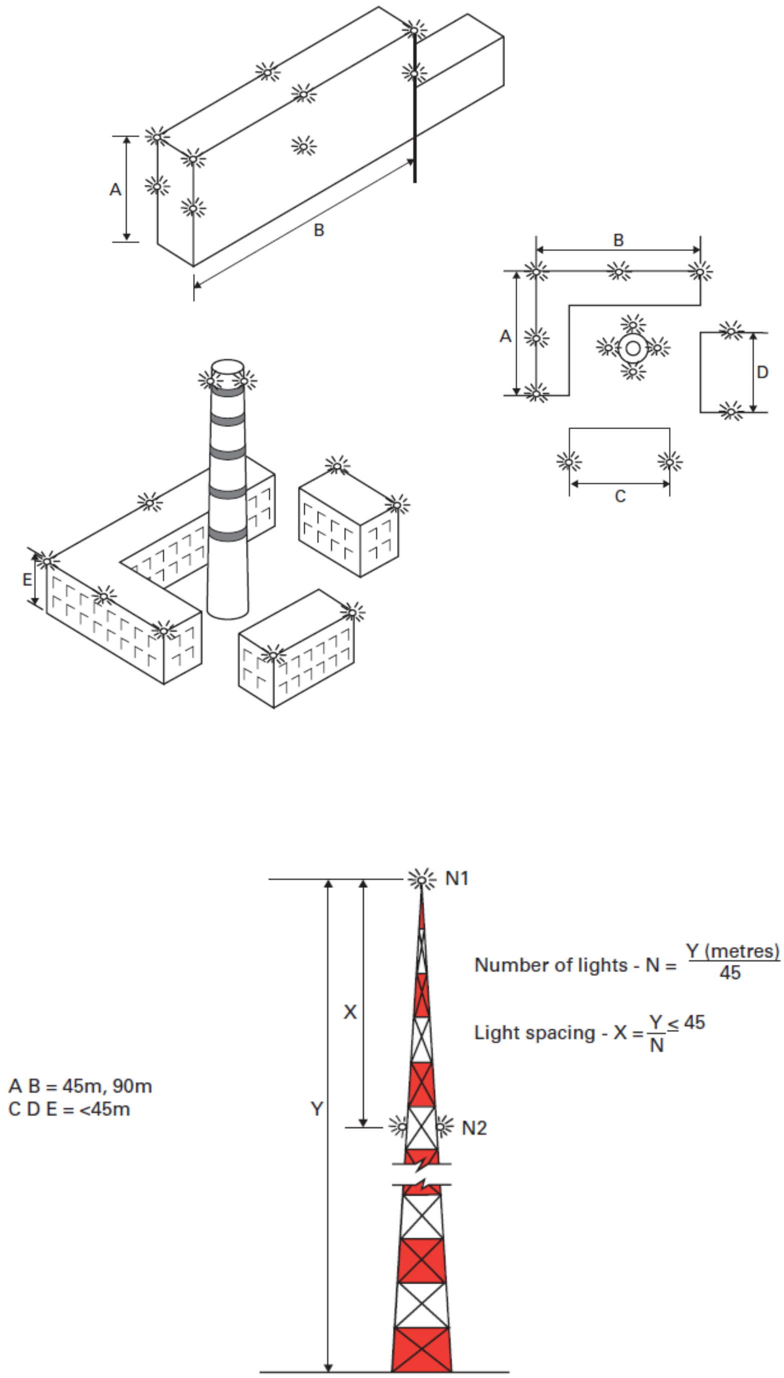
2. In the case of a chimney or other similar structure, the top light should be placed between 1.5 m and 3.0 m below the top in order to reduce the effects of discolouration or corrosion from the exhaust fumes.

3. In the case of a guyed tower or antenna where it is not possible to locate an obstacle light on the top because of the weight of equipment involved, such a light should

be located at the highest practicable point acceptable to the CAA.

4. In the case of a wind turbine, obstacle lights should be installed on the highest point of the nacelle in such a manner as to provide an unobstructed view for aircraft approaching from any direction.

Figure 4.18 Lighting of objects

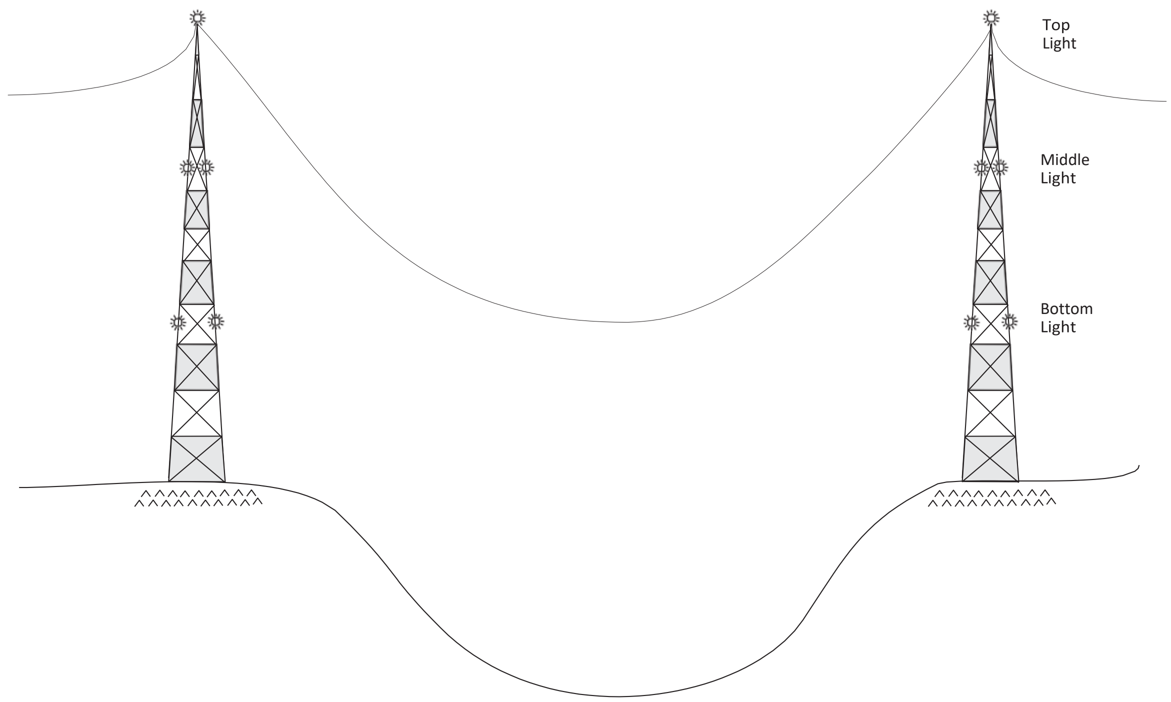


Intermediate lights

4.105 Where the top of an obstacle is more than 45 m above the level of the surrounding ground, additional lights should be provided at intermediate levels. These additional lights should be spaced as equally as practicable between the top light and ground level as follows:

1. when low or medium intensity obstacle lights are used the spacing should not exceed 52 m;
2. where deemed necessary by an aeronautical study, the spacing of high intensity flashing white obstacle lights on an obstacle other than a tower supporting overhead cables or wires should not exceed 105 m;
3. where obstacle lights are used on a tower supporting overhead wires or cables (figure 4.19) they should be located at three levels:
    a) on the top of the tower;
    b) on the tower at the lowest level of the catenary of the wires or cables; and
    c) at approximately mid-way between these two levels.
4. at each level the lights should be arranged to give full cover in azimuth.

Figure 4.19 Example of intermediate lighting



Lighting of unserviceable parts of the movement area

4.106 Unserviceable parts of the movement area of an aerodrome used at night should be lit as follows:

1. to delineate unsafe areas, lights should be spaced at intervals of not more than 7.5 m;
2. to close off unserviceable sections of runways or taxiways, lights should be spaced at intervals of not more than 3 m.

Note: *The normal runway and taxiway lighting within the unserviceable area should be suppressed.*

4.107 A light used to mark unserviceable parts of the movement area should consist of a steady red light of sufficient intensity to ensure conspicuity, considering adjacent lights and the general level of illumination against which it would normally be viewed. It should have a minimum intensity of not less than 10 cd.

Lighting of vehicles

4.108 The responsibility for marking and lighting vehicles used on the movement area must be determined between the licence holder and the operators of the vehicles. Licence holders are responsible for ensuring that vehicles on the movement area are lit and/or marked as required, irrespective of ownership.

4.109 The specification for yellow flashing vehicle obstacle lights is given in chapter 6, appendix A, table 6A.1. Strobe lighting is unacceptable. Obstacle lights for 'Follow-me' vehicles only shall have characteristics described in figure 6A 19.

4.110 The lights specified should be fitted at the highest point of the prime mover vehicle.

4.111 The highest point of trailers should be fitted with steady red lights of not less than 10 cd.

4.112 Obstacle lights on vehicles should be switched on whenever the vehicles are within the movement area; however, the number of vehicles displaying flashing lights should be restricted to the operational minimum.

4.113 Aerodrome ambulances, fire and rescue appliances should, in addition, carry blue flashing lights for use while carrying out emergency duties.

4.114 In conditions where emergency vehicles not normally based at an aerodrome are called upon for assistance, flashing blue lights, where fitted, should be operated within the movement area.

Light characteristics (see chapter 6, appendix A, table 6A.1)

Low intensity obstacle lights

4.115 On fixed obstacles, low intensity lights should be steady red and omni- directional.

Medium intensity obstacle lights

4.116 Medium intensity obstacle lights should be steady red light.

High intensity obstacle lights

4.117 High intensity obstacle lights should be flashing white lights.

Replacement of lamps

4.118 Unserviceable lamps should be replaced as soon as possible and in any event within 24 hours. Periodic replacement of all lamps is advisable – the active life being deemed to be 80% of the rated lamp life. Where such preventive maintenance cannot be arranged, tungsten lamps may be underrun on voltage down to a minimum of 90% of rated voltage, provided that the specified output can be met. This procedure should increase lamp life to about 400% of the rated lamp life. When this procedure is used, preventive replacement should be carried out after the increased interval. The requirements for periodic change of lamps may, however, be varied or waived where fittings having acceptable performance and proved life are used.

Note: NOTAM action should be taken to promulgate unserviceabilities.

Periods of illumination of obstacle lighting

4.119 High intensity flashing white obstacle lights should be lit at all times throughout the day and night.

4.120 Steady red medium and low intensity obstacle lights should be lit:

1. on and adjacent to an aerodrome from 30 minutes before sunset to 30 minutes after sunrise during the hours of availability notified in the UK AIP or by NOTAM;
2. on en route obstacles from 30 minutes before sunset to 30 minutes after sunrise. Should switching present problems, these lights may remain lit continuously.

CHAPTER 5

Wildlife strike risk hazard management for aerodromes

Introduction

5.1 Wildlife, birds especially, waterfowl, birds in flocks and other forms of wildlife, have the potential to cause significant damage to airframes and engines, especially turbine engines, and therefore their presence on an aerodrome and its immediate flight paths should be deterred. All reasonable measures should be taken to address those features on the aerodrome that may attract wildlife, control the existence wildlife on the aerodrome, and, where practicable, in the vicinity of the aerodrome to prevent bird flight lines across the aerodrome and its approach and departure routes.

5.2 The aerodrome operator shall:

1. assess the wildlife hazard on and in the vicinity of the aerodrome;
2. establish means and procedures to minimise the risk of collision between wildlife and aircraft at the aerodrome; and
3. notify the appropriate authority if a wildlife assessment indicates conditions in the vicinity of the aerodrome are conducive to a wildlife hazard problem.

5.3 Guidance material on current best practice for all aspects of wildlife control is detailed in CAP 772, Aerodrome Wildlife Strike Hazard Management and Reduction.

Wildlife control management

5.4 A Wildlife Management Plan (WMP) should be developed in order to:

1. assess the potential wildlife strike risk;
2. reduce wildlife infestation on the aerodrome as much as practicable;
3. implement a safeguarding system to identify and, where possible, address existing and planned developments within 13 km of the aerodrome that may have the potential to increase the wildlife strike risk;
4. monitor and assess wildlife strike or wildlife strike events; and
5. strive to improve the effectiveness of the plan through ongoing evaluation by competent personnel.

5.5 Details of, or reference to, the wildlife management plan should be included in the aerodrome manual.

CHAPTER 6

Aeronautical Ground Lighting(AGL)

Basic licensing requirements

General information

6.1 AGL provides flight crew with location, orientation and alignment information in adverse visibility conditions and at night. table 6.1 outlines the minimum prescribed scales of AGL needed in order to satisfy the aerodrome licensing requirement in respect of low visibility and night operations; it also highlights those elements of AGL equipment considered by the CAA to be operationally desirable for a particular operation. The type of lighting is specified according to the runway approach category and take-off (T/O) minima. Where the prescribed scale cannot be provided for an instrument runway, there may be a consequential penalty on operational minima (UK AIP AD 1.1.2 Aerodrome Operating Minima, paragraphs 4.2 to 4.5.2). The components, listed in table 6.1, are described in the succeeding paragraphs in the order in which they will be seen by a pilot approaching an aerodrome. The characteristics of the lights and their overall height limits are detailed in appendix 6A.

6.2 AGL for precision instrument approach runways should be high intensity so that it is usable by day and night. Low intensity may be used for other runways, but high intensity lighting is strongly recommended for non-precision instrument approaches and should be provided where there are public transport passenger operations.

6.3 AGL requirements for lower than standard category I and other than standard category II approach operations can be found in EU-OPS.

Table 6.1 AGL – minimum licensing requirements

	Day or night operations					Night only operations			Notes	Text ref
	App Cat II & III	T/O RVR <400	App Cat I	T/O RVR 400–800	App N/P Instrument	T/O RVR 800–1200	App Non-Instrument	T/O >1200		
Equipment	**Scale L1**		**Scale L2**		**Scale L3**		**Scale L4**			
Aerodrome Beacon	O	–	R	–	R	–	R	–		Para 6.12 to 6.16
Approach										
HI C/L 5-bars	R	–	R	–	–	–	–	–		Para 6.20 to 6.32
Supplementary	R	–	–	–	–	–	–	–		
Simple	–	–	–	–	R	–	O	–	1	
Sequenced strobe	–	–	–	–	–	–	–	–		
Approach Slope										Para 6.33 to 6.47
PAPI	R	–	R	–	O	–	–	–	2	
HI (A)PAPI	–	–	–	–	R	–	O	–	2	
LI (A)PAPI	–	–	–	–	–	–	R	–	2, 4	
Runway										Paras 6.2, 6.48 to 6.87
HI edge, threshold, end	R	R	R	R	R	O	–	–		
LI edge, threshold, end	–	–	–	–	–	R	R	R	3, 4	
HI C/L	R	R	O	O	–	–	–	–		
Touchdown zone	R	–	O	–	–	–	–	–		
Stopway	R	R	R	R	R	R	R	R		
Taxiway										
Centreline	R	R	O	O	–	–	–	–		Para 6.88 to 6.142
Edge	–	–	R	R	R	R	O	O	4, 5	
Illuminated Signs	R	R	R	R	R	R	O	O		
Stop bars	R	R	R	R	–	–	–	–		
Runway Guard	R	R	R	R	R	R	–	–		
Obstacle	R	R	R	R	R	R	R	R	6	Chap 4 Para 4.71 to 4.120
Alternate Input Power Supply	R	R	R	R	O	O	O	O		Para6.157
Illuminated Wind Sleeve	R	R	R	R	R	R	R	R		Chap 7 Para 7.10

R = Required, O = Operationally desirable, C/L = Centreline, HI = High Intensity, LI = Low Intensity,

NP = Non Precision, App = Approach

Notes:

1. All runways used for public transport passenger operations should be equipped with PAPI.
2. Additional guidance on the purpose and significance of AGL may be found in the Visual Aids Handbook, CAP 637.

Periods of display of aeronautical ground lighting

6.4 Aeronautical ground lighting should be displayed at least 15 minutes before the estimated time of arrival of any aircraft and until at least 15 minutes after the actual time of departure of any aircraft as follows:

By day:

- High intensity systems, where installed on the runway to be used, whenever the visibility is less than 5 km and/or the cloud base is less than 700 ft.

By night:

- Irrespective of weather conditions.

6.5 Aerodrome beacons and obstacle lighting should be displayed at night whenever the aerodrome is available for use.

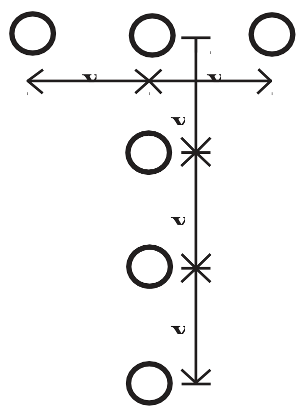
AGL for helicopter night landing training

6.6 Where helicopter night landing training is conducted at an aerodrome, a six-light proportional T (see figure 6.1) may be provided. The lights of the proportional T should be omni-directional, white and useable from a distance of 4 nm.

6.7 When positioned on an aerodrome with a fixed wing runway also in use, the proportional T should be sited so as to permit safe parallel approaches, to avoid obstructions and to minimise noise nuisance.

6.8 If provided, a proportional T must be notified to the CAA and included in the Permission to display AGL. Procedures for the use of the proportional T should be included in the aerodrome manual

Figure 6.1 Proportional 'T'



Note: It is recommended that the dimension x should be 10 m

Aerodrome beacon

Application

6.9 Where operationally necessary an aerodrome beacon or an identification beacon shall be provided at each aerodrome intended for use at night.

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

Aeronautical Beacon

6.11 An aerodrome beacon shall be provided at an aerodrome intended for use at night if one or more of the

6.12 following conditions exist:

a) aircraft navigate predominantly by visual means;

b) reduced visibilities are frequent; or

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

Location

6.13 The aerodrome beacon shall be located on or adjacent to the aerodrome in an area of low ambient background lighting.

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

Characteristics

6.15 The characteristics of aerodrome beacons are described in appendix 6A.

Identification Beacon

6.16 An identification beacon is intended for use where aerodromes in the same vicinity operate at night and confusion could arise as to the identity of the airfield in question. The beacon flashes a two letter morse code symbol in green identifying the airfield.

6.17 The type of identification beacon and any associated morse code symbol to be provided at an aerodrome will be determined by the CAA.

6.18 An identification beacon should be situated on a part of the aerodrome where the level of local background lighting is low and so that it is visible from all directions of approach. The site chosen should be such that the beacon will not cause a hazard by impairing the vision of flight and ground crews engaged in carrying out their duties nor cause any interference with other visual or radio aids.

Characteristics

6.19 The characteristics of aerodrome beacons are described in appendix 6A.

Approach lighting and circling guidance lights

6.20 Approach lighting provides alignment, roll guidance and limited distance-to- go information for the visual completion of an instrument approach. Circling guidance lights provide orientation with the runway for traffic outside the approach area, e.g. in the aerodrome circuit.

High intensity coded centreline and crossbar approach lighting system

6.21 The standard approach lighting system consists of a 900 m coded line of white lights, on the extended centreline of the runway, and five crossbars at 150m intervals. The bars decrease in width towards the runway threshold, lines through the outer lights of the bars converging to meet the runway centreline 300 m upwind from threshold. The illustration at figure 6.2 shows the plan view for precision instrument approach operations. Vertical setting angles are contained in table 6A.2 and the associated Notes, and in figure 6A.1.

6.22 Terrain or other constraints may limit the length or type of approach lighting that can be installed to less than that specified. In such circumstances, a lesser length is acceptable but will normally incur a penalty on aerodrome operating minima. Whatever length is installed should be appropriate to the approach procedure and specified pattern.

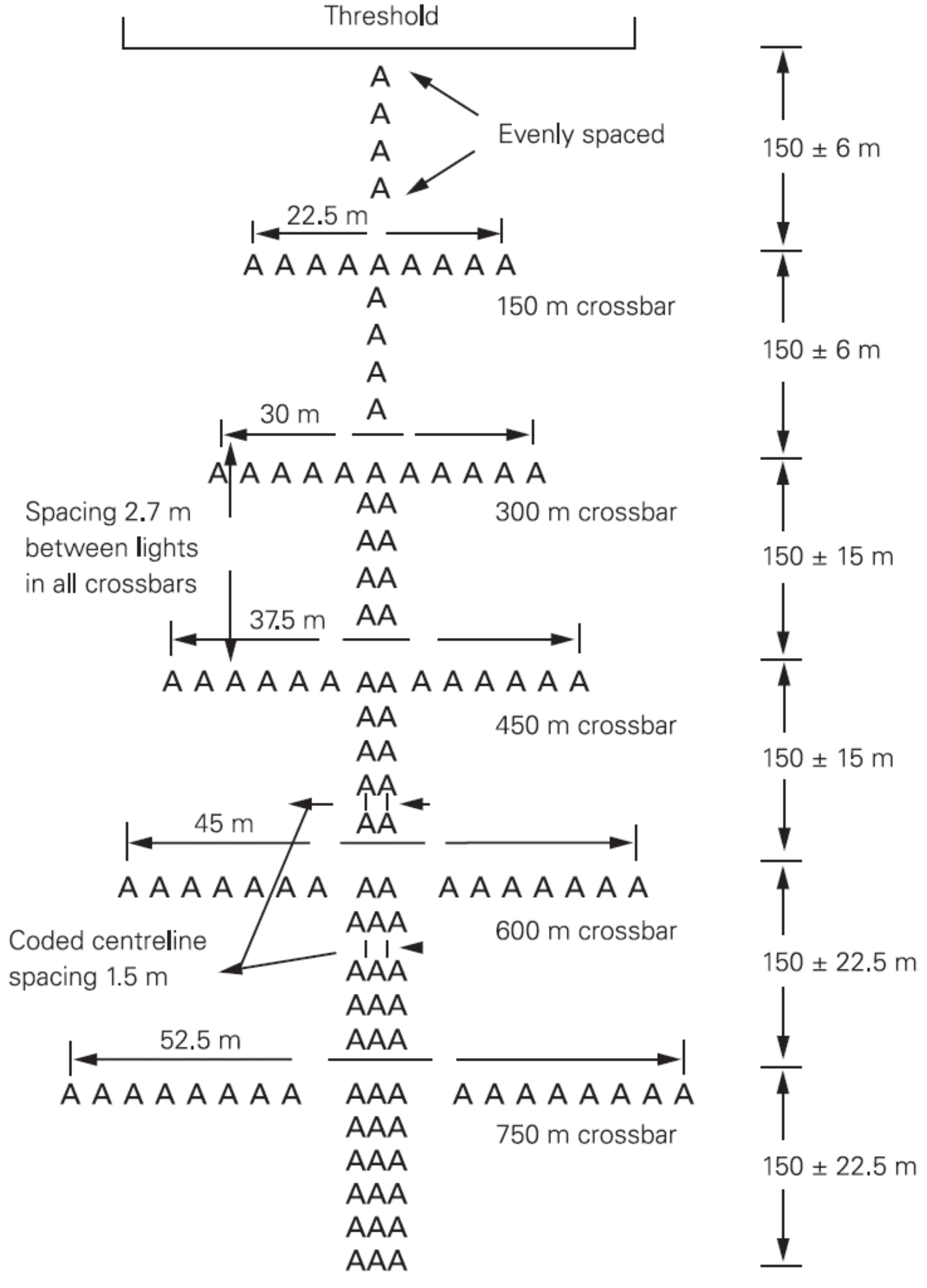
Supplementary approach lighting

6.23 Supplementary approach lighting required for Category II and III operations consists of:

1. two additional white lights on each side of the centreline light forming barrettes along the inner 300 m of the approach centreline, the lights in each barrette being spaced 1.2 m apart; and
2. red side row barrettes of four lights spaced 1.5 m apart on each side of each centreline barrette over the inner 270 m of the approach lighting system. The lateral gauge of the barrettes should be equal to that of the Touchdown Zone (TDZ) lighting. The pattern is illustrated in figure 6.3 and the light characteristics are specified in figure 6A.2.

6.24 Three stages of luminous intensity are required for this part of the system.

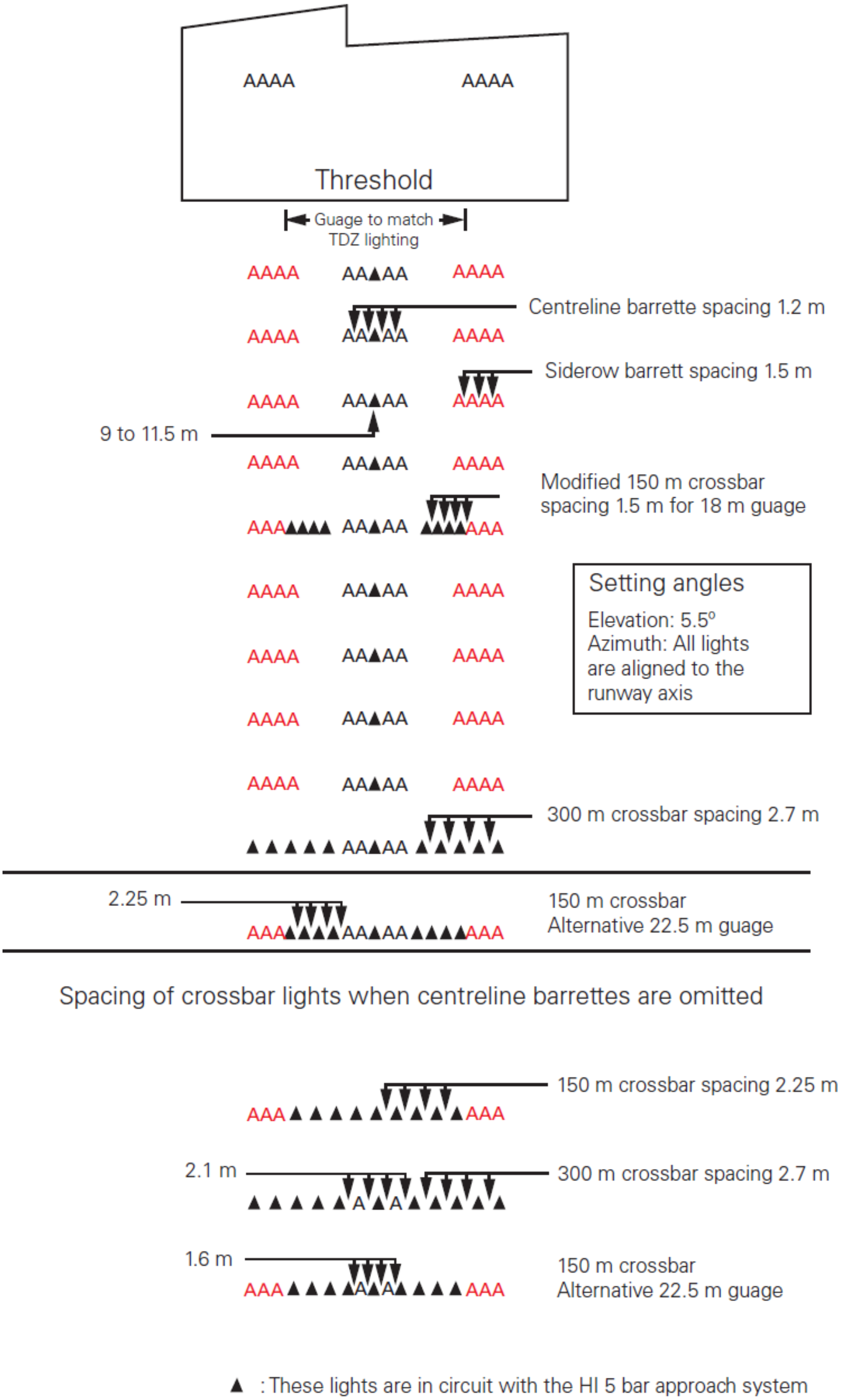
Figure 6.2 High intensity coded centreline and crossbar approach lighting system



Note:

See paragraph 3.5.1 for profile limits and table 6A 2 note 3, and figure 6A 1 for elevation setting angles.

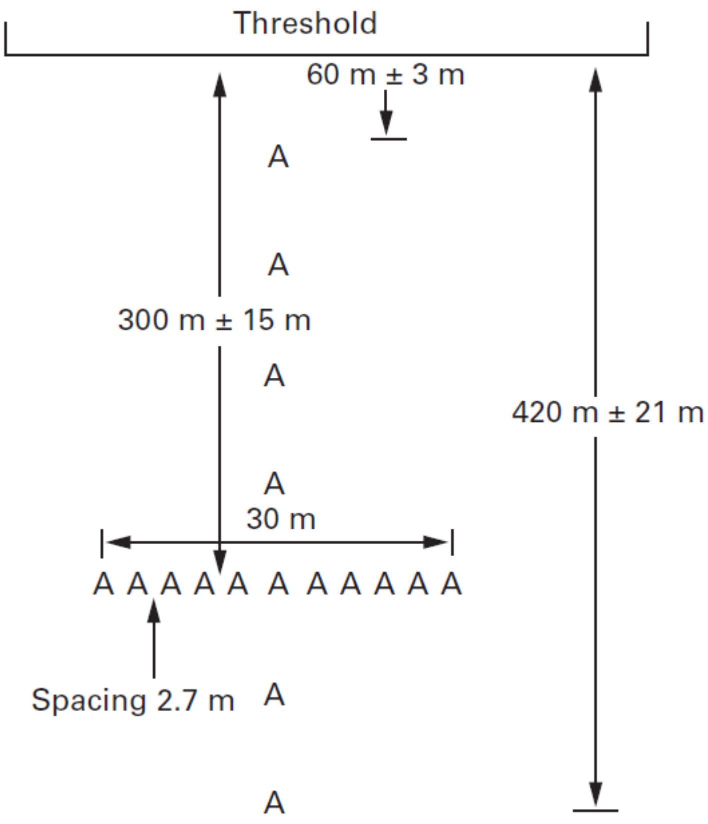
Figure 6.3 Supplementary approach lighting system



Simple approach lighting system

6.25 The system consists of a row of lights, white for high intensity and red for low intensity, on the extended centreline of the runway at 60 m intervals for a distance of at least 420 m from the runway threshold, with a crossbar 30 m in width at 300 m from the threshold. The pattern is illustrated in figure 6.4 and the light performance requirements are given in figure 6A.1 for HI lights and table 6A.1 for LI lights.

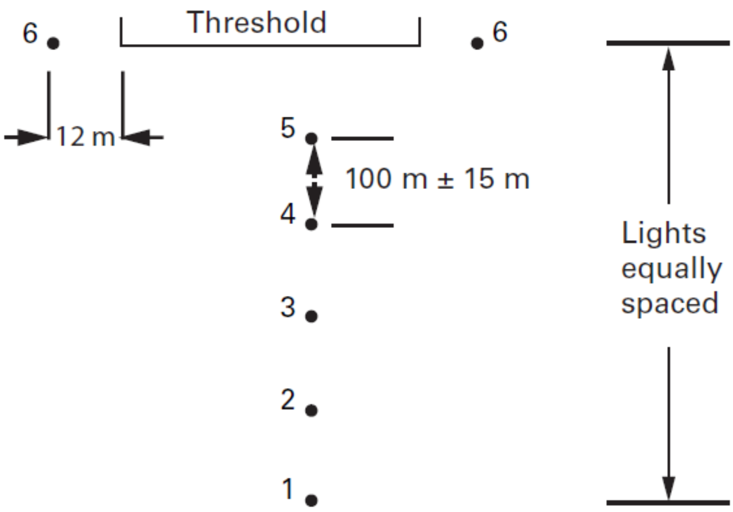
Figure 6.4 Simple approach lighting system



6.26 A high intensity system should have five stages of luminous intensity.

6.27 Sequenced capacitor discharge (strobe) approach lighting is an alternative means of providing simple approach and circling guidance lighting. This system should consist of seven omni-directional strobe lights, five of them located on the extended runway centreline and the other two at the runway threshold as shown in figure 6.5. The light performance requirements are given in table 6A.1.

Figure 6.5 Sequenced strobe approach lighting



Note: The number indicates order of the pulse sequence

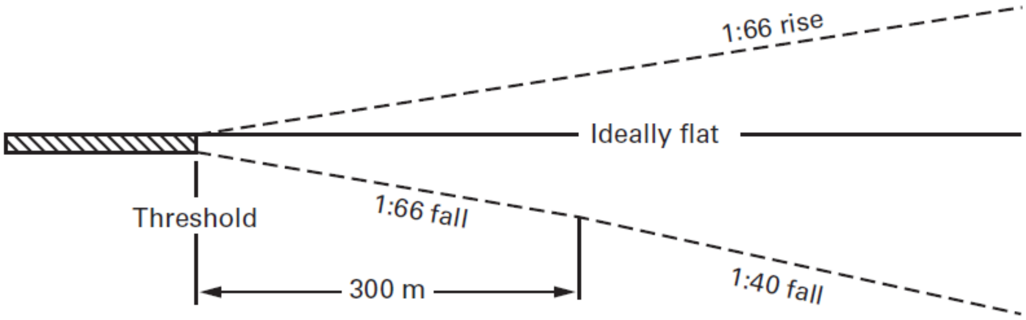
6.28 The objective is to provide a continuous ripple along the length of the extended centreline. The duration of each discharge should not exceed 200 milliseconds and the next discharge in sequence should commence within 1.2 seconds of the initiation of the previous discharge. Adjustment to the discharge duration and trigger rate should be made in order to achieve the optimum ripple effect without any breaks.

6.29 The strobe approach lights shall be independently switched from the rest of the AGL.

Approach lighting profile and obstacle protection

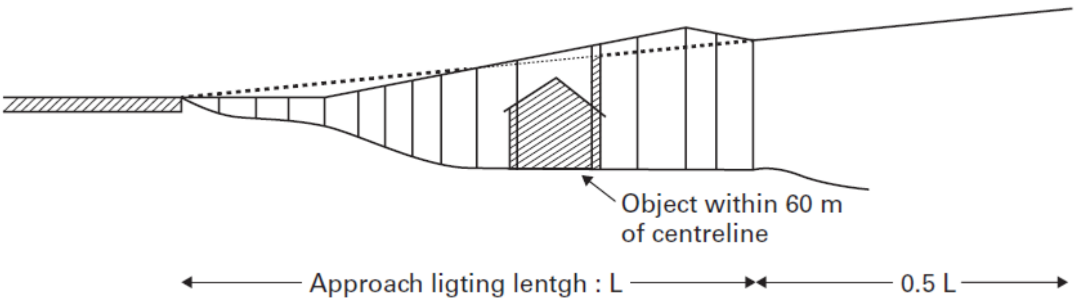
6.30 Ideally, all the approach lights should lie in a horizontal plane at the same level as the runway threshold. However, this is seldom achievable because of terrain undulations or obstacles in the approach area. The profile of the centreline lights should not exceed the limits shown at figure 6.6. The lateral gradient of the lights in each crossbar should not be greater than 1:80 with the mid-point in the plane of the centreline lights. Excessive gradients may cause misleading perspective and height cues, and changes of gradient within the length of the system may result in an uneven sequence of the lights when seen from the approach. To keep these effects to a minimum, successive changes in profile gradients should be as few as possible and not exceed 1:60.

Figure 6.6 Approach light centreline profile limits



6.31 An approach light plane is established to ensure that objects do not obscure or distort the lighting pattern observed from an aircraft on the approach. The plane, or more commonly a series of planes, contains the lights comprising the system and extends from the threshold to 1.5 times the length of the installation at a width of 120 m equally disposed about the extended centreline of the runway. Beyond the outer end of the approach lights the gradient of the plane contains the threshold and the outermost lights.

Figure 6.7 Approach light plane



Circling Guidance Lighting

6.32 Circling guidance lighting should be provided where visual approaches to the aerodrome or flying training take place at night. It should also be provided in special circumstances; e.g. where obstacles affect visual maneuvering, in which case high intensity lighting may be specified if a daylight capability is necessary. The omni-directional component of runway edge lights will normally provide sufficient orientation to a pilot flying in the aerodrome circuit. If the presence of such a component is insufficiently conspicuous, guidance should be provided by any of the following systems:

1. separate lights adjacent to the runway;

2. omni-directional red low intensity approach lights;
3. omni-directional white sequenced strobe approach lighting; or
4. runway alignment beacons, flashing white or red on the runway extended centreline.

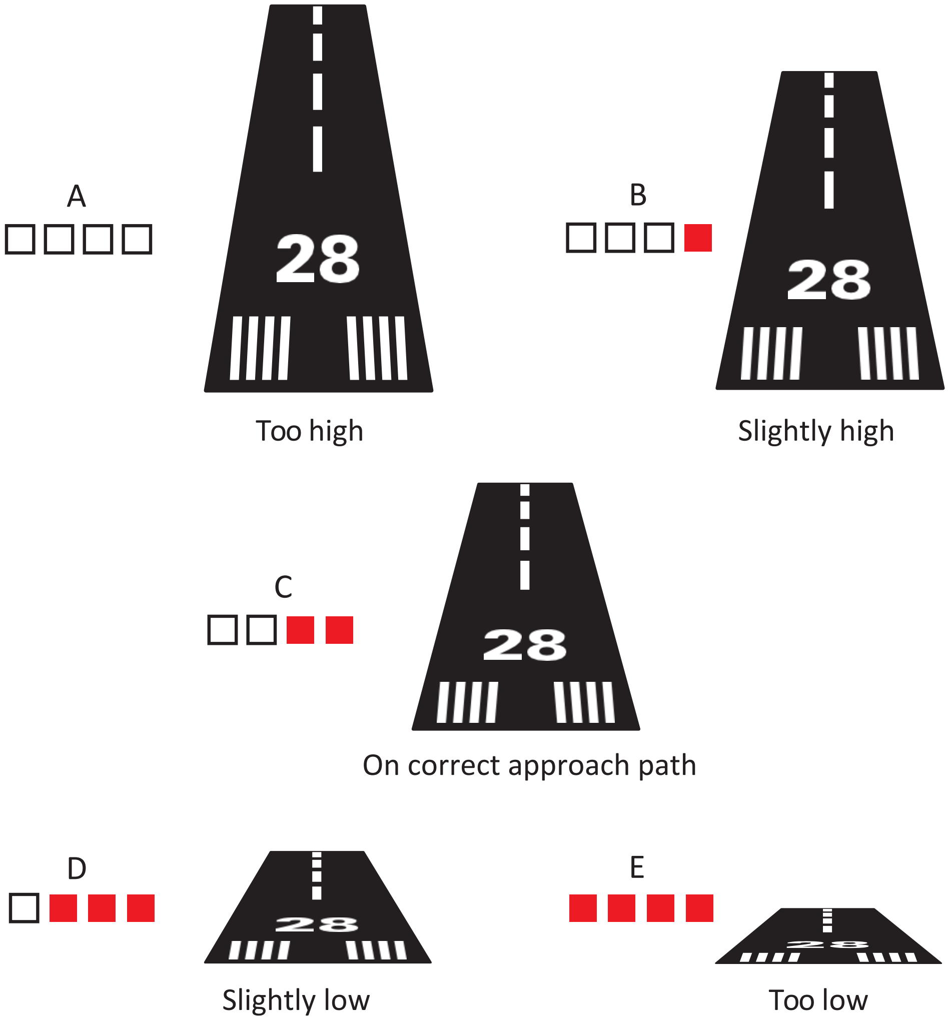
Approach slope indicators

General

6.33 Approach slope indicators provide flight crew with information on the achieved approach angle, as well as giving clearance over approach obstacles.

6.34 The basic system is the PAPI. In certain circumstances (see table 6.1), less than the full system may be provided. These abbreviated systems are prefixed ‘A’. The units are normally installed on the left-hand side of the runway, viewed from the approach; a right-hand installation is permitted if it is not practicable to position them on the left or if a second set is required. Details of the installation criteria for (A)PAPI and its required setting angles are given in appendix 6B.

Figure 6.8 Typical PAPI system



6.35 The units direct a beam of light, red in the lower half and white in the upper, towards the approach. They are set at different elevation angles so as to give a combination of red and white for an on-slope signal, all-red if the aircraft is too low, and all-white if it is too high (see figure 6.8). A transition zone will be perceived between the red and white sectors of each unit. PAPI units have a perceived transition of approximately three minutes of arc and are known as sharp transition units.

6.36 The siting and elevation settings of approach slope indicators installed on runways served by ILS should be such that the visual approach slope conforms as closely as possible to the ILS glidepath.

6.37 Systems required for day and night use should consist of high intensity units with a luminous intensity control.

6.38 The CAA should be consulted before any approach slope indicator is installed or repositioned. The following information should be provided:

1. the number and type of units, their proposed location and angular settings;
2. any difference in elevation between the runway threshold and the proposed sites of the individual units, enabling siting adjustments to be made for any longitudinal or transverse slope, see figure 6B.2; and
3. either a survey of the obstacle clearance surface shown at figures 6B.1 or 6B.3, as appropriate, or other evidence that the surface is not infringed by any object.

Precision Approach Path Indicator (PAPI)

6.39 PAPI consists of four sharp transition units located as a wingbar, preferably on the left side of the runway. If roll guidance is required and is not provided by other visual means, four units should be positioned on each side of the runway so that the wingbars appear opposite each other. Siting data are contained in appendix 6B, together with information on elevation setting angles.

6.40 Each unit provides discrete information. Two factors important to the reliability of the system are therefore the number of lamps per unit and the knowledge that the lamps are working when required. Units should have two or more lamps, and the lamps may, if convenient, be interleaved. In this case the interleaving should be between lamps and not luminaires (see 'Interleaving of AGL Electrical Circuits'). PAPI installations should be equipped with a monitoring system which will detect lamp failure so that flight crew may be advised and the failure investigated and remedied without delay.

6.41 Lenses must be kept clean to produce a usable signal. In certain meteorological conditions condensation may form on either side of the lenses when the units are not in use. This will degrade and distort the signal to an unacceptable extent for some time after the system is switched on. The problem can be overcome either by running the lamps at very low power while the unit is not in use, or by operating low powered heaters fitted to the units. Where neither of these provisions is made, the units should be selected to full luminous intensity for at least 15 minutes, or other such period recommended by the units' manufacturer, before they are required for use

(A)PAPI

6.42 (A)PAPI consists of two sharp transition units located as a wingbar, preferably on the left side of the runway. A high intensity system should be used for Scale L3. That for Scale L4 may be high or low intensity. Low intensity units are of limited use by day, having a range of about 3 km. Each unit should have at least two lamps. Siting data and information on setting angles are contained in appendix 6B.

6.43 (A)PAPI systems are not suitable for approach paths in excess of 4 degrees in elevation and for public transport passenger jet operations (see table 6 . 1).

Luminous intensity control requirements for approach slope indicators

6.44 PAPI, and high intensity (A)PAPI should have at least five luminous intensity stages: 100%, 30%, 10%, 3% and 1%.

6.45 An additional 80% stage may be added to conserve lamp life if the manufacturer so advises. An 80% setting is normally adequate for daylight use except when approaches are made towards a low sun.

6.46 A luminous intensity control is not essential for low intensity systems, but at least two stages (100% and 30%) are desirable since the units are often considerably brighter than the runway edge lights. This applies particularly to PAPI/(A)PAPI at low intensity where a further 10% stage is advisable in most cases.

Unserviceability of (A)PAPI systems

6.47 PAPI and (A)PAPI installations should be withdrawn from service if one unit is found to be unserviceable, except where installations are on both sides of the runway, in which case only the affected side should be withdrawn. However, when PAPI is installed for scales L3 and L4 and either of the outside units become unserviceable, the two central units may be used temporarily as an (A) PAPI without altering the setting angles.

Runway and stopway lighting

6.48 Runway threshold, end and edge lighting are intended to define the usable extent of the runway – not the declared distances. For low visibility operations, centreline lighting is added in order to provide alignment and some distance-to- go information by colour coding; touchdown zone lighting is added in order to improve texture and perspective and to give flight crew an indication of the area within which a balked landing must be initiated if it is to be contained within the OFZ. Stopway lights delineate the stopway. The cabling for these lights should be buried.

6.49 The characteristics of the lights, including height limits, are detailed at appendix 6A, and layouts are shown at figures 6.9 and 6.10. Setting angles are given in table 6A.1, table 6A.2 and figures 6A.3 to 6A.10.

6.50 High intensity lights should have five luminous intensity stages. Low intensity lighting needs only one setting.

Runway edge lighting

6.51 Runway edge lights consist of two parallel rows of lights equidistant from the runway centreline. They should be located along the edges of the area declared for use as the runway. A licence holder seeking a variation to this requirement will need the approval of the CAA; this should be sought before proceeding with any planning or other work.

6.52 On runways of up to 50 m in width, the longitudinal spacing of the lights should be 60 m ± 6 m. Where the width of the runway exceeds 50 m, a closer longitudinal spacing as determined by the CAA may be required dependent upon the nature of operations and other visual aids serving the runway. The lights on opposite sides of the runway should be on lines at right angles to the centreline, as shown at figure 6.9. Where uni- or bi-directional light units are used at aerodromes and visual approaches to the airfield or flying training take place at night, an omni-directional light should be provided at each alternate position in order to provide circling guidance

6.53 Runway edge lights should be white except in the following instances:

1. On a precision instrument approach runway without centreline lighting, yellow lights should be installed on the upwind 600 m or one third of the lighted runway length available, whichever is the less. This section is known as the yellow caution zone and gives visual warning of approaching the runway end. If centreline lights are installed subsequently, the yellow caution zone lights should be replaced with white lights.
2. Where a threshold is displaced, the lights between the beginning of the runway and the displaced threshold should show red in the approach direction.
3. One or two omni-directional blue lights may replace or supplement the edge lights to indicate an exit taxiway.

6.54 Scale L4 lighting may comprise fixed or portable lights. The location of portable lights should be marked permanently. The power for electric edge lights should be provided preferably by mains or locally generated electricity, but battery powered lights are acceptable provided that the battery lives are adequate for the duration of night flying operations. Gooseneck paraffin flares are acceptable as edge lights subject to the proviso of table 6.1, Note 3, but electric lighting should be used in such a pattern for the threshold and runway end.

Runway threshold and runway end lights

6.55 Runway threshold lights are green and indicate the start of the available landing distance. Runway end lights are red and delineate the extremity of the runway that is available for maneuvering – not the declared distances. The characteristics of these lights are detailed in appendix 6A.

6.56 Figure 6.10 shows the layouts permitted according to circumstances.

6.57 Threshold wingbars should be provided for Scales L1 and L2, and for other Scales where the threshold is displaced. They are recommended for Scales L3 and L4 in the interests of added conspicuity.

6.58 Threshold lights should have luminous intensity compatible with that of the runway edge lights.

Figure 6.9 Runway lighting

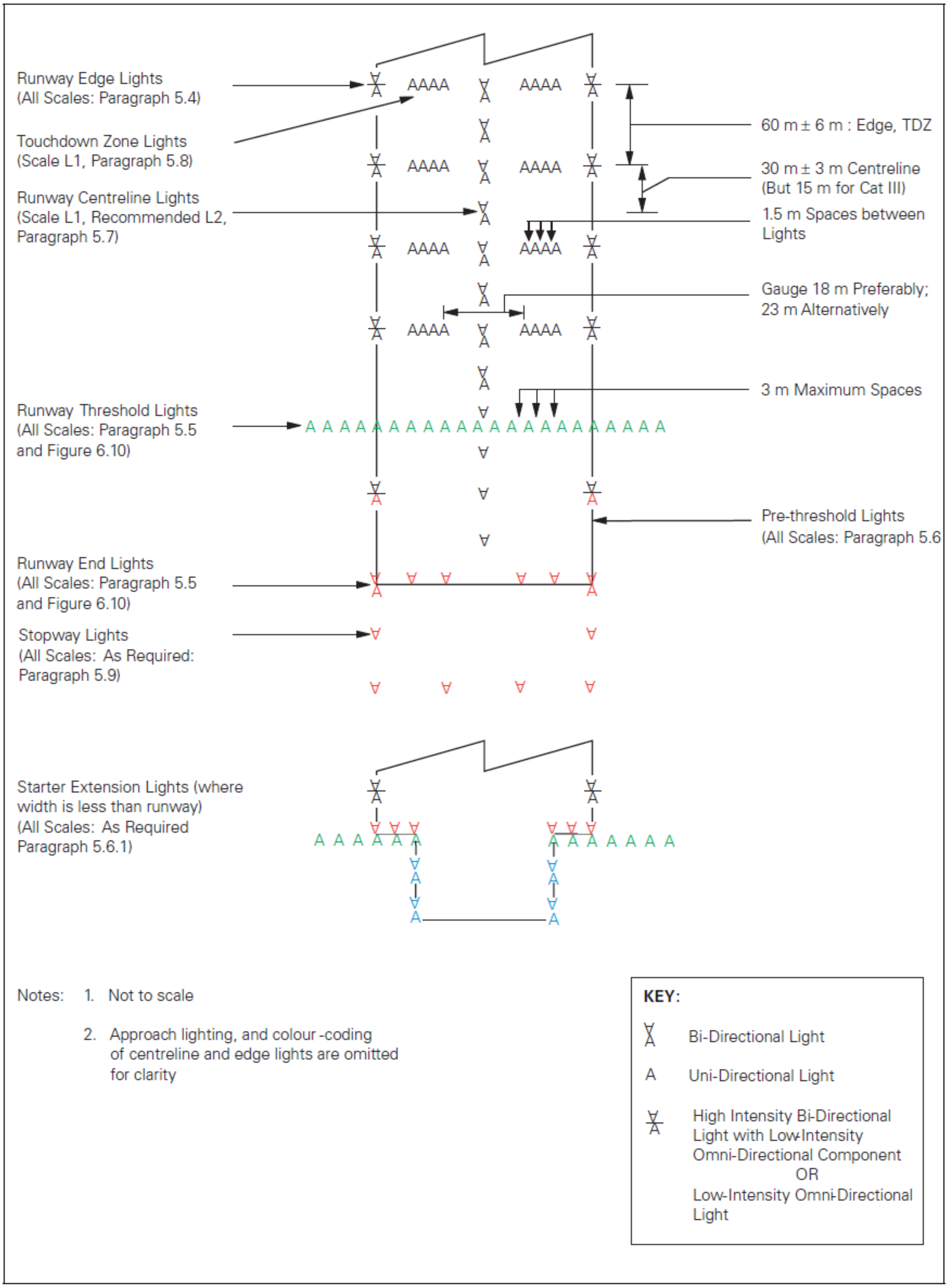
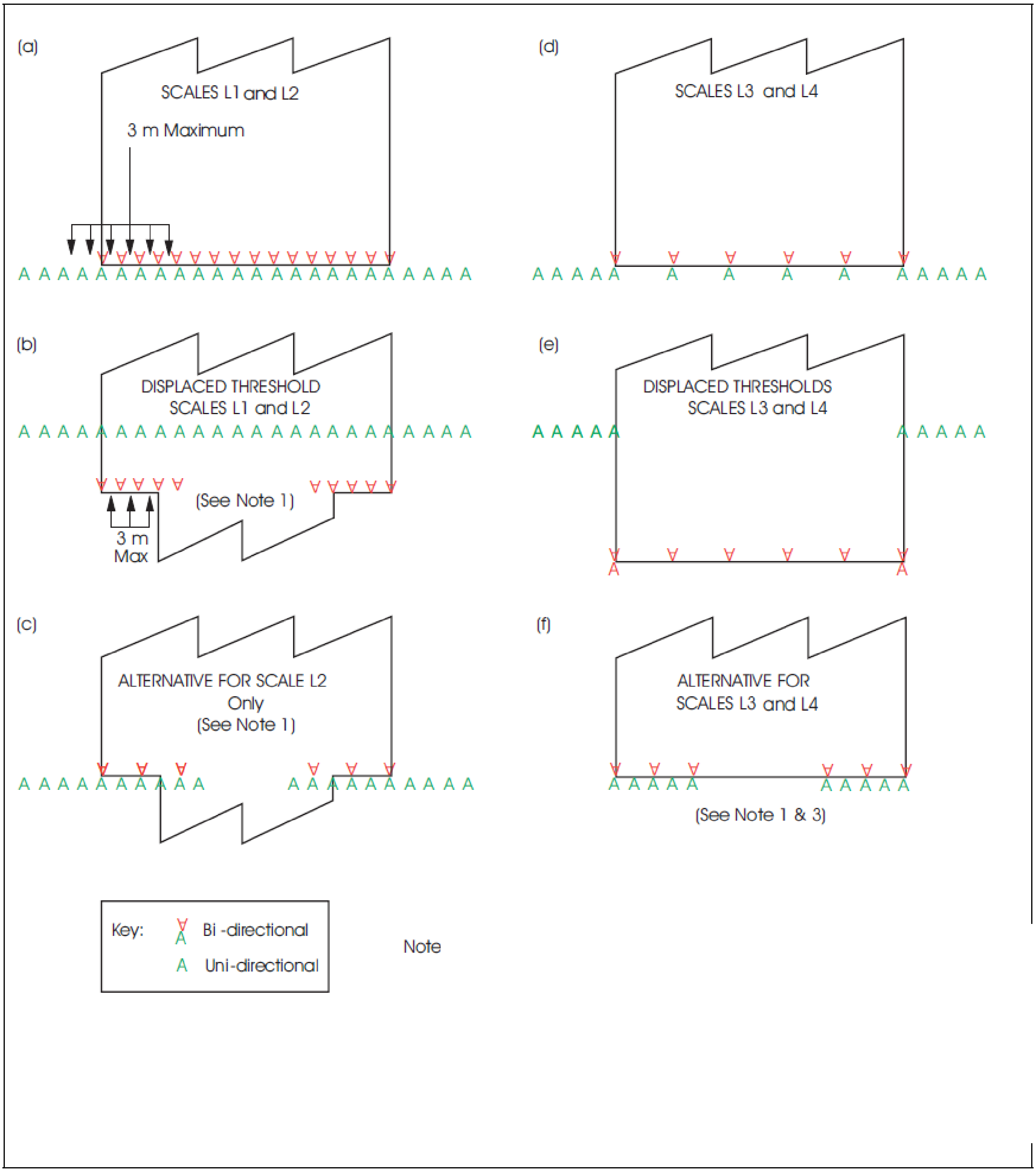


Figure 6.10 Runway threshold and runway end lighting



Notes:

1. The centre gap, which is designed to allow the use of elevated lights where a stopway exists, should not exceed half the runway width. Number of threshold lights will be dependent on runway width with light spacing 3m maximum.
2. Uni- or bi-directional lights should be used, except for portable lights in Scale L4 which may be omni-directional.
3. Wing bar lights may be used to provide added conspicuity.

Starter extension lighting

6.59 A starter extension which is narrower than its associated runway should have blue edge lighting.

6.60 A pre-threshold runway of the same width as its associated runway should have edge lighting showing red on approach and white in the opposite direction with longitudinal spacing as for the runway edge lights.

Runway centreline lights

6.61 White runway centreline lights are required for take-off in RVR below 400m and for precision instrument approach runways Category II and III. They extend from the threshold of the runway to 900m from the upwind runway end, then the following 600m should be alternate white and red lights, and the final 300 m to the runway end, all red lights. Where the end of TORA/LDA does not coincide with the runway end, the section of red lights should be extended to the runway end. Runway centre line lights should be located along the centre line of the runway, except that the lights may be uniformly offset to the same side of the runway centre line by not more than 60 cm where it is not practicable to locate them along the centre line. The circuits for the white and red lights should be arranged so as to preserve the colour coding in the event of a circuit failure. The spacing between centreline lights should be 30m except that for Category III operations and for take-off in RVR below 350m, the spacing should be 15 m. The layout of runway centreline lights is illustrated at figure 6.9.

6.62 For Category II operations, centreline lights with characteristics meeting the requirements in table 6A.2 should be set to give maximum luminous intensity at 3° above the horizontal.

Touchdown Zone Lights (TDZ)

6.63 Touchdown zone barrettes symmetrically disposed either side of the runway centreline should extend from the threshold for a distance of 900 m or to the midpoint of the runway, whichever is less. Each barrette has four white lights spaced not more than 1.5 m apart, the innermost lights being not less than 9m nor more than 11.5 m either side of the centreline. The longitudinal spacing between barrettes should be 60 m ±6 m. The lateral gauge of the barrettes should be equal to that of the Supplementary Approach lighting red side row barrettes. The layout of the touchdown zone lights is illustrated in figure 6.9.

6.64 A setting angle of 3° should be used for Category II operations. For Category III operations using Category II lighting, the TDZ lights should be set to give their maximum luminous intensity at 5.5° above the horizontal. Newly constructed or re-equipped runways for Category III operations should have TDZ lighting with the characteristics specified in figure 6A.5.

Simple touchdown zone lights

6.65 The purpose of simple touchdown zone lights is to provide pilots with enhanced situational awareness in all visibility conditions and to help them to decide whether to commence a go-around if the aircraft has not landed by a certain point on the runway. It is essential that pilots operating at aerodromes with simple touchdown zone lights be familiar with the purpose of these lights.

6.66 Except where TDZ lights are provided in accordance with paragraphs 6.63 to 6.4, at an aerodrome where the approach angle is greater than 3.5 degrees and/or the landing distance available combined with other factors increases the risk of an overrun, simple touchdown zone lights should be provided.

6.67 Simple touchdown zone lights shall be a pair of lights located on each side of the runway centreline 0.3m beyond the upwind edge of the final touchdown zone marking. The lateral spacing between the inner lights of the two pairs of lights shall be equal to the lateral spacing selected for the touchdown zone marking.

6.68 The spacing between the lights of the same pair shall not be more than 1.5 m or half the width of the touchdown zone marking, whichever is greater. (See figure 11.)

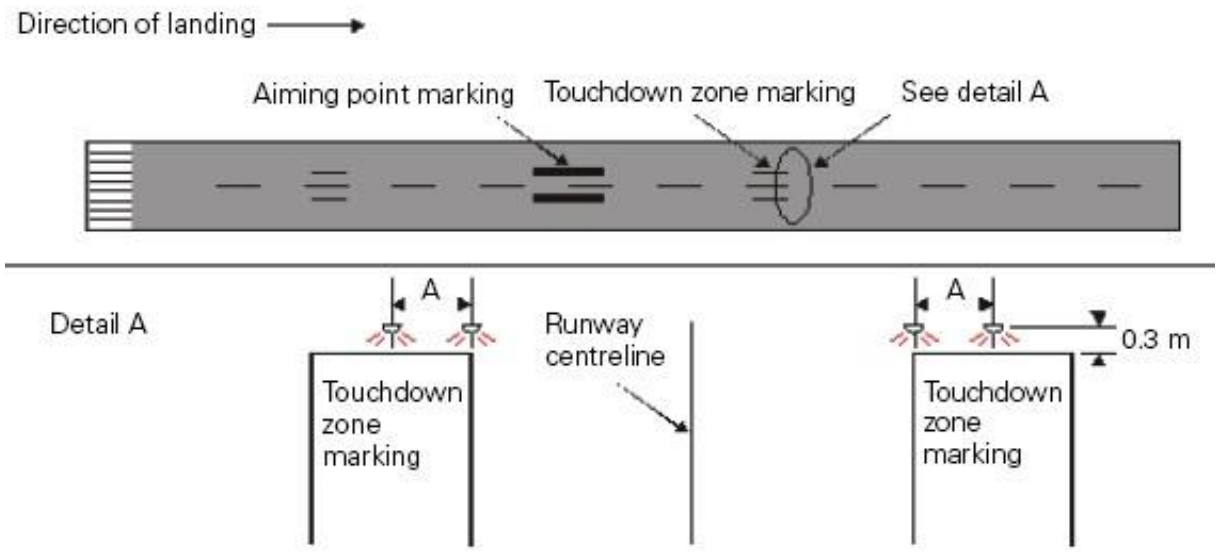
6.69 Where provided on a runway without TDZ markings, simple touchdown zone lights should be installed in such a position that provides the equivalent TDZ information.

6.70 Simple touchdown zone lights shall be fixed unidirectional lights showing variable white, aligned so as to be visible to the pilot of a landing aeroplane in the direction of approach to the runway.

6.71 Simple touchdown zone lights shall be in accordance with the specifications in appendix 6A figure 6A 5.

6.72 As a good operating practice, simple touchdown zone lights should be supplied with power on a separate circuit to other runway lighting so that they may be used when other lighting is switched off.

Figure 6.11 Spacing between the lights of the same pair



Note: Dimension A is 1.5 m or half the width of the touchdown zone marking, whichever is greater.

Rapid exit taxiway indicator lights

6.73 The purpose of rapid exit taxiway indicator lights (RETILs) is to provide pilots with 'distance to go' information to the nearest rapid exit taxiway on the runway, to enhance situational awareness in low visibility conditions and enable pilots to apply braking action for more efficient roll-out and runway exit speeds. It is essential that pilots operating at aerodromes with runways displaying RETILs be familiar with the purpose of these lights.

6.74 RETILs may be considered for all paved runways, but their use is enhanced on runways used in RVR less than 400m and/or where the traffic density is heavy.

6.75 RETILs should be located on the runway on the same side of the runway centreline as the associated rapid exit taxiway, in the configuration shown in figure 6.12. In each set the lights should be located 2 m apart and the light nearest the runway centreline shall be displaced 2 m from the runway centreline.

6.76 Where more than one rapid exit taxiway exists on a runway, the set of RETILs for each exit should not overlap when displayed.

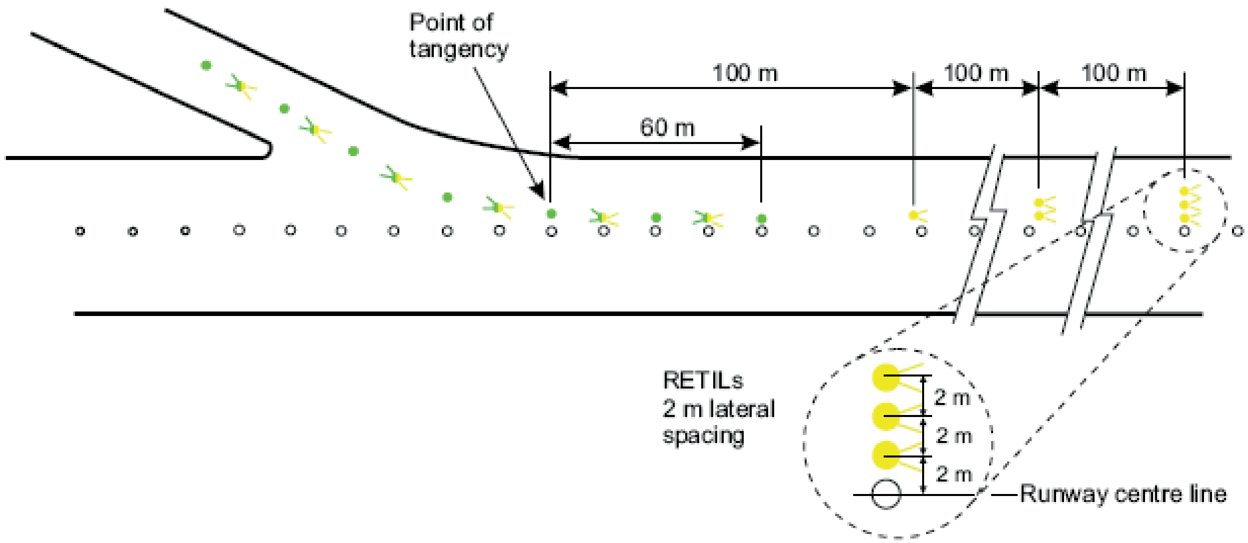
6.77 RETILs shall be fixed unidirectional yellow lights, aligned so as to be visible to

6.78 the pilot of a landing aeroplane in the direction of approach to the runway, and in accordance with the specifications given in figures 6A.6 and 6A.7.

6.79 RETILs should not be displayed in the event of any lamp failure or other failure that prevents the display of the light pattern depicted in figure 6.11 in full.

6.80 RETILs should be supplied with power on a separate circuit to other runway lighting so that they may be used when other lighting is switched off.

6.81 Figure 6.12 Rapid exit taxiway indicator lights



Runway turn pad lighting

6.82 Runway turn pad lights should be provided for continuous guidance on a runway turn pad intended for use at night and in RVR conditions less than 400 m, to enable an aeroplane to complete a 180° turn and align with the runway centreline.

6.83 Runway turn pad lights should normally be located on the runway turn pad marking, except that they may be offset by not more than 0.30m where it is not practicable to locate them on the marking.

6.84 Runway turn pad lights on a straight section of the turn pad marking should be spaced at intervals of not more than 15m, while the spacing for lights on the curved sections of the turn pad should not exceed 7.5m.

6.85 Runway turn pad lights should be uni-directional fixed lights showing green with beam dimensions such that the light is visible only from aeroplanes on or approaching the turn pad. The characteristics of runway turn pad lights are given in figures 6A.12, 6A.13 and 6A.14.

6.86 Taxiway edge lights on a runway turn pad should be placed at uniform longitudinal intervals not exceeding 30m.

Stopway lights

6.87 The end of any stopway associated with a runway used at night should be marked with four uni-directional red lights equally spaced across the width of the stopway. The edges of the stopway should be marked by pairs of similar red lights at a uniform spacing not exceeding 60 m. The layout is illustrated in figure 6.9.

Taxiway lighting

Taxiway edge lighting

6.88 Blue lighting is used to indicate the edge of a taxiway and should be installed on paved taxiways where centreline lighting is not provided. However, retroflective edge markers may be used instead of edge lights for Scale L4. The lights should be placed in pairs, one on each side of the taxiway on lines at right angles to the centreline except at junctions.

6.89 The spacing of the lights on straight sections and curves of radius 150m or greater serving runways with Scale L2 lighting should not exceed 30m.

6.90 On taxiways serving runways with Scale L3 and L4 lighting, the spacing should not exceed 60m but should preferably be no greater than 45m.

6.91 On curves of radius less than 150m, the lights should be located on radii passing through points on the taxiway centreline spaced at one fifth the radius of the curve of the centreline.

6.92 On small fillets less than 15m radius at the taxiway edge, a minimum spacing of 3m should be used.

6.93 Taxiway edge lighting may be used to augment centreline lighting where aircraft are required to negotiate difficult curves.

6.94 The edges of turning and holding areas should be marked with blue lights.

6.95 The characteristics of elevated taxiway edge lights are given at table 6A.1.

Taxiway centreline lighting

6.96 Green taxiway centre line lights shall be provided on an exit taxiway, taxiway, de-icing/anti-icing facility and apron intended for use in runway visual range conditions less than a value of 350 m in such a manner as to provide continuous guidance between the runway centre line and aircraft stands, except that these lights need not be provided where the traffic density is light and taxiway edge lights and centre line marking provide adequate guidance. Additionally, Taxiway centre line lights should be provided in all visibility conditions on a runway forming part of a standard taxi-route where specified as components of an advanced surface movement guidance and control system.

6.97 The characteristics of centreline lights required for day/night use in RVRs of less than 350m are given at figures 6A.12 to 6A.14.

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

6.99 A three-stage luminance intensity control should be provided. Low intensity centreline lights are suitable for night use only and are not intended to support operations in RVRs of less than 400m; their characteristics are given in figures 6A.15 and 6A.16. Where occasional take-off movements take place in RVRs less than 350 m, taxiway edge lighting supplemented by centreline marking may exceptionally be approved by the CAA.

6.100 The effectiveness of taxiway centreline lights is dependent upon the slant visibility from the cockpit, the distance between successive lights and their luminous intensity. Therefore, the light spacing should be designed to correspond with the minimum RVR in which operations are intended as given in table 6.2:

Table 6.2 Taxiway Centreline Light Spacing

Taxiway	Minimum RVR	
	< 350m	> 350m
Straight	15m	30m
Curved	7.5m	15m

6.101 Note: Spacing may be altered by up to ±10% to facilitate pavement design.

6.102 For operations in RVR less than 350m, the reduced spacing for curved sections should extend 60 m before the start and 60m beyond the end of the curves; for operations in RVR of 350 m or greater, this distance is reduced to 30 m.

6.103 On runways equipped with ILS, taxiway centreline lights located within the ILS critical/sensitive area or the OFZ should be colour coded to show alternate green/yellow in both directions. The colour coding should commence with a green light close to the runway centreline and end with a yellow light at the perimeter of the ILS critical/sensitive area or the lower edge of the side surface of the OFZ, whichever is the farther from the runway. At rapid exit taxiways the lead-off lights should commence adjacent to the runway centreline at least 60m before the intersection with the exit taxiway curvature. At all other taxiway/runway intersections the lead-off lights should commence at least 30 m before the intersection. The section of lighting running parallel to the runway centreline should be offset transversely by 0.75m ±0.15m.

Stop-bars

6.104 Stop-bars are intended to help protect the runway against inadvertent incursions. A stop-bar consists of a single row of flush or semi-flush inset lights installed laterally across a taxiway showing red towards the intended direction of approach.

6.105 Stop-bars should be provided at all runway taxi-holding positions and intermediate taxi-holding positions intended for use in RVR conditions less than a value of 550m, unless procedures have been agreed with the CAA to limit the number of aircraft either on the maneuvering area or on final approach within 5nm to one aircraft at any given time. Runway incursions may take place in all visibility or weather conditions. The provision of stop bars at runway-holding positions and their use at night and in visibility conditions greater than 550m runway visual range can form part of effective runway incursion prevention measures.

6.106 Stop-bars installed at taxiway/runway intersection should be uni-directional and show red towards the direction of approach to the runway. Stop-bars installed at intermediate taxi-holding positions may be bi-directional where the holding position is intended for use in each direction. Stop-bars installed at runway taxi-holding positions and intermediate taxi-Holding positions should be independently switchable; all other stop-bars protecting the runway as described in appendix 2B should be permanently illuminated during LVO. Where there is more than one stop bar associated with a taxiway/runway intersection, only one should be illuminated at any given time.

6.107 An independently switchable stop-bar should consist of a stop-bar interlocked with a section of taxiway centreline lead-on lighting beyond the stop-bar. The section of interlocked taxiway centreline lead-on lighting should, wherever practicable, be at least 90m in length. The interlock should be designed to meet the requirements at paragraph 6.233.

6.108 The light fittings making up a stop-bar shall be spaced equally across the taxiway in a line at right angles to the taxiway centreline at intervals of no greater than 3m. They should be positioned coincident with any associated taxiway holding position marking so as not to obscure or interfere with the integrity of the marking. The outer lights of the stop-bar should be located on the edges of the taxiway. However, at holding positions where a flight crew’s view of the stop-bar might be obscured, the stop-bar should be extended beyond the edge of the taxiway by the addition of four omni-directional elevated lights, two placed on each side of the taxiway along the stop-bar axis at intervals equal to the spacing of other lights making up the stop-bar. Stop-bars installed at taxiway/runway intersections not used in Low Visibility Operations in order to protect the runway against inadvertent incursions should be located no closer to the runway than the distances laid down at chapter 3, table 3.3.

6.109 The characteristics of lights, including elevated side lights used in stop-bars, are given in figures 6A.12 to 6A.16.

Intermediate Holding Position Light

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

6.111 Intermediate holding position lights should be provided at an intermediate holding position where there is no need for stop-and-go signals as provided by a stop bar.

6.112 Aerodrome operators considering the installation of an IHPL should obtain initial approval from the CAA.

6.113 Intermediate holding position lights should consist of three fixed unidirectional lights showing yellow in the direction of approach to the intermediate holding position with a light distribution similar to taxiway centre line lights if provided.

6.114 The lights should be disposed symmetrically about and at right angle to the taxiway centre line, with individual lights spaced 1.5m apart.

6.115 Intermediate holding position lights chromaticity should be in accordance with the specifications in Figures 6A.12 to 6A.16.

De-icing/anti-icing facility exit lights

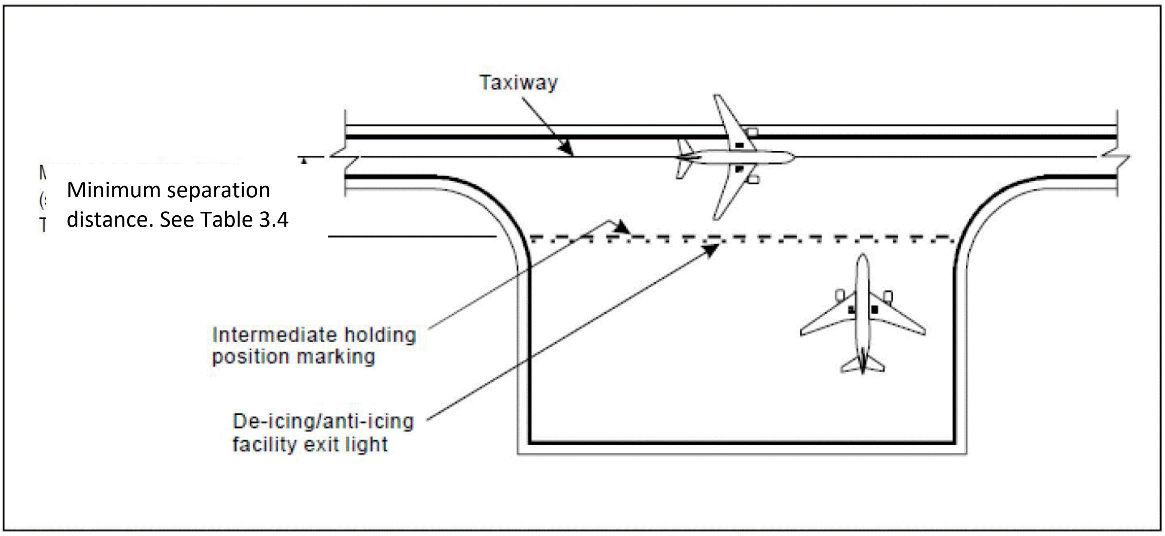
6.116 The purpose of the de-icing/anti-icing facility exit lights is to indicate the exit boundary of a remote de-icing/anti-icing facility adjoining a taxiway should the facility be available on the aerodrome.

6.117 Location: Where provided, de-icing/anti-icing facility exit lights should be located 0.3 m inward of the intermediate holding position marking displayed at the exit boundary of a remote de-icing/ anti-icing facility.

6.118 Characteristics: Where provided, de-icing/anti-icing facility exit lights should consist of in-pavement fixed unidirectional lights spaced at intervals of 6 m showing yellow in the direction of the approach to the exit boundary with a light distribution similar to taxiway centre line lights (see Figure 6.12a) below.

6.119 (d) De-icing/anti-icing facility exit lights chromaticity should be in accordance with the specifications in Table 6A.2 and Figure 6A.22 or 6A.23, as appropriate.

Figure 6.12a De-Icing/anti-icing facility exit lights



No entry bar

6.120 A no entry bar should be provided across a taxiway which is intended to be used as an exit only taxiway to assist in preventing inadvertent access of traffic to that taxiway.

6.121 A no entry bar should be located across the taxiway at the end of an exit only taxiway where it is desired to prevent traffic from entering the taxiway in the wrong direction.

6.122 A no entry bar should be collocated with a no entry sign and/or a no entry marking.

6.123 Note: Specifications of a no entry sign are described in Chapter 7 Para. 7.39

6.124 A no entry bar should consist of unidirectional lights spaced at uniform intervals of no more than 3 m showing red in the intended direction(s) of approach to the runway.

6.125 A pair of elevated lights should be added to each end of the no entry bar where the in-pavement no entry bar lights might be obscured from a pilot's view, for example, by snow or rain, or where a pilot may be required to stop the aircraft in a position so close to the lights that they are blocked from view by the structure of the aircraft.

6.126 The intensity in red light and beam spreads of no entry bar lights shall be in accordance with the specifications in ICAO annex 14, Volume I, appendix 2, AGL Characteristics, figures A2-17 and A2-19., as appropriate.

6.127 Where a wide beam fixture is required, the intensity in red light and beam spreads of no-entry bar lights should be in accordance with the specifications of ICAO annex 14, Volume I, appendix 2, AGL Characteristics, figures A2-17 and A2-19.

6.128 The lighting circuit shall be designed so that:

1. no-entry bars are switchable selectively or in groups;
2. when a no-entry bar is illuminated, any taxiway centreline lights installed beyond the no-entry bar, when viewed towards the runway, shall be extinguished for a distance of at least 90m; and
3. when a no-entry bar is illuminated, any stop bar installed between the no- entry bar and the runway shall be extinguished.

Runway Status Lights

6.129 Runway status lights (RWSL) is a type of autonomous runway incursion warning system (ARIWS). The two basic visual components of RWSL are runway entrance lights (RELs) and take-off hold lights (THLs). Either component may be installed by itself, but the two components are designed to be complementary to each other.

6.130 Location:

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

   Note.— Where two or more runway-holding positions are provided, the runway-holding position referred is that closest to the runway.

2) RELs shall consist of at least five light units and shall be spaced at a minimum of 3.8 m and a maximum of 15.2 m longitudinally, depending upon the taxiway length involved, except for a single light installed near the runway centreline.

3) Where provided, THLs shall be offset 1.8 m on each side of the runway centre

4) line lights and extend, in pairs, starting at a point 115 m from the beginning of the runway and, thereafter, every 30 m for at least 450 m.

   Note. — Additional THLs may be similarly provided at the starting point of the take-off roll.

6.131 Characteristics:

1) Where provided, RELs shall consist of a single line of fixed in pavement lights showing red in the direction of aircraft approaching the runway.

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

3) Intensity and beam spread of RELs shall be in accordance with the specifications of Appendix 6A, Figures 6A.12 and 6A.14.

   Note. — Consideration for reduced beam width may be required for some REL lights at acute angled runway/taxiway intersections to ensure the RELs are not visible to aircraft on the runway.

4) Where provided, THLs shall consist of two rows of fixed in pavement lights showing red facing the aircraft taking off.

5) THLs shall illuminate as an array on the runway less than two seconds after the system determines a warning is needed.

6.132 Intensity and beam spread of THLs shall be in accordance with the specifications of Appendix 6A, Figure 6A.22.

6.133 RELs and THLs should be automated to the extent that the only control over each system will be to disable one or both systems.

Taxiway guidance and control systems

6.134 At aerodromes where operations take place in RVR less than 400 m or where ground movement requirements are complex, a taxiway guidance and control system should be installed, except where aircraft movements are limited in accordance with the procedure outlined at paragraph 6.101. The system should operate by selective switching of the taxiway centreline lights so that individual sections or routes are illuminated, each terminating at a lighted stop-bar.

Runway guard lights

6.135 Runway Guard Lights are a visual aid intended to caution flight crews or vehicle drivers that they are about to enter a runway. runway guard lights should be provided on all taxiways/runway intersections associated with a runway intended for use in RVR less than 1200m. The system consists of two units, one located on each side of the taxiway at the distance given in paragraph 6.132 (configuration A), aligned so as to be visible to the pilot, or vehicle driver, approaching the holding position. Each unit comprises a pair of alternately illuminating yellow lamps which operate at between 30 and 60 cycles per minute, with periods of light illumination and suppression equal and opposite in each case. The lights should be in operation whenever the RVR is less than 1200m and be switched independently of any stop-bar lights.

6.136 Runway Guard Lights should not exceed a height above which their presence may endanger aircraft and should meet frangibility requirements in appendix 6A. They should be located on each side of the taxiway as close as possible to the pavement edge and adjacent to the Runway Taxi-Holding Position closest to the runway, normally the non-instrument runway holding point. Where additional Runway Taxi-Holding Positions are provided, such as for Category II and III operations, additional runway guard lights shall be provided and illuminated when that holding position is in use.

6.137 Where runway guard lights are operated in good visibility conditions at night, the luminous intensity may be reduced to 30% but the signal characteristics specified in paragraph 6.131 must be retained.

6.138 On wide throat taxiways used in low visibility conditions when enhanced conspicuity of the taxiway/runway intersection is required, an alternative form of runway guard light may be used (Configuration B). This consists of a row of inset lights equally spaced at no more than 3 m intervals across the taxiway at the distance from the runway centreline specified in paragraph 6.132 above, aligned so as to be visible to the pilot or vehicle driver approaching the holding position. The lights should have the characteristics described at paragraph 6.131 above but adjacent lights should be alternately illuminated and alternate lights should be illuminated in unison. This alternative form of Runway Guard Light should not be collocated with a stop-bar. The light performance characteristics are given in figure 6A.12 for LI lights and 6A.17 for HI lights.

Figure 6.13 Runway guard lights

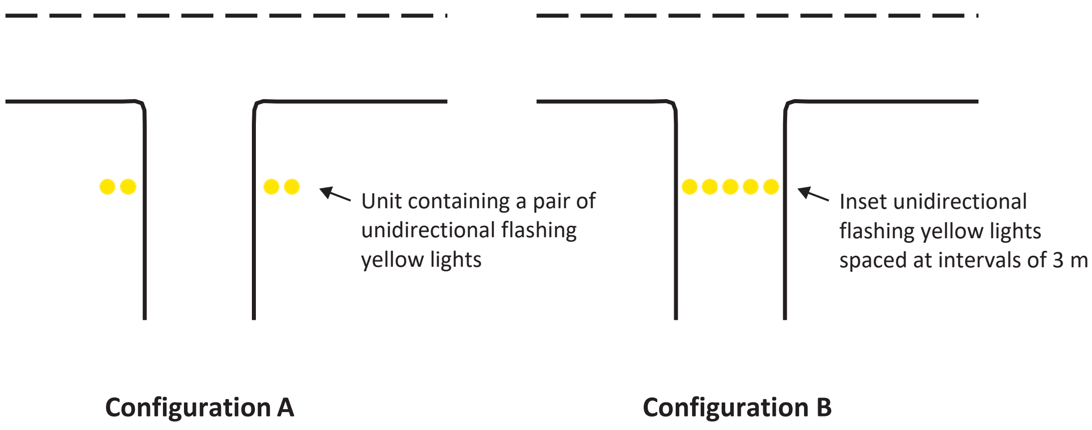
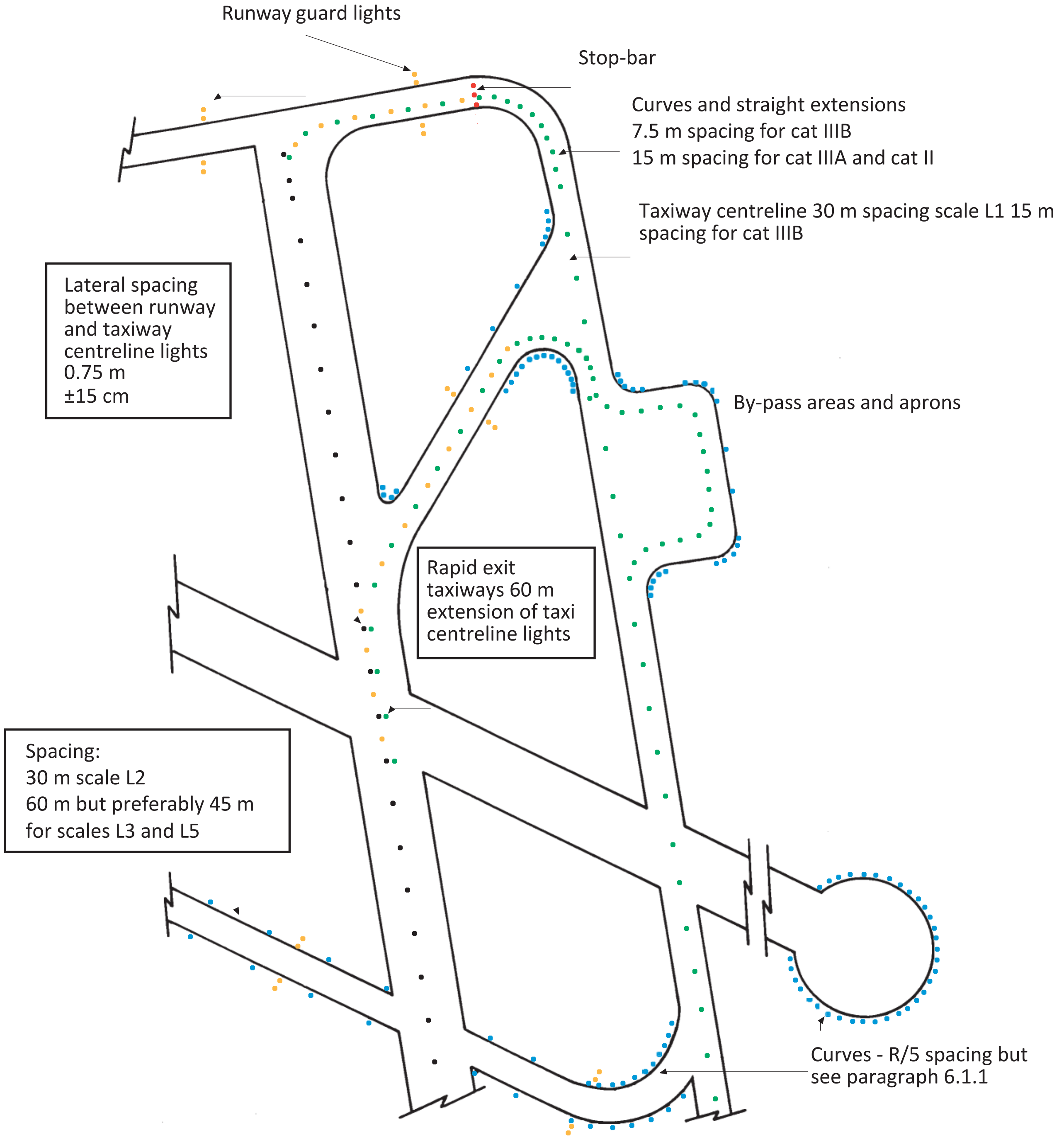


Figure 6.14 Taxiway lighting



Road-holding position lights

6.139 Road-holding position lights should be provided at the intersection of all roads with runways used in visibility less than 1200 m. The lights should be located 1.5 m from the edge of the left side of the road and adjacent to the road-holding position marking and sign described in chapter 7.

6.140 The road-holding position light should consist of either:

1. a red/green traffic light where a controlled crossing exists; or
2. an amber light system meeting the characteristics of runway guard lights at a point where caution should be exercised.

6.141 The road-holding position light beam shall be uni-directional and aligned so as to be visible to the driver of a vehicle approaching the holding position. The intensity of the light beam shall be adequate for the conditions of visibility and ambient light in which the use of the holding position is intended but shall not dazzle the driver.

6.142 Road-holding position lights should always be accompanied by a road-holding position sign such as that illustrated at figure 7.40 and, where appropriate, an instruction or cautionary notice.

Signs

6.143 The requirements for the lighting of signs are detailed at chapter 7.

Retroflective taxiway edge markers and centreline studs

6.144 Retroflective edge markers or centreline studs either together or separately may be used instead of taxiway edge lights for Scale L4 and, if agreed by the CAA, on other taxiways that are used infrequently. Edge markers should not exceed 0.36 m in height. Centreline studs should not exceed 25 mm in height.

6.145 Edge markers should have a minimum viewing area of 150 cm2 and be blue in colour; centreline studs should be green and have a minimum viewing area of 20 cm^2.

Unpaved taxiway routes

6.146 If taxiing is confined to specific routes but the taxiway is not paved, the routes should be either edged with blue portable lights spaced not more than 60 m apart and laid out as for normal taxiway edge lighting, or marked with taxiway edge markers, spaced not more than 30 m apart. At the discretion of the CAA, apron floodlighting may be accepted as sufficient illumination of taxiways in the vicinity of the apron.

Aerodromes without specific taxiway routes

6.147 Where specific taxiway routes are not provided on grass aerodromes, the lighting requirement may be met by white lights marking the boundary of the maneuvering area. The lights should be spaced not more than 90 m apart and emit a minimum of 10 candelas.

Apron lighting and visual docking guidance systems

Apron lighting

6.148 The edges[6] of aprons should be marked with blue lights in accordance with the specifications given in paragraph 6.141. Where aerodrome licence holders consider that blue edge lights are not required, advice should be sought from the CAA.

6.149 Apron floodlights should be located so as to provide adequate illumination on all apron areas, with a minimum of glare to pilots of aircraft in flight and on the ground, aerodrome and apron controllers, and personnel on the apron. The arrangement and aiming of floodlights should be such that an aircraft stand receives light from two or more directions to minimise shadows.

6.150 The spectral distribution of apron floodlights shall be such that the colours used for aircraft marking connected with routine servicing, and for surface and obstacle marking, can be correctly identified.

6.151 The average illuminance should be at least the following:

1. Aircraft stand:
    a) Horizontal illuminance - 20 lux with a uniformity ratio (average to minimum) of not more than 4 to 1; and
    b) Vertical illuminance - 20 lux at a height of 2 m above the apron in relevant directions.
2. Other apron areas:
    a) Horizontal illuminance - 50% of the average illuminance on the aircraft stands with a uniformity ratio (average to minimum) of not more than 4 to 1.

Visual Docking Guidance Systems (VDGS)

6.152 A VDGS providing both azimuth and stopping guidance should be installed when it is necessary to indicate, by a visual aid, the precise positioning of an aircraft on a stand.

6.153 VDGS should meet the requirements specified in ICAO annex 14, chapter 5.

Obstacle lighting

6.154 Details of this lighting are given in chapter 4.

6 For the purposes of this paragraph, 'edge' means the extremity of any apron beyond which the wing tip to object separation distance for the largest aircraft that can use the apron is not assured.

Control of AGL luminous intensity

6.155 AGL incorporating high intensity lights may be used in varying visibility and ambient lighting conditions. In certain conditions, inset supplementary approach lighting at displaced thresholds and touchdown zone lighting at higher luminous intensity settings can cause unacceptable levels of glare to flight crew lining up for take-off. The final choice of AGL luminous intensity setting rests with the flight crew; therefore, except for obstacle lighting, the luminous intensity of AGL that has an output of more than 150 candelas directed towards an approaching aircraft should be individually and independently controllable in accordance with the luminous intensity stages detailed in Table 6.3.

Table 6.3 Luminous intensity control stages

Lighting	Stages	
	Minimum	Recommended
High intensity approach and runway systems, PAPI and High intensity (A)PAPI, except for supplementary approach lighting in Scale L1	100%, 30%, 10%, 3%, 1% (see Note 1)	Additionally, 0.3%
Supplementary approach	100%, 30%, 10%	
Taxiway centreline and stop-bars	100%, 30% Additionally 10% for HI	
Low intensity systems and taxiway edge exceeding 5 candelas output	–	100%, 30% (see note 2)

Notes:

1. Unless the manufacturer recommends otherwise, an 80% PAPI and 30% (A) PAPI luminous intensity may be used to increase lamp life.
2. An additional 10% setting for low intensity (A)PAPI is also advisable.

Typical luminous intensity settings

6.156 It is essential that the various services that make up the AGL present a well- balanced and even pattern to flight crew; hence the provision of an additional ability to select pre-set combinations of luminous intensity settings with one switch may be of benefit.

6.157 A luminous intensity control is not essential for low intensity systems, but at least two stages (100% and 30%) are desirable. An additional 10% stage is advisable for low intensity PAPI/(A)PAPI systems.

6.158 The luminous intensity stages not only attempt to provide the most appropriate settings according to ambient light and visibility conditions, but also take into account the different light outputs for each type of AGL. The optimum overall pattern for approach and runway lighting should be in the order of a 2:1 balance, which is reflected in the average light output requirements in candela of the lights (see appendix 6A). It is therefore essential that the light output and alignment of every light is correct in order to achieve the optimum overall lighting pattern.

Notes:

1. *Change setting at 600 m RVR when visibility is deteriorating and at 800 m RVR when visibility is improving. When the runway edge luminous intensity is set to less than 10%, the IRVR system is unable to provide a reading. When the observed visibility deteriorates to less than 1500 m, the runway edge lights should be set to 10% or greater.*
2. *Low intensity may be used at 30% if conditions warrant; low intensity and high intensity may be used together or independently; high intensity should be set at 3% except that where there is little or no extraneous lighting, it may be operated at 1% or 0.3% if available and conditions warrant.*
3. *When used for taxiway guidance/control (stop-bars) system purposes, otherwise not required.*
4. *Settings other than 100% should be used as indicated when available.*
5. *80% may be used if available.*
6. *Where required.*
7. *Where taxi guidance signs capable of being illuminated are installed, they should be lit at night and whenever the weather conditions are C or D during the day.*

6.159 An IRVR system will not display a reading if the runway edge lighting luminous intensity is set to less than 10%; therefore, when the observed visibility deteriorates to less than 1500 m, the runway and approach lighting luminous intensity should be set to a minimum of 10%.

Luminous intensity balance considerations for coloured lighting

6.160 Colour filters reduce the light output. The best balance between coloured and white lights may be obtained by either of the following means:

1. Separate electrical AGL circuits with luminous intensity controls for the different elements so that the green threshold and red runway end lighting may be selected at one or two steps higher than the white edge lighting.
2. Higher output lights or the use of increased wattage lamps in the existing lights for the coloured lighting. With this method the whole system can remain on a common AGL circuit, but care has to be exercised in order to ensure that the increased heat generated by higher wattage lamps does not damage the colour filters or aircraft tyres.

Alternate input power supply for AGL systems

6.161 At least one alternate input power supply should be provided for scales L1 and L2 including internally lit mandatory signs where appropriate and is recommended for other scales. Table 6.5 details the maximum time interval to be achieved between failure of the normal source of supply and the restoration of individual services Maximum Switchover Time (MTS) when in the associated visibility conditions. A MTS of one second can be achieved by automatic changeover either:

1. between two incoming power supplies and a closed ring system; or
2. between a diesel generating set supplying the load with reversion to the normal supply on failure of the generating set.

6.162 MTS is 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.

6.163 Where the power supply to an aerodrome is provided by two separate grid sources, one of them may be considered as an alternate input power supply if common failure modes in addition to that expected with a grid and standby generator design do not exist and the simultaneous loss of both supplies can be shown to be only a remote possibility.

6.164 If no alternate power supply is available, the aerodrome authorities should notify the effect by NOTAM. The NOTAM action should be taken by only one source on the aerodrome. ATS should notify flight crew on initial RTF contact and by ATIS when possible. Flight crews can then be expected to follow the appropriate instructions in their operations manual. Routine checks should be carried out on AGL input power supplies.

6.165 Where there is no alternate power supply to support lighting to Scales L3 and L4, portable emergency lighting should be available in sufficient numbers for the minimum runway lighting pattern to be provided in the event of an AGL input power failure.

6.166 Licence holders should put in place procedures that will ensure that emergency lighting provided in accordance with paragraph 6.161 will be in operation within 15 minutes of any loss of the input power supply.

Table 6.5 Alternate power supply – maximum switchover time

Runway	Aids requiring power	Maximum switchover time
Precision instrument approach Categories II and III (Scale L1)	Inner 300m of the Approach lighting	1 second
	Runway edge	15 seconds
	Runway threshold and end	1 second
	Runway centreline	1 second
	Runway touchdown zone	1 second
	All stop-bars for Category III	1 second
	Runway guard lights	15 second
	Category II stop-bars at taxi holding positions	1 second
	Other stop-bars	15 seconds
	Essential taxiway, mandatory signs	15 seconds
	Obstacle	15 seconds
	PAPI	15 seconds
Precision instrument approach Category I (Scale L2)	Approach lighting	15 seconds
	Runway edge	15 seconds
	Runway threshold and end	15 seconds
	Essential taxiway lights and mandatory signs	15 seconds
	Obstacle	15 seconds
	PAPI	15 seconds
Non-precision instrument approach (Scale L3)	Approach lighting	15 seconds
	Runway edge	15 seconds
	Runway threshold and end	15 seconds
	Obstacle	15 seconds
	PAPI and (A)PAPI	15 seconds
Take-off runway intended for use in runway visual range conditions less than 800 m	Runway edge	15 seconds*
	Runway end	1 second
	Runway centreline (where fitted)	1 second
	All stop-bars	1 second
	Essential taxiway	15 seconds
	Obstacle	15 seconds

* 1 second where no runway centreline lighting provided

Control and monitoring of aeronautical ground lighting

General requirements

6.167 At the majority of aerodromes, the AGL should be controlled remotely from an ATC VCR. In such a case, a remote monitoring facility should also be provided in the VCR where an adequate assessment of the serviceability of the AGL cannot be made by other means.

6.168 In the absence of a VCR and/or remote-control facilities, the AGL should be switched directly from its power source (in most cases the constant current regulator (CCR)). The AGL should be verified as operationally serviceable by means of a visual inspection and/or indications from the AGL equipment. Where operationally significant, this information should be notified immediately to the AGL operator and, where necessary, flight crew.

6.169 The control of an AGL system from beyond the boundary of a licensed aerodrome will only be approved by the CAA for the sole use of the emergency services. Where this type of control is desired, an operational requirement proposed by the aerodrome authority and supported by the emergency services involved should be submitted in the first instance to the CAA.

6.170 When in use, the operational status of the AGL system should be continuously monitored. An appropriate means of detecting an AGL system failure or fault and other serviceability information should be provided. The AGL system serviceability information should be provided to the AGL operator in a simple but accurate and concise way, so that if necessary, the user may pass a report to flight crew. The report should enable flight crew to determine whether the AGL meets their current operational flight requirements or not.

6.171 The design of the control and monitoring system should be kept as simple as possible. It should be ergonomically sound, easy to operate, simple to understand, unambiguous and it should be configured so as to prevent accidental mis-selection of the AGL. The remote control and monitoring facilities provided for ATC use shall be approved by the CAA under Article 169 of the ANO. Further guidance on the manner in which serviceability information may be presented in remote control facilities in ATC VCRs can be found in CAP 670, ATS Safety Requirements.

6.172 The complexity of the AGL control and monitoring system will depend upon the operational requirements of the aerodrome concerned. In many cases, the control facilities can be simple, requiring only hardwired switches and relays to meet the functional requirements of the AGL system. However, aerodromes with increasingly more complex taxiway routeing systems and heavy volumes of traffic find that programmable electronic systems provide the capability and flexibility needed. Moreover, the gradual reduction in cost of programmable electronic systems may permit a better overall system to be installed to cater for routine maintenance and future modifications.

6.173 The AGL control and monitoring system should:

1. be suitable for the aerodrome, and be adaptable to changes in an aerodrome's physical characteristics (layout, installations, etc.) or operational procedures;
2. be inspired by safety in such a way that allows for the redundancy of equipment or elements which are critical for failsafe design;
3. have a high dependability;
4. be capable of communicating with other related systems, as required.

6.174 Where software is used for the purpose of control or monitoring of the AGL, the following aspects shall be addressed:

1. through analysis of the potential hazards introduced by the software to perform system functions, target safety integrity levels shall be specified for each software function. The chosen software design and build tools, and operating system, shall be shown to be appropriate for the production of the software to achieve the target safety integrity levels;
2. known hazardous software states shall be either removed or mitigated by the total system design; and
3. documented evidence shall be produced to demonstrate accomplishment of the target safety integrity levels.

6.175 The requirements for software in safety related ATS systems are contained in CAP 670, ATS Safety Requirements.

6.176 Commercial-off-the-shelf (COTS) systems may provide a cost and time-effective solution for the design of a part or even the whole AGL system. COTS includes all types of software and electronic or electrical processing equipment and may also be applied to luminaires and other hardware. The following conditions in addition to paragraph 6.150 shall be satisfied where a COTS product is being considered for AGL safety-related applications:

1. the scope of the design specification for the COTS product shall include the purpose for which it is intended to be used;
2. the COTS product shall be designed, manufactured and tested to an appropriate standard or to a level consistent with the safety-related aspects of its application;
3. the functionality of the COTS product shall conform to the applicable safety requirements;
4. any changes or user-defined modifications to the COTS product shall be made under a suitable configuration change control system;
5. proof of 1 to 4 above can be provided and submitted to the CAA.

Control equipment

6.177 The control equipment should:

1. provide a clear layout with efficient ergonomics to support simple and safe handling.
2. facilitate the switching on or off of the AGL;
3. facilitate the switching of luminous intensity settings of the AGL;
4. facilitate alarm handling (visual and audible);
5. if necessary, for complex aerodrome layouts, provide programmable inputs (for example taxiway routeing).

6.178 Where an operational requirement exists for the simultaneous selection of AGL for more than one runway, the potential hazards of incorrect selection should be identified and, where appropriate, suitable interlocks and alert/warning devices should be provided.

6.179 Where stop-bars and associated runway lead-on/off lighting are installed, a separate selector panel and associated monitoring display should be incorporated into the air controller's position in order to provide for the operational control of these services. However, where the air controller has direct and ready access to the main AGL control panel, the CAA may approve the operational control of these services from the main panel.

Monitoring equipment

6.180 The task of the monitoring function is to indicate the actual operational state of the AGL system and to detect a failure of the control and monitoring system itself. The monitoring equipment should:

1. provide information concerning the operational status of the AGL system and should display it at all times. The information required is determined by the provisions of paragraph 6.163 to 6.166 but would typically include the following:
   a) AGL on or off;
   b) AGL performance, e.g., luminous intensity correct or within tolerance and lamp failure.
2. notify the existence of an alarm by appropriate visual and aural means.

6.181 Where used, a hard-wired mimic display panel should depict the individual systems and layout of the AGL by way of a representative lighted display corresponding in pattern colour and orientation to the systems installed on the aerodrome. The detail of pattern and layout of the mimic display should reflect the complexity of the AGL installations and should be capable of providing timely information to ATC staff on the status of each circuit of those systems and of any associated taxiway guidance system. The selection of any AGL (or part thereof) should illuminate the corresponding display on the mimic panel only when the selected service is activated and verified as serviceable.

6.182 The requirements of paragraph 6.177 should also be applied to the use of a visual display unit for the control and/or monitoring of the AGL, including touch- screen devices. The software aspects are outlined at paragraphs 6.170 to 6.171.

6.183 An audio-visual alarm should be provided in order to draw the attention of the AGL operator to any disparity between the AGL selection and the corresponding verification, whenever a selected AGL fails, fails to activate or fails to meet the requirements set out in table 6.6. The audio alarm should be capable of being temporarily suppressed while the visual indication of the fault should remain on both the control panel and monitoring display panel, where these are separately located, until the fault is cleared. Subsequent failures should reactivate the audio alarm even when the fault has not been cleared fully. The aspects to consider for a monitoring display are:

1. if the indicator is on, the AGL is on and serviceable;
2. if the indicator is off, the AGL is off;
3. if the indicator is active (i.e., flashing) and accompanied by an audible alert, the AGL serviceability state has changed.

6.184 The reporting to flight crew of the serviceability of the AGL, the AGL operator needs to be able to state whether the AGL is in one of the following states: serviceable, downgraded, or failed. Therefore, where a new system is installed or significant modification is carried out on an existing system, the AGL control and monitoring system should be capable of determining and indicating which of the aforementioned states applies. For existing AGL control and monitoring systems, a method of reporting such states should be implemented. Using existing indications and a look-up table is one method that may be suitable. The status of the AGL will probably differ according to visibility conditions and other factors; therefore, the status report (or look-up table) should reflect these factors. Further guidance on the assessment of AGL serviceability and the presentation of this information is provided in CAP 670, ATS Safety Requirements.

6.185 Consideration should be given to the provision of an intermediate warning level that indicates a degradation of performance of the AGL and the likelihood of further degradation to alarm level. In the event of a warning level being achieved, action may be taken to prevent an alarm state being reached.

6.186 Verification of AGL performance should be derived from a device that is designed to monitor the true status of the services selected. Any such device should be proved to be satisfactory to the CAA. For constant current series circuits, an acceptable means of providing verification of luminous intensity is the detection of the true root mean square (RMS) current within the primary series circuit. Table 6.6 indicates the logarithmic current values and tolerances for serviceable AGL using such a device. This type of verification does not however provide an assurance that the AGL meets the photometric requirements outlined at appendix 6A. Therefore, the integrity of this verification method should be augmented by the adoption of a maintenance regime that incorporates the measurement of the photometric characteristics of the AGL while in service.

6.187 Technical serviceability information about the AGL system other than that required to meet the requirement of paragraph 6.166 need not be displayed or trigger alerts at ATC or other operational positions.

6.188 All operationally significant events, alarms or failures should be recorded and retained for at least 30 days. The content of a hard copy record may be restricted to error and principal switching messages if no circumstances occurred that might require an investigation into the AGL system integrity, condition or state during the period. However, magnetic, optical or electronic storage should contain all monitored data.

AGL fault conditions

6.189 An AGL system fault exists if:

1. there is a difference between a requested status and the actual status of the AGL; or
2. a malfunction of a significant component or function is detected; or
3. the result of a measurement is not within the specified tolerance.

6.190 Unserviceable light fittings should not be permitted to alter the basic pattern of the AGL system, which should always give adequate guidance. For AGL in use in RVR less than 400 m, no two adjacent light fittings should be unserviceable.

6.191 Where a stop-bar fails to function and is required for use, the stop-bar and the associated section of taxiway should be withdrawn from service until the fault is rectified.

6.192 In the event of a failure that disables the control equipment, the AGL should assume a pre-determined fail-safe condition. Reversion should normally be to the last set selection where that is a safe condition.

6.193 In the event of restoration following a system or power failure, the AGL should be restored to the same status as that which prevailed before the failure or to a safe pre-set condition and there should be no loss of logging facilities.

Maintenance of AGL systems

General

6.194 The Electricity at Work Regulations 1989 encompass all work carried out on AGL and other electrical installations in and around aerodromes. Under certain circumstances the Electricity Safety, Quality and Continuity Regulations 2002 may also apply. As these are Statutory Instruments, compliance with them is mandatory. The equipment and system shall be shown to be electrically safe by means of demonstrated compliance with recognised Standards and Approvals and shall comply with all Health and Safety and personal safety requirements in this respect. This includes the compliance with the Low Voltage Directive 2006/95/EC where applicable.

6.195 A maintenance policy should be produced and followed that addresses the safety of personnel engaged in the maintenance of AGL constant current series circuits. The maintenance policy should address the following aspects:

1. the organisation, roles and responsibilities;
2. the maintenance philosophy, that includes and takes account of:
   a) the maintenance objectives;
   b) the operational requirements;
   c) the maintenance resources.
3. a maintenance schedule and procedures, which include:
   a) planned, controlled, conditional and corrective maintenance programmes;
   b) post-maintenance activities;
   c) the modification or upgrading of equipment.
4. specific safety procedures;
5. the management of records and documentation;
6. the provision of spares, tools and test equipment;
7. inspections.

6.196 The maintenance of AGL equipment should consider the objectives of aerodrome operations and address the impact on such operations while maintenance activities are being carried out. In addition, during periods of maintenance, or equipment failure, it may be necessary to operate AGL circuits on local control at the remote power centers, thus removing control from ATC while the work is being carried out. A procedure for local operation should be agreed with ATC before local switching of AGL circuits commences. A record of all maintenance operations should be kept, including periods when local operation of a circuit or power centre is under the control of maintenance staff. A logbook should be provided at each power centre for this purpose and retained for at least three years after the date of the last entry. All logbooks, together with installation drawings and operating and maintenance manuals, should be available for examination during licensing inspections.

6.197 By assessing the performance of each light on a regular basis and targeting maintenance on the under-performing light, the overall performance of the installation can be considerably improved. Targeting work on those lights that are under- performing ensures that maximum benefit can be obtained from maintenance activity, thereby minimising wastage and enabling maintenance expenditure to be optimised.

6.198 The conventional AGL maintenance strategies of block change, or change on failure, have been shown to be inadequate with many of the lamps failing to meet the required standard either immediately or shortly after the maintenance activity. Lamps and associated equipment do not age at a uniform rate and consequently only limited benefit is achieved from a routine block change. On the other hand, if the performance of individual lights is allowed to decay until lamp failure occurs, then each light will be operating below the required standard for a substantial percentage of its life. Both strategies result in the possibility of entering LVPs with the installation operating below the required serviceability levels. Routine and regular targeted maintenance procedures are essential if this scenario is to be avoided.

6.199 The performance of lights can change rapidly, especially at large aerodromes with high movement rates. Therefore, it is important to assess performance accurately on a regular basis and act upon the information collected. The frequency with which such assessments should be undertaken is dependent upon the type and age of the installation, maintenance policy adopted, movement rates and prevailing weather conditions. Typically, a weekly survey, with associated maintenance, has been found to be adequate for a major aerodrome.

6.200 Changing the light fitting will not always ensure the required performance is achieved since the luminous intensity of the beam is dependent on the total electrical and optical system. The importance of maintaining the primary series circuit current is only a single factor in the system and additional work may be required at specific locations, for instance a faulty transformer or a slightly dirty lens can reduce output by up to 50%. A single application of de-icing fluid to a runway can reduce the light output of centreline lights by up to 70%.

Maintenance objectives

6.201 The maintenance of AGL should have, as its objective, that during any period of operations all AGL equipment is serviceable but that, in any event, the serviceability levels detailed in table 6.7 should be regarded as the absolute minimum for the operation intended.

Table 6.7 Minimum percentage of serviceable light fittings

AGL	Landing		Take-off	
	Category I	Category II/III	RVR <800m	RVR >800m
Approach beyond 450 m	85%	85%		–
Approach inner 450 m	85%	95%		–
Runway threshold	85%	95%	–	–
Runway end	85%	85%	85%	75%
Runway edge	85%	95%	95%	85%
Runway C/L where fitted	85%	95%	95%	85%
TDZ where fitted	85%	90%	–	–

6.202 The objectives contained in table 6.7 specifically target precision instrument approach runways and operations in low visibility. For precision instrument approach runways, the CAA expects the aerodrome authority to provide evidence that the performance of the associated AGL meets the requirements for all weather operations, which include table 6.7. One method of providing such evidence is to carry out regular measurements of the photometric performance (i.e., the luminous intensity, beam coverage and alignment) of the AGL when in service.

Maintenance practices

6.203 Persons should be protected against dangers that may arise from contact with live parts of the installation. Only limited protection against overcurrent and open circuit can be provided therefore no work should be undertaken on live AGL constant current series circuits unless adequate provisions are made to ensure the safety of personnel.

6.204 Approach and runway lighting patterns are designed for viewing from the air. At ground level the pattern may appear to be perfect, but small errors in the setting of lights may present a ragged and apparently incomplete pattern to flight crew. If local circumstances permit, maintenance staff should be given the opportunity to view the AGL from the air.

6.205 The overall performance of AGL can be dramatically improved and maintained with the introduction of an adequate cleaning regime. The nature of their general location makes inset fittings particularly susceptible to the presence of dirt, dust, moisture and the effects of heavy loads. Staining of the glassware and rubber deposits can considerably reduce the light output of these lights and reductions of the order of 50% are not uncommon. The periodicity of AGL cleaning will depend upon environmental and operating conditions but typically AGL on runways that are subjected to a heavy traffic density should be cleaned at least once per week, and other AGL should be cleaned at least once every two weeks.

6.206 A routine ground inspection of all AGL systems where practicable should be made daily or before use as appropriate and any defects remedied as soon as practicable. All deficiencies and associated remedial action should be logged and the system should again be inspected before use after remedial action.

6.207 As an aid to maintenance it is recommended that each AGL location be marked with an identification number where practicable, large enough to be legible from a passing vehicle (e.g. 27/A/14 refers to light fitting No 14 of circuit A on runway 27) as follows:

1. lights in paved areas – numbers painted with white road paint adjacent to the light fitting;
2. lights in grassed areas – numbers painted on the light fitting;
3. pole or mast mounted lights – numbers painted on plates attached to the poles or masts.

6.208 An up-to-date set of drawings showing the AGL layout, light fitting location numbers and cable routeing, along with operating and maintenance manuals containing adequate information for the safe operation and maintenance of the AGL system should be provided at all appropriate sites.

6.209 Where AGL and equipment is installed on private land, rights of access should be maintained in order that regular maintenance may be carried out.

6.210 If the process detailed in paragraph 6.198 is carried out on a regular and adequate basis, individual lamp conformance can be assessed and therefore a lamp could be changed or cleaned on an individual basis and only when necessary. Where it is not possible to perform this level of maintenance, AGL lamps should be replaced in groups as part of a planned change programme based on the length of operating time or an observed deterioration. Lamps should be changed after 90% of nominal life at maximum luminous intensity (operating time at other luminous intensity levels being ignored). Any observed deterioration of an AGL pattern should be promptly corrected. The replacement of AGL lamps only on failure should be a last resort.

6.211 The insulation value of a primary series circuit may decrease by a very significant amount before any operational effect on the AGL is noticed; however, in this case there would be a much greater risk of harm to maintenance or installation persons. Therefore, a device should be provided to measure the insulation value of the primary series circuit with an error of not greater than 10%. The measurement should be performed as part of the routine maintenance or by using an automatic facility. Where an automatic measurement facility is provided, the measurement shall be done at a rate of not less than once per hour. Remedial action should be taken where the insulation between primary and secondary series circuits and between primary series circuit and earth falls below 30 M ohms. The insulation properties of secondary series circuit cables should be checked on a regular basis and when an insulation failure is suspected. The resistance between secondary series circuit and earth should be not less than 5 M ohms.

6.212 Adequate spares should be held on site in order to support the complete AGL system maintenance procedures. An appropriate parts control system should be instigated in order to ensure that the correct parts are available and used when replacements are carried out. Components such as lenses may appear to be identical but may have substantially different photometric performance.

6.213 Licence holders should adopt maintenance practices to minimise the potential for intergranular corrosion of aluminium alloy light fittings. Corrosion may be initiated by the use of high alkaline property cleaning fluids, which may damage or destroy the passivated layer protecting the fitting from corrosion.

6.214 To minimise future cracking of aluminium alloy light fittings due to intergranular corrosion, licence holders should prevent the contact of fluids with a high acidic or alkaline property (PH less than 4 to greater than 8.5) with aluminium alloy parts of AGL fittings. Licence holders should address the potential for corrosion where there is an essential operational need to use a fluid with a high acidic or alkaline property in the vicinity of AGL and a suitable alternative with a more neutral solution cannot be found.

6.215 Mechanical loading may affect the structural integrity of AGL fixtures and fittings while in service and may also exacerbate the effects of corrosion. Accordingly:

1. staff should look for the effects of poor installation, especially with regard to debris entrapment between fitting, seating ring and base, and rectify as necessary;
2. replacement components should, where possible, form a part of a bespoke or homogenous assembly, and attention should be paid to the compatibility and suitability of materials;
3. seating rings should be designed and constructed to the same tolerances as the AGL fitting. If signs of wear exist, the stud location and load transfer surfaces should be jig-checked and discarded if found to be out of tolerance.

6.216 BS 3224 (1988) Part 5, Light Fittings for Civil Land Aerodromes, was withdrawn following concerns raised by independent research into the impact loads suffered by inset runway assemblies. The following process should be adopted:

1. a maintenance inspection regime, where appropriate, designed to take into account the following:
    a) aircraft traffic volume;
    b) location of assemblies;
    c) age of assemblies;
    d) chemical usage; and
    e) previous maintenance history.
2. a risk assessment for inspection periods based on sub-paragraphs a) and b) above should be developed and modifying factors applied in respect of the other three sub-paragraphs;
3. aircraft traffic volume should be expressed in terms of total ATMs i.e. including both take-off and landings;
4. location of assemblies should be defined in terms of structural risk. It may be appropriate to consider dividing the runway into three zones defined as high, medium and low equating to the touchdown area, parts of the runway where more than, say, 50% of traffic vacates and all other areas.

6.217 The maintenance procedures detailed in this paragraph should be adopted as a minimum requirement and take paragraph 6.192 into account. Additional maintenance may be needed following extreme weather conditions, where high incidence of vandalism occurs or following agricultural work within the area bounded by the approach system. A competent engineer should assess the AGL maintenance requirements and augment the minimum requirements in scope and frequency where necessary. The minimum maintenance procedures are as follows:

1. Daily: A visual inspection of the AGL should be undertaken. Unserviceabilities should be recorded and appropriate remedial action taken;
2. Six-monthly (or more often as indicated by risk assessment): check and take remedial action as required to ensure that:
   a) the alignment of all elevated lights is within tolerance. If hinged masts are used with alignment carried out at ground level, the checking procedure should include the mast settings when reinstated;
   b) primary series circuit current levels at all luminous intensity settings comply with the levels and tolerances given in table 6.6. Actual values and the type and serial number of the test instrument used should
   be noted in the maintenance log. It is desirable that a percentage of secondary series circuit currents should be checked;
   c) all AGL control and monitoring facilities are serviceable;
   d) all earth connections are satisfactory;
   e) the insulation resistance of all primary series circuits is satisfactory;
   f) the structural integrity of the assembly is satisfactory.
3. At regular intervals: On specific installations, maintenance in accordance with the manufacturer’s recommendations should be carried out and remedial action taken where required. Photometric checks, if appropriate, should be carried out in accordance with traffic density and AGL performance.

Notes:

1. *Additional alignment checks to elevated lights should be carried out after severe storms, heavy snowfalls and after work that could have affected light alignment has been carried out in their vicinity.*
2. *Wood poles supporting approach lights should be inspected and tested before climbing. They are now considered to be an obsolescent mounting method and lighter, frangible, hinged masts are preferred.*

6.218 All maintenance activities should be recorded in a suitable log. Maintenance and flight check records should be retained for at least three years at the aerodrome for use by maintenance staff and for examination during licensing inspections.

6.219 All test equipment, alignment devices and protective clothing should be calibrated/checked or replaced at intervals recommended by the manufacturer and the results recorded in the maintenance log.

Photometric requirements

6.220 The maintenance objectives for AGL are detailed in paragraph 6.197 and table 6.7. The objectives are specified in terms of the maximum number of unserviceable lights at any one time. A light should be deemed unserviceable if its average luminous intensity is, for any reason, less than 50% of the average luminous intensity specified in the relevant isocandela diagram at appendix 6A, or the brightest part of the beam is not within the specified main beam area.

6.221 AGL maintenance should be focused on assuring maximum availability of lights that are of the correct intensity and alignment. The most effective means to determine this is through photometric measurement and visual assessment.

6.222 It should be the aim for AGL to meet or exceed the average luminous intensities specified in the isocandela diagrams. Where this is not possible, the aerodrome licence holder should establish and maintain the best AGL photometric performance achievable, taking into consideration the following factors:

1. the design performance of the lights when new;
2. the aerodrome traffic type and density; and
3. the prevailing weather conditions (including whether anti-icing or de-icing procedures are used).

6.223 With the use of photometric measurement within a robust maintenance programme, it should be possible to achieve and maintain a demonstrable performance level of at least 70% of the specified minimum. Where movement rates are high and aircraft types heavy, even if this level cannot be continuously achieved, AGL maintained in this way should display a significantly improved, balanced pattern of lights, which is of value to pilots.

Checking of (A)PAPI systems

6.224 (A)PAPI serviceability gives rise to additional considerations as moisture or dirt on the lenses will diffuse the beam and can result in a white signal being emitted at all angles of elevation. To prevent this potentially hazardous situation from occurring, additional measures should be adopted as follows:

1. On a daily basis, particular attention should be paid to the following items with respect to (A)PAPI systems:
   a) all lamps are serviceable and evenly illuminated;
   b) there is no apparent damage to units;
   c) the change from red to white is coincident for all elements of a unit;
   d) the heating facilities are functioning correctly;
   e) all lenses are clean.
2. The vertical alignment of each (A)PAPI unit should be checked once every week to a tolerance of ±1 minute of arc and should be verified by inspection with a suitable instrument and flight check at least twice every year. Clinometers are intended to

be used for a quick check that the installation has not been disturbed and should not be used for alignment adjustments. Small alignment errors can be observed according to the time of day, weather and other environmental conditions and will normally require no adjustment; however, where a significant difference is noted (probably on only one unit, a consistent error on all units usually indicates a clinometer calibration error) the unit may be adjusted using a clinometer but must be checked using a suitable instrument and flight checked as soon as possible. Clinometers should be calibrated annually or as recommended by the manufacturer or when an error is suspected.

3. At weekly intervals the (A)PAPI system should be inspected internally and cleaned, lenses should be polished and anti-misting fluid applied if appropriate.
4. High intensity units that have no permanently-on lens heaters should be operated for 15 minutes at maximum luminous intensity or as recommended by manufacturers in order to disperse moisture. In low intensity units, moisture clearance by this method takes much longer and it is more practical to inspect the units. Operational procedures should allow for moisture dispersal or removal before use.
5. Some units are supplied with integral lens heaters. These should be run continuously if there is any possibility of condensation occurring. Alternatively, high intensity lamp units may be operated continuously at low luminous intensity (typically a primary series circuit current level of 1.5A RMS is set) when not in operational use; such units are ready for immediate use. Routine daily checks should include serviceability of the permanent heat system.
6. Units without permanently-on lens heaters cannot be guaranteed free from moisture at switch-on, so allowances should be made for such warm-up period as the unit manufacturer recommends.

6.225 The integrity of (A)PAPI systems is of the utmost importance, and a unit should be considered unserviceable if:

1. it has less than half of its originally specified minimum average luminous intensity; or
2. it has an elevation setting error exceeding ± 1 minute of arc; or
3. its physical condition, on inspection, is in question, e.g., if a filter glass is cracked.

Checking of AGL system input power supply

6.226 A check of an alternate input power supply to the AGL system (where provided) operating under full load should be made at least once each month. Where the alternate input power supply is provided by independent generators, they should be run for at least 15 minutes under full load when carrying out this check.

6.227 Where automatic switch-over is provided for the AGL system input power supplies, a check of the switching system should be made in addition to those checks contained in paragraph 6.222 in order to ensure that the switchover times required at table 6.5 can be met.

6.228 A log should be kept detailing each check undertaken. Switch-over times and generator running times should be noted along with any action taken to ensure that the requirements are met.

AGL flight checks

6.229 All approach and runway AGL on an instrument runway shall be flight checked in accordance with appendix 6C at least once every six months.

6.230 All approach and runway AGL on runways other than those applicable in paragraph 6.205 shall be flight checked in accordance with appendix 6C at least once every 12 months.

6.231 An (A)PAPI system shall be flight checked in accordance with appendix 6D at least once every six months.

6.232 Commissioning flight checks of new AGL installations, including A(PAPI), shall be conducted prior to their operational use. The CAA may choose to participate in or conduct such checks.

6.233 AGL flight checks shall be conducted by competent persons, holding appropriate flight crew qualifications. The aerodrome licence holder should ensure that such persons are competent.

6.234 The aerodrome licence holder should ensure that the results of flight checks, which may be subject to audit by the CAA, are evaluated and actioned accordingly.

6.235 Runway lighting deployed on a temporary basis, including (A)PAPI and approach lighting where appropriate, should be flight checked daily prior to being used at night. This procedure should be adopted for each subsequent deployment.

Installation of AGL systems

General

6.236 An AGL system should normally comprise a single control and monitoring installation and several constant current series circuits. The following elements make up a typical constant current series circuit (see figure 6.13):

1. a constant current regulator (CCR);
2. a primary series circuit, which includes:
    a) primary cable;
    b) AGL series transformer(s) (may be known as isolating transformer).
3. a secondary series circuit, which includes:
    a) secondary cables;
    b) the light fitting or other devices.

Interleaving of AGL electrical circuits

6.237 The configuration of the electrical circuits (constant current series circuits) that make up the AGL system should be designed so that a failure of a single circuit will not cause a total lack of guidance. One means of providing a continuity of service is to incorporate interleaving techniques where alternate lamps (or as necessary to provide the required guidance information) are controlled by different CCRs. However, the minimum requirement is as follows:

1. Two separate interleaved circuits for each of the following systems:
   a) approach lighting on precision instrument approach runways;
   b) supplementary approach lighting;
   c) HI runway edge, threshold and end lighting. See Note 1 below and Note 1 of table 6.5;
   d) HI runway centreline lighting;
   e) touchdown zone lighting;
   f) for each stop-bar (sub-paragraphs 3., 4. and 5. below refer);
   g) HI taxiway centreline lighting (including runway lead-on and lead-off lighting but excluding systems with route switching or block control where the failure of a lighting circuit would not present a flight crew with a hazardous situation in low visibility).

Notes:

1. *Threshold lighting should be on independent interleaved circuits.*
2. *Where technically desirable, threshold and end lighting may be served by the same circuits as runway centreline lighting provided that any operational penalty suffered as a result of loss of use of the runway at night where both centreline circuits fail, is acceptable to the aerodrome operator.*
3. *One separate circuit for each of the following systems:*
   a) HI simple approach lighting;
   b) approach lighting on non-precision instrument approach runways;
   c) LI runway edge, threshold and end lighting;
   d) PAPI or (A)PAPI but see paragraph 6.45;
   e) taxiway and apron edge lighting.
4. *Stop-bars and associated taxiway lead-on lighting should be on separate circuits so that a loss of one of these facilities will not affect the serviceability of the other. In addition, the stop-bar and lead-on lighting circuits should be interlocked so that the stop-bar and lead-on lighting cannot be illuminated simultaneously. Verification of the stop-bar and lead-on lighting selection should be provided. However, the design of the interlocked stop-bar and lead-on lighting should be such that a failure of the stop bar circuit cannot cause the lead-on lighting to illuminate.*

5. *Where stop-bars and taxiway centreline lighting are interlocked to provide block switching and verification of the stop-bar selection is provided, stop- bars at intermediate taxi-holding positions need not be interleaved.*
6. *Stop-bars at runway holding points should consist of two separate interleaved circuits. Other stop-bars should be interleaved where no taxiway centreline lighting is provided.*
7. *Runway guard lights may be served by the taxiway lighting circuits other than those for stop-bars provided that the requirements of paragraphs 6.132 and 6.134 are met. Verification that the runway guard lights are operating is required.*

6.238 Where interleaved circuits are provided, alternate lights should normally be connected to the same circuit. However, care must be taken in the design of interleaved circuits to ensure that in the event of the failure of one or more circuits, a recognisable pattern and any colour coding is retained.

6.239 Interleaved circuits may be provided for the services listed in paragraph 6.233 in order to increase integrity or to overcome a technical difficulty. However, approach slope indicator installations should be limited to two circuits per runway end.

6.240 Where a runway is used also as a taxiway and both taxiway and runway lighting are provided, the lighting circuits shall be interlocked in order to prevent the selection of both systems simultaneously.

6.241 The interleaving criterion is still applicable where individual or addressable AGL switching is installed.

Electromagnetic Compatibility (EMC)

6.242 The AGL system and its components shall conform to the Radio and Telecommunications Terminal Equipment Directive 1999/5/EC. It shall not cause radiated or conducted electromagnetic interference to other systems such as information technology equipment (ITE), or radio navigational aids that may be located on or near the aerodrome, or that may use the same power supply. All equipment included in the electrical installations shall have immunity to electromagnetic phenomena and electromagnetic fields such as from radio transmitters, transients on power lines, atmospheric discharges etc.

6.243 An aerodrome movement area is generally considered an uncontrollable electromagnetic environment. EMC levels (emission and immunity limits) should be assessed in order to ensure that existing or expected disturbance levels will not increase when new equipment is installed and that such equipment is sufficiently immune. Shielded cables in the constant current series circuits are recommended in order to achieve EMC. When installing new equipment or undertaking development, the new infrastructure should not alter significantly the local magnetic field density. This is especially critical in areas where aircraft hold prior to departure.

APPENDIX 6A

Aeronautical ground lighting characteristics

General

1. The characteristics of low intensity AGL and of enroute obstacle lighting can be found at table 6A.1. The requirements for the upgrade of existing systems to Category III Standard are at table 6A.2. figures 6A.1 to 6A.18 show the photometric characteristics and beam coverage of high intensity AGL that all newly installed lights should display.

2. A light is considered to have failed if its average luminous intensity is, for any reason, less than half of the minimum average luminous intensity specified in the relevant isocandela diagrams of this appendix. Where more than one light is used in a unit, the unit is considered to have failed if its light output is similarly reduced.

3. Only AGL conforming to the specified colours should be displayed to flight crew and vehicle drivers (see paragraphs 29 to 38 for colour specifications and a means of verification).

4. The importance of adequate maintenance cannot be over-emphasised. The average intensity should never fall below 50% of the value shown in the figures and it should be the aim of aerodrome licence holders to maintain a level of light exceeding the specified minimum intensities.

Construction and height of lighting fittings

5. All AGL fittings should be of such construction and height that their presence does not endanger aircraft.

6. Elevated fittings should be of lightweight construction and frangible, and if mounted on supports these should also be frangible. Where approach lights are mounted on high supports, the top 4–6 m should be made frangible. The following provision shall apply:

7. Elevated approach lights and their supporting structures should be frangible except that, in that portion of the approach lighting system beyond 300 m from the threshold:

   1. where the height of a supporting structure exceeds 12m, the frangibility requirement applies to the top 12 m only; and
   2. where a supporting structure is surrounded by non-frangible objects, only that part of the structure that extends above the surrounding objects needs to be frangible.

8. Within the maneuvering area, elevated fittings should be conspicuous.

9. Elevated light fittings should not exceed 0.36 m in height above the adjacent pavement level. In stopways and clearways used for routine maneuvering (e.g., as entry or exit taxiways) the lights should be flush with the pavement. Otherwise, the fittings in these areas should not exceed the following dimensions:

1. 0.46m above ground level in stopways;
2. 0.9m above local ground level in clearways.

10. Inset fittings should be capable of bearing the loads imposed by any aircraft normally using the aerodrome when landing, taking off or taxying. The contours and temperature of the top surface of the light fitting should not cause damage to aircraft undercarriage components, especially tyres.

11. The projection of an inset fitting above the surrounding surface should not exceed:

1. 16mm within 7.5m either side of the runway centreline except that inset approach lights in this area and taxiway lights crossing a runway or leading to a runway centreline may project 25mm;
2. 19mm between 7.5m from the runway centreline to 3 m from the runway edge except that inset approach lights in these areas may project 3 mm and taxiway lights crossing or leading to a runway centreline may project 25mm;
3. 38mm within 6m of the runway end or within 3 m of the runway edge;
4. 32mm for displaced threshold lights;
5. 2 mm in taxiway surfaces.

12. Inset fittings should be secured in the surface so as to prevent accidental extraction. It is particularly important that stable mountings are provided so that the beam spread angles are maintained within the tolerances detailed in the appropriate table.

Aerodrome beacons

13. Aerodrome beacons should be omni-directional and have a minimum effective flash luminous intensity equivalent to not less than 2000 cd in white. The light distribution of the beam should be such that it is clearly visible from 10 km between 1° and 45° above the horizon on a clear night. The flash rate should be fixed as follows:

1. coded beacons – 6 to 8 words per minute;
2. non-coded beacons – 20 to 30 flashes per minute.

Note: *At locations where a high level of ambient background lighting persists, it may be necessary to increase the effective flash luminous intensity in order to meet the above parameters.*

Instrument runways and associated taxiways

14. Figures 6A.1 to 6A.18 of this appendix give the characteristics of lighting to be used for new installations. table 6A.2 gives the minimum characteristics of lights in existing systems if they are to be made acceptable for Category III operations. When practicable, it is recommended that lights with the characteristics detailed in table 6A.2 be replaced by lights with characteristics shown in figures 6A.1 to 6A.10.

15. Figures 6A.12 to 6A.16 give details of characteristics for taxiway centreline and stop-bar lights.

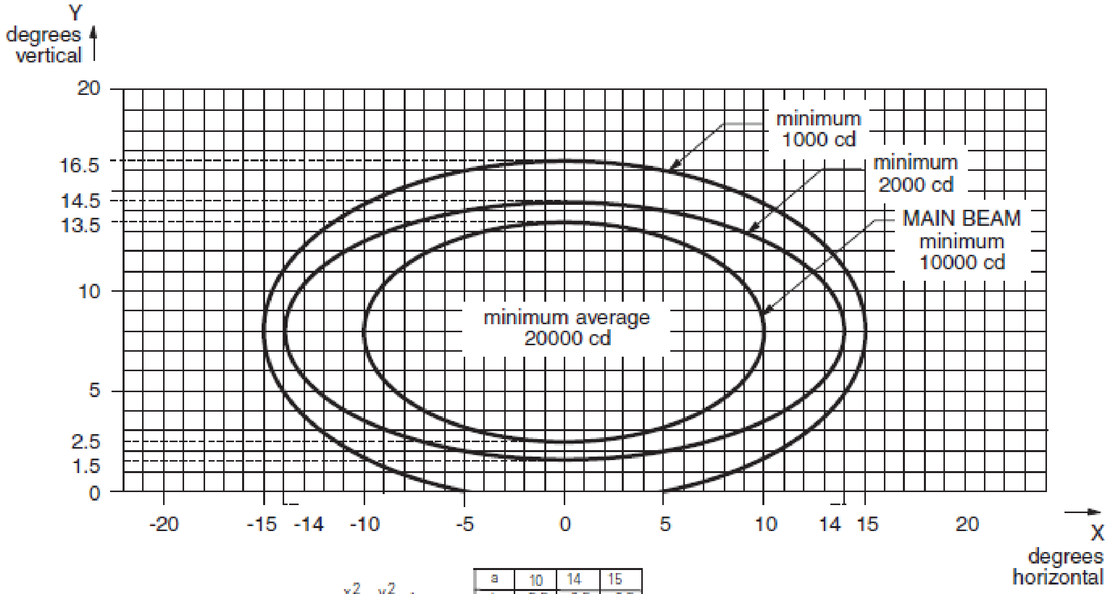
Table 6A.2 Characteristics of high intensity aeronautical ground lights

Light	Colour	Minimum beam coverage (degrees) (note 1)		Ratio of average intensity	Minimum average intensity in specified colours Cd x 10^3 (note 2)	Isocandela diagram reference
		Horizontal	Vertical			
1	2	3	4	5	6	7
Approach centreline and crossbars	White	20	8	2	20	6A.1
Approach side row	Red	15	7	0.5	5	6A.2
Threshold	Green	11	5.5	1	10	6A.3
Threshold wing bars	Green	15	7	1	10	6A.4
Touchdown zone	White	9	5	0.5	5	6A.5
Runway centreline 30 m spacing	White/red/yellow	9	5	0.5	5 (note 5)	6A.6
Runway centreline 15 m spacing	White/red/yellow	9	5	0.25 to 0.5 (note 2)	2.5 (notes 2, 5)	6A.7
Runway end	Red	11	5.5	0.25 to 0.5	2.5	6A.8
Runway edge 45 m wide	White Yellow Red	11 11 11	5.5 5.5 5.5	1 0.4 0.15	10 10 10	6A.9
Runway edge 60 m wide	White Yellow Red	13 13 13	6 6 6	1 0.4 0.15	10 10 10	6A.10

Notes:

1. Throughout the beam coverages the luminous intensity at maximum output should not be less than half the average luminous intensity and should not exceed the average luminous intensity by more than 50%.
2. A luminous intensity of 5 kilocandelas, intensity ratio 0.5, should be used for Category III operations.
3. Alignment tolerances have not been included in the beam spread angles given in Columns 3 and 4.
4. Where inset lights are used instead of elevated lights, e.g. on a runway with a displaced threshold, the luminous intensity requirements can be met by installing multiple fittings of lower intensity at each position.
5. Values given are for white light.
6. Beam coverages quoted are for the extremities of an ellipse.

Figure 6A.1 Isocandela diagram for approach centreline light and crossbars (white light)



Notes: 1 Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	10	14	15
b	5.5	6.5	8.5

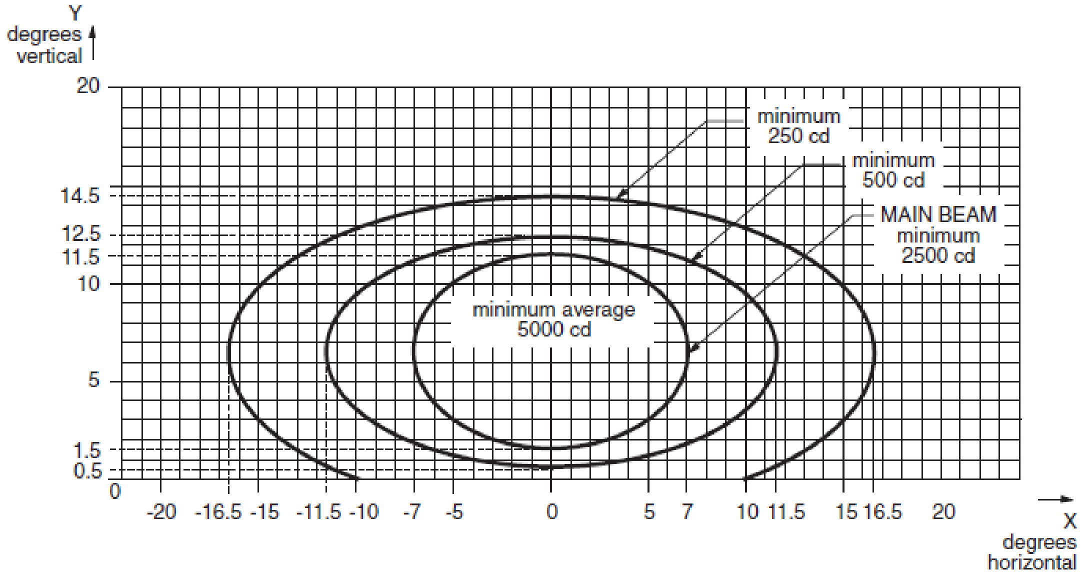
2 Toe-in 2 degrees any light in crossbars beyond 22.5 m from centreline

3 Vertical setting angles of the lights shall be such that the following vertical coverage of the main beam will be met:

distance from threshold	vertical main beam coverage		
threshold to 315 m	0	-	11
316 m to 475 m	0.5	-	11.5
476 m to 640 m	1.5	-	12.5
641 m and beyond	2.5	-	13.5 (as illustrated above)

4 See collective notes for Figures 1 to 11

Figure 6A.2 Isocandela diagram for approach side row light (red light)



Notes: 1 Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	7.0	11.5	16.5
b	5.0	6.0	8.0

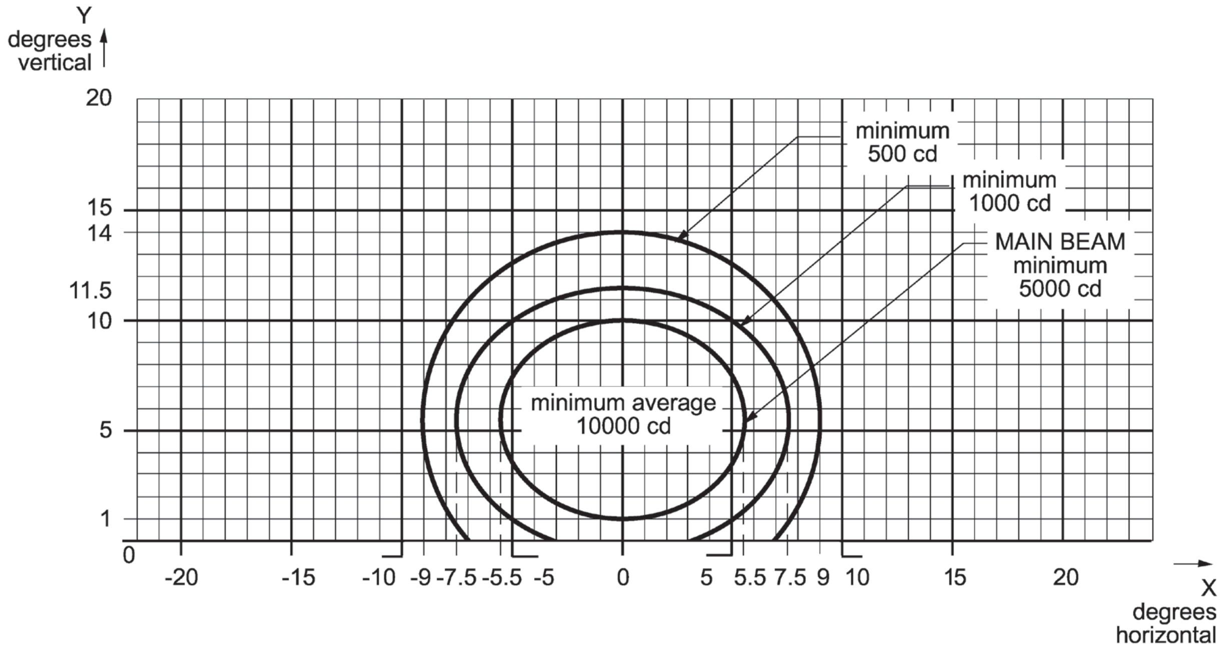
2 Toe-in 2 degrees

3 Vertical setting angles of the lights shall be such that the following vertical coverage of the main beam will be met:

distance from threshold	vertical main beam coverage		
threshold to 115 m	0.5°	-	10.5°
116 m to 215 m	1°	-	11°
216 m and beyond	1.5°	-	11.5° (as illustrated above)

4 See collective notes for Figures 1 to 11

Figure 6A.3 Isocandela diagram for threshold light (green light)



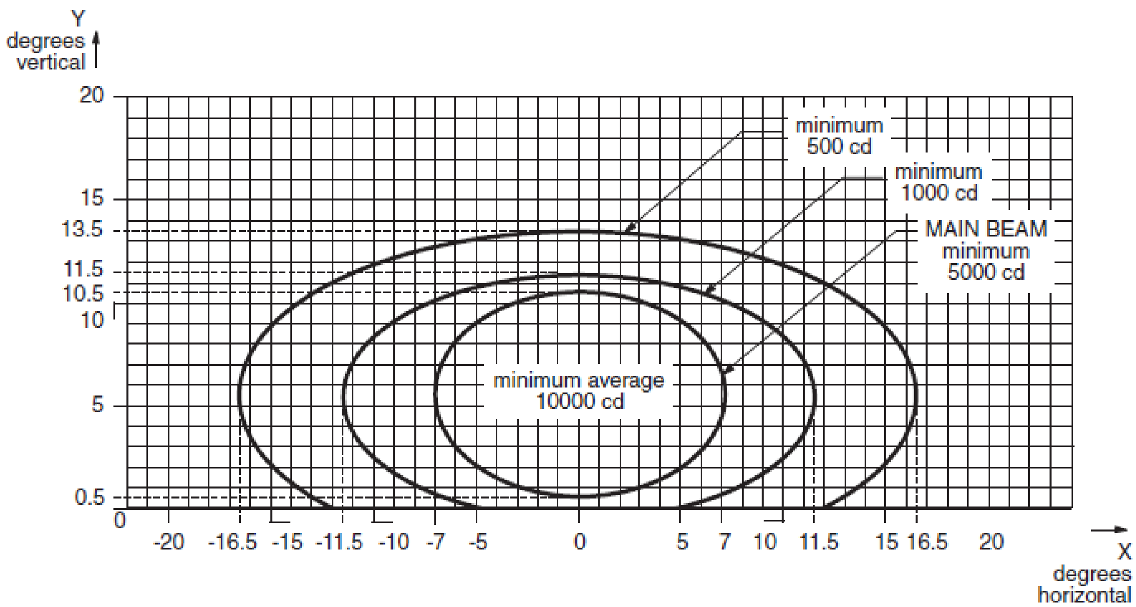
Notes: 1 Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	5.5	7.5	9.0
b	4.5	6.0	8.5

2 Toe-in 3.5 degrees

3 See collective notes for Figures 1 to 11

Figure 6A.4 Isocandela diagram for threshold wing bar light (green light)



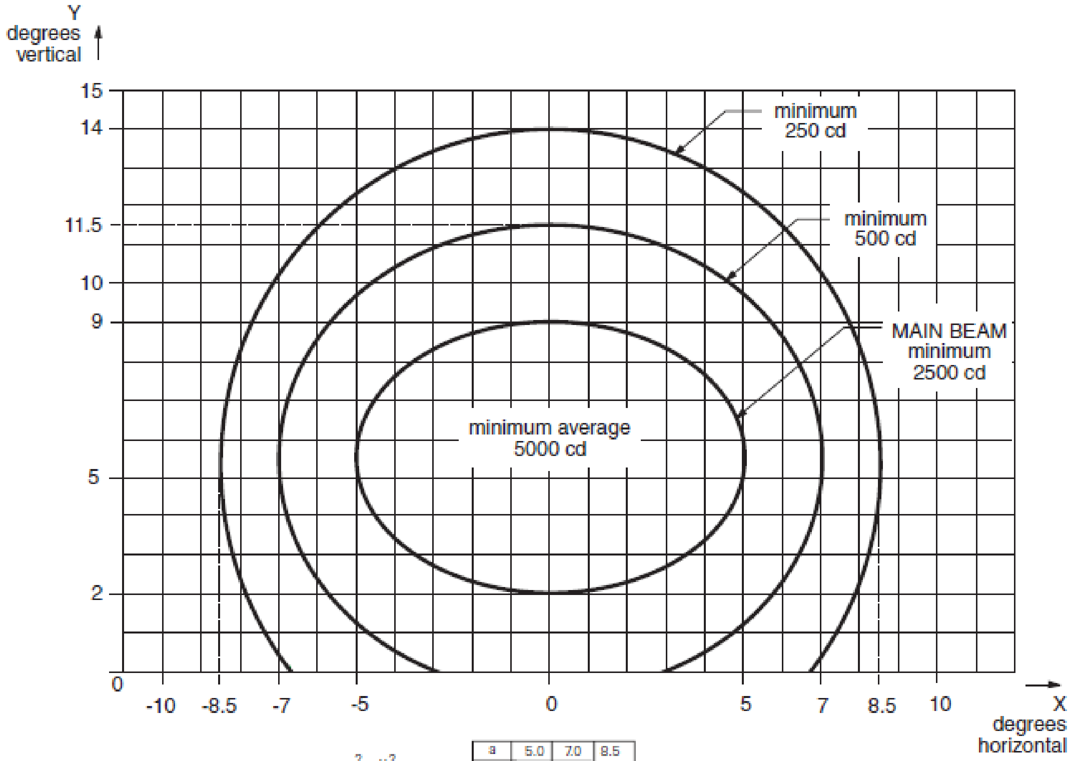
Notes: 1 Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	7.0	11.5	16.5
b	5.0	6.0	8.0

2 Toe-in 2 degrees

3 See collective notes for Figures 1 to 11

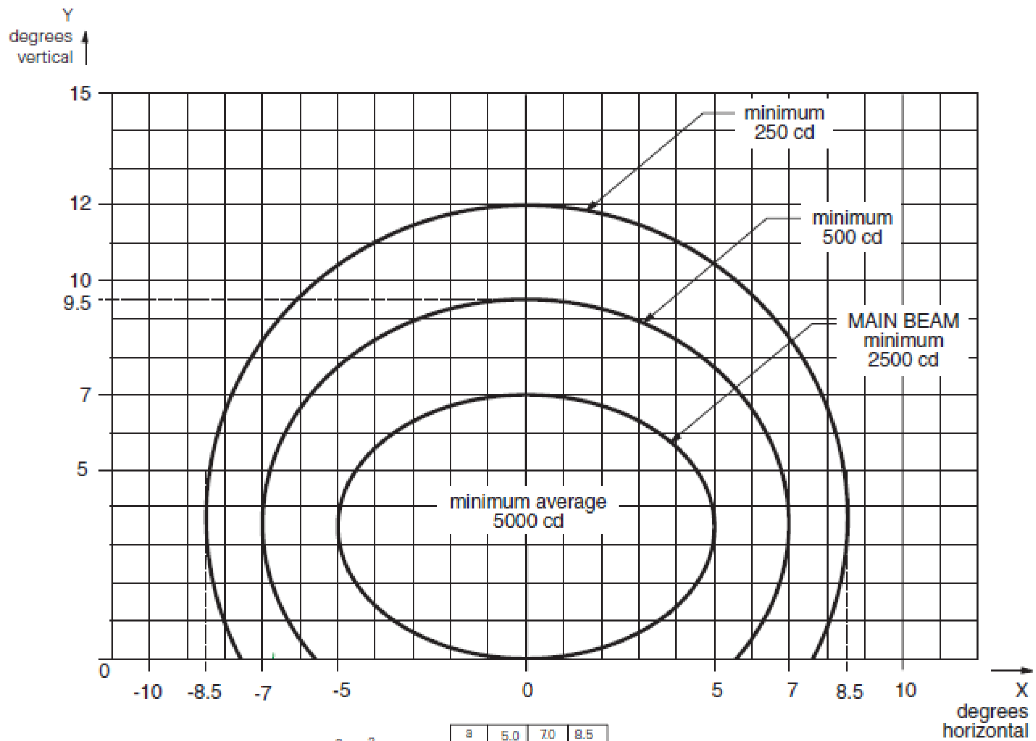
Figure 6A.5 Isocandela diagram for touchdown zone light (white light)



a	5.0	7.0	8.5
b	3.5	6.0	8.5

Notes:
1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$
2. Toe-in 4 degrees
3. See collective notes for Figures 1 to 11

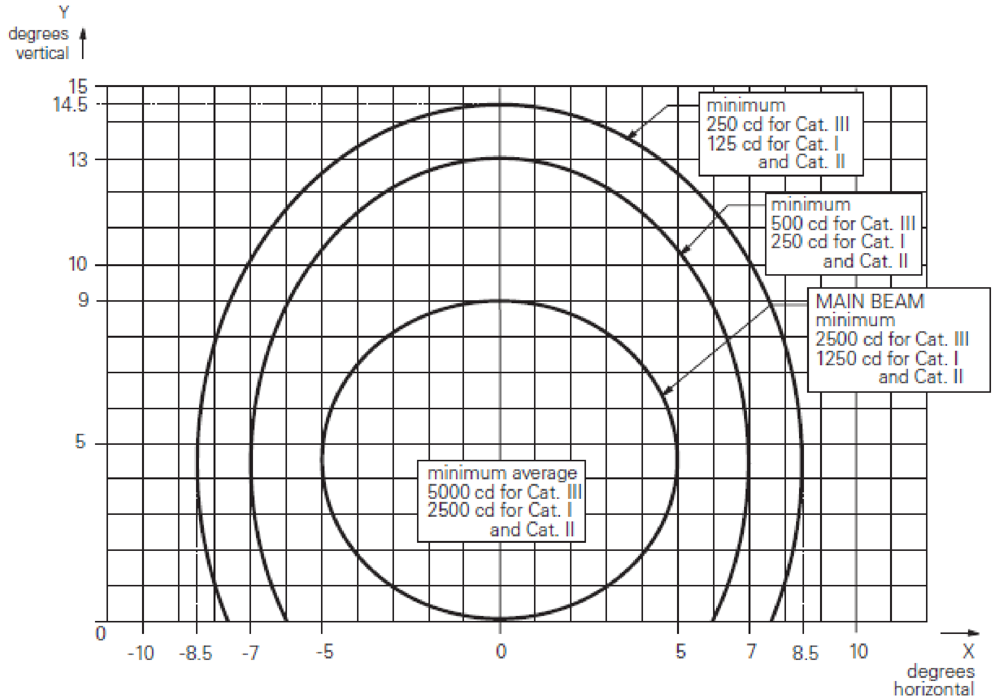
Figure 6A.6 Isocandela diagram for runway centreline light with 30 m longitudinal



a	5.0	7.0	8.5
b	3.5	6.0	8.5

Notes:
1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$
2. For red light multiply values by 0.15
3. For yellow light multiply values by 0.40
4. See collective notes for Figures 1 to 11

Figure 6A.7 Isocandela diagram for runway centreline light with 15 m longitudinal



Notes: 1 Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

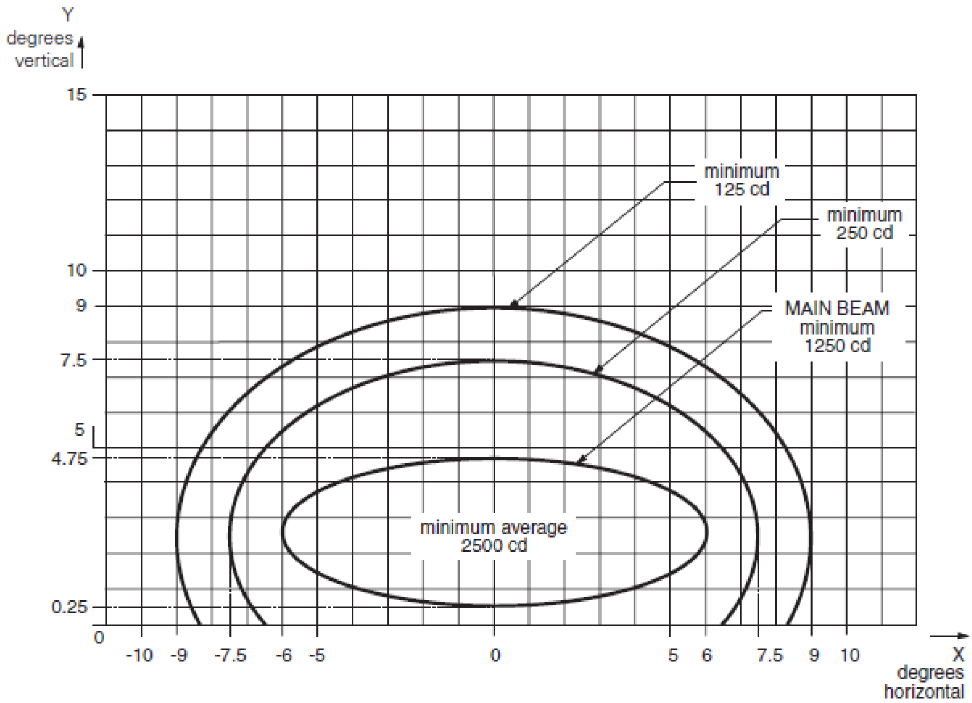
a	5.0	7.0	8.5
b	4.5	8.5	10

2 For red light multiply value by 0.15

3 For yellow light multiply value by 0.4

4 See collective notes for Figures 1 to11

Figure 6A.8 Isocandela diagram for runway end light (red light)

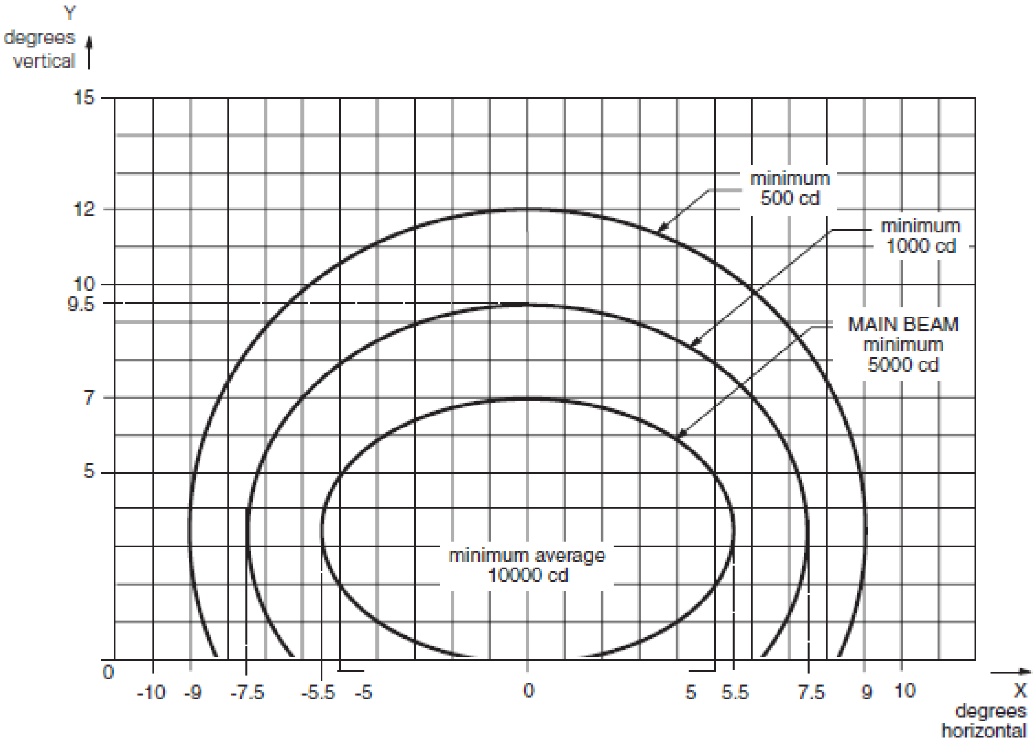


Notes: 1 Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	6.0	7.5	9.0
b	2.25	5.0	6.5

2 See collective notes for Figures 1 to 11

Figure 6A.9 Isocandela diagram for runway edge light where width of runway is 45 m



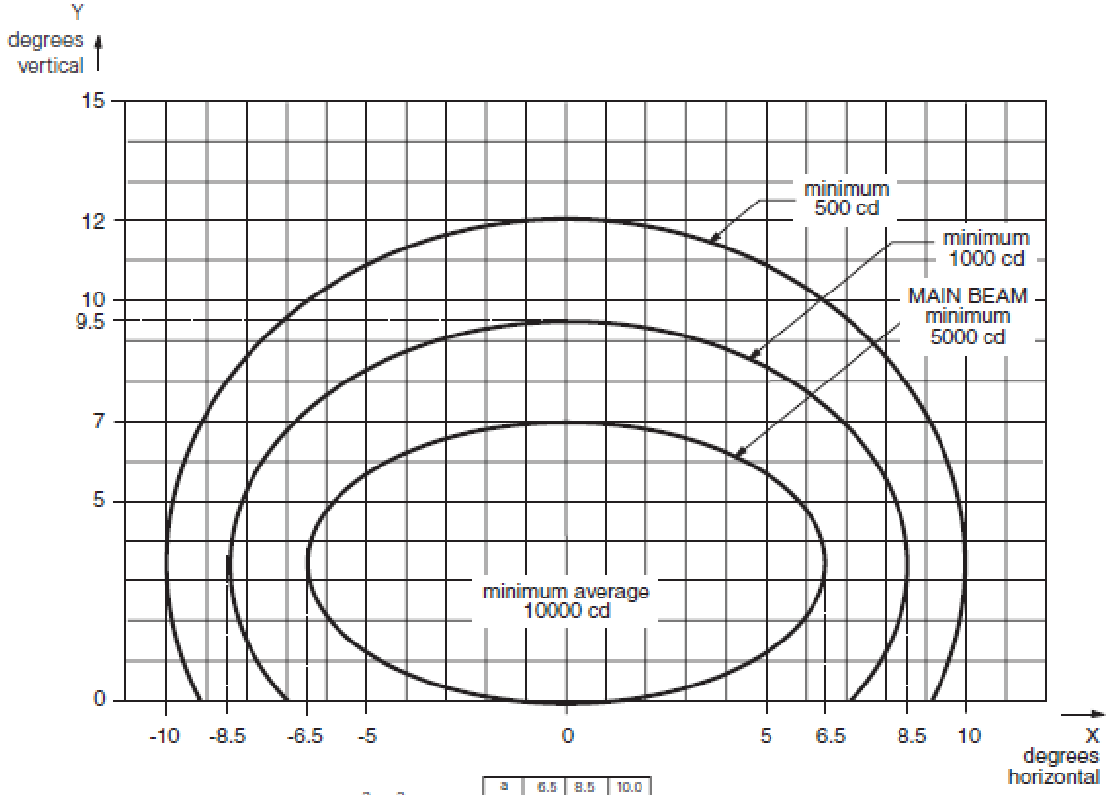
Notes:

1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	5.5	7.5	9.0
b	3.5	6.0	8.5

2. Toe-in 3.5 degrees
3. For yellow light multiply values by 0.4
4. For red light multiply values by 0.15
5. See collective notes for Figures 1 to 11

Figure 6A.10 Isocandela diagram for runway edge light where width of runway is 60 m



a	6.5	8.5	10.0
b	3.5	6.0	8.5

Notes:

1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$
2. Toe-in 4.5 degrees
3. For yellow light multiply values by 0.4
4. For red light multiply values by 0.15
5. See collective notes for Figures 1 to 11

Figure 6A.11 Grid points to be used for the calculation of average intensity of approach and runway lights

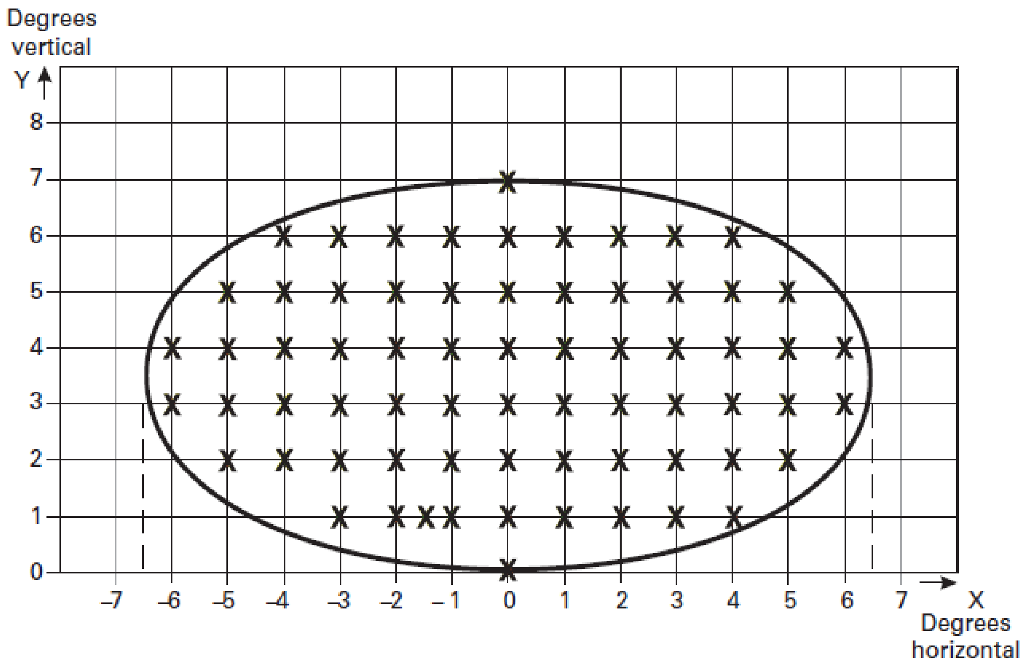
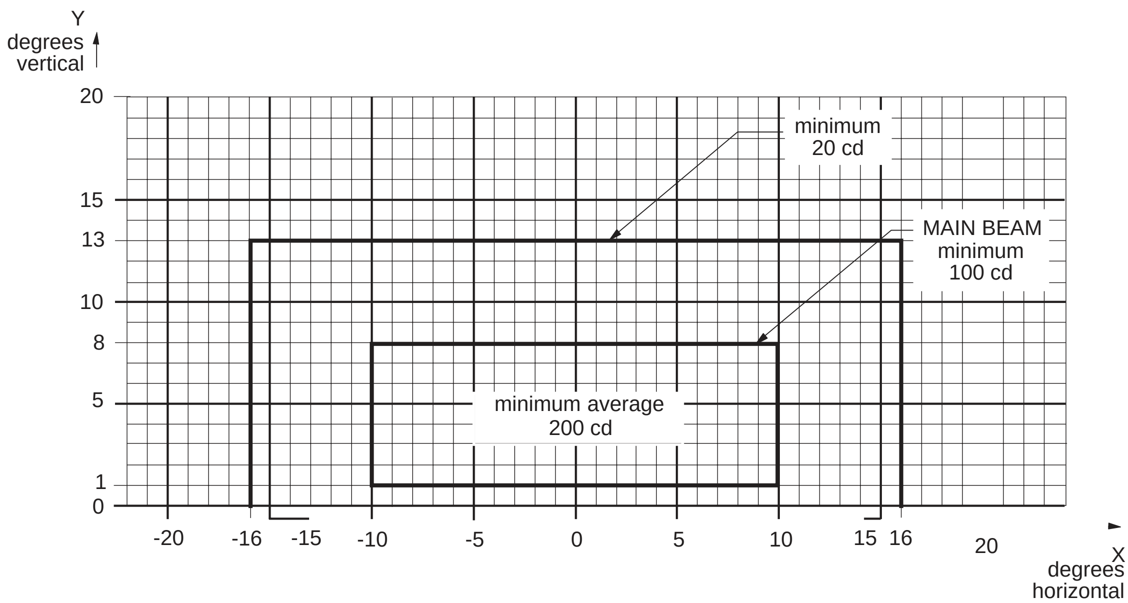


Figure 6A.12 Isocandela diagram for taxiway centreline (15 m spacing), RELs, no-entry bar, turn pad lights and stop-bar lights in straight sections intended for use in runway visual range conditions of less than a value of the order of 350 m where large offsets can occur and for low-intensity runway guard lights (configuration B).

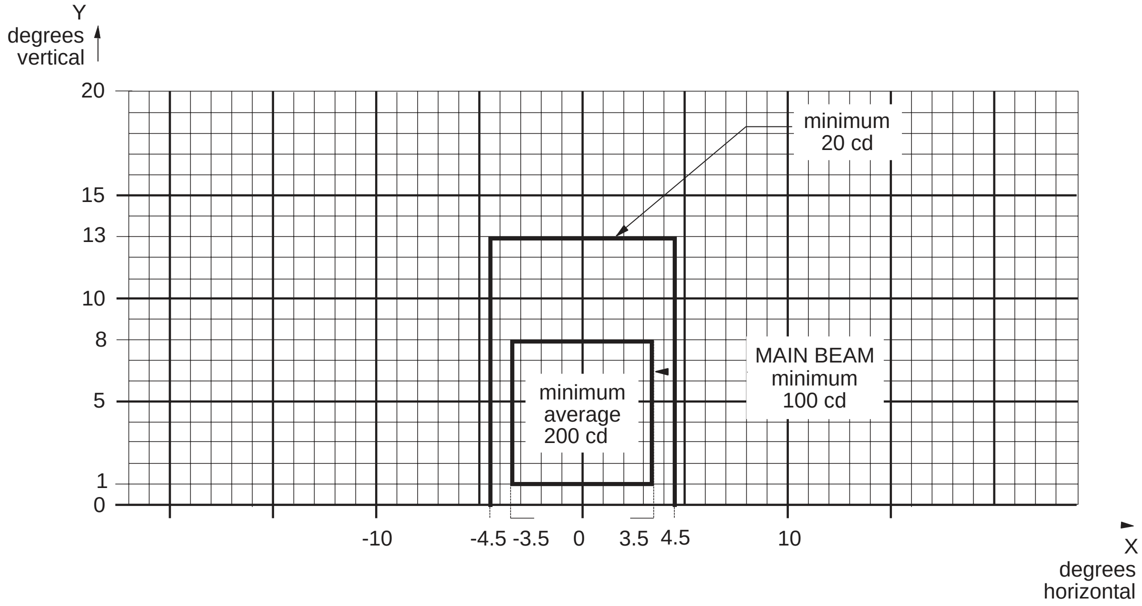


Notes:

1 These beam coverages allow for displacement of the cockpit from the centreline up to distances of the order of 12 m and are intended for use below and after curves

2 See collective notes for Figures 12 to 17

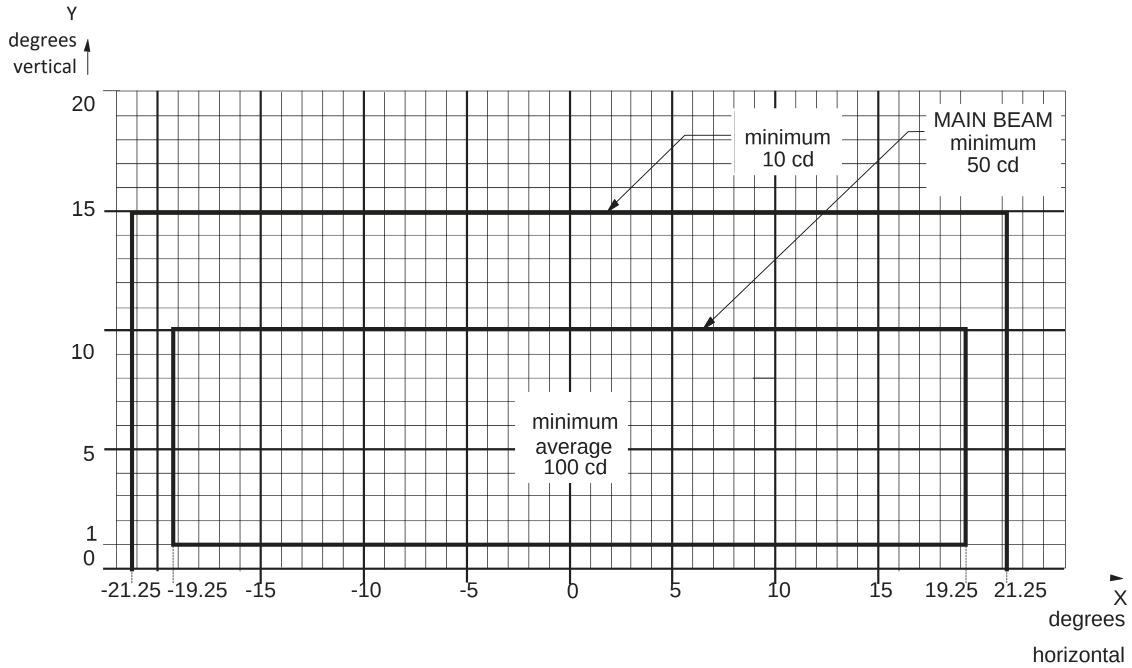
Figure 6A.13 Isocandela diagram for taxiway centreline (15 m spacing), turn pad lights and stop-bar lights in straight sections intended for use in runway visual range conditions of less than a value of the order of 350 m



Notes: 1 These beam coverages are generally satisfactory and cater for a normal displacement of the cockpit from the centreline of approximately 3 m

2 See collective notes for Figures 12 to 17

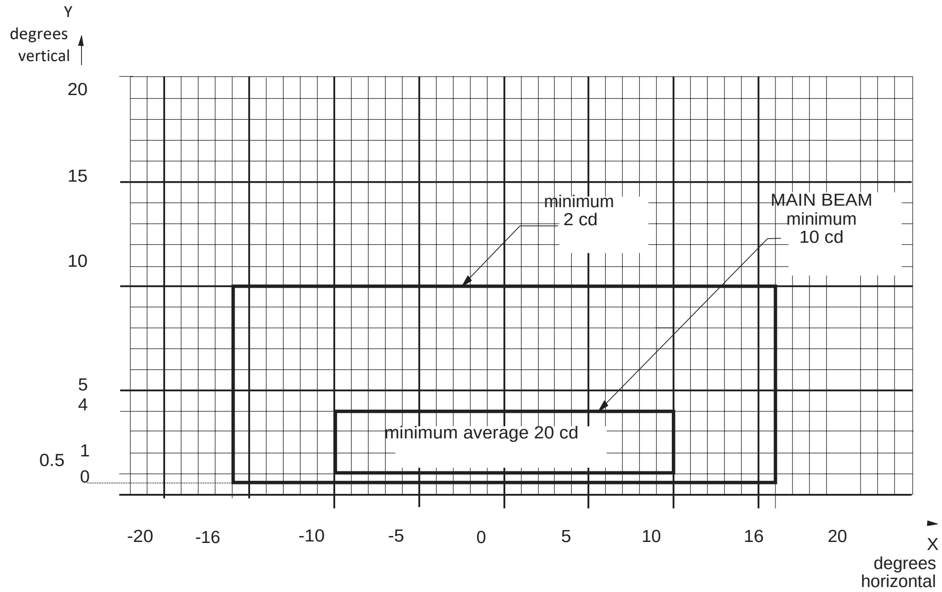
Figure 6A.14 Isocandela diagram for taxiway centreline (7.5 m spacing), RELs, no-entry bar, turn pad lights and stop-bar lights in curved sections intended for use in runway visual range conditions of less than a value of the order of 350 m



Notes:

(1) Lights on curves to be toed-in 15.75 degrees with respect to the tangent of the curve
(2) See collective notes for Figures 12 to 17

Figure 6A.15 Isocandela diagram for taxiway centreline (30 m, 60 m spacing) and stop-bar lights in straight sections intended for use in runway visual range conditions of the order of 350 m or greater



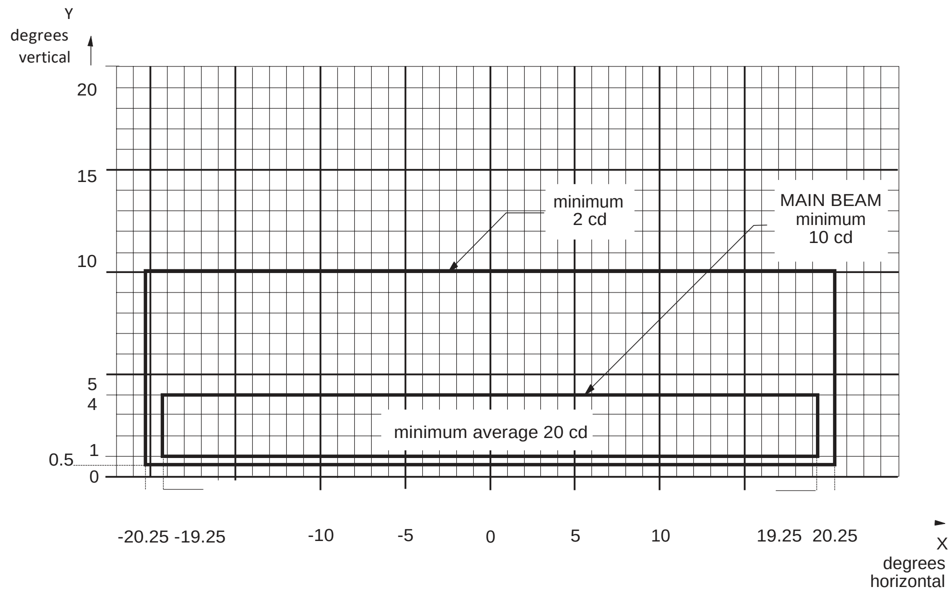
Notes:

(1) At locations where high background luminance is usual and where deterioration of light output resulting from dust, snow and local contamination is a significant factor, the cd-values should be multiplied by 2.5

(2) Where omni-directional lights are used they shall comply with the vertical beam requirements in this figure

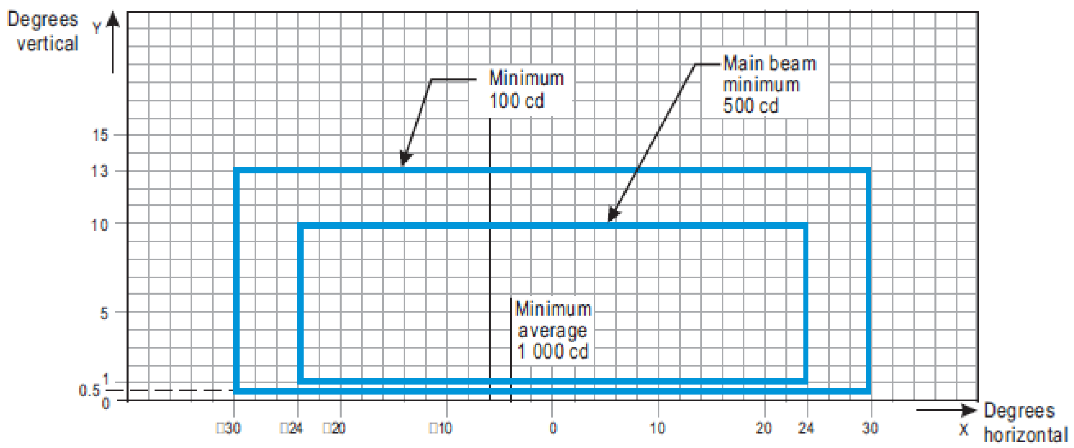
(3) See collective notes for Figures 12 to 17

Figure 6A.16 Isocandela diagram for taxiway centreline (7.5 m, 15 m, 30 m spacing) and stop-bar lights in curved sections intended for use in runway visual range conditions of the order of 350 m or greater.



Notes:
1. Lights on curves to be toed-in 15.75 degrees with respect to the tangent of the curve
2. At locations where high background luminance is usual and where deterioration of light output resulting from dust, snow and local contamination is a significant factor, the cd-values should be multiplied by 2.5
3. These beam coverages allow for displacement of the cockpit from the centreline up to distances of the order of 12 m as could occur at the end of curves
4. See collective notes for Figures 12 to 17

Figure 6A.17 Isocandela diagram for high-intensity runway guard lights (configuration B)



Notes:

1. Although the lights flash in normal operation, the light intensity is specified as if the lights were fixed for incandescent lamps.

2. See collective notes for Figures 12 to 17.

Figure 6A.18 Grid points to be used for the calculation of average intensity of taxiway centreline and stop-bar lights

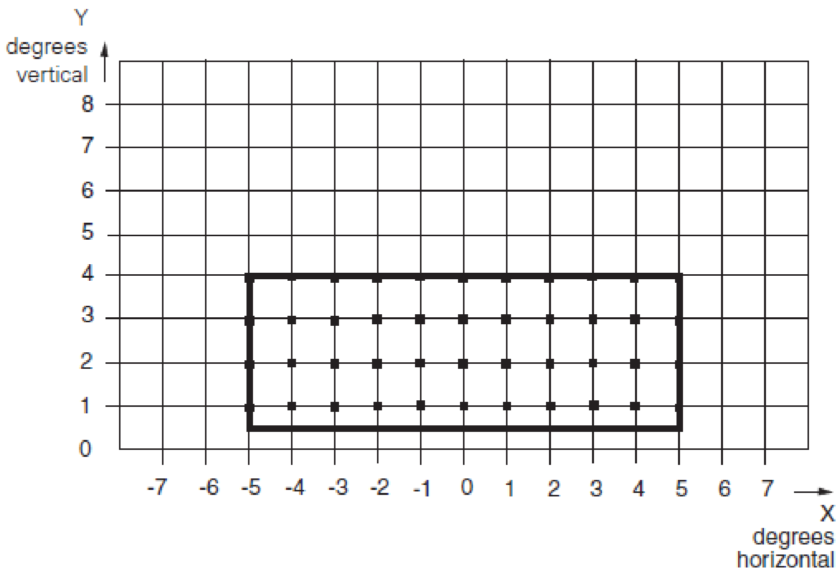
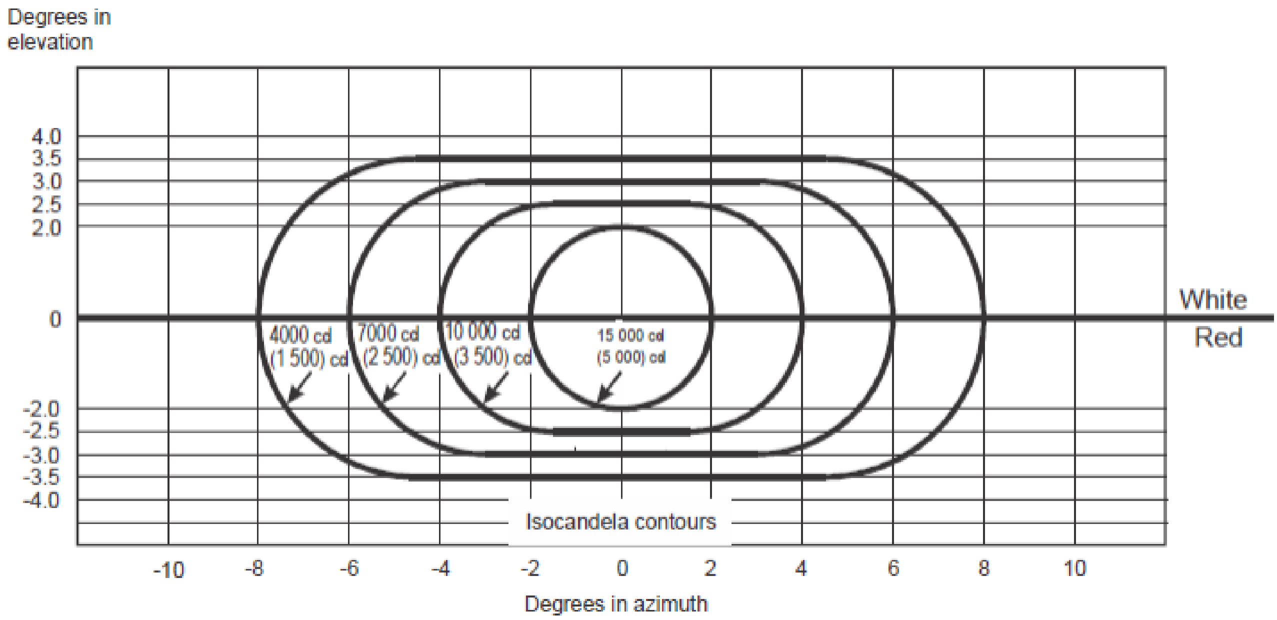


Figure 6A.19 Light intensity distribution of PAPI and (A)PAPI



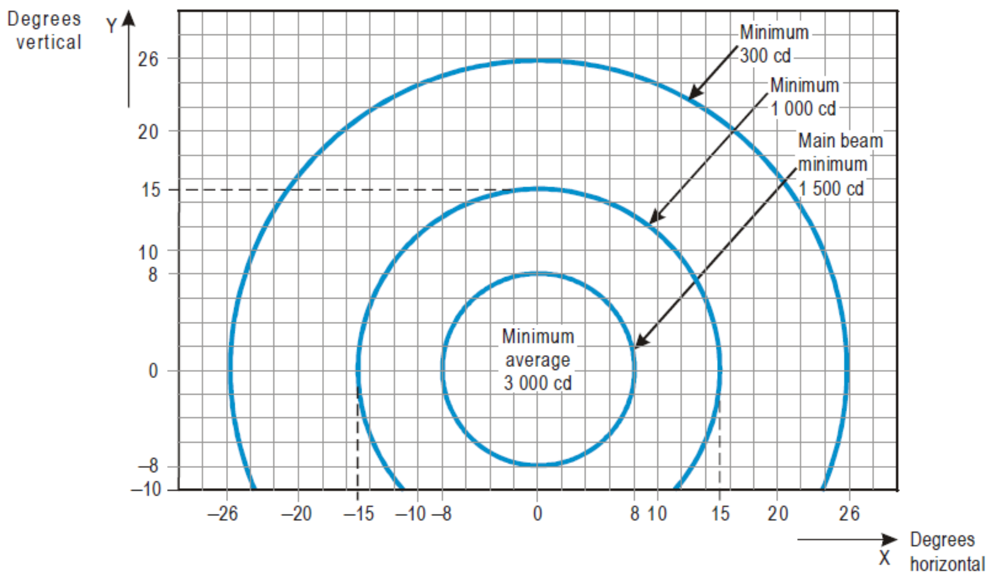
Notes.

(1) These curves are for minimum intensities in red light.

(2) The intensity value in the white sector of the beam is no less than 2 and may be as high as 6.5 times the corresponding intensity in the red sector.

(3) The intensity values shown in brackets are for APAPI.

Figure 6A.20 Isocandela diagram for each light in low-intensity runway guard lights (configuration A)

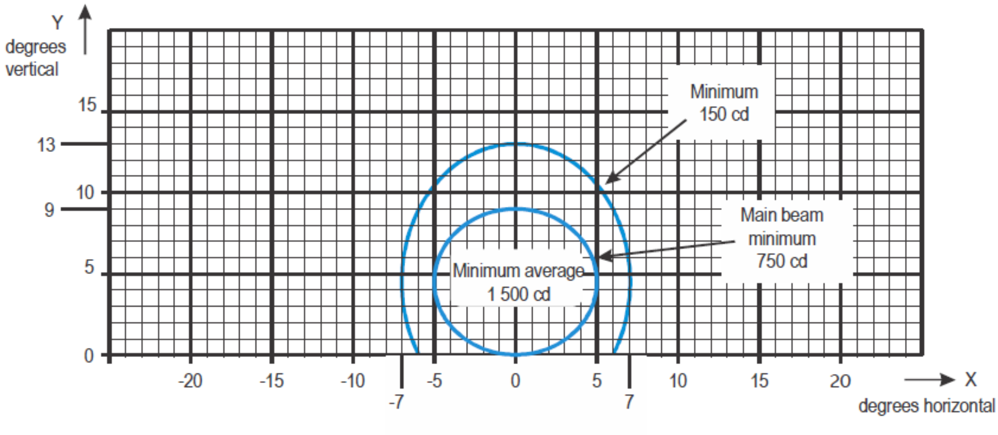


Notes:

(1) Although the lights flash in normal operation, the light intensity is specified as if the lights were fixed for incandescent lamps.

(2) The intensities specified are in yellow light.

Figure 6A.22 Isocandela diagram for take-off and hold lights (THL) (red light)



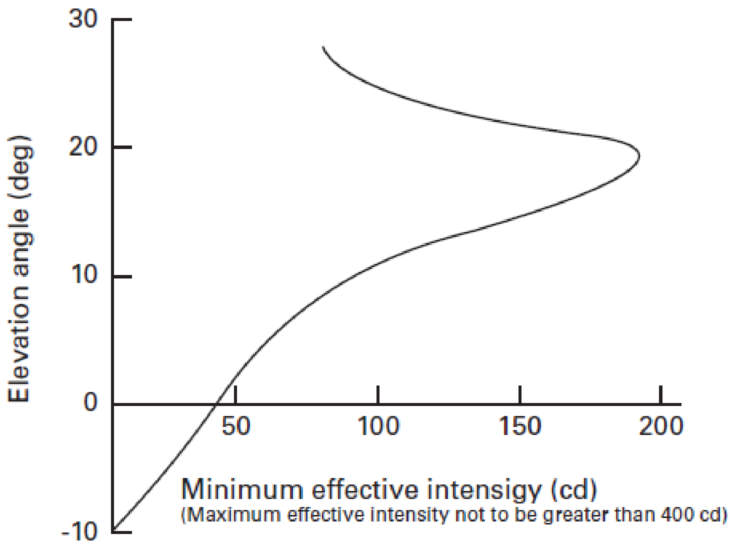
Notes:

1 Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	5.0	7.0
b	4.5	8.5

2 See collective notes for Figures 6A.1 to 6A.11 and 6A.12 to 6A.22

Figure 6A.21 Follow me vehicle obstruction light



Photometric characteristics

Collective notes for figures 6A.1 to 6A.11

16. The ellipses in each figure are symmetrical about the common vertical and horizontal axis.

17. On the perimeter of and within the ellipse defining the main beam in figures 6A.1 to 6A.10, the maximum light intensity value shall not be greater than three times the minimum light intensity value measured in accordance with paragraph 18.

18. Figures 1 to 20 show the minimum allowable light intensities. The average intensity of the main beam is calculated by establishing grid points as shown in figure 6A.11 and using the intensity values measured at all grid points located within and on the perimeter of the ellipse representing the main beam. The average value is the arithmetic average of light intensities measured at all considered grid points.

19. No deviations are acceptable in the main beam pattern when the lighting fixture is properly aimed. The light unit shall be installed so that the main beam is aligned within ± 1.2 degrees of the specified requirement.

20. Average intensity ratio. The ratio between the average intensity within the ellipse defining the main beam of a typical new light and the average light intensity of the main beam of a new runway edge light shall be as follows:

Approach centreline and crossbars	Figure 6A.1	1.5 – 2.0
Approach side row	Figure 6A.2	1.5 – 1.0
Threshold	Figure 6A.3	1.0 – 1.5
Threshold wing bar	Figure 6A.4	1.0 – 1.5
Touchdown zone	Figure 6A.5	0.5 – 1.0
Runway centreline (longitudinal spacing 30m)	Figure 6A.6	0.5 – 1.0 (white light)
Runway centreline (longitudinal spacing 15m)	Figure 6A.7	0.5 – 1.0 for cat III (white light)
		0.25 – 0.5 for cat I, II (white light)
Runway end	Figure 6A.8	0.25 – 0.5
Runway edge (45m runway width)	Figure 6A.9	1.0 (white light)
		0.4 (yellow light)
		0.15 (red light)
Runway edge (60m runway width)	Figure 6A.10	1.0 (white light)
		0.4 (yellow light)
		0.15 (red light)

21. The beam coverages in the figures provide the necessary guidance for approaches down to an RVR of 150 m and take-offs down to an RVR of 100 m .

Collective notes for figures 6A.12 to 6A.22

22. Figures 6A.12 to 6A.16 show candela values in green and yellow for taxiway centreline lights and runway guard lights and in red for stop-bar lights.

23. On the perimeter of and within the rectangle defining the main beam in figures 6A.12 to 6A.16, the maximum light intensity value shall not be greater than three times the minimum light intensity value measured in accordance with paragraph 24.

24. Figures 6A.12 to 6A.16 show the minimum allowable light intensities. The average intensity of the main beam is calculated by establishing grid points as shown in figure 6A.17 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 arithmetical average of the light intensities measured at all considered grid points.

25. No deviation is acceptable in the main beam when the lighting fixture is properly aimed.

26. 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.

27. Vertical angles are measured from the longitudinal slope of the taxiway surface.

28. The light unit shall be installed so that the main beam is aligned within ± 0.5 degree of the specified requirement.

Colour requirements for AGL

General

29. The colour of light signals is an important characteristic of the guidance provided by the AGL. It is incumbent upon aerodrome licence holders to ensure that wherever a light signal depends on colour to provide essential information,

30. the lighting equipment employed displays no misleading signals within the equipment beam spread or at any angle within the intended viewing segment.

Figure 6A.22 Colours for aeronautical ground lights (filament-type lamps)

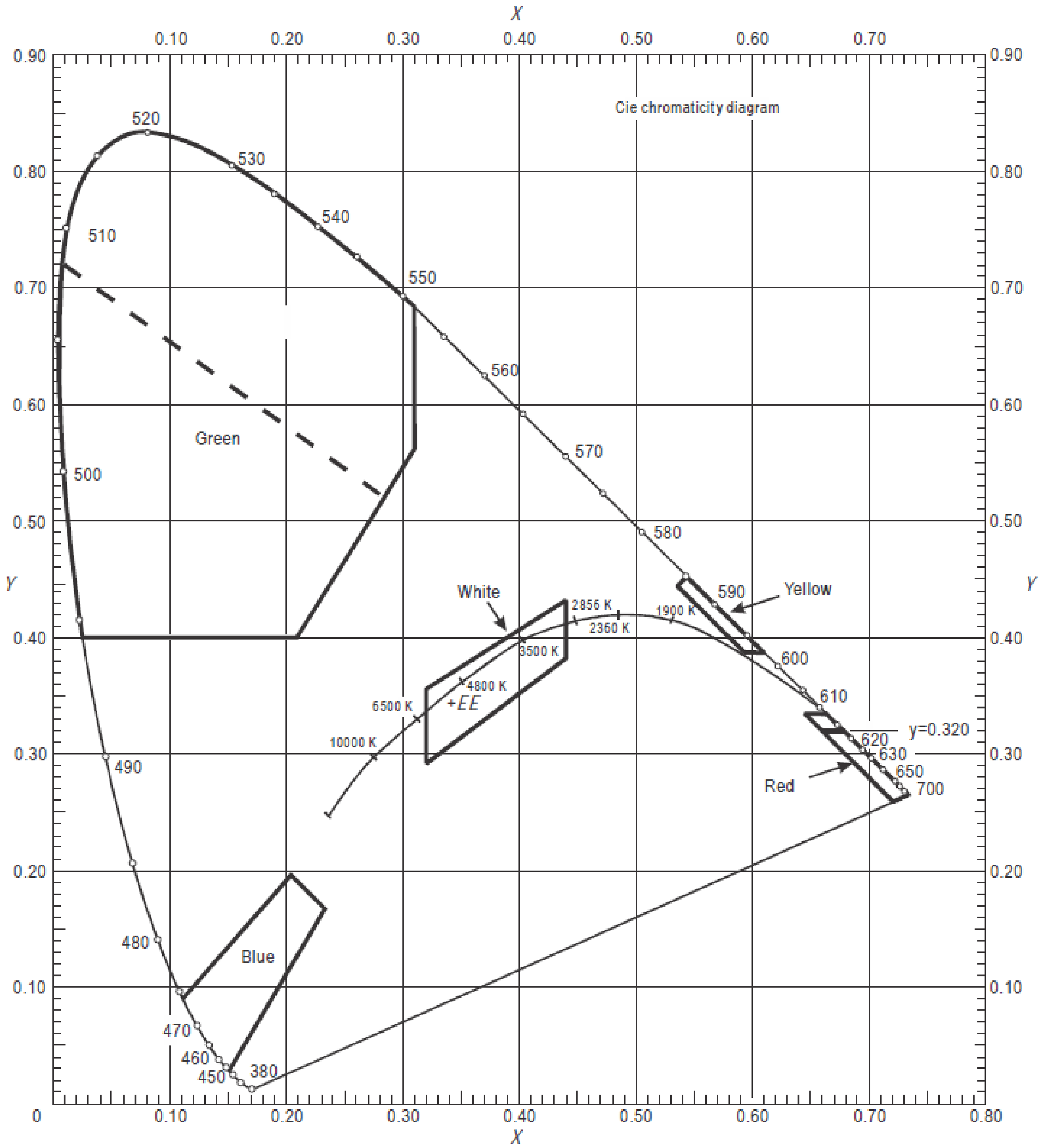


Figure 6A.23 Colours for aeronautical ground lights (solid state lighting)

31. The colour change associated with light fittings employing dichroic filters, when measured in the high intensity part of the beam, is generally still within the appropriate colour specification. However, depending on the layout of an aerodrome, it is possible for flight crew or a vehicle driver to see incorrect colour signals when viewing a light signal from large offset angles. An example of the problem occurs where a stop-bar is installed on a wide taxiway leading onto a runway in such a manner that it is intended that the stop-bar should be seen when approached at an acute angle. In such situations it is possible for the stop- bar to display yellow rather than red light.

32. The colour of AGL should be verified by the manufacturer as being within the boundaries of figure 6A.20 by measurement at five points within the area

bounded by the innermost isocandela curve (isocandela diagrams 6A.1 to 6A.18 refer), with operation at rated current or voltage as follows:

33. in the case of elliptical or circular isocandela curves, the colour measurements should be taken at the centre and at the horizontal and vertical limits;

34. in the case of rectangular isocandela curves, the colour measurements should be taken at the centre and the limits of the diagonals (corners);

35. the colour of the light should be checked at the outermost isocandela curve to ensure that there is no colour shift that might cause signal confusion;

36. a measurement of colour co-ordinates for the outermost isocandela curve should be made by the manufacturer and recorded for review and judgement of acceptability by the aerodrome authority;

37. where lights may be viewed and used by flight crew from directions beyond that of the indicated isocandela curve (e.g. stop-bars at wide taxi-holding positions), the aerodrome authority should make a visual assessment of the actual application and, if necessary, require a check of colour shift at angular ranges beyond the outermost isocandela curve; and

38. the signal colours for (A)PAPI and AGL having a colour transition sector should be measured at points, as indicated above, except that the colour areas shall be treated separately and no point shall be within 0.5 degrees of the transition sector.

Chromaticities

39. The Chromaticities of AGL shall be within the following boundaries: CIE Equations (see figure 6A.20).

a)	Red	
	Purple boundary	y = 0.980 – x
	Yellow boundary	y = 0.335
b)	Yellow	
	Red boundary	y = 0.382
	White boundary	y = 0.790 – 0.667x
	Green boundary	y = x – 0.120
c)	Green	
	Yellow boundary	x = 0.360 – 0.080y
	White boundary	x = 0.650y
	Blue boundary	y = 0.390 – 0.171x
d)	Blue	

	Green boundary	y = 0.805x + 0.065
	White boundary	y = 0.400 – x
	Purple boundary	x = 0.600y + 0.133
e)	White	
	Yellow boundary	x = 0.500
	Blue boundary	x = 0.285
	Green boundary	y = 0.440
	and	y = 0.150 + 0.640x
	Purple boundary	y = 0.050 + 0.750x
	and	y = 0.382
f)	Variable white	
	Yellow boundary	x = 0.255 + 0.750y
	and	x = 1.185 – 1.500y
	Blue boundary	x = 0.285
	Green boundary	y = 0.440
	and	y = 0.150 + 0.640x
	Purple boundary	y = 0.050 + 0.750x
	and	y = 0.382

40. Where dimming is not required, or where observers with defective colour vision must be able to determine the colour of the light, green signals should be within the following boundaries:

- Yellow boundary y = 0.726 – 0.726x
- White boundary x = 0.650y
- Blue boundary y = 0.390 – 0.171x

41. Where increased certainty of recognition is more important than maximum visual range, green signals should be within the following boundaries:

- Yellow boundary y = 0.726 – 0.726x
- White boundary x = 0.625y – 0.041
- Blue boundary y = 0.390 – 0.171x

Discrimination between lights

42. If there is a requirement to discriminate yellow and white from each other, they should be displayed in close proximity of time or space as, for example, by being flashed successively from the same beacon.

43. If there is a requirement to discriminate yellow from green and/or white, as for example on exit taxiway centreline lights, the y co-ordinates of the yellow light should 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.*

44. The colour variable white is intended to be used only for lights that are to be varied in intensity, e.g. to avoid dazzling. If this colour is to be discriminated from yellow, the lights should be so designed and operated that:

1. the x co-ordinate of the yellow is at least 0.050 greater than the x co-ordinate of the white; and
2. the disposition of the lights will be such that the yellow lights are displayed simultaneously and in close proximity to the white lights.

APPENDIX 6B

PAPI: Siting and setting angles

Layout and elevation setting angles

General:

1. The PAPI system comprises a four-unit wing bar normally located in a line at right angles to the runway. Each unit should contain three light projectors.

Definition and positioning:

2. The PAPI system should consist of a wing bar of four sharp transition multi-lamp (or paired single lamp) units equally spaced. The APAPI system should consist of a wing bar of two sharp transition multi-lamp (or paired single lamp) units. The PAPI and APAPI system should be located on the left side of the runway unless it is physically impracticable to do so. Where a runway is used by aircraft requiring visual roll guidance, which is not provided by other external means, then a second wing bar may be provided on the opposite side of the runway for PAPI or APAPI.

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

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

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

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

4. The wing bar of an APAPI should be constructed and arranged in such a manner that a pilot making an approach should:

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

   b) when above the approach slope, see both the units as white; and

   c) when below the approach slope, see both the units as red.

5. The light units should be located as in the basic configuration illustrated in Figure 6B.1, subject to the installation tolerances given below. The units forming a wing bar should be mounted so as to appear to the pilot of an approaching aeroplane to be substantially in a horizontal line. The light units should be mounted as low as possible and should be frangible.

Characteristics:

6. The system should be suitable for both day and night operations.

7. Colour:

a) The colour transition from red to white in the vertical plane should be such as to appear to an observer, at a distance of not less than 300 m, to occur within a vertical angle of not more than 3´.

b) At full intensity, the chromaticity of lights units should be in accordance with the specifications in Figure 6A.19, as appropriate, and the red light should have a Y coordinate not exceeding 0.320.

8. Intensity:

a) The light intensity distribution of the light units should be as shown in Figure 6A.19.

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

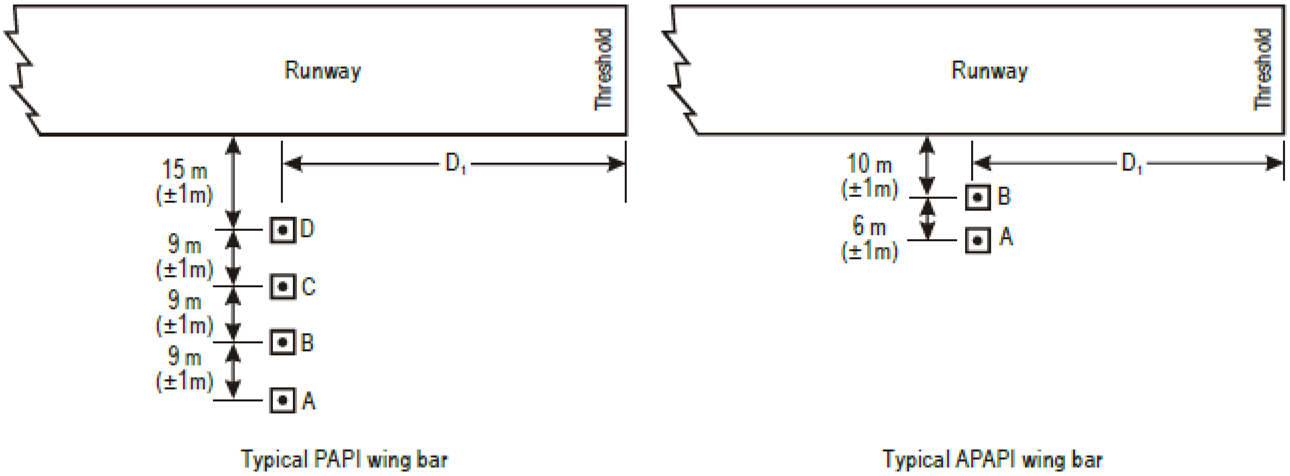
9. Light orientation:

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

10. Other characteristics:

a) The light units should be so designed that deposits of condensation, snow, ice, dirt, or other contaminants, on optically transmitting or reflecting surfaces should interfere to the least possible extent with the light signals and should not affect the contrast between the red and white signals and the elevation of the transition sector.

Figure 6B.1 PAPI: Siting of PAPI and APAPI



INSTALLATION TOLERANCES

a) Where a PAPI or APAPI is installed on a runway not equipped with an ILS or MLS, the distance D1 should be calculated to ensure that the lowest height at which a pilot will see a correct approach path indication (Figure 6B.2, angle B for a PAPI and angle A for an APAPI) provides the wheel clearance over the threshold specified in Table 6B.1 for the most demanding amongst aeroplanes regularly using the runway.

b) Where a PAPI or APAPI is installed on a runway equipped with an ILS and/or MLS, the distance D1 should be calculated to provide the optimum compatibility between the visual and non-visual aids for the range of eye-to-antenna heights of the aeroplanes regularly using the runway. The distance should be equal to that between the threshold and the effective origin of the ILS glide path or MLS minimum glide path, as appropriate, plus a correction factor for the variation of eye-to-antenna heights of the aeroplanes concerned. The correction factor is obtained by multiplying the average eye-to-antenna height of those aeroplanes by the cotangent of the approach angle. However, the distance should be such that in no case will the wheel clearance over the threshold be lower than that specified in column (3) of Table M-1.

Note: See CS ADR-DSN.L.540 for specifications on aiming point marking. Further guidance on the harmonisation of PAPI, ILS and/or MLS signals is contained in ICAO Doc 9157, Aerodrome Design Manual, Part 4, Visual Aids.

c) If a wheel clearance, greater than that specified in a) above is required for specific aircraft, this can be achieved by increasing D1.

d) Distance D1 should be adjusted to compensate for differences in elevation between the lens centres of the light units and the threshold.

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

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

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

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

Approach slope and elevation setting of light units for PAPI and APAPI

Approach slope:

11. The approach slope as defined in Figure 6B.2, should be so designed to be appropriate for use by the aeroplanes in the approach.

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

Elevation setting of light units

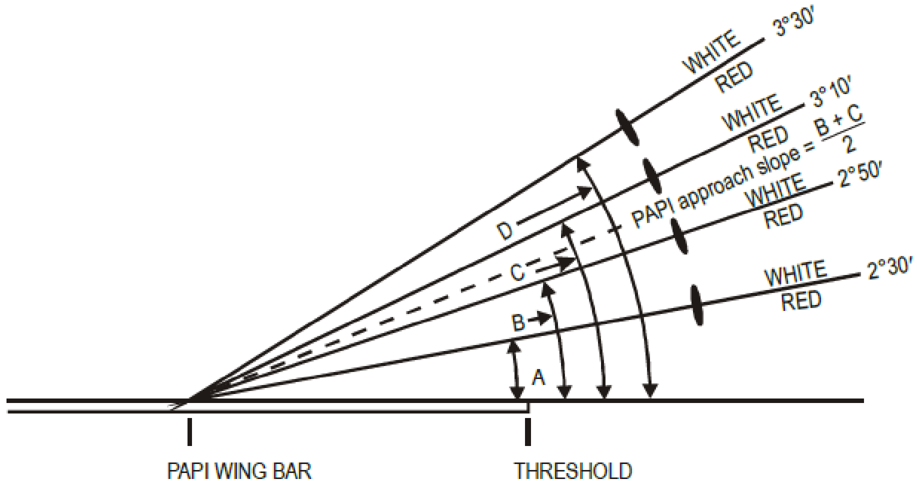
13. The angle of elevation settings of the light units in a PAPI wing bar should be such that, during an approach, the pilot of an aeroplane observing a signal of one white and three reds should clear all objects in the approach area by a safe margin (see Table 6B.1).

14. The angle of elevation settings of the light units in an APAPI wing bar should be such that, during an approach, the pilot of an aeroplane observing the lowest on-slope signal, i.e., one white and one red, should clear all objects in the approach area by a safe margin (see Table 6B.1).

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

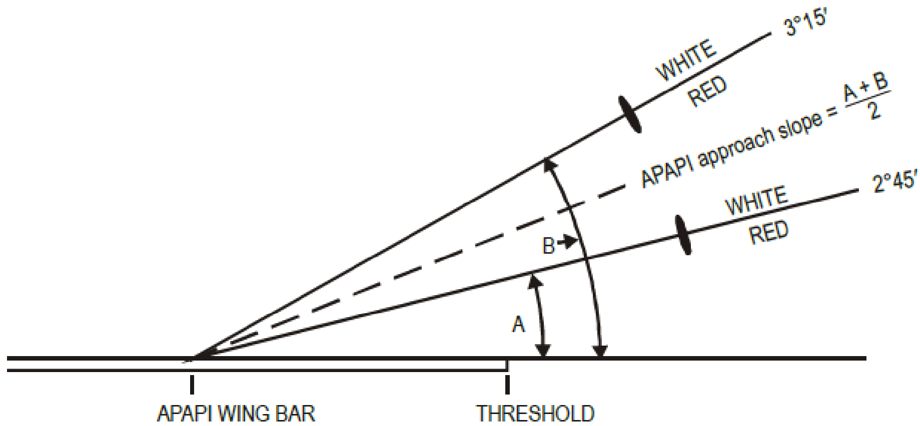
16. Where wing bars are installed on each side of the runway to provide roll guidance, corresponding units should be set at the same angle so that the signals of each wing bar change symmetrically at the same time.

Figure 6B.2 Light beams and angle of elevation setting of PAPI and APAPI



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

A — 3° PAPI ILLUSTRATED



B — 3° APAPI ILLUSTRATED

Obstacle protection surface for PAPI and APAPI

Applicability:

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

Characteristics:

18. The characteristics of the obstacle protection surface, i.e., origin, divergence, length, and slope should correspond to those specified in the relevant column of Table 6B.2 and in Figure 6B.3.

19. New objects or extensions of existing objects should not be permitted above an obstacle protection surface except when the new object or extension would be shielded by an existing immovable object, or if after a safety assessment, it is determined that the object would not adversely affect the safety of operations of aeroplanes.

20. Where a safety assessment indicates that an existing object extending above an obstacle protection surface could adversely affect the safety of operations of aeroplanes one or more of the following measures shall be taken:

    c) remove the object;

    d) suitably raise the approach slope of the system;

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

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

    g) suitably displace the threshold; and

    h) where (g) is found to be impracticable, suitably displace the system upwind of the threshold such that the object no longer penetrates the obstacle protection surface.

Wheel clearance and Minimum Eye Height over Threshold (MEHT)

21. Wheel clearance over threshold should take account of the eye-to-wheel height of the most demanding aircraft when it is at the lowest possible on-slope signal from the PAPI. The MEHT will be agreed in consultation with the CAA.

22. The angle which establishes the MEHT is two minutes of arc less than the setting angle of the unit defining the lower on-slope boundary (see figure 6B.2). Where a runway is not equipped with ILS, MEHT should provide the wheel clearances specified in table 6B.1. The MEHT is the combination of the eye-to- wheel height and the wheel clearance.

Table 6B.1 Wheel clearance over threshold for PAPI and (A)PAPI

Eye-to-wheel height of aeroplane in the approach configuration Note 1	Desired wheel clearance Notes 2, 3 (metres)	Minimum wheel clearance Note 4 (metres)
(1)	(2)	(3)
up to but not including 3 m	6	3 (Note 5)
3 m up to but not including 5 m	9	4
5 m up to but not including 8 m	9	5
8 m up to but not including 14 m	9	6

Notes:

1. In selecting the eye-to-wheel height group, only aeroplanes meant to use the system on a regular basis shall be considered. The most demanding among such aeroplanes shall determine the eye-to-wheel height group.
2. Where practicable the desired wheel clearances shown in column (2) shall be provided.
3. The wheel clearances in column (2) may be reduced to no less than those in column (3) where an aeronautical study indicates that such reduced wheel clearances are acceptable.
4. When a reduced wheel clearance is provided at a displaced threshold it shall be ensured that the corresponding desired wheel clearance specified in column (2) will be available when an aeroplane at the top end of the eye-to- wheel group chosen overflies the extremity of the runway.
5. This wheel clearance may be reduced to 1.5 m on runways used mainly by lightweight non-turbojet aeroplanes.

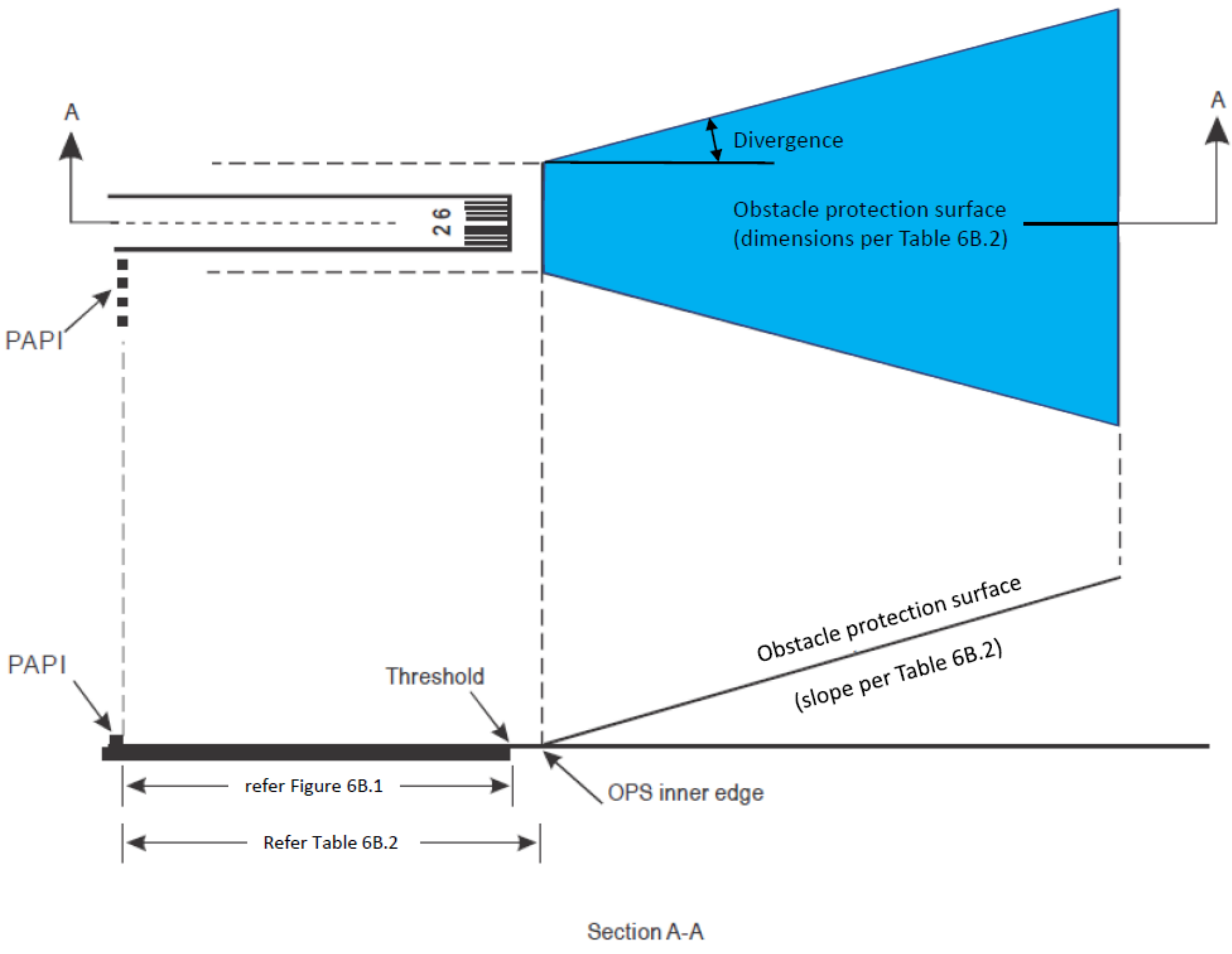
Table 6B.2 Dimensions and slopes of the obstacle protection surface

	Runway type/code number							
	Non-instrument				Instrument			
	Code number				Code number			
Surface dimensions	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Length of inner edge	60 m	80 m	150 m	150 m	150 m	150 m	300 m	300 m
Distance from the visual approach slope indicator system 2	D_1+30 m	D_1+60 m	D_1+60 m	D_1+60 m	D_1+60 m	D_1+60 m	D_1+60 m	D_1+60 m
Divergence (each side)	10 %	10 %	10 %	10 %	15 %	15 %	15 %	15 %
Total length	7 500 m	7 500 m	15 000 m	15 000 m	7 500 m	7 500 m	15 000 m	15 000 m
a) PAPI 1	—	A–0.57°	A–0.57°	A–0.57°	A–0.57°	A–0.57°	A–0.57°	A–0.57°
b) APAPI 1	A–0.9°	A–0.9°	–	–	A–0.9°	A–0.9°	–	–

1 Angles as indicated in Figure 6B.2

2 D_1 is the distance of the visual approach slope indicator system from threshold prior to any displacement to remedy object penetration of the obstacle protection surface (refer to Figure 6B.1). The start of the obstacle protection surface is fixed to the visual approach slope indicator system location, such that displacement of the PAPI results in an equal displacement of the start of the obstacle protection surface.

Figure 6B.3 Obstacle protection surface for visual approach slope indicator systems



APPENDIX 6C

Procedure for the routine flight inspection of approach and runway lights

Approach lighting pattern

Check 1

1. Carry out a normal approach from the Final Approach Fix (FAF) or at least 5 nm starting with all approach lights at the maximum luminous intensity setting. Check that a uniform pattern is presented to an aircraft on the normal approach path. Flight variations should be made about the approach path. Small variations in elevation and azimuth should not produce any noticeable change in the intensity of the lights. Large variations will produce a progressive reduction in intensity as the aircraft leaves the area of primary cover of the lights. These changes in intensity should be similar for all lights. Ragged changes are normally caused by incorrect setting angles of individual units, and a note of these should be made for subsequent checking on the ground.

Check 2

2. During the approach call for progressive reductions in luminous intensity down to the minimum setting. Check that all lights respond correctly and simultaneously to the setting changes. With all approach lights set at a suitable luminous intensity setting (the lowest at which the individual lights are discernible is normally best) check that all the individual lights are illuminated. Note and record all outages and misalignments.

Supplementary approach lights (when installed)

Check 3

3. Repeat checks 1 and 2 above for supplementary approach lighting.

Check 4

4. Repeat with approach and supplementary approach lighting combined.

Runway edge, threshold and end lights

Check 5

5. With edge, threshold and end lights at maximum luminous intensity, check that a uniform pattern is presented to an aircraft taking off, landing and going around. Check that there is a progressive and even reduction in the intensity of the lights as the aircraft leaves their area of primary cover.

Check 6

6. From the downwind leg check that all omni-directional runway lights are visible and that they clearly define the runway edges.

Check 7

7. During a normal approach, initially with the runway lights at maximum intensity, call for progressive reductions in the light intensities down to the minimum setting. Check that all lights respond correctly and simultaneously to the setting changes. At a low luminous intensity setting, carry out a low go-around and check for any light outages or misalignments.

Runway centreline lights

Check 8

8. Repeat checks 5 and 7 above for the runway centreline lights.

Touchdown zone lights

Check 9

9. Repeat checks 5 and 7 above for touchdown zone lights.

Complete check of approach and runway lighting

Check 10

10. With all approach and runway lights set at the luminous intensity levels appropriate to the conditions prevailing (see table 6.4) carry out a normal approach. Check that a balanced lighting system is presented to flight crew. Call for luminous intensity adjustments appropriate to other conditions and check that the intensity balance is maintained. Check that the colour of the AGL corresponds to that expected.

11. Check visibility of illuminated wind sleeve and landing T where installed.

Obstacle lights

Check 11

12. Check obstacle lighting on or in the immediate vicinity of the aerodrome for outages.

Location/identification beacon

Check 12

13. Check that the beacon is clearly discernible at a range appropriate to the conditions, and that the coding/flash rate is correct.

Dangerous/confusing lights

Check 13

14. Check for dangerous or confusing lights.

CIVIL AVIATION AUTHORITY

Aeronautical Ground Lighting Flight Inspection Report (Simple)

(This form is to be completed during or immediately after the flight)

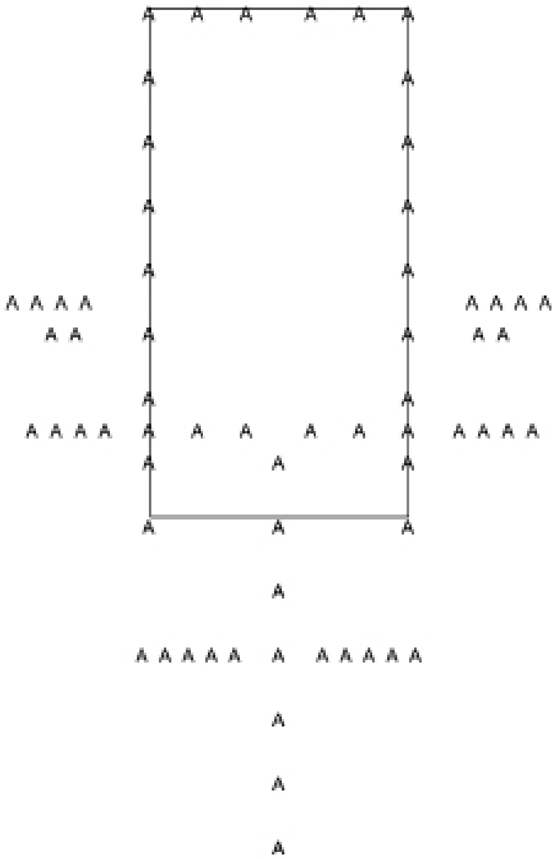
Aerodrome____________________________ **Runway**___________

	PAPI		Transition			APAPI	
☐	W	W	W	W	☐	W	W
☐	W	W	W	R	☐	W	R
☐	W	W	R	R	☐	R	R
☐	W	R	R	R			
☐	R	R	R	R			

Range (FAF) ______ nm

Intensity Changes

- ☐ 100%
- ☐ 80%
- ☐ 30%
- ☐ 10%
- ☐ 3%
- ☐ 1%
- ☐ OFF



Continuous Assessment

	Low	On-slope	High
Intensity	☐	☐	☐
Alignment	☐	☐	☐

Overall Assessment

- ☐ Approach/Runway Balance
- ☐ Circling Guidance
- ☐ Approach
- ☐ Strobe
- ☐ Threshold
- ☐ Runway Edge
- ☐ Stop-end
- ☐ Windsleeves
- ☐ Beacon
- ☐ Obstacle

Inspected by ______________ **Date**______________

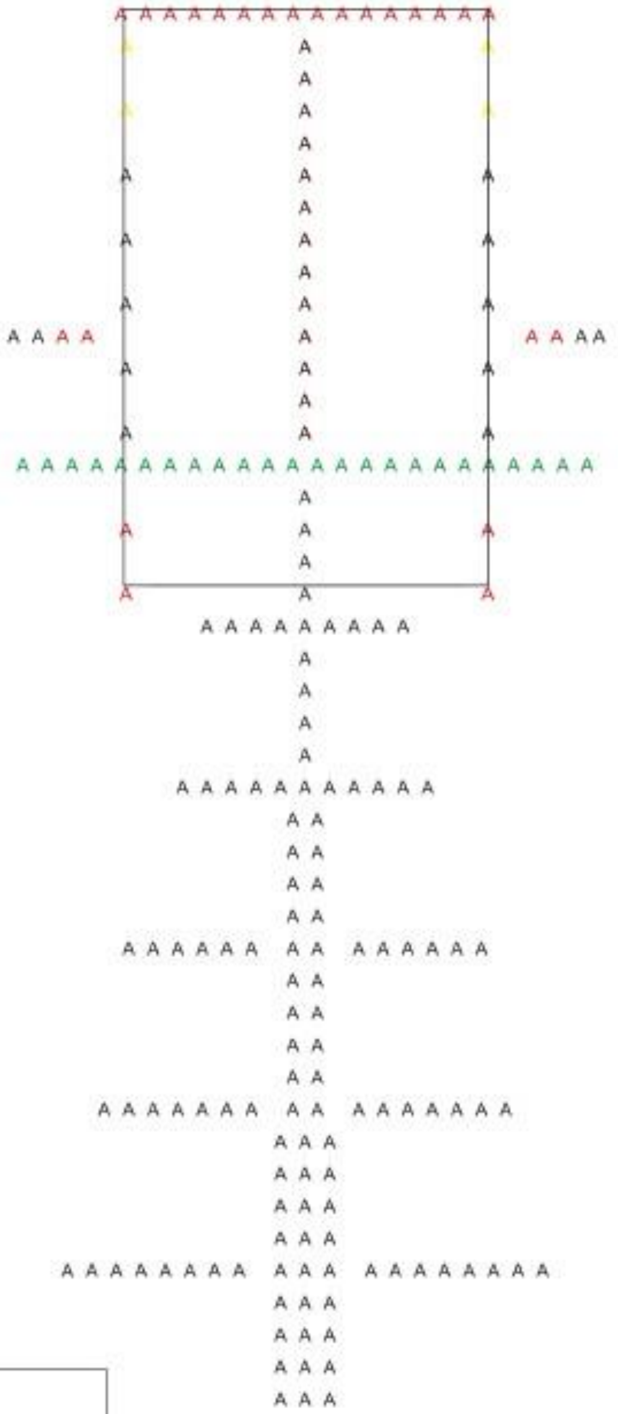
CA 1560 E (Part 1)
170400

CIVIL AVIATION AUTHORITY

Aeronautical Ground Lighting Flight Inspection Report (CAT I)

(This form is to be completed during or immediately after the flight)

Aerodrome ______________________ **Runway** __________



PAPI Transition **ILS Correlation**

PAPI Transition					ILS Correlation
☐	W	W	W	W	☐
☐	W	W	W	R	☐
☐	W	W	R	R	☐
☐	W	R	R	R	☐
☐	R	R	R	R	☐

Range (FAF) ______ nm

Intensity Changes

- ☐ 100%
- ☐ 80%
- ☐ 30%
- ☐ 10%
- ☐ 3%
- ☐ 1%
- ☐ OFF

Continuous Assessment

	Low	On-slope	High
Intensity	☐	☐	☐
Alignment	☐	☐	☐

Overall Assessment

- ☐ Approach/Runway Balance
- ☐ Circling Guidance
- ☐ Approach
- ☐ Threshold
- ☐ Runway Centreline
- ☐ Runway Edge
- ☐ Runway Centreline Coding
- ☐ Stop-end
- ☐ Windsleeves
- ☐ Beacon
- ☐ Obstacle

Inspected by ____________ **Date** ____________

CA 1560 E (Part 2)
170400

CIVIL AVIATION AUTHORITY

Aeronautical Ground Lighting Flight Inspection Report (CAT II/III)

(This form is to be completed during or immediately after the flight)

Aerodrome__________________________ **Runway**___________

PAPI Transition **ILS Correlation**

PAPI Transition					ILS Correlation
☐	W	W	W	W	☐
☐	W	W	W	R	☐
☐	W	W	R	R	☐
☐	W	R	R	R	☐
☐	R	R	R	R	☐

Range (FAF) ______ nm

Intensity Changes

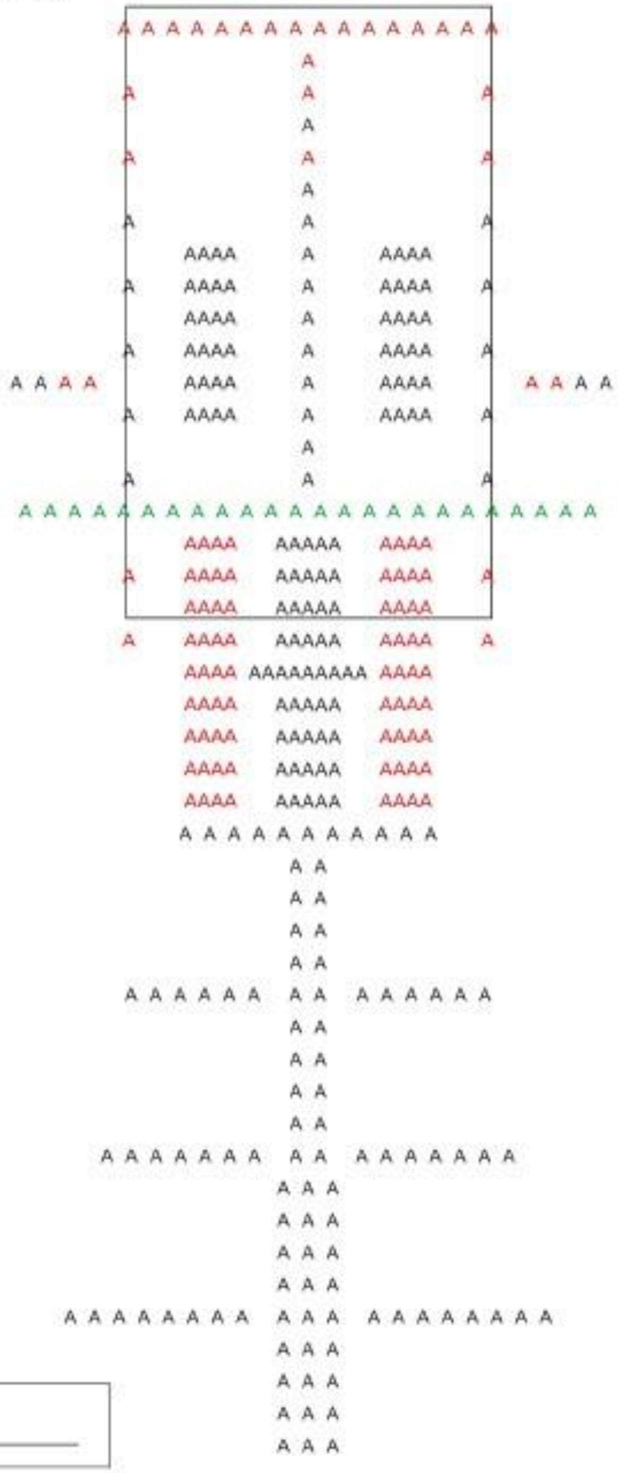
- ☐ 100%
- ☐ 80%
- ☐ 30%
- ☐ 10%
- ☐ 3%
- ☐ 1%
- ☐ OFF

Continuous Assessment

	Low	On-slope	High
Intensity	☐	☐	☐
Alignment	☐	☐	☐

Overall Assessment

- ☐ Approach/Runway Balance
- ☐ Circling Guidance
- ☐ Approach
- ☐ Supplementary
- ☐ Threshold
- ☐ Touchdown Zone (TDZ)
- ☐ Runway Centreline
- ☐ Runway Edge
- ☐ Runway Centreline Coding
- ☐ Stop-end
- ☐ Windsleeves
- ☐ Beacon
- ☐ Obstacle



Inspected by ______________ **Date**______________

CA 1560 E (Part 3)

Notes:

1. High intensity units may be checked by day at intensities of 30% or higher. Checks should be completed at dusk or night for lower intensities and for low intensity units. However, care must be exercised when checking obstacle clearances at night.
2. These checks should not be carried out in weather conditions worse than cloud ceiling 1500 ft and visibility 10 km.

APPENDIX 6D

Procedure for the flight inspection of PAPI and (A)PAPI

Effective range

Check 1

1. At a range of approximately 7.5–9 km and height about 1500 ft QFE check the effective range. In daylight the difference between the red and white lights should be clearly discernible at a minimum of 7.5 km in good visibility.

Colour changes

Check 2

2. Commence an approach from 7.5 km flying level at 1000 ft QFE and check that the units are evenly illuminated and that signal changes from red to white are sharp. Check also that the colour change sequence is even. Where PAPI is on both sides of the runway check that the colour change of corresponding opposite units is coincident.

   Note: In reduced visibility it may be necessary to carry out this check at closer range in which case the height will have to be reduced. The minimum practicable height is 500 ft.

Check 3

3. Commence an approach from about 5 km and acquire an on-slope signal. Continue the approach, descend until 4 reds (or 2 reds in the case of (A)PAPI) are just visible. Then climb until 4 whites (or 2 whites) are visible. Return to on-slope and continue to a point close to the threshold. The colour changes should be consistent with change in height and permit easy correction of approach height and angle.

Luminous intensity settings

Check 4

4. Make a normal approach from approximately 7.5 km starting at about 1000 ft QFE. Maintain an ‘on-slope’ indication and during the approach call for progressive reductions in intensity of the units. Check that all units change intensity correctly and simultaneously.

Table 6A.1 Characteristics of obstacle lights and low intensity aeronautical ground lights

Lighting system (purpose of the light fitting)		Colour	Beam coverage (degrees) average		Minimum setting intensity (candelas)	Elevation projection angle (degrees)	Remarks
			Horizontal	Vertical			
1		2	3	4	5	6	7
1	Low intensity approach	Red	Omni-directional	+5 to +8 0 to +15	200 50	-	
2	Low intensity runway edge	White	Omni-directional	±4	200	4.0	Elevated fittings
3	Low intensity runway edge (battery)	White	Omni-directional	±4 to ±8 +8 to +8	50 10	4.0	Portable elevated fittings
4	Low intensity threshold	Green	Omni-directional	±4	100	4.0	Elevated fittings
5	Low intensity threshold (battery)	Green	Omni-directional	±4	40	4.0	Portable elevated fittings
6	Low intensity runway end	Red	Omni-directional	±4	100	4.0	Elevated fittings
7	Low intensity runway end (battery)	Red	Omni-directional	±4	18	4.0	Portable elevated fittings
8	Taxiway edge	Blue	Omni-directional	0 to 6 6 to 75	2 0.2	3.5	
9	Stopway	Red	Omni-directional ± 6.5	0 to +15	100	-	
10	Runway guard lights	Yellow	Omni-directional ± 15	0 to +15	200	-	30 to 60 cycles per minute with periods of light suppression and illumination equal and opposite in each case

Lighting system (purpose of the light fitting)		Colour	Beam coverage (degrees) average		Minimum setting intensity (candelas)	Elevation projection angle (degrees)	Remarks
			Horizontal	Vertical			
1		2	3	4	5	6	7
11	Low intensity obstacle (group A)	Red	Omni-directional	0 to +30	10	-	Steady
12	Low intensity obstacle (group B)	Red	Omni-directional	+5 to +8 0 to +15	200 50	-	Steady
13	Vehicle obstacle	Yellow	360º	±10º (note 1)	40	-	Flash rate 60 to 90 minute. Maximum intensity not to exceed 400 Cd
14	Medium intensity obstacle	Red	Omni-directional	±4º	2000 ±20%	-	Steady
15	High intensity obstacle	White	120º	3	200 000 day 20 000 dusk 2000 night	0	40 flashed per minute (notes 2, 3, 4)
16	Simple sequenced approach	White	Omni-directional	0 to + 15	5000	-	Elevated fittings. Flash sequence 1 per second per unit

Notes:

1. The coverage requirement for 'follow me' vehicles only is illustrated in figure 6A.21.
2. Where an intermediate high intensity obstacle light is fitted, the angle should be 3° for a light less than 92 m agl, 2° for a light between 92 m and 122 m agl, and 1o for a light between 122 m and 151 m agl.
3. If more than one light is fitted, the lights should flash simultaneously.
4. Lights should flash sequentially if indicating overhead wires or cables.

Compatibility with non-visual aids

Check 5

5. Where an instrument glidepath is available carry out an instrument approach maintaining the glidepath, or in the case of a radar approach, following ATC instructions. Check that the PAPI indicates 'on-slope' from a range of 7.5 km to close into the threshold. The ILS glidepath should be near the lower limit of the PAPI 'on-slope' signal if an aeroplane with a small eye-to-aerial height is used. The person inspecting the system should carry a diagram of the installation to facilitate recording any observed deficiencies.

Obstacle check

Check 6

6. Fly sufficiently low from 7.5 km so as to be just within the all-red indication and check that there is clearance from obstacles throughout the horizontal coverage of the beam.

FLIGHT CHECK: PAPI/APAPI Aerodrome:..

Runway designation			
Effective range (km)			
Colour change: Red-to-White (Level run 1000 ft QFE from 7.5 km)			
Intensity balance of individual units (and of Left and Right sides if applicable)			
Intensity check	100%		
	80%		
	30%		
	10%		
	3%		
	1%		
	< 1%		
Integration with non-visual aids			
Synchronisation L–R (if applicable)			
Obstacle clearance			
Fitting type			

Date	Day/Dusk/Night
Time GMT	Weather
Aircraft Registration:	W/V
	Visibility
Captain	Cloud
	Turbulence

NOTES:

L					R			
1	2	3	4		4	3	2	1
0	0	0	0		0	0	0	0

1 1
2 2
3 3
4 4

Inspected by:

CA1560 E
000000

CHAPTER 7

Aerodrome signals, signs and markings

Introduction

7.1 Aerodrome signals, signs and markings provide guidance and information to pilots and assist them in complying with the Rules of the Air Regulations 2008. All signals, signs and markings should be repainted, cleaned or replaced as soon as their conspicuity is degraded.

7.2 Colour specifications for paints can be found in British Standard Specification 381C ‘Colours for Specific Purposes’. The individual specifications are 356 Golden Yellow, 557 Light Orange and 537 Signal Red. Colour specifications for signs and surface markings are given at figures 20 and 21; those for reflective materials are prescribed in BS873 Part 6 or its successor.

7.3 Licensed aerodromes should meet the requirements for signals, signs and markings described in this chapter. Such signals as are prescribed by the rules are marked with an asterisk (*) in the following paragraphs, and they are allowed a dimensional tolerance of 10%.

7.4 Any marshalling service provided should comply with rule 62.

Signals

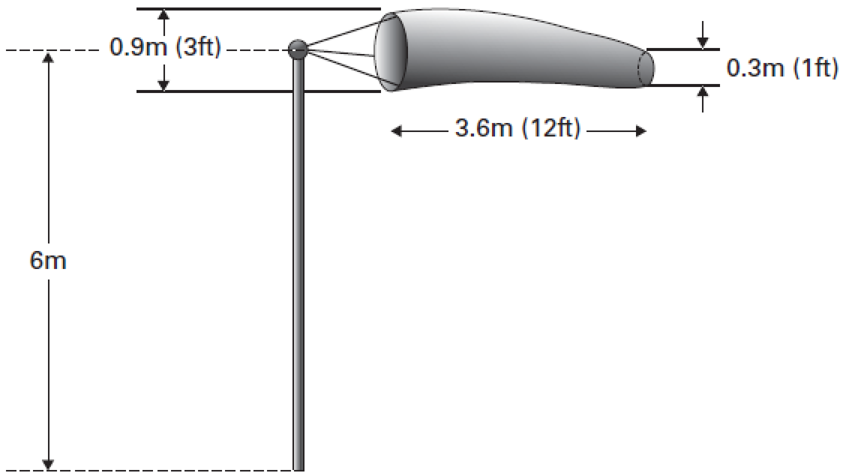
7.5 An aerodrome should display at least one wind sleeve and the signals described in these paragraphs, as appropriate, except that a landing T, signals area, or signals on a signals mast, need not be displayed at an aerodrome which is available only to radio-equipped aircraft at which an ATC or flight information service is available. An aerodrome used extensively by non-radio-equipped aircraft should display the name of the aerodrome in letters at least 3 m high.

7.6 Where appropriate, an aerodrome should have a signal lamp capable of producing white, red and green lights, to make the signals specified in rule 61. Pyrotechnic lights or flares should also be available for the same purpose.

Wind sleeves

7.7 At least one wind sleeve of the following dimensions should be provided at an aerodrome:

Figure 7.1 Wind sleeve dimensions



7.8 Wind sleeves should be coloured so as to give maximum contrast with their background. At aerodromes which accept non-radio aircraft, the location of at least one wind sleeve should be emphasised by a white circular band 7.5 m in diameter and 0.6 m wide around the base of the mast.

7.9 Wind sleeves should be so positioned on the aerodrome as to be visible from the approaches to all runways and be free from the effects of any disturbances caused by nearby objects. They should be sited so that at least one sleeve is visible from each take-off position and so that they meet the requirements in chapter 3 of this publication.

7.10 An illuminated wind sleeve is intended to provide flight crew, at night, both in the air and on the ground with a clear indication of wind speed and direction. Aerodromes licensed for the landing and take-off of aircraft at night should provide at least one illuminated wind sleeve. The illuminated wind sleeve shall be lighted by methods so that it is fit for purpose, ensuring that it is conspicuous by day and by night from the landing and take-off threshold and ensuring that from an observer's standing position on ground level there is no glare at a range of 25m or more.

7.11 The usefulness of any visual aid is determined largely by its size, conspicuity and location. Given conditions of good atmospheric visibility, the maximum distance at which the information available from an illuminated wind sleeve can be usefully interpreted is 1 km. Thus, in order that a pilot may make use of this information while on approach, the wind sleeve should be sited no farther from the runway threshold than 600 m. Obstacle criteria excluded, the ideal location is 300m along the runway from the threshold and laterally displaced at 80m from the runway centreline. This means, in effect, that only those aerodromes where the thresholds are less than 1200m apart can meet the minimum requirement with a single unit. Most code 3 and 4 aerodromes will require two or more units suitably sited in order to provide the best possible coverage.

7.12 The final choice of unit numbers and location will depend on a variety of factors which will vary from aerodrome to aerodrome. However, when deciding on the most appropriate location, account should be taken to ensure that the wind sleeve is:

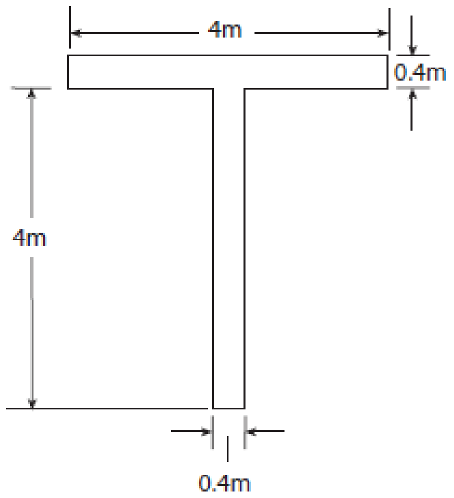
a) outside the cleared and graded area of the runways and taxiways and beneath the
b) 1:10 obstacle surface;
c) clear of the OFZ and ILS critical/sensitive areas where appropriate;
d) preferably not more than 200m lateral displacement from the runway edge;
e) preferably between 300m and 600m from the runway threshold measured along the runway;
f) in an area with low background levels of illumination;
g) visible from the approach and take-off positions of all licensed runways;
h) free from the effects of air disturbance caused by nearby objects.

Signals Area

7.13 When required, the signals specified below should be displayed in a signals area. This area should be a square with internal sides measuring 12 m, bordered by a white strip 0.3 m wide and should be visible from the air from all directions. Where appropriate the signals area should be illuminated at night. (See Note 1 to table 6.1.)

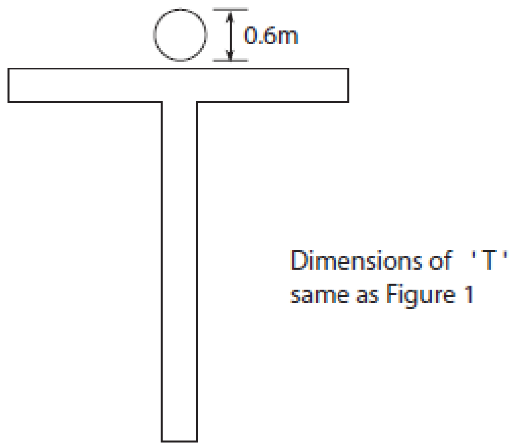
7.14 A white landing T as shown in figure 7.2 signifies that aeroplanes and gliders taking off or landing shall do so in a direction parallel with the shaft of the T and towards the cross arm, unless otherwise authorised by the appropriate air traffic control unit.

Figure 7.2 Landing direction



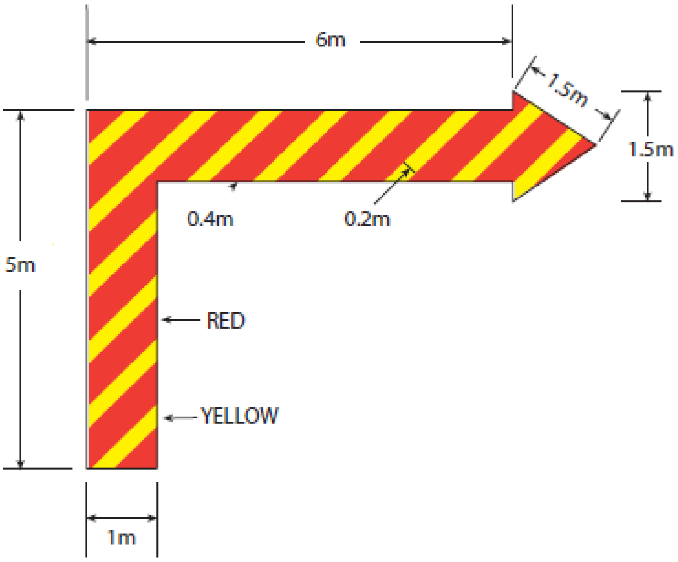
7.15 A white disc as shown in figure 7.3 of 0.6m diameter displayed alongside the cross arm of the T in line with the shaft of the T signifies that the direction of landing and take-off do not necessarily coincide.

Figure 7.3 Landing/take-off direction



7.16 A red and yellow striped arrow as shown in figure 7.4 the shaft of which is at least 1 m wide placed along the whole or not less than a total of 11 m of two adjacent sides of the signals area and pointing in a clockwise direction signifies that a right-hand circuit is in force.

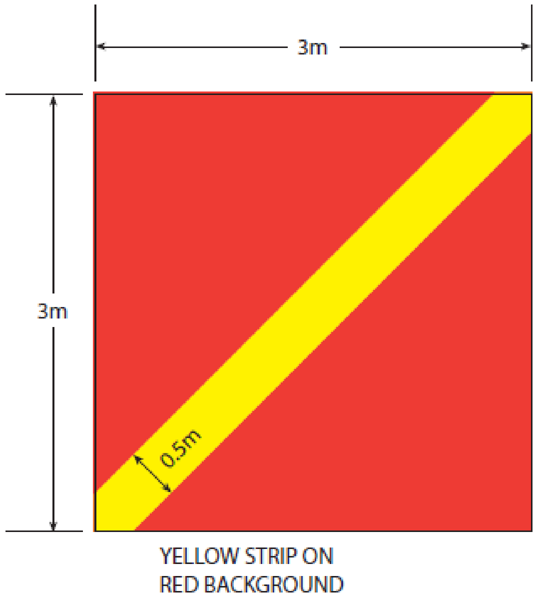
Figure 7.4 Right-hand circuit



7.17 A red panel of 3m square when displayed in conjunction with yellow diagonal stripes has the following meaning:

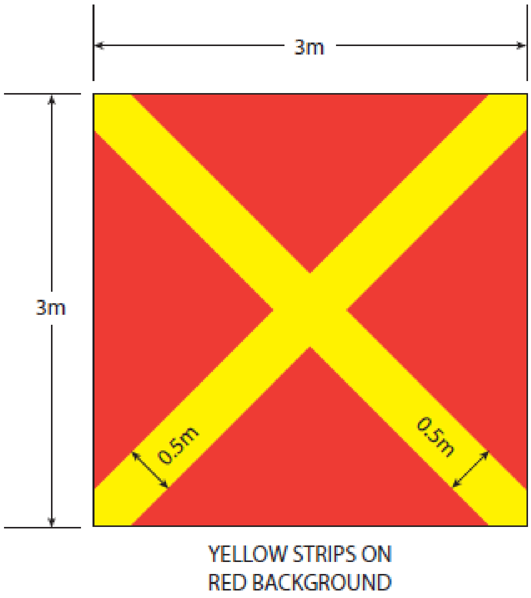
1. a yellow diagonal stripe at least 0.5m wide as shown in figure 7.5 signifies that the state of the maneuvering area is poor and pilots must exercise special care when landing.

Figure 7.5 State of maneuvering area



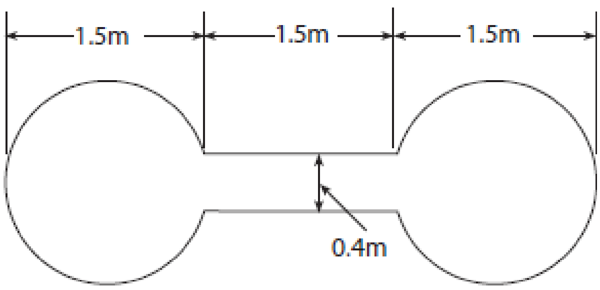
2. yellow stripes at least 0.5m wide along each diagonal as shown in Figure 7.6 signify that the aerodrome is unsafe for the movement of aircraft and that landing is prohibited.

Figure 7.6 Aerodrome unsafe



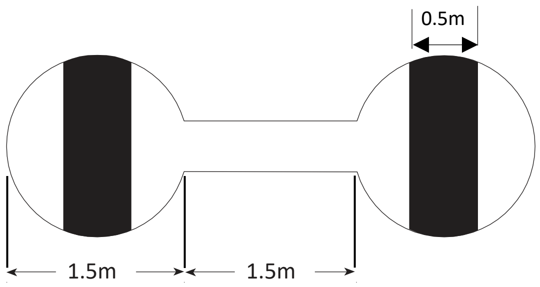
7.18 A white dumbbell as shown at figure 7.7 signifies that movements of aeroplanes and gliders on the ground shall be confined to paved, metalled or similar hard surfaces.

Figure 7.7 Restricted ground movement



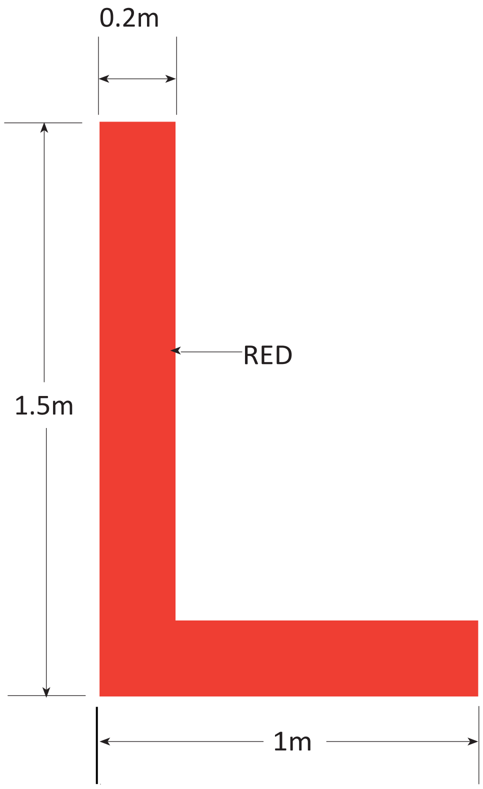
7.19 A black stripe as shown at figure 7.8 of 0.6m width, placed across each disc of the dumbbell at right angles to its shaft signifies that aeroplanes and gliders taking off or landing shall do so on a runway but that movement on the ground is not confined to paved, metalled or similar hard surfaces.

Figure 7.8 Unrestricted ground movement



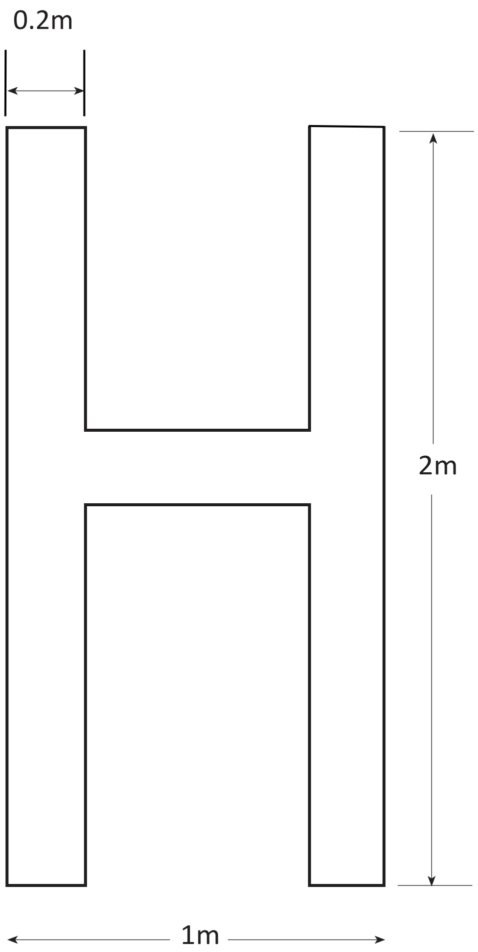
7.20 A red letter L as shown in figure 7.9 displayed on the dumb-bell signifies that light aircraft are permitted to take off and land either on a runway or on the area designated by the marking specified in paragraph 7.118.

Figure 7.9 Designated light aircraft operating area



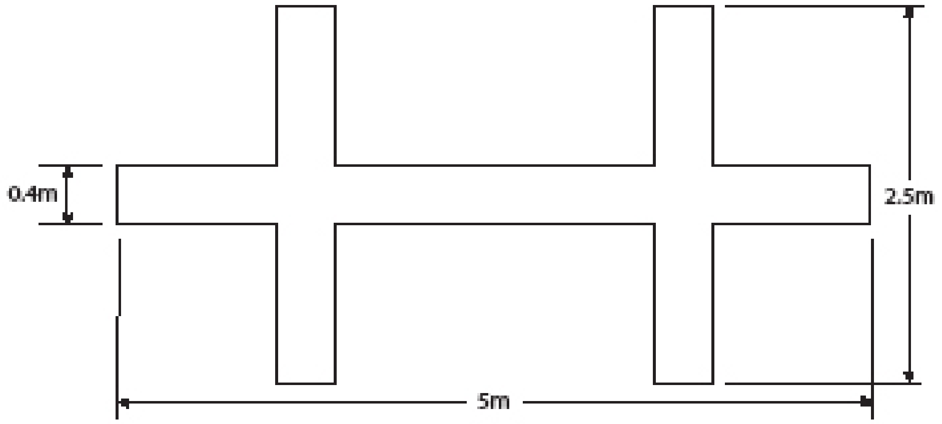
7.21 A white letter H as shown in figure 7.10 signifies that helicopter shall take off and land only within the area designated by the marking specified in paragraph 7.117.

Figure 7.10 Helicopter landing area



7.22 A white double cross as shown at figure 7.11 signifies that glider flying is in progress.

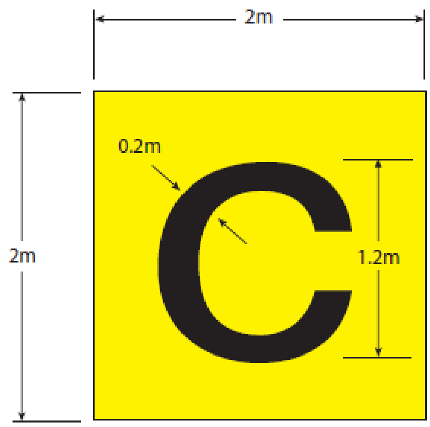
Figure 7.11 Glider flying in progress



Signals visible from the ground

7.23 A black letter C against a yellow background as shown at figure 7.12 indicates the place at which a pilot can report to the air traffic control unit or to the person in charge of the aerodrome.

Figure 7.12 Reporting point



7.24 Black arabic numerals in two-figure groups and, where parallel runways are provided the letter or letters L (left), LC (left centre), RC (right centre) and R (right), placed against a yellow background, indicate the direction for take-off or the runway in use.

7.25 A checkered flag or board 1.2 m by 0.9 m containing 12 equal squares, 4 horizontally and 3 vertical coloured red and yellow alternately, signifies that aircraft may move on the maneuvering area and in accordance with the permission of the air traffic control unit at the aerodrome.

7.26 A black ball 0.6 m in diameter suspended from a mast signifies that the directions of take-off and landing not necessarily the same.

7.27 Two red balls each 0.6 m in diameter, disposed vertically one above the other, 0.6m apart and suspended from a mast, signify that glider flying is in progress at the aerodrome.

7.28 A rectangular green flag of not less than 0.6 m side flown from a mast indicates that a right-hand circuit is in force.

Taxi guidance signs

7.29 Taxi guidance signs are divided into two categories, namely mandatory signs and information sign.

7.30 Variable message signs as specified in annex 14 Volume 1 paragraph 5.4 are not currently permitted in the UK.

Mandatory signs

7.31 The following mandatory signs should be provided on the maneuvering area of an aerodrome in o identify by a sign any location beyond which an aircraft or vehicle should not proceed unless auth ATC. Mandatory signs display white characters on a red background. Except for the provisions of para 7.36 below, Mandatory signs should not be accompanied by information signs.

7.32 Internally lit mandatory signs should be provided with an alternative power source in accordance requirements of chapter 6.

Runway taxi-holding position signs

7.33 Runway taxi-holding position signs identify the designated taxi-holding position (as determined in accordance with chapter 3) associated with a particular runway and consist of the runway designation white on a red background as illustrated at figure 7.13. Figure 7.14 illustrates some typical runway holding position sign layouts. The number of signs required at each runway taxi-holding position is described at paragraph 7.78.

7.34 Where the runway is equipped with ILS, the runway taxi-holding position should be established at of the critical/sensitive area in order to protect the ILS when in use. The signs associated with ILS runway taxi-holding positions should be annotated CAT I, CAT II, CAT III, CAT II/III or CAT I/II/III as appropriate illustrated in figure 7.13 (b), (c), (d) and (e) except that where the non-instrument runway taxi-hold and the CAT I runway taxi-holding position are collocated, the CAT I annotation is not used (see fig 7.13 (a)). Where the ILS Runway Taxi-Holding Position is at such a distance from the runway that it would hinder the expeditious flow of traffic in VMC, a non-instrument Runway Taxi-Holding Position should also be established closer to the runway as illustrated in Figure 7.14 (e), (f) and (g).

7.35 Where a runway is served by more than one taxiway, the runway taxi-holding position sign should accompanied by a taxiway location sign (described at paragraph 7.44) In order to assist in identifying the holding position, as illustrated at Figure 7.14 (b), (c) and (d). The Taxiway Location Sign should be positioned outboard of the Runway Taxi-Holding Position Sign.

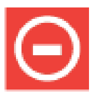
7.36 At aerodromes where no ATC service is provided, non-instrument Taxi-Holding Position Signs should be used to identify the position where aircraft and vehicles are required to stop and hold when conceding right of way prior to entering or crossing a runway.

7.37 A runway exit sign shall be provided where there is an operational need to identify a runway exit.

7.38 A runway exit sign shall be located on the same side of the runway as the exit is located (i.e. left or right).

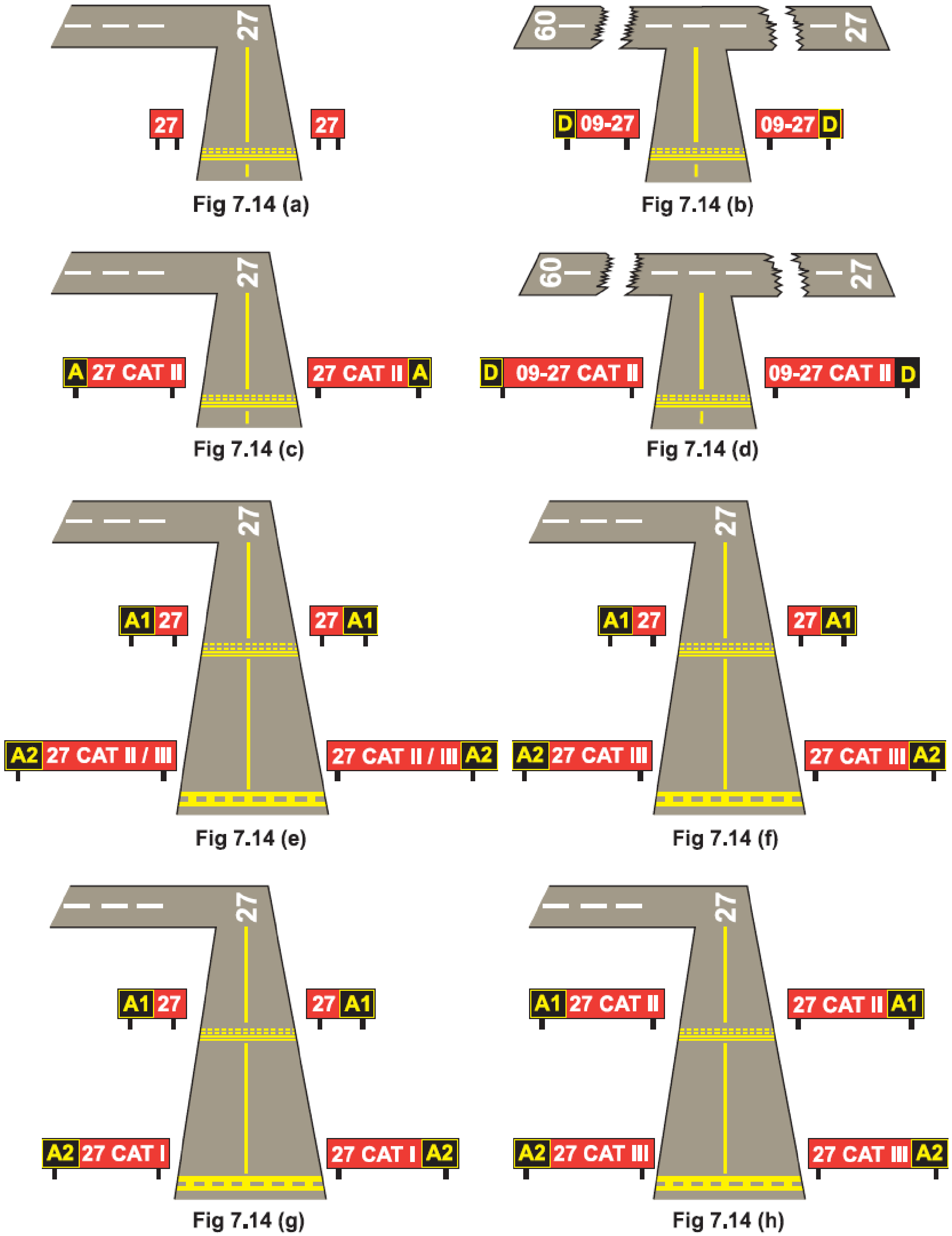
7.39 A runway exit sign shall be located prior to the runway exit point in line with a position at least 60 m prior to the point of tangency where the code number is 3 or 4, and at least 30 m where the code number is 1 or 2.

Figure 7.13 Mandatory Signs for Aircraft Surface Movements

(a)	**Visual Runway Taxi-Holding Position Sign** – denotes the Visual Taxi-Holding Position and also the ILS CAT I Holding Position where the Visual and CAT I holding positions are co-located.	(i) (ii)	27 09–27
(b)	**CAT I Runway Taxi-Holding Position Sign** – denotes the ILS CAT I Taxi-Holding Position only where a Visual Taxi-Holding Position is established closer to the runway in order to expedite traffic flow.	(i) (ii)	27 CAT I 09–27 CAT I
(c)	**CAT II Runway Taxi-Holding Position Sign** – marks the ILS CAT II Taxi-Holding Position – a visual Taxi-Holding Position may be established closer to the runway where it is necessary to expedite traffic flow.	(i) (ii)	27 CAT II 09–27 CAT II
(d)	**CAT III Runway Taxi-Holding Position Sign** – marks the ILS CAT III Taxi-Holding Position – a CAT II Taxi-Holding Position and a Visual Taxi-Holding Position may be established closer to the runway where it is necessary to expedite traffic flow.	(i) (ii)	27 CAT III 09–27 CAT III
(e)	**Combined Runway Taxi-Holding Position Sign** – marks the Taxi-Holding Position where the ILS Taxi-Holding Positions are co-incident. A Visual Taxi-Holding Position Sign may be established closer to the runway when it is necessary to expedite traffic flow.	(i) (ii)	27 CAT II/III 27 CAT I/II/III 09–27 CAT II/III
(f)	**Intermediate Taxi-Holding Position Sign** – marks a holding position established to protect a priority route.		B2
(g)	**No Entry Sign**		

Note:
1. The signs at (i) should be used where the taxiway is in the vicinity of one extremity of a runway and the taxiway normally serves only the runway direction concerned. The signs at (ii) should be used where the taxiway normally serves both runway directions.
2. Where a runway Taxi-Holding Position serves more than one runway, the sign layout at Fig 7.18 should be used.
3. Sign dimensions are given in Appendix 7A.
4. Mandatory signs may also be provided as markings if required.

Figure 7.14 Typical runway taxi-holding position signs and associated taxiway marking



The diagrams illustrate typical signs associated with various runway taxi-holding positions on taxiway ‘A’ leading to the threshold of runway 27 and on taxiway’ leading to an intermediate taxiway entrance to runway 09-27.

Note 1: The signs at intermediate taxiway entrances as shown at figures 7.14 (b) and (d) above are handed to show a left turn is required to reach the threshold of runway 09 and a right turn to reach the threshold of runway 27.

Note 2: At grass aerodromes the runway taxi-holding position sign, which marks that point beyond which aircraft should not proceed without the approval of ATC, should be sited no closer to the runway centreline than the distances specified in table 3.3.

Intermediate taxi-holding position signs

7.38 Where it is considered necessary to locate taxi-holding positions other than at runway/taxiway intersections – for example at taxiway/taxiway intersections in order to protect a priority route – the holding position should be identified by a single sign located wherever practicable on the left side of the taxiway. The sign consists of a combination of the letter designating the taxiway and a number identifying the hold position e.g. A1, A2, B2 etc. in white on a red background. An example of an intermediate taxi-holding position sign is shown at figure 7.13 (F).

No entry signs

Where part of an aerodrome is restricted to one-way traffic or is withdrawn from use, no entry signs, as illustrated at figure 7.13 (g), should be located on both sides of the mouth of the area showing in the direction from which entry is prohibited.

Information signs

7.39 The following information signs should be provided where there is an operational need to provide additional guidance to pilots maneuvering aircraft on the ground.

Taxiway location signs

7.40 Taxiway location signs should be used to identify individual taxiways.

7.41 All in-use taxiways should be designated by a letter of the alphabet alpha, bravo, charlie, etc. - However, the letters oscar, india and x-ray are not used. The use of numbers alone on the maneuvering area shall be reserved for the designation of runways. As far as possible the allocation of designation letters should follow a logical pattern eliminating the possibility for confusion. Where there are more taxiways than letters of the alphabet, double letters should be used to designate short taxiway stubs between a runway and parallel taxiway or between a taxiway and adjacent apron. An example of a taxiway layout is shown at figure 7.15.

7.42 Taxiway Location Signs bear the taxiway designation letter in yellow on a black background surrounded by a yellow border, as illustrated at Figure 7.16 (a)(i).

7.43 Taxiway location signs should be positioned at the approach to a taxiway intersection.

7.44 At a complicated intersection, taxiway location signs should also be located at each exit from the intersection in order to provide confirmation that the correct route is being followed. They may also be placed at intermediate positions along a very long taxiway. Examples of the layout of taxiway location signs at different types of intersection are shown at figure 7.17.

7.45 Where a taxiway location sign is collocated with a runway taxi-holding position sign, as described at paragraph 7.36, The character identifying the taxiway should be accompanied by an arabic numeral as illustrated at figures 7.14 (e), (f), (g) and (h) and 7.16 (a) (ii) in order to identify individual taxi-holding positions.

Taxiway ending sign

7.46 Where a taxiway ends at an intersection other than an intersection with a runway, a yellow diagonal marker is overlaid on the appropriate taxiway location sign as shown in figure 7.16 (G).

Figure 7.15 Example: designating taxiway

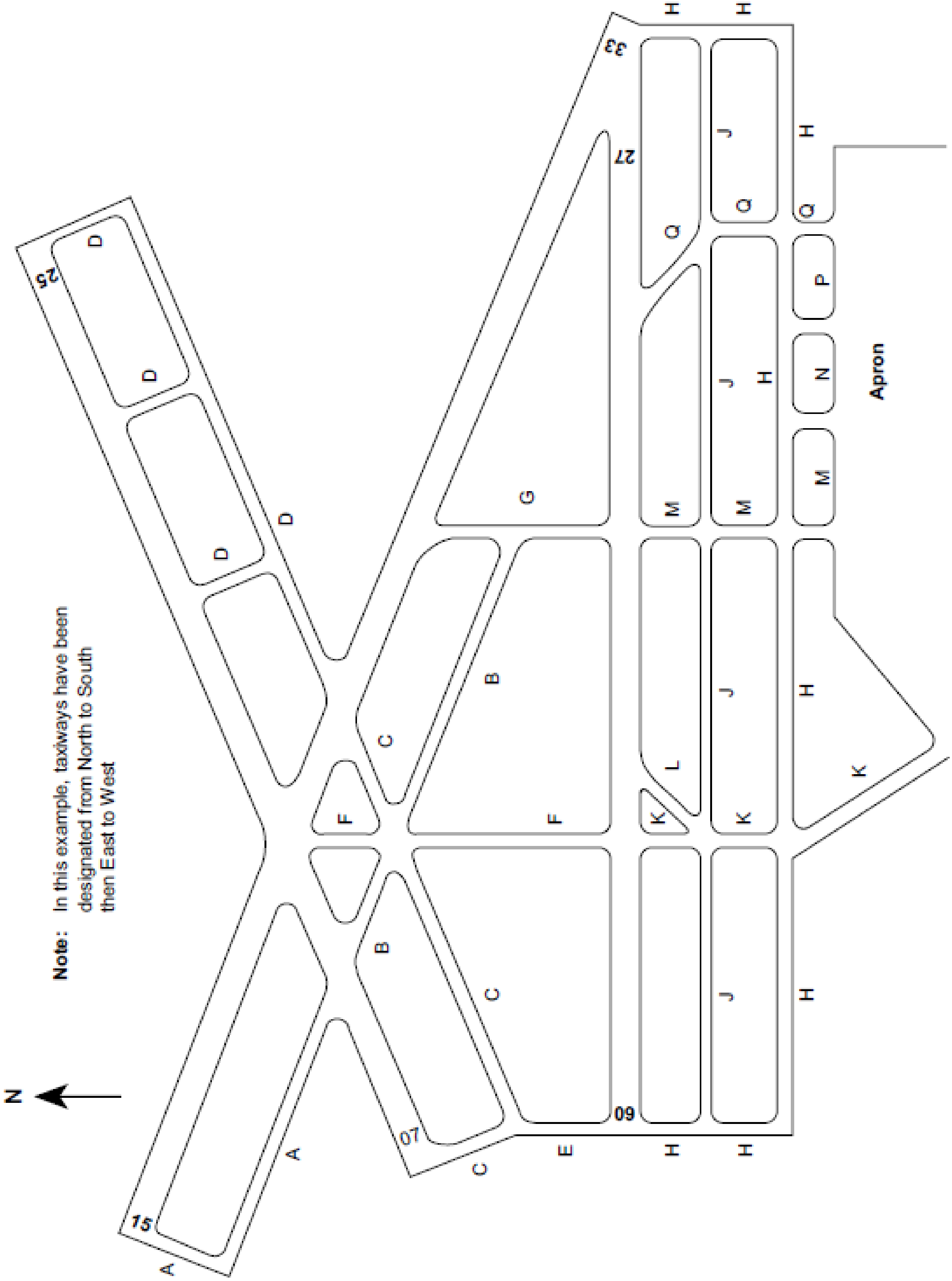


Figure 7.16 Examples of information signs

(i) (ii) (a) Taxiway location signs

(b) Runway location sign

(c) Direction sign

(d) Runway destination sign

(e) Destination sign to different runways

Note the use of a hyphen to separate reciprocal designators and the use of a dot to separate other designators

(f) Inbound destination sign

(g) Taxiway ending sign

Runway location sign

7.47 Where runways intersect and the possibility of confusion could arise, runway location signs should be placed at the edge of a runway as shown in figure 7.19. These signs stand independently of other signs and bear the runway designation in yellow on a black background surrounded by a yellow border as shown at figure 7.16 (B).

Runway intersection take-off sign

7.48 An intersection take-off sign should be provided when there is an operational need to indicate the remaining take-off run available (TORA) for intersection take-offs.

Runway vacated sign

7.49 Where it is considered necessary for pilots to report runway vacated, a taxiway location sign as illustrated at figure 7.16 (a) should be used to indicate to the pilot the position at which the report should be made. The sign would normally be located on the reverse side of ILS runway taxi-holding position sign or at the edge of the cleared and graded area for non-instrument runways and correspond in designation with the taxiway location sign identifying the runway taxi-holding position.

Direction signs

7.50 Direction signs located at the approach to a taxiway intersection indicate the direction of taxiways leading out of that intersection. These signs bear the letter designating each taxiway leading out of the intersection along with an arrow oriented to illustrate the direction and degree of the turn. The designation letter and the arrow are black on a yellow background as shown at figure 7.16 (c). Direction signs should be accompanied by a taxiway location sign. However, an individual direction sign may be located adjacent to a runway edge in order to indicate a particular runway exit point. Examples of the layout of signs at taxiway intersections are shown at figure 7.18.

Destination signs

7.51 Destination signs such as those illustrated at figure 7.16 (d), (e) and (f) should be used where it is determined that the combination of location and direction signs would not provide adequate guidance to a destination. Destination signs should not be accompanied by location or direction signs. Common abbreviations used for inbound destinations are:

APRON	general parking, servicing and loading areas
GEN AV	general aviation
STANDS	aircraft stands
FUEL	areas where aircraft are fuelled or serviced
TERM	gate positions at which aircraft are loaded or unloaded
CIVIL	areas set aside for civil aircraft
MIL	areas set aside for military aircraft
PAX	areas set aside for passenger handling
CARGO	areas set aside for cargo handling
INTL	areas set aside for handling international flights
HELI	helicopter parking

Apron signs

7.52 Stand identification signs (also known as stand number indicator boards) should be provided where practicable, to identify the aircraft parking stand from the taxiway centreline. Such signs should be clearly visible from the cockpit of an aircraft prior to entering the aircraft stand.

7.53 Apron stand designators should not be the same as taxiway designators.

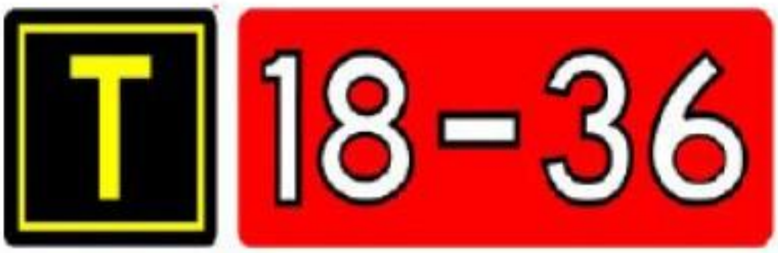
Character size, spacing and style

7.54 The character size to be used for letters and numbers is determined by the type of operation that the sign is intended to support and is prescribed at table 7.1. Where a taxiway location sign is located jointly with a mandatory sign, as described at paragraph 7.35, the character size shall be that of the mandatory sign and where an information sign contains 10 or more characters, 0.2m characters may be used in the manner illustrated at appendix 7a, figure 7a.9.

7.55 Where the conspicuity of the inscription on a mandatory instruction sign needs to be enhanced, the outside edge of the white inscription may be supplemented by a black outline. The black outline should be 10mm in width for runway code letters 1 and 2, and 20 mm in width for runway code letters 3 and 4, as shown in figure 7.17.

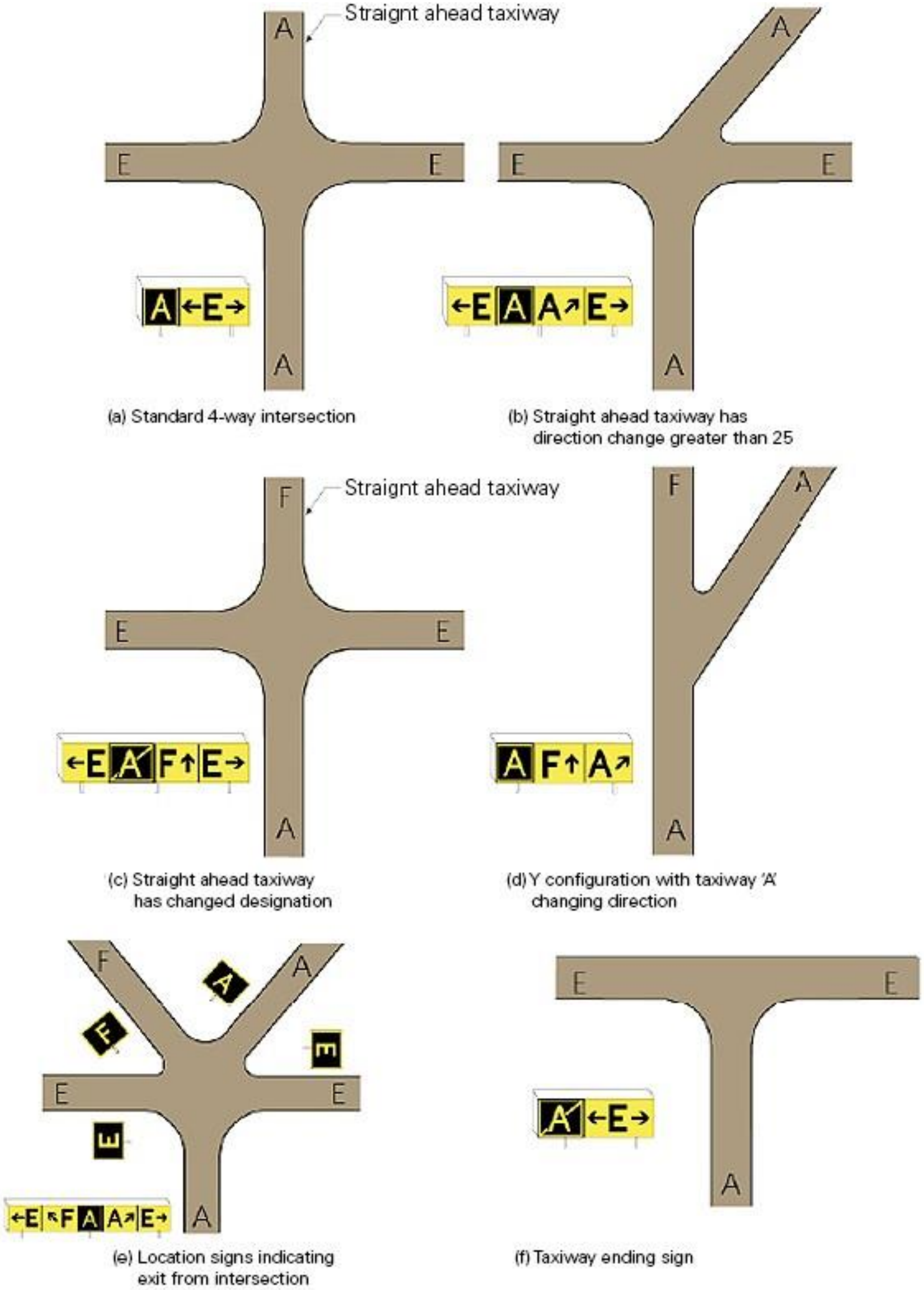
Figure 7.17 Enhanced mandatory instruction sign

Example of sign face



Example of unlighted sign face

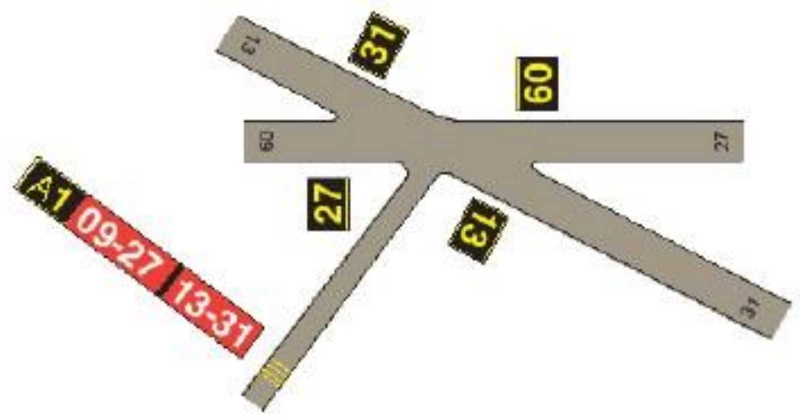
Figure 7.18 Examples of taxi guidance signs at taxiway intersections



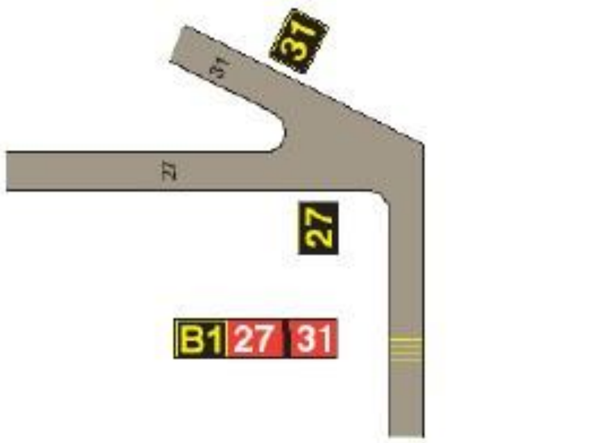
Notes:

1. Signs are laid out as shown above, i.e. From left to right in a clockwise manner. Left turn signs are on the left of the taxiway location sign, right turn signs on the right, except in situations corresponding to (a) and (f) above where the double arrow direction sign is inboard of the taxiway location sign. Adjacent signs are separated by a black vertical delineator.
2. Double arrow direction signs are used only at simple intersections such as those illustrated at figure (a) and (f) above.

Figure 7.19 Examples of use of runway location signs and signs at runway taxi-holding positions serving more than one runway



(a) Taxiway entrance at intersection to two runways



(b) Taxiway entrance at intersection of two runway ends

Notes:

1. Taxi-holding position signs installed at intersections such as those illustrated above are used in the manner shown.
2. Runway location signs for runways 31 and 13 are positioned in this example on the right side of the runway in order to avoid confusion.

Table 7.1 Signs character size

Operations conducted in RVR of	Character size			
	Mandatory signs		Information signs	
	Height mm	Stroke width mm	Height mm	Stroke width mm
800m or more	300	48	200	32
< 800m	400	64	300	48

7.56 The character size to be used for other characters is as follows:

1. DOTS – Where a dot is employed on a sign such as that illustrated in figure 7.16 (e), the diameter of the dot shall be equal to the stroke width of the other characters employed, as illustrated in appendix 7A, figure 7A.6.
2. HYPHENS – Where a hyphen is employed on a sign such as that illustrated at figure 7.13 (a), (b), (c), (d) and (e) it shall have the same stroke width as the other characters employed but the length shall be equal to 1/3 of the height of the other characters, as illustrated in appendix 7A, figure 7A.6.
3. ARROWS – Where an arrow is employed on a direction or destination sign, it shall have the same stroke width and height of the other characters employed. The style and proportions of the arrow shall conform to the detail in appendix 7A, figure 7.A.6.
4. DIAGONAL LINES
   a) Where diagonal lines are used to separate symbols such as cat II/III they shall be of the same stroke width and height as other characters used. Overall size and proportions are shown at appendix 7A, figure 7A.6.
   b) Where diagonal lines are used on taxiway ending signs, as illustrated at figure 7.16 (g), the stroke width of the diagonal shall be equal to 3/4 of the stroke width of the character. The size of the break between the diagonal and the character should be approximately 1/2 the character stroke width.

7.57 The space between individual characters making up a sign shall be determined as outlined at appendix 7A, table 7A–1.

7.58 The style and proportions of characters used shall be those given at appendix 7A.

7.59 Roman numerals as illustrated at appendix 7A, figure 7A.6 shall be used on category I, II and III signs.

Face size

7.60 The face size of taxi guidance signs shall conform to the proportions and layout as illustrated at appendix 7A, figure 7A.1.

Borders and delineators

7.61 Signs having a black background shall be provided with a yellow border, as shown in figure 7.16 (a), (b) and (g), equal in width to 1/2 of the character stroke employed.

Otherwise no provision is made for borders. The yellow border shall be included in the overall dimensions of the face size described at paragraph 7.60.

7.62 Where signs of the same background colour are joined together (or where a sign with a yellow border adjoins a sign with a yellow background) the signs shall be separated by a black vertical delineator as illustrated in figures 7.18 and 7.19. The black vertical delineator separating adjoining signs shall have a width of three quarters of the width of the character stroke employed but shall not reduce the overall visible face size.

Illumination of signs

7.63 The minimum levels of average luminance for lit signs used in support of operations conducted in RVR less than 800 m day or night are listed at table 7.2. Facility should be provided to increase these levels by a factor of up to 2 where a sign is located in an area where the background luminance at night exceeds 200 cd/m^2. The method of calculating average sign luminance is described at paragraph 7.74.

7.64 All signs (including yellow borders required by paragraph 7.61) used in support of operations in RVR less than 800 m day or night should be internally lit, except that where only departures take place in such conditions or where aircraft movements are restricted to one at a time in the manner prescribed in chapter 6, signs may be externally lit in the manner prescribed in paragraph 6.8.

7.65 Signs used in support of operations in RVR of 800 m or greater at night should be illuminated as follows:

1. Where operations are conducted in RVR 800 – 1500m at night, signs may be either internally or externally lit. Where signs are externally lit they should be provided with a dedicated source of light which conforms to the following requirements:
    - a) only white light shall be used and the light source shall be shielded so as to avoid dazzle or glare to pilots using adjacent areas;
    - b) the light source shall be so positioned that it provides an even distribution of light over the whole sign face without any unwanted reflection of the light source;
    - c) the light source, including any shielding and support equipment, shall be so positioned that no part of the face of the sign is obscured from the view of those for whom the sign is intended.
2. Where operations are conducted at night but only when the visibility is 1500 m or greater, signs need not be provided with a dedicated source of light provided that the sign face is manufactured from materials that conform to the colour code prescribed in this section for Taxi Guidance Signs and have photometric qualities equal to or better than those prescribed at BS873 Part 6 table 1. The chromaticity co-ordinates for such materials are prescribed at BS873 Part 6 table 4.

Table 7.2 Minimum average sign luminance (signs used in support of operation rvr less than 800 m)

Colour	Luminance cd/m^2
Red	30
Yellow	150
White	300
Green	45

Notes:

1. The method of calculating average sign luminance is described at Figure 7.22. The Red luminance value should be between 10% and 20% of that of the White.
2. The average luminance level should not exceed three times the minimum average.

7.66 The colour specification for signs is prescribed at Figure 7.20 (internally lit) and Figure 7.21 (externally lit).

Figure 7.20 Colours of luminescent or transilluminated (internally illuminated) signs and panels

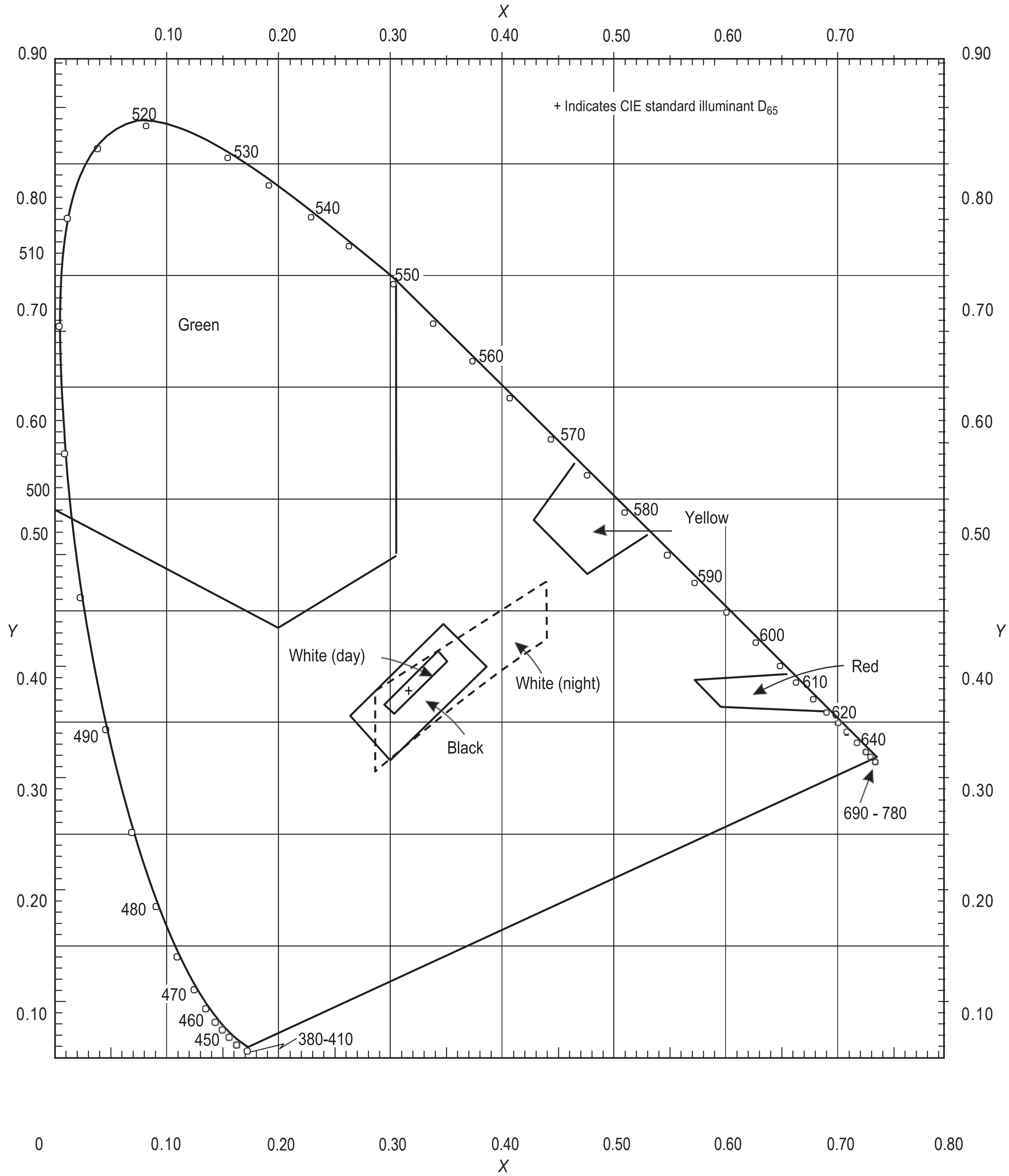
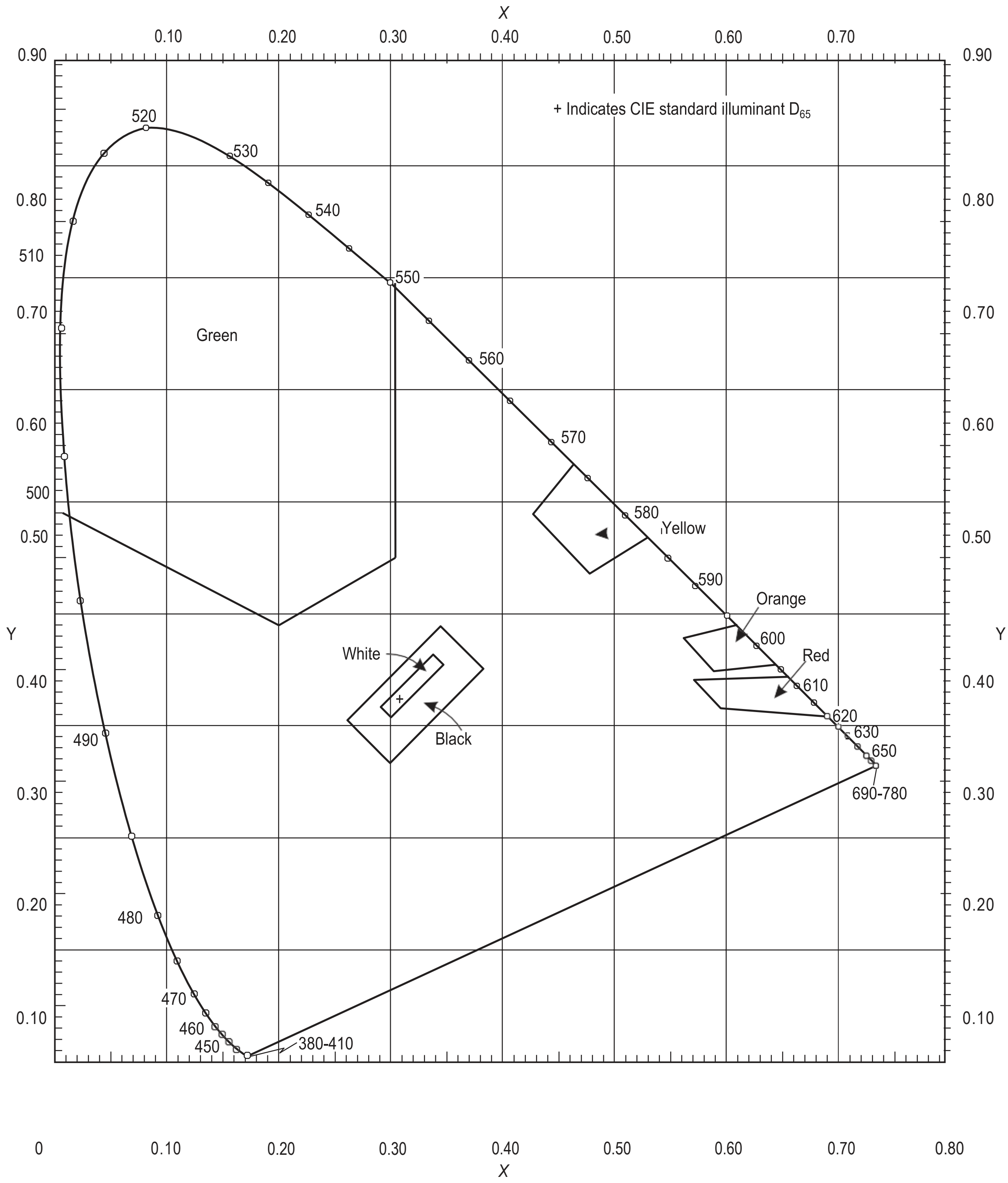


Figure 7.21 Colours for surface markings and externally lit signs



7.67 All lighted signs shall be equipped with a suitable disconnect plug so designed as to ensure that in the event that the sign is torn from its base, the power source is safely isolated.

7.68 Power for the illumination of internally lit signs may be provided from adjacent constant current series circuits if the required electrical capacity is available. This type of installation may provide the selection of different luminous intensity settings; however, care must be taken to ensure that the signs are lit at all required times of operation. In this case, the luminous intensity settings should correspond to that of taxiway centreline and stop-bars as indicated in chapter 6 tables 6.3 and 6.4. Care should also be taken to ensure that the constant current power supply is not adversely affected by the additional (and electrically different) load created by signage and that the illumination requirements are met.

Construction

7.69 Taxi guidance signs shall be frangible but nevertheless capable of withstanding wind loads of up to 60 m/sec (a suitable means of test is described at BS 3224 Part 1 paragraph 5.3.2) without sustaining damage. Where a sign or series of collocated signs is so constructed that part of the supporting or retaining structure appears as a frame surrounding the face, the size of the sign should be adjusted where necessary in order to ensure that the frame does not cover any part of the face and that the requirements of paragraph 7.61 are met. Signs constructed in this manner should not display a frame to the face of the sign greater than 45 mm in width; the colour of this frame should be black.

7.70 Where a number of signs are collocated, for example at a taxiway intersection or at a taxi-holding position, the signs should be secured in a single common structure with black vertical delineators outlining the extent of each sign as described at paragraph 7.62.

7.71 Where individual signs are made up of adjoining single character plates held together in a common frame, care must be taken to ensure that the method of construction does not lead to degradation of legibility at night either by light leakage between adjacent plates or by blanking caused by the location of frame members designed to hold the plates in place. Upright frame members designed to secure single character plates on the same sign should, where visible on the sign face, display the same colour as the sign background. Signs constructed in this manner must conform to the character spacing requirements at paragraph 7.56.

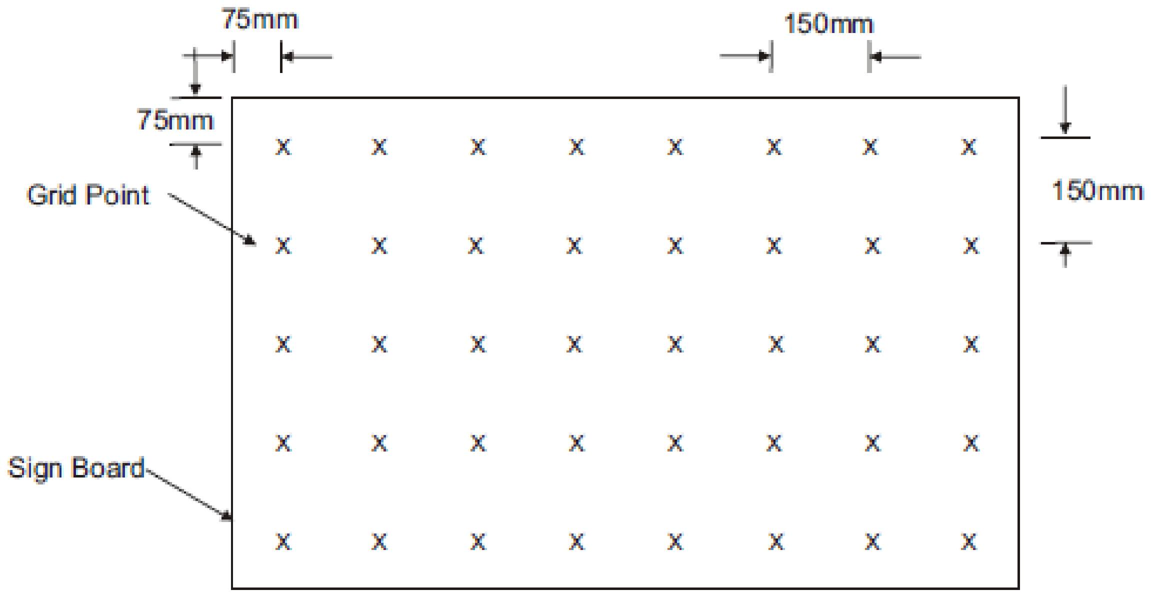
7.72 Except where signs are mounted back to back, the rear of a sign constructed in the form of a box should comply with the requirements in chapter 4 and for marking fixed obstacles. Normally a single conspicuous colour, preferably orange or yellow, will suffice.

7.73 Sign faces should be made of materials that can withstand sustained temperatures within the range –40 to +55 degrees Celsius, relative humidity from 10 to 90% and altitudes of up to 2000 m without detriment to performance or durability. The material chosen should not be capable of reflecting external light to the extent that the readability of the sign is adversely affected.

7.74 In order to determine conformance with the requirements of paragraphs 7.63 to 7.68, the average luminance of a sign should be calculated in the following manner:

1. Starting at the top left corner of the sign face establish a reference grid point at 75 mm from both the left edge and the top of the sign f a c e .
2. Construct a grid pattern as illustrated in figure 7.22 based on the reference grid point established at paragraph 7.73 1., ensuring that the rows of grid points are correctly aligned parallel to both the top and left edge of the sign face. Where the edge of the sign is between 225 mm and 150 mm away from the last grid point, add a further row and/or column 75 mm away from the edge of the 150 mm grid.
3. Measure the luminance levels at each grid point established in paragraphs 1 and 2, ensuring that the area used for each individual measurement does not exceed that prescribed by a circle of diameter 30 mm centred on the grid point.
4. For mandatory signs and taxiway location signs, the luminance value of the character should be measured at a minimum of 5 well-spaced points within each character and these values used to compute the average luminance for white or yellow characters.
5. In calculating average luminance and inspecting for uniformity, the luminance value measured on any character should be deleted from the calculation. Grid points within 75 mm of the edge of the sign should be excluded from the calculation. The ratio between points 75 mm apart should not exceed 1.25 to 1. In order to achieve uniformity of signal, the luminance value should not exceed a ratio of 1.5 to 1 between adjacent grid points and 5 to 1 between the maximum and minimum values over the whole face.
6. Measurements made for compliance with the sign colour specifications should be made at the same grid points and over the same areas as specified at paragraph 7.73, sub-paragraphs 1 to 3.
7. Where a curved-faced sign is submitted for evaluation the surface should be assumed to be flat and the grid formatted in the same manner described above.
8. Throughout the test, the intended lamp type and power supply shall be used. Where different lamp types are available, each option shall be tested. Similarly, where different power supply options are available, the sign shall be tested with each power supply type. The provision of power for the test shall take into consideration the power factor and loading that may be typically encountered at an aerodrome installation. Any combination of lamp and power supply type for a sign that fails to conform to the illumination requirements shall be reported to the CAA and not be used at a licensed aerodrome.
9. Where two or more modules are housed in a single sign box, each module should be evaluated as a separate sign face. The ratio between the average luminance level of modules of the same colour and type should not exceed 1.5 to 1

Figure 7.22 Means of calculating average luminance of a sign



Siting

10. Taxi guidance signs should be sited so as to comply with the criteria laid down in chapter 3. They should normally be positioned at right angles to the runway or taxiway centreline but may be toed-in where appropriate in order to provide for maximum legibility e.g. where signs are located on or close to a bend in the taxiway.
11. Runway taxi-holding position signs installed in support of operations in RVR less than 1500 m should be sited on both sides of the taxiway as illustrated in figure 7.14. Where a runway is used only in visibility conditions of 1500m or greater the Runway taxi-holding position may be identified by a single Runway taxi-holding position sign located wherever practicable on the left side of the taxiway.
12. Mandatory signs should be located in line with the surface marking used to define the associated Holding Position described in this chapter.
13. Information signs should be located, whenever practicable, on the left side of a taxiway or runway and so positioned as to give adequate time for a pilot to make use of the information provided.

Markings

General

7.73 Markings provide perspective information, alignment guidance, location, and runway and threshold identification.

7.74 Markings shall be white for runways and yellow for taxiways. Black outlining (at least 150 mm in width) should be provided where there is insufficient background contrast. Colour specifications for paved surface markings are detailed at Figure 7.21.

7.75 All markings on paved runways should have friction values not less than the friction assessment Minimum friction level for the surrounding runway. Markings on aprons and taxiways should be made with materials having similar wet friction qualities to those of the surrounding paved surfaces.

Markings on paved runways

7.76 Centreline marking should be provided on all paved runways and consists of lines 30 m apart throughout the length of the runway. At runway intersections, the marking of the major runway should be continued and that of the subsidiary runway should be interrupted. The dimensions of the marking are shown at table 7.3.

Table 7.3 Runway centreline and threshold markings – dimensions

	Runway C/L marking			Threshold marking									
Runway width m	**Length of and distance between each mark m**	**Width m**		**Number of stripes**		**Length of stripes m**	**Width of and distance between stripes m**		**Width of centre gap m**		**Character height m**		
						W	**X**		**Y**		**Z**		
		P	NP	P	NP		P	NP	P	NP	P	NP	
45	30	0.9	0.45	12	6	30	1.8	1.8	3.6	22.5	15	15	
30	30	0.9	0.45	8	6	30	1.8	0.9	3.6	20.0	15	12	
23	30	0.45	0.3	6	6	24	1.8	0.6	3.6	16.0	12	9	
18	30	0.45	0.3	4	4	24	1.8	0.3	3.6	15.0	12	9	

P = Precision Instrument approach runway

NP = Non-Precision instrument approach runway

7.77 Runway edge markings should be provided on all precision instrument approach runways and also on those other paved runways where there is insufficient contrast between the runway and the shoulders. Edge marking should also be provided where the declared or available runway width is less than the apparent total width e.g. the central 30m of a 45m runway and where runway edge lighting lies outside the declared width of the runway. Runway edge marking should consist of two parallel lines, one placed along each edge of the runway with the outer edge of each line marking the declared edge of the runway. The lines should be 0.9m wide where the runway is 30m or more in width and 0.45m wide on narrower runways. Edge markings should be interrupted at runway intersections. Where edge lights are located along the extremity of the declared runway width, the edge marking may be located inboard of the edge lights in order to avoid painting light fittings.

7.78 A runway designator comprising a two-figure group showing the magnetic heading to the nearest whole ten degrees, should be located at each threshold. In the case of parallel runways, a white letter (L – Left or R – Right) is added to the designator. The dimensions and patterns are shown at appendix 7B, figures 7B.1 and 7B.2. Examples of layout are shown at figure 7.23.

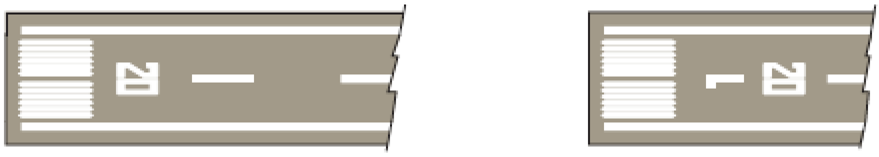
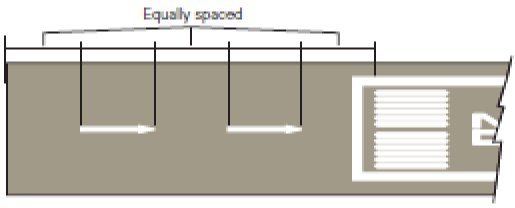
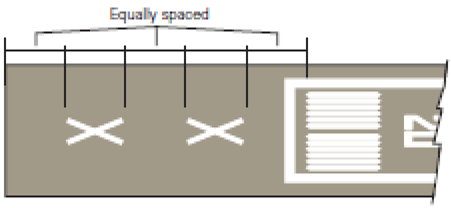
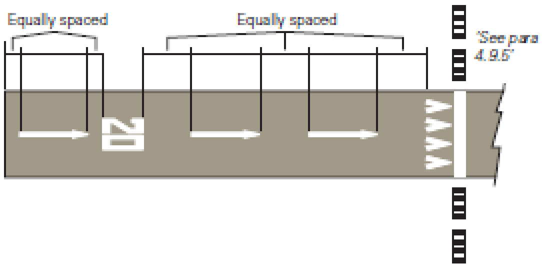
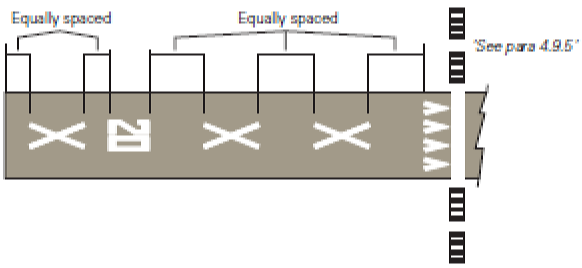
7.79 Runway threshold markings should be provided according to the status of the runway, as shown at figure 7.23. The dimensions of threshold markings are given in table 7.3.

7.80 Aiming Point (AP) and Touchdown Zone (TDZ) markings conforming to those illustrated at figure 7.24 and located at the positions detailed in figure 7.25 should be provided on all precision instrument approach runways and on those other runways where additional conspicuity of the touchdown zone is desirable. An Aiming Point marking should be provided on paved non-instrument runways where there is no visual approach slope guidance.

7.81 A temporarily displaced threshold should be marked as illustrated in figure 7.23.

7.82 Where a starter extension does not extend to the full length of the available pavement, the starter extension marking, as illustrated in figure 7.23(e) may be used.

Figure 7.23(a) Paved runway threshold markings

Type of threshold	Precision instrument approach runways
1	
2(i)	
2(ii)	
2(iii)	
3(i)	
3(ii)	

Key:

1 Not displaced.

2 Permanently displaced or temporarily displaced for more than six months.

(i) Pre-threshold area of runway fit for movement of aircraft.

(ii) Pre-threshold area of runway unfit for movement of aircraft and unsuitable as stopway.

(iii) Pre-threshold area of runway fit for use by aircraft as a stopway, but not for normal movement of aircraft.

3 Temporarily displaced for six months or less. (Runway designator is NOT moved.)

(i) Pre-threhold area of runway fit for movement of aircraft.

(ii) Pre-threshold area of runway unfit for movement of aircraft.

Note:

1 Overall dimensions are given at figure7.23(d).

Figure 7.23(b) Paved runway threshold markings

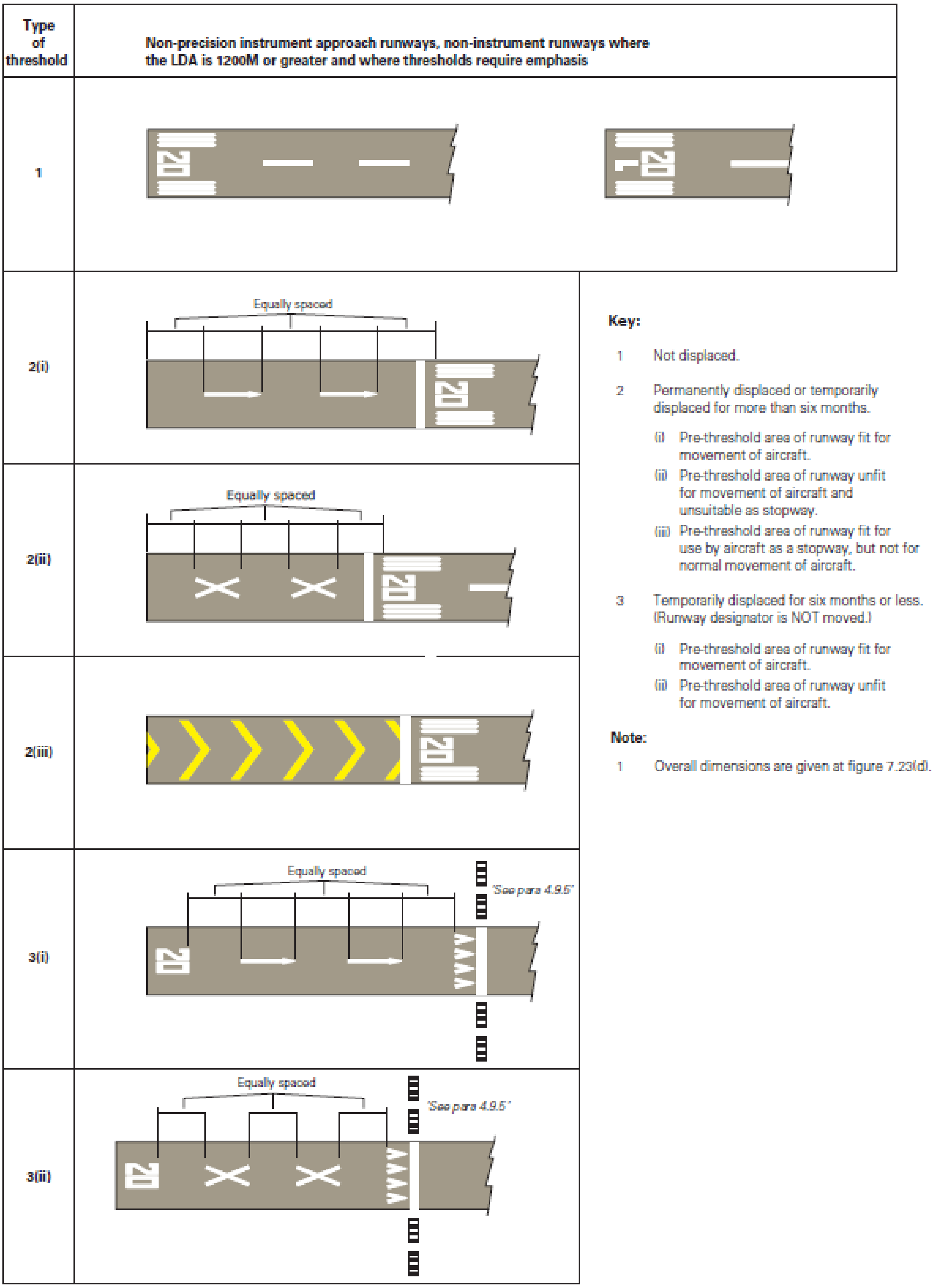
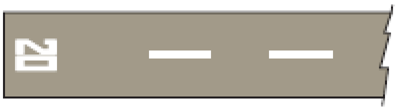
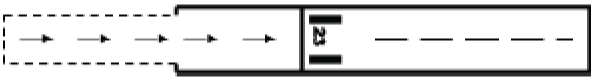
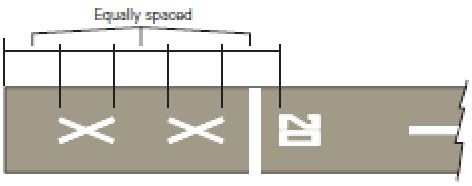
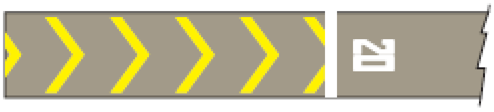
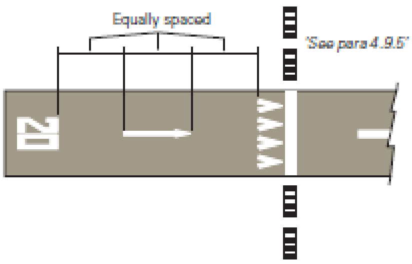
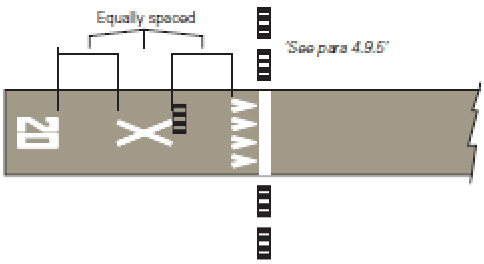


Figure 7.23(c) Paved runway threshold markings

Type of threshold	Non-instrument runways where the LDA is < 1200M
1	
2(i)	
2(ii)	
2(iii)	
3(i)	
3(ii)	

Key:

1 Not displaced.

2 Permanently displaced or temporarily displaced for more than six months.

(i) Pre-threshold area of runway fit for movement of aircraft.

(ii) Pre-threshold area of runway unfit for movement of aircraft and unsuitable as stopway.

(iii) Pre-threshold area of runway fit for use by aircraft as a stopway, but not for normal movement of aircraft.

3 Temporarily displaced for six months or less. (Runway designator is NOT moved.)

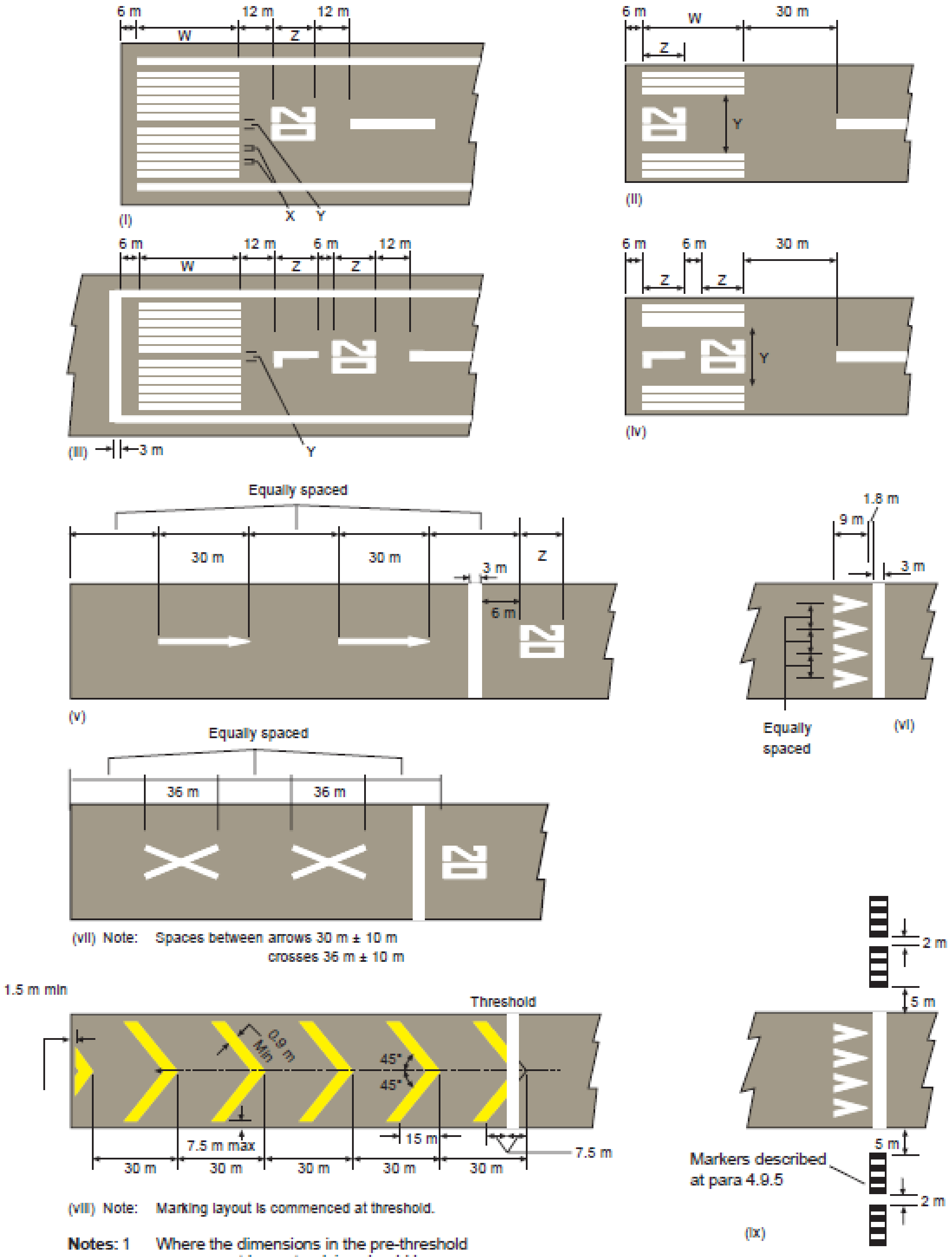
(i) Pre-threshold area of runway fit for movement of aircraft.

(ii) Pre-threshold area of runway unfit for movement of aircraft.

Note:

1 Overall dimensions are given at figure7.23(d).

Figure 7.23(d) Threshold markings dimensions



Notes: 1 Where the dimensions in the pre-threshold area cannot be met, advice should be sought from the CAA.

2 For dimensions W, X, Y & Z see table 7.3.

3 A threshold transverse stripe for a temporary displaced threshold may be reduced to 1.2 m in width.

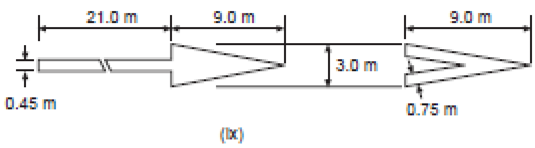


Figure 7.23(e) Starter extension markings

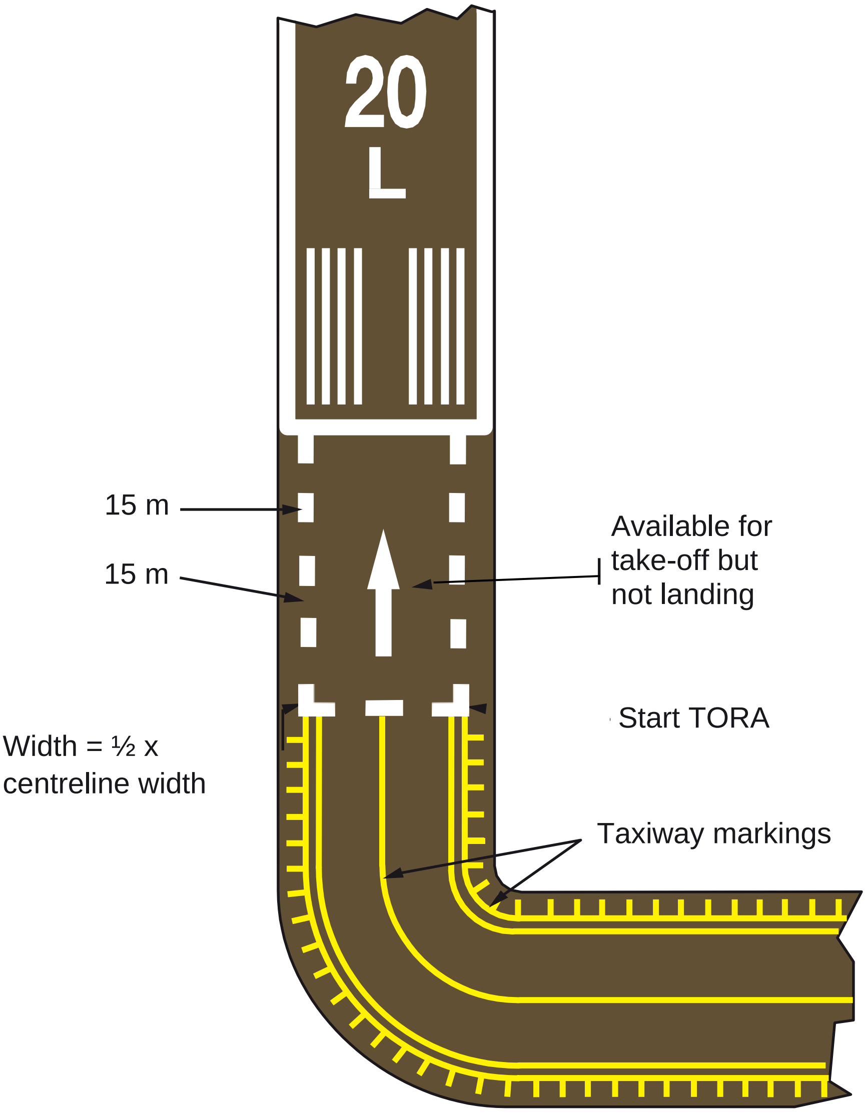


Figure 7.24 Aiming point and touchdown zone markings – dimensions

Location and dimensions	Landing distance available			
	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
(1)	(2)	(3)	(4)	(5)
Distance from threshold to beginning of marking (a)	150 m	250 m	300 m	400 m
Length of stripe (b)	30-45 m	30-45 m	45-60 m	45-60 m
Width of stripe	4 m	6 m	6-10 m (c)	6-10 m (c)
Lateral spacing between inner sides of stripes	6 m (d)	9 m (d)	18-22.5 m	18-22.5 m

(a) Where a PAPI system is provided for the runway, the beginning of the marking should be coincident with the visual approach slope origin.

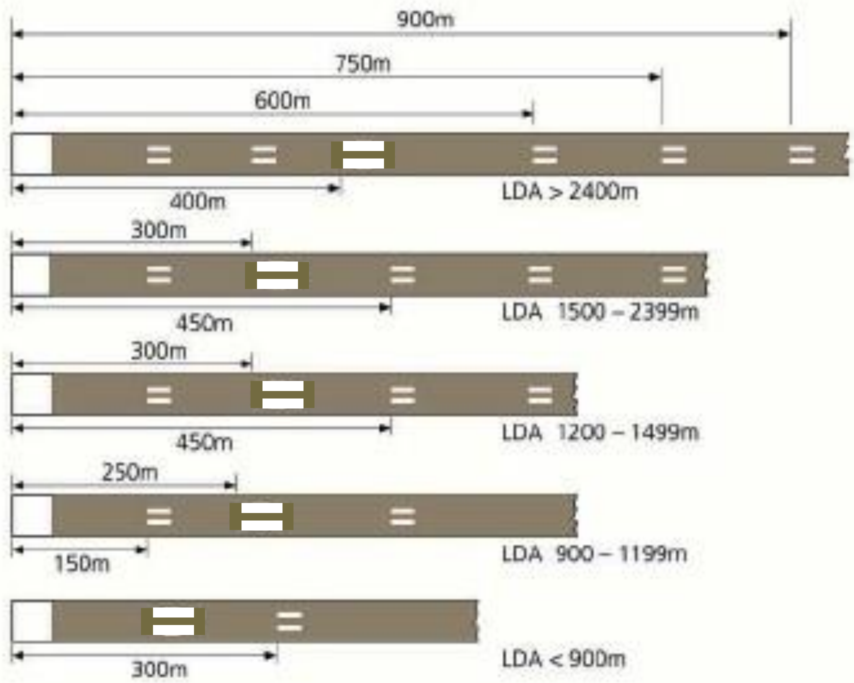
(b) Where greater dimensions of the specified ranges are intended to be used where increased conspicuity is required.

(c) Where lateral spacing may be varied within these limits to minimise the contamination of the marking by rubber deposits.

(d) These figures were deduced by reference to the outer main gear wheel span which is element 2 of the aerodrome reference code

Note: For runways in excess of 45 m, contact your aerodrome inspector.

Figure 7.25 Paved runways – location of touchdown zone and aiming point markers



Distance between Thresholds/ Declared LDA metres	Location of TDZ markers distance in metres from Threshold	Location of AP marker distance in metres from Threshold
> 2400	150, 300, 600, 750 and 900	400
1500 – 2399	150, 450, 600 and 750	300
1200 – 1499	150, 450 and 600	300
900 – 1199	150 and 450	250
<900	300	150

Notes:

1. Where the runway is served by an instrument approach at both ends, use distance between thresholds to determine the location of the TDZ markings. The distance between the last TDZ marks serving each landing direction should be not less than 300 m.
2. Where PAPI is provided, the beginning of the Aiming Point (AP) Markers shall be coincident with the PAPI approach slope origin. However, if the difference in distance between the PAPI location and that depicted in the applicable diagram above will not, as agreed mutually with the CAA, result in a significant reduction in safety, it is acceptable to leave existing AP markers in their present position.

Runway turn pad markings

7.83 Where a runway turn pad is provided, a runway turn pad marking should be provided for continuous guidance to enable an aircraft to complete a 180° turn and align with the runway centreline. These markings should be yellow.

7.84 A runway turn pad marking should be at least 150 mm in width and continuous in length. The marking should be curved from the runway centreline into the turn pad. The radius of the curve should be compatible with the maneuvering compatibility and normal taxying speeds of the aircraft for which the runway turn pad is intended. The intersection angle of the turn pad marking with the runway centreline should not be greater than 30°.

7.85 The runway turn pad marking should extend parallel to the runway centreline marking for at least 60m beyond the point of tangency where the code number is 3 or 4, and for at least 30m where the code number is 1 or 2.

7.86 The runway turn pad marking should guide the aircraft in such a way as to allow a straight portion of taxying before the point where the 180° turn is to be made.

7.87 The design of the curve allowing an aircraft to negotiate a 180° turn should be based on a nose-wheel steering angle not exceeding 45°. The design should be such that, when the cockpit of the aircraft remains over the runway turn pad marking, the clearance distance between any wheel of the aircraft landing gear and the edge of the runway turn pad should be not less than specified in chapter 3.

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

Day markers for snow-covered runways

7.89 Type‘C’ markers as illustrated at Figure 7.30 should be used to indicate the threshold, end and usable width of a snow-covered runway. The spacing of markers along the sides of the runway should be at intervals of not more than 100 m. Markers may not be needed where elevated runway edge lighting is installed. Where necessary the threshold should additionally be marked with Runway Threshold Marker Boards and positioned as illustrated in figure 7.23(d).

Markings on unpaved runways

7.90 Where aircraft performance considerations necessitate the notification of field lengths for a grass aerodrome, the boundaries of unpaved runways and stopways should be delineated by runway edge markers visible from an aircraft on the approach at a range of at least 2km. Delineation should be effected by either of the following methods:

1. white, flat, rectangular markers flush with the surface, 3m long, 1m wide and spaced at intervals not exceeding 90m; or
2. frangible markers single-coloured to contrast with their background and firmly secured to the surface spaced at intervals not exceeding 90m; the height of the markers should not exceed 500mm.

7.91 Where frangible markers are used to delineate the boundaries of unpaved runway, or other areas within the runway clear and graded area, whether temporary or otherwise, such markers should be lightweight. Whilst ballast may be required to ensure stability of the markers, aerodrome operators should ensure that the units retain their frangibility, taking into account the types of aircraft that commonly use the runway.

7.92 Runway edge markers should be arranged in pairs on opposite sides of and equi-distant from the centreline.

7.93 The corners of an unpaved runway or stopway should be indicated by additional markings placed at right angles to and adjoining the appropriate longitudinal markers.

7.94 The threshold of an unpaved runway should be marked with a designator showing the magnetic heading to the nearest whole ten degrees. Spacing and dimensions are given at appendix 7B, table 7B.1. Elevated markers used to indicate a displaced threshold should be located as wing bars as illustrated at figure 7.23 and figure 7.32.

7.95 A temporarily displaced threshold should be marked in the manner illustrated at figure 7.23. However, the chevrons and displacement arrows may be omitted.

7.96 An unpaved runway should be provided with centreline marking if the runway edge marking is not easily seen during take-off or landing.

7.97 Where landings and take-offs are not confined to marked runways and the aerodrome boundary is not readily apparent, boundary markers should be provided.

Taxiway markings

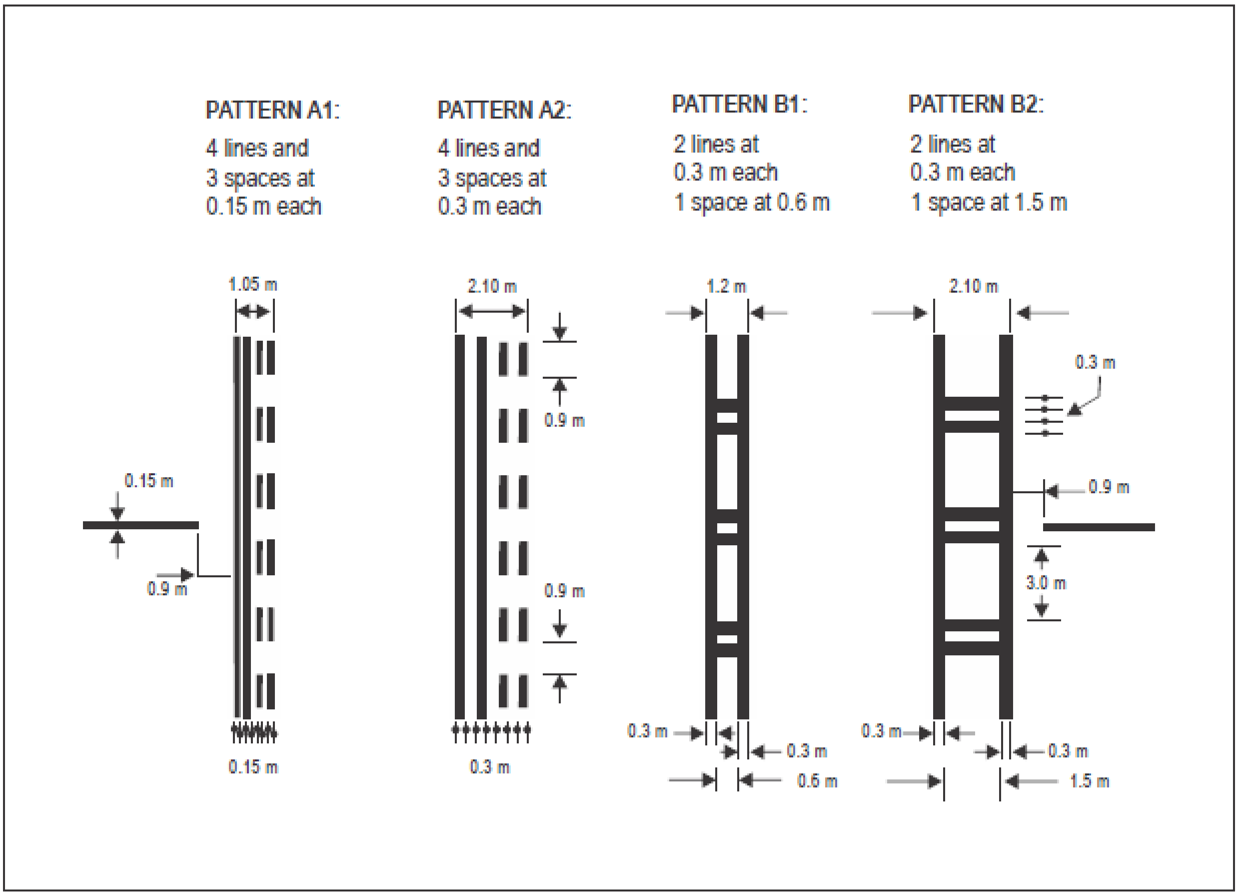
7.98 The centreline of paved taxiways serving precision instrument approach runways and other taxiways where the route is difficult to follow should be marked by a continuous yellow line 0.15 m wide, so as to provide guidance between the runway and aircraft stands. Where the taxiway leads onto or off the runway, the yellow line should be curved into the nearside of and 0.75m ± 0.15m from the runway centreline, except at the runway threshold where the yellow line should be discontinued at the edge of the runway in the manner illustrated at figure 7.28. When a taxiway crosses a runway, the centreline may be continued across the runway, interrupted as necessary for the runway markings. Taxiway centre line marking should be provided on a runway when the runway is part of a standard taxi-route and where the taxiway centre line is not coincident with the runway centre line. At taxiway intersections the taxiway centrelines should be intersected in the manner illustrated at figure 7.27. At rapid exit taxiways the taxiway marking should commence adjacent to the runway centreline at least 60 m before the intersection with the exit taxiway curvature. At all other taxiway/runway intersections the lead-off lines should commence at least 30m before the intersection.

7.99 Runway taxi-holding positions should be established in accordance with the requirements of chapter 3 on each taxiway serving a runway. On each taxiway the runway taxi-holding position closest to the runway should be marked as shown in figure 7.26 pattern‘A’. Other runway taxi-holding positions where provided on the same taxiway but farther from the runway should be marked as shown at figure 7.26 pattern‘B’.

Note 1*: Until 26 November 2026, the dimensions of runway-holding position markings shall be as shown in Figure 7.26, pattern A1 (or A2) or pattern B1 (or B2), as appropriate.*

***Note 2**: As of 26 November 2026, the dimensions of runway-holding position markings shall be as shown in Figure 7.26, pattern A2 or pattern B2, as appropriate.*

Figure 7.26 Runway taxi-holding position marks



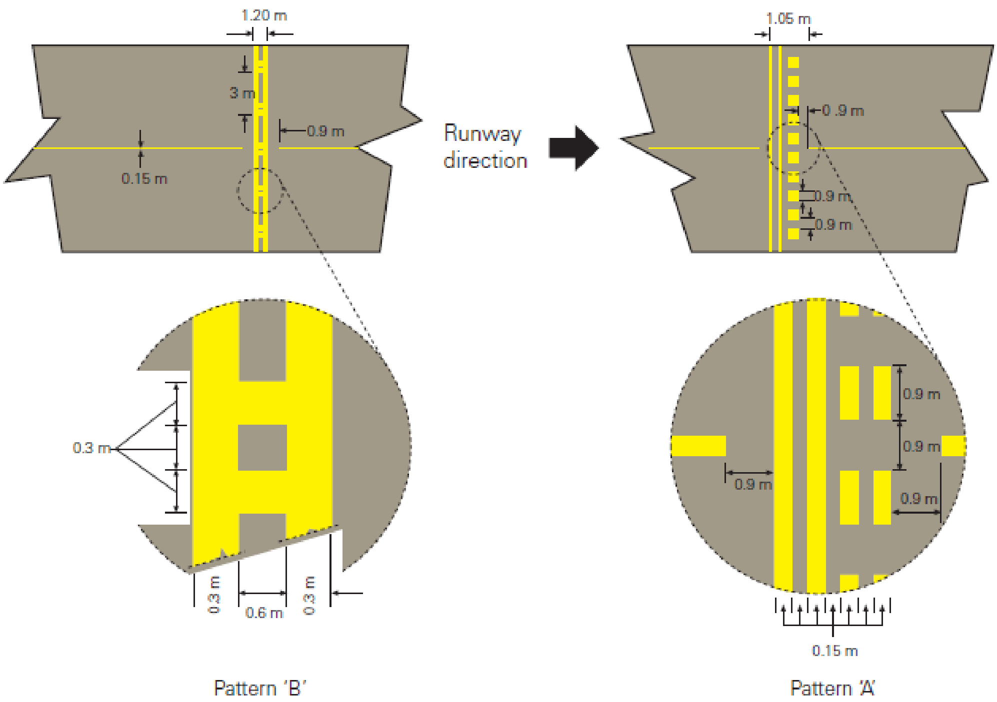
Notes:

1. The runway taxi-holding position marking should be positioned at right angles to the taxiway centreline marking.
2. No part of the runway taxi-holding position marking should be closer to the runway than the appropriate distance as determined by use of table 3.3.
3. Patterns A1 and B1 are no longer valid after 2026.

7.100 Intermediate taxi-holding position markings as illustrated in figure 7.27 should be displayed wherever it is intended to locate an Intermediate taxi-holding position.

7.101 Where it is necessary to define the outer edges of a taxiway, e.g. where a paved taxiway shoulder has a bearing strength less than that of the main taxiway or where a taxiway lies adjacent to a paved area not intended for use as a taxiway, the outer edges of the taxiway should be marked as illustrated in figure 7.28. The mark should be so positioned that the inner edge of the mark represents the outer edge of the taxiway.

Figure 7.27 Intermediate taxi-holding position marking

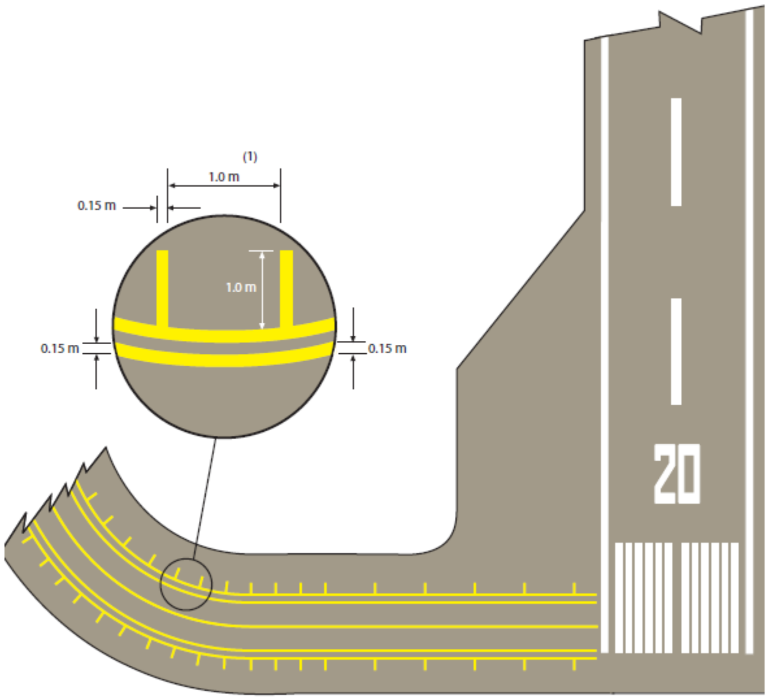


Note: an intermediate taxi-holding position marking should be placed at right angles to the taxiway centreline and in such a position so as to ensure that the minimum separation distances outlined in column 5 of table 3.4 (In chapter 3) are achieved.

7.102 On taxiways or aprons where it is impracticable to install an information sign, the information should be displayed in the form of a marking on the pavement positioned so as to be legible from the cockpit of an approaching aircraft. The markings should conform to the illustrations at appendix 7C.

7.103 Where it is necessary to define the edges of an unpaved taxiway, suitable frangible markers, such as linlaners, coloured blue, should be provided. If used at night, suitable retro-reflective material should be applied.

Figure 7.28 Taxiway edge marking



7.104 Where it is considered necessary, as part of an aerodrome's runway incursion prevention measures, to denote the proximity of a runway holding position, enhanced taxiway centreline markings may be provided. Where provided, an enhanced taxiway centreline marking shall extend from the runway holding position Pattern A (as defined in figure 7.29, enhanced taxiway centreline marking) to a distance of up to 47m in the direction of travel away from the runway or to the next runway holding position, 7m distance.

7.105 Where provided, enhanced taxiway centreline marking shall be installed at each taxiway/runway intersection.

7.106 Where provided, an enhanced taxiway centreline marking shall extend from the runway-holding position pattern A to a distance of up to 45 m (a minimum of three (3) dashed lines) in the direction of travel away from the runway or to the next runway-holding position, if within 45m distance.

7.107 Where provided:

1. An enhanced taxiway centreline marking shall extend from the runway-holding position pattern A to a distance of up to 47 m in the direction of travel away from the runway (see figure 2D.3).
2. If the enhanced taxiway centreline marking intersects another runway-holding position marking, such as for a precision approach category II or III runway, that is located within 47 m of the first runway-holding position marking, the enhanced taxiway centreline marking shall be interrupted 0.9 m prior to and after the intersected runway-holding position marking. The enhanced taxiway centreline marking shall continue beyond the intersected runway-holding position marking

for at least three dashed line segments or 47 m from start to finish, whichever is greater.

3. If the enhanced taxiway centreline marking continues through a taxiway/ taxiway intersection that is located within 47 m of the runway-holding position marking, the enhanced taxiway centreline marking shall be interrupted 1.5 m prior to and after the point where the intersected taxiway centre line crosses the enhanced taxiway centre line. The enhanced taxiway centre line marking shall continue beyond the taxiway/taxiway intersection for at least three dashed line segments or 47 m from start to finish, whichever is greater.
4. Where two taxiway centrelines converge at or before the runway-holding position marking, the inner dashed line shall not be less than 3 m in length.
5. Where there are two opposing runway-holding position markings and the distance between the markings is less than 94 m, the enhanced taxiway centreline markings shall extend over this entire distance. The enhanced taxiway centreline markings shall not extend beyond either runway-holding position marking.

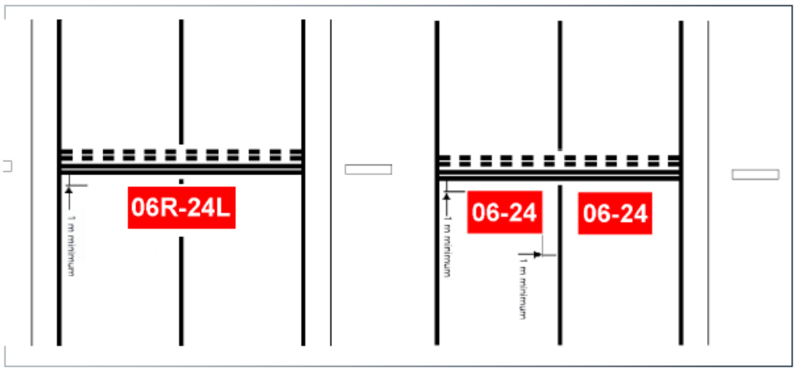
Mandatory instruction markings

7.108 Where operationally required, such as on wide taxiways, or to assist in the prevention of a runway incursion, a runway taxi-holding position sign may be supplemented by a mandatory instruction marking in the form of a runway designation marking. This marking should also be used where it is impractical to install a mandatory instruction sign.

7.109 Where required, the mandatory instruction marking on taxiways with code letters A-D should be located across the taxiway equally placed about the taxiway centreline and on the holding side of the runway-holding position marking as shown in figure 7.30(a). For taxiways where the code letter is E or F, the marking should be located on both sides of the taxiway centreline marking and on the holding side of the runway-holding position marking as shown in figure 7.30(b). In both cases the distance between the nearest edge of the marking and the runway holding position marking or the taxiway centreline marking should be not less than 1 m.

7.110 The character height should be 4 m for inscriptions where the code letter is C, D, E or F, and 2 m where the code letter is A or B.

Figure 7.30 Mandatory Instruction Marking



Apron markings

7.111 Unless marshalling guidance is available, aircraft stand markings should be provided on a paved apron. Markings should be located so as to provide the obstacle clearances specified in chapter 3 when the nose wheel follows

7.112 the stand marking. Aircraft stand markings may include items such as stand identification, lead-in line or arrow, turn bar, turning line, alignment bar, stop line and lead-out line, as are required by the parking configuration and to complement other parking aids. These markings should be yellow.

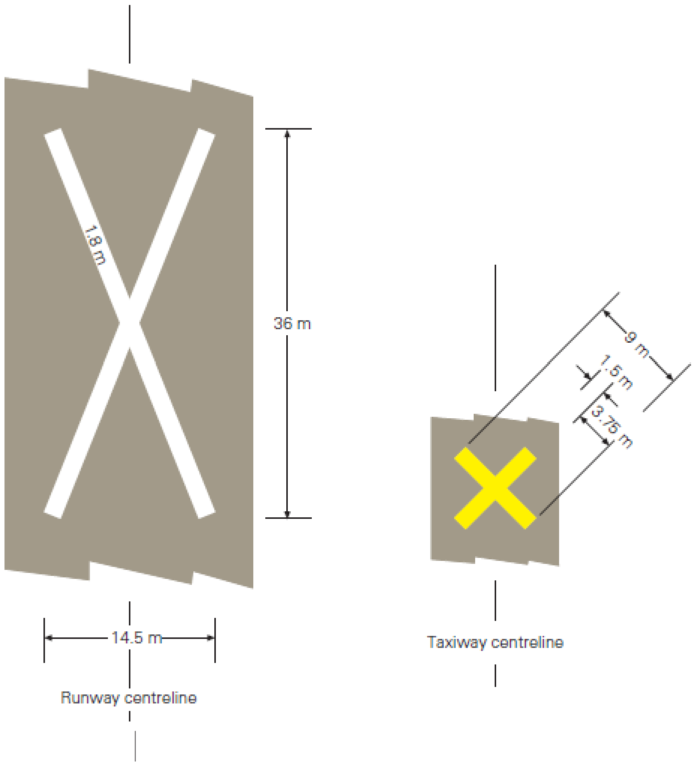
7.113 Apron safety lines and other markings should be provided as required to define the areas intended for use by ground vehicles and other aircraft servicing equipment, etc., to provide safe separation from aircraft. They should include items such as wing tip clearance lines and service road boundary lines, vehicle parking and no parking areas, pedestrian routes and airbridge operating areas as required by the parking configurations and ground facilities. Markings should be of colours that do not conflict with markings used by aircraft and should be maintained so as to retain their conspicuity.

7.114 Examples of markings are provided in CAP 637, Visual Aids Handbook. appendix 7C of this chapter provides guidance on the dimensions of markings.

Markings of unfit areas

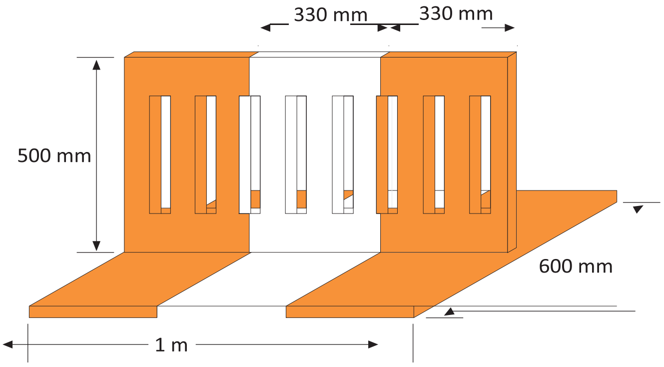
7.115 One or more crosses as illustrated at figure 7.31 should be used to mark runways or taxiways declared as unfit for the movement of aircraft. The crosses should be spaced at intervals of not more than 300 m except where they form part of the marking for a displaced runway threshold when the spacing at figure 7.23 applies.

Figure 7.31 Closed runway and taxiway markings



7.116 Type'A' ground markers as illustrated in figure 7.32, spaced not more than 15 m apart, signify the boundary of that part of a paved runway, taxiway or apron unfit for the movement of aircraft.

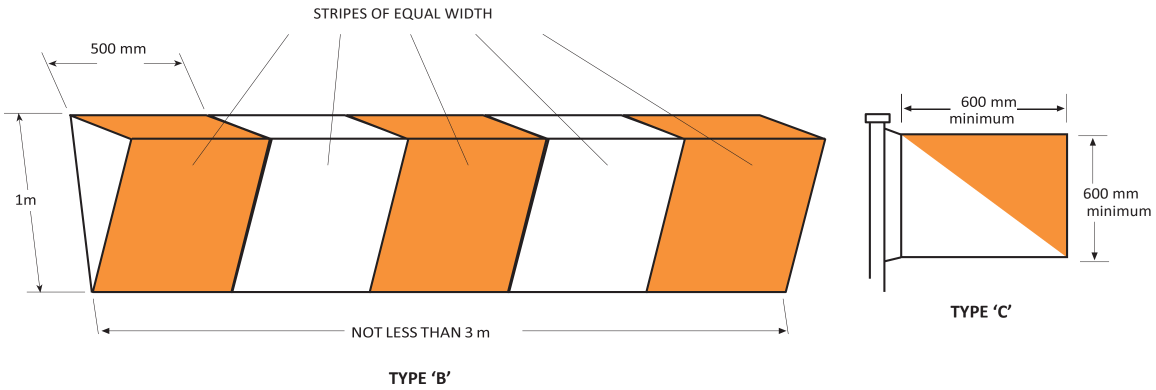
Figure 7.32 Bad ground marker type'A'



7.117 Areas on unpaved maneuvering areas that are unfit for the movement of aircraft should be marked by one or more crosses as specified in figure 7.31 and bounded by ground markers type'B' alternating with type'C' illustrated at figure 7.33. The type'C' marker should also be used to mark the usable portion of a snow covered runway and should be located where runway edge lighting would normally be expected. The distance between successive type'C' markers therefore should not exceed 60 m.

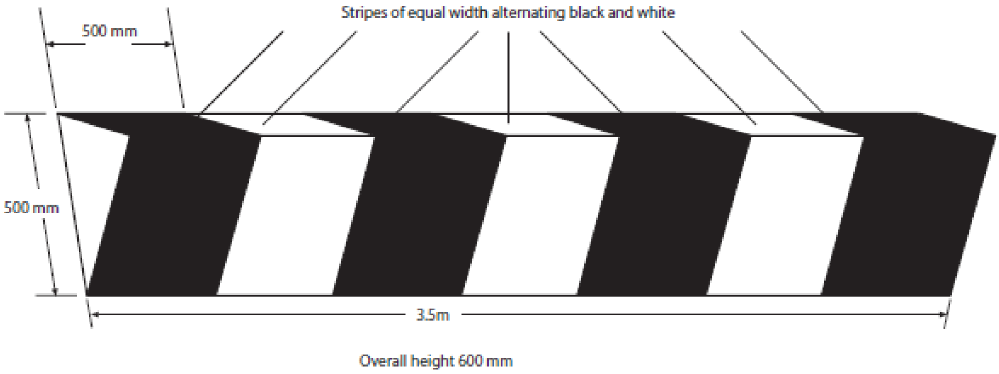
7.118 Alternatively, cones may be used to denote such areas. Cones should be at least 0.5 m in height and red, orange or yellow, or any of these colours in combination with white. Whilst ballast may be required to ensure stability, aerodrome operators should ensure that cones retain their frangibility.

Figure 7.33 Bad ground markers types'B' and 'C'



7.119 Where a runway threshold is temporarily displaced, or where a threshold is insufficiently conspicuous (e.g. snow covered runway) the threshold should be marked with the boards illustrated at figure 7.34 (in addition to the pavement markings), positioned in accordance with the illustrations at figure 7.23.

Figure 7.34 Runway threshold marker board

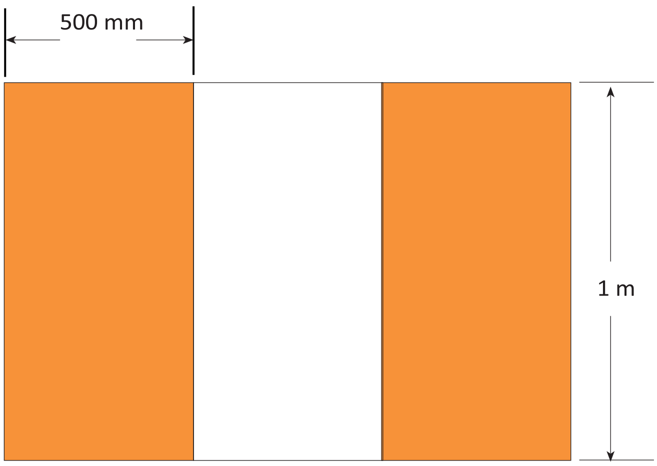


7.120 When a runway or taxiway, or portion thereof, is permanently closed, all normal runway and taxiway markings should be obliterated.

Other markers

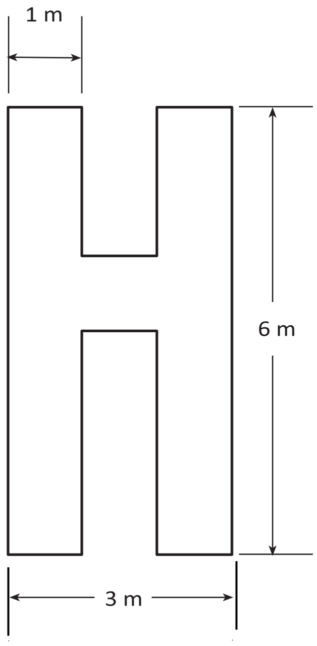
7.121 An aerodrome boundary that is insufficiently conspicuous should be delineated by orange and white striped markers either as illustrated in figure 7.35 or as specified in paragraph 7.124. Spacing should not exceed 45m.

Figure 7.35 Aerodrome boundary marker



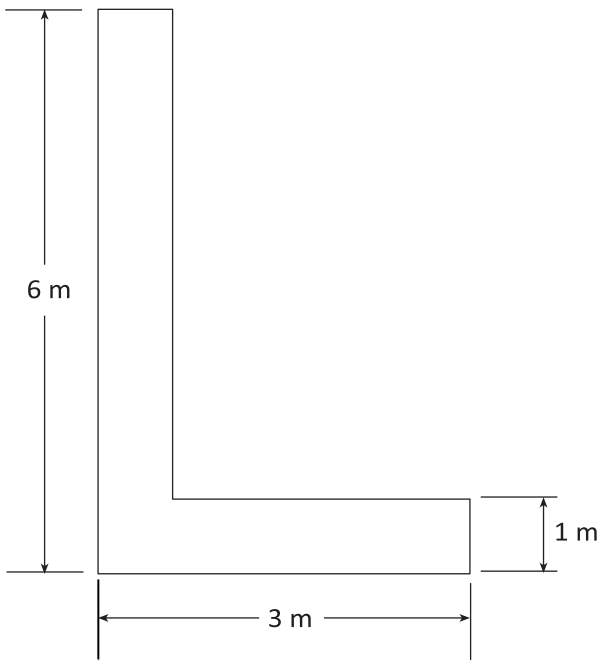
7.122 A white letter H as illustrated in figure 7.36 indicates a part of the maneuvering area to be used only for the take-off and landing of helicopters.

Figure 7.36 Helicopter landing area mark



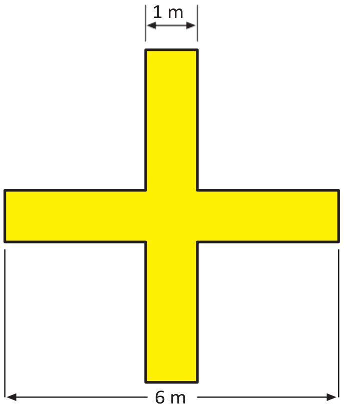
7.123 A white letter L as illustrated in figure 7.37 indicates a part of the maneuvering area to be used only for the take-off and landing of light aircraft.

Figure 7.37 Light aircraft landing/take-off area mark



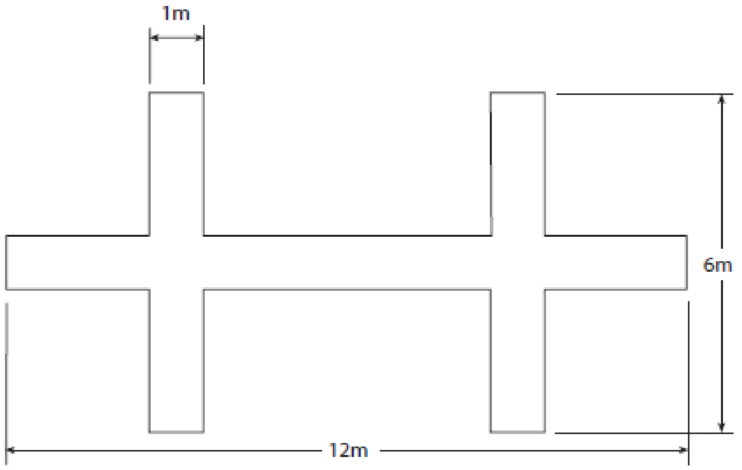
7.124 A yellow cross of dimensions illustrated in figure 7.38 indicates that tow ropes and similar articles towed by aircraft are to be dropped only in the area in which the cross is placed.

Figure 7.38 Yellow cross



7.125 A white double cross as illustrated at figure 7.39 indicates an area to be used only for the taking off and landing of gliders.

Figure 7.39 White double cross – dimensions



7.126 A white landing T as specified in paragraph 7.14 or 7.15, placed at the left hand side of the runway when viewed from the direction of landing indicates the runway to be used.

Road signs and markings

7.127 Road signs and markings used on aerodrome movement areas should, where practicable, conform with:

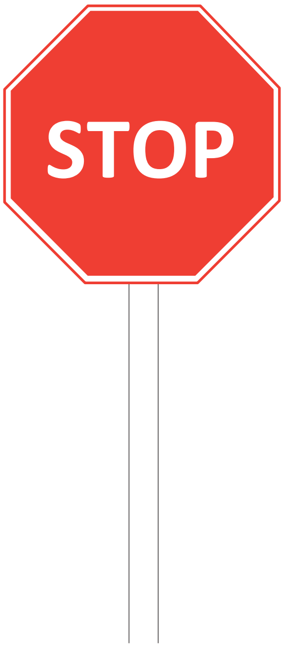
- Statutory Instrument 2002 No. 3113 – The Traffic Signs Regulations and General Directions 2002;
- Statutory Instrument 1997 No. 2400 – The Zebra, Pelican and Puffin Pedestrian Crossings Regulations and General Directions 1997;
- Statutory Instrument 1998 No. 901 – The Pelican and Puffin Pedestrian Crossings General (Amendment) Directions 1998.

Road-holding position sign

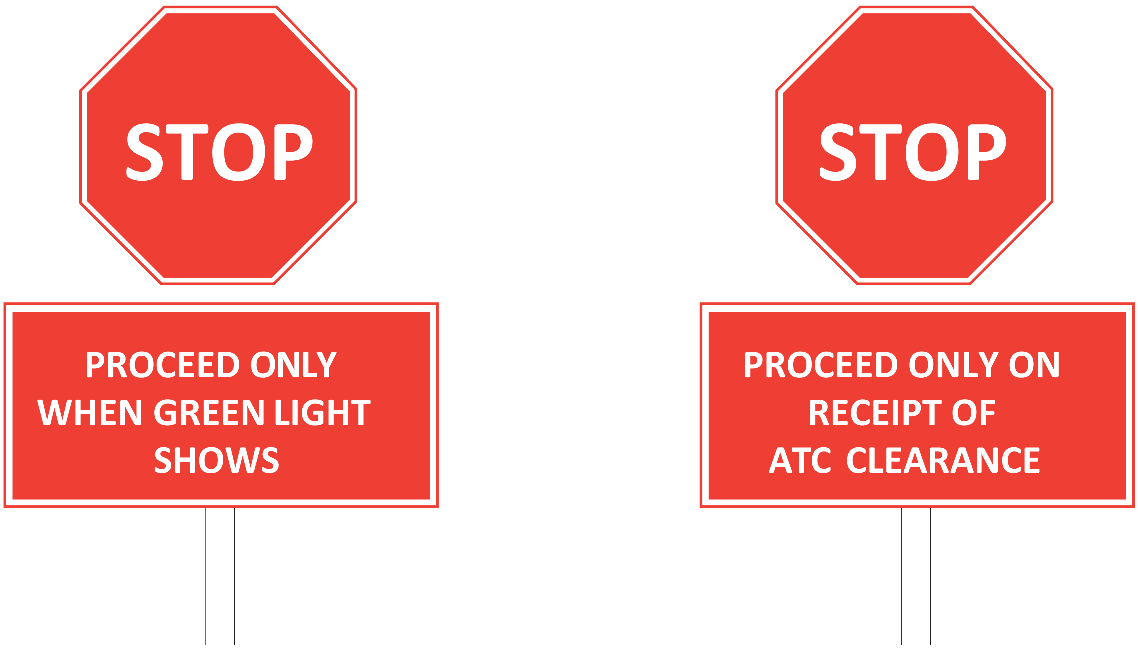
7.128 Whenever a route intended for vehicular traffic use intersects a taxiway or a runway, a road-holding position sign should be located not closer to the appropriate taxiway or runway than the distances notified in chapter 3 and 1.5 m from the defined edge of the vehicular traffic route.

7.129 The road-holding position sign should combine a standard road traffic 'STOP' sign with, where appropriate, an instruction on how the driver of a vehicle should proceed. Examples of road-holding position signs are illustrated at figure 7.40.

Figure 7.40 Road-holding position signs (not to scale)



(a) Standard stop sign



(b) Stop sign with supplementary instructions

Note: For dimensions see 'The Traffic Signs Regulations and General Directions 1994'

APPENDIX 7A

Taxi guidance signs style and proportion of characters, sign layout and face size

Characters, sign layout and face size

1. This appendix details the style and proportions of the characters to be employed on and the layout and face size of taxi guidance signs.

2. The characters are shown at appendix 7A, figures 7A.2 to 7A.6 for a 50 mm letter height. The characters may be enlarged to the desired letter height by any conventional enlarging process and the letters will remain in the proper proportion. However, any errors and inconsistencies in the space and character stroke width introduced as a result of enlargement will have to be corrected to reflect the requirements of tables 7.1 and 7A.1. A 5 mm grid has been superimposed on the letters to facilitate the enlarging process. For example, to obtain 300 mm letter height, enlarge the grid squares to 30 mm.

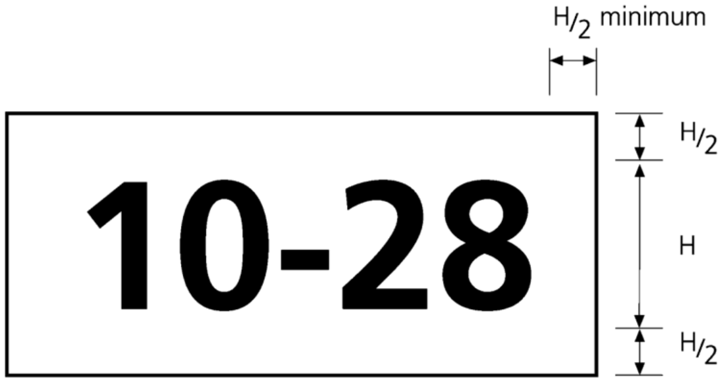
3. A set of spacing tables is provided at table 7A.1. These tables give the letter and numeral width by direct reading for several standard letter heights. In addition, the dimension for space between any combination of letters or numerals may be obtained through a two-step process described in the table. This space is the distance measured horizontally between the extreme right edge of the preceding letter and the extreme left edge of the following letter. No part of these letters may extend into this space.

4. The width of a word or name may be readily determined by adding the sum of the letter widths to the sum of the spaces between letters.

5. All characters having an arc at the top or bottom are extended slightly above or below the grid lines. This is in accord with accepted practice for rounded letters.

6. Sign face size shall be determined in the manner shown in figure 7A.1.

Figure 7A.1



7. Examples of sign layout and face size proportions are given in figures 7A.7 to 7A.10.

Notes:

1. Vertical dimensions may be increased by up to H/10 in order to accommodate construction tolerances.
2. Horizontal dimensions are a minimum. H/2 may be increased in order to allow flexibility in manufacture of a range of standard frames and enclosures.

Figure 7A.2 Sign characters proportions and style

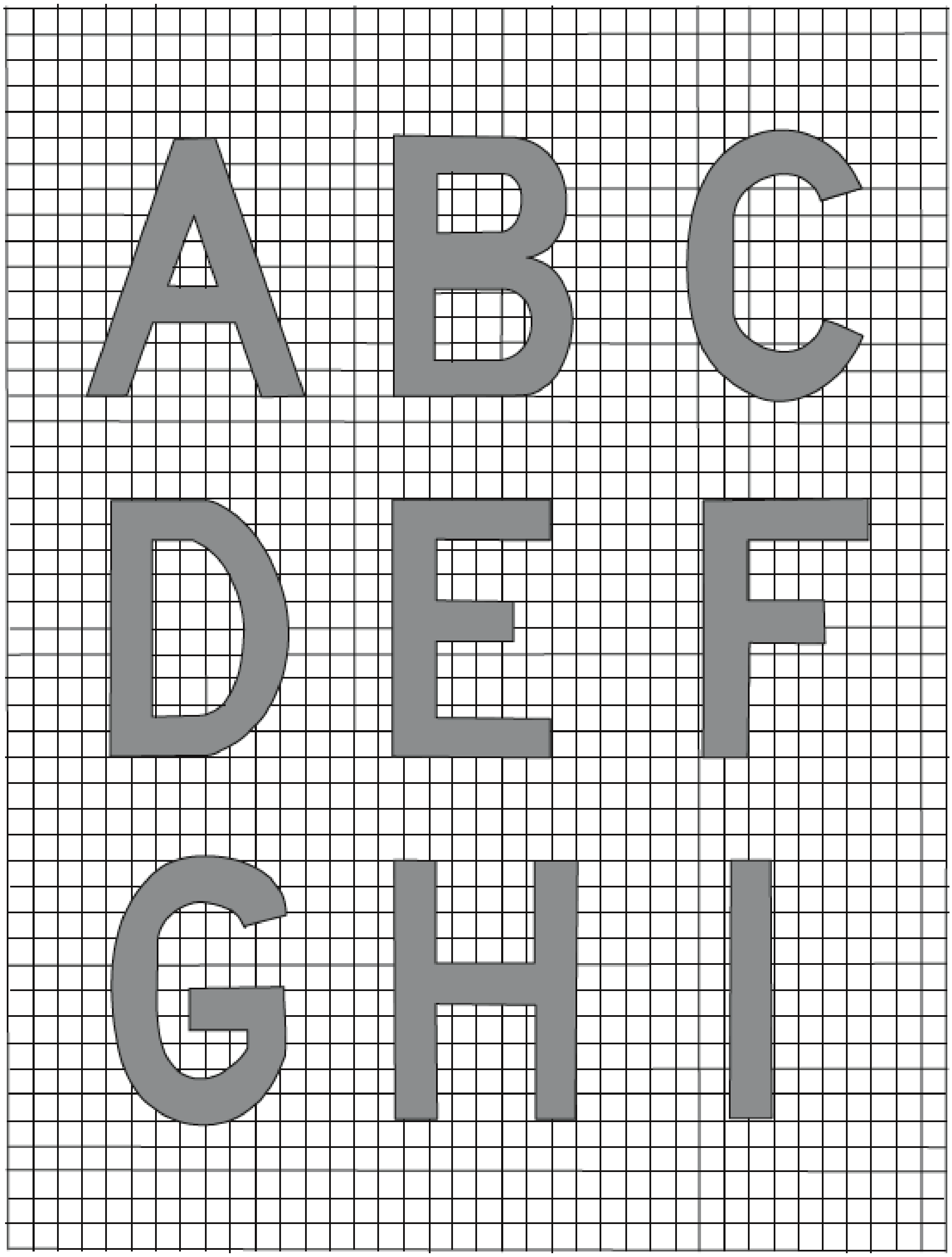


Figure 7A.3 Sign characters proportions and style

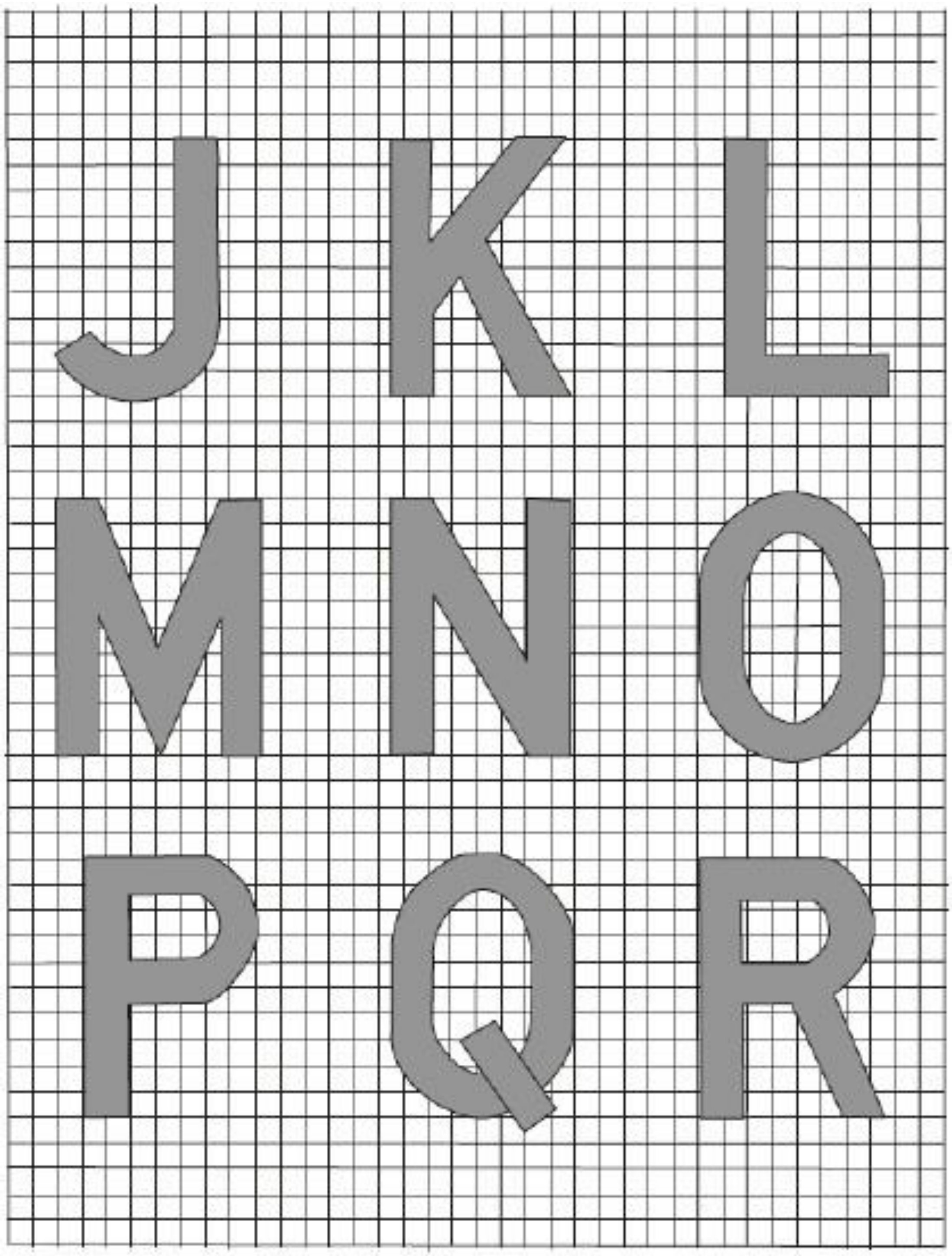


Figure 7A.4 Sign characters proportions and style

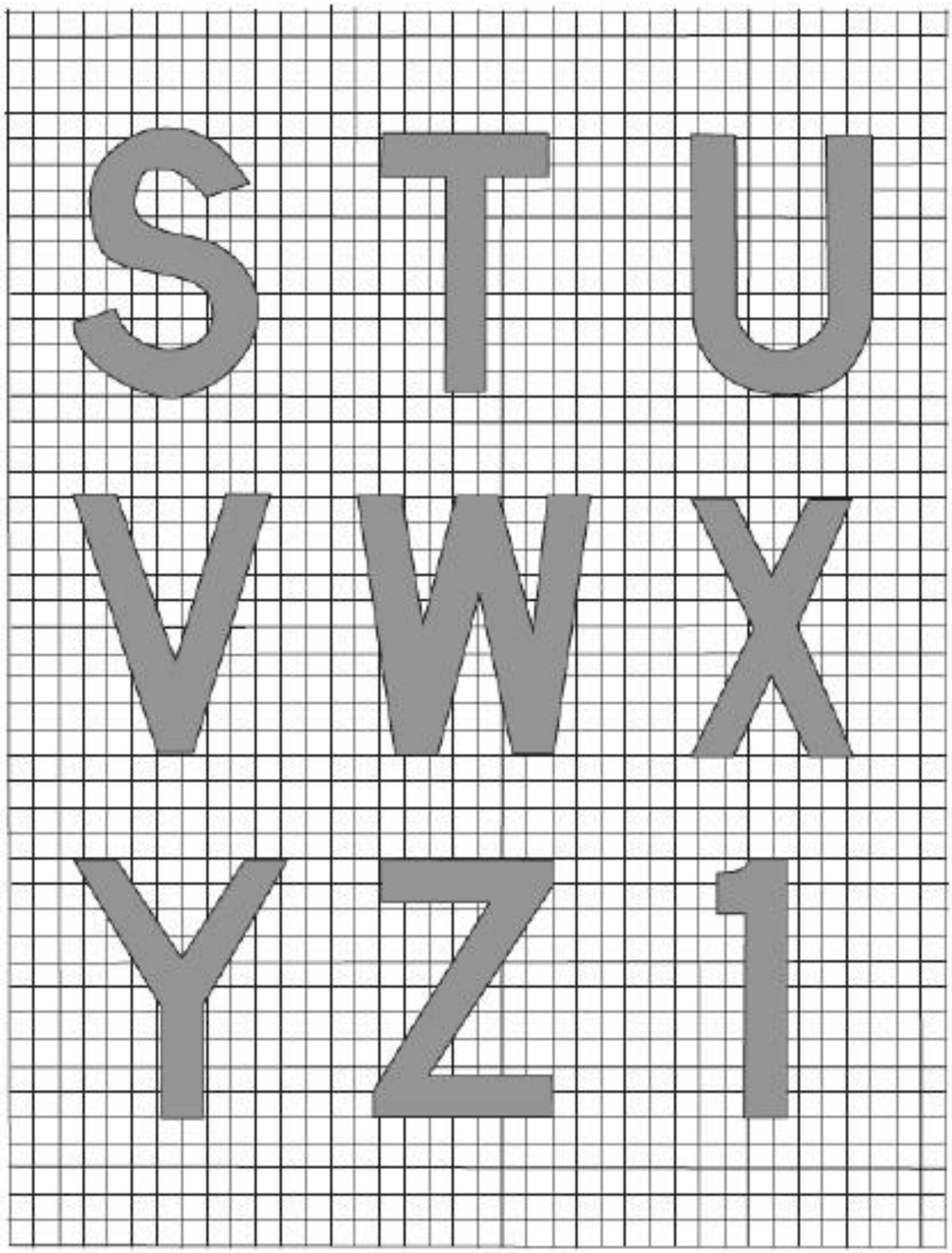


Figure 7A.5 Sign characters proportions and style

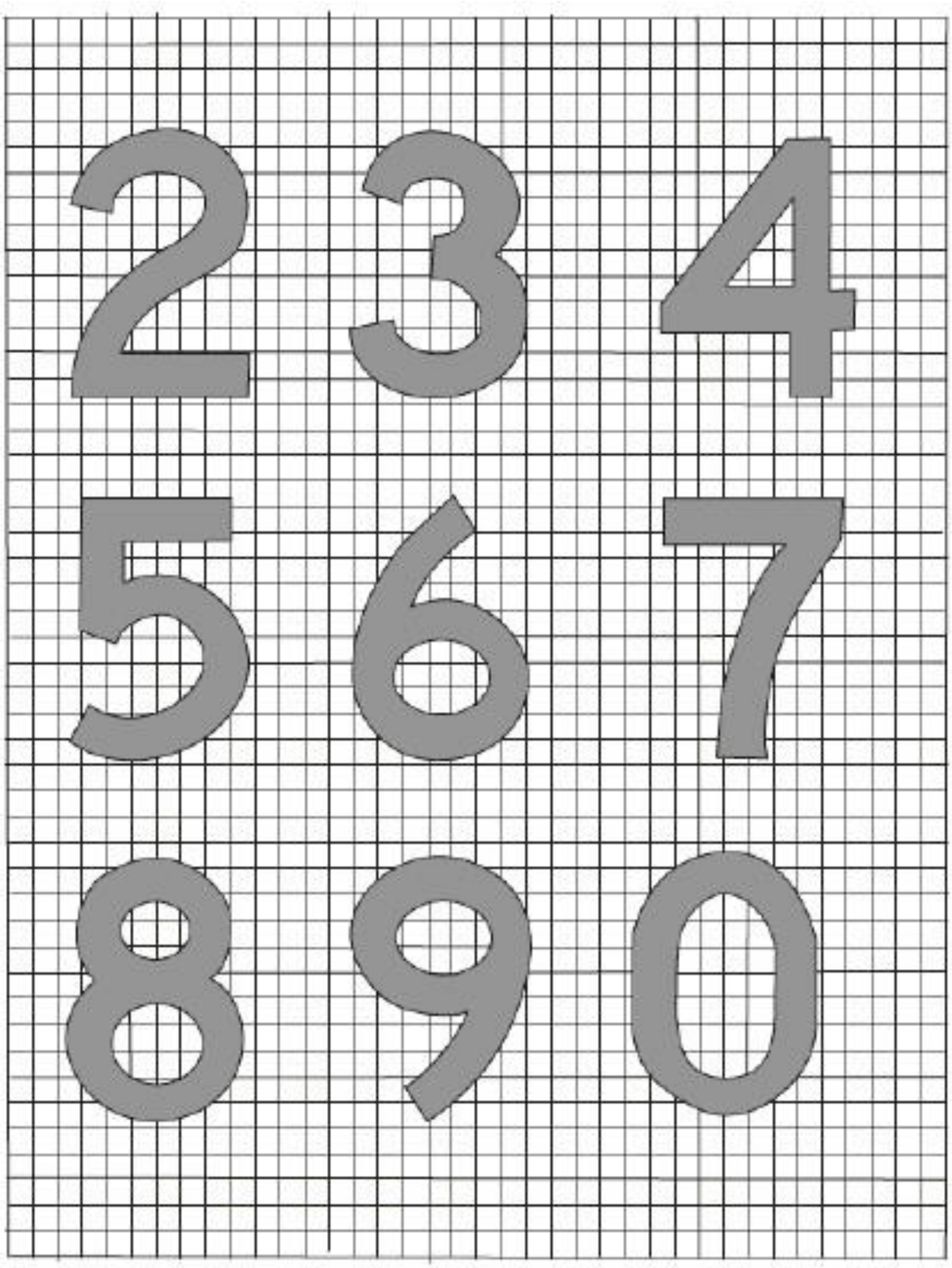


Figure 7A.6 Sign characters proportions and style

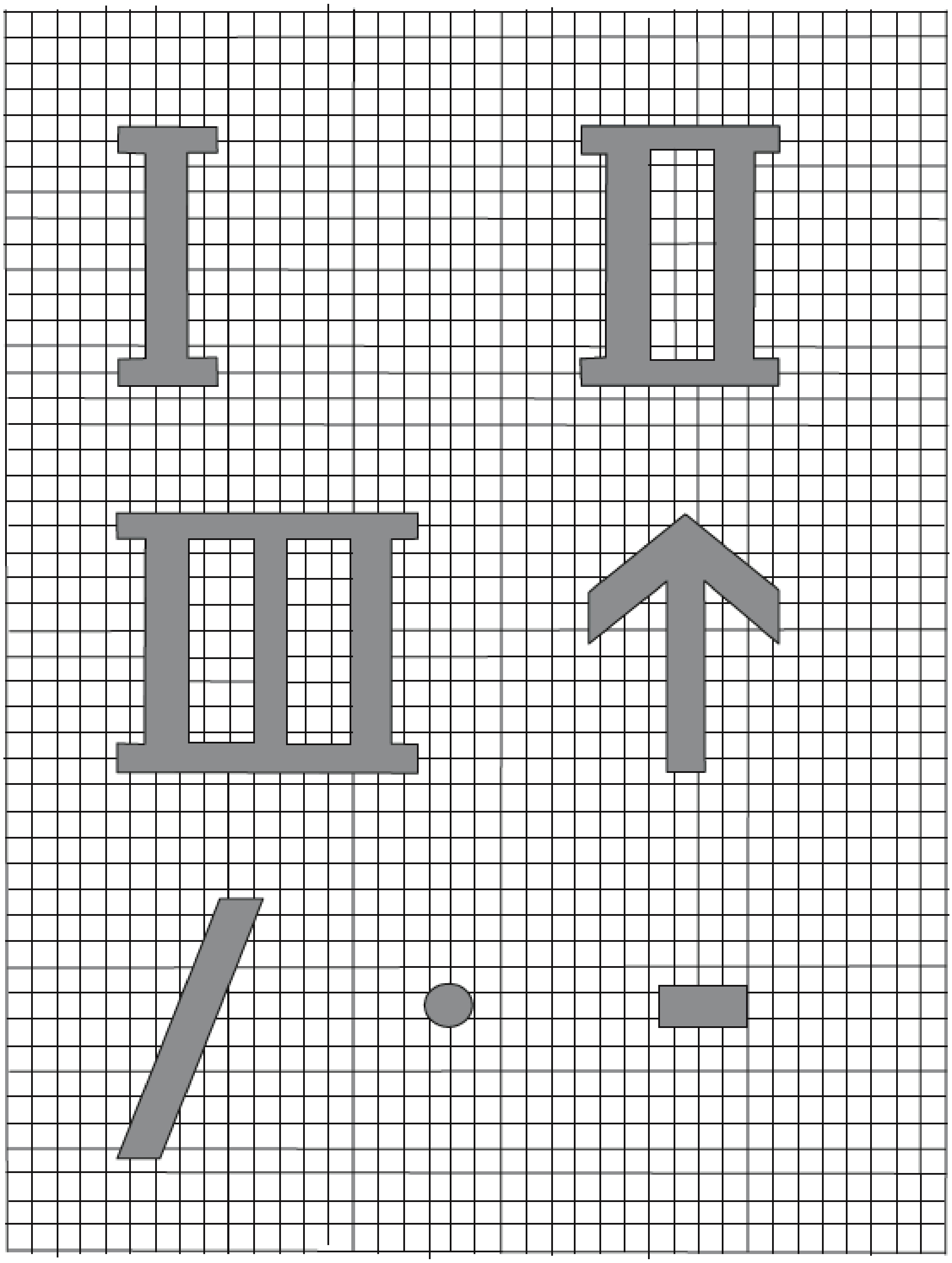


Table 7A.1(a) Letter and numeral widths and space between letters or numerals

Letter to letter code number			
Preceding Letter	Following letter		
	B, D, E, F, H, I, K, L, M, N, P, R, U	C, G, O, Q, S, X, Z	A, J, T, V, W, Y
	Code number		
A	2	2	4
B	1	2	2
C	2	2	3
D	1	2	2
E	2	2	3
F	2	2	3
G	1	2	2
H	1	1	2
I	1	1	2
J	1	1	2
K	2	2	3
L	2	2	4
M	1	1	2
N	1	1	2
O	1	2	2
P	1	2	2
Q	1	2	2
R	1	2	2
S	1	2	2
T	2	2	4
U	1	1	2
V	2	2	4
W	2	2	4
X	2	2	3
Y	2	2	4
Z	2	2	3

Table 7A.1(b) Letter and numeral widths and space between letters or numerals

Numeral to numeral code number			
Preceding numeral	**Following number**		
	1, 5	**2, 3, 6, 8, 9, 0**	**4, 7**
	Code number		
1	1	1	2
2	1	2	2
3	1	2	2
4	2	2	4
5	1	2	2
6	1	2	2
7	2	2	4
8	1	2	2
9	1	2	2
0	1	2	2

Table 7A.1(c) Letter and numeral widths and space between letters or numerals

Space between characters			
Code number	**Letter height (mm)**		
	200	**300**	**400**
	Space (mm)		
1	48	71	96
2	38	57	76
3	25	38	50
4	13	19	26

Table 7A.1(d) Letter and numeral widths and space between letters or numerals

Width of letter			
Letter	Letter height (mm)		
	200	300	400
	Width (mm)		
A	170	255	340
B	137	205	274
C	137	205	274
D	137	205	274
E	124	186	248
F	124	186	248
G	137	205	274
H	137	205	274
I	32	48	64
J	127	190	254
K	140	210	280
L	124	186	248
M	157	236	314
N	137	205	274
O	143	214	286
P	137	205	274
Q	143	214	286
R	137	205	274
S	137	205	274
T	124	186	248
U	137	205	274
V	152	229	304
W	178	267	356
X	137	205	274
Y	171	257	342
Z	137	205	274

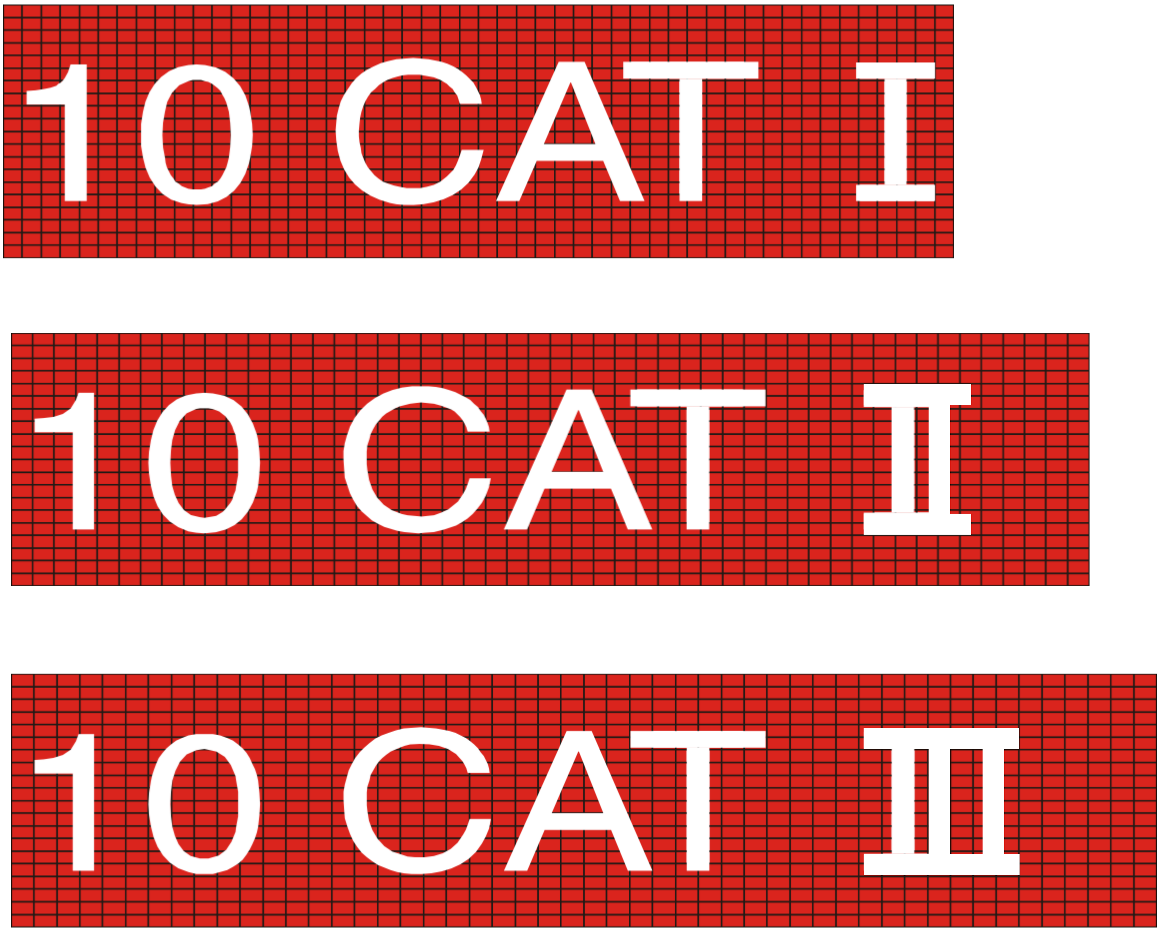
Table 7A.1(e) Letter and numeral widths and space between letters or numerals

Width of numeral			
Numeral	Numeral height (mm)		
	200	300	400
	Width (mm)		
1	50	74	98
2	137	205	274
3	137	205	274
4	149	224	298
5	137	205	274
6	137	205	274
7	137	205	274
8	137	205	274
9	137	205	274
0	143	214	286

Instructions

1. To determine the proper space between letters or numerals, obtain the code number from table 7A.1(a) or (b) and cross-refer to table 7A.1(c) as appropriate to establish the letter height for that code number.
2. The space between words or groups of characters forming an abbreviation or symbol should be equal to half of the height of the characters used except that where an arrow is located with a single character such as 'A', the space may be reduced to not less than one quarter of the character height in order to provide a good visual balance.
3. Where a numeral follows a letter or vice versa use code 1.
4. Where a hyphen, dot, or diagonal stroke follows a character or vice versa use code 1.

Figure 7A.7 Sign face size proportions and layout



Notes:

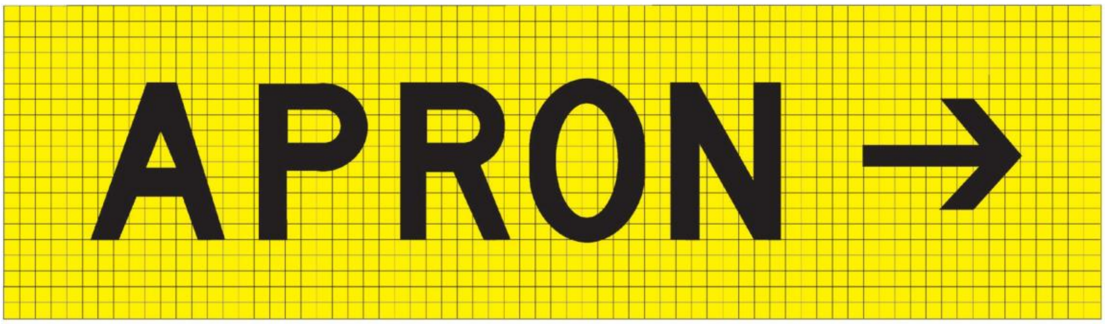
1. The grid is shown only for the purpose of illustrating sign face and character proportions and should not show on a completed sign face.
2. For correct spacing between characters/symbols refer to table 7A.1.

Figure 7A.8 Sign face size proportions and layout

Notes:

1. The grid is shown only for the purpose of illustrating sign face and character proportions and should not show on a completed sign face.
2. For correct spacing between characters/symbols see table 7 A . 1 .

Figure 7A.9 Sign face size proportions and layout continued

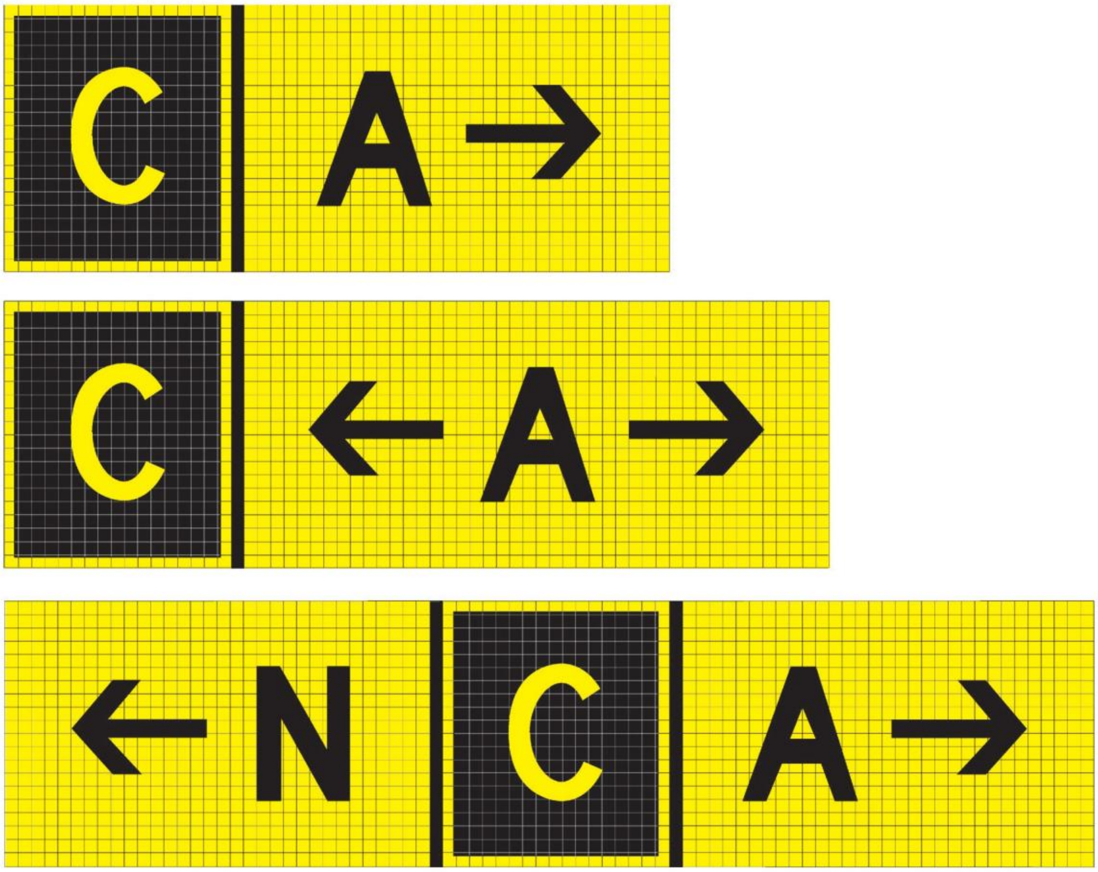


Where an information sign contains 10 or more characters, it may be constructed in the manner shown below, using 20cm letter height.

Notes:

1. The grid is shown only for the purpose of illustrating sign face and character proportions and should not show on a completed sign face.
2. For correct spacing between characters/symbols see table 7 A . 1 .

Figure 7A.10 Sign face size proportions and layout



Notes:

1. The grid is shown only for the purpose of illustrating sign face and character proportions and should not show on a completed sign face.
2. For correct spacing between characters/symbols see table 7 A . 1 .

APPENDIX 7B

Form and proportions of runway designator marking

1. This appendix details the form and proportions of the characters that should be used for runway designator marking drawn on a 5 mm grid in order to facilitate enlarging. The height of character to be employed is determined by the runway type and width and is listed at table 7.3. The spacing between characters is detailed at table 7B.1.

Table 7B.1 Runway designator marking – spacing between characters

Designator		**Character height (m)**		
1st character	**2nd character**	**15**	**12**	**9**
		Spacing (m)		
0	1	3.25	2.6	1.95
0	2–9	3.5	2.8	2.1
1	1	6.25	5	3.75
1	0,2–9	3.75	3	2.25
2	1	3.25	2.6	1.95
2	0,2–9	3.5	2.8	2.1
3	1	3.25	2.6	1.95
3	0,2–9	3.5	2.8	2.1

Figure 7B.1 Runway designator character dimensions – 15m characters

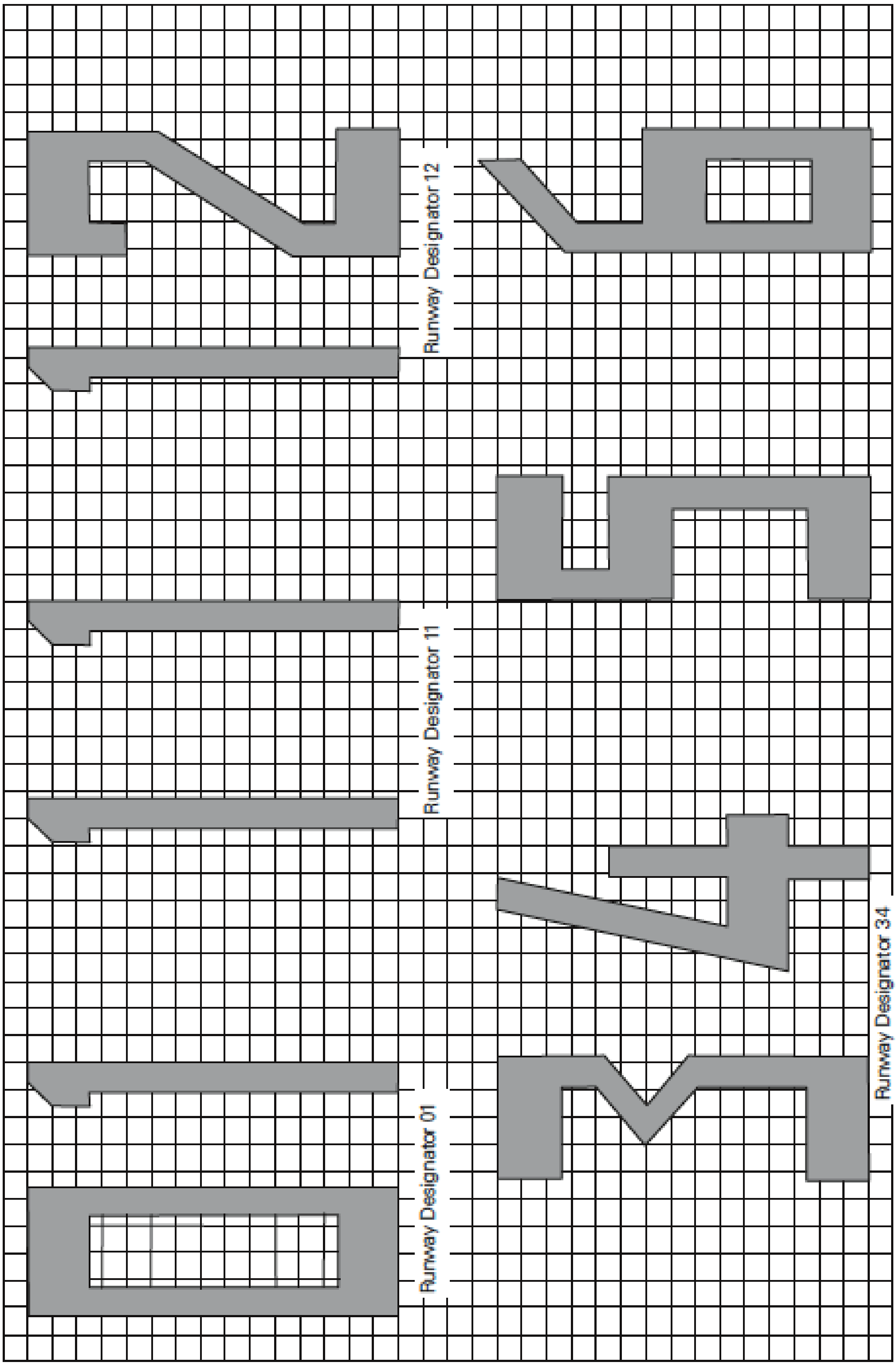
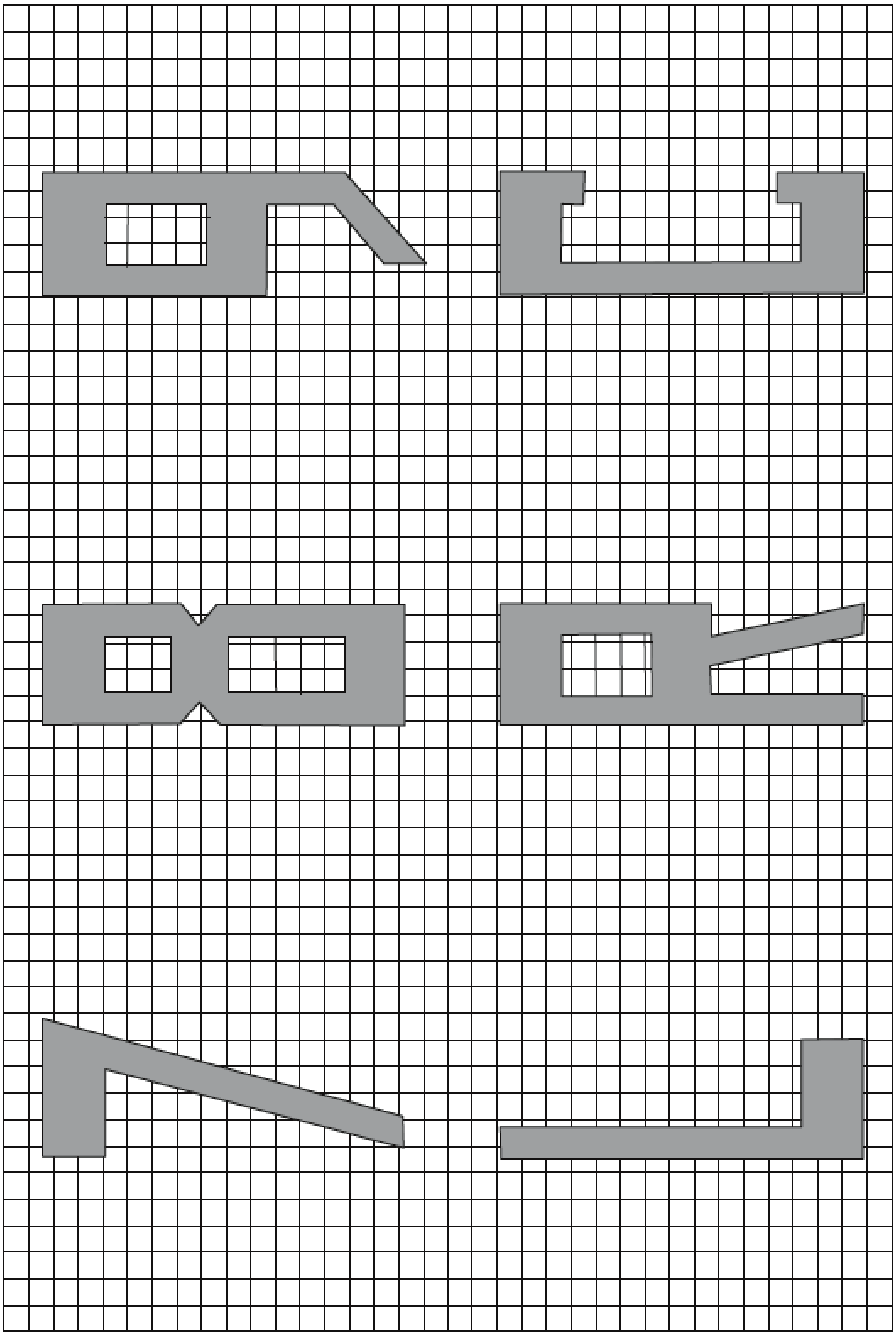


Figure 7B.2 Runway designator character dimensions – 15m characters



APPENDIX 7C

Form and proportions of pavement

Information marking – taxiways and aprons

1. This appendix details the form and proportions of the letters and numbers that should be used for pavement information markings on taxiways and aprons, drawn on a 5 mm grid in order to facilitate enlarging. The characters and symbols may be enlarged to the desired size by any conventional process and will remain in proper proportion. To obtain characters of any height, divide the desired height in millimetres by 20 and use this value for size of the grid unit. For example, characters 2 m high will require a grid unit dimension of 100 mm. Similar means may be used to enlarge the symbols. Standard characters are twenty grid units high and five units wide. Horizontal strokes are three units deep. The space between characters should be two units, but optical spacing may be used. All characters having an arc at the top or bottom are extended slightly above or below the grid lines. An identical set of curves is used for 'B', 'D' and similar characters. Another identical set of curves is used for 'C', 'G', '2' etc.

2. The height of characters employed should be not less than 2 m and normally not more than 4 m.

3. Examples of surface painted signs are shown at figure 7 C . 6 .

Figure 7C.1 Pavement markings

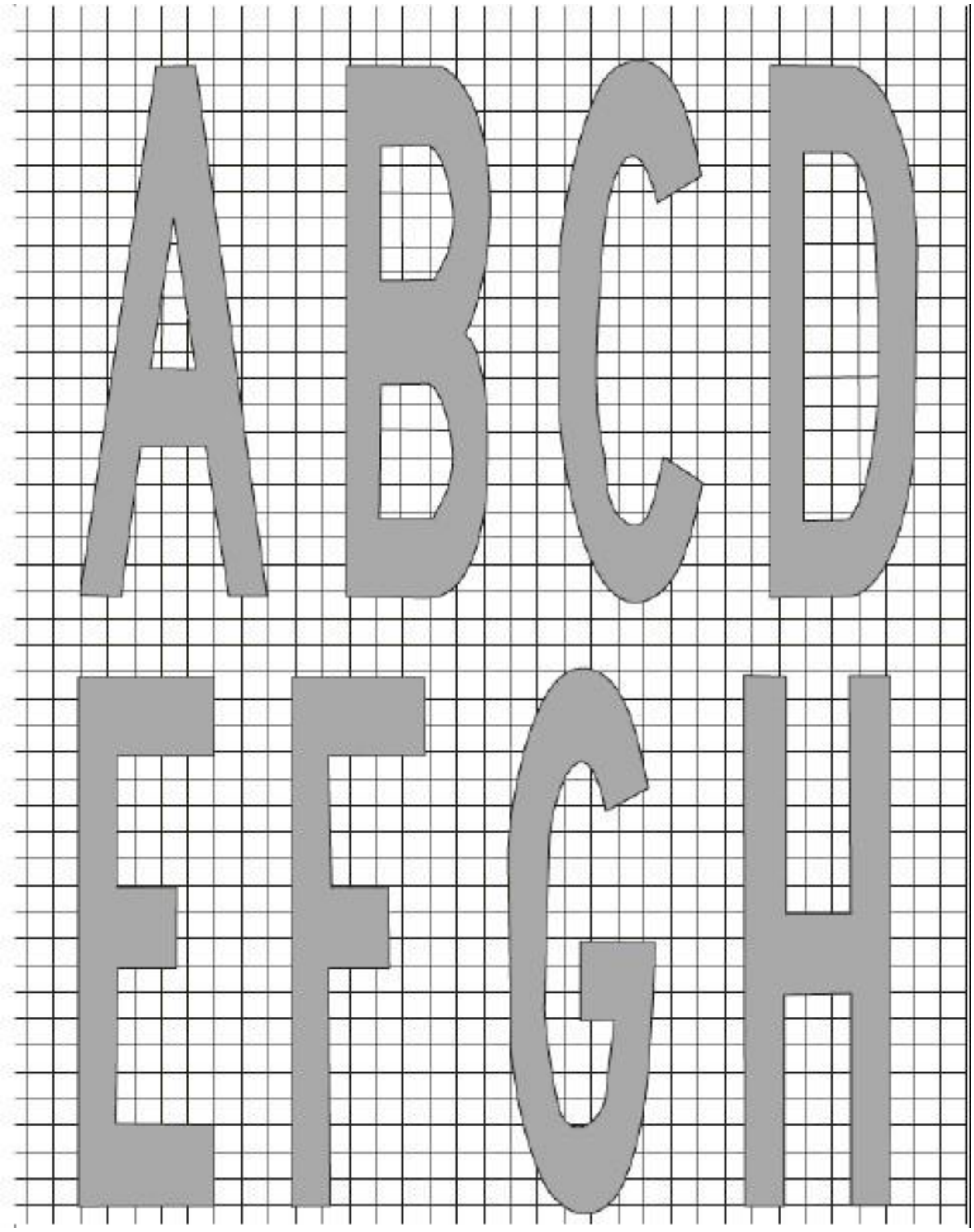


Figure 7C.2 Pavement markings

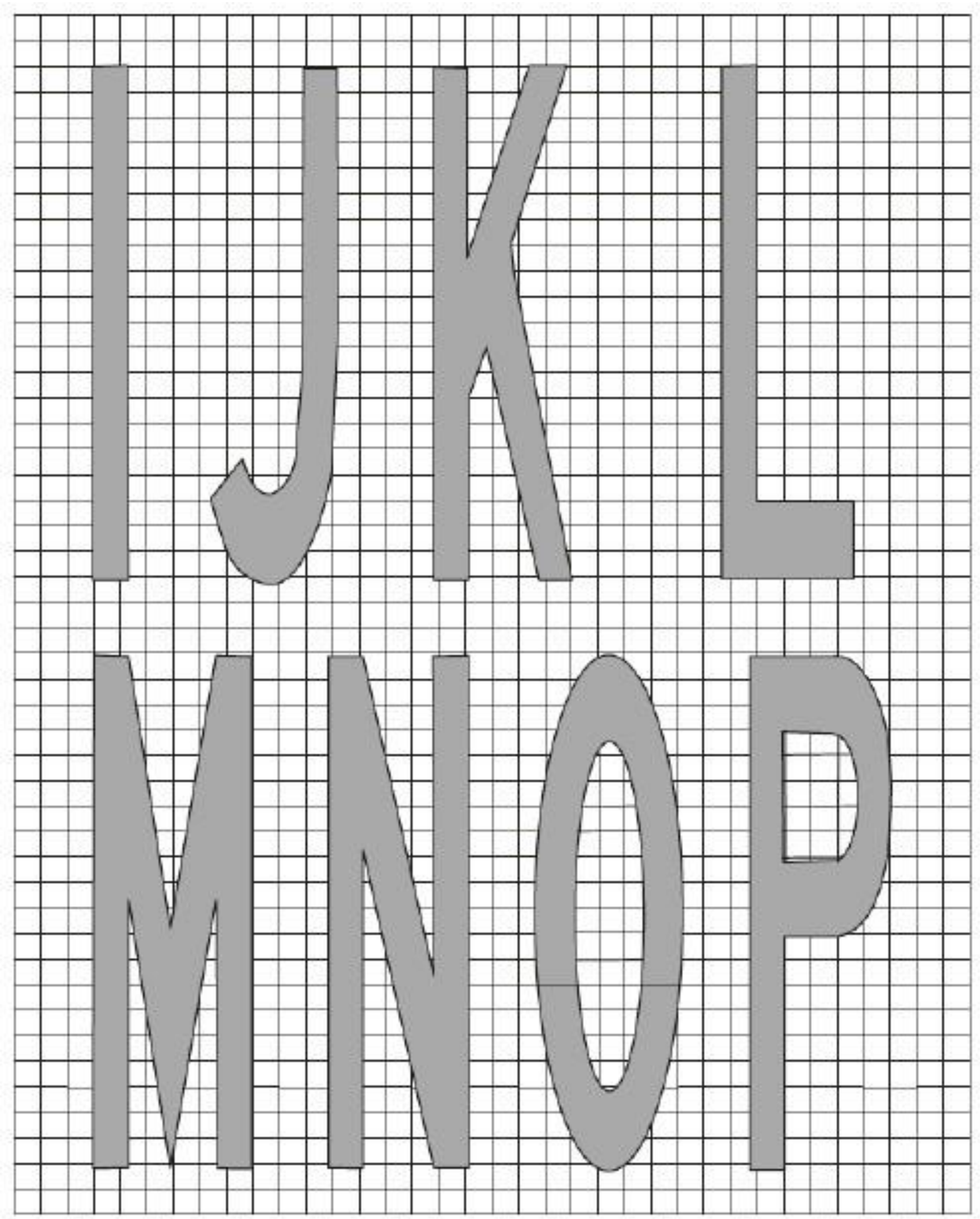


Figure 7C.3 Pavement markings

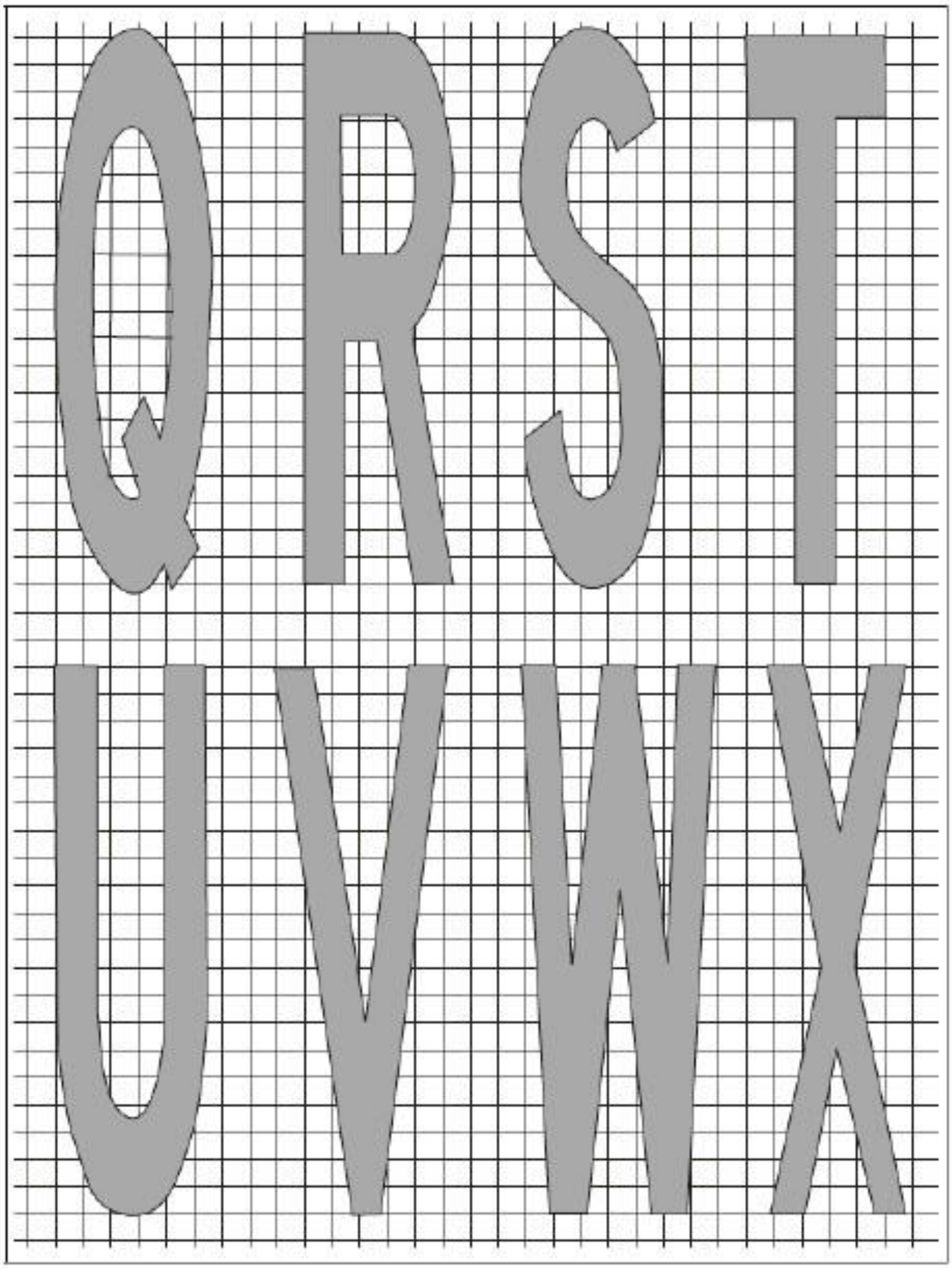


Figure 7C.4 Pavement markings

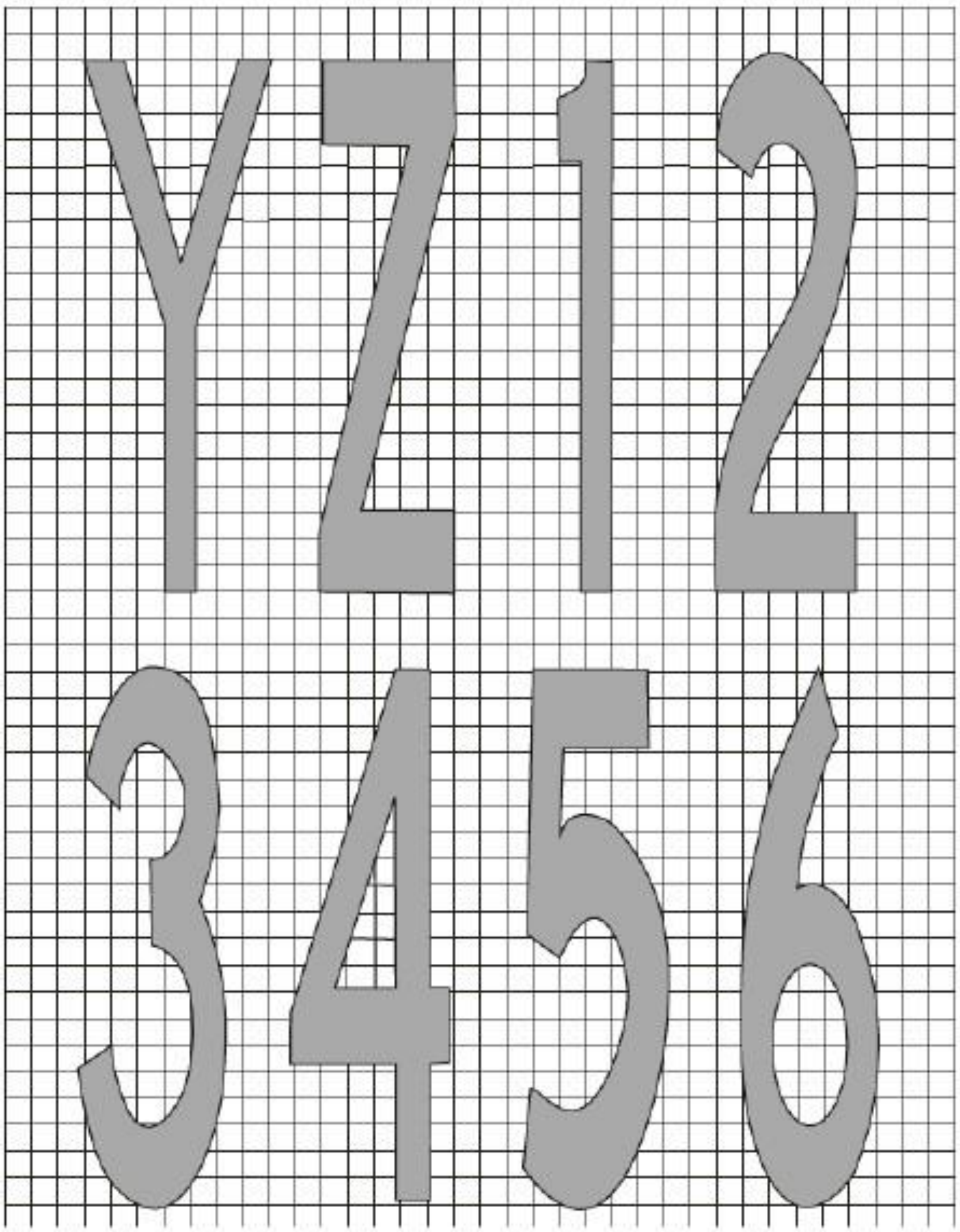


Figure 7C.5 Pavement markings

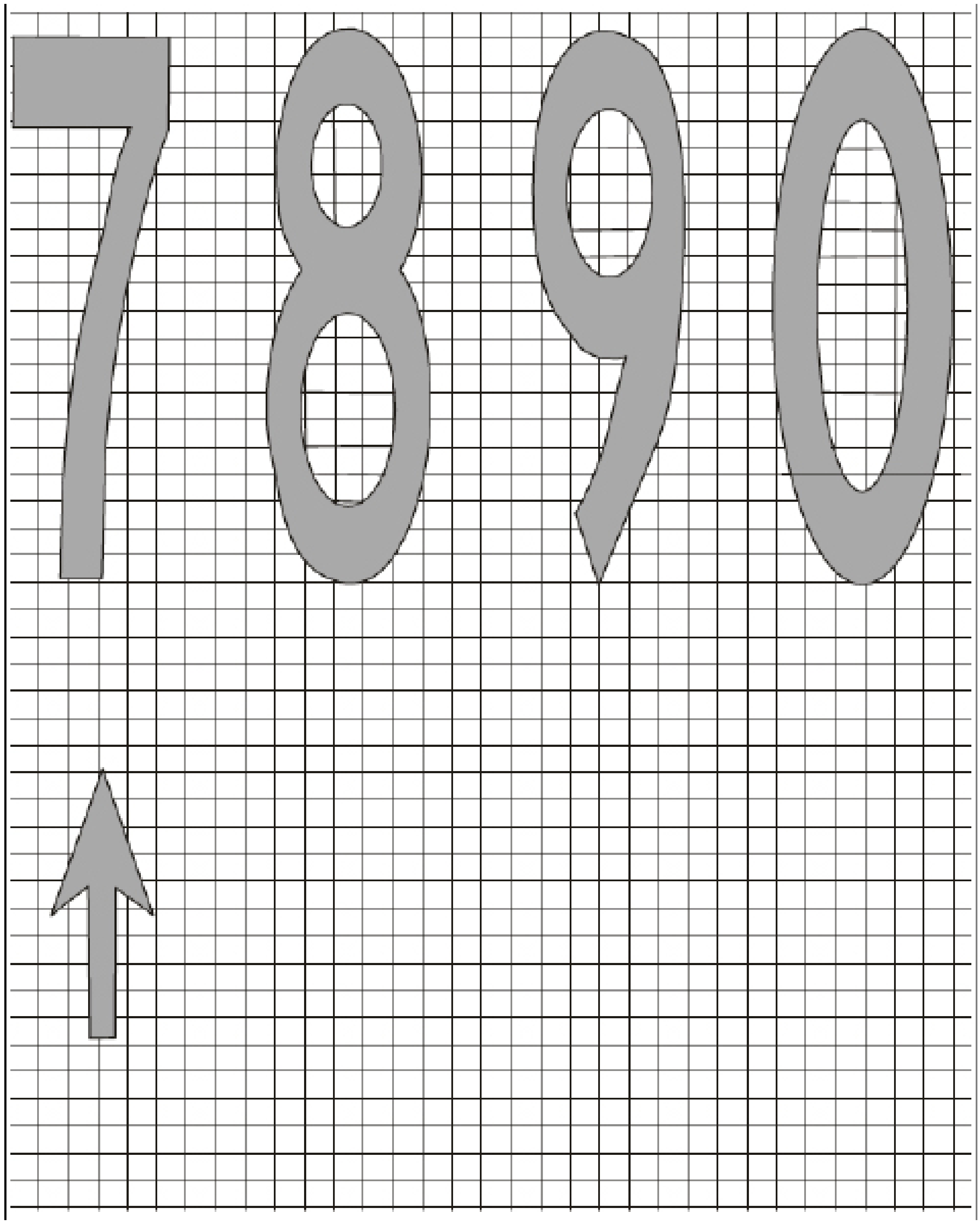
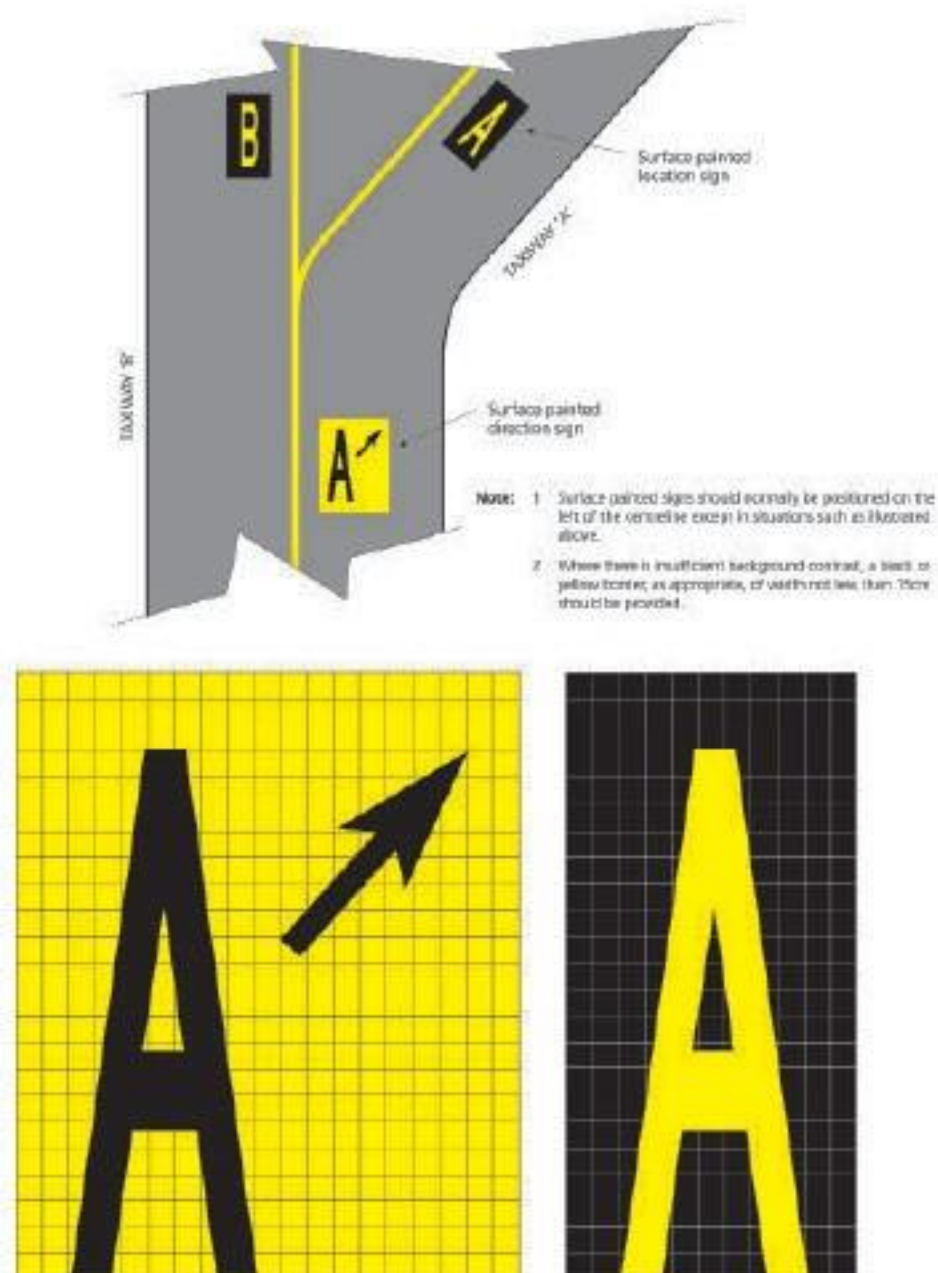


Figure 7c.6 Pavement markings for taxiways and aprons – examples of surface painted signs



Note: The grid is shown only for the purpose of illustrating sign size in relation to character proportions and should not show on the completed sign.

CHAPTER 8

Rescue and fire fighting service (RFFS)

Introduction

8.1 Condition 2 in the public use and ordinary aerodrome licenses makes it mandatory for Aerodrome Operators to provide a Rescue and Fire Fighting Service (RFFS) appropriate to their aerodrome and as detailed in this chapter.

8.2 This chapter provides the minimum requirements relating to RFFS categories 3–10. Requirements relating to RFFS category one and two are contained in appendix 8B.

8.3 Requirements relating to helicopter categories H1-H3 are contained in appendix 8A. Requirements for RFFS category special and helicopter category special are contained in appendix 8 C.

8.4 The objective of this chapter is to provide guidance to Aerodrome Operators on meeting CAA requirements relating to the establishment of a Rescue and Fire Fighting Service (RFFS) at a UK licensed aerodrome, and on ensuring the RFFS is capable of meeting ongoing regulatory requirements.

8.5 The scale and standards of RFFS including medical resources to be provided at licensed aerodromes in the United Kingdom accord with the International Civil Aviation Organization (ICAO) Standards and Recommended Practices (SARPs).

8.6 The Air Navigation Order (ANO) requires Aerodrome Operators to include in the aerodrome manual the scale of rescue, first aid and fire service facilities and the aerodrome emergency procedures. Guidance on the preparation and contents of the aerodrome manual is provided in chapter 2 of this CAP.

8.7 The effects on the environment of RFFS activities should be considered and mitigated wherever possible. The main areas of concern the RFFS should consider are water and media run-off, and air quality.

RFFS provision

8.8 Rescue and fire fighting equipment and services shall be provided at an aerodrome.

8.9 The level of protection normally available at an aerodrome should be expressed in terms of the category of the rescue and fire fighting services as described in table 8.1 and in accordance with the types and amounts of extinguishing agents normally available at the aerodrome.

8.10 The rescue and firefighting level of protection is appropriate to the aerodrome category determined using the principles in paragraphs 8.11 and 8.12 below except that where the number of movements (landing or take-off) of aeroplanes

performing passenger transportation in the highest category, normally using the aerodrome, is less than 700 in the busiest consecutive three months, the level of protection provided in accordance with paragraphs 8.11 and 8.12 below may be reduced by no more than one category below the determined one.

8.11 The aerodrome (RFFS) category shall be determined from table 8.1 and shall be based on the longest aeroplanes normally using the aerodrome and their fuselage width.

8.12 If, after selecting the category appropriate to the longest aeroplane's overall length, the aeroplane's fuselage width is greater than the maximum width for that category, then the category for that aeroplane shall be one category higher.

Table 8.1 Aerodrome category for rescue and fire fighting

Aerodrome category (1)	Aeroplane overall length (2)	Maximum fuselage width (3)
3	12m up to but not including 18m	3m
4	18m up to but not including 24m	4m
5	24m up to but not including 28m	4m
6	28m up to but not including 39m	5m
7	39m up to but not including 49m	5m
8	49m up to but not including 61m	7m
9	61m up to but not including 76m	7m
10	76m up to but not including 90m	8m

8.13 The aerodrome operator, in order to assess whether the rescue and firefighting level of protection to be provided at the aerodrome is appropriate to the aerodrome rescue and firefighting category, should, at least annually, forecast the aeroplane traffic expected to operate at the aerodrome for the next twelve-month period. Upon knowledge of planned changes to traffic volume and structure, additional assessments might be necessary. In doing so, the aerodrome operator may use all information available from aeroplane operators as well as statistics on aeroplane movements during the year preceding the day of the review.

8.14 During anticipated periods of reduced activity, the level of protection available shall be no less than that needed for the highest category of aeroplane planned to use the aerodrome during that time regardless of the number of movements.

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

8.16 A change should be expressed in terms of the new category of the rescue and fire fighting service available at the aerodrome.

8.17 Aerodrome Operators should develop contingency plans to limit the need for changes to the promulgated level of services. This may involve, for example, a preventative maintenance plan to ensure the mechanical efficiency of equipment and vehicles, and arrangements to cover unplanned leave and absence of the minimum level of RFF personnel including supervisory level.

8.18 The RFFS shall be provided throughout the hours a licensed aerodrome is available for use by aircraft engaged on flights required to use a licensed aerodrome and for 15 minutes after the departure of the last aircraft or until the aircraft has reached its destination, whichever is the shorter.

8.19 The level of protection required for all-cargo, mail, ferry, training, test, positioning and end-of-life aeroplane operations, including those carrying dangerous goods, irrespective of the number of movements, may be reduced in accordance with Table 8.1A as follows:

Table 81.A

Aerodrome category	RFF level of protection required
3	3
4	4
5	5
6	5
7	6
8	6
9	7
10	7

RFFS principal objective

8.20 The principal objective of a rescue and fire fighting service is to save lives. For this reason, the provision of means of dealing with an aircraft accident or incident occurring at, or in the immediate vicinity of, an aerodrome assumes primary importance because it is within this area that there are the greatest opportunities for saving lives. This must assume at all times the possibility of, and need for, extinguishing a fire which may occur either immediately following an aircraft accident or incident, or at any time during rescue operations.

8.21 The most important factors bearing on effective rescue in a survivable aircraft accident are the training received, and the effectiveness of the equipment and the speed with which personnel and equipment designated for rescue and fire fighting purposes can be put into use.

8.22 Requirements to combat building fires and fuel farm fires, or to deal with foaming of runways are not taken into account.

Operational objective

8.23 The operational objective of the RFFS is to respond as quickly as possible to aircraft accidents and/or incidents in order to create maximum opportunity for saving life. Achievement of response times is dependent on the size of aerodrome, location of fire station(s) and disposition of vehicles and personnel at any given time.

8.24 The operational objective of the rescue and fire fighting service shall be to achieve a response time not exceeding three minutes to any point of each operational runway, in optimum visibility and surface conditions. The operational objective of the rescue and fire fighting service should be to achieve a response time not exceeding three minutes to any other part of the movement area in optimum visibility and surface conditions.

8.25 The operational objective of the rescue and fire fighting service should be to achieve a response time not exceeding two minutes to any point of each operational runway, in optimum visibility and surface conditions.

8.26 Response time is considered to be the time between the initial call to the rescue and fire fighting service, and the time when the first responding vehicle(s) is (are) in position to apply foam at a rate of at least 50% of the discharge rate specified in table 8.3.

Note: *Optimum visibility and surface conditions are defined as daytime, good visibility, no precipitation with normal response route free of surface contamination e.g. water, ice or snow.*

8.27 A response safe system of work includes a number of elements that must come together to deliver an effective and safe response. A comprehensive hazard and risk analysis should be conducted over the optimum response routes within the aerodrome boundary that RFFS vehicles are likely to use to achieve the operational objective. The analysis and system of work should consider:

a) standard operating procedures

b) call handling

c) alerting system

d) position of the fire station or standby area

e) position of training area where a response may be made from

f) suitable access roads and routes

g) visibility and surface conditions

h) a clear route

i) vehicle performance

j) vehicle maintenance

k) effective equipment

l) competent staff

m) communications

n) an effective safety culture

o) effective leadership and incident command

p) human factors

q) monitoring and review including records

8.28 In assessing an effective response all of these areas will be scrutinised and reviewed. Aerodrome Operators should not focus on any one aspect in isolation in measuring effectiveness.

Continuous agent application

8.29 During flight operations, sufficient trained and competent personnel should be designated to be readily available to ride the rescue and fire fighting vehicles and to operate the equipment at maximum capacity. These trained personnel should be deployed in a way that ensures that minimum response times can be achieved and that continuous agent application at the appropriate rate can be fully maintained. Consideration should also be given for personnel to use hand lines, ladders and other rescue and fire fighting equipment normally associated with aircraft rescue and fire fighting operations.

8.30 Any other vehicles required to deliver the amounts of extinguishing agents specified in table 8.3 should arrive no more than one minute after the first responding vehicle(s) so as to provide continuous agent applications.

Minimum levels of personnel

8.31 In determining the number of personnel required to provide for rescue and fire fighting , consideration should be given to the types of aircraft using the aerodrome.

8.32 In determining the minimum number of rescue and fire fighting personnel and supervisory levels required, a Task Resource Analysis (TRA) should be completed and the level of staffing and qualification promulgated in, or referenced to, the aerodrome manual. CAP 1150 should be referred to for additional guidance.

8.33 The objective of providing an adequate level of competent personnel is to have available sufficient staff at all responsibility levels to ensure that:

a) the RFFS is capable of achieving the Principal Objective;

b) all vehicles and equipment can be operated effectively and safely;

c) continuous agent application at the appropriate rate(s) can be fully maintained;

d) sufficient supervisory grades can implement an Incident Command System;

e) the RFFS elements of the aerodrome emergency plan can be effectively achieved.

8.34 The minimum staffing and supervisory levels resulting from the analysis should be detailed in the aerodrome manual.

8.35 The Aerodrome Operator shall develop and implement a training programme to ensure that RFFS personnel are competent in their task and role.

8.36 Aerodrome Operators are, or should designate a person who is, responsible for the overall control and management of the aerodrome RFFS, and this person should adopt the role of fire service manager. The RFFS management structure should provide for a competent person to take command of an emergency response throughout the promulgated hours of operation.

8.37 RFFS personnel should be identified by markings in accordance with the National Incident Command System. The officer in charge of the aerodrome RFFS should wear a conspicuous coloured tunic or tabard in order to become distinguishable from the local authority fire officer.

8.38 To produce foam or other extinguishing agent on the move there should be a driver and a monitor operator.

Extraneous duties

8.39 No extraneous duty should create conditions likely to compromise individual or crew performance or introduce additional hazards. RFFS personnel designated as part of the minimum level for response, and who are engaged on extraneous duties, shall be capable of meeting the response time objective while carrying out those duties. It is not considered reasonable to require personnel designated as part of the minimum riding strength to be engaged on duties involving the handling of fuel.

Medical standards

8.40 The objective of requiring medical assessments for aerodrome RFFS personnel is to ensure an acceptable standard for the fitness of personnel likely to be engaged in operational duties.

8.41 As the nature of RFF operations involves periods of intense physical activity, all RFF personnel have to possess a minimum level of physical fitness and medical fitness to be able to perform the tasks associated with these operations. Physical fitness and medical fitness is often described as the overall physical condition of the body, which can range from peak condition for performance at one end of the spectrum to extreme illness or injury at the other.

8.42 The key fitness components for RFF are generally aerobic fitness, anaerobic fitness, flexibility and medical fitness. Optimum physical fitness and medical fitness for RFF personnel would mean that a firefighter is able to carry out RFF activities safely, successfully and without undue fatigue.

Aerobic fitness:

8.43 This is the ability to continue to exercise for prolonged periods of time at low to moderate or high intensity. This is typically what limits the ability to continue to run, cycle or swim for more than a few minutes and is dependent upon the body's heart, lungs and blood to get the oxygen to the muscles (VO2) providing the sustained energy needed to maintain prolonged exercise. Typical aerobic activities include walking, jogging, cycling, rope skipping, stair climbing, swimming, or any other endurance activities.

Anaerobic fitness:

8.44 This works differently to aerobic fitness. It is an activity that requires high levels of energy and is done for only a few seconds or minutes at a high level of intensity. The term anaerobic means "without oxygen". Participation in anaerobic activities leads to anaerobic fitness, which may be defined as higher levels of muscular strength, speed and power. Examples of anaerobic activities include heavy weight lifting, running up several flights of stairs, sprinting, power swimming, or any other rapid burst of hard exercises.

Flexibility:

8.45 This refers to the ability to move the limbs and joints into specific positions at the end of their normal range of movement. Flexibility is important as it will allow the body to work in cramped positions without unduly stressing the muscles, tendons and ligaments and may reduce the risk of injury. Flexibility is best developed using slow controlled stretching exercises.

8.46 The physical fitness assessment should be catered to the components mentioned above. RFF services should develop various types of tests to ensure that these components are tested to determine if the RFF personnel has the required physical fitness level for the job. The physical fitness assessment should also be conducted at least once a year. The physical fitness assessment should be conducted for pre-employment entry as a firefighter as well as ongoing physical fitness assessments for existing RFF staff to ensure they are maintaining their level of physical fitness.

Medical fitness:

8.47 Medical fitness assessments specific to RFF services should be developed. The medical fitness assessments should be conducted for pre-employment entry as a firefighter as well as ongoing medical fitness assessments for existing staff. The frequency of medical fitness assessments should be determined by each agency.

8.48 The medical fitness assessments should be used to identify any underlying medical conditions, which may pose a risk to the individual firefighter during physically demanding activities. The objective of requiring medical assessments for aerodrome RFFS personnel is to ensure an acceptable standard for the fitness of personnel likely to be engaged in operational duties.

8.49 Operators should ensure that initial and ongoing medical assessment is conducted by a competent organisation.

RFFS training

8.50 All rescue and fire fighting personnel shall be properly trained to perform their duties in an efficient manner and shall participate in live fire drills commensurate with the types of aircraft and the type of rescue and fire fighting equipment in use at the aerodrome, including pressure-fed fuel fires. Pressure-fed fuel fires can be either hydrocarbon or liquefied petroleum gas (LPG) and the training facilities should be commensurate with the risks.

8.51 Where LPG is used for live fire drills, provision should also be made for RFFS personnel to periodically practice the application of the types of extinguishing agent available at the aerodrome onto a hydrocarbon liquid fire.

8.52 The frequency of live fire drills, and the periodic application of firefighting agent to control and extinguish a hydrocarbon liquid fire, should be determined through a suitable training needs analysis.

8.53 RFFS personnel should receive appropriate initial and regular comprehensive recurrent training appropriate to their role and task to maintain the skills necessary to ensure that RFFS equipment can be put to use effectively. Guidance on developing and implementing an RFFS training programme can be found in CAP 699, Framework for the Competence of Rescue and Fire Fighting Service (RFFS) Personnel.

8.54 The rescue and fire fighting personnel training programme shall include training in human performance, including team co-ordination as set out in CAP 699.

Equipment

8.55 Rescue equipment commensurate with the level of aircraft operations should be provided on the rescue and fire fighting vehicle(s) and be based on the task and resource analysis.

8.56 All responding rescue and fire fighting personnel shall be provided with personal protective equipment to enable them to perform their duties in an effective manner.

8.57 Account should be taken of the Provision and Use of Work Equipment Regulations (PUWER) and the Personal Protective Equipment at Work Regulations which require that equipment is:

1. suitable for the intended use;
2. safe for use, maintained in a safe condition and, in certain circumstances, inspected to ensure this remains the case;
3. used only by people who have received adequate information, instruction and training; and
4. accompanied by suitable safety measures, e.g. protective devices, markings, warnings.

8.58 Guidance on the rescue equipment to be provided at an aerodrome is given in the ICAO

Airport Services Manual, Part 1.

8.59 Records of all tests and inspections shall be maintained by the Aerodrome Operator for a period of five years. The records should include details of consequential action where an inspection has revealed a defect or deficiency.

Appliances

8.60 The objective is to design and procure appliance(s) that are fit for the purpose for which they are required.

8.61 The minimum number of foam-producing vehicles shall not be less than that set out in table 8.2

8.62 Guidance on minimum characteristics of RFFS vehicles is given in the ICAO Airport Services Manual Part 1, which also gives guidance on procurement: procurement should be based on a formal specification process that provides a phased approach and considers the preliminary preparation of specification, and additional contractual considerations.

Table 8.2 Minimum number of RFFS appliances/vehicles

Aerodrome category	3	4	5	6	7	8	9	10
Minimum number of foam producing vehicles	1	1	1	2	2	3	3	3

8.63 A system of preventative maintenance of rescue and fire fighting vehicles should be employed to ensure effectiveness of the equipment and compliance with the specified response time throughout the life of the vehicle.

Minimum useable amounts of extinguishing agents

	Foam meeting performance level A		**Foam meeting performance level B**		**Foam meeting performance level C**		**Complementary agents**	
Aerodrome **category (1)**	**Water (L) (2)**	**Discharge rate foam solution (L/min) (3)**	**Water (L) (4)**	**Discharge rate foam solution (L/min) (5)**	**Water (L) (6)**	**Discharge rate foam solution (L/min) (7)**	**Dry chemical powders (kg) (8)**	**Discharge rate (kg/ sec) (9)**
3	1 800	1 300	1 200	900	820	630	135	2.25
4	3 600	2 600	2 400	1800	1 700	1 100	135	2.25
5	8 100	4 500	5 400	3 000	3 900	2 200	180	2.25
6	11 800	6 000	7 900	4 000	5 800	2 900	225	2.25
7	18 200	7 900	12 100	5 300	8 800	3 800	225	2.25
8	27 300	10 800	18 200	7 200	12 800	5 100	450	4.5
9	36 400	13 500	24 300	9 000	17 100	6 300	450	4.5
10	48 200	16 600	32 300	11 200	22 800	7 900	450	4.5

Notes:

the quantities of water shown in columns 2, 4 and 6 are based on the average overall length of aeroplanes in a given category

See paragraphs 8.64, 8.65, 8.72, 8.75, 8.76, 8.77, 8.78 and 8.79

8.64 At aerodromes where operation by aeroplanes larger than the average size in the given category are planned, the quantities of water should be recalculated and the amount of water for foam production and the discharge rates for foam solution should be increased accordingly. Additional guidance is available in chapter 2 of the ICAO (Doc.9137), Airport Services Manual, Part 1. In addition to the above the following should be taken into account:

1. Where the level of protection is reduced in accordance with 8.10 above, a recalculation of quantities of extinguishing agents should be carried out based on the largest aeroplane in the reduced category;
2. For all-cargo, mail, training, test, positioning and end-of-life aeroplane operations, including those carrying dangerous goods, the recalculation of extinguishing agents should be based on the largest aeroplane in the category specified in Table 8.1A above.

Extinguishing agents

8.65 The objective of an extinguishing agent is to extinguish/suppress a fire on which it is applied. Principal agents are provided for permanent control, i.e., for a period of several minutes or longer. Complementary agents may provide rapid fire suppression but generally only offer a transient control, which is available during application. The ICAO Critical Area Concept is not intended to ensure extinguishment of the entire fire, it seeks to control only the area of fire adjacent to the fuselage. The objective is to safeguard the integrity of the fuselage and maintain tolerable conditions for its occupants.

8.66 Both principal and complementary agents should normally be provided at an aerodrome.

Principal extinguishing agents

8.67 The principal extinguishing agent should be:

1. a foam meeting the minimum performance level A; or
2. a foam meeting the minimum performance level B; or
3. a foam meeting the minimum performance level C; or
4. a combination of these agents

except that the principal extinguishing agent for aerodromes in categories 1 to 3 shall meet the minimum performance level B or C.

8.68 The required quantities of extinguishing agents shall be in accordance with the aerodrome category, determined by tables 8.1, 8.2, and 8.3 and shall be available for immediate discharge from RFFS appliances.

8.69 For RFFS Categories 3-10, the discharge rates for foam shall be met using vehicle monitor(s).

8.70 Where different types of extinguishing agents are used on an aerodrome, care must be taken to ensure that incompatible types are kept apart and stored in accordance with manufacturer's guidance.

8.71 Alternative principal extinguishing agents which are not defined in the ICAO Airport Services Manual (Doc.9137) Part 1, will require evidence that demonstrates the agent achieves an equivalent level of performance.

8.72 The quantity of foam concentrates separately provided on vehicles for foam production shall be in proportion to the quantity of water provided and the foam concentrate selected.

8.73 The amount of foam concentrate provided on a vehicle should be sufficient to produce at least two loads of foam solution.

8.74 When a combination of different performance level foams are provided at an aerodrome, the total amount of water to be provided for foam production should be calculated for each foam type and the distribution of these quantities should be documented for each vehicle and applied to the overall rescue and fire fighting requirement.

8.75 The amounts of water specified for foam production are predicated on an application rate of 8.2 L/min/m2 for a foam meeting performance level A, 5.5 L/ min/m2 for a foam meeting performance level B and 3.75L/min/m2 for a foam meeting performance Level C.

Worked example:

8.76 An RFFS Category 6 aerodrome, using performance level B foam, is required to have two appliances with a total of 7,900 litres of water and 948 litres of foam concentrate (two shots). It is also required to have 1,896 litres of foam concentrate in reserve (200% of 948). The total foam concentrate required on the aerodrome is 2,844 litres.

8.77 It actually has two appliances with 5,000 litres of water and 600 litres (2 x 300) of foam concentrate on each vehicle and 1,644 litres of foam concentrate in reserve, making its total 2,844 litres.

Note: *By distributing its foam concentrate in this way it enables the vehicles to run with full tanks avoiding any free space which could upset the vehicle handling characteristics.*

Complementary extinguishing agents

8.78 The complementary extinguishing agent should be a dry chemical powder suitable for extinguishing hydrocarbon fires, or any other alternative agent having equivalent firefighting capability.

8.79 The complementary agents should comply with the appropriate specifications of the International Organisation for Standardisation (ISO).

8.80 A quantity of gaseous agent or CO_2 shall be provided for use on small or hidden fires. A minimum extinguisher size is 5 kg for major and 2 kg for smaller vehicles.

8.81 Systems should be capable of delivering the agent through equipment which will ensure its effective application.

8.82 The discharge rate of complementary agents should be not less than the values shown in Table 8.3

8.83 If a 'high performance' dry powder is used it may be permissible to reduce the amount provided.

8.84 If an aerodrome operator wishes to reduce the quantity of dry powder provided (as outlined in 8.75 above) they must apply to CAA for such a concession.
The application must be supported by an assessment that shows how the aerodrome operator is assured that the lower quantity of dry powder can provide an equivalent level of fire extinguishing performance for the types of fires where the agent is expected to be used.

Reserve supply of agents

8.85 A 200% reserve of foam concentrate and 100% of complementary agents and propellant gas shall be available at the aerodrome.

8.86 Extinguishing agent quantities designated as reserve should be held in any appropriate manner which easily allows vehicles to be replenished promptly (including on vehicles themselves).

8.87 Agent carried on appliances in excess of the minimum quantities can contribute to the reserve.

8.88 Where a major delay in the replenishment of the supplies is anticipated, the amount of reserve supply should be increased as determined by a risk assessment.

Storage of extinguishing agents

8.89 In addition to any statutory or legal requirements, consideration should be given to:

1. avoiding prolonged or extreme storage conditions;
2. regular inspection and testing;
3. keeping of log books and records;
4. manufacturers' recommended service and test intervals.

8.90 Where different generic types of extinguishing agents are used on the aerodrome, care must be taken to ensure that incompatible types are kept apart and care is exercised when these have to be used simultaneously against fires (e.g. powders and foams). In particular, the mixing of different types of foam concentrate may lead to serious sludging and possible malfunctioning of vehicle foam production systems. If it is necessary to change the concentrate type carried on a vehicle, it is essential that the manufacturers of the concentrate and the vehicle are consulted for guidance to ensure that all parts of the foam system are thoroughly cleaned prior to the new concentrate being used. This is vital to prevent any damage to foam systems or detrimental foam performance caused by the inadvertent mixing of incompatible foam concentrate types.

8.91 For extinguishing agents that have a certificate of conformity and have remained sealed and stored according to manufacturer's guidance, a test to assess condition is not required within their shelf life unless the manufacturer's guidance recommends it.

8.92 Any stocks of fire extinguishing agents, such as foam concentrates held in bulk tanks, including appliance tanks, and drums where the seal has been broken, should be assessed for continued satisfactory performance by taking samples from each batch and having these analysed at regular intervals by a competent person. (By way of guidance, the measurement of those physical and chemical properties determined as being important during the selection phase using methods outlined in national standards will be appropriate).

8.93 Aerodrome Operators should ensure that suppliers of fire extinguishing media provide a certificate of assurance for each batch to the effect that the media supplied meets all requirements of para 8.101 and any supplementary conditions agreed with themselves prior to the occasion of the first purchase (e.g. suitability for use in premixed form). Material Safety Data Sheets should be used to determine the best practice with respect to hazards, use, storage and disposal of extinguishing agents.

Foam production performance testing

8.94 It is essential that the foam produced by an RFFS vehicle, or other such appliance, is of an acceptable quality and the delivery parameters such as monitor jet range and pattern meet and are maintained to the appropriate operational requirement.

8.95 In order to ensure that foam production by an RFFS vehicle is of an acceptable standard a Foam Production Performance Test (i.e. an 'Acceptance Test') should be carried out:

1. when a RFFS vehicle is first acquired by the Aerodrome Operator for operational use at an aerodrome. (Acquisition may mean the new or second- hand purchase, leasing or hire of a RFFS Vehicle);
2. when significant maintenance, refurbishment or component replacement has been undertaken on a RFFS vehicle that could effect a change in the foam quality or production performance of the foam-making system. This includes a change of foam-making branches, nozzles or monitors. Only those parts of the system that could have been affected by the work undertaken or the component change need to be tested.

8.96 The Foam Production Performance Test should confirm the following:

1. the induction percentage for all foam-making devices. (If the foam production system is fitted with an Induction Monitoring System, the test results obtained

2. from analysis of the foam sample should correspond with those provided with the monitoring system, i.e., check for correct calibration and accuracy of induction monitoring system). Induction can be checked using water instead of foam;
3. the expansion ratio of all foam-making devices;
4. the quarter drainage time of all foam-making devices;
5. the jet range of the main monitor;
6. the spray pattern of the main monitor.

8.97 The test should be carried out to confirm the performance against a specification based on ICAO Airport Services Manual (Doc 9137), Part I - Rescue and Fire Fighting, Chapter 8, and should be conducted to an appropriate standard.

8.98 For vehicles equipped with foam monitors capable of producing foam while on the move, the tests shall include an assessment of this capability. Where both a high and low discharge capability has been provided on larger monitors; this provision should be tested in line with manufacturer's guidance.

8.99 For systems designed to induce at 6%, induction should be in the range 5% to 7% at the optimum working conditions. For systems designed to induce at 3%, the range is 3% to 4% and for 1% systems, the range is 1% to 1.1%. Pre-mixed foam systems shall have foam concentrate introduced to within a tolerance of 1.0 to 1.1 times the manufacturer's desired induction rate. Care should be taken in the use of freeze point depressants where pre-mixed foam systems are exposed to low temperatures, since excessive amounts of additives may have adverse effects on fire extinguishing performance.

In-service test

8.100 The in-service test should be conducted:

1. to ensure the ongoing capability of the foam production system;
2. at least every 12 months.

8.101 Once the foam production system has been fully tested, and assuming no changes have been made, the in-service testing shall consist of periodic checks to ensure induction accuracy.

8.102 The most effective method of continually assuring the induction accuracy is for the vehicle to be fitted with a monitoring device which:

1. monitors the induction percentage;
2. records the dates and percentage inductions of foam concentrate;
3. has an alert if the induction rate goes outside set parameters.

8.103 The frequency of the in-service tests should be determined and conducted in conjunction with the vehicle maintenance provider. The foam specimen for checking the induction percentage can be collected during normal procedural 'spot' tests or training. The most common method of conducting such a test is by using a refractometer; however, other methods are available.

8.104 Pre-mixed foam units shall be maintained and hydraulically pressure tested in accordance with the intervals set by manufacturer's guidance. Only foam concentrates suitable for use in pre-mixed form shall be used in these kinds of pressure vessels.

Foam properties

8.105 Expansion ratio: the amount of air entrained into a foam stream governs its expansion, which in turn may affect the fluidity of the finished foam and therefore the rate of spread over the surface of burning fuels. The expansion of a representative sample of the foam blanket produced should be no less than 6:1, a value between 8:1 and 12:1 being preferred.

8.106 Drainage time: the rate at which foam solution drains from a foam blanket may be a partial consideration in that foam blanket's efficiency in progressively controlling and extinguishing fires and subsequent post-fire security. Some guidance regarding an appropriate level of post-fire security provided by a finished foam blanket may be derived from experience of carrying out the ICAO fire tests. The time taken for the drainage of 25% of the foam solution from a representative sample of the foam blanket produced should be at least three minutes, and preferably more than five minutes. Any use of non-aspirated foam may need to be quickly supplemented by using aspirating foam to achieve a foam blanket of satisfactory stability.

8.107 Certain combinations of types of foam concentrate and branch pipes may be found to perform differently from others. Care should be taken during the selection process to ensure that the optimum combination of foam and equipment is chosen.

Foam performance levels and specifications

8.108 Foam concentrates used to provide the extinguishing agents quantities listed at table 8.3 are required to meet either performance level A, B or C as designated by ICAO in the Airport Services Manual (Doc 9137), Part I – Rescue and Fire Fighting, chapter 8. The performance level A, B or C is to be certificated by a recognised, accredited third party testing authority.

8.109 Training foams do not comply with any recognised national or international standards; however, they will be quality assured by the manufacturer. They may be formulated to mimic the operational foams for induction, drainage and expansion properties; however, their fire fighting properties may be reduced. Personnel must understand this feature of training foams before they are used. Care should be taken to prevent confusion between the storage and use of training foams with their operational counterparts. Where the manufacturer can demonstrate that the training foam produces identical test results to those expected to be obtained by the operational fire fighting foam, it may be used to conduct the foam production performance and in-service tests.

8.110 The management of training foam should be in line with operational foam as set out in this chapter.

Provision of additional water supplies at licensed aerodromes

8.111 Supplementary water supplies, for the expeditious replenishment of rescue and fire fighting vehicles at the scene of an aircraft accident, should be provided.

8.112 The objective of providing additional water supplies at adequate pressure and flow is to ensure rapid replenishment of aerodrome RFFS vehicles. This supports the principle of continuous application of extinguishing media to maintain survivable conditions at the scene of an aircraft accident for far longer than that provided for by the minimum amounts of water set out in table 8.3.

8.113 Additional water to replenish vehicles may be required in as little as five minutes after an accident; therefore, Aerodrome Operators should conduct an analysis to determine the extent to which it, and its associated storage and delivery facilities, should be provided.

8.114 The aerodrome should consult closely with the local authority fire and rescue service when conducting this analysis, and the following factors are among those items which should be considered (but not limited to):

a) sizes and types of aircraft using the aerodrome
b) the capacities and discharge rates of aerodrome fire vehicles
c) the provision of strategically located hydrants
d) the provision of strategically located static water supplies
e) utilisation of existing natural water supplies
f) vehicle response times
g) historical data of water used during aircraft accidents
h) the need and availability of supplementary pumping capacity
i) the provision of additional vehicle-borne supplies
j) the level of support provided by local authority emergency services
k) the pre-determined response of local authority emergency services
l) fixed pumps where these may provide a rapid and less resource intensive

method of replenishment

m) additional water supplies adjacent to airport fire service training areas

n) overhead static water supplies

o) foam concentrate compatibility

Fire station(s)

8.115 All rescue and fire fighting vehicles should normally be housed in a fire station.

8.116 Satellite fire stations should be provided whenever the response time cannot be achieved from a single fire station.

8.117 The fire station should be located so that the access for rescue and fire fighting vehicles into the runway area is direct and clear, requiring a minimum number of turns.

8.118 Guidance on the design and construction of fire stations can be found in ICAO Airport Services Manual (Doc.9137), Part 1 - Rescue and Fire Fighting.

Communications and alerting systems

8.119 A discrete communication system should be provided linking a fire station with the control tower, any other fire station on the aerodrome and the rescue and fire fighting vehicles.

8.120 An alerting system for rescue and fire fighting personnel, capable of being operated from that station, should be provided at a fire station, any other fire station on the aerodrome and the aerodrome control tower.

8.121 Communications equipment provided should ensure effective two-way communication between parties with an effective range that ensures reception within all areas that the RFFS may be required to operate in.

8.122 Radio facilities to enable the RFFS to communicate with responding Local Authority Fire Services shall be provided.

8.123 A method of monitoring the movement area for the purpose of alerting and deploying the RFFS without delay shall be provided.

8.124 Equipment to provide effective communication between vehicle drivers and foam monitor operators shall be provided.

8.125 Radio equipment to enable fire officers to maintain communications when not in their vehicles shall be provided.

8.126 Radio telecommunications (RTF) equipment shall be provided to enable the airport fire officer(s) to communicate with the aircraft flight deck. An aeronautical radio frequency, 121.600 MHz, is to be used for this purpose. All RTF communications on this frequency shall be recorded on suitable equipment that has the capability to identify the time the communication took place. Procedures shall be in place to store recordings on archival media for a minimum period of 30 days from the date of the last recorded message. The CAA and Air Accident Investigation Branch (AAIB) may require access to the recordings.

8.127 To use 121.600 MHz, the RFFS must obtain prior approval to install and operate radio equipment from the relevant licensing authority. The use of 121.600 MHz is limited to direct communications between the fire officer and pilot when the aircraft is on the ground and only within the period of a declared emergency.

Difficult environs, the 1000 m area and access roads

8.128 Where an aerodrome is located close to water/swampy areas, or difficult terrain, and where a significant portion of approach or departure operations takes place over these areas, specialist rescue services and fire fighting equipment appropriate to the hazard and risk shall be available.

8.129 Emergency access roads should be provided on an aerodrome where terrain conditions permit their construction, so as to facilitate achieving minimum response times. Particular attention should be given to the provision of ready access to approach areas up to 1000 m from the threshold, or at least within the aerodrome boundary. Where a fence is provided, the need for convenient access to outside areas should be taken into account.

8.130 An assessment of the approach and departure areas within 1000 m of the runway threshold should be carried out to determine the options available for intervention. In considering the need for any specialist rescue and access routes, the following should be considered:

a) the environment of the risk area, in particular the topography and composition of the surface

b) the physical hazards and associated risks that exist within the area

c) the options for access and for rescue and fire fighting purposes

d) changes to the response area, e.g. tidal, seasonal

e) the hazards, risks and control measures of the options for rescue

f) the use of external services

g) an analysis of the advantages and disadvantages of the options

h) policies and procedures to define and implement standards

i) competence standards to match the above

j) monitoring and review of the capability

8.131 Aerodrome Operators should ensure the development of special procedures and availability of equipment to deal with accidents that may occur in these areas. These facilities need not be located on, or provided by, the aerodrome if they can be made available by off-aerodrome agencies as detailed in the aerodrome emergency plan.

8.132 Where RFFS vehicles respond to incidents using the public highway, an assessment of the implications of such a response should be carried out. The following should be considered:

1. the legal requirements for vehicles and drivers
2. that suitable policies and procedures are in place
3. competence and training requirements for drivers
4. pre-planning of routes for suitability
5. the monitoring and review of such responses

8.133 Emergency access roads should be capable of supporting the heaviest vehicles that will use them and be usable in all weather conditions. Roads within 90m of a runway should be surfaced to prevent surface erosion and the transfer of debris to the runway. Sufficient vertical clearance should be provided from overhead obstructions for the largest vehicles.

8.134 When the surface of the road is indistinguishable from the surrounding area, or in areas where snow may obscure the location of the roads, edge markers should be placed at intervals of about 10 m.

8.135 With regard to access, Aerodrome Operators should consider the following:

1. providing direct access to the operational runway(s);
2. designating access routes to the response area;
3. the maintenance of roads and access routes;
4. eliminating the possibility of any vehicle blocking the progress of responding emergency vehicles;
5. taking account of the gross weight and maximum dimensions of the RFFS vehicle(s) expected to use them;
6. that roads are capable of being traversed in all conditions;
7. exit gates or frangible sections in the security fence;
8. exit points will need to be clearly identified. Retro-reflective tape or markers will be of assistance where the aerodrome may need to be accessible during the hours of darkness or conditions of low visibility;
9. any delethalisation requirements;
10. providing sufficient vertical clearance from overhead obstructions for the largest vehicle.

Maintaining the response capability in low visibility conditions

8.136 To meet the operational objective as nearly as possible in less than optimum conditions of visibility, especially during low visibility operations, suitable guidance, equipment and/or procedures for rescue and fire fighting services should be provided.

8.137 RFFS vehicles should approach any aircraft accident by the quickest route commensurate with safety, although this might not necessarily be the shortest distance to the scene. Traversing through unimproved areas can take longer than travelling a greater distance on paved surfaces, therefore a thorough knowledge by RFFS personnel of the topography of the aerodrome and its immediate vicinity is fundamental. The use of grid maps and careful selection of routes is essential for success in meeting the response objective.

8.138 RFFS vehicles should be equipped with an airfield chart clearly showing all taxiways, runways, holding points and vehicle routes marked with their appropriate designation. The chart(s) should be accompanied by written instructions clearly detailing the action that the driver should take in the event that the vehicle should break down or that the driver should become unsure of the vehicle's position on the aerodrome.

8.139 Consideration should be given to the provision and use of technical equipment, e.g. surface movement radar, infrared vision systems, taxiway centreline lighting, vehicle positioning equipment and other navigation aids that could enhance RFFS response to the location of an accident site in low visibility conditions.

8.140 Once low visibility operations have been initiated it may be necessary to restrict the operation of vehicles and persons in the aircraft maneuvering area. Procedures developed for ATC to assist the RFFS in case of an accident or incident should be initiated.

8.141 RFFS and associated external emergency response personnel should be made aware of the existence of any areas that may from time to time become impassable because of weather or other conditions, and of the location of obstacles both permanent and temporary.

8.142 Operational procedures should be developed through which ATC stop or divert all aircraft and non-essential traffic that conflicts with responding RFFS vehicles. RFFS personnel should continuously monitor the minimum visibility operating conditions in order to maintain response capability under such conditions.

8.143 Further guidance can be found in CAP 168, chapter 2 appendix 2B low visibility operations.

Work in Progress (WIP)

8.144 The extent to which WIP is likely to affect the response capability or operational performance of the RFFS and other emergency services should be considered during the work planning process. Where it is considered, the proposed works might have an impact, suitable mitigations should be developed and, if necessary, adjustments to the emergency plan should be made and promulgated, prior to the commencement of work.

Recording of incident data

8.145 Data from incidents attended by the RFFS can be useful in a number of ways. They can be

8.146 used to inform task and resource analysis, procurement, response policies and procedures. Whilst it is at the discretion of Aerodrome Operators how and what data they record it is suggested that the following are key fields. A template spreadsheet containing these fields is available from CAA by emailing aerodromes.ATM@caa.co.uk and requesting an 'RFFS Incident Reporting Data Template'.

Example template

Date	Incident identifier
Type of incident	Time incident closed
Type of aircraft	No. of PAX on board
Location of incident	No. of PAX evacuated
Time of call	No. of PAX rescued
Called by	Slides deployed
Time in attendance	Slides used
Size of fire	By how many pax
Fire fighting agents used	Was PEMS used (passenger evacuation management system)
Amount of agents used; initial extinguishment and prolonged control	Hazardous materials involved What How much
Time of burn before agent applied	Source of ignition
Category reduced	Category restored
RFFS vehicles attending	Fire fighting equipment used
FRS vehicles attending	Rescue equipment used
No. Of RFFS personnel	Damage to aircraft
Actions by others, FFG. or rescue	Area of damage sq m
Fatalities	Time to evacuate
Casualties	Follow up actions date closed
RFFS vehicle accidents/incidents	

Inspections and audits of the RFFS by CAA aerodrome inspectors

8.147 The objective of audits and inspections by the CAA is to establish and ensure continued regulatory compliance and the ability of the RFFS to achieve the principal and operational objectives. The CAA will perform an initial inspection/ audit of an aerodrome's RFFS unit prior to, and then subsequent to, the issue of an aerodrome licence. Once the licence has been issued, the CAA will undertake regular inspections/audits.

8.148 The CAA Inspectors will seek:

1. evidence that the Aerodrome Operator has made a full assessment of the operational requirements;
2. evidence that the necessary procedures and practices have been documented and are in place for an effective response to aircraft accidents or incidents,

3. documentary evidence relating to the training, and assessment of competence, of personnel employed in the RFFS,
4. records of training received and assessments made, including those for training exercises conducted with other emergency services,
5. records of inspections, test and maintenance of all vehicles and equipment.

8.149 The Aerodrome Operator may be required to demonstrate the effectiveness of any of the objectives contained within this chapter. This may include any element, or all elements, of the aerodrome emergency plan.

APPENDIX 8A

Surface level heliports

Introduction

1. This appendix specifies the minimum RFFS requirements, which are specifically applicable to surface level heliports.

2. A heliport is defined as ‘an area intended to be used wholly or in part for the arrival, departure and surface movement of helicopters’.

3. For areas for the exclusive use of helicopters at aerodromes primarily for the use of aeroplanes, distribution of extinguishing agents, response time, rescue equipment and personnel have not been considered in this appendix; see CAP168 Chapter 8 .

4. The principal objective of a rescue and fire fighting service is to save lives in the event of a helicopter accident or incident.

5. This must assume at all times the possibility of and need for extinguishing a fire which may:

   1. exist at the time a helicopter is touching down, lifting off, taxying, parked, etc;
   2. occur immediately following a helicopter accident or incident; or
   3. occur at any time during rescue operations.

6. For this reason, the provision of adequate means of dealing promptly with an accident or incident occurring at, or in the immediate vicinity of, a heliport assumes primary importance because it is within this area that there are the greatest opportunities to save lives.

7. The most important factors bearing on effective rescue in a survivable helicopter accident are the training received, the effectiveness of the firefighting equipment and the speed with which personnel and equipment designated for rescue and fire fighting purposes can be put into u s e .

8. Guidance material on rescue and fire fighting services for heliports can be found in:

   1. ICAO Airport Services manual (Doc 9137), Part 1 – Rescue and Fire Fighting ICAO Heliport manual (Doc 9261)).
   2. The scale and standards of RFFS to be provided at licensed surface level heliports in the United Kingdom accord with the ICAO Standards and Recommended Practices (SARPs)

Minimum scale of services to be provided

9. The heliport operator shall provide, and staff, an effective RFFS capability that can respond to a helicopter accident/incident pending the arrival of external emergency services. Information concerning the level of protection provided at a heliport for

helicopter rescue and firefighting purposes shall be made available

10. The level of protection normally available at a heliport should be expressed in terms of the category of the rescue and firefighting service as described in Para 18 below, and in accordance with the types and amounts of extinguishing agents normally available at the heliport.

11. The provisions shall be available whenever flights required to use a licensed heliport are taking place. They shall be maintained for at least 15 minutes after the time of departure of any aircraft requiring the use of a licensed heliport or until the aircraft has reached its destination, whichever is the shorter.

12. Changes in the level of protection normally available at a heliport for rescue and fire fighting shall be notified to the appropriate air traffic services units and aeronautical information units to enable those units to provide the necessary information to arriving and departing aircraft. When such a change has been corrected, the above units shall be advised accordingly. Notification should be by radio and NOTAM.

13. Changes in the level of protection from that are normally available at the heliport could result from, but may not be limited to, a change in the availability of extinguishing agent or equipment used to deliver agents, or of personnel used to operate the equipment.

14. A change should be expressed in terms of the new category of the rescue and firefighting service available at the heliport

Level of protection

15. The level of protection to be provided for rescue and fire fighting shall be based on the overall length of the longest helicopter normally using the heliport and in accordance with the heliport fire fighting category determined from table 8A.1.

16. The level of protection to be provided at a heliport (heliport RFFS category) shall be determined from table 8A.1 appropriate to the overall length of the longest helicopter using the heliport irrespective of its frequency of operations. However, during anticipated periods of operations by smaller helicopters, the heliport fire fighting category may be reduced to that of the highest category of helicopter planned to use the heliport at that time.

Table 8A.1 Heliport Fire Fighting Category

Category (1)	Maximum Fuselage Length (2)	Maximum Fuselage Width (3)
H0	Up to but not including 8m	1.5m
H1	From 8m up to but not including 12m	2m
H2	From 12m up to but not including 16m	2.5m
H3	From 16m up to but not including 20m	3m

Note: The relevant dimensions of commonly used helicopters can be found in ICAO Heliport Manual (Doc 9261)

17. To determine the appropriate heliport fire fighting category the higher category of fuselage length or fuselage width should be applied.

18. See appendix (Appendix 8C for guidance on HS (Special) category helicopters.

19. For a helicopter take-off and landing area located on the maneuvering area of an aerodrome licensed for use by fixed wing aircraft, the RFFS at the aerodrome will be acceptable for helicopter operations provided that the amounts are at least equal to those required for H0, H1, H2 or H3 operations, as appropriate and as shown in table 8A.2, and that the response time can be achieved.

Extinguishing agents

20. Principal and complementary agents shall be provided at a surface level heliport, as specified in table 8A.2 . Principal agents provide a level of post-fire security i.e. for a period of several minutes or longer. Complementary agents have rapid-fire suppression capability but provide control only during application and for a short period thereafter.

21. Hose line(s) of sufficient length(s) appropriate to dealing with fires involving the sizes and types of aircraft normally using the heliport, and which include a hand controlled foam-making branch, shall be provided.

22. The discharge rate of complementary agents should be selected for optimum effectiveness of the agent used.

23. Complementary Fire Fighting Agents shall comply with the appropriate specifications of the International Organisation for Standardisation (ISO).

24. Dry chemical powder and gaseous agents are normally considered more efficient than carbon dioxide for aircraft rescue and fire fighting operations.

25. Where the main complementary agent is a dry chemical powder, a quantity of gaseous agent or CO2 shall be provided for use on small or hidden fires. A minimum extinguisher size is 5 kg for major and 2 kg for smaller vehicles.

26. Where the main complementary agent is gaseous agent or CO_2, there shall be a minimum 9 kg of dry powder provided to assist in dealing with a running fuel fire.

27. A 200% reserve of foam concentrate and 100% of complementary agents shall be available at the heliport.

28. At a surface level heliport up to 100% of the water may be substituted with complementary agent. For the purpose of substitution the following equivalents should be used

    1. 1 kg of gaseous agent or dry powder = 0.66 litres of water for the production of foam meeting performance level B.
    2. 2 kg of CO2 = 0.66 litres of water for the production of foam meeting performance level B.

NOTE: *where a heliport has substituted up to 100% of the water with complementary agent, it is recommended that the reserve supply of complementary agent held is increased to 200%*

29. If a 'high performance' dry powder is used it may be permissible to reduce the minimum amount provided. For details see Chapter 8 paragraph 8.76 above.

Table 8A.2 Minimum usable amounts of principal fire extinguishing agents required for surface level heliports

	Foam meeting performance level B		Foam meeting performance level C		Complementary agents	
Category	Water (L)	Discharge rate foam solution/min (L)	Water (L)	Discharge rate foam solution/min (L)	Dry chemical powder (kg)	Gaseous media (kg)
H0	500	250	330	165	23	9
H1	800	400	540	270	23	9
H2	1200	600	800	400	45	18
H3	1600	800	1100	550	90	36

Response time

30. Response time is considered to be the time between the initial call to the rescue and fire fighting service and the time when the first responding vehicle(s) is (are) in position to apply foam at a rate of at least 50% of the discharge rate specified in table 8A.2.

31. At a surface level heliport, the operational objective of the rescue and fire fighting service should be to achieve response times not exceeding two minutes in optimum conditions of visibility and surface conditions.

32. The response area is considered as Final Approach and Take-Off area(s) (FATO), designated aiming point(s) and Touchdown and Lift Off area(s) (TLOF), including all areas used for the maneuvering, rejected take-off, taxiing, air taxiing and parking of helicopters.

33. To ensure an effective response as close to the operational objective in less than optimum conditions, the heliport fire service should provide and instigate suitable guidance and/or procedures.

34. It is recognised that the two-minute response time may not always be achievable to all areas of a surface level heliport where helicopters may arrive or depart, especially training areas, which may be designated outside the heliport boundary. In these cases the RFFS should respond as safely as possible. In the case of training areas designated outside the heliport boundary, the operator of the helicopter has a duty of care to ensure that the appropriate RFFS requirements and response are provided.

Minimum number of staff designated as RFFS personnel

35. Trained personnel shall be designated to respond and operate the RFFS provision whenever flights required to use a licensed heliport are taking place. The minimum number of personnel and level of supervision are defined in table 8A.4.

36. Heliport Operators should assess the medical and fitness suitability of all personnel detailed to respond as part of the RFFS.

Table 8A.4

Heliport RFFS category	Minimum number of personnel	Minimum supervision level
H0	Two	To be determined locally.
H1	Two	To be determined locally.
H2	Three	A competent person to supervise an emergency response throughout the promulgated hours of operation.
H3	Four	A competent person to supervise an emergency response throughout the promulgated hours of operation.

Extraneous duties

37. No extraneous duty should create conditions likely to compromise individual or crew performance or introduce additional hazards. RFFS personnel designated as part of the minimum level for response, and who are engaged on extraneous duties, shall be capable of meeting the response time objective while carrying out those duties.

Vehicles and ancillary equipment

38. A vehicle fit for purpose shall be provided and be readily available for immediate use to carry personnel and RFFS equipment to the scene of the incident. Non-self-propelled appliances (trailers) are permissible, but they must be connected to a suitable towing vehicle during helicopter movements.

39. Where soft or other difficult terrain is immediately adjacent to, or comprises part of the response area, a suitable all-wheel drive vehicle will be required to ensure an effective response. In other situations, the vehicle must be suitable for the terrain at the specific site.

40. For night operations, sufficient lighting equipment for adequate illumination of an incident must be provided. This equipment may be carried on the vehicle, or by any other suitable means.

41. A method of monitoring the helicopter movement area for the purpose of instantaneously alerting and deploying the facility shall be provided.

42. A reliable method of summoning assistance from off-heliport local emergency services shall be provided.

43. Communications equipment should be provided, which will have a transmitting range effective within the response areas.

44. Where a considerable proportion of helicopter movements take place over water areas, the provision of a rescue craft should be considered. The objective should be to recover the maximum anticipated number of occupants of the largest helicopter in use in the most expeditious manner.

45. Rescue equipment commensurate with the level of aircraft operations should be provided. (See table 8A.5.)

46. All responding rescue and fire fighting personnel shall be provided with personal protective equipment to enable them to perform their duties in an effective manner.

47. Account should be taken of the PUWER and the Personal Protective Equipment at Work Regulations which require equipment is:

1. suitable for the intended use;
2. safe for use, maintained in a safe condition and, in certain circumstances, inspected to ensure this remains the case;
3. used only by people who have received adequate information, instruction and training; and
4. accompanied by suitable safety measures, e.g. protective devices, markings, warnings.

48. Records of all tests and inspections shall be maintained by the Heliport Operator for a period of five years. The records should include details of consequential action where an inspection has revealed a defect or deficiency.

Table 8A.5

Equipment resource RFFS categories H1, H2 & H3	
Axe, Aircraft non-wedging Saw, General purpose Crowbar Side cutting pliers Set screwdrivers Fire-resistant blanket Ladder/steps (appropriate to helicopter size) General purpose line	Bolt cropper Hacksaw (with spare blades) Harness knife (with sheath) Tin snips Adjustable wrench Hook, grab or salving Powered cutting tool (H3 only)

Medical provisions

49. Minimum quantities of medical equipment resources appropriate to the sizes and types of aircraft should be provided. Advice can be found on the Health and Safety Executive (HSE) website.

Training

50. Heliport Operators shall ensure that participating personnel are trained and competent in the operation of the RFFS equipment provided at the heliport. The training should be competence-based.

51. The Heliport Operators shall nominate a competent person(s) to conduct training.

52. Personnel shall receive training prior to initial participation and periodically thereafter. The Heliport Operator or the nominated competent person will determine periodicity. Examples of areas where training should be provided are detailed in table 8A.6.

53. Assessment of the competency of the person(s) determining, evaluating and conducting training shall be the responsibility of the Heliport Operator.

Table 8A.6 Example training competence (initial and ongoing)

1	Heliport Operator's safety policies
2	Hazards arising from aircraft operation and safety-related procedures
3	Triangle of fire
4	Extinguishing agents - use and methods of application
5	Fire appliance operations, driving training for emergency response
6	Ancillary equipment, selection, storage and handling, use, inspection and testing, maintenance and record-keeping
7	Personal protective equipment
8	Helicopter construction
9	Helicopter familiarisation
10	Response area topography
11	Fire and rescue procedures
12	Helicopter tactics and techniques – appliance positioning, external/internal fires, access, forcible entry, assistance with evacuation
13	Initial emergency medical aid and casualty handling
14	Personal training record(s)
15	Emergency plans
16	Preservation of evidence

Emergency planning/emergency orders

54. Emergency orders, which form part of the heliport manual, shall include arrangements for alerting the facility, for the immediate notification of other key heliport personnel and for summoning externally based emergency services. These orders shall detail procedures for anticipated emergency situations, including accidents/incidents which occur in the approach and departure areas. The areas within which a response will be made shall be shown in the heliport manual.

55. Off-heliport emergency services should be given the opportunity to familiarise themselves with the emergency procedures as well as the topography of the heliport.

Inspections of the RFFS by CAA aerodrome inspectors

56. The RFFS should operate as an effective unit. The Heliport Operator shall be required by the CAA to demonstrate that effectiveness from time to time.

57. The CAA Inspectors may also require to see documentary evidence relating to the training of personnel employed in the RFFS e.g. records of training and assessment including those for training exercises conducted with other emergency services.

58. Records of all tests and inspections of extinguishing media shall be maintained by the Heliport Operator for a period of five years. The records should include details of consequential action where an inspection has revealed a defect or deficiency.

APPENDIX 8B

Rescue and fire fighting service (RFFS) requirements at category I and II aerodromes

Introduction

1. This appendix specifies the minimum RFFS requirements, which are applicable to aerodromes where the category is I or II. This appendix has been compiled in such a way as to assist an Aerodrome Operator in demonstrating compliance with the requirements at the levels stated.

Minimum scale of services to be provided

2. The Aerodrome Operator shall provide and staff an effective RFFS capability that can respond to an aircraft accident/incident pending the arrival of external emergency services.

3. The RFFS should be available whenever flights required to use a licensed aerodrome are taking place. It should be maintained for at least 15 minutes after the time of departure of any aircraft requiring the use of a licensed aerodrome or until the aircraft has reached its destination, whichever is the shorter.

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

5. A change should be expressed in terms of the new category of the rescue and fire fighting service available at the aerodrome.

6. Note: Aerodrome Operator should develop contingency plans to limit the need for changes to the promulgated level of services. This may involve, for example, a preventative maintenance plan to ensure the mechanical efficiency of equipment and vehicles, and arrangements to cover unplanned leave and absence of the minimum level of RFF personnel including supervisory level.

Level of protection

7. The level of protection to be provided shall be based on the overall length of the longest aeroplane using the aerodrome.

8. The level of protection to be provided at an aerodrome shall be determined from table 8B.1 appropriate to the overall length of the longest aeroplane using the aerodrome irrespective of its frequency of operations. However, during

9. anticipated periods of operations by smaller aeroplanes, the category may be reduced to that of the highest category of aeroplane planned to use the aerodrome at that time.

Table 8B.1 RFF category

Aerodrome category (RFF)	Aircraft overall length		
I		Up to but not including	9 m
II	From 9 m	Up to but not including	12 m

Remission

10. Remission enables aerodromes to provide RFFS facilities to one category below that determined by the size of the largest aeroplane.

11. Where the number of movements of the aeroplanes in the highest category normally using the aerodrome is less than 700 in the busiest consecutive three months, the level of protection provided shall not be less than one category below the determined category.

12. Aerodromes currently promulgating RFFS Category 1 or 2 may apply remission on only one category higher than their promulgated category.

Extinguishing agents

13. Principal and complementary agents shall be provided as specified in tables 8B.2 and 8B.3. Principal agents provide a level of post-fire security i.e. for a period of several minutes or longer. Complementary agents have rapid fire suppression capability but provide control only during application and for a short period thereafter.

Table 8B.2 Min quantities of principal fire extinguishing agents required

Aerodrome category (RFFS)	Foam meeting performance level B			Discharge rate foam solution (litres/minute)
	Water (litres)	Foam concentrate (litres)		
		At 3%	At 6%	
I	230	7	14	230
II	670	20	40	550
Aerodrome category (RFFS)	**Foam meeting performance level C**			**Discharge rate foam solution (litres/minute)**
	Water (litres)	**Foam concentrate (litres)**		
		At 3%	**At 6%**	
I	155	5	10	155
II	450	14	27	370

14. Hose line(s) of sufficient length(s) appropriate to dealing with fires involving the sizes and types of aircraft normally using the aerodrome, and which include a hand-controlled foam-making branch, shall be provided.

Table 8B.3 Min quantities of complementary fire extinguishing agents required

Aerodrome category (RFFS)	**Complementary agent (Kg)**		
	Dry chemical powder	**or gaseous agent**	**or carbon dioxide CO_2**
	Or a combination (in proportion)		
I	45	45	90
II	90	90	180

15. Complementary fire fighting agents shall comply with the appropriate specifications of the ISO.

16. Dry chemical powder and gaseous agents are normally considered more efficient than carbon dioxide for aircraft rescue and fire fighting operations.

17. Where the main complementary agent is a dry chemical powder, a quantity of gaseous agent or CO2 shall be provided for use on small or hidden fires. A minimum extinguisher size is 5 kg for major and 2 kg for smaller vehicles.

18. Where the main complementary agent is gaseous agent or CO_2, there shall be a minimum 9 kg of dry powder provided to assist in dealing with a running fuel fire.

19. The discharge rate of complementary agents should be selected for optimum effectiveness of the agent.

20. A 200% reserve of foam concentrate and 100% of complementary agents shall be available at the aerodrome.

21. At aerodrome categories 1 and 2 up to 100% of the water may be substituted by complementary agent. For the purpose of substitution the following equivalents should be applied:

    1. 1 kg of gaseous agent or dry powder = 0.66 litres of water for the production of foam meeting performance level B.
    2. 2 kg of CO2 = 0.66 litres of water for the production of foam meeting performance level B.

NOTE*: where an aerodrome has substituted up to 100% of the water with complementary agent, it is recommended that the reserve supply of complementary agent held is increased to 200%*

22. If a ‘high performance’ dry powder is used it may be permissible to reduce the minimum amount provided. For details see Chapter 8 paragraph 8.76 above.

Response time

23. The operational objective of the RFFS should be to achieve a response time not exceeding three minutes to any part of the maneuvering area in optimum visibility and surface conditions.

24. Response time is considered to be the time between the initial call to the rescue and fire fighting service and the time when the first responding vehicle(s) is (are) in position to effect fire fighting and rescue operations.

25. Any other vehicles required to deliver the amounts of extinguishing agents specified in table 8B.2 should arrive no more than one minute after the first responding vehicle(s) so as to provide continuous agent applications.

Minimum number of staff designated as RFFS personnel

26. Trained personnel shall be designated to respond and operate the RFFS provision whenever flights required to use a licensed aerodrome are taking place. The minimum number of personnel and level of supervision are defined in table 8B.4.

Table 8B.4

RFFS category	Minimum number of personnel	Minimum supervision level
I	Two	To be determined locally.
II	Three	A competent person to supervise an emergency response throughout the promulgated hours of operation.

27. Aerodrome Operators should assess the medical and fitness suitability of all personnel detailed to respond as part of the RFFS.

Extraneous duties

28. No extraneous duty should create conditions likely to compromise individual or crew performance or introduce additional hazards. RFFS personnel designated as part of the minimum level for response, and who are engaged on extraneous duties, shall be capable of meeting the response time objective while carrying out those duties.

Vehicles and ancillary equipment

29. A vehicle fit for purpose shall be provided and be readily available for immediate use to carry personnel and RFFS equipment to the scene of the incident. Non- self-propelled appliances (trailers) are permissible but they must be connected to a suitable towing vehicle during aircraft movements.

30. Where soft or other difficult terrain is immediately adjacent to, or comprises part of the response area, a suitable all-wheel drive vehicle will be required to ensure an effective response. In other situations the vehicle must be suitable for the terrain at the specific site.

31. For night operations, sufficient lighting equipment for adequate illumination of an incident must be provided. This equipment may be carried on the vehicle, or by any other suitable means.

32. A minimum quantity of ancillary equipment resource appropriate to the sizes and types of aircraft should be provided. table 8B.5 provides a generic list of equipment for Categories 1 and 2 aerodromes that has been identified as acceptable. However, the Aerodrome Operator may carry out an assessment and provide alternative equipment, which can facilitate effective access to the types of aircraft operating or likely to operate at the aerodrome.

33. A method of monitoring the aircraft movement area for the purpose of instantaneously alerting and deploying the facility shall be provided.

34. A reliable method of summoning assistance from off-aerodrome local emergency services shall be provided.

35. Communications equipment should be provided, which will have a transmitting range effective within the response areas.

36. All responding rescue and fire fighting personnel shall be provided with personal protective equipment to enable them to perform their duties in an effective manner.

37. Account should be taken of the Provision and Use of Work Equipment Regulations (PUWER) and the Personal Protective Equipment at Work Regulations which require that equipment is:

1. suitable for the intended use;
2. safe for use, maintained in a safe condition and, in certain circumstances, inspected to ensure this remains the case;
3. used only by people who have received adequate information, instruction and training; and
4. accompanied by suitable safety measures, e.g. protective devices, markings, warnings.

38. Records of all tests and inspections shall be maintained by the Aerodrome Operator for a period of five years. The records should include details of consequential action where an inspection has revealed a defect or deficiency.

Table 8B.5

Equipment resources – categories I and II	
Axe, Aircraft non-wedging Saw, General purpose Crowbar Side-cutting pliers Set screwdrivers Fire-resistant blanket Ladder/steps (appropriate to aircraft size) General purpose line	Bolt cropper Hacksaw (with spare blades) Harness knife (with sheath) Tin snips Adjustable wrench Hook, grab or salving Breathing masks (filter)

Medical provisions

39. Minimum quantities of medical equipment resources appropriate to the sizes and types of aircraft should be provided. Advice can be found on the Health and Safety Executive (HSE) website.

Training

40. Aerodrome Operators shall ensure that participating personnel are trained and competent in the operation of the RFFS equipment provided at the aerodrome. The training should be competence-based.

41. The Aerodrome Operator shall nominate a competent person(s) to conduct training.

42. Personnel shall receive training prior to initial participation and periodically thereafter.

43. The Aerodrome Operator or the nominated competent person will determine periodicity. Examples of areas where training should be provided are detailed in table 8B.6.

44. Assessment of the competency of the person(s) determining, evaluating and conducting training shall be the responsibility of the Aerodrome Operator.

Table 8B.6 Example training competence (initial and ongoing)

1	Aerodrome Operator's safety policies
2	Hazards arising from aircraft operation, dangerous goods and safety-related procedures
3	Triangle of fire
4	Extinguishing agents - use and methods of application
5	Fire appliance operations, driving training for emergency response
6	Use of equipment, selection, storage and handling, inspection and testing, maintenance and record-keeping
7	RFFS personnel safety and personal protective equipment
8	Aircraft construction and evacuation assistance
9	Aircraft familiarisation
10	Aerodrome familiarisation and topography
11	Fire fighting and rescue operations
12	Fixed wing and rotary aircraft (tactics and techniques) – appliance positioning, external/internal fires, access, forcible entry, assistance with evacuation
13	Emergency first aid and casualty handling
14	Personal training record(s)
15	Emergency plans
16	Emergency communications systems
17	Preservation of evidence

Emergency planning/emergency orders

45. Emergency orders, which form part of the aerodrome manual, shall include arrangements for alerting the facility, for the immediate notification of other key aerodrome personnel and for summoning externally based emergency services. These orders shall detail procedures for anticipated emergencies including accidents/incidents which occur up to 1000 metres from the runway threshold. The areas within which a response will be made shall be shown in the aerodrome manual.

46. Off-aerodrome emergency services should be given the opportunity to familiarise themselves with the emergency procedures as well as the topography of the aerodrome.

Inspections of the RFFS by CAA aerodrome inspectors

47. The RFFS should operate as an effective unit. The Aerodrome Operator shall be required by the CAA to demonstrate that effectiveness from time to time.

48. The CAA inspectors may also require to see documentary evidence relating to the training of personnel employed in the RFFS e.g. certificates of competence, records of training and assessment including those for training exercises conducted with other emergency services.

49. Records of inspections, test and maintenance of vehicles and equipment provided for the use of the RFFS should be available for audit.

APPENDIX 8C

Initial emergency response (IER) requirements for RFFS category special aerodromes – aeroplanes and helicopters

Aerodrome emergency procedures

1. A responsible person should be designated to promulgate clear and concise emergency procedures.

2. Emergency orders, which form part of the aerodrome manual, shall include arrangements for alerting the IER facility, for the immediate notification of other key aerodrome personnel and for summoning externally based emergency services. These orders shall detail procedures for anticipated emergency situations including accidents/incidents which occur up to the aerodrome boundary.

3. Off-aerodrome emergency services should be given the opportunity to familiarise themselves with the emergency procedures and the topography of the aerodrome.

4. The IER should operate as an effective unit. The Aerodrome Operator shall be required by the CAA to demonstrate that effectiveness.

IER personnel and training

5. A minimum number of competent IER personnel shall be detailed to operate the IER equipment and should be available for immediate response during flying operations. A competent person should conduct an assessment of the hazards and associated risks following which IER personnel should be provided with sufficient training to carry out their role.

6. IER Personnel should be competent in at least the following:

   - the aerodrome emergency procedures;
   - the aerodrome topography;
   - achieving a response as expediently as possible;
   - application of the necessary procedures to deal with the types of emergencies appropriate to the operation, hazards and risks;
   - the selection, use, and maintenance of equipment;
   - the application of the extinguishing agents;
   - Initial Emergency Medical Aid (IEMA) and casualty handling.

7. Records of all training should be maintained.

IER vehicle and equipment

8. A vehicle that is mechanically reliable, fit for purpose, and which is capable of accommodating IER personnel should be provided. The vehicle, including any towed equipment, should be capable of traversing the terrain likely to be encountered in response to any incident; all-wheel drive may be necessary. Specified equipment should be carried either on the vehicle or on a suitable trailer connected to the vehicle.

9. Radio communications equipment should be provided and should have a range that will ensure effectiveness within the expected response area.

10. A minimum quantity of ancillary equipment appropriate to the sizes and types of aircraft should be provided.

11. Account should be taken of the PUWER and the Personal Protective Equipment at Work Regulations which require that equipment is:

    1. suitable for the intended use;
    2. safe for use, maintained in a safe condition and, in certain circumstances, inspected to ensure this remains the case;
    3. used only by people who have received adequate information, instruction and training; and
    4. accompanied by suitable safety measures, e.g. protective devices, markings, warnings.

Fire fighting agents

12. The tables below identify the quantities of fire fighting agent that are recommended. The agent should be available for immediate discharge from the vehicle/pressure unit.

Table 8C.1

Minimum usable amounts of extinguishing agents				
Foam meeting performance level B			**Complementary agent**	
Water (litres)	Foam concentrate (litres/min)	Discharge rate of foam solution (litres/min)	Dry powder or gaseous agents (kg)	or CO_2 (kg)
90	6 @ 6% 3 @ 3%	60	18	36
Foam meeting performance level C			**Complementary Agent**	
Water (litres)	Foam concentrate (litres/min)	Discharge rate of foam solution (litres/min)	Dry powder or gaseous agents (kg)	or CO_2 (kg)
60	4 @ 6% 2 @ 3%	40	18	36

Table 8C.2

Minimum usable amounts of extinguishing agents compressed air foam system					
Foam meeting performance level B				**Complementary agent**	
Water (litres)	Foam concentrate		Discharge rate of foam solution (litres/min)	Dry powder or gaseous agents (kg)	or CO_2 (kg)
	Induction rate	Expansion ratio			
60	0.2–0.4%	8–9:1	60	18	36
Foam meeting performance level C				**Complementary agent**	
Water (litres)	Foam concentrate		Discharge rate of foam solution (litres/min)	Dry powder or gaseous agents (kg)	or CO_2 (kg)
	Induction rate	Expansion ratio			
40	0.2–0.4%	8–9:1	40	18	36

13. Dry powders and gaseous agents are normally considered more efficient than CO_2 for aircraft rescue and fire fighting operations. When selecting dry powder for use with foam, care must be exercised to ensure compatibility.

14. It is acceptable to replace all or part of the amount of water for foam production by complementary agents. For the purpose of agent substitution the following equivalents should be used: 1 kg of complementary agent = 0.66 L water for production of a foam meeting performance level B.

Inspections of the IER by the CAA's aerodrome inspectors

15. At aerodromes where the RFF category is special, the CAA will, prior to initial licensing, be required to be satisfied that initial emergency response arrangements are satisfactory and will audit the arrangements as part of the normal audit process.

CHAPTER 9

Emergency planning

Introduction

9.1 The guidance contained in this chapter is developed from UK best practice, the requirements of Civil Contingency legislation and ICAO Standards and Recommended Practices (SARPs). Further information is contained in the ICAO Airport Services manual, Part 7, Airport Emergency Planning (Doc 9137–AN/898).

9.2 Aircraft accidents have the potential to involve a large number of casualties and fatalities. However, although they may be considered as disasters for the purposes of emergency planning, it would be incorrect to suggest that all aircraft accidents have the capability to achieve disaster proportions. Many will be capable of being dealt with locally using the facilities provided by the aerodrome or with limited support from category I responders. Nevertheless, an incident involving even the smallest aircraft can be life-threatening, not only to the occupants but also to those in the vicinity of the incident. Whilst the scale of response to a disaster may be much greater than that required for the majority of aircraft accidents, the principles of prevention, preparedness, response and recovery do not change.

9.3 Even though the Aerodrome Operator will have demonstrated to the CAA inspectors the ability of the aerodrome to meet the fire, rescue, and medical requirements specified earlier in this publication, the mere provision of equipment, supplies or personnel to the required standard does not necessarily constitute an efficient operational unit. The Aerodrome Operator should also be able to demonstrate that the aerodrome's emergency arrangements are effective, and that appropriate use can be made of all available resources, in particular external emergency services, if an aircraft accident or other incident were to occur.

9.4 An aerodrome may generate hazards in addition to those that relate directly to the operation of aircraft, e.g. the handling of bulk fuel storage. Aerodrome Operators should make plans to deal with emergencies that arise from these activities. The quantities of equipment, extinguishing agents and personnel required to deal with such emergencies may exceed those provided by the aerodrome for the scale of RFFS required to protect the movements of aircraft only.

9.5 Where an aerodrome accepts flights involving the carriage of dangerous goods, the RFFS should develop appropriate policies and procedures to deal with types of dangerous goods likely to be encountered in an incident and ensure that RFFS personnel are adequately trained and protected.

9.6 The terminology used in this chapter is drawn from ICAO SARPs and the different arrangements that exist within the devolved administrations within the UK. As such there may be local differences of the terms used. It is important that whatever term are used locally they are set out in the plans and understood by all stakeholders.

Civil Contingencies Act 2004

9.7 The Civil Contingencies Act 2004 and supporting regulations and statutory guidance establish a clear set of roles and responsibilities for those involved in emergency preparation and response at the local level. The Act divides local Responders into two categories, imposing a different set of duties on each.

9.8 Category I organisations are at the core of the response to most emergencies (e.g. emergency services, local authorities, NHS bodies). Category I responders are subject to the full set of civil protection duties.

9.9 Category II organisations are less likely to be involved in the heart of planning work but will be heavily involved in incidents that affect their sector. Category II responders have a lesser set of duties – co-operating and sharing relevant information with other category I and II Responders.

9.10 Aerodrome operators responsible for aerodromes through which, according to the most recent data available, at least 50,000 passengers or 10,000 tonnes of freight per year were transported are included as category II Responders under Civil Contingencies regulations.

9.11 The mechanisms for multi-agency co-operation at the local level are generally based on local police areas (with the exception of London), and bring together all the organisations who have a duty to co-operate under the Civil Contingencies Act, along with others who would be involved in the response. In England these are Local Resilience Forums (LRF), in Scotland Strategic Co-ordinating Groups (SCG), in Wales the Wales Resilience Forum (WRF) and in Northern Ireland the Civil Contingencies Group (CCG). For this guidance these will be known by the term Local Emergency Management Arrangements (LEMA).

9.12 Regardless of whether a duty exists under the Civil Contingencies Act 2004 or not, Aerodrome Operator should liaise with their LEMA to ensure that there is appropriate and adequate consideration of the risks and response required to aircraft incidents.

9.13 The arrangements at an aerodrome may include setting up an Emergency Planning Committee. Either there should be a link from the emergency planning arrangements at an aerodrome to the LEMA by direct membership, or representation through a member of the LEMA who has the aerodrome emergency planning included in their terms of reference or responsibilities.

9.14 Detailed guidance regarding emergency planning and the Civil Contingencies legislation can be found on the www.gov.uk website.

Emergency planning objectives

9.15 The objective of aerodrome emergency planning is to anticipate the effects an emergency might have on life, property, and aerodrome operations, and to prepare a course, or courses, of action to minimise those effects, particularly in respect of saving lives.

Emergency planning arrangements

9.16 The list at table 9.1 is intended to assist an Aerodrome Operator in choosing those organisations that should be represented on the aerodrome's emergency planning committee. However, the list is not comprehensive and some aerodromes may need expertise from organisations not shown, while others may find some of the organisations shown to be inappropriate.

Table 9.1 On- and off-aerodrome services from which planning committee members could be selected:

Aerodrome RFFS	Local Ambulance Trust
Aerodrome Police	Coastguard and Offshore Rescue
Aerodrome Security	Doctors
Airline Operators	Local Authority Fire and Rescue Service
Customs and Excise	First Aid Organisations
Occupational Medical	Local Hospital Trust
Mechanical Transport	Police
Telecommunications	Press
Works Facilities	Religious Leaders
Environment Agency	

9.17 The tasks that the emergency planning arrangements may consider are:

1. terms of reference of the planning committee
2. development of an emergency plan and orders
3. tactics
4. liaison
5. co-operative training
6. exercise planning
7. post-accident/incident and post-exercise reviews
8. review and monitoring
9. recording

9.18 A senior member of the aerodrome management team with the direct support of the Accountable Manager should chair any meetings. Records of the meetings should be taken and retained and the person accountable for the emergency planning arrangements shall be identified within the aerodrome manual.

Aerodrome emergency plan

9.19 The aerodrome emergency plan should set out how an emergency situation or incident can be managed in order to minimise the effects it may have on life, property, and aerodrome operations, and how the best use of appropriate available resources should be applied to achieve that aim.

9.20 An aerodrome emergency plan shall be established at an aerodrome, commensurate with the aircraft operations and other activities conducted at the aerodrome.

9.21 The aerodrome emergency plan shall provide for the co-ordination of the actions to be taken in an emergency occurring at an aerodrome or in its vicinity.

9.22 The plan shall co-ordinate the response or participation of all existing agencies which, in the opinion of the appropriate authority, could be of assistance in responding to an emergency.

9.23 The plan should provide for the co-operation and co-ordination with the rescue co-ordination centre, as necessary.

9.24 The aerodrome emergency plan document should include at least the following:

1. the types of emergencies planned for;
2. agencies involved in the plan;
3. responsibility and role of each agency, the emergency operations centre and the command post, for each type of emergency;
4. information on names and telephone numbers of the offices or people to be contacted in the case of a particular emergency; and
5. a grid of the aerodrome and its immediate vicinity.

9.25 The plan shall observe human factors principles to ensure optimum response by all existing agencies participating in emergency operations. The principles should include:

1. the effects of human performance on the plan, for example workload, capabilities, functions, decision aids, environmental constraints, team versus individual performance;
2. training effectiveness;
3. staffing including numbers, skills levels and organisational structure;
4. personnel selection;
5. safety and health aspects, for example hazardous materials, safety systems and protective equipment.

9.26 A fixed emergency operations centre and a mobile command post should be available for use during an emergency. The mobile command post may be provided as part of the supporting emergency services response.

9.27 The emergency operations centre should be a part of the aerodrome facilities and should be responsible for the overall co-ordination and general direction of the response to an emergency. However, local arrangements will dictate the exact location and nature of this facility.

9.28 The command post should be a facility capable of being moved rapidly to the site of an emergency, when required, and should undertake the local co-ordination of those agencies responding to the emergency.

9.29 A person should be assigned to assume control of the emergency operations centre and, when appropriate, another person the command post. These would normally be category I responders.

9.30 Adequate communication systems linking the command post and the emergency operations centre with each other and with the participating agencies should be provided in accordance with the plan and consistent with the particular requirements of the aerodrome.

9.31 The plan shall include the ready availability of and co-ordination with appropriate specialist rescue services to be able to respond to emergencies where an aerodrome is located close to water and/or swampy areas and where a significant portion of approach or departure operations takes place over these areas. Further guidance on search and rescue can be found in the document 'Search and Rescue Framework for the United Kingdom of Great Britain and Northern Ireland' available on the Maritime and Coastguard Agency website.

9.32 Emergency orders shall clearly translate the emergency plan into a course or courses of action to be followed for a given emergency or incident, that will ensure the achievement of the emergency planning objectives.

9.33 Emergency instructions should provide details to individuals, or to departments, of the actions required to initiate the emergency plan.

9.34 The aerodrome emergency plan and orders shall include procedures for leading passengers evacuated from aircraft to secure areas away from the scene of an incident.

Emergency orders

9.35 Emergency orders should be drawn up detailing the lines of communication that will ensure all the agencies (or services) appropriate to the emergency are notified and alerted. These orders should be confined exclusively to actions to deal with emergencies or incidents.

9.36 The Aerodrome Operator should liaise with local emergency responders and establish responsibilities for incident command, particularly for the scene immediately adjacent to the aircraft. Any agreements should be recorded in the aerodrome manual.

9.37 Emergency Instructions should be drawn up and displayed, detailing the actions to be taken by any particular person or service under each emergency situation, to ensure that the emergency orders are completed. They should contain separate sections for display and use by the various persons or services concerned, e.g. air traffic control, aerodrome rescue and fire fighting service, aerodrome telephone exchange, police, etc.

9.38 Each department, section or individual should have on display, or immediately to hand, the emergency instructions that apply to their role in each emergency procedure.

Medical equipment

9.39 The objective is to ensure that sufficient medical services are provided. This objective should have regard to the type and configuration of aircraft, and the facilities should be based on a formal assessment. The assessment should ensure that the available emergency medical services provided are adequate and take into account the largest aircraft using the aerodrome.

9.40 Aerodrome Operator shall assess the level of medical supplies to be held on the aerodrome for emergency purposes. The Aerodrome Operator should seek the advice and co-operation of the local NHS Trust and responding ambulance services. Consideration should also be given to whether additional supplies should be made available to cater for an accident involving more than one aircraft.

9.41 Additional guidance on the provision of medical equipment and services can be found in the ICAO Airport Services Manual Part 7 Airport Emergency Planning appendix 3 (Airport Medical Services).

9.42 Portable casualty shelters and blankets for use during inclement weather conditions should be considered, taking into account the numbers of casualties that could reasonably be expected.

9.43 Portable lighting should be provided for illuminating an accident scene, particularly triage and casualty handling areas.

9.44 Aerodrome Operator should ensure that records appertaining to the medical facilities, covering specification, tests and inspection, and maintenance, are retained and can be made available for CAA inspection if requested. The records should include details of consequential action where an inspection has revealed a defect or deficiency. The records shall be retained for a minimum period of five years.

9.45 Where the journey time for the first Local Authority ambulance could exceed 15 minutes the provision of an on-site ambulance should be considered or alternative arrangements agreed with the NHS.

Supporting services, operating companies or agents

9.46 Circumstances at any individual aerodrome may require particular services to be involved in the event of an accident or incident. Appropriate services should be identified within the emergency plan.

9.47 Liaison with the LEMA should be established to identify appropriate supporting services.

9.48 The roles of supporting services are set out in the guidance to the Civil Contingencies Act 2004.

9.49 It is important that full details of the aircraft are available, i.e. number of persons aboard, details of any dangerous goods or unusual freight (radio-active materials, livestock, etc.) and in this respect the aircraft operating company or its agents should be responsible for providing any documents, passenger lists and manifests concerning the aircraft involved.

9.50 The post-accident arrangements for any survivors who are not injured, as well as for passengers' relatives and friends who may be at the aerodrome waiting for the aircraft to land and may be unaware that an accident has occurred, is a joint responsibility between the aerodrome, the airline and/or its agents, and category I responders and should be set out in the emergency plan.

9.51 Following an aircraft accident, specialist equipment e.g. additional lighting or heavy lifting gear may be required that may not normally be readily available. The emergency committee should consider the potential need for this equipment and arrange for it to be available should circumstances require it. Care should be taken to ensure that the type and use of this equipment does not introduce the risk of fire in areas which may have become contaminated by fuel spillage.

9.52 Incidents involving aircraft will attract the attention of the press and media. Aerodrome Operators may wish to appoint a member of staff to liaise with members of the local and national press.

Assembly of assisting services

9.53 An aerodrome emergency plan must consider that category I responders are not likely to be familiar with the aerodrome layout, or the incident may occur in weather conditions that could hamper the ability of emergency services to find the accident site. A system must be devised whereby emergency services familiar or unfamiliar with the aerodrome can be easily guided to the accident or incident. One such system is to distribute a plan of the aerodrome overlaid with a grid, such that each square has an individual identifier. Consideration should be given to escort arrangements. Suitable assembly or rendezvous points should be established, to which incoming vehicles should report, and from which they can be escorted to the accident or incident site with the minimum of delay. In all cases a person should be posted at the aerodrome main gate and the rendezvous point, and a telephone should be made available at both locations.

9.54 The arrangements and facilities for assisting services should be matched against the emergency plan, be suitable and fit for purpose.

Definitions of emergencies and incidents

Aircraft accident/aircraft accident imminent

9.55 Aircraft accidents which have occurred or are inevitable on, or in the vicinity of, the aerodrome.

Aircraft ground incident

9.56 Where an aircraft on the ground is known to have an emergency situation other than an accident, requiring the attendance of emergency services.

Full emergency

9.57 When it is known that an aircraft in the air is, or is suspected to be, in such difficulties that there is a danger of an accident.

Local standby

9.58 When it is known that an aircraft has, or is suspected to have, developed some defect but the trouble would not normally involve any serious difficulty in effecting a safe landing.

Weather standby

9.59 When weather conditions are such as to render a landing difficult or difficult to observe.

Unlawful acts

9.60 Action to be taken in the case of any unlawful act will be contained in the aerodrome's contingency plan, which will be drawn up in conjunction with the local police using department for transport guidance.

Off-aerodrome accidents

9.61 Emergency orders should contain details of the action to be taken in the case of aircraft accidents occurring outside the aerodrome boundaries

Other duties

9.62 The emergency arrangements are generally focused on an aircraft accident or incident. Equipment and techniques recommended are generally directed towards this goal. However, the plans may include other incidents that occur such as domestic fires, road traffic crashes and hazardous materials. Emergency orders should include the action to be taken by aerodrome-based responders and, where appropriate, external emergency services, in the event of such calls being received.

9.63 The classification 'domestic' is given to any incident:

1. on the aerodrome not included in paragraphs 9.56 To 9.61;

2. outside the aerodrome boundary (other than aircraft accidents) which is liable to constitute a danger to flying or aerodrome property;
3. which the aerodrome rescue and fire fighting service might attend where the response is according to an agreement with the local emergency services;
4. which is in response to calls from the public or police on humanitarian grounds.

Command and control

9.64 The importance of an agreed framework for command and co-ordination should not be underestimated. This enables each agency to tailor its own response and interface with the plans of other agencies without disrupting its own procedures.

9.65 There is further information on managing the local multiagency response to, and recovery from, emergencies on the www.Gov.Uk website. This section describes the three management tiers and briefly mentions the arrangements for managing an incident site.

9.66 Whether it should be fully implemented at an aircraft accident should be determined by the severity and numbers of casualties. At the start of any incident for which there has been no warning, the operational level should be activated first, with the other levels coming into being with the escalation of the incident, or a greater awareness of the situation.

9.67 An Aerodrome Operator should have a clear and coherent policy that sets out the approach for delivering effective aircraft incident command and liaison with external emergency services.

Bronze – the operational level

9.68 Bronze is the level at which the management of immediate 'hands-on' work is undertaken at the site(s) of the emergency. Personnel first on the scene will take immediate steps to assess the nature and extent of the problem. Bronze commanders will concentrate their effort on the specific tasks within their areas of responsibility – for example, the police will concentrate on establishing cordons, maintaining security and managing traffic. In most instances, the police will co-ordinate the operational response at the scene to ensure a coherent and integrated multi-agency response.

9.69 A key function of a Bronze commander will be to consider whether circumstances warrant a Silver level of management. Where the Silver level of management is established, Bronze commanders become responsible for implementing the Silver commander's tactical plan within their geographical area or functional area of responsibility.

Silver – the tactical level

9.70 The purpose of the Silver level is to ensure that the actions taken by Bronze are coordinated and coherent in order to achieve maximum effectiveness and efficiency. Silver will usually comprise the most senior officers of each agency committed within the area of operations, and will assume tactical command of the situation, usually from an incident control point located nearby or directly adjacent to the scene. They will address issues such as the setting up of an outer cordon, and the location of key functions or facilities such as a survivor assembly point, casualty clearing station and media liaison point.

9.71 In those cases where it becomes clear that resources, expertise or coordination are required beyond the capacity of Silver (e.g. where there is more than one incident), it may be necessary to invoke the Gold level of management to take overall command and set the strategic direction.

Gold – the strategic level

9.72 If it becomes necessary to implement multi-agency management at the Gold level, a Strategic Co-ordinating Group (SCG) (commonly referred to as ‘Gold Command’ or simply ‘Gold’) would be formed, which brings together Gold commanders from relevant organisations to establish the policy and strategic framework within which Silver will work. Chairing the SCG will normally fall to the police. However, depending on the circumstances it may be more appropriate for another agency to take the lead (for instance, the local authority may take the lead in the recovery phase).

9.73 Depending on the nature, extent and severity of the emergency, either the regional tier or central government may become involved. The SCG will then become the primary interface with these other levels of response.

Control of the incident site

9.74 The UK government has issued guidance on how an incident site should be managed including the use of cordons. This guidance can be found under ‘preparation and planning for emergencies’ on the www.gov.uk website.

Testing and exercises

9.75 The plan shall contain procedures for periodic testing of the adequacy of the plan and for reviewing the results in order to improve its effectiveness.

9.76 The plan shall be tested by conducting:

1. a full-scale aerodrome emergency exercise at intervals not exceeding two years; and partial emergency exercises in the intervening year to ensure that any deficiencies found during the full-scale aerodrome emergency exercise have been corrected; or
2. a series of modular tests commencing in the first year and concluding in a full-scale aerodrome emergency exercise at intervals not exceeding three years and reviewed thereafter, or after an actual emergency, so as to correct any deficiency found during such exercises or actual emergency.

Note: *The exercises should be set to rotate the time of the year and daylight or darkness.*

9.77 Where an aircraft accident occurs to which the response has adequately tested all or part of the plan, a licence holder may use that experience as part of the above exercise process.

9.78 Guidance on exercises is available from the following sources:

- ICAO Airport Services manual Part 7, Airport Emergency Planning, chapter 13
- under 'preparation and planning for emergencies' on the www.gov.uk website

Rendezvous point signs and directional arrows

Signs used on the public highway

9.79 Signs placed on a public highway will need to conform to the dimensions and colour scheme as defined by the Department for Transport (DfT) 'Working drawings for traffic signs'; details are available on the www.legislation.gov.uk website. Examples of these signs are:

Figure 9.1

		
2708	2709	2710
Junction ahead leading to route for emergency vehicles to a temporary incident control point	Permanently mounted sign indicating a route for emergency vehicles to an emergency services incident point	Permanently mounted sign indicating a route for emergency vehicles to an emergency services incident point

Signs used on the aerodrome

9.80 Rendezvous point signs should be displayed at the point(s) designated by the aerodrome emergency orders. Signs should be clearly visible from any direction from which vehicles are likely to approach.

9.81 Signs located on the aerodrome should be large enough to be seen from a distance and comprise bright, white letters 'EMERGENCY SERVICES RENDEZVOUS POINT' on a contrasting green background with a contrasting yellow border.

Figure 9.2

9.82 Sufficient signs bearing RVP directional arrows should be placed in such a manner that ‘off-aerodrome’ responders are directed to the RVP.

Figure 9.3

9.83 Where appropriate, signs should be illuminated.

Assessment of the aerodrome emergency plan

9.84 CAA Inspectors will require to be assured of the suitability of the Aerodrome Operator’s emergency plan. Consequently, inspectors will wish to see documentary evidence relating to the arrangements put in place by the Aerodrome Operator. Inspectors may attend an exercise pre-briefing, testing or debriefing, or may choose to attend emergency exercises conducted by the aerodrome. Notification of a proposed full-scale exercise must be given to the CAA inspector at least six months in advance.

CHAPTER 10

Aeronautical information

Information to be made available

10.1 'Aeronautical Information Product' is the collective term for aeronautical information that a State is required to provide and which consists of:

(1) Aeronautical Information Publication (AIP), including Amendments and Supplements;

(2) Aeronautical Information Circulars (AIC);

(3) Aeronautical charts;

(4) NOTAM; and

(5) Digital data sets.

10.2 All UK aeronautical information products are made available via the UK AIS website www.ais.org.uk.

10.3 The aerodrome operator is responsible for providing data relevant to the aerodrome and available services to the users, the relevant air traffic services and aeronautical information services providers.

10.4 The aerodrome operator must have formal arrangements with the organisations with which it exchanges aeronautical data or aeronautical information and shall ensure that all data relevant to the aerodrome and available services is provided to UK AIS with the required quality, in terms of accuracy, integrity, resolution, traceability, timeliness, completeness and format, as described in CAP1054.

10.5 AIP Amendments, AIP Supplements, AICs and Permanent NOTAM can be submitted by Authorised Sources via Aurora Data Originators Portal (www.aurora.nats.co.uk). Only Authorised Sources have access to the Portal and can submit changes to aeronautical information products. More information about UK AIP, Aurora Data Originators Portal, Formal Arrangements, Authorised Sources and data sponsors can be found in CAP 1054.

10.6 NOTAM proposals should be submitted by AFS (EUECYIYP). In the event of being unable to submit NOTAM proposals via this method, then the UK AIS Generic Email eg_notamprop@ead.eurocontrol.int may be used. Comprehensive UK AIS NOTAM Guidance Material for NOTAM Sponsors can be found on the UK AIS website.

10.7 The aeronautical information published in the AIP for which aerodrome operators are responsible for is shown in CAP 1054, Annex A.

10.8 Detailed specifications concerning the AIP and other Aeronautical Information Products are contained in ICAO Annex 15 and PANS-AIM (Doc 10066) - that includes the scope of each of the aeronautical information products (i.e. what information requires publication in aeronautical information products and which product is the most appropriate) and aeronautical data and information maintenance requirements (when submission should be made to UK AIS to publish or amend aeronautical information product(s)).

Action required for occurrences of operational significance other than those involving electronic aids and communication facilities

10.9 Whenever any of the following conditions occur or can be anticipated and are of operational significance, the licence holder should take action to amend the UK AIP and/or to promulgate the change by NOTAM by contacting AIS:

1. changes in the availability of the maneuvering area and changes in the runway declared distances; except that increases in declared distances may only be made with the agreement of the CAA;
2. changes in the permanent level of RFFS category; except that changes may only be made with the agreement of the CAA;
3. significant changes in aerodrome lighting and other visual aids;
4. presence or removal of temporary obstructions to aircraft operation in the maneuvering area;
5. presence or removal of hazardous conditions due to snow, ice or slush on the movement area;

Note: *Notification of such conditions may be by use of the SNOWTAM proforma (form CA 1271). Details on how to complete the SNOWTAM form are published in an AIC.*

6. presence of airborne hazards to air navigation;
7. interruption, return to service, or major changes to rescue facilities and fire fighting services available, except that permanent changes to the promulgated RFF Category may only be made with the agreement of the CAA;
8. failure or return to operation of hazard beacons and obstruction lights on or in the vicinity of the aerodrome;
9. erection or removal of obstructions to air navigation, and erection or removal of significant obstacles in take-off, climb or approach areas;
10. air displays, air races, parachute jumping, or any unusual aviation activity along with any other information of operational significance.

10.10 When any of the above arises at short notice a request for NOTAM action should be made to AIS.

10.11 When the situation is premeditated a written request for AIP Amendment or Supplement action should be made to AIS with a copy sent to the airspace, ATM and aerodromes team. Licence holders should be aware that certain types of information are required to be published in accordance with the AIRAC System, which requires significant advance notice to be given.

10.12 Any of these occurrences could affect the operation of the electronic aids or communication facilities. Advice in this respect should always be sought from the authority responsible for their operation who in turn will decide whether further NOTAM action is required.

Action required for occurrences affecting electronic aids and communications facilities

10.13 NOTAM action will be necessary in the following circumstances:

1. the establishment or withdrawal of electronic aids to air navigation;
2. changes in the regularity or reliability of operation of any electronic aid to air navigation or aeronautical communication facility.

10.14 The operating authority for these aids should:

1. request NOTAM action by AIS; or
2. request AIP amendment or supplement action through liaison with the appropriate ATS regional office or through appropriate channels for NATS facilities.

10.15 The operating authority will be consulted on any other occurrences detailed in paragraph 10.9 and 10.12.

UK AIS contact details

10.16 Contact details and service hours for principal UK AIS sections are detailed below and also available in the UK AIP GEN 3.1 paragraph 1 *Responsible Service*:

UK AIS section	Service Hours	Contact details
UK AIS Publications Section (AIP/SUP/AIC/etc.) - general enquiries	Monday to Friday (0800-1600)	01489-887462
UK NOTAM Office (NOF/INO)	H24	01489-612488 / 01489-612489
UK NOTAM Office (NOF/INO)	Available under contingency conditions	07769-672014 (Mobile)
UK AIS Charting Section	Monday to Friday (0800-1600)	01489-887463
Email (NOTAM Proposals)	H24	eg_notamprop@ead.eurocontrol.int
Fax (AIS/NOTAM)	H24	01489-612490
AIS Information Line UK	H24	08085-354802 / +44(0)1489-887515 (International)

10.17 The UK AIS information line is a voice recorded message system, designed to supplement the information available on the UK AIS website. It is not designed to replace the need to obtain a full pre-flight briefing. The message provides information on temporary restricted areas, airspace upgrades and emergency restrictions of flying.

CHAPTER 11

Water aerodromes

Introduction

11.1 ICAO annex 14 does not differentiate between land and water as a surface from which aircraft can operate; nor, since Schedule 1 defines that an 'aerodrome' can be an area of water, does the ANO.

11.2 Operations on water differ significantly from those conducted on land, and the licensing criteria for land aerodromes are inappropriate in some areas. Although based on the existing land aerodrome criteria, the different operational and safety risks when operating onto and from water, particularly in more challenging environments such as rivers and lochs, have been recognised and addressed. For example, seaplanes require more flexibility in choosing optimum areas of water for take-off and landing; hence, solutions have been developed to address the designation and identification of the water on which seaplane operations will take place.

11.3 The process of granting a licence by the CAA for a water aerodrome is no different from that of a land aerodrome, and each application would be assessed on the ability to meet the relevant requirements. The following licensing criteria focus on those licensing factors where water aerodromes differ from land aerodromes. These factors primarily include the physical characteristics of the operating environment, mooring procedures, and rescue and fire fighting services; however, one fundamental licensing criterion that requires the licence holder to establish and maintain an appropriate Safety Management System (SMS) remains the same. The criteria should therefore be considered in addition to criteria outlined elsewhere in this document that apply to land and water aerodromes equally.

11.4 The water aerodrome licensing criteria are designed to cater for day, Visual Flight Rules (VFR) operations only; they do not cater for night, Instrument Meteorological Conditions (IMC) or, currently, operations by seaplanes of performance groups A and B.

11.5 In addition to aviation legislation, a seaplane in contact with the water is subject to maritime legislation; including the International Regulations for the Prevention of Collision at Sea, harbour regulations and local byelaws that are not addressed in this document. Where appropriate, licence holders should consult with those bodies that have a regulatory or statutory interest in the use of, or in the operation of, an aerodrome within the licensed area. These include the Maritime Coastguard Agency; the Ports Authorities; the Health and Safety Executive; the Environmental Agency; local government and national parks authorities; and the Transport Security and Contingencies Directorate at the Department for Transport.

Note: *All commercial flight activities (fixed wing and rotary) of 10 tonnes or more maximum authorised take-off, and de facto the locations that they operate from, are subject to EU Regulation 2320/02 on aviation security and, therefore, the UK National Aviation Security Programme administered and enforced by Transport and Contingencies Directorate at the DfT.*

Aerodrome manual and notification in the UK aeronautical information publication

11.6 ANO Article 212(7) requires the inclusion in the aerodrome manual of information and instructions relating to the matters listed under Schedule 12. Items (11), (12), (13) and (14) of Schedule 12 do not directly apply to water aerodromes.

11.7 The following items, in addition to those notified for a land aerodrome and applicable to a water aerodrome, should be published in the aerodrome manual and the AIP:

1. the aerodrome reference point (ARP) co-ordinates and the Aerodrome Reference Elevation (ARE);
2. the shape of the maneuvering area(s); the lengths and bearings of the edges (in degrees magnetic); and the means of identification; and
3. specific procedures and measures by which the safety of seaplane operations is assured, and an indication of any areas where seaplane operations are restricted or prohibited.

Physical characteristics

Reference point and elevation

11.8 The aerodrome reference point (ARP) should be located at the planned geometric centre of the maneuvering area, or at the main one if more than one is provided.

11.9 An Aerodrome Reference Elevation (ARE) should be determined at the ARP. This elevation should be determined from the Chart Height, or from the lowest recorded water level, converted to an elevation in metres above ordnance datum.

Movement area

11.10 Licence holders should determine the area of any land and water on which seaplane operations may take place. It is this area that shall be the movement area.

11.11 One or more maneuvering area(s) should be established within the movement area from which all seaplane operations requiring the use of a licensed aerodrome should take place.

11.12 Operational procedures should be developed for safe seaplane taxying and mooring in the proximity of other seaplanes and obstacles that minimise the risk of damage to occupied or unoccupied seaplanes, particularly where this might result from variations in wind direction, water current, depth and ebb, and flow of tide. ICAO annex 2, Rules of the Air, specifies Standards applicable to water operations that, although similar to those applicable to land aerodrome operations, are not reproduced in CAP 393, Air Navigation: The Order and the Regulations.

11.13 As far as practicable, all reasonable effort should be made to provide a movement area that is free from debris likely to cause damage to a seaplane. In particular, procedures should be established for the regular inspection of the maneuvering area(s) to remove FOD.

Maneuvering area

11.14 In some cases, the available maneuvering area will be large enough to provide a choice of take-off and landing direction, dependent upon prevailing water surface and weather conditions. For the purpose of this chapter, this type of maneuvering area is termed 'omni-directional'. However, in other cases, such as on a river or narrow loch, it may be more appropriate to provide a maneuvering area that caters for take-off and landing in one direction and its reciprocal only, in a direction parallel to the longer sides of the maneuvering area. This type of maneuvering area is termed 'bi-directional'. Unless specified otherwise, the licensing criteria apply to both types of maneuvering area.

11.15 The maneuvering area(s) should be square, rectangular or rhomboidal in shape, and should encompass all parts of the water surface intended for the taking off and landing of seaplanes.

11.16 For the purpose of providing the appropriate minimum strip width and obstacle limitation surfaces, maneuvering areas are coded according to the maximum take-off mass, or performance group, of the largest seaplane likely to operate from the water aerodrome, as shown in table 11.1.

11.17 Code W1, W2 and W3 maneuvering areas should have a minimum width, at any point, equal to the visual strip width for code numbers 1, 2 and 3 land runways respectively, as outlined in chapter 3.

Table 11 Water aerodrome maneuvering area coding

Maneuvering area code	W1	W2	W3
Seaplane maximum take-off mass	Less than 2730 kg	2730 kg to 5700 kg	5701 kg or more and seaplanes of performance groups A and B

Obstacle Limitation Surfaces (OLS)

Note: *Licence holders should consult the CAA for code W3 criteria not specified below.*

Take-off climb and approach surface

11.18 A take-off climb surface and an approach surface should be established in the direction of take-off or landing for each maneuvering area, with the elevation of the inner edges of both surfaces equal to the ARE. The inner edges of the take-off climb surface and an approach surface originate at a distance of 30 m from the appropriate edges of a code W1 maneuvering area, and 60 m from the appropriate edges of code W2 and W3 maneuvering areas, and slope upwards and outwards until reaching their limiting distance.

11.19 The take-off climb surface and an approach surface for a code W1, W2 and W3 omni-directional maneuvering area should form a continuous surface surrounding the maneuvering area and be equal to the corresponding length and slope dimensions for land-based runway code numbers 1, 2 and 3 respectively.

11.20 The dimensions of the take-off climb surface and an approach surface relating to a code W1, W2 and W3 bi-directional maneuvering area should correspond to the dimensions for land-based runway code numbers 1, 2 and 3 respectively; see chapter 4.

Transitional, inner horizontal and conical surface

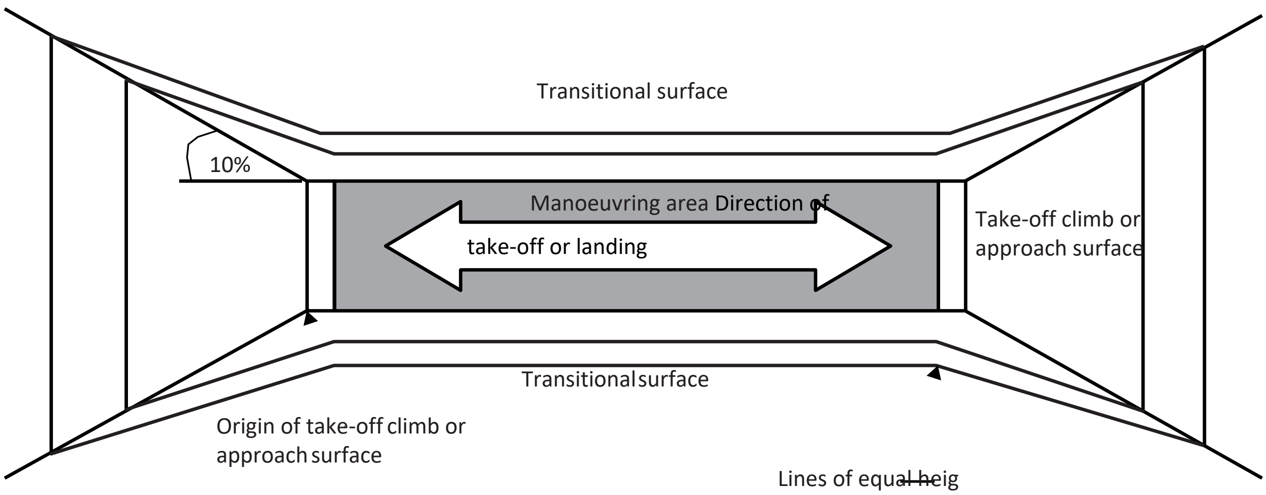
11.21 The inner edge of the transitional surface is coincidental with the edge of the maneuvering area in both elevation and position. It slopes upwards and outwards with distance from the maneuvering area until it intercepts the plane of the inner horizontal surface.

11.22 A transitional surface is not required for an omni-directional maneuvering area.

11.23 An inner horizontal surface should be established at a height of 45 m above the ARE, and should be circular in shape radiating from the ARP to a distance of 2000m and 2500m for codes W1 and W2 maneuvering areas respectively.

11.24 The conical surface relating to codes W1 and W2 maneuvering areas slopes upwards and outwards from the periphery of the inner horizontal surface in accordance with the criteria shown in chapter 4 for the land-based runway code numbers 1 and 2 respectively.

Figure 11 Take-off climb, approach and transitional surfaces for a bi-directional maneuvering area



Wildlife strike hazard

11.25 Licence holders should provide a wildlife hazard management plan that includes the identification of the risk and hazards that may exist, and suitable mitigation measures.

11.26 All reasonable measures should be taken to discourage wildlife from gathering in the movement area, and under anticipated departure and arrival flight paths.

Visual aids

11.27 The edges of each maneuvering area should be easily identifiable by pilots departing from, or arriving at, the water aerodrome.

11.28 Floating visual aids should be conspicuous and conform to maritime regulations or,

11.29 where such regulations and requirements do not exist or are not applicable, the intended use of shapes, colours and lights specified in chapters 4, 6 and 7 should be considered.

Signals

11.30 Aerodrome signals, to assist pilots in complying with the Rules of the Air Regulations 1991 (the Rules) and ICAO annex 2 relevant to the operation of the water aerodrome, should be provided as specified in chapter 7, unless the same guidance and information can be provided to pilots by an alternative means of compliance

Rescue and Fire Fighting Services (RFFS)

11.31 Procedures for the enhancement of passenger and crew post-accident survival should be developed, and facilities in terms of staff and equipment, appropriate to the type of seaplane operations anticipated at the water aerodrome, should be provided. Within the provision of these procedures and facilities, account should be taken of the effect that variable environmental conditions might have on the ability of the RFFS to respond rapidly to accidents and incidents.

11.32 Where provided, a rescue vessel should be of a design and size that would allow survivors to be brought aboard, or it should be equipped with an adequate number of floatation devices of a design that would enable survivors to remove themselves from the water.

11.33 The RFFS should achieve a response time not exceeding 15 minutes to any point of the movement area in good visibility and water surface conditions.

11.34 At a water aerodrome where the hours of operation are notified, the RFFS should be available 15 minutes before and after the times published. Where the hours of operation are not notified, the RFFS should be available prior to the engine start of the first departing seaplane, or to the first arriving seaplane commencing its final approach; and until the last arrival is moored, or 15 minutes after take-off of the final seaplane.

11.35 RFFS personnel should receive initial and recurrent competence-based training relevant to their role and task and should at all times be physically capable of performing the tasks expected of them.

Emergency planning

11.36 The objectives of emergency planning outlined in chapter 9 apply equally to a water aerodrome.

11.37 The emergency plan should consider the particular hazards associated with seaplane operations, including:

1. passenger evacuation into a further life-threatening environment, e.g. deep water;
2. the onset of hypothermia, and its associated effects, during and following prolonged immersion in cold water; and
3. the immediate toxicity and respiratory effects on survivors in the water following the ingestion of floating fuel and oils and their associated vapours, and fire suppressant foams, powders and gases.

11.38 Additional guidance on seaplane accidents in the water is outlined in appendix 6 to the ICAO Airport Services manual (Doc 9137) Part 7.

CHAPTER 12
Heliports

12.1 This chapter applies to land-based heliports that wish to be licensed.

12.2 ANO Articles 207 to 209 indicate what helicopter operations are required to be conducted at, from or to a licensed facility.

12.3 The licensing process for a heliport is the same as that required for fixed-wing aerodromes, and is laid out in CAP 168, chapters 1 and 2.

12.4 The standards and best practice against which the application for a licence will be assessed are those laid out in ICAO annex 14 Volume 2, and where applicable also annex 14 Volume 1. ICAO document 9261 – AN/903, The Heliport Manual, provides expanded guidance on the requirements of annex 14 Volume 2.

12.5 When compiling the aerodrome manual, licence applicants should also be aware of any requirements that might apply to their operations from ICAO annex 6, Operation of Aircraft, Part III International Operations, Helicopters.

12.6 Certain aspects of the requirements of other ICAO Annexes may also apply and should be considered or discussed with their nominated aerodrome/heliport inspector when applying for an aerodrome licence.

12.7 Guidance on the standards and best practice for the operation of heliports that do not require a licence can be obtained from Flight Operations (Helicopters), SARG, Aviation House, Gatwick, and also from the British Helicopters Association (BHA), Fairoaks Airport, Chobham, Woking, Surrey, GU24 8HU, Telephone 01276 856100. Email: info@britishhelicoptersassociation.org