TECHNICAL STANDARDS - NAMCATS: Part 139 Aerodromes

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1. GENERAL

1.1 Section 227 of the Civil Aviation Act, 2016 (Act no. 6 of 2016 – hereinafter "the Act") empowers the Executive Director of Civil Aviation to issue technical standards for civil aviation "on such matters as may be prescribed". Section 227(3) of the Act further empowers the Executive Director of Civil Aviation to incorporate into a technical standard any international aviation standard or any amendment without publishing the text of such standard or any amendment "by mere reference" to the title, number and years of issue of such standard or amendment or to any other particulars by which such standard or amendment is sufficiently identified.

1.2 By way of Government Notice 293/2018 published in Government Gazette 6763 dated 8th November 2018, NAMCARs (2018) provides for Part 139 – " Aerodromes" . This Part 139 provides for the issue of technical standards as NAM-CATS-AH. The Executive Director of Civil Aviation has, pursuant to the empowerment mentioned above, issued technical standards relating to NAMCARs Part 139 (Aerodromes) to be known as NAM-CATS-AH.

1.3 NAM-CATS-AH comprises the standards, rules, requirements, methods, specifications, characteristics and procedures which are applicable to aerodrome design and operations as prescribed in NAMCARs, Part 139.01.1 .

1.4 To the extent possible, each reference to a technical standard in this document, is a reference to the corresponding regulation in the Namibian Civil Aviation Regulations.

Example: *(1) Technical standard 139.01.2 refers to regulation 2 of Subpart 01 of the Part 139*
(2) Technical standard 139.02 refers to either the whole, or more than one specific regulation, of Subpart 02 of Part 139.

1.5 Where there is any perceived disparity of meaning or inconsistency between these technical standards and the regulations, the provisions of the regulations will take precedence.

1.6 Where there is a difference between a standard and procedure prescribed in ICAO documents and the Civil Aviation Technical Standards (CATS), the CATS standard will prevail.

2. GUIDANCE MATERIAL

2.1 Guidelines and recommendations in support of any particular technical standard are contained in schedules or appendices to, and/or compliance notes inserted throughout, the technical standards. These guidelines are intended to provide recommendations and guidance to illustrate a means, but not necessarily the only means of complying with the regulations and technical standards. They may explain certain regulatory requirements by providing interpretive and explanatory materials. It is expected that aerodrome operators will document internal actions in their own operational manuals, to put into effect those, or similarly adequate, practices.

3. AMENDMENTS TO THE TECHNICAL STANDARDS

3.1 The NCAA Safety Division Aerodromes and Ground Aids (AGA) has responsibility for the technical content of this technical standard.

3.2 This technical standard is issued, and may only be amended, under the authority of the Executive Director of Civil Aviation.

3.3 Requests for changes to the content of this technical standard must be forwarded to the Executive Director and may come from:

(a) technical areas within NCAA; or

(b) aviation industry service providers or operators; or

3.4 The need to change the content of this technical standard may arise for any of the following reasons:

(a) to ensure safety;

(b) to ensure standardisation;

(c) to respond to changed NCAA regulations or standards;

(d) to respond to changes initiated by ICAO;

(e) to accommodate proposed initiatives or new technologies.

3.5 NCAA may approve trials of new procedures or technologies to develop appropriate standards.

4. INTERNATIONAL STANDARDS

4.1 Section 227 of the Civil Aviation Act, 2016 empowers the Executive Director of Civil Aviation to issue technical standard for civil aviation. Section 227 of the Civil Aviation Act, 2016 further empowers the Executive Director of Civil Aviation to incorporate into a technical standard any international aviation standard or any amendment without stating the text of such standard or amendment, by mere reference to the title, number and year of issue of such standard or amendment, or to any other particulars by which such standard or amendment is sufficiently identified.

4.2 The following international standards, recommended practices and procedures, as amended from time to time, are incorporated into the technical standards contained in this document:

(a) ICAO Annex 14 – Aerodromes - Volume I – Aerodrome design and operations

(b) ICAO Annex 14 – Aerodromes – Volume II – Heliports

4.3 Differences from ICAO Standards, Recommended Practices and Procedures are published in the AIP.

These Technical Standards apply with immediate effect and repeals the – Civil Aviation Technical Standards NAM-CATS-AH “Licensing and operation of aerodromes and heliports”pushed under Gvernment Notices No. 2786 of 09 August 2002.

Further access is available on NCAA website: www.ncaa.com.na/resources

Issued by : Mr. Reinhard Gärtner

Interim Executive Director of Ci vil Aviation

NAMIBIA CIVIL AVIATION AUTHORITY
NCAA
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AUSPANNPLATZ
WINDHOEK
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Date : 25th August 2020

SCHEDULE

PART 139 – AERODROMES (NAM-CATS-AH)

List of Technical Standards

SUBPART 1 - GENERAL REQUIREMENTS

139.01.2 Definitions for this Part

1.1. When the following terms are used in this Document, they have the following meanings:

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

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

(In this Part, the term aerodrome whenever used includes aerodromes and heliports)

Aerodrome beacon. Aeronautical beacon used to indicate the location of an aerodrome from the air.

Aerodrome certificate. A certificate issued by the Executive Director under applicable regulations for the operation of an aerodrome.

Aerodrome elevation. The elevation of the highest point of the landing area.

Aerodrome identification sign. A sign placed on an aerodrome to aid in identifying the aerodrome from the air.

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

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

Aerodrome operator. A person who is certified, licensed, permitted or approved to operate an aerodrome.

Environmental Management Act. The Environmental Management Act, 2007 (Act No. 7 of 2007), as amended.

Local authority council. The entity that administers the affairs of a municipality, town or village referred to in the Local Authority Act, 1992 (Act No. 23 of 992), and Regional Councils Act, 1992 (Act No. 22 of 1992).

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

Aerodrome traffic density.

a) **Light.** Where the number of movements in the mean busy hour is not greater than 15 per runway or typically less than 20 total aerodrome movements.

b) **Medium.** Where the number of movements in the mean busy hour is of the order of 16 to 25 per runway or typically between 20 to 35 total aerodrome movements.

c) **Heavy.** Where the number of movements in the mean busy hour is of the order of 26 or more per runway or typically more than 35 total aerodrome movements.

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

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

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

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

Aircraft stand. A designated area on an apron intended to be used for parking an aircraft.

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

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

Arresting system. A system designed to decelerate an 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.

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

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

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

Certified aerodrome. An aerodrome whose operator has been granted an aerodrome certificate.

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

Commercial air transport operation. Means an aircraft operation involving the transport of passengers, cargo or mail or aerial work for remuneration or higher.

Critical aeroplane. The type of aeroplane which is the most demanding for the relevant elements of the physical infrastructure and the facilities for which the aerodrome is intended and include:

a) aeroplane physical characteristics; and

b) aeroplane operational characteristics.

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

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

Data integrity (assurance level). A degree of assurance that an aeronautical data and its value has not been lost or altered since the origination or authorized amendment.

Data quality. A degree or level of confidence that the data provided meet the requirements of the data user in terms of accuracy, resolution and integrity.

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

Declared distances.

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

b) **Take-off distance available (TODA).** The length of the take-off run available plus the length of the clearway, if provided.

c) **Accelerate-stop distance available (ASDA).** The length of the take-off run available plus the length of the stopway, if provided.

d) **Landing distance available (LDA).** The length of runway which is declared available and suitable for the ground run of an aeroplane landing.

Dependent parallel approaches. Simultaneous approaches to parallel or near-parallel instrument runways where radar separation minima between aircraft on adjacent extended runway centre lines are prescribed.

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

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

Ellipsoid height (Geodetic height). The height related to the reference ellipsoid, measured along the ellipsoidal outer normal through the point in question.

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

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

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

Geodetic datum. A minimum set of parameters required to define location and orientation of the local reference system with respect to the global reference system/frame.

Geoid. The equipotential surface in the gravity field of the Earth which coincides with the undisturbed mean sea level (MSL) extended continuously through the continents.

Geoid undulation: The distance of the geoid above (positive) or below (negative) the mathematical reference ellipsoid.

Gregorian calendar. Calendar in general use; first introduced in 1582 to define a year that more closely approximates the tropical year than the Julian calendar (ISO 19108).

Hazard beacon. An aeronautical beacon used to designate a danger to air navigation.

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

Holding bay. A defined area where aircraft can be held, or bypassed, to facilitate efficient surface movement of aircraft.

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

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

Human Factors principles. Principles which apply to aeronautical design, certification, training, operations and maintenance and which seek safe interface between the human and other system components by proper consideration to human performance.

Human performance. Human capabilities and limitations which have an impact on the safety and efficiency of aeronautical operations.

Identification beacon. An aeronautical beacon emitting a coded signal by means of which a particular point of reference can be identified.

Independent parallel approaches. Simultaneous approaches to parallel or near-parallel instrument runways where radar separation minima between aircraft on adjacent extended runway centre lines are not prescribed.

Independent parallel departures. Simultaneous departures from parallel or near-parallel instrument runways.

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

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 1 000 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.** A runway served by visual aids and non-visual aid(s) intended for landing operations following an instrument approach operation type B to and along the surface of the runway and:

A — intended for operations with a decision height (DH) lower than 30 m (100 ft), or no decision height and a runway visual range not less than 175 m.

B — intended for operations with a decision height (DH) lower than 15 m (50 ft), or no decision height and a runway visual range less than 175 m but not less than 50 m.

C — intended for operations with no decision height (DH) and no runway visual range limitations.

Integrated Aeronautical Information Package. A package in paper, or electronic media which consists of the following elements:

(a) AIP, including amendment service;

(b) Supplements to the AIP;

(c) NOTAM and PIB;

(d) AIC; and

(e) checklists and lists of valid NOTAM.

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

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 taxiing aircraft and vehicles must stop and hold until further cleared to proceed, when so instructed by the aerodrome control tower.

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

Landing direction indicator. A device to indicate visually the direction currently designated for landing and for take-off.

Laser-beam critical flight zone (LCFZ). Airspace in the proximity of an aerodrome but beyond the LFFZ where the irradiance is restricted to a level unlikely to cause glare effects.

Laser-beam free flight zone (LFFZ). Airspace in the immediate proximity of the aerodrome where the irradiance is restricted to a level unlikely to cause any visual disruption.

Laser-beam critical flight zone (LCFZ). Airspace in the proximity of an aerodrome but beyond the LFFZ where the irradiance is restricted to a level unlikely to cause glare effects.

Laser-beam free flight zone (LFFZ). Airspace in the immediate proximity of the aerodrome where the irradiance is restricted to a level unlikely to cause any visual disruption.

Laser-beam sensitive flight zone (LSFZ). Airspace outside, and not necessarily contiguous with, the LFFZ and LCFZ where the irradiance is restricted to a level unlikely to cause flash-blindness or after-image effects.

Licensed aerodrome. An aerodrome whose operator has been granted an aerodrome license.

Lighting system reliability. The probability that the complete installation operates within the specified tolerances and that the system is operationally usable.

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

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

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

Movement. A take-off or landing constitute a movement.

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

Near-parallel runways. Non-intersecting runways whose extended centre lines have an angle of convergence/divergence of 15 degrees or less.

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

Normal flight zone (NFZ). Airspace not defined as LFFZ, LCFZ or LSFZ but which must be protected from laser radiation capable of causing biological damage to the eye.

Obstacle. All fixed (whether temporary or permanent) and mobile objects, or parts thereof, that:

a) are located on an area intended for the surface movement of aircraft; or

b) extend above a defined surface intended to protect aircraft in flight; or

c) stand outside those defined surfaces and that have been assessed as being a hazard to air navigation.

Obstacle free zone (OFZ). The airspace above the inner approach surface, inner transitional surfaces, and balked landing surface and that portion of the strip bounded by these surfaces, which is not penetrated by any fixed obstacle other than a low-mass and frangibly mounted one required for air navigation purposes.

Operating staff. refers to those persons, whether or not they are employed by the aerodrome operator, whose duties are concerned either with ensuring safety of aerodrome operations or require them to have access to the aerodrome movement areas and all other areas within the aerodrome perimeter.

Orthometric height. Height of a point related to the geoid, generally presented as an MSL elevation.

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

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

Permit. An aerodrome whose operator has been granted an aerodrome permit.

Precision approach runway. See Instrument runway.

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

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

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

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

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

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

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

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

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

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

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

Runway strip. A defined area including the runway and stopway, if provided, intended:

a) to reduce the risk of damage to aircraft running off a runway; and

b) to protect aircraft flying over it during take-off or landing operations.

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

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 standing water.

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

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 centre line of a runway can see the runway surface markings or the lights delineating the runway or identifying its centre line.

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

Segregated parallel operations. Simultaneous operations on parallel or near-parallel instrument runways in which one runway is used exclusively for approaches and the other runway is used exclusively for departures.

Shoulder. An area adjacent to the edge of a pavement so prepared as to provide a transition between the pavement and the adjacent surface.

Sign.

a) Fixed message sign. A sign presenting only one message.

b) Variable message sign. A sign capable of presenting several predetermined messages or no message, as applicable.

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

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

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

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

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

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

a) **Aircraft stand taxilane**. A portion of an apron designated as a taxiway and intended to provide access to aircraft stands only.

b) **Apron taxiway.** A portion of a taxiway system located on an apron and intended to provide a through taxi-route across the apron.

c) **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 minimizing runway occupancy times.

Taxiway intersection. A junction of two or more taxiways.

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

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

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

Usability factor. The percentage of time during which the use of a runway or system of runways is not restricted because of the crosswind component.

139.01.4. Use of common reference systems

(a) Horizontal reference system

World Geodetic System — 1984 (WGS-84) must be used as the horizontal (geodetic) reference system. Reported aeronautical geographical coordinates (indicating latitude and longitude) must be expressed in terms of the WGS-84 geodetic reference datum.

(b) Vertical reference system

Mean sea level (MSL) datum, which gives the relationship of gravity-related height (elevation) to a surface known as the geoid, must be used as the vertical reference system.

(c) Temporal reference system

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

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

139.01.6 Aerodrome reference code

1. **Introduction**

1.1. The intent of the reference code is to provide a simple method for interrelating the numerous specifications concerning the characteristics of aerodromes so as to provide a series of aerodrome facilities that are suitable for the aeroplanes that are intended to operate at the aerodrome. The code is not intended to be used for determining runway length or pavement strength requirements. The code is composed of two elements which are related to the aeroplane performance characteristics and dimensions. Element 1 is a number based on the aeroplane reference field length and element 2 is a letter based on the aeroplane wingspan. The code letter or number within an element selected for design purposes is related to the critical aeroplane characteristics for which the facility is provided. When applying the standards in this document, firstly, identify the aeroplanes which the aerodrome is intended to serve and then determine the two elements of the code.

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

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

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

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

Table 1. 1: Aerodrome reference code

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

139.01.7 Notifying and reporting of aerodrome data and information

1. **Introduction**

1.1. *Notification of inaccuracies in aeronautical information service (AIS) publications*. An aerodrome operator must review all Aeronautical Information Publications (AIPs), AIP Supplements, AIP Amendments, Notices to Airmen (NOTAMs), Pre-flight Information Bulletins and Aeronautical Information Circulars issued by AIS on receipt thereof and immediately after such reviews must notify AIS of any inaccurate information contained therein that pertains to the aerodrome.

1.2. *Notification of changes to the aerodrome facilities, equipment and level of service planned in advance.* An aerodrome operator must notify AIS and the NCAA, in writing, at least 60 days before effecting any change to the aerodrome facility or equipment or the level of service at the aerodrome that has been planned in advance and which is likely to affect the accuracy of the information contained in any AIS publication.

1.3. *Issues requiring immediate notification*. Subject to the requirements in paragraph 1.4 below, an aerodrome operator must give AIS and must arrange for air traffic control to receive immediate notice detailing any of the following circumstances of which the operator has knowledge:

(a) *obstacles, obstructions and hazards*:

(i) any projections by an object through an obstacle limitation surface relating to the aerodrome; and

(j) the existence of any obstruction or hazardous condition affecting aviation safety at or near the aerodrome;

(b) *level of service*: reduction in the level of service at the aerodrome as set out in any of the AIS publications referred to paragraph 1.1 above;

(c) *movement area*: closure of any part of the movement area of the aerodrome; and

(d) any other condition that could affect aviation safety at the aerodrome and against which precautions are warranted.

1.4. *Immediate notification to pilots*. When it is not feasible for an aerodrome operator to arrange for the air traffic control unit to receive notice of a circumstance referred to in paragraph 1.3 above, the aerodrome operator must give immediate notice direct to the pilots who may be affected by that circumstance.

139.01.34. Land use in vicinity of aerodrome

1. Introduction

1.1 Activities around an aerodrome that can affect the safe and efficient operation of aircraft must be taken into consideration when planning land uses in the vicinity of aerodromes.

1.2 Aircraft noise factors must be considered in the development of land around aerodromes due to its environmental impact. Land uses around aerodromes must consider their relative sensitivity to aircraft noise exposure and compatibility or incompatibility to aircraft noise and to aerodrome operations.

1.3 Where land in the vicinity of an aerodrome is used for agricultural purposes, these activities must be such that they do not attract birds which present a hazard to aircraft operations at the aerodrome.

1.4 When planning a highway or railway system near an aerodrome or when planning one which includes an access road or railway to the aerodrome, coordination with the aerodrome operator must be carried out to protect the approach and climb-out paths of the aircraft operating in the aerodrome. Care must be taken to avoid potential obstacles such as high vehicles or road lighting which may potentially cause confusion or endanger aircraft safety and to ensure that designated safety zones are maintained.

1.5 When recreational facilities are planned near aerodromes, the potential risk of an aircraft accident and its effects must be considered when planning activities where large groups of people are involved. Recreational activities which are likely to attract birds such fairgrounds and racetracks, outdoor theatres, and amphi-theatres must be avoided. Tennis courts and golf courses, if located under approach areas to an aerodrome, must be at least 3 km from the aerodrome boundary. The Executive Director may consider for approval other recreational uses which are deemed to be compatible within approximately 5 km of the an aerodrome.

1.6 Electrical plants and power lines near an aerodrome may constitute a hazard to aircraft approach and climb out areas and approval must be sought from the Executive Director prior to their installation.

1.7 Landfills and incinerators may create a smoke problem. Water storage, landfills and sewage treatment may attract birds. Consultation and authorisation must therefore be sought from the aerodrome authorities and the Executive Director prior to their installation in the vicinity of an aerodrome.

1.8 When planning commercial and residential areas around aerodromes, consultation must be made with the aerodrome authorities and the Executive Director due to aircraft noise effect and the potential risk and effects of an aircraft accident to such areas.

1.9 When planning industries at or in the vicinity of aerodromes, that emit offensive noises, odours and smoke, or that create electronic interference with aerodrome operations, consultations must be made with the aerodrome authorities and the Executive Director and necessary authorisations obtained.

2.1 Aerodrome Master Plan

An operator of category A aerodrome must develop an aerodrome master plan which supports a layout designed to yield the optimum airport capacity consistent with the available land, within the vicinity of the airport.

a) The airport master plan should guide the operator to:
   i. Development of physical facilities of an airport for aviation and non-aviation use;
   ii. Development of land uses for areas surrounding an airport;
   iii. Determination of the environmental effects of airport construction and operation; and
   iv. Establishment of access requirements of the airport.

b) An aerodrome master plan is used to:

i. Provide short – and long-term policy;
ii. Identify potential problems as well as opportunities;
iii. Assist in securing financial aid;
iv. Serves as a basis for negotiations between the aerodrome authority and stakeholders; and
v. Generate local interest and support.

c) A master plan process should include:
i. Policy and coordination planning;
ii. Economic planning;
iii. Physical planning;
iv. Environmental planning; and
v. Financial planning.

139.01.35 Aeronautical studies

1. Introduction

1.1. An aeronautical study is a study of an aeronautical problem to identify possible solutions and select a solution that is acceptable without degrading safety. An aeronautical study may be conducted in cases of deviations from the standards, where specifically required in Part 139.

1.2. An aeronautical study must aim at assessing the impact of deviations from Part 139 requirements and the aerodrome standards in order to –
(a) present alternative means of ensuring the safety of aircraft operations;
(b) to estimate the effectiveness of each alternative; and
(c) to recommend procedures to compensate for the deviation.

1.3. An aeronautical study may be used as a tool to review aerodrome processes and procedures to ensure that safety criteria in place are appropriate. An aeronautical study must include current status review, quantifiable data and safety risk assessments of any significant change or changes that may affect the safety of aerodrome operations.

Compliance Note. Advisory Pamphlet AGA-AP139/01 provides guidance on the conduct of an aeronautical study by an aerodrome operator.

2. Requirements for aeronautical study

2.1. An aeronautical study must be conducted prior to a significant change occurring at an aerodrome. Significant changes that require an aeronautical study include:

(a) a significant increase in aerodrome aircraft traffic volumes; or
(b) a significant change in type of aircraft operations; or
(c) a significant change in the aerodrome physical characteristics; or
(d) an increase in accidents or incidents at or in the vicinity of the aerodrome.

2.2. If it is not practicable for an aeronautical study to be conducted prior to the significant change referred to in paragraph 1.3 above, the aeronautical study must be conducted as soon as practicable after the change.

2.3. An aeronautical study may be carried out when aerodrome standards cannot be met as a result of development. Such a study may also be undertaken during the planning of a new aerodrome or during the certification of an existing aerodrome.

2.4. An aerodrome operator is accountable for the implementation of aeronautical studies, inclusive of technical analysis, risk assessment and proposed risk mitigation for any contemplated deviation from safety requirements.

2.5. A person conducting an aeronautical study must, immediately after completing the study—

(a) review the operation of the aerodrome and, if necessary, make any changes that are required in the interests of aviation safety, to the aerodrome manual; and
(b) submit the resultant outcome of the study to the Executive Director.

3. Technical Analysis

3.1. The technical analysis conducted by the person conducting an aeronautical study must –

(a) provide justification for a deviation on the grounds that an equivalent level of safety can be attained by other means;

(b) be applied in situations where the cost of correcting a problem that violates a standard is excessive but where the unsafe effects of the problem can be overcome by some procedural means which offers both practical and reasonable solutions.

3.2. In conducting an analysis of the results of an aeronautical study, NCAA inspectors must –

(a) draw upon their practical experience and specialized knowledge;

(b) consult other specialists in relevant areas;

(c) when considering alternative procedures in the deviation approval process, bear in mind the safety objective of the aerodrome certification regulations and the applicable standards so that the intent of the regulations is not circumvented.

4. Approval of deviations

4.1. Where an aerodrome does not meet the prescribed standards, the Executive Director may determine, following the results of an aeronautical study, the conditions and procedures that are necessary to ensure an acceptable level of safety is maintained at the aerodrome.

4.2. Where the only reasonable means of providing an equivalent level of safety is to adopt suitable procedures and to require, as a condition of certification, that cautionary advice be published in the appropriate AIS publications, the caution will be primarily dependent on two considerations –

(a) the need for pilots to be made aware of potentially hazardous conditions; and

(b) the responsibility of the NCAA to publish deviations from standards that would otherwise be assumed under certificate status.

139.01.39 Use of military aerodromes

1. Form of application

1.1. An operator of an aircraft who desires to use a military aerodrome for civil aviation purposes shall submit an application in the form prescribed by the Executive Director not less than 14 working days before the date that the operator intend to use the military aerodrome.

1.2. The form referred to in 1.1, in which an application for use of military aerodrome, is contained in Annexure I.

1.3. Approval of the Minister for Defence

1.3.1. An application for use of a military aerodrome for civil aviation purposes must be submitted to the Executive Director, using the prescribed form, accompanied by the approval of the Minister for Defence. The applicant is responsible for obtaining the written approval from the Minister of Defence and must attach it to the application form.

1.3.2. The approval from the Minister for Defence must specifically authorize the Executive Director to conduct safety inspections and audits of the aerodrome's facilities, equipment, and procedures, for the purpose of determining its suitability for use for civil aviation purposes.

2. Conditions that must be satisfied to get an authorization to use a military aerodrome for civil aviation purposes.

2.1. Aerodrome requirements

2.1.1. Before an authorization is given for the use of a military aerodrome for civil aviation purposes, the Executive Director must be satisfied that:

(a) the aerodrome is provided with physical characteristics appropriate to the characteristics of the civilian aircraft intended to be used by the applicant;

(b) the aerodrome is provided with obstacles limitation surfaces appropriate for the type of operations the applicant intends to conduct;

(c) the aerodrome is provided with visual aids for navigation appropriate to the lowest meteorological minima and the ambient light conditions during the operation of the applicant's aircraft, as well as visual aids for denoting obstacles and denoting restricted areas;

(d) the aerodrome is provided with equipment and installations appropriate for ground servicing and protection of the type of aircraft that the applicant intends to use;

(e) the aerodrome is provided with rescue and firefighting services commensurate to the type of aircraft the applicant intends to use and the frequency of operations;

(f) the aerodrome has established an emergency management system with the objective to minimize the possibility and extent of personal injury, and property damage on, or in the vicinity of, the aerodrome;

(g) the aerodrome has established an environment management programme to minimize the effects of hazard or potential hazard presented by bird and wildlife on, and in the vicinity of the aerodrome; and

(h) the aerodrome has established a procedure for notification of aerodrome data and information to the applicant and other civilian users.

2.2. Assessing the application

2.2.1. In assessing an application, the Executive Director must ascertain that:

(a) the aerodrome physical characteristics, obstacles limitation surfaces, visual aids, equipment and installations conform to the Part 139 requirements for the characteristics of aircraft the applicant intends to use, the lowest meteorological minima for the type of operations, and the ambient light during the operations of the aircraft;

(b) the rescue nd firefighting services are equivalent to those required for the protection of the type of aircraft the applicant intends to use;

(c) there is an aerodrome emergency management system capable of dealing with the types of emergencies that may arise during the operations of the type of aircraft the applicant intends to use and the type and frequency of operations;

(d) the aerodrome has identified the hazard or potential hazard posed by bird and wildlife and established an environment management programme to minimize the effect of such hazard or potential hazard;

(e) there is a system in place to ensure that the applicant and other civilian users receive initial and continuous update aerodrome information and data.

3. Authorisation by the Executive Director

3.1. To ensure that the application meets the conditions set out in section 2 above, the Executive Director must appoint qualified aerodrome inspectors, or designated officers to conduct interviews or carry out site inspections.

3.2. The aerodrome inspectors, and/or designated officers may also ask for clarification or additional information if the information provided through the application is deemed inadequate.

3.3. If the issue of the authorization involves the attachment of certain conditions, written notification of the conditions will be provided.

3.4. If the Executive Director refuses to grant an application, written notification of the refusal, together with reasons for doing so, must be provided to the applicant within 14 days after the Executive Director makes that decision.

139.01.40. Specific procedures for aerodrome operations

1. Introduction

1.1. When the aerodrome accommodates an aeroplane that exceeds the certificated characteristics of the aerodrome, the compatibility between the operation of the aeroplane and aerodrome infrastructure and operations must be assessed and appropriate measures developed and implemented in order to maintain an acceptable level of safety during operations.

The following procedures should be included in the aerodrome compatibility study:

a) identify the aeroplane physical and operational characteristics;

b) identify the applicable regulatory requirements;

c) establish the adequacy of the aerodrome infrastructure and facilities vis-à-vis the requirements of the new aeroplane (see the appendix to this chapter);

d) identify the changes required to the aerodrome;

e) document the compatibility study; and

f) perform the required safety assessments identified during the compatibility study.

1.2. Information concerning alternative measures, operational procedures and operating restrictions implemented at an aerodrome must be promulgated.

1.2.1. Detailed description of regulations applicable to the use of the aerodrome, including the acceptability of training flights, non-radio and microlight aircraft and similar, and to ground maneuvering and parking but excluding flight procedures must be promulgated in Section AD 2.20 of the aeronautical information publication.

1.2.2. The aerodrome operator determines the most appropriate method for communicating safety information to the stakeholders and ensures that all safety-relevant conclusions of the safety assessment are adequately communicated.

1.2.3. In order to ensure adequate dissemination of information to interested parties, information that affects the current Aeronautical Information Product (AIP) or other relevant safety information is:

(a) promulgated in the relevant section of the AIP or automatic terminal information service (ATIS); and

(b) published in the relevant aerodrome information communications through appropriate means.

1.3. The aerodrome operator must determine the most appropriate method for communicating safety information to the stakeholders and ensure that all safety-relevant conclusions of the safety assessment are adequately communicated.

1.4. In order to ensure adequate dissemination of information to interested parties, information that affects the current aeronautical information product (AIP) or other relevant safety information must be:

(a) promulgated in the relevant section of the AIP or automatic terminal information service (ATIS); and

(b) published in the relevant aerodrome information communications through appropriate means.

139.01.42 Low visibility operations

1. Introduction

1.1. During conditions of low visibility, normally caused by fog, special procedures must be in place to ensure that aerodrome vehicles or workers do not inadvertently lose their way and enter active runways or taxiways. In such conditions the time available for aircraft and possibly vehicles to take evasive action will be too short to avoid an accident.

1.2. The aerodrome operator must determine the visibility at which operation under low visibility procedures will be affected at an aerodrome and the visibility at which the call for operation under low visibility procedures will be made. Once low visibility procedures have been implemented, they must remain in force until there is a clear trend of improving visibility. The aerodrome operator must determine the visibility at which operation under low visibility procedures will be terminated.

1.3. In addition to procedures, an aerodrome operator must ensure that special aerodrome facilities are made available for Category II/III operations. For example, the runway approach lighting, taxiway lights and secondary power supplies have to conform to Category II/III standards. The ILS must be up to Category II/III requirements as prescribed in Part 171, and the runway must be protected by an obstacle-free zone.

2. Low visibility procedures

2.1. When low visibility operations are likely and at a pre-agreed visibility condition, air traffic control must notify the relevant aerodrome operations. Aircraft operators must also be notified immediately prior to low visibility procedures commence.

2.2. Aerodrome operations must respond to the initial call from air traffic control by arranging for the tasks detailed below, as appropriate, to be carried out:

(a) advise aerodrome security so that airside access for vehicles and personnel is restricted;

(b) prohibited areas are closed off by lighting, portable or switched;

(c) ensure that all contractors working in manoeuvring area evacuate the area, and leave the site marked and secure;

(d) check that any lights provided to indicate the ILS sensitive area are switched on and working;

(e) notify the following, advising them the "Category II or III (as appropriate) operations on the appropriate runway are being conducted":

(i) Aerodrome rescue and firefighting service;

(ii) Security control staff;

(iii) Apron management staff;

(iv) Senior operations management; and

(f) advise ATC when the checks are completed and safeguarding complete.

2.3. Once all controlled accesses have been closed by airside security, operations may have to arrange leader vehicles to supervise taxiway crossings to remote stands, fuel farms, etc., for any essential vehicles.

2.4. Perimeter security must notify operations of any unauthorised vehicle or persons seen entering the maneuvering area, and a team must be dispatched to investigate and keep air traffic control and senior operations management informed.

2.5. When advised by the air traffic control that Category II/III conditions are cancelled, operations must ensure that the actions detailed in paragraphs 2.2 to 2.4 above are positively restored and previously notified personnel are re-advised.

SUBPART 2 - AERODROME DESIGN AND CONSTRUCTION REQUIREMENTS

139.02.2 Construction of an aerodrome

1. Introduction

1.1 The form referred to in NAMCARs 139.02.2, in which an application to construct an aerodrome must be made, is contained in **Annexure A**

139.02.3 Requirements for aerodrome design

1. Introduction

1.1. Architectural and infrastructure-related requirements for the optimum implementation of international civil aviation security measures must be integrated into the design and construction of new facilities at an aerodrome.

1.2. Architectural and infrastructure-related requirements for the optimum implementation of security measures must also be integrated into the design and construction of alterations to existing facilities at an aerodrome.

1.3. The design of aerodromes must consider, where appropriate, land-use and environmental control measures described in 139.01.34.

139.02.4 Issuance of certificate of intent

The form referred to in NAMCARs 139.02.4, on which an aerodrome certificate of intent is issued, is contained in **Annexure B**

SUBPART 3 - CERTIFICATION OF CATEGORY A AERODROMES

139.03.3 Application for aerodrome certificate

1. Introduction

1.1. The form referred to in NAMCARs 139.03.3, in which an application for the initial, renewal and amendment of an aerodrome certificate must be made, is contained in **Annexure A**

1.2. In assessing an application, the Executive Director will be looking particularly for evidence on:

(a) compliance of the aerodrome infrastructure which are applicable to the type of aircraft and operations that the aerodrome intends to serve; and

(b) Implementation of operational requirements referred to in NAMCARs 139.03.3.

139.03.4 Issuance of aerodrome certificate

1. Introduction

1.1. To ensure that the application meets the conditions set out in NAMCARs, 139.03.3, the Executive Director will appoint qualified aerodrome Inspectors, or authorized officers to review the application, conduct interviews or carry out site inspections.

1.2. The certification process is conducted in five phases:

(a) Dealing with the expression of interest: During this phase, NCAA assesses whether the operation of an aerodrome at the location specified in the application will not endanger the safety of aircraft operations or contravene to Namibia environmental requirements.

(b) Assessing the formal application: In the second phase, the application for the issuance of a certificate is assessed by the aerodromes inspectors, and/or authorized officers, to validate the information provided and to conduct an evaluation of the aerodrome operations manual submitted by the applicant to determine its compliance with the standards and practices specified in the regulations.

(c) Inspection of facilities and equipment: The third phase consists of on-site inspections of the facilities and equipment to ensure that they meet the prescribed standards.

(d) Issuing or refusing to issue, amend, or renew the certificate: During the fourth phase, the NCAA completes the certification process and notifies to the applicant its decision to issue or refusal to issue a certificate. The conditions to be endorsed on the certificate are also determined and included in the certificate to be issued.

(e) Publication of the licensed status in the Namibia Aeronautical Information Publication: Finally, the fifth phase is the publication of the status of a certified aerodrome in the Namibia Aeronautical Information Publication.

1.3. The Aerodrome Inspectors, and/or authorized officers may ask for clarification or additional information if the information provided through the application is deemed inadequate.

1.4. The Aerodrome Inspectors, and/or authorized officers will notify the proposed or current certificate holder of any discrepancies that should be resolved before the certificate can be issued, amended or renewed.

1.5. The certificate will be issued, amended, or renewed only after it has been determined that the proposed or current certificate holder is fully capable of fulfilling its obligations as required by the regulations and will comply with the national regulations in an appropriate manner.

1.6. If the issuing, amending, and renewing an aerodrome certificate, or issuing a certificate of intent involves the attachment of certain conditions, written notification of the conditions will be provided.

1.7. An aerodrome certificate, amendment, renewal or certificate of intent may be refused based on one or more of the following determinations for which details would be given to the applicant:

(a) the inspection of aerodrome facilities and equipment revealed that they do not conform to the prescribed requirements for the type of aircraft and operations the applicant intends to serve;

(b) the assessment of the aerodrome operations manual revealed that it does not contain the information required by the regulations;

(c) the assessment of the aerodrome operating procedures, quality assurance system and safety management system revealed that they do not make satisfactory provision for the safety of aircraft operations, control and supervision of the operations and maintenance of the aerodrome; and

(d) the assessment of the above facts and other factors (to be listed) revealed that the applicant will not be able to properly operate and maintain the aerodrome as required by the regulations.

139.03.5 Aerodrome certificate

The form referred to in NAMCARs 139.03.5, on which an aerodrome certificate is issued, is contained in **Annexure C**

139.03.16 Issuance of interim aerodrome certificate

The form on which an interim aerodrome certificate is issued, is contained in **Annexure E**

SUBPART 4 - LICENSING OF AERODROMES IN CATEGORIES B AND C

139.04.3 Application for aerodrome license

3.1. The form referred to in NAMCARs 139.04.3, in which an application for the initial, renewal and amendment of an aerodrome license must be made, is contained in **Annexure A**

3.2 In assessing an application, the Executive Director will be looking particularly for evidence on:

(a) compliance of the aerodrome infrastructure which are applicable to the type of aircraft and operations that the aerodrome intends to serve, and

(b) Implementation of operational requirements referred to in NAMCARs 139.04.3.

139.04.4 Issuance of aerodrome license

4.1. To ensure that the application meets the conditions set out in NAMCARs, 139.04.3, the Executive Director will appoint qualified aerodrome Inspectors, or authorized officers to review the application, conduct interviews or carry out site inspections.

4.2. The certification process is conducted in five phases:

(a) Dealing with the expression of interest: During this phase, NCAA assesses whether the operation of an aerodrome at the location specified in the application will not endanger the safety of aircraft operations or contravene to Namibia environmental requirements.

(b) Assessing the formal application: In the second phase, the application for the issuance of a license is assessed by the aerodromes inspectors, and/or authorized officers, to validate the information provided and to conduct an evaluation of the aerodrome operations manual submitted by the applicant to determine its compliance with the standards and practices specified in the regulations.

(c) Inspection of facilities and equipment: The third phase consists of on-site inspections of the facilities and equipment to ensure that they meet the prescribed standards.

(d) Issuing or refusing to issue, amend, or renew the license: During the fourth phase, the NCAA completes the certification process and notifies to the applicant its decision to issue or refusal to issue a license. The conditions to be endorsed on the license are also determined and included in the license to be issued.

(e) Publication of the licensed status in the Namibia Aeronautical Information Publication: Finally, the fifth phase is the publication of the status of a certified aerodrome in the Namibia Aeronautical Information Publication.

4.3. The Aerodrome Inspectors, and/or authorized officers may ask for clarification or additional information if the information provided through the application is deemed inadequate.

4.4. The Aerodrome Inspectors, and/or authorized officers will notify the proposed or current license holder of any discrepancies that should be resolved before the license can be issued, amended or renewed.

4.5. The license will be issued, amended, or renewed only after it has been determined that the proposed or current license holder is fully capable of fulfilling its obligations as required by the regulations and will comply with the national regulations in an appropriate manner.

4.6. If the issuing, amending, and renewing an aerodrome license, or issuing a license of intent involves the attachment of certain conditions, written notification of the conditions will be provided.

4.7. An aerodrome license, amendment, renewal or license of intent may be refused based on one or more of the following determinations for which details would be given to the applicant:

(a) the inspection of aerodrome facilities and equipment revealed that they do not conform to the prescribed requirements for the type of aircraft and operations the applicant intends to serve;

(b) the assessment of the aerodrome operations manual revealed that it does not contain the information required by the regulations;

(c) the assessment of the aerodrome operating procedures, quality assurance system and safety management system revealed that they do not make satisfactory provision for the safety of aircraft operations, control and supervision of the operations and maintenance of the aerodrome; and

(d) the assessment of the above facts and other factors (to be listed) revealed that the applicant will not be able to properly operate and maintain the aerodrome as required by the regulations.

139.04.5 Aerodrome license

The form referred to in NAMCARs 139.04.5, on which an aerodrome license is issued, is contained in **Annexure D**

139.04.16. Issuance of interim aerodrome licence

The form on which an interim aerodrome license is issued, is contained in **Annexure F**

SUBPART 7 - AERODROME MANUAL

139.07.2 Requirements for Aerodrome Manual

1. Introduction

An application for an aerodrome certificate or license must be accompanied by an aerodrome manual produced in accordance with Part 139. Once granted a certificate or license, the aerodrome operator must maintain the aerodrome manual to ensure the accuracy of the information therein; and enable all aerodrome personnel to have access to the relevant parts of the manual.

1.1 Function of the Aerodrome Manual

Part 139 includes minimum requirements broad enough to encompass all certified or licensed aerodromes. The aerodrome manual serves as the bridge between the requirements of Part 139 and their application to a particular aerodrome, taking into account its size, type or level of activity, and configuration. To ensure the aerodrome manual fulfils its intended purpose, it should be:

(a) Comprehensive. The aerodrome manual must address all Part 139 requirements that apply to the aerodrome. A comprehensive aerodrome manual will provide aerodrome personnel with all the information they need to comply with these requirements.

(b) Direct. The content of the aerodrome manual should be accurate, clear, and speak directly to Part 139 requirements. An aerodrome manual that provides clear instructions but avoids excessive detail will help ensure that personnel understand how the aerodrome operator will attain regulatory compliance at the aerodrome.

1.2 Preparation of the Aerodrome Manual

(a) Approval.

Aerodrome Operator Approval. Part 139 requires that the manual contains a Statement of compliance signed by an official of the aerodrome operator designated as the "Senior Accountable Manager". In this context, "Senior Accountable Manager" means an official of the operator who has the authority to implement and enforce all provisions of the aerodrome manual and who had been vested with the powers and duties in respect of the compliance with such provisions. Changes in aerodrome management personnel do not require new statement of compliance as long as the aerodrome operator continues to keep its aerodrome manual current. The statement of compliance must include the aerodrome name, the official's title and name, the official's signature, and the date.

NCAA Approval. Prior to issuing an Aerodrome Certificate or License, the NCAA must approve an aerodrome operator's aerodrome manual. Each page of the aerodrome manual should show NCAA approval and the date of initial NCAA approval or, if the page has been revised, the date of approval for the most recent change. This applies to all aspects of the aerodrome manual, including the table of contents, control and distribution pages, plans, grid maps, and appendices. To facilitate this approval process, each aerodrome manual page should include a location for indicating NCAA approval and the approval date. For ease of use, the NCAA approval block should have a consistent format and location throughout the document.

(b) Format. Page layout and organization of content should be considered during preparation of the aerodrome manual.

(1) Page Layout. The aerodrome manual is a working document that reflects current aerodrome conditions and instructions to the personnel. It should be easy to maintain and revise. In addition to the date and NCAA approval, each page of the aerodrome manual should specify the page number and document part and section. The aerodrome manual must also include a Page Revision Log that can function as an inventory of current pages. This log can simply include columns of page numbers with space for approval dates alongside. This serves as a checklist for maintenance of the aerodrome manual as it tracks pages that have been revised, added, or deleted.

Organization of Content. A sequence is suggested in section 2, the organization of the aerodrome manual.

(c) Distribution. The aerodrome operator must include in the aerodrome manual a procedure for its distribution. The aerodrome manual should be distributed to the personnel having a role to play in its implementation. The aerodrome manual is not intended to provide complete instructions for all jobs or operational procedures, but it should provide instructions for any critical tasks that are necessary for compliance with Part 139.

1.3 Required contents

The aerodrome manual must contain operating procedures, equipment descriptions, responsibility assignments, and any other information needed to comply with Part 139.

(a) Provisions of Subpart 139.03 and 139.04. Subpart 139.03 and 139.04 is the main body of certification and licensing requirements that an aerodrome must meet to obtain and hold an Aerodrome Certificate or License. The aerodrome manual must address all required provisions of Subpart 139.03 and 139.04.

(b) Limitations. The NCAA may impose limitations on certified or licensed aerodromes. These limitations can cover a range of regulatory provisions. Generally, they deal with unusual operational characteristics at an aerodrome, such as a need to restrict air carrier operations from using certain areas of the aerodrome, to operate at certain times, or to specify aircraft rescue and firefighting limitations. The aerodrome manual must contain copies of any limitation placed on the aerodrome by the NCAA. Sections of the aerodrome manual that discuss related provisions of Part 139 must refer to applicable limitations.

1.4 Compliance

The aerodrome manual addresses the mandatory elements by including them in the detailed narratives for the related Subpart 139.03 and 139.04 Sections. However, some special elements better lend themselves to other forms of presentation, such as tables and charts. For example, the aerodrome operator might fulfill the requirement to explain lines of responsibility of the personnel by including an organizational chart and a table of the lines of responsibility, which can be referred to repeatedly throughout the aerodrome manual. In all cases, the aerodrome manual should document any elements that are not included in the manual so a complete accounting of all elements is readily available.

1.5 Guidelines for Specificity

In each Section, the aerodrome manual should answer the following questions: WHO is going to perform the tasks, WHAT do the tasks consist of, HOW are they to be performed, and WHEN should they occur. WHO, WHAT, HOW, and WHEN are often closely associated, and most instructions will need to address all of them.

(a) WHO. The instructions in the aerodrome manual should be clear to staff who routinely perform the tasks described as well as to staff required to act when the usual chain of responsibility and authority is temporarily interrupted. The aerodrome manual must explain what is required from a regulatory standpoint and clearly state who (functional position) is primarily responsible for carrying out each function. Since a substitute might not normally perform (or directly oversee) a required task, the aerodrome manual should provide specific instructions about critical aspects of the job, including whom to contact if problems arise.

(b) WHAT and HOW. The WHAT and HOW of the aerodrome manual instructions refer to the tasks assigned to various individuals or departments charged with achieving compliance with Part 139. Unless all personnel assigned to the task are fully familiar with the regulatory requirement, the aerodrome manual must provide guidance appropriate to the training and experience of the personnel.

(c) WHEN. The timing of tasks will often be triggered by circumstances, such as a certain number of movements, reports of malfunctions or a specific occurrence. The aerodrome manual must clearly define the circumstances that trigger action. It must also address the frequency of tasks that occur on a regular basis.

1.6 Aerodrome Operators Limits

A few of the provisions of Part 139, deal with matters beyond the authority of most aerodrome operators such as including obstruction lights outside aerodrome boundaries and security measures. The aerodrome operator must engage the responsible authorities, establish and document the necessary coordination arrangements “to the extent practicable” and indicate the authority “which agrees to provide" the required services. Part 139 does not require the aerodrome operator to take actions that exceed its authority.

139.07.3 Contents of the Aerodrome Manual

Relationship Between the Proposed Contents and the Requirements for Aerodrome Manual. The proposed content aims at assisting the aerodrome operator to ensure that all required elements are incorporated into the aerodrome manual in a structured manner and compliant with all the requirements under Part 139.

1. Proposed Structure of the Aerodrome Manual.

It is proposed to organize the aerodrome manual in five parts as follows:

- Part I – GENERAL: General information on the aerodrome
- Part II - PARTICULARS OF THE AERODROME SITE: Site plans
- Part III - PARTICULARS OF THE AERODROME REQUIRED TO BE REPORTED TO THE AERONAUTICAL INFORMATION SERVICE (AIS): General geographical information and aerodrome dimensions and related information
- Part IV - PARTICULARS OF THE AERODROME OPERATING PROCEDURES AND SAFETY MEASURES: Operating procedures to ensure safe operations.
- Part V - AERODROME ADMINISTRATION, QUALITY ASSURANCE SYSTEM AND SAFETY MANAGEMENT SYSTEM: Organization for the administration of the aerodrome, planning, implementation and monitoring of the Quality Assurance System and Safety Management System.

The details of the content of each part are given in the following paragraphs.

Part I – GENERAL:

The objective of the part I of the aerodrome manual is to provide general information related to the regulatory requirements and conditions of operation of the aerodrome. The aerodrome operator demonstrates its understanding of the obligations vested to it by Part 139. It also presents the procedures to control, amend, and distribute the operations manual. Part I should include the following information:

- Statement of compliance by the Senior Accountable Manager;
- Purpose and scope of the Aerodrome Manual;
- Legal requirement for a certificate or license and an aerodrome manual;
- Conditions for use of the aerodrome;
- Obligations of the aerodrome operator;
- Limitations on the use of the aerodrome; and
- Procedures to control, amend, and distribute the operations manual.

Part II – PARTICULARS OF THE AERODROME SITE:

The objective of the part II of the aerodrome manual is to provide general information on the boundaries, and layout of the aerodrome. The information serves as a reference for the operator and the regulator with regards to the development and evaluation of some of the procedures required to be included in the manual. As a minimum, Part II shall contain a plan of the aerodrome showing the main aerodrome facilities for the operation of the aerodrome including, particularly, the location of each wind direction indicator.

Part III – PARTICULARS OF THE AERODROME REQUIRED TO BE REPORTED TO THE AERONAUTICAL INFORMATION SERVICE (AIS):

The objective of the part III of the aerodrome manual is to gather the detailed operational information required by the users and which is to be published in the Aeronautical Information Services (AIS). The operator demonstrates that the facilities, installation and equipment conform to the requirements for the type of aircraft the aerodrome intends to serve, meteorological minima and the ambient light conditions during the operation of the aircraft. The accuracy of the information in Part III is critical to aircraft safety. Information requiring engineering survey and assessment should be gathered or verified by qualified technical persons, and the reports of such engineering survey and qualifications of the persons who carried them made available to NCAA for inspection during the process of evaluating the manual. Part III should include the following information:

GENERAL GEOGRAPHICAL INFORMATION:

a. the name of the aerodrome;
b. the location of the aerodrome;
c. the geographical coordinates of the aerodrome reference point determined in terms of the World Geodetic System – 1984 (WGS-84) reference datum (degree, minutes and seconds);
d. the aerodrome elevation;
e. the elevation of each threshold and geoid undulation, the elevation of the runway end and ay significant high and low points along the runway, and the highest elevation of the touchdown zone of a precision approach runway;
f. the aerodrome reference temperature;
g. details of the aerodrome beacon; and aerodrome identification beacon; and
h. the name of the aerodrome operator and the address and telephone numbers at which the aerodrome operator (senior management) may be contacted at all times.

AERODROME DIMENSIONS AND RELATED INFORMATION:

1) runway/s – true bearing, designation numbers, length, width, displaced threshold location, slope, surface type, type of runway and, for a precision approach runway, the existence of an obstacle free zone;
2) length, width and surface type of strip, runway end safety areas, stop ways;
3) length, width and surface type of taxiways;
4) apron surface type and aircraft stands;
5) clearway length and ground profile;
6) visual aids for approach procedures, visual approach lighting type and visual approach slope indicator system; marking and lighting of runways, taxiways and aprons; other visual guidance and control aids on taxiways (including runway holding positions, intermediate holding positions and stop bars) and aprons, location and type of visual docking guidance system; wind direction indicator/s, availability of standby power for lighting;
7) the location and radio frequency of VOR aerodrome checkpoints;
8) the location and designation of standard taxi routes;
9) the geographical coordinates of each threshold;
10) the geographical coordinates of appropriate taxiway centre line points;

11) the geographical coordinates of each aircraft stand;
12) The geographical coordinates and the top elevation of significant obstacles in the approach and take-off areas; in the circling area and in the vicinity of the aerodrome. (This information may best be shown in the form of charts such as those required for the preparation of aeronautical information publications (AIP's), as contained in NAMCATS-AH Subpart11;
13) pavement surface type and bearing strength using the Aircraft Classification Number – Pavement Classification Number (ACN-PCN) method;
14) one or more pre-flight altimeter check locations established on an apron and their elevation;
15) declared distances; take-off run available (TORA), take-off distance available (TODA), accelerate-stop distance available (ASDA), landing distance available (LDA); and
16) rescue and fire-fighting: the level of protection provided, expressed in terms of the category of the rescue and fire-fighting services, which should be in accordance with the longest aeroplane normally using the aerodrome and the type and amounts of extinguishing agents normally available at the aerodrome.

Part IV – PARTICULARS OF THE AERODROME OPERATING PROCEDURES AND SAFETY MEASURES:

The objective of the part IV of the aerodrome manual is to provide the standard operating procedures and safety measures that the operator has adopted to ensure orderly and safe operations. The operator demonstrates its operational competence to meet its requirements under Part 139. It also sets procedures and instructions that are necessary to enable the operating staff to perform their duties. The procedures should be presented following the system of WHO, WHAT, HOW, and WHEN. Procedures may be kept as separate document(s) or possibly as appendix(es) referenced in the aerodrome manual; however, the content is viewed as part of the approved aerodrome manual. In all cases, any change to the procedures required to be included in the aerodrome manual shall be submitted to the Executive Director for approval.

The list of procedures and information required are given below:

AERODROME REPORTING

This procedure provides details for reporting any changes to the aerodrome information set out in the AIP and procedures for requesting the issue of NOTAMs, including the following:

a) Arrangement for reporting any changes to the NCAA and recording the reporting of changes during and outside the normal hours of aerodrome operations;

b) The names and roles of persons responsible for notifying the changes, and their telephone numbers during and outside the normal hours of aerodrome operations; and

c) The address and telephone numbers, as provided by the NCAA, of the place where changes are to be reported to the NCAA.

ACCESS TO THE AERODROME MOVEMENT AREA

This procedure provides details of the arrangements that have been developed and are to be followed in coordination with the agency responsible for preventing unlawful interference in civil aviation at the aerodrome and for preventing unauthorized entry of persons, vehicles, equipment, animals or other things into the movement area, including the respective roles of the aerodrome operator, airline operators, the aerodrome security entity, the NCAA and other government departments, as applicable. Information should also be provided on the names and roles of the personnel responsible for controlling access to the aerodrome, and the telephone numbers for contacting them during and after working hours.

AERODROME EMERGENCY MANAGEMENT SYSTEM (AEMS)

The AEMS describes the system in place for the dealing with emergencies on or in the vicinity of the aerodrome, to include:

- A list of emergencies planned for; and for each type of emergency:
  - ✓ procedures for prompt response to the emergencies,
  - ✓ the persons involved in executing the allocated tasks, and
  - ✓ for each person responsible for a task, detailed guidance on what he/she is expected to do;

- A grid map or other means of identifying locations and terrain features;
- A fully equipped emergency operations centre and command post;
- A description of the structures with responsibilities in the AEMS, including:
  - ✓ Location;
  - ✓ Particulars of personnel to be contacted;
  - ✓ Available rescue and medical equipment; and
  - ✓ Coordination arrangements.

RESCUE AND FIRE FIGHTING

This section shall describe the plan in place related to rescue and firefighting, to include:

- Description of the ARFF category;
- Facilities;
- Equipment;
- Personnel;
- Names and numbers as appropriate; and
- Any off-site agencies that may assist the aerodrome during an emergency event.

AERODROME INSPECTION

Aerodrome inspection procedures describe the arrangements in place for inspections of the movement area, obstacles limitations surfaces, visual aids and electrical systems, to include for each aspect:

- Areas to be inspected during and outside the normal hours of aerodrome operations;
- Communications protocol with air traffic control during an inspection;
- inspection checklist, logbook, reporting, monitoring and follow-up actions; and
- Details of inspection intervals and times.

AERODROME MAINTENANCE

Aerodrome maintenance procedures describe the arrangements in place for maintenance of the movement area (Paved areas, Unpaved areas, Runway and taxiway strips, Drainage systems), visual aids (navigation, denoting obstacles, denoting restricted areas) and electrical systems (main supply, distribution, secondary power supplies), to include for each aspect:

- preventative maintenance (including but not limited to routine maintenance) and corrective maintenance (including but not limited to emergency maintenance and specific provisions during conditions of low visibility);
- method of dealing with partial or total system failure; and
- The names and roles of the persons responsible for the inspection and maintenance of the lighting, and the telephone numbers during and after working hours.

APRON MANAGEMENT

This section shall describe the responsibilities for managing the apron and the applicable procedures, to include:

- Arrangements between:
    - air traffic and apron management services; and
    - Airport and aircraft operators.
- Gate and ramp space management and allocation, including equipment parking and storage areas;
- Engine start and push-back procedures;
- Marshalling service (if applicable); and
- Vehicle escort procedures (if applicable).

VEHICLE CONTROL

This procedure describes the arrangements for the control of surface vehicles operating on or near movement areas, including:

- Applicable traffic rules;
- Speed limits;
- Enforcement procedures;
- Driver training; and
- Requirements for granting permits.

OBSTACLE CONTROL

This section shall set out the procedures for:

a) Monitoring the obstacle limitation surfaces;
b) Controlling obstacles within the authority of the operator;
c) Monitoring the height of buildings or structures within the boundaries of the obstacle limitation surfaces;
d) Controlling new developments in the vicinity of aerodromes; and
e) Notifying the NCAA of the nature and location of obstacles and any subsequent addition or removal of obstacles for action as necessary, including amendment of the AIS publications.

REMOVAL OF DISABLED AIRCRAFT

The operator shall describe the procedures for removing a disabled aircraft on or adjacent to the movement area, including the following;

a) the roles of the aerodrome operator and the holder of the aircraft certificate of registration;
b) arrangements for notifying the holder of the certificate of registration;
c) arrangements for liaising with the air traffic control unit;
d) arrangements for obtaining equipment and personnel to remove the disabled aircraft;
e) the names and roles and telephone number of persons responsible for arranging for the removal of disabled aircraft; and

f) arrangement for obtaining Directorate of Aircraft Accident Investigation (DAAI) approval for the removal of an aircraft involved in an accident/incident.AERODROME.

ENVIRONMENT MANAGEMENT PROGRAMME

This section shall describe procedures dealing with the threat posed by wildlife, including:

- wildlife assessments and studies.
- implementing wildlife control programmes.
- Names and numbers of those responsible for wildlife control (during and after-hours numbers).

LOW VISIBILITY PROCEDURES

This section shall describe the particulars of procedures to be introduced for low-visibility operations, including the measurement and reporting of runway visual range as and when required, and the names and telephone numbers, during and after working hours, of the persons responsible for measuring the runway visual range.

Part V – AERODROME ADMINISTRATION, QUALITY ASSURANCE SYSTEM AND SAFETY MANAGEMENT SYSTEM

The objective of the part V of the aerodrome manual is to provide detailed information on the organization of the aerodrome management including the quality assurance system and safety management system as required under Part 139 and Part 140. The operator presents its organizational structure for administration of the aerodrome which also sets the responsibilities of the key personnel. Part V should include:

ADMINISTRATION:

To fulfil the requirements of Part 139, the operator presents in this section the aerodrome organizational chart showing the names and positions of key personnel, including the reporting lines and their responsibilities. The details of the following key personnel must also be included:

- Senior Accountable Manager;
- Person Responsible for the Quality Assurance System; and
- Aerodrome Manager.

The operator also provides information on the number and type of personnel for operating and maintaining the aerodrome, as well sufficient resources, equipment, and provisions for initial and recurrent training.

Although not required to be included in the aerodrome manual the operator shall avail all the records related to the appointment of key personnel, as well as to the procedures for initial assessment and maintaining the competence of the key personnel, for the NCAA inspectors to review during the evaluation of the manual.

QUALITY ASSURANCE SYSTEM:

To fulfill the requirements of Part 139 aerodrome operator provides —

- A description of the policy and objectives of the quality assurance system including management commitment, responsibilities, and accountabilities for its planning, implementation and monitoring, structures in place for internal reviews and assessment of performance;
- A list of key personnel (preferably in a chart or table), their respective roles, and the lines of reporting on matters related to the safety program;
- A detailed presentation of the safety program, the associated inspection program and reporting system;
- A determination of the level and quality of the system through indicators, targets, and established means to determine acceptability of operations;
- A description of the tools in place to control and supervise the quality assurance system including reporting procedures, and processes across the organization of the operator for addressing deficiencies identified through the inspection or the reporting system; and
- Detailed information on the training and education program, and communication activities in place to ensure that the personnel and stakeholders of the aerodrome operator are fully aware of the quality assurance system in place, their respective roles, and results achieved.

SAFETY MANAGEMENT SYSTEM:

To fulfil the requirements of Part 139 and 140, the aerodrome operator provides the particulars of the safety management system established for ensuring compliance with all safety requirements and achieving continuous improvement in safety performance, the essential features being:

a) Safety policy including the safety management process and its relation to the operational and maintenance process;

b) The aerodrome operator's SMS structure and responsibility including:
   (i) an organizational chart supporting the commitment to the safe operation of the aerodrome as well as one simply showing the hierarchy of responsibility for safety management;
   (ii) the name, status and safety responsibilities of the accountable executive;
   (iii) the name, status and responsibilities of the safety manager;
   (iv) the name, status and responsibilities of the official in charge of day-to-day safety of aerodrome operations; and
   (v) instructions as to the order and circumstances in which the above-named staff may act as the accountable executive.

c) Arrangements procedures for staff training and competency including:
   (i) the review and evaluation of the adequacy of training provided;
   (ii) the review and evaluation of the certification system for testing staff competency;

d) System for complying with regulatory requirements relating to accidents, incidents and mandatory occurrence reporting;

e) The system for hazard analysis and risk assessment;

f) The system for the management of change;

g) The safety management system criteria/strategy including:
   (i) a system for setting of safety performance targets;
   (ii) a system for setting of safety performance indicators;
   (iii) a system for allocating priorities for implementing safety initiatives;
   (iv) a framework for controlling the risks to as low a level as is reasonably practicable;

h) The system for internal safety audits and review detailing the systems and programmes for quality control of safety;

i) The system for documenting all safety-related aerodrome facilities and which provides for easy retrieval of records including:
   (i) records on aerodrome operational and maintenance;
   (ii) information on the design and construction of aircraft pavements;
   (iii) information on aerodrome lighting;

j) Safety-related committees;

k) Safety assurance measures including:
   (i) measures for accident prevention;
   (ii) system for risk control involving analysis and handling of accidents; incidents, complaints, defects, faults, discrepancies and failures;
   (iii) system for continuing safety monitoring including the system for monitoring of and action on critical safety areas which require a higher level of safety management;

l) Responsibility for monitoring the contractors and third parties operating on the aerodrome including incorporation and enforcement of safety-related clauses in the contracts for construction work at the aerodrome;

m) System for safety promotion including:

(i) the system for continuous safety training and awareness; and

(ii) the methods and procedures for the effective communication of safety information.

139.07.4 Amendment of aerodrome manual

REVIEW OF THE AERODROME MANUAL

The aerodrome manual requires an aerodrome operator to include in the aerodrome manual a procedure for its amendment. Careful preparation for the amendment process will ease this task.

a. Lay the Groundwork. Through its organization, the aerodrome manual should lend itself to assigning self-contained segments for review to person(s) knowledgeable about particular subjects. The aerodrome operator should identify who will review various parts or sections of the aerodrome manual and when these reviews will take place. Periodic reviews should make revision of the aerodrome manual easier, but the aerodrome operator must be prepared to break with the schedule and update the aerodrome manual immediately if conditions on the aerodrome change or modifications of instructions become necessary.

b. Establish the Process. The aerodrome operator must document the process for review and revision of the aerodrome manual, including how to amend it to respond to changing situations at the aerodrome. Using the WHO, WHAT, HOW, and WHEN guidelines will help ensure that all necessary elements are addressed. The aerodrome operator should make sure that everyone involved in the review and revision of the aerodrome manual is aware of this process.

REVISION AND FOLLOW-UP.

The aerodrome operator should submit an aerodrome manual amendment to the NCAA at least 30 days before its effective date. However, aerodrome operators should try to submit amendments as far in advance as possible to allow enough time for NCAA review and approval. If timing issues arise, the aerodrome operator must contact the Executive Director who can assign an inspector to work with aerodrome management to prepare the change as expeditiously as possible and assist in keeping the aerodrome in compliance with Part 139. In the case of lengthy or complicated changes, the aerodrome operator should discuss with the assigned inspector the possibility of providing a draft for early review and consideration. A Page Revision Log summarizing individual page and text revisions will help expedite the review process. When a revision to the aerodrome manual becomes effective, the aerodrome operator must place special emphasis on any effected areas of aerodrome operations to ensure personnel are aware of changes and understand how the changes might impact operations.

SUBPART 8 - OBLIGATIONS OF AERODROME OPERATORS

139.08.3 Personnel requirements: accountable manager and key personnel

1. Introduction

1.1 Before issuing of an aerodrome certificate or licence, NCAA must be satisfied that the personnel of the aerodrome are adequate in number, are qualified and have the necessary competencies and experience to operate and maintain the aerodrome and to conduct the safety functions of the aerodrome.

1.2 The aerodrome operator must employ an adequate number of qualified and skilled personnel to perform all critical activities for aerodrome operation and maintenance.

1.3 An operator of the aerodrome must carry out a task resource analysis to determine and document, the minimum number of personnel required for each operational and maintenance area at the aerodrome and ensure that the determined number of personnel are available throughout the hours of operation of the aerodrome. Guidance on task resource analysis is provided in AGA-AP139-06 (Task Resources Analysis).

1.4 If the NCAA or other relevant authority of the government requires competency certification for the personnel of an aerodrome, the operator must employ only those personnel who poses the required certification.

2. Training of Personnel

2.1 Personnel involved in operating and maintaining the aerodrome and its services and facilities must have the necessary competencies to be able to perform their duties at the aerodrome. This requires the establishment of a training programme which includes basic, recurrent and specialized training for technical personnel. The personnel training programme must include as appropriate, human factors training.

2.2 An operator of an aerodrome must be able to demonstrate through an established training programme, that persons carrying out aerodrome safety functions, have had the appropriate training and experience to undertake those functions.

2.3 The operator must implement a programme to upgrade the competency of the personnel it employs to perform critical operation and maintenance activities at the aerodrome.

2.4 Essential competencies required for safety functions at an aerodrome include but are not limited to –

(a) operation and maintenance of aerodrome facilities and equipment used by aircraft including communication systems;
(b) assessing and reporting on the physical characteristics and conditions of the aerodrome facilities and equipment;
(c) assessing and reporting on aerodrome lighting systems;
(d) operation and maintenance of rescue and firefighting equipment;
(e) inspection and reporting on the obstacle limitation surfaces;
(f) on-going assessment and reporting of hazards and safety risk analysis and mitigation;
(g) on-going evaluation of wildlife hazard;
(h) initiating of a NOTAM;
(i) use of radio; and
(j) supervision of the safety of aerodrome works.

2.5 The training programme must incorporate the review and evaluation of the adequacy of training provided to personnel and of the system used for testing of their competency.

3. Procedure for Assessing Personnel Competency

3.1. This procedure should answer the following questions: WHO is going to perform the assessment, WHAT does the assessment consist of, HOW will the assessment be performed, and WHEN should the assessment occur. WHO, WHAT, HOW, and WHEN are often closely associated, and most instructions will need to address all of them.

139.08.4 Quality Assurance System

1.1 To comply with the certification requirements, an aerodrome operator must develop, document, implement, and maintain a Quality Management System (QMS) with appropriate internal quality assurance procedures.

1.2 The QMS must comprise the structure, responsibilities, processes, and procedures of the aerodrome operator's organisation that promotes and establishes an environment and culture of continuing improvement that will enhance the safety of the aerodrome operations.

1.3 The internal quality assurance procedures referred to in paragraph 1.1 must identify, document and correct instances of non-conformance, or non-compliance. These procedures must be put in place for all areas of the aerodrome operator's activities that are required under NAMCARs Part 139. In addition to providing for compliance with regulatory requirements, the QMS must be designed to improve the aerodrome operator's performance and benefit the users of the aerodrome.

1.4 The QMS of a certified aerodrome must embrace the following principles –

A continual process that incorporates the techniques of inspections, audits, and reviews to assess the adequacy of managerial controls in key programmes and systems;

An ongoing process that identifies deficiencies, develops corrective action plans to correct these deficiencies, and performs follow-up reviews; and

An independent process that, organisationally, has straight-line reporting responsibility to top management.

1.5 The internal quality assurance procedures must not be misunderstood as a process that will replace the compliance inspection and audit requirements that are carried out by the NCAA.

1.6 The essential elements of an aerodrome operator's internal quality management system include:

(a) definition of the management commitment and responsibilities to the quality plan and procedures;

(b) a documented, approved, safety policy and plan to identify, implement, and maintain safety policy procedures;

(c) a procedures for corrective action to ensure existing problems that have been identified within the system are corrected;

(d) a procedure for preventive action to ensure that potential causes of problems that have been identified within the system are remedied;

(e) a procedure to ensure the QMS and the internal quality assurance procedures are subjected to continual, regular and structured review;

(f) an internal audit programme to audit the applicant's organisation for conformity with the procedures in its exposition and achievement of the goals set in its safety policy;

(g) a procedure to ensure quality indicators, including defect and incident reports, and personnel and customer feedback, are monitored to identify existing problems or potential causes of problems within the system;

(h) a records system that clearly documents what has taken place, allowing statistical analysis to monitor the continuing suitability and effectiveness of the QMS and the aerodrome operation; and

(i) a document control procedure to manage, develop, document, change, and distribute the organisation's quality and operational procedures.

1.7 An aerodrome operator's internal quality assurance procedures must identify a person (also known as the management representative) within the organisation, who has the responsibility and authority to –

(a) develop, implement and maintain the Quality Management System;

(b) manage the organisation's internal audit programme;

(c) identify and record any findings or concerns, and the evidence necessary to confirm findings or concerns;

(d) initiate, recommend, or provide solutions to findings or concerns through consultation with the management owning the non-conforming process or activity;

(e) communicate and co-ordinate activities with external auditors;

(f) analyse the root causes of concerns and findings for presentation to management for a review of trends and potential areas of concern; and

(g) conduct and record regular Management Reviews to ensure corrective and preventive actions are addressed and closed out within a specific time.

139.08.6 Safety Management System

1. Framework for safety management

1.1 The framework for the implementation and maintenance of an SMS comprises four components and twelve elements as the minimum requirements for SMS implementation. The aerodrome

SMS must be implemented based on the four components and twelve elements of the SMS framework:

1) Safety policy and objectives

1.1 Management commitment and responsibility;

1.2 Safety accountabilities;

1.3 Appointment of key safety personnel;

1.4 Coordination of emergency response planning; and

1.5 SMS documentation.

2) Safety risk management

2.1 Hazard identification; and

2.2 Safety risk assessment and mitigation.

3) Safety assurance

3.1 Safety performance monitoring and measurement;

3.2 The management of change; and

3.3 Continuous improvement of the SMS.

4) Safety promotion

4.1 Training and education; and

4.2 Safety communication.

2. Objectives of the aerodrome SMS

2.2 An aerodrome SMS must be designed to manage the safety requirements based on the complexity of the aerodrome. The SMS must be implemented in such a way that it supports the aerodrome operator in among other things:

(a) identifying and rectifying areas of non-compliance with aerodrome regulations and associated standards;
(b) detecting hazards through accumulation of evidence, assessing of associated risks and putting in place mitigation measures;
(c) ensuring continuous improvements of the aerodrome safety system.

3. SMS Documentation

3.1 An aerodrome SMS provides a framework within which the aerodrome manual and other Manuals can be incorporated thereby embedding safety as an integral part of all aerodrome procedures and management processes. The SMS must consist of well documented, easy to comprehend procedures that are continuously managed to support the aerodrome operator's obligations with respect to the aerodrome manual and the aerodrome certification requirements. The SMS documentation must cover all aspects of the SMS including –

(a) the safety policy and objectives;
(b) SMS requirements;
(c) SMS processes and procedures;
(d) Organisation structure including accountabilities, responsibilities and authorities for SMS processes and procedures; and
(e) SMS outputs.

3.2 The Documentation must include an SMS manual prepared in accordance with Section 139.07 of this Document. The SMS Manual must –

(a) describe the SMS system;-
(b) include a set of procedures that must be followed; and

(c) address each element according to the aerodrome operator's specific system.

4. Integration of SMS with Existing systems

4.1 An aerodrome operator must integrate existing systems into the aerodrome SMS. Existing business systems or processes that may be integrated into an aerodrome SMS include:

(a) Document control processes;
(b) Change management processes;
(c) Enterprise or Project Risk Management Systems;
(d) Contractor management processes;
(e) Quality Management System (QMS);
(f) Environmental Management System;
(g) Occupational Health and Safety Management System; and
(h) Security Management System.

4.2 While the quality management system (QMS) focuses on assuring product/service quality, and the means to achieve it, safety management focuses on the identification of hazards and the mitigation of risks associated with those hazards. SMS must therefore utilise and integrate quality management techniques, risk management and human factor principles into the processes and procedures of the operator to ensure safety objectives are realised.

5. Safety obligation of other organisations

5.1 The aerodrome operator must oblige all users of the aerodrome, including fixed-base operators, ground handling agencies and other organizations that perform activities independently at the aerodrome in relation to flight or aircraft handling, to comply with the requirements laid down by the aerodrome operator with regard to safety at the aerodrome. The aerodrome operator must monitor such compliance.

5.2 The aerodrome operator must require all users of the aerodrome, including fixed-base operators, ground handling agencies and other organizations performing activities related to operation of aircraft at the aerodrome, to cooperate in the programme to promote safety at, and the safe use of, the aerodrome by immediately informing it of any accidents, incidents, defects and faults which have a bearing on safety.

6. Aerodrome safety assessments

6.1 The aerodrome safety assessment process must address the impact of a safety concern, including a change or deviation, on the safety of operations at the aerodrome and takes into consideration the aerodrome's capacity and the efficiency of operations, as necessary. The safety assessment must be used to assess safety concerns arising from, inter alia, deviations from standards and applicable regulations, identified changes at the aerodrome or when any other safety concerns arise.

6.2 When a safety concern, change or a deviation has an impact on several aerodrome stakeholders, consideration must be given to the involvement of all stakeholders affected in the safety assessment process. The stakeholders impacted by the change may need to conduct a separate safety assessment themselves in order to fulfil the requirements of their SMSs and coordinate with other relevant stakeholders. When a change has an impact on multiple stakeholders, a collaborative safety assessment must be conducted to ensure compatibility of the final solutions.

6.3 A safety assessment considers the impact of the safety concern on all relevant factors determined to be safety-significant. The list below provides a number of items that may need to be considered when conducting a safety assessment at an aerodrome:

(a) aerodrome layout, including runway configurations; runway length; taxiway, taxilane and apron configurations; gates; jet bridges; visual aids; and the RFF services infrastructure and capabilities;

(b) types of aircraft, and their dimensions and performance characteristics, intended to operate at the aerodrome;

(c) traffic density and distribution;

(d) aerodrome ground services;

(e) air-ground communications and time parameters for voice and data link communications;

(f) type and capabilities of surveillance systems and the availability of systems providing controller support and alert functions;

(g) flight instrument procedures and related aerodrome equipment;

(h) complex operational procedures, such as collaborative decision-making (CDM);

(i) aerodrome technical installations, such as advanced surface movement guidance and control systems (A-SMGCS) or other air navigation aids;

(j) obstacles or hazardous activities at or in the vicinity of the aerodrome;

(k) planned construction or maintenance works at or in the vicinity of the aerodrome;

(l) any local or regional hazardous meteorological conditions (such as wind shear); and

(m) airspace complexity, ATS route structure and classification of the airspace, which may change the pattern of operations or the capacity of the same airspace.

6.4 Subsequent to the completion of the safety assessment, the aerodrome operator is responsible for implementing and periodically monitoring the effectiveness of the identified mitigation measures.

6.5 The aerodrome operator must submit the safety assessment report to the NCAA for review. The NCAA will review the safety assessment and its identified mitigation measures, operational procedures and operating restrictions, and is thereafter responsible for the subsequent regulatory oversight of their application.

6.6 An aerodrome safety assessment must be composed of four basic steps as follows:

(a) definition of a safety concern and identification of the regulatory compliance;

(b) hazard identification and analysis;

(c) risk assessment and development of mitigation measures; and
(d) development of an implementation plan for the mitigation measures and conclusion of the assessment.

7. Promulgation of safety information

7.1 The aerodrome operator must determine the most appropriate method for communicating safety information to the stakeholders and ensure that all safety-relevant conclusions of the safety assessment are adequately communicated.

7.2 In order to ensure adequate dissemination of information to interested parties, information that affects the current aeronautical information product (AIP) or other relevant safety information must be:

(a) promulgated in the relevant section of the AIP or automatic terminal information service (ATIS); and
(b) published in the relevant aerodrome information communications through appropriate means.

139.08.7 Runway safety programme

1. Runway safety team

1.1 A runway incursion prevention programme must start with the establishment of runway safety teams at individual aerodromes. The primary roles of a local runway safety team are to:

(a) develop an action plan for runway safety;
(b) advise management as appropriate on potential runway incursion issues; and

(c) recommend strategies for hazard removal and mitigation of the residual risk.

1.2 The team must comprise representatives from:

(a) aerodrome operations,
(b) air traffic service providers,
(c) airlines or aircraft operators,
(d) pilot and air traffic controller associations; and
(e) any other groups with a direct involvement in runway operations.

1.3 The team must meet on a regular basis. Frequency of meetings must be determined by the individual groups. At some aerodromes, other groups such as airside safety committee may already exist that could carry out the functions of a runway safety team.

1.4 Terms of reference for the runway safety team include:

(a) determining the number, type and, if available, the severity of runway incursions;
(b) considering the outcome of investigation reports in order to establish local hot spots or problem areas at the aerodrome;
(c) working as a cohesive team to better understand the operating difficulties of personnel working in other areas and recommending areas for improvement;
(d) ensuring that the recommendations contained in the NCAA "Runway Safety Procedures Manual" regarding the prevention of runway incursions are implemented;
(e) identifying any local problem areas and suggesting improvements;
(f) conducting a runway safety awareness campaign that focuses on local issues, for example, producing and distributing local hot spot maps or other guidance material as considered necessary; and
(g) regularly reviewing the airfield to ensure its adequacy and compliance with regulatory standards and requirements.

2. Objectives of runway safety programme

2.1 The objectives of runway safety programme include:

(a) to improve runway safety data collection, analysis and dissemination;
(b) to check that signage and markings are Part 139-compliant and visible to pilots and drivers;
(c) to develop initiatives for improving the standard of communications;
(d) to identify potential new technologies that may reduce the possibility of a runway incursion;
(e) to ensure that procedures are compliant with the regulatory standards and requirements; and
(f) to develop and distribute runway safety education and training material and initiate local awareness training to all relevant personnel on the aerodrome.

3. Runway safety programme requirements

3.1 The programme for the prevention of runway incursions must involve:

(a) conducting local runway incursion prevention awareness campaigns at each aerodrome for air traffic controllers, pilots and drivers and other personnel who are involved in runway operations;
(b) ensuring that infrastructure and procedures relating to runway operations are in compliance with specified standards;
(c) ensuring compliance with certification or licensing requirements;
(d) joint cross-training and familiarisation to pilots, air traffic controllers and vehicle drivers to increase their understanding of the roles and difficulties of personnel working in other area;
(e) visits to the manoeuvring area by all parties for familiarization of signs, markings and aerodrome layout;

(f) consideration of recommended best practices for aerodromes, pilots and air traffic controllers when implementing strategies for preventing runway incursions;
(g) reporting and investigation of runway incursion incidents in sufficient detail to identify specific causal and contributory factors;
(h) sharing of runway safety data with other aviation safety organizations both nationally and internationally to enhance lesson learning;
(i) provision in "real time" of time-critical aerodrome information that may affect operations on or near the runway; and
(j) the collection, provision and dissemination of aeronautical information, ensuring the accuracy, timeliness and integrity of data, and having processes in place to allow users of aeronautical information to provide feedback on the accuracy of aeronautical information.

3.2 Aerodrome operators must limit the physical possibility for pilots and vehicle drivers to mistakenly enter runways. To do this, aerodrome operators must consider the following elements in the design and location of the aerodrome infrastructure:

(a) the optimal use of perimeter taxiways;
(b) the avoidance of runway crossings; and
(c) simplistic and logical taxi/runway layouts in order to make the aerodrome instinctive, logical and user-friendly for vehicle drivers, air traffic controllers and pilots.

3.3 Aerodrome operators must:

(a) implement safety management systems in accordance with Parts 139 and 140 provisions with continued focus on runway safety;
(b) implement Part 139 provisions and maintenance programmes relating to runway operations (e.g. markings, lighting, signage);
(c) ensure adequate dissemination of information about work areas during construction or maintenance and that signs and markings are maintained and are clearly visible, adequate and unambiguous in all operating conditions;
(d) have in place formal driver training and assessment programme;

(e) conduct formal communications training and assessment for drivers and other personnel who operate on or near the runway;
(f) ensure the use of standard ICAO naming conventions for runways and taxiways; and
(g) have clear and precise procedures to be followed by vehicle drivers and other personnel who operate on or near the runway.

139.08.12 Aerodrome serviceability inspections

1. Introduction

1.1 An aerodrome serviceability inspection is an inspection of the aerodrome to ensure that it is safe for aircraft operations.

1.2 An inspection checklist must be used when conducting aerodrome serviceability inspections.

1.3 Whilst aerodrome serviceability inspections are essentially visual checks, the process must include appropriate remedial actions where faults or deficiencies are identified. If the identified fault or deficiency cannot be remedied immediately, appropriate NOTAM action must be taken.

1.4 The aerodrome serviceability inspection must include the following:
(a) an inspection of the movement area to check its surface condition (including for the presence of foreign objects);
(b) an inspection of aerodrome markings, lighting, wind direction indicators and ground signals;
(c) an inspection for any obstacles infringing the take-off, approach and transitional surfaces;
(d) an inspection for any birds or animals on or near the movement area;

(e) an inspection of any measures to control the inadvertent entry of persons or animals into the movement area (including aerodrome fencing);

(f) an empirical assessment of the bearing strength of unrated runway pavements;

(g) an empirical assessment of the runway strip or each runway strip where the runway concerned is not marked and the whole runway strip may be used for aircraft operations; and

(h) a check of whether any NOTAMS for the aerodrome are current and accurate.

1.5 Particulars of the procedures for carrying out serviceability inspections, including the use of a checklist, and for reporting any changes to aerodrome information or for requesting the issue of a NOTAM; are to be included in the aerodrome manual.

2. Significant Objects

2.1 Any significant object found in the course of the inspection, including aircraft parts which may have fallen from the aircraft, or the remains of birds which may have been struck by an aircraft, must be reported immediately to air traffic control, where appropriate, and to the NCAA.

3. Surface conditions of the movement area, including the presence of water

3.1 The inspection must check for:

(a) loss of visibility of markers and markings;

(b) use of incorrect markers and markings;

(c) any disturbance to level and alignment of lights;

(d) visual light intensity check; does a light stand out less bright than others in the same system?

(e) discoloured or dirty lenses;

(f) outage lamps, incorrect lamps fitted, or lamps fitted wrongly;

(g) the condition of the frangibility of light bases;

(h) exposed edges around footings and other aerodrome installations;
(i) damage to wind indicator assembly or mounting; and
(j) damage to wind indicator sleeve fabric, or loss of conspicuous colour.

4. Cleanliness of the movement area

4.1 The inspection must check for:

(a) foreign objects, such as aircraft fastening devices and other parts,
(b) mechanics tools, small items of equipment and personal items;
(c) debris, such as sand, loose rocks, concrete, wood, plastic, pieces of tyre and mud; and
(d) with particular vigilance during and after construction activity, where vehicles and plant travel over unpaved areas under wet conditions.

5. Obstacles Infringing the Take-off, Approach and Transitional Surfaces

5.1 The aerodrome operator must have procedures and equipment in place to enable inspection personnel to identify objects protruding through the OLS. Equipment must include appropriate instrumentation, such as:

(a) a hand held clinometer;
(b) 'sighting plane' installations; or
(c) more formal survey equipment.

6. Birds or animals on, or in the vicinity of the movement area

6.1 The inspection must include:

(a) the condition of aerodrome fencing, particularly in critical areas;
(b) climatic or seasonal considerations, such as the presence of birds at certain times of the year, or related to the depth of water in drainage ponding areas;

(c) possible shelter provided by aerodrome infrastructure such as buildings, equipment and gable markers;

(d) bird hazard mitigating procedures incorporated in the environmental management procedures for the aerodrome;

(e) off-airport attractors like animal sale yards, picnic areas, aeration facilities and waste disposal or landfill areas, and

(f) use of harassment procedures where appropriate.

7. Empirical assessment of the Bearing Strength of Unrated Runway Pavements and of Runway Strips

7.1 The bearing strength of a runway strip will only be required to be assessed where an unsealed runway is not marked and the whole of the runway strip is available for aircraft operations.

7.2 Whilst discretion and judgement together with local knowledge, will always form part of empirical assessment of bearing capacity, appropriate test procedures must be in place for the practical guidance of persons making the assessment. Simple test procedures can be devised such as those involving:

(a) use of a crowbar when a dry surface may conceal a soft unserviceable base;

(b) the back of a pick, in the hands of someone with practical pavement experience; or

(c) a suitably laden utility or truck to simulate the wheel loads of user aircraft.

8. Currency of NOTAMs

8.1 Daily serviceability inspection must include checking any outstanding NOTAM for the aerodrome. Check that the contents of the NOTAM, particularly the effective period(s) are still current.

9. Aerodrome fencing

9.1 The inspection must check for damaged fences, open gates and signs of attempted entry by either animals or humans.

10. Inspection logbooks

10.1 The aerodrome operator must maintain aerodrome inspection logbooks for recording the date and time of each aerodrome serviceability inspection, the results of each inspection and any action taken. Logbooks must be retained for at least 2 years.

139.08.13 Aerodrome technical inspections

1. Introduction

1.1 The technical inspections conducted by an aerodrome operator must include as applicable, the following:

(a) an inspection of the infrastructure, obstacle limitation surfaces (OLS), visual and non-visual aids and aerodrome equipment for the use of aircraft;
(b) an instrument survey of the approach, take-off and transitional surfaces;
(c) an inspection and testing of the aerodrome lighting and electrical systems, including the visual approach slope indicator;
(d) an electrical testing of any earthing points at the aerodrome;
an inspection of the rescue and firefighting services;
(e) an inspection and assessment of the movement area pavements and drainage;
(f) an inspection of signs on the movement area;
(g) an inspection of facilities at the aerodrome used for any of the following:
(i) aerodrome emergencies;
(ii) the handling of hazardous materials;

(iii) wildlife hazard management;

(iv) stand-by and emergency aerodrome lighting;

(h) an inspection of airside vehicle control arrangements (if any);

(i) a check of the currency and accuracy of:

(i) aerodrome information published in AIP; and

(ii) aerodrome operating procedures specified in the aerodrome manual for the aerodrome.

1.2 The aerodrome technical inspection must be conducted by a person or persons with appropriate technical qualifications and experience and in particular–

(a) the movement area, other pavements and drainage must be inspected by a person with technical qualification in civil engineering; and

(b) the lighting and electrical facilities must be inspected by an electrical engineer or a qualified electrician; and

(c) the obstacle limitation surfaces must be inspected by a person who:

(i) is technically qualified or experienced in surveying; and

(ii) has a sound knowledge and understanding of the standards and survey procedures for obstacle limitation surfaces.

1.3 An appropriate checklist must be prepared for the inspection of each technical area.

139.08.15 Aerodrome environmental management programme

1. Introduction

1.1 A holder of an aerodrome certificate/licence must establish an aerodrome environmental management programme in the area within its authority and where any foreign object debris (FOD), oil and fuel spillages, bird and animal presents or are likely to present a hazard to aircraft operating to or from the aerodrome to minimise the effects of such hazard or potential hazard.

1.2 In establishing the aerodrome environmental management programme, the holder of an aerodrome certificate must take due cognisance of relevant conservation and environmental legislation applicable in Namibia including the Environmental Management Act 2007 and regulations made thereunder.

1.3 The holder of an aerodrome certificate/licence must ensure that environmental management meeting is conducted with interval not exceeding three months and that –

(a) the minutes of the meetings are kept and clearly indicate all identified environmental issues that may affect the operations;
(b) the meetings address all environmental issues within the boundaries of the aerodrome and in the immediate vicinity up to a radius of 10 kilometre that might affect the aerodrome operations negatively; and
(c) mitigating measures to rectify all identified environmental issues are recorded for audit purposes including communication with external parties.

139.08.16 Aerodromes works safety

1. Introduction

1.1 The operator of a certified or licensed aerodrome must arrange aerodrome works so as not to create any hazard to aircraft or confusion to pilots. The aerodrome manual must include particulars of the procedures for planning and safely carrying out aerodrome works.

1.2 Aerodrome works may be carried out without the closure of the aerodrome, provided safety precautions are adhered to. Aerodrome works may be carried out in the following manner:

(a) where the works are of a nature that they will disrupt aircraft operations, they must be carried out under a proper aerodrome works safety plan (also known as method of works plan); and

(b) where works are of a maintenance nature they must be carried out as time-limited works.

1.3 Where a threshold is required to be temporarily displaced by more than 300 m due to aerodrome works, the matter must be referred to the NCAA to assess the operational significance of that displacement.

2. Aerodrome Works Safety Plan

2.1 At a certified or licensed aerodrome, unless the aerodrome is closed during aerodrome works, or the work is of an emergency nature, the aerodrome operator must not carry out aerodrome works, other than time-limited works, without a Works Safety Plan. The works safety plan sets out the arrangements for carrying out those works.

2.2 The works safety plan must be prepared as described in 3 below. When preparing a works safety plan, an aerodrome operator must consult:

(a) commercial air transport operators using the aerodrome;

(b) Air Traffic Control; and

(c) if the works safety plan may affect its operations, the Rescue and Fire Fighting Service unit at the aerodrome;

so as to ensure the safety of aircraft operations at the aerodrome.

2.3 The aerodrome operator must submit a copy of the works safety plan, and any alteration thereof, to the Executive Director, as soon as possible after the Plan is prepared or altered.

2.4 A works safety plan is not required, if the aerodrome operator closes the aerodrome to aircraft operations while aerodrome works are being carried out. Reasonable notice of intention to close the aerodrome must be given to the NCAA, air traffic services, air operators and all organisations and persons likely to be affected by the closure.

2.5 The operator must not close the aerodrome to aircraft operations due to aerodrome works, unless a NOTAM giving notice of the closure has been issued not less than 14 days before closure takes place.

2.6 A works safety plan is not required for emergency aerodrome works carried out to repair unforeseen damage to part of the manoeuvring area, or to remove an obstacle, or if the works do not require any restrictions to aircraft operations. Where practicable, a NOTAM, giving the time and date of the commencement of the works must be issued, as early as possible, but preferably not less than 48 hours before commencement of the works.

3. Contents of a works safety plan

3.1 The works safety plan must be presented in sections in the following sequence:

(a) title page;
(b) works information;
(c) restrictions to aircraft operations;
(d) restrictions to works organisation;
(e) administration;
(f) authority;
(g) drawings; and
(h) distribution list.

4. Time-limited Works

4.1 Aerodrome works may be carried out as time-limited works if normal aircraft operations are not disrupted, the movement area can be restored to normal safety standards and any obstacle created by those works removed in not more than 30 minutes.

4.2 Time-limited works include the following works:

(a) maintenance of markings and lights;
(b) grass mowing;
(c) rolling surfaces;
(d) sweeping pavements;
(e) minor repairs to pavements; and
(f) surveys and inspections.

4.3 A person must not commence time-limited works that require more than 10 minutes to restore normal safety standards to the movement area and remove obstacles, unless a NOTAM has been issued not less than 24 hours before the commencement, giving the date and time of commencement and the time required to restore normal safety standards.

4.4 Subject to paragraph 4.5 below time-limited works must not be carried out at night or if visibility is less than 5 kilometres.

4.5 Paragraph 4.4 does not apply at a controlled aerodrome or in other cases if the area can be restored to the required safety standards so as to allow aircraft operations to take place without delay.

4.6 Time-limited works must be stopped and normal safety standards restored, when required to allow an aircraft operation to take place.

4.7 All reasonable measures must be taken to complete the restoration of normal safety standards not less than 5 minutes before the scheduled or notified time of an aircraft operation.

5. Resumption of Aerodrome Works

5.1 At an uncontrolled aerodrome, works that have been stopped to allow the restoration of normal safety standards may be resumed:

(a) if stopped for an aircraft arrival, immediately after the arrival, if the safety of the aircraft is not endangered by the resumption; or
(b) if stopped for an aircraft departure, 15 minutes after the departure has taken place; or
(c) if stopped for an aircraft arrival that does not take place; 30 minutes after the time scheduled or notified for the arrival (when a new ETA is established).

5.2 At a controlled aerodrome, air traffic control may, at the request of the aerodrome operator, vary the time limits set out in paragraph 5.1 for restoring normal safety standards or resuming aerodrome works. A variation under this paragraph is subject to such conditions as air traffic control may impose

6. Management and Control of Aerodrome Works

6.1 An aerodrome operator must –

(a) ensure that aerodrome works are carried out in accordance with these standards;
(b) appoint a person in writing as a works safety officer for the purpose of ensuring the safe conduct of aerodrome works;
(c) before appointing a person as a works safety officer, be satisfied that the person is able to perform the functions of a works safety officer;

(d) ensure that a works safety officer is present at all times if aerodrome works are being carried out and the aerodrome is open to aircraft operations, except where one of the persons carrying out the time-limited work has been trained to perform the function of the works safety office;

(e) take all reasonable measures to ensure that the works organisation carries out aerodrome works in a manner that will ensure the safety of aircraft operations;

(f) ensure that persons, vehicles, plant and equipment required for carrying out aerodrome works, are not permitted to enter the movement area or remain on it, except for the purpose of carrying out those works;

(g) state in the works safety plan, the procedures for entering works areas; and

(h) allow access to works areas only along routes shown in the works safety plan.

6.2 An aerodrome operator must ensure that –

(a) aerodrome markers, markings and lights required for, or affected by, aerodrome works are installed, altered or removed in accordance with the appropriate standards;

(b) parts of the movement area that are unserviceable as a result of aerodrome works being carried out are marked and lit in accordance with the appropriate standards;

(c) all obstacles created as a result of aerodrome works being carried out are marked and lit in accordance the appropriate standards;

(d) vehicles and plant used in carrying out aerodrome works are marked in accordance the appropriate standards;

(e) vehicles and plant used in carrying out aerodrome works at night must be lit in accordance with the appropriate standards;

(f) a vehicle used by a works safety officer while supervising aerodrome works at a controlled aerodrome is equipped with a radio for two-way communication with air traffic control;

(g) at a controlled aerodrome, each vehicle used by a works safety officer is given a call sign for the purpose of communication with air traffic control; and

(h) any vehicle or plant that is not marked or lit, or equipped with two-way communication as required sub-paragraphs (d), (e), (f) and (g) above, is not used in carrying out aerodrome works unless it is used under the direct supervision of the works safety officer or within the limits of appropriately marked and lit works areas.

6.3 An aerodrome operator must upon the completion of aerodrome works and the restoration of normal safety standards to the movement area, cancel any NOTAM issued to notify those works.

7. Works on a runway strip

7.1 Works on runway strips must be carried out in the shortest possible time, and where undertaken within 23 m of the edge of the runway or runway shoulder:

(a) works must only be undertaken on one side of the runway at any one time;

(b) the works area at any one time must not exceed 9 square metres, except for machine cut trenches, not exceeding a width of 100 mm and length of 280 m;

(c) materials such as gravel, signs and lights, etc left within this part of the runway strip, must not exceed one metre in height above ground. Any material likely to be affected by propeller wash or jet blast, must be removed; and

(d) plant and vehicles must vacate this area when the runway is in use.

7.2 Where works are undertaken on a runway strip between 23 m from the edge of the runway or runway shoulder and the edge of the graded runway strip, similar restriction must be applied within this area of the runway strip, as for paragraph 7.1 above, except that the works area may extend up to an area of 18 square metres at any one time, and the height of materials may extend up to two metres.

7.3 Where works are to be undertaken in the vicinity of navigational or landing aids located within the runway strips, care must be taken to ensure that neither the works nor vehicles or plant associated with the works, affect the performance of the aids

SUBPART 9 - AERODROME DATA

139.09.2 Aeronautical data

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

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

1.3. Where made available in accordance with 1.2 above, the selection of the aerodrome mapping data features to be collected must be made with consideration of the intended applications.

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

139.09.4. Aerodrome and runway elevation

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

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

1.3. For precision approach runway, the elevation and geoid undulation of the threshold, the elevation of the runway end and the highest elevation of the touchdown zone must be measured to the accuracy of one-quarter metre or foot and reported to the aeronautical information services authority. Geoid undulation must be measured in accordance with the appropriate system of coordinates.

139.09.5. Aerodrome reference temperature

1.1. An aerodrome operator must determine and notify an aerodrome reference temperature in degrees Celsius.

1.2. The aerodrome reference temperature must be the monthly mean of the daily maximum temperatures for the hottest month of the year (the hottest month being that which has the highest monthly mean temperature), averaged over a period of 5 years.

139.09.6. Aerodrome dimensions and related information

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

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

(b) strip —

(i) runway end safety area — length, width to the nearest metre or foot, surface type;

(ii) stopway — length, width to the nearest metre or foot, surface type; and

(iii) arresting system — location (which runway end) and description;

(c) taxiway — designation, width, surface type;

(d) apron — surface type, aircraft stands;

(e) the boundaries of the air traffic control service;

(f) clearway — length to the nearest metre or foot, ground profile;

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

(h) location and radio frequency of any VOR aerodrome checkpoint;

(i) location and designation of standard taxi-routes; and

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

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

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

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

1.5. The geographical coordinates of obstacles in Area 2 (the part within the aerodrome boundary) and in Area 3 (Aerodrome movement area) as illustrated in *Figure 9.1 (Terrain and obstacle* *coverage areas)*. These obstacles must be measured and reported to the aeronautical information services authority in degrees, minutes, seconds and tenths of seconds. In addition, the top elevation, type, marking and lighting (if any) of obstacles must be reported to the aeronautical information services authority.

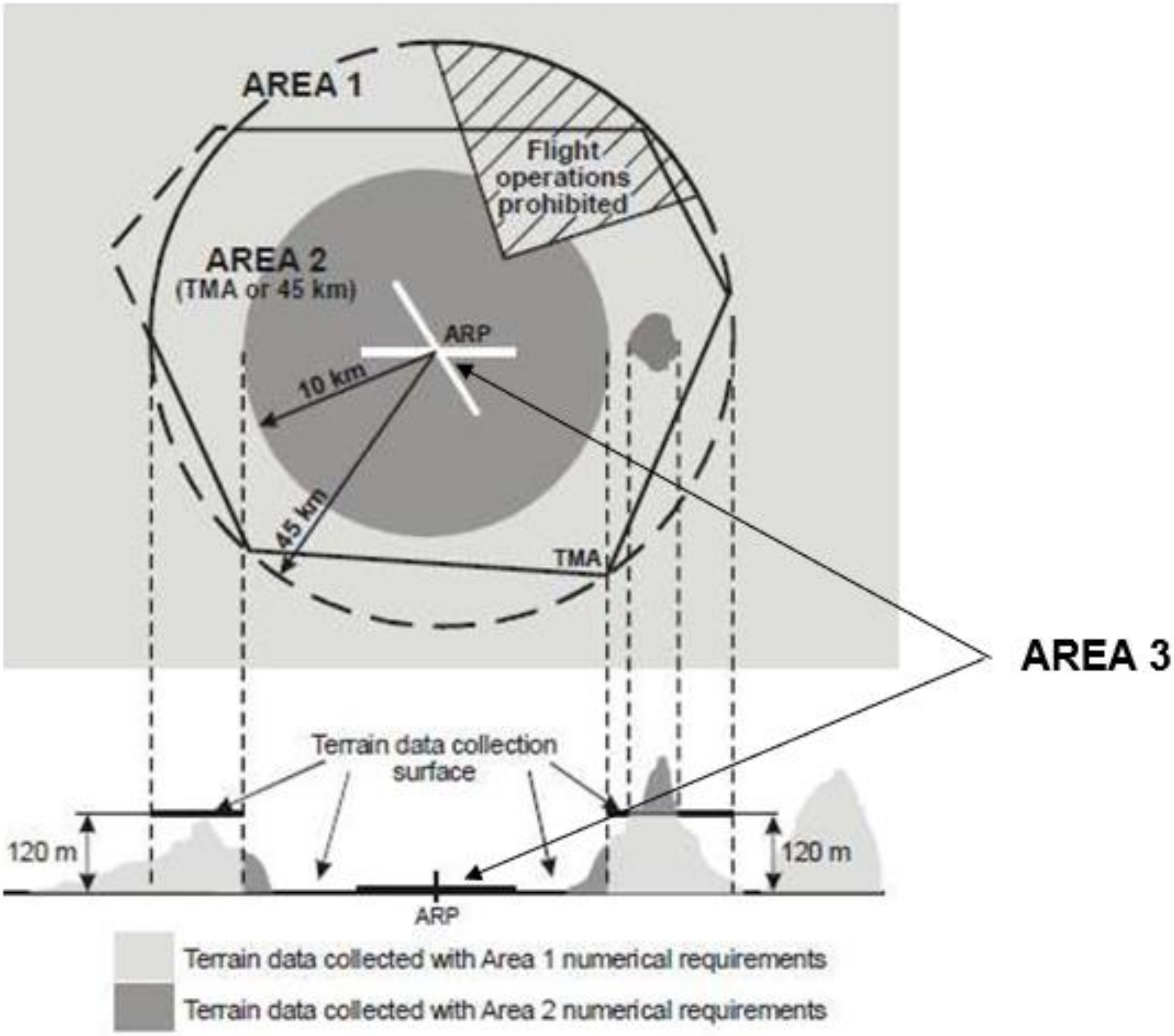


Figure 9. 1: Terrain and obstacle coverage areas

139.09.7. Strength of pavements

1.1. The bearing strength of a pavement must be determined by the aerodrome operator.

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

(a) the pavement classification number (PCN);

(b) pavement type for ACN-PCN determination;

(c) subgrade strength category;

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

(e) evaluation method.

Compliance Note. If necessary, PCNs may be published to an accuracy of one-tenth of a whole number.

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

Compliance Note. Different PCNs may be reported if the strength of the pavement is subject to significant seasonal variation.

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

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

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

a) *Pavement type for ACN-PCN 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).

b) *Subgrade strength category:*

	Code
High strength: characterized by K = 150 MN/m^3 and representing all K values above 120 MN/m^3 for rigid pavements, and by CBR = 15 and representing all CBR values above 13 for flexible pavements	A
Medium strength: characterized by K = 80 MN/ m^3 and representing a range in K of 60 to 120 MN/ m^3 for rigid pavements, and by CBR = 10 and representing a range in CBR of 8 to 13 for flexible pavements.	B
	C

Low strength: characterized by K = 40 MN/ m^3 and representing a range in K of 25 to 60 MN/ m^3 for rigid pavements, and by CBR = 6 and representing a range in CBR of 4 to 8 for flexible pavements.	
Ultra low strength: characterized by K = 20 MN/ m^3 and representing all K values below 25 MN/ m^3 for rigid pavements, and by CBR = 3 and representing all CBR values below 4 for flexible pavements.	D

c) *Maximum allowable tire pressure category:*

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

Note. Where the pavement is used by large aircraft or aircraft with tire pressures in the upper categories referred to in 1.6 c), particular attention must be given to the integrity of light fittings in the pavement and pavement joints.

d) *Evaluation method:*

	Code
Technical evaluation: representing a specific study of the pavement characteristics and application of pavement behaviour technology.	T

Using aircraft experience: representing a knowledge of the specific type U
and mass of aircraft satisfactorily being supported under regular use.

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

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

PCN 80 / R / B / W / T

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

PCN 50 / F / A / Y / U

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

PCN 40 / F / B / 0.80 MPa /T

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

1.7. Criteria must be established to regulate the use of a pavement by an aircraft with an ACN higher than the PCN reported for that pavement in accordance with 1.2 and 1.3.

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

(a) maximum allowable aircraft mass; and

(b) maximum allowable tire pressure.

Example: 4 000 kg/0.50 MPa.

2. The ACN-PCN method of reporting pavement strength

2.1. *Overload operations*

2.1.1. Overloading of pavements can result either from loads too large, or from a substantially increased application rate, or both. Loads larger than the defined (design or evaluation) load shorten the design life, whilst smaller loads extend it. With the exception of massive overloading, pavements in their structural behaviour are not subject to a particular limiting load above which they suddenly or catastrophically fail. Behaviour is such that a pavement can sustain a definable load for an expected number of repetitions during its design life. As a result, occasional minor overloading is acceptable, when expedient, with only limited loss in pavement life expectancy and relatively small acceleration of pavement deterioration. For those operations in which magnitude of overload and/or the frequency of use do not justify a detailed analysis, the following criteria are suggested:

(a) for flexible pavements, occasional movements by aircraft with ACN not exceeding 10 per cent above the reported PCN must not adversely affect the pavement;

(b) for rigid or composite pavements, in which a rigid pavement layer provides a primary element of the structure, occasional movements by aircraft with ACN not exceeding 5 per cent above the reported PCN must not adversely affect the pavement;

(c) if the pavement structure is unknown, the 5 per cent limitation must apply; and

(d) the annual number of overload movements must not exceed approximately 5 per cent of the total annual aircraft movements.

2.1.2. Such overload movements must not normally be permitted on pavements exhibiting signs of distress or failure. Furthermore, overloading must 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 must review the relevant pavement condition regularly, and must also review the criteria for overload operations periodically since excessive repetition of overloads can cause severe shortening of pavement life or require major rehabilitation of pavement.

139.09.8. Pre-flight altimeter check point

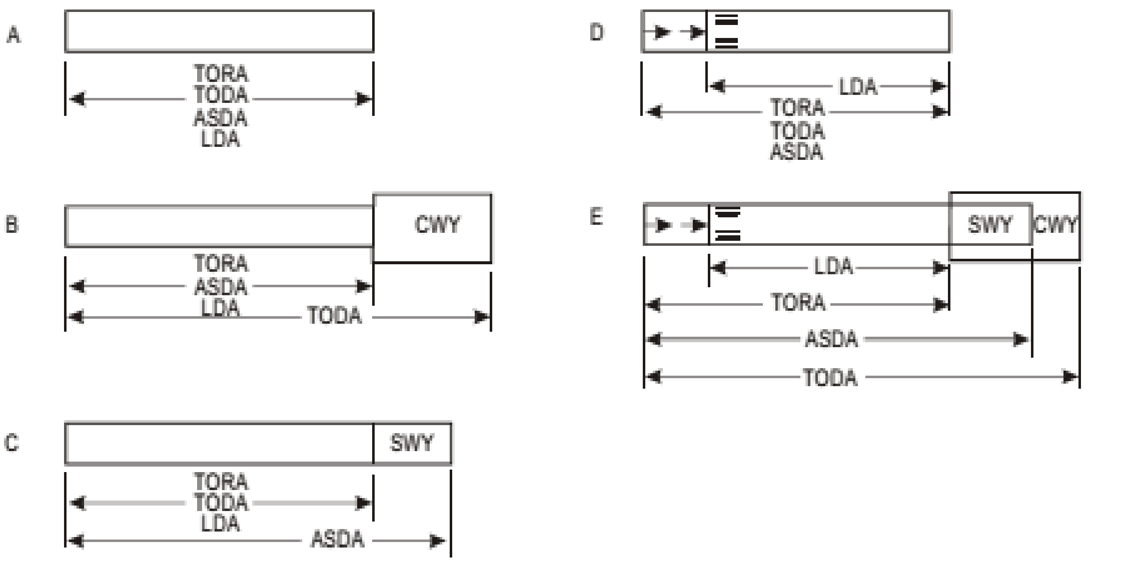
1.1 One or more pre-flight altimeter check locations must be established for an aerodrome.

1.2 A pre-flight check location may be located on an apron.

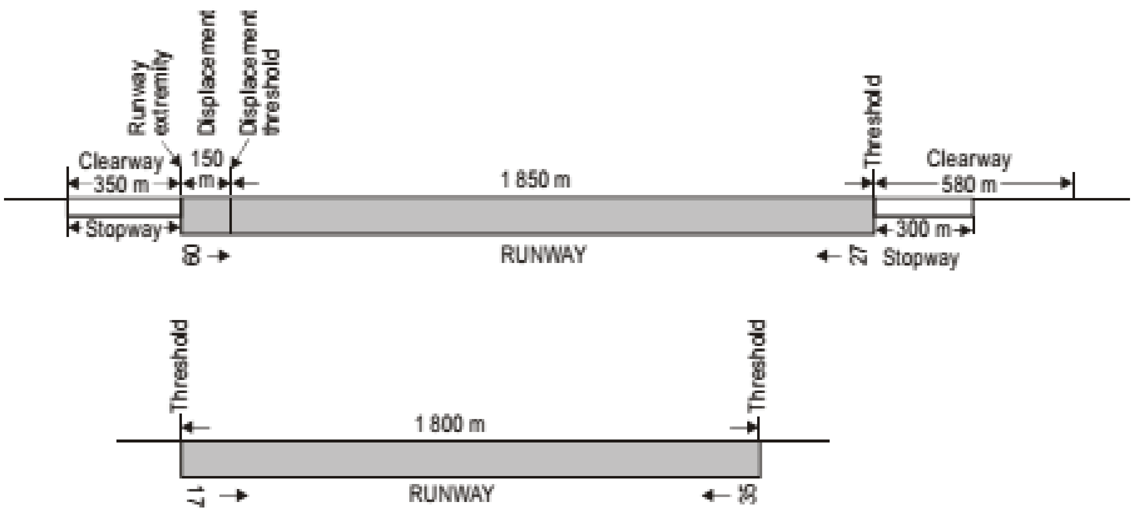
1.3 The elevation of a pre-flight altimeter check location must be the average elevation of the area on which it is located, rounded to the nearest metre or foot. The elevation of any portion of a pre-flight altimeter check location must be within 3 m (10 ft) of the average elevation for that location.

139.09.9. Declared distances

3.1 The declared distances to be calculated for each runway direction comprise: the take-off run available (TORA), take-off distance available (TODA), accelerate-stop distance available (ASDA), and landing distance available (LDA) as illustrated below:



Note.— All declared distances are illustrated for operations from left to right.



F

RUNWAY	TORA	ASDA	TODA	LDA
	m	m	m	m
09	2 000	2 300	2 580	1 850
27	2 000	2 350	2 350	2 000
17	NU	NU	NU	1 800
35	1 800	1 800	1 800	NU

Figure 9. 2: Illustration and determination of declared distances

3.2 Where a runway is not provided with a stopway or clearway and the threshold is located at the extremity of the runway, the four declared distances must be equal to the length of the runway, as shown in Figure 9.2 above.

3.3 Where a runway is provided with a clearway (CWY), then the TODA will include the length of clearway, as shown in (B) above.

3.4 Where a runway is provided with a stopway (SWY), then the ASDA will include the length of stopway, as shown (C) above.

3.5 Where a runway has a displaced threshold, then the LDA will be reduced by the distance the threshold is displaced, as shown in (D) above. A displaced threshold affects only the LDA for approaches made to that threshold; all declared distances for operations in the reciprocal direction are unaffected.

3.6 Illustrations in (B) through to (D) illustrate a runway provided with a clearway or a stopway or having a displaced threshold. Where more than one of these features exist, then more than one of the declared distances will be modified — but the modification will follow the same principle illustrated. An example showing a situation where all these features exist is shown in (E).

3.7 A suggested format for providing information on declared distances is given in (F) above. If a runway direction cannot be used for take-off or landing, or both, because it is operationally forbidden, then this must be declared and the words “not usable” or the abbreviation “NU” entered.

139.09.10. Condition of movement area and related facilities

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

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

(a) construction or maintenance work;

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

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

(d) other contaminants on a runway, taxiway or apron;

(e) other temporary hazards, including parked aircraft;

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

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

1.3 To facilitate compliance with 1.1 and 1.2, the following inspections must be carried out each day:

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

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

1.4 Personnel assessing and reporting runway surface conditions must be trained and competent to perform their duties.

1.5 1.5 The philosophy of the runway condition report is that the aerodrome operator assesses the runway surface conditions whenever water is present on an operational runway. From this assessment, a runway condition code (RWYCC) and a description of the runway surface are reported which can be used by the flight crew for aeroplane performance calculations. This report, based on the depth and coverage of the water, is the best assessment of the runway surface condition by the aerodrome operator; however, all other pertinent information may be taken into consideration.

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

- DRY
- STANDING WATER
- WET
- LOOSE SAND

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

1.8 Information that a runway or portion thereof is slippery when wet must be made available.

1.9 Notification must be given to relevant aerodrome users when the friction level of a paved runway or portion thereof is less than the minimum friction level specified by the aerodrome operator in accordance with NAMCARs Part 139.17.3.

139.09.11. Information on disabled aircraft removal

1.1 The contact details of the office of the aerodrome coordinator of operations for the removal of an aircraft disabled on or adjacent to the movement area must be made available, on request, to aircraft operators.

1.1 Information concerning the capability to remove an aircraft disabled on or adjacent to the movement area must be made available.

139.09.12. Information on rescue and firefighting level of protection

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

1.2 The level of protection normally available at an aerodrome must be expressed in terms of the category of the rescue and firefighting services as prescribed in NAMCARs Part 139.16.3 and in accordance with the types and amounts of extinguishing agents normally available at the aerodrome.

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

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

139.09.13. Information concerning visual approach slope indicator systems

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

(a) associated runway designation number;

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

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

(d) nominal approach slope angle(s) for a T-VASIS, AT-VASIS, PAPI and an APAPI; and

(e) minimum eye height(s) over the threshold of the on-slope signal(s). For a T-VASIS or an AT-VASIS this must be the lowest height at which only the wing bar(s) are visible; however, the additional heights at which the wing bar(s) plus one, two or three fly-down light units come into view may also be reported if such information would be of benefit to aircraft using the approach. For a PAPI this must be the setting angle of the third unit from the runway minus 2’, i.e. angle B minus 2’, and for an APAPI this must be the setting angle of the unit farther from the runway minus 2’, i.e. angle A minus 2’.

139.09.14. Coordination between aeronautical information services and aerodrome operators

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

(a) information on the status of certification of aerodromes and aerodrome conditions;

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

(c) any other information considered to be of operational significance.

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

1.3. Of a particular importance are changes to aeronautical information that affect charts and/or computer-based navigation systems which qualify to be notified by the aeronautical information regulation and control (AIRAC) system, as specified in NAMCARs Part 175. The predetermined, internationally agreed AIRAC effective dates must be observed by the responsible aerodrome services when submitting the raw information/data to aeronautical information services.

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

SUBPART 10 - AERODROME PHYSICAL CHARACTERISTICS

139.10.2 Runways

1. Number and orientation of runways

1.1 *Determining orientation, siting and number of runways*

1.1.1 Many factors affect the determination of the orientation, siting and number of runways. One important factor is the usability factor, as determined by the wind distribution, which is specified hereunder. Another important factor is the alignment of the runway to facilitate the provision of approaches conforming to the approach surface specifications described in NAMCARs 139.11.

1.1.2 Factors to be taken into account in the determination of the siting and orientation of runway include:

(a) *Type of operation* – Attention must be paid in particular to whether the aerodrome is to be used in all meteorological conditions or only in visual meteorological conditions, and whether it is intended for use by day and night, or only by day.

(b) *Climatological conditions* – A study of the wind distribution must be made to determine the usability factor. A study must also be made of the occurrence of poor visibility and/or low cloud base. Account must be taken of their frequency as well as the accompanying wind direction and speed.

(c) *Topography of the aerodrome site, its approaches, and surroundings* –

(i) compliance with the obstacle limitation surfaces;

(ii) current and future land use. The orientation and layout must be selected so as to protect as far as possible the particularly sensitive areas such as residential, school and hospital zones from the discomfort caused by aircraft noisecurrent and future runway lengths to be provided;

(iii) construction costs; and

(iv) possibility of installing suitable non-visual and visual aids for approach-to-land.

(d) *Air traffic in the vicinity of the aerodrome, particularly –*

(i) proximity of other aerodromes or ATS routes;

(ii) traffic density; and

(iii) air traffic control and missed approach procedures.

1.1.3 The number of runways to be provided in each direction depends on the number of aircraft movements to be catered to.

1.1.4 When a new instrument runway is being located, particular attention needs to be given to areas over which aeroplanes will be required to fly when following instrument approach and missed approach procedures, so as to ensure that obstacles in these areas or other factors will not restrict the operation of the aeroplanes for which the runway is intended.

1.1.5 The number and orientation of runways at an aerodrome must be such that the usability factor of the aerodrome is not less than 95 per cent for the aeroplanes that the aerodrome is intended to serve.

1.1.6 The siting and orientation of runways at an aerodrome must, where possible, be such that the arrival and departure tracks minimize interference with areas approved for residential use and other noise-sensitive areas close to the aerodrome in order to avoid future noise problems.

1.2 *Choice of maximum permissible crosswind components*

1.2.1 In the application of usability factor of 95 percent as indicated in 1.1.5 above, it must be assumed that landing or take-off of aeroplanes is, in normal circumstances, precluded when the crosswind component exceeds:

- 37 km/h (20 kt) in the case of aeroplanes whose reference field length is 1 500 m or over, except that when poor runway braking action owing to an insufficient longitudinal coefficient of friction is experienced with some frequency, a crosswind component not exceeding 24 km/h (13 kt) may be assumed;
- 24 km/h (13 kt) in the case of aeroplanes whose reference field length is 1 200 m or up to but not including 1 500 m; and
- 19 km/h (10 kt) in the case of aeroplanes whose reference field length is less than 1 200 m.

1.3 *Data to be used*

1.3.1 The selection of data to be used for the calculation of the usability factor must be based on reliable wind distribution statistics that extend over as long a period as possible, preferably of not less than five years. The observations used must be made at least eight times daily and spaced at equal intervals of time. Some allowance for gusty conditions must be made as follows:

(a) Wind statistics used for the calculation of the usability factor are normally available in ranges of speed and direction, and the accuracy of the results obtained depends, to a large extent, on the assumed distribution of observations within these ranges. In the absence of any sure information as to the true distribution, it is usual to assume a uniform distribution since, in relation to the most favourable runway orientations, this generally results in a slightly conservative usability factor.

(b) The maximum mean crosswind components refer to normal circumstances. There are some factors which may require that a reduction of those maximum values be taken into account at a particular aerodrome. These include –

(i) the wide variations which may exist, in handling characteristics and maximum permissible crosswind

(ii) components, among diverse types of aeroplanes (including future types) within each of the three groups given in 1.2.1 above;

(iii) prevalence and nature of gusts;

(iv) prevalence and nature of turbulence;

(v) the availability of a secondary runway;

(vi) the width of runways;

(vii) the runway surface conditions — water, snow and ice on the runway materially reduce the allowable crosswind component; and

(viii) the strength of the wind associated with the limiting crosswind component.

2. *Location of threshold*

2.1 A threshold must be located at the extremity of a runway unless operational considerations justify the choice of another location.

2.2 Factors to be considered in the siting of a threshold include:

(a) the threshold is normally located at the extremity of a runway, if there are no obstacles penetrating above the approach surface ;

(b) the height of the ILS reference datum and/or MLS approach reference datum; and

(c) the obstacle clearance limits – in determining that no obstacles penetrate above the approach surface, account must be taken of mobile objects (vehicles on roads, trains, etc.) at least within that portion of the approach area within 1 200 m longitudinally from the threshold and of an overall width of not less than 150 m.

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

Compliance Note. Guidance on factors which may be considered in the determination of the location of a displaced threshold is provided in paragraphs 2.4 to 2.8 below.

2.4 A runway may be displaced –

(a) if an object extends above the approach surface and the object cannot be removed;
(b) to meet the obstacle limitation objectives, the threshold may be displaced down the runway for the distance necessary to provide that the approach surface is cleared of obstacles.

2.5 Factors to be considered in the determination of the location of a displaced threshold include:

(a) the types of aeroplanes which the runway is intended to serve;
(b) the limiting visibility and cloud base conditions under which the runway will be used;
(c) the position of the obstacles in relation to the threshold and extended centre line; and
(d) in the case of a precision approach runway, the significance of the obstacles to the determination of the obstacle clearance limit.

2.6 Notwithstanding the consideration of landing distance available, the selected position for the threshold must not be such that the obstacle free surface to the threshold is steeper than 3.3 per cent where the code number is 4 or steeper than 5 per cent where the code number is 3.

2.7 In the event of a threshold being located according to the criteria for obstacle free surfaces in paragraph 2.5 above, the obstacle marking requirements of must continue to be met in relation to the displaced threshold.

2.8 Depending on the length of the displacement, the runway visual range at the threshold could differ from that at the beginning of the runway for take-offs. The use of red runway edge lights with photometric intensities lower than the nominal value of 10 000 cd for white lights increases that phenomenon. The impact of a displaced threshold on take-off minima must be assessed by the aerodrome operator.

3. *Actual length of runways*

3.1 *Primary runway*

3.1.1 Except as provided in 3.3 below, the actual runway length to be provided for a primary runway must be adequate to meet the operational requirements of the aeroplanes for which the runway is intended and must be not less than the longest length determined by applying the corrections for local conditions to the operations and performance characteristics of the relevant aeroplanes.

Compliance Note 1. This specification does not necessarily mean providing for operations by the critical aeroplane at its maximum mass.

Compliance Note 2. Both take-off and landing requirements need to be considered when determining the length of runway to be provided and the need for operations to be conducted in both directions of the runway .

Compliance Note 3. Local conditions that may need to be considered include elevation, temperature, runway slope, humidity and the runway surface characteristics.

3.2 *Secondary runway*

3.2.1 The length of a secondary runway must be determined similarly to primary runways except that it needs only to be adequate for those aeroplanes which require to use that secondary runway in addition to the other runway or runways in order to obtain a usability factor of at least 95 per cent.

3.3 *Runways with stopways or clearways*

3.3.1 Where a runway is associated with a stopway or clearway, an actual runway length less than that resulting from application of 3.1 or 3.2 above, as appropriate, may be considered satisfactory, but in such a case any combination of runway, stopway and clearway provided must permit compliance with the operational requirements for take-off and landing of the aeroplanes the runway is intended to serve.

3.3.2 The decision to provide a stopway and/or a clearway as an alternative to an increased length of runway will depend on the physical characteristics of the area beyond the runway end, and on the operating performance requirements of the prospective aeroplanes. The runway, stopway and clearway lengths to be provided must be determined by the aeroplane take-off performance, taking into account the landing distance required by the aeroplanes using the runway to ensure that adequate runway length is provided for landing. The length of a clearway, must not exceed half the length of take-off run available.

3.3.3 The runway, stopway and clearway lengths provided at the aerodrome must be adequate for the aeroplane requiring the longest take-off and accelerate-stop distances, taking into account its take-off mass, runway characteristics and ambient atmospheric conditions.

3.3.4 In case economic considerations preclude the provision of stopway and, as a result, only runway and clearway are to be provided, the runway length (neglecting landing requirements) must be equal to the accelerate-stop distance required or the take-off run required, whichever is the greater. The take-off distance available will be the length of the runway plus the length of clearway.

3.3.5 The minimum runway length and the maximum stopway or clearway length to be provided may be determined as follows, from the data in the aeroplane flight manual for the aeroplane considered to be critical from the viewpoint of runway length requirements:

(a) if a stopway is economically possible, the lengths to be provided are those for the balanced field length. The runway length is the take-off run required or the landing distance required, whichever is the greater. If the accelerate-stop distance required is greater than the runway length so determined, the excess may be provided as stopway, usually at each end of the runway. In addition, a clearway of the same length as the stopway must also be provided;

(b) if a stopway is not to be provided, the runway length is the landing distance required, or if it is greater, the accelerate-stop distance required, which corresponds to the lowest practical value of the decision speed. The excess of the take-off distance required over the runway length may be provided as clearway, usually at each end of the runway.

3.3.6 A clearway may in certain circumstances be considered where the take-off distance required for all engines operating exceeds that required for the engine failure case.

3.3.7 A stopway must be designed to withstand at least a certain number of loadings of the aeroplane which the stopway is intended to serve without inducing structural damage to the aeroplane.

4. Width of runway

4.1 The width of a runway must be not less than the appropriate dimension specified in the following tabulation:

Table 10. 1:Width of Runway

	Outer Main Gear Wheel Span (OMGWS)			
Code number	Up to but not including 4.5 m	4.5 m up to but not including 6 m	6 m up to but not including 9 m	9 m up to but not including 15 m
1[a]	18 m	18 m	23 m	–
2 [a]	23 m	23 m	30 m	–
3	30 m	30 m	30 m	45 m
4	–	–	45 m	45 m
a. The width of a precision approach runway must not be less than 30 m where the code number is 1 or 2.				

Compliance Note 1. The combinations of code numbers and OMGWS for which widths are specified have been developed for typical aeroplane characteristics.

The factors affecting runway widths are:

a) deviation of an aeroplane from the centre line at touchdown;
b) cross wind conditions;
c) runway surface contamination (e.g rain, snow, slush or ice)
d) rubber deposits;
e) crab landing approaches used in cross-wind conditions;
f) approach speeds used;
g) visibility; and
h) Human Factors.

5. Minimum distance between parallel runways

5.1 Where parallel non-instrument runways are intended for simultaneous use, the minimum distance between their centre lines must be:

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

5.2 Where parallel instrument runways are intended for simultaneous use, subject to conditions specified below the minimum distance between their centre lines must be:

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

except that:

(a) for segregated parallel operations the specified minimum distance:
   (i) may be decreased by 30 m for each 150 m that the arrival runway is staggered toward the arriving aircraft, to a minimum of 300 m; and
   (ii) must be increased by 30 m for each 150 m that the arrival runway is staggered away from the arriving aircraft.

(b) for independent parallel approaches, combinations of minimum distances and associated conditions may be applied when it is determined that such combinations would not adversely affect the safety of aircraft operations.

6. Slopes on runways

6.1 *Longitudinal slopes*

6.1.1 The slope computed by dividing the difference between the maximum and minimum elevation along the runway centre line by the runway length must not exceed:

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

- 2 per cent where the code number is 1 or 2

6.1.2 Along no portion of a runway must the longitudinal slope exceed:

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

6.2 *Longitudinal slope changes*

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

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

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

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

6.2.3 When a runway is planned that will combine the extreme values for the slopes and changes in slope permitted, a study must be made to ensure that the resulting surface profile will not hamper the operation of aeroplanes.

6.3 *Sight distance*

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

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

Compliance Note. Consideration will have to be given to providing an unobstructed line of sight over the entire length of a single runway where a full-length parallel taxiway is not available. Where an aerodrome has intersecting runways, additional criteria on the line of sight of the intersection area would need to be considered for operational safety.

6.4 *Distance between slope changes*

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

(a) the sum of the absolute numerical values of the corresponding slope changes multiplied by the appropriate value as follows:
  - 30 000 m where the code number is 4;
  - 15 000 m where the code number is 3; and
  - 5 000 m where the code number is 1 or 2; or

(b) 45 m;

whichever is greater.

Compliance Note. Guidance on implementing this specification is given in Attachment A to NAM-CATS-AH, Subpart 4.

6.5 *Transverse slopes*

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

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

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

For a cambered surface the transverse slope on each side of the centre line must be symmetrical.

Compliance Note. On wet runways with crosswind conditions the problem of aquaplaning from poor drainage is apt to be accentuated.

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

7. Strength of runways

7.1 A runway must be capable of withstanding the traffic of aeroplanes the runway is intended to serve.

8. Surface of runways

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

8.2 A paved runway must be so constructed or resurfaced as to provide surface friction characteristics at or above the minimum friction level set by the aerodrome operator.

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

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

8.5 The average surface texture depth of a new surface must be not less than 1.0 mm

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

139.10.3 Runway shoulders

1. Introduction

1.1 Runway shoulders must be provided for a runway where the code letter is D, E or F.

2. Width of runway shoulders

2.1 For aeroplanes with OMGWS from 9 m up to but not including 15 m the runway shoulders must extend symmetrically on each side of the runway so that the overall width of the runway and its shoulders is not less than:

- 60 m where the code letter is D or E;
- 60 m where the code letter is F with two- or three-engined aeroplanes; and
- 75 m where the code letter is F with four (or more)-engined aeroplanes.

3. Slopes on runway shoulders

3.1 The surface of the shoulder that abuts the runway must be flush with the surface of the runway and its transverse slope must not exceed 2.5 per cent.

4. Strength of runway shoulders

4.1 The portion of a runway shoulder between the runway edge and a distance of 30 m from the runway centreline must be prepared or constructed so as to be capable, in the event of an aeroplane running off the runway, of supporting the aeroplane without inducing structural damage to the aeroplane and of supporting ground vehicles which may operate on the shoulder.

5. Surface of runway shoulders

5.1 A runway shoulder must be prepared or constructed so as to resist erosion and the ingestion of the surface material by aeroplane engines.

5.2 Runway shoulders for code letter F aeroplanes must be paved to a minimum overall width of runway and shoulder of not less than 60 m.

139.10.4 Runway turn pads

1. Introduction

1.1 Where the end of a runway is not served by a taxiway or a taxiway turnaround and where the code letter is D, E or F, a runway turn pad must be provided to facilitate a 180-degree turn of aeroplanes. See typical turn pad layout in the Figure 10.1 below:

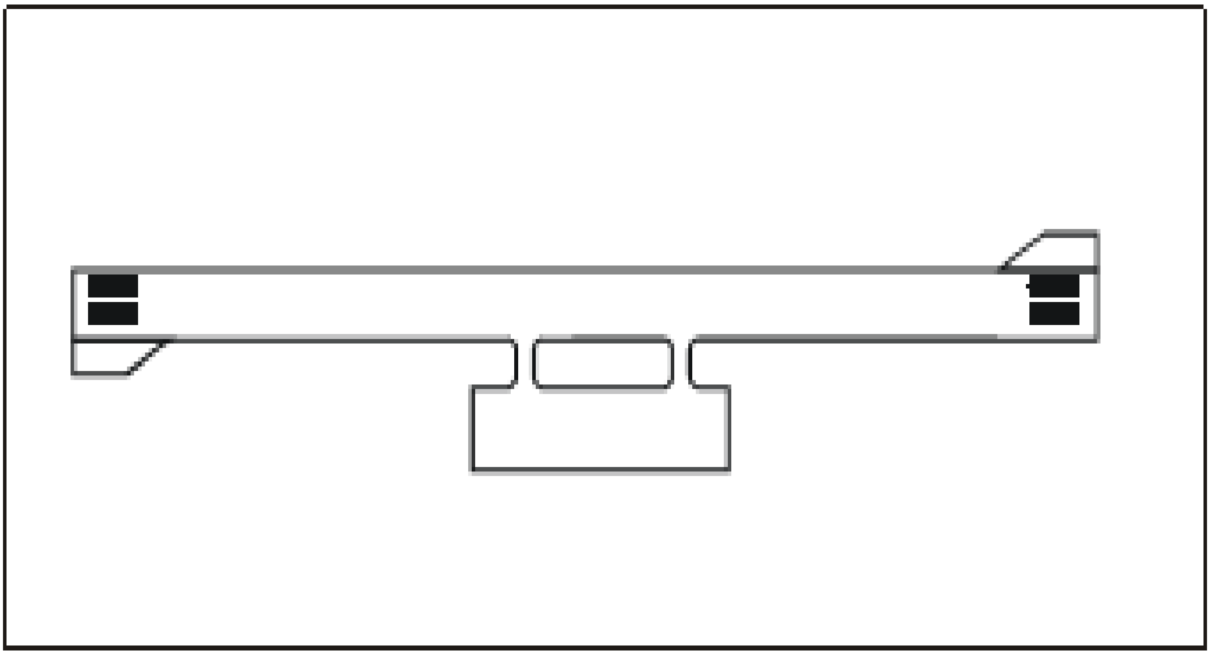


Figure 10. 1 Typical turn pad layout

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

1.3 The runway turn pad may be located on either the left or right side of the runway and adjoining the runway pavement at both ends of the runway and at some intermediate locations where deemed necessary.

1.4 The intersection angle of the runway turn pad with the runway must not exceed 30 degrees.

1.5 The nose wheel steering angle to be used in the design of the runway turn pad must not exceed 45 degrees

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

Table 10. 2: Width of Turn pad

OMGWS				
	Up to but not including 4.5 m	4.5 m up to but not including 6 m	6 m up to but not including 9 m	9 m up to but not including 15 m
Clearance	1.50 m	2.25 m	3 m[a] or 4 m[b]	4 m
a. If the turn pad is intended to be used by aeroplanes with a wheel base less than 18 m. b. If the turn pad is intended to be used by aeroplanes with a wheel base equal to or greater than 18 m.				

Note. Wheel base means the distance from the nose gear to the geometric centre of the main gear.

2. Slopes on runway turn pads

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

3. Strength of runway turn pads

3.1 The strength of a runway turn pad must 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.

Compliance Note. Where a runway turn pad is provided with flexible pavement, the surface would need to be capable of withstanding the horizontal shear forces exerted by the main landing gear tires during turning maneuvers.

4. Surface of runway turn pads

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

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

5. Shoulders for runway turn pads

5.1 The runway turn pads must 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.

Compliance Note. As a minimum, the width of the shoulders would need to cover the outer engine of the most demanding aeroplane and thus may be wider than the associated runway shoulders.

5.2 The strength of runway turn pad shoulders must 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.

139.10.5 Runway strips

1. Introduction

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

2. Length of runway strips

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

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

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

3. Width of runway strips

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

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

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

3.2 A strip including a non-precision approach runway must extend laterally to a distance of at least:

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

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

3.3 A strip including a non-instrument runway must extend on each side of the centre line of the runway and its extended centre line throughout the length of the strip, to a distance of at least:

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

4. Objects on runway strips

4.1 An object situated on a runway strip which may endanger aeroplanes must be regarded as an obstacle and must, as far as practicable, be removed.

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

(a) within 77.5 m of the runway centre line of a precision approach runway category I, II or III where the code number is 4 and the code letter is F; or
(b) within 60 m of the runway centre line of a precision approach runway category I, II or III where the code number is 3 or 4; or
(c) within 45 m of the runway centre line of a precision approach runway category I where the code number is 1 or 2.

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

5. Grading of runway strips

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

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

from the centre line of the runway and its extended centre line must provide a graded area for aeroplanes which the runway is intended to serve in the event of an aeroplane running off the runway.

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

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

from the centre line of the runway and its extended centre line must provide a graded area for aeroplanes which the runway is intended to serve in the event of an aeroplane running off the runway.

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

5.4 That portion of a strip to at least 30 m before the start of a runway must be prepared against blast erosion in order to protect a landing aeroplane from the danger of an exposed edge.

5.5 Where the areas in 5.4 above have paved surfaces, they must be able to withstand the occasional passage of the critical aeroplane for runway pavement design.

6. Slopes on runway strips

6.1 *Longitudinal slopes*

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

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

6.2 *Longitudinal slope changes*

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

6.3 *Transverse slopes*

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

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

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

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

7 Strength of runway strips

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

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

from the centre line of the runway and its extended centre line must be so prepared or constructed as to minimize hazards arising from differences in load-bearing capacity to aeroplanes which the runway is intended to serve in the event of an aeroplane running off the runway.

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

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

- 40 m where the code number is 2; and
- 30 m where the code number is 1;

from the centre line of the runway and its extended centre line must be so prepared or constructed as to minimize hazards arising from differences in load-bearing capacity to aeroplanes which the runway is intended to serve in the event of an aeroplane running off the runway.

139.10.6 Runway end safety areas

1. Introduction

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

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

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

2. Dimensions of runway end safety area

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

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

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

2.2 A runway end safety area may, as far as practicable, extend from the end of a runway strip to a distance of at least:

- 240 m where the code number is 3 or 4; or a reduced length when an arresting system is installed;
- 120 m where the code number is 1 or 2 and the runway is an instrument one; or a reduced length when an arresting system is installed; and
- 30 m where the code number is 1 or 2 and the runway is a non-instrument one.

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

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

3. Objects on runway end safety areas

3.1 An object situated on a runway end safety area which may endanger aeroplanes may be regarded as an obstacle and must, as far as practicable, be removed.

4. Clearing and grading of runway end safety areas

4.1 When provided, a runway end safety area must provide a cleared and graded area for aeroplanes which the runway is intended to serve in the event of an aeroplane undershooting or overrunning the runway.

Note. The surface of the ground in the runway end safety area does not need to be prepared to the same quality as the runway strip.

5. Slopes on runway end safety areas

5.1 Introduction

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

5.2 *Longitudinal slopes*

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

5.3 *Transverse slopes*

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

6. Strength of runway end safety areas

6.1 A runway end safety area where provided, must be so prepared or constructed as to reduce the risk of damage to an aeroplane undershooting or overrunning the runway, enhance aeroplane deceleration and facilitate the movement of rescue and firefighting vehicles.

139.10.7 Clearways

1. Location of clearways

1.1 The origin of a clearway where provided must be at the end of the take-off run available.

2. Length of clearways

2.1 The length of a clearway must not exceed half the length of the take-off run available.

3. Width of clearways

3.1 A clearway must extend laterally to a distance of at least 75 m on each side of the extended centre line of the runway.

4. Slopes on clearways

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

(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.

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

5. Objects on clearways

5.1 An object situated on a clearway which may endanger aeroplanes in the air must be regarded as an obstacle and must be removed.

139.10.8 Stopways

1. Width of stopways

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

2. Slopes on stopways

2.1 Slopes and changes in slope on a stopway, and the transition from a runway to a stopway, must comply with the specifications for the runway with which the stopway is associated except that:

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

(b) at the junction of the stopway and runway and along the stopway the maximum rate of slope change may be 0.3 per cent per 30 m (minimum radius of curvature of 10 000 m) for a runway where the code number is 3 or 4.

3. Strength of stopways

3.1 A stopway must 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.

4. Surface of stopways

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

139.10.9 Radio altimeter operating area

1. Introduction

1.1 When provided, a radio altimeter operating area must be established in the pre-threshold area of a precision approach runway.

2. Length of the area

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

3. Width of the area

3.1 A radio altimeter operating area, must extend laterally, on each side of the extended centre line of the runway, to a distance of 60 m, except that, when special circumstances so warrant, the distance may be reduced to no less than 30 m if an aeronautical study indicates that such reduction would not affect the safety of operations of aircraft.

4. Longitudinal slope changes

4.1 On a radio altimeter operating area, slope changes must be avoided or kept to a minimum. Where slope changes cannot be avoided, the slope changes must be as gradual as practicable and abrupt changes or sudden reversals of slopes avoided. The rate of change between two consecutive slopes must not exceed 2 per cent per 30 m.

139.10.10 Taxiways

1. Introduction

1.1 Taxiways may be provided to permit the safe and expeditious surface movement of aircraft.

1.2 Sufficient entrance and exit taxiways for a runway may be provided to expedite the movement of aeroplanes to and from the runway and provision of rapid exit taxiways considered when traffic volumes are high.

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

Table 10. 3: Taxiway clearance distances

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

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

Note. Wheel base means the distance from the nose gear to the geometric centre of the main gear.

2. Width of taxiways

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

Table 10. 4: Taxiways width

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	15m	23 m

3. Taxiway curves

3.1 Changes in direction of taxiways must be as few and small as possible. The radii of the curves must be compatible with the manoeuvring capability and normal taxiing speeds of the aeroplanes for which the taxiway is intended. The design of the curve must be such that, when the cockpit of the aeroplane remains over the taxiway centre line markings, the clearance distance between the outer main wheels of the aeroplane and the edge of the taxiway must not be less than those specified in 1.3 above.

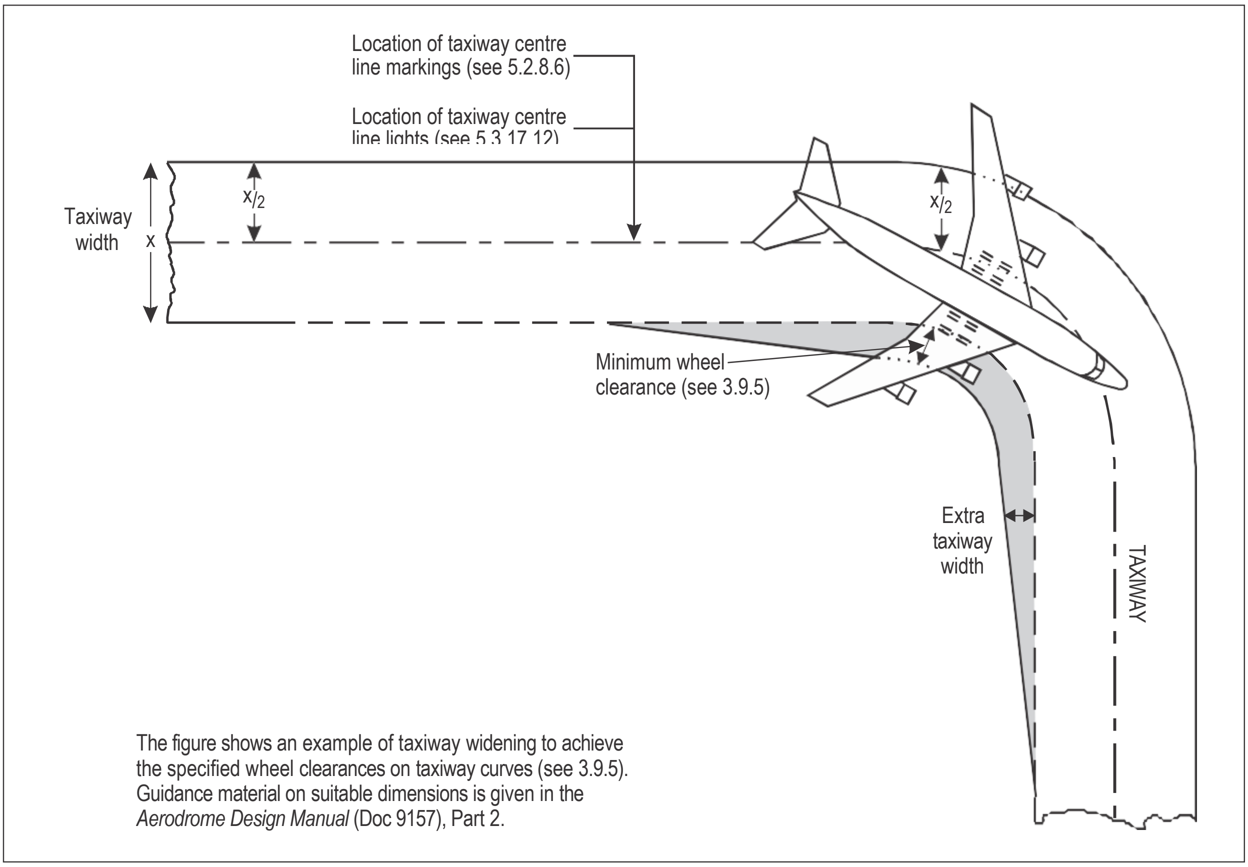


Figure 10. 2: Taxiway curve

Note. The figure shows an example of taxiway widening to achieve the specified wheel clearances on taxiway curves.

4. Junctions and intersections

4.1 To facilitate the movement of aeroplanes, fillets may be provided at junctions and intersections of taxiways with runways, aprons and other taxiways. The design of the fillets must ensure that the minimum wheel clearances specified in paragraph 1.3 are maintained when aeroplanes are manoeuvring through the junctions or intersections.

Compliance Note. Consideration will have to be given to the aeroplane datum length when designing fillets.

5. Taxiway minimum separation distances

5.1 The separation distance between the centre line of a taxiway and the centre line of a runway, the centre line of a parallel taxiway or an object must not be less than the appropriate dimension specified in the Table 10.5 below, except that it may be permissible to operate with lower separation distances at an existing aerodrome if an aeronautical study indicates that such lower separation distances would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

Table 10. 5 Taxiway minimum separation distances

Distance between taxiway centre line and runway centre line (metres)									Taxiway centre line to taxiway centre line (metres)	Taxiway, other than aircraft stand taxilane, centre line to object (metres	Aircraft stand taxilane centre line to aircraft stand taxilane centre line	Aircraft stand taxilane centre line to object (metres)
Code letter	Instrument runways Code number				Non-instrument runways Code number							
	1	2	3	4	1	2	3	4				

											(metres	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
A	77.5	77.5	-	-	37.5	47.5	-	-	23	15.5	19.5	12
B	82	82	-	-	42	52	87	-	32	20	28.5	16.5
C	88	88	158	158	48	58	93	93	44	26	40.5	22.5
D	-	-	166	166	-	-	101	101	63	37	59.5	33.5
E	-	-	172.5	172.5	-	-	107.5	107.5	76	43.5	72.5	40
F	-	-	180	180	-	-	115	115	91	51	87.5	47.5
Note 1. The separation distances shown in columns (2) to (9) represent ordinary combinations of runways and taxiways.												
Note 2. The distances in columns (2) to (9) do not guarantee sufficient clearance behind a holding aeroplane to permit the passing of another aeroplane on a parallel taxiway. An aeronautical study on the minimum taxiway separation distances will be required to ensure operational safety.												

6. Slopes on taxiways

6.1 *Longitudinal slopes*

6.1.1 The longitudinal slope of a taxiway must not exceed:

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

6.2 *Longitudinal slope changes*

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

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

6.3 *Sight distance*

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

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

6.4 *Transverse slopes*

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

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

− 2 per cent where the code letter is A or B.

7. Strength of taxiways

7.1 The strength of a taxiway must be at least equal to that of the runway it serves, due consideration being given to the fact that a taxiway will be subjected to a greater density of traffic and, as a result of slow moving and stationary aeroplanes, to higher stresses than the runway it serves.

8. Surface of taxiways

8.1 The surface of a taxiway must not have irregularities that cause damage to aeroplane structures.

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

9. Rapid exit taxiways

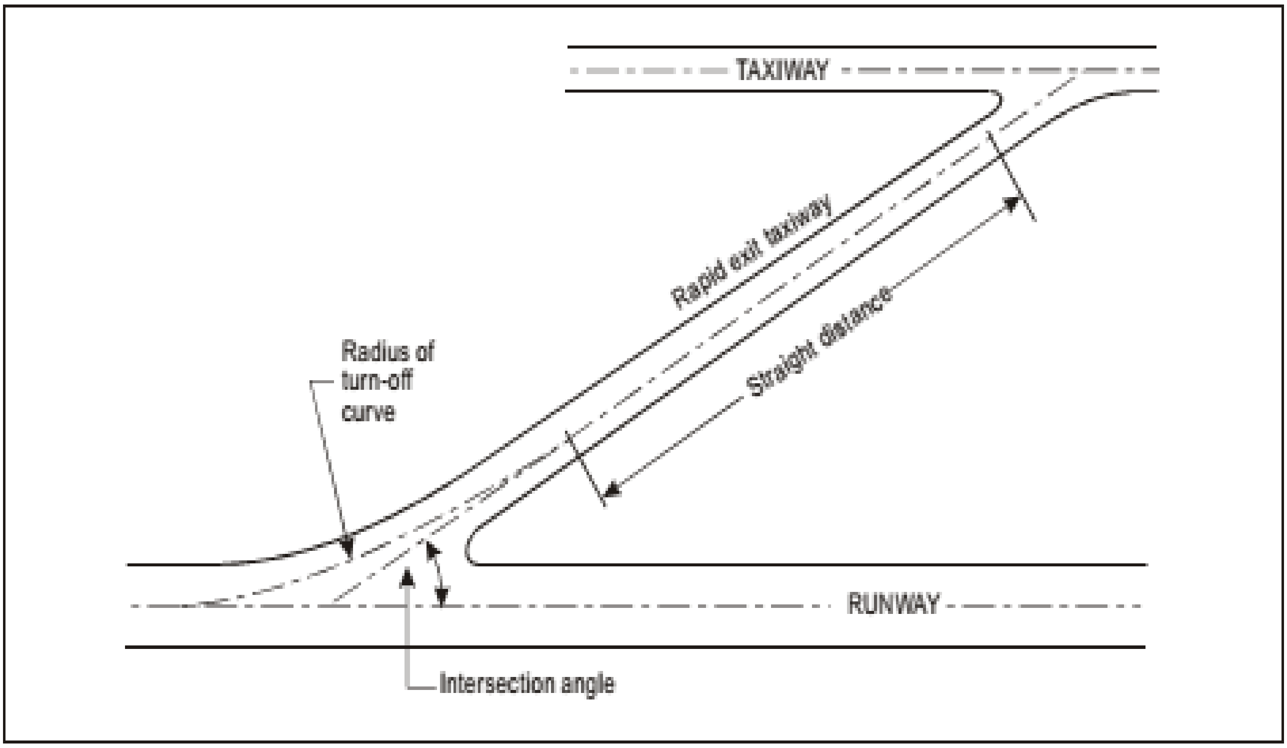


Figure 10. 3: Rapid exit taxiway

9.1 A rapid exit taxiway must be designed with a radius of turn-off curve of at least:

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

to enable exit speeds under wet conditions of:

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

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

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

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

10. Taxiways on bridges

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

10.2 Access must be provided to allow rescue and firefighting vehicles to intervene in both directions within the specified response time to the largest aeroplane for which the taxiway bridge is intended.

10.3 A bridge must be constructed on a straight section of the taxiway with a straight section on both ends of the bridge to facilitate the alignment of aeroplanes approaching the bridge.

139.10.11 Taxiway shoulders

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

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

- 25 m where the code letter is C.

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

1.2 When a taxiway is intended to be used by turbine-engined aeroplanes, the surface of the taxiway shoulder must be so prepared as to resist erosion and the ingestion of the surface material by aeroplane engines.

139.10.12 Taxiway strips

1. General

1.1 A taxiway, other than an aircraft stand taxilane, must be included in a strip.

2. Width of taxiway strips

2.1 A taxiway strip must extend symmetrically on each side of the centre line of the taxiway throughout the length of the taxiway to at least the distance from the centre line given in Table 10.5, column 11.

3. Objects on taxiway strips

3.1 The taxiway strip must provide an area clear of objects which may endanger taxiing aeroplanes.

4. Grading of taxiway strips

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

- 10.25 m where the OMGWS is up to but not including 4.5 m
- 11 m where the OMGWS is 4.5 m up to but not including 6 m
- 12.50 m where the OMGWS is 6 m up to but not including 9 m
- 18.50 m where the OMGWS is 9 m up to but not including 15 m, where the code letter is D
- 19 m where the OMGWS is 9 m up to but not including 15 m, where the code letter is E
- 22 m where the OMGWS is 9 m up to but not including 15 m, where the code letter is F

5. Slopes on taxiway strips

5.1 The surface of the strip must be flush at the edge of the taxiway or shoulder, if provided, and the graded portion must not have an upward transverse slope exceeding:

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

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

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

139.10.13 Holding bays, runway-holding positions, intermediate holding positions and road-holding positions

1. Introduction

1.1 Holding bay(s) may be provided when the traffic density is medium or heavy.

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

(a) on the taxiway, at the intersection of a taxiway and a runway; and
(b) at an intersection of a runway with another runway when the former runway is part of a standard taxi-route.

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

1.4 An intermediate holding position may be established on a taxiway at any point other than a runway-holding position where it is desirable to define a specific holding limit.

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

2. Location

2.1 The distance between a holding bay, runway-holding position established at a taxiway/runway intersection or road-holding position and the centre line of a runway must be in accordance with Table 10.6 and, in the case of a precision approach runway, such that a holding aircraft or vehicle will not interfere with the operation of radio navigation aids.

Table 10. 6 Minimum distance from the runway centre line to a holding bay, runway-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
Non-precision approach	40 m	40 m	75 m	75 m
Precision approach category I	60 m[b]	60 m[b]	90 m[a,b]	90 m[a,b,c]
Precision approach categories II and III	-	-	90 m[a,b]	90 m[a,b,c]
Take-off runway	30 m	40 m	75 m	75 m

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

b. This distance may need to be increased to avoid interference with radio navigation aids, particularly the glide path and localizer facilities. Information on critical and sensitive areas is contained in 2.1 above.

Note . 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 . 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 must 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 centre line, being clear of the obstacle free zone.

2.2 At elevations greater than 700 m (2 300 ft) the distance of 90 m specified in Table 10.6 for a precision approach runway code number 4 must be increased as follows:

(a) up to an elevation of 2 000 m (6 600 ft); 1 m for every 100 m (330 ft) in excess of 700 m (2 300 ft);
(b) elevation in excess of 2 000 m (6 600 ft) and up to 4 000 m (13 320 ft); 13 m plus 1.5 m for every 100 m (330 ft) in excess of 2 000 m (6 600 ft); and
(c) elevation in excess of 4 000 m (13 320 ft) and up to 5 000 m (16 650 ft); 43 m plus 2 m for every 100 m (330 ft) in excess of 4 000 m (13 320 ft).

2.3 If a holding bay, runway-holding position or road-holding position for a precision approach runway code number 4 is at a greater elevation compared to the threshold, the distance of 90 m or 107.5 m, as appropriate, specified in Table 10.6 must be further increased 5 m for every metre the bay or position is higher than the threshold.

2.4 The location of a runway-holding position established in accordance with 1.3 above must be such that a holding aircraft or vehicle will not infringe the obstacle free zone, approach surface, take-off climb surface or ILS/MLS critical/ sensitive area or interfere with the operation of radio navigation aids.

139.10.14 Aprons

1. Introduction

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

2. Size of aprons

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

3. Strength of aprons

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

4. Slopes on aprons

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

4.2 On an aircraft stand the maximum slope must not exceed 1 per cent.

5. Clearance distances on aircraft stands

5.1 An aircraft stand must 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

When special circumstances so warrant, these clearances may be reduced at a nose-in aircraft stand, where the code letter is D, E or F:

(a) between the terminal, including any fixed passenger bridge, and the nose of an aircraft; and

(b) over any portion of the stand provided with azimuth guidance by a visual docking guidance system.

139.10.15 Isolated aircraft parking position

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

1.2 The isolated aircraft parking position must be located at the maximum distance practicable and in any case never less than 100 m from other parking positions, buildings or public areas, etc. Care must be taken to ensure that the position is not located over underground utilities such as gas and aviation fuel and, to the extent feasible, electrical or communication cables.

SUBPART 11 - OBSTACLE RESTRICTION AND REMOVAL

139.11.2 Erection of obstacles

(1) The erection or growth of an obstacle at or in the vicinity of an aerodrome, must not be permitted where the obstacle may prevent an aircraft operation from being conducted safely or the aerodrome from being usable.

(2) Buildings or other objects which will constitute an obstruction or potential hazard to aircraft moving in the navigable air space in the vicinity of an aerodrome, or navigation aid, or which will adversely affect the performance of the radio navigation or instrument landing systems, may not be erected or allowed to come into existence without the prior written approval of the Executive Director and if erected in the absence of approval are liable to forced removal without right of compensation.

(3) No building or object higher than 45 metres above the aerodrome elevation, or in the case of a water aerodrome, the normal level of the water, may be erected within a distance of 15 kilometres measured from the aerodrome reference point without written approval of the Executive Director.

(4) A person must not cause or permit any object, to penetrate the obstacle limitation surface, without the written permission of the Executive Director, where the object may cause an increase in an obstacle clearance altitude or in the height for an instrument approach procedure or of any associated visual circling procedure.

(5) The object referred to in sub-regulation (4) includes a new object or an extension of an existing object above the obstacle limitation surface.

(6) In the event of a conflict of interest between land use authorities and air space users, air safety must be regarded as predominant and not to be compromised by land development projects or other obstacles.

139.11.4 Obstacle limitation surfaces

1. Outer horizontal surface

1.1. In the existence of some Stated, significant operational problems can arise from the erection of tall structures in the vicinity of airports beyond the areas currently recognized in NAMCARs part 139 as areas in which restriction of new construction may be necessary. The operational implications fall broadly under the headings of safety and efficiency.

1.2. *Safety implications*. It is particularly desirable to review carefully any proposal to erect high mass or other skeletal structures in area which would otherwise be suitable for use by aircraft on wide visual circuits, on arrival routes towards the airport or circuit, or on departure or missed approach climb-paths. Avoidance by marking or lighting cannot be relied upon in view of this relatively inconspicuous character of these structures, especially in conditions of reduced visibility, and notification of their existence will similarly not always guarantee avoidance.

1.3. *Efficiency implications*. If tall structures are erected in or near areas otherwise suitable for instrument approach procedures, increased procedures heights may need to be adopted, with consequent adverse effects on regularity and on the duration of the approach procedure, such as the denial or useful altitude allocations to aircraft in associated holding patterns. Such structures may furthermore limit desirable flexibility for radar vectored initial approaches and the facility to turn en route during the departure climb or missed approach.

1.4. In view of these potentially important operational considerations, the NCAA considers it desirable to adopt measures to ensure that they have advance notice of any proposals to erect tall structures. This will enable the NCAA to study the aeronautical implications and take such action as prescribed in NAMCARs part 139 to protect aviation interests. In assessing the operational effect of proposed new construction, tall structures would not be of immediate significance if they are proposed to be located in:

a) an area already substantially obstructed by terrain or existing structures of equivalent height; and

b) an area which would be safely avoided by prescribed procedures associated with navigational guidance when appropriate.

1.5. As a broad specification for the outer horizontal surface, tall structures can be considered to be of possible significance if they are both higher than 45m above local ground level, and higher than 150m above aerodrome elevation within a radius of 15 000m of the centre of the airport where the runway code number is 3 or 4. The area of concern may need to be extended to coincide with the obstacle-accountable areas of PANS-OPS for the individual approach procedures at the airport under consideration.

2. Conical surface

2.1 *Description – Conical surface*. A surface sloping upwards and outwards from the periphery of the inner horizontal surface, see Figure 11.1 below.

2.2 *Characteristics* - The limits of the conical surface must comprise:

(a) a lower edge coincident with the periphery of the inner horizontal surface; and
(b) an upper edge located at a specified height above the inner horizontal surface.

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

3. Inner horizontal surface

3.1 *Description — Inner horizontal surface*. A surface located in a horizontal plane above an aerodrome and its environs, see Figure 11.3 below.

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

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

4. Approach surface

4.1 *Description — Approach surface*. An inclined plane or combination of planes preceding the threshold, see Figure 11.3 below.

4.2 *Characteristics* — The limits of the approach surface must comprise:

(a) an inner edge of specified length, horizontal and perpendicular to the extended centre line of the runway and located at a specified distance before the threshold;
(b) two sides originating at the ends of the inner edge and diverging uniformly at a specified rate from the extended centre line of the runway;
(c) an outer edge parallel to the inner edge; and
(d) the above surfaces must be varied when lateral offset, offset or curved approaches are utilized, specifically, two sides originating at the ends of the inner edge and diverging

uniformly at a specified rate from the extended centre line of the lateral offset, offset or curved ground track.

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

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

5. Inner approach surface

5.1 *Description — Inner approach surface*. A rectangular portion of the approach surface immediately preceding the threshold, see Figure 11.3 below.

5.2 *Characteristics* — The limits of the inner approach surface must comprise:

(a) an inner edge coincident with the location of the inner edge of the approach surface but of its own specified length;
(b) two sides originating at the ends of the inner edge and extending parallel to the vertical plane containing the centre line of the runway; and
(c) an outer edge parallel to the inner edge.

6. Transitional surface

6.1 *Description — Transitional surface*. A complex surface along the side of the strip and part of the side of the approach surface, that slopes upwards and outwards to the inner horizontal surface, see Figure 11.3 below.

6.2 *Characteristics* — The limits of a transitional surface must comprise:

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

(b) an upper edge located in the plane of the inner horizontal surface.

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

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

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

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

7. Inner transitional surface

7.1 *Description— Inner transitional surface*. A surface similar to the transitional surface but closer to the runway, see Figure 11.3 below.

7.2 *Characteristics* — The limits of an inner transitional surface must comprise:

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

(b) an upper edge located in the plane of the inner horizontal surface.

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

(a) along the side of the inner approach surface and balked landing surface — equal to the elevation of the particular surface at that point; and
(b) along the strip — equal to the elevation of the nearest point on the centre line of the runway or its extension.

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

8. Balked landing surface

8.1 *Description — Balked landing surface*. An inclined plane located at a specified distance after the threshold, extending between the inner transitional surface, see Figure 11.3 below.

8.2 *Characteristics* —The limits of the balked landing surface must comprise:

(a) an inner edge horizontal and perpendicular to the centreline of the runway and located at a specified distance after the threshold;
(b) two sides originating at the ends of the inner edge and diverging uniformly at a specified rate from the vertical plane containing the centre line of the runway; and
(c) an outer edge parallel to the inner edge and located in the plane of the inner horizontal surface.

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

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

9. Take-off climb surface

9.1 *Description — Take-off climb surface.* An inclined plane or other specified surface beyond the end of a runway or clearway, see Figure 11.3 below.

9.2 *Characteristics* —The limits of the take-off climb surface must comprise:

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

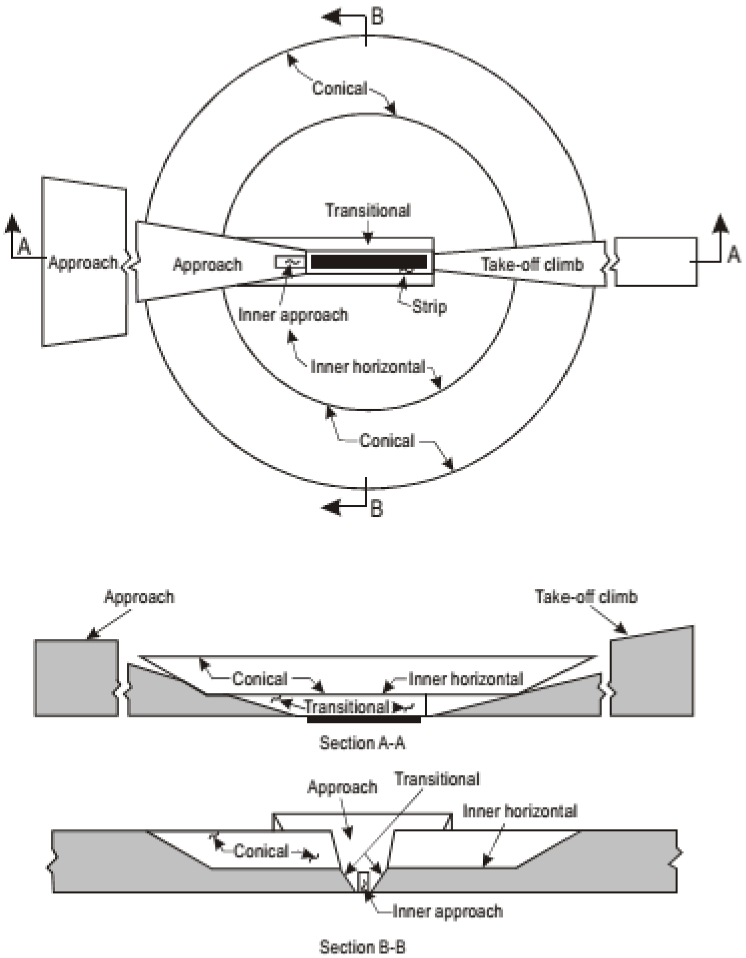
(b) two sides originating at the ends of the inner edge, diverging uniformly at a specified rate from the take-off track to a specified final width and continuing thereafter at that width for the remainder of the length of the take-off climb surface; and

(c) an outer edge horizontal and perpendicular to the specified take-off track.

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

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

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



See Figure 11.3 for inner transitional and balked landing obstacle limitation surfaces and Figure 11.2 for a three-dimensional view

Figure 11. 1:Obstacle limitation surfaces

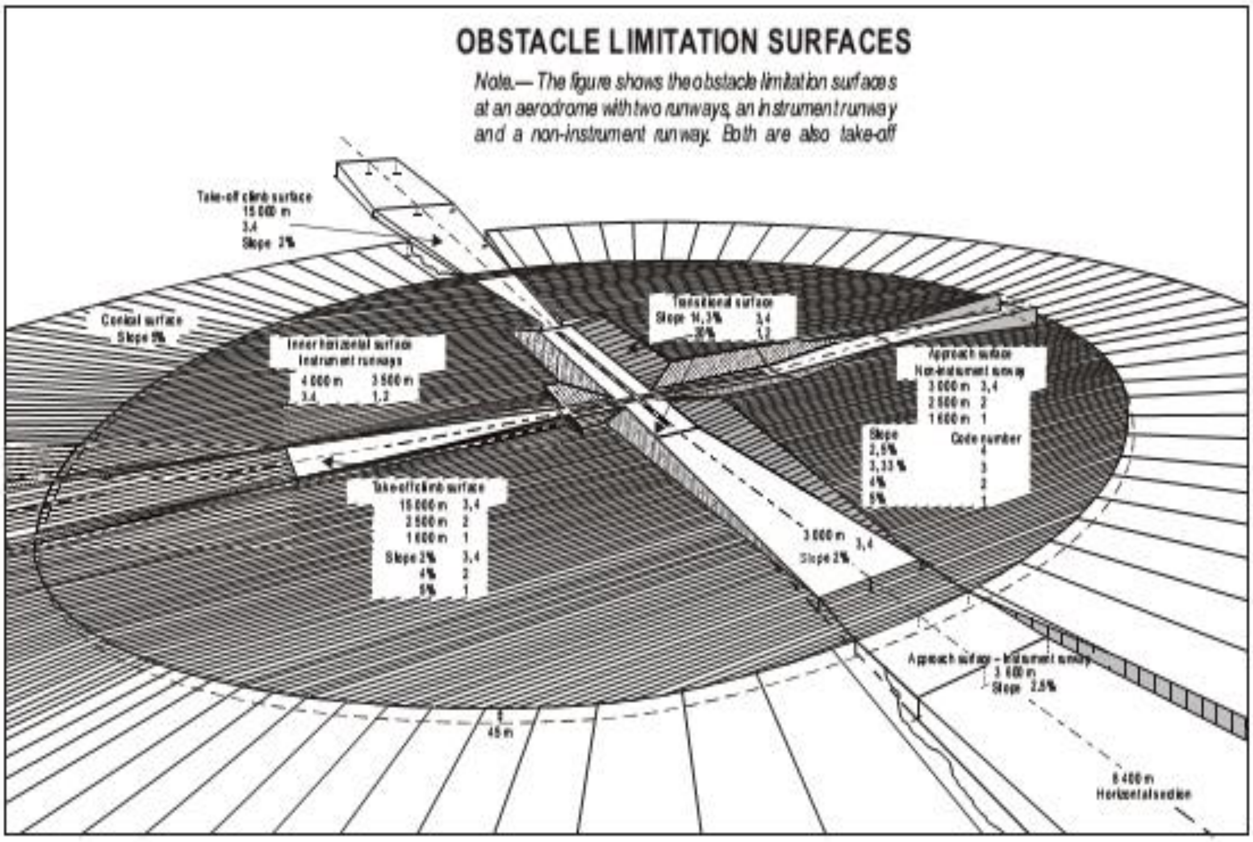


Figure 11. 2: Three-Dimensional view of Obstacle Limitation Surfaces

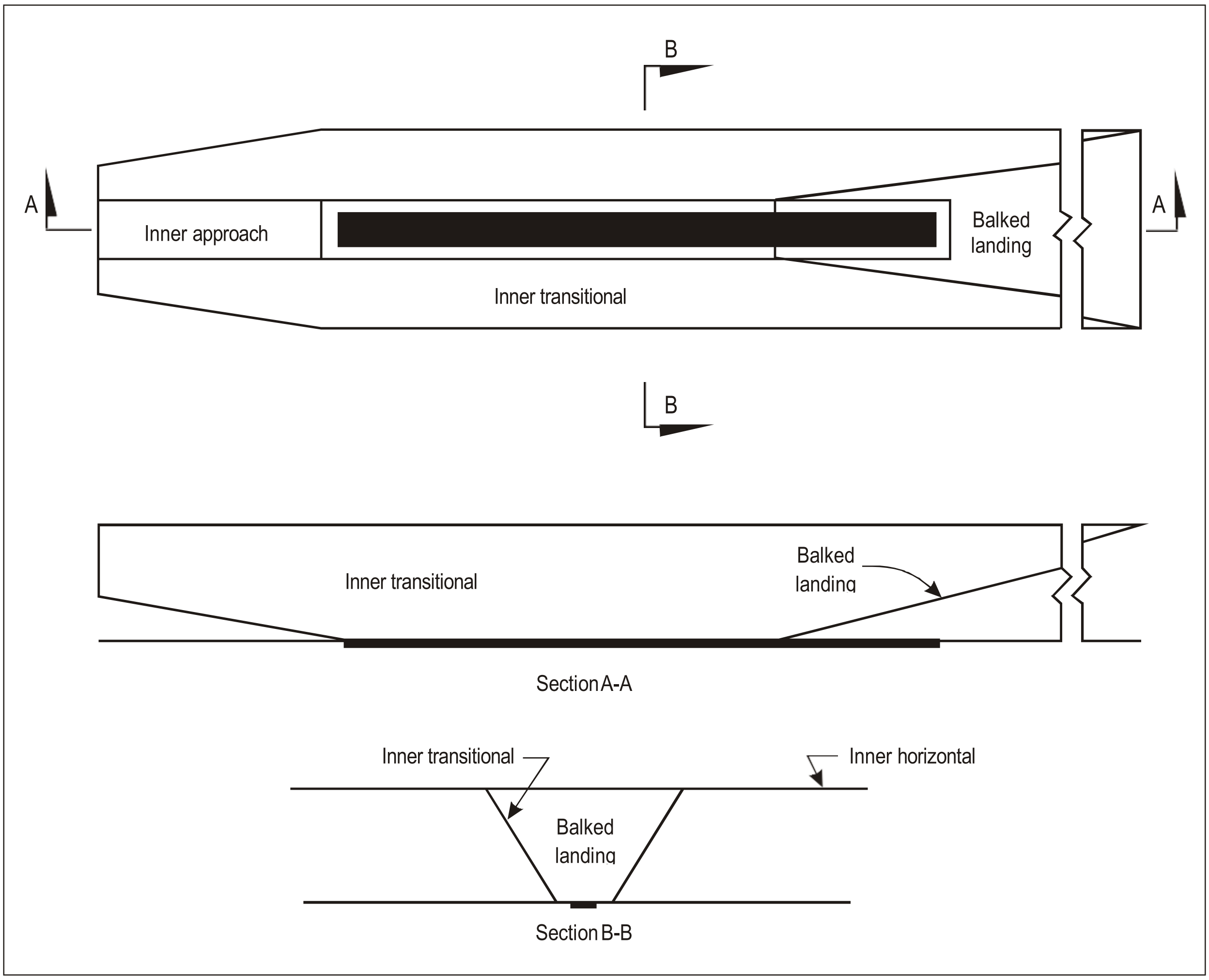


Figure 11. 3: Inner approach, inner transitional and balked landing obstacle limitation surface

139.11.5 Obstacle limitation requirements

1. Non-instrument runways

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

- conical surface;
- inner horizontal surface;
- approach surface; and
- transitional surfaces.

1.2 The heights and slopes of the surfaces must not be greater than, and their other dimensions not less than, those specified in Table 11.1 below.

Table 11. 1: Dimensions and slopes of obstacle limitation surfaces — Approach runways

					RUNWAY CLASSIFICATION					
Surface and dimensions		Non-instrument Code number			Non-precision approach Code number			Precision approach category 1 Code number		II or III Code number
	1	2	3	4	1,2	3	4	1,2	3,4	3,4
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
CONICAL										
Slope	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Height	35m	55m	75m	100 m	60m	75m	100m	60m	100m	100m

INNER HORIZONTAL										
Height	45m	45m	45m	45m	45m	45m	45m	45m	45m	45m
Slope	2000 m	2500 m	4000 m	4000 m	3500 m	4000 m	4000 m	3500 m	4000 m	4000 m
INNER APPROACH										
Width	—	—	—	—	—	—	—	90m	120m[2]	120m[2]
Distance from threshold	—	—	—	—	—	—	—	60m	60m	60m
Length	—	—	—	—	—	—	—	900m	900m	900m
Slope								2.5%	2%	2%
APPROACH										
Length of inner edge	60m	80m	150 m	150 m	140 m	280m	280m	140m	280m	280m
Distance from threshold	30m	60m	60m	60m	60m	60m	60m	60m	60m	60m
Divergence (each side	10%	10%	10%	10%	15%	15%	15%	15%	15%	15%
First section										
Length	1600 m	2500 m	3000 m	3000 m	2500 m	3000 m	3000 m	3000 m	3000 m	3000 m
Slope	5%	4%	3.33 %	2.5%	3.33 %	2%	2%	2.5%	2%	2%

Second section										
Length	—	—	—	—	—	3600 m[b]	3600 m[b]	12000 m	3600 m[b]	3600 m[b]
Slope	—	—	—	—	—	2.5%	2.5%	3%	2.5%	2.5%
Horizontal section										
Length	—	—	—	—	—	8400 m[b]	8400 m[b]	—	8400 m[b]	8400 m[b]
Total length	—	—	—	—	—	15000 m	15000 m	15000 m	15000 m	15000 m
TRANSITIONAL										
Slope	20%	20%	14.3 %	14.3 %	20%	14.3%	14.3%	14.3%	14.3%	14.3%
INNER TRANSITIONAL										
Slope	—	—	—	—	—	—	—	40%	33.3%	33.3%
BALKED LANDING SURFACE										
Length of inner edge	—	—	—	—	—	—	—	90m	120m[a]	120m[a]
Distance from threshold	—	—	—	—	—	—	—	c	1800 m[d]	1800 m[d]

Divergence (each side	—	—	—	—	—	—	—	10%	10%	10%
Slope	—	—	—	—	—	—	—	4%	3.33%	3.33%

a. All dimensions are measured horizontally unless specified otherwise.
b. Variable length (see 2.3 or 3.5).
c. Distance to the end of strip.
d. Or end of runway whichever is less.
e. Where the code letter is F (Column (3) Table 1-1), the width is increased to 155 m except for those aerodromes that accommodate a code letter F aeroplanes equipped with digital avionics that provide steering commands to maintain an established track during the go-around manoeuvre.

Note. See Circular 301, 345 and Chapter 4 of the PANS-Aerodromes, Part I (Doc 9981) for further information.

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

1.4 New objects or extensions of existing objects must not be permitted above the conical surface or inner horizontal surface except when, in the opinion of the Executive Director, the object would be shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

1.5 Existing objects above any of the surfaces required by 1.1 must as far as practicable be removed except when, in the opinion of the Executive Director, the object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

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

2. Non-precision approach runways

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

- conical surface;
- inner horizontal surface;
- approach surface; and
- transitional surfaces.

2.2 The heights and slopes of the surfaces must not be greater than, and their other dimensions not less than, those specified in Table 11.1, except in the case of the horizontal section of the approach surface (see 2.3 below).

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

(a) a horizontal plane 150 m above the threshold elevation; or

(b) the horizontal plane passing through the top of any object that governs the obstacle clearance altitude/height (OCA/H);

whichever is the higher.

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

2.5 New objects or extensions of existing objects must not be permitted above the approach surface beyond 3 000 m from the inner edge, the conical surface or inner horizontal surface except when, in the opinion of the Executive Director, the object would be shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

2.6 Existing objects above any of the surfaces required by 2.1 must as far as practicable be removed except when, in the opinion of the Executive Director, the object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

3. Precision approach runways

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

- conical surface;
- inner horizontal surface;
- approach surface; and
- transitional surfaces.

3.2 The following obstacle limitation surfaces may be established for a precision approach runway category I:

- inner approach surface;
- inner transitional surfaces; and
- balked landing surface.

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

- conical surface;
- inner horizontal surface;
- approach surface and inner approach surface;
- transitional surfaces;
- inner transitional surfaces; and
- balked landing surface.

3.4 The heights and slopes of the surfaces must not be greater than, and their other dimensions not less than, those specified in Table 11.1, except in the case of the horizontal section of the approach surface.

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

(a) a horizontal plane 150 m above the threshold elevation; or
(b) the horizontal plane passing through the top of any object that governs the obstacle clearance limit;

whichever is the higher.

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

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

3.8 New objects or extensions of existing objects must not be permitted above the conical surface and the inner horizontal surface except when, in the opinion of the Executive Director, an object would be shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

3.9 Existing objects above an approach surface, a transitional surface, the conical surface and inner horizontal surface must as far as practicable be removed except when, in the opinion of the Executive Director, an object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes

4. Runways meant for take-off

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

- take-off climb surface.

3.2 The operational characteristics of aeroplanes for which the runway is intended must be examined to see if it is desirable to reduce the slope specified in Table 11.2 below when critical operating conditions are to be catered to. If the specified slope is reduced, corresponding adjustment in the length of the take-off climb surface must be made so as to provide protection to a height of 300 m.

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

Table 11. 2: Dimensions and slopes of obstacle limitation surfaces

RUNWAYS MEANT FOR TAKE-OFF

Surface and dimensions[a]	Code number		
	1	2	3
(1)	(2)	(3)	(4)
TAKE-OFF CLIMB			
Length of inner edge	60m	80m	180m
Distance from runway end[b]	30m	60m	60m
Divergence (each side)	10%	10%	12.5%
Final width	380m	580m	1200m 1800m[c]
Length	1600m	2500m	15000m
Slope	5%	4%	2% [d]

a. All dimensions are measured horizontally unless specified otherwise.
b. The take-off climb surface starts at the end of the clearway if the clearway length exceeds the specified distance.
c. 1 800 m when the intended track includes changes of heading greater than 15° for operations conducted in IMC, VMC by night.
d. See 4.2 and 4.5.

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

4.5 Existing objects that extend above a take-off climb surface must as far as practicable be removed except when, in the opinion of the Executive Director, an object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes.

139.11.6 Objects outside the obstacle limitation surfaces

1.1 A person must consult with the Executive Director concerning proposed construction beyond the limits of obstacle limitation surfaces that extend above a height of 45 metres above the mean level of the landing areas, in order to permit an aeronautical study to be conducted on the effect of such construction on the operation of aircraft.

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

1.3 All objects, whether temporary or permanent, which project above the horizontal surface within a radius of 15 kilometres as measured from the aerodrome reference point must be marked.

1.4 Any other object which projects the horizontal surface beyond a radius of 15 kilometres as measured from the aerodrome reference point, or above the conical surface and which constitutes a potential hazard to aircraft must be marked.

1.5 Buildings or other objects which will constitute an obstruction or potential hazard to aircraft moving in the navigable air space in the vicinity of an aerodrome, or navigation aid, or which will adversely affect the performance of the radio navigation or instrument landing systems, must not be erected or allowed to come into existence without the prior approval of the Executive Director.

1.6 No buildings or objects higher than 45 metres above the mean level of the landing area, or, in the case of a water aerodrome, the normal level of the water within a distance of 15 kilometer measured from the nearest point on the boundary of an aerodrome, may be erected without the approval of the Executive Director.

1.7 No building, structure or object which projects above a slope of 1 in 20 and which is within 3000 metres measured from the nearest point on the boundary of an aerodrome may be erected or be allowed to come into existence, without the prior approval of the Executive Director.

1.8 No building, structure or other object which will project above the approach, transitional or horizontal surfaces of an aerodrome may be erected or allowed to come into existence, without the prior approval of the Executive Director.

139.11.7 Removal of obstacles and other objects

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

1.2 Anything which may, in the opinion of the Executive Director, after aeronautical study, endanger aircraft on the movement area or in the air within the limits of the inner horizontal and conical surfaces must be regarded as an obstacle and must be removed in so far as practicable.

1.3 A person must remove any obstacle in the vicinity of aerodrome, except where, after an aeronautical study, the Executive Director determines that the obstacle does not adversely affect the safety or significantly affect the regularity of operations of aircraft.

1.4 Where an owner fails to remove an obstacle within the time directed by the Executive Director, the Executive Director must arrange to have the obstacle removed at the cost of the owner of that obstacle.

SUBPART 12 - VISUAL AIDS FOR NAVIGATION

139.12.2 Wind direction indicator

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

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

1.3 Provision must be made for illuminating at least one wind indicator at an aerodrome intended for use at night and/or in low visibility conditions.

139.12.3 Landing direction indicator

1.1 The landing direction indicator must be in the form of a "T" as illustrated in figure 12.1 below:

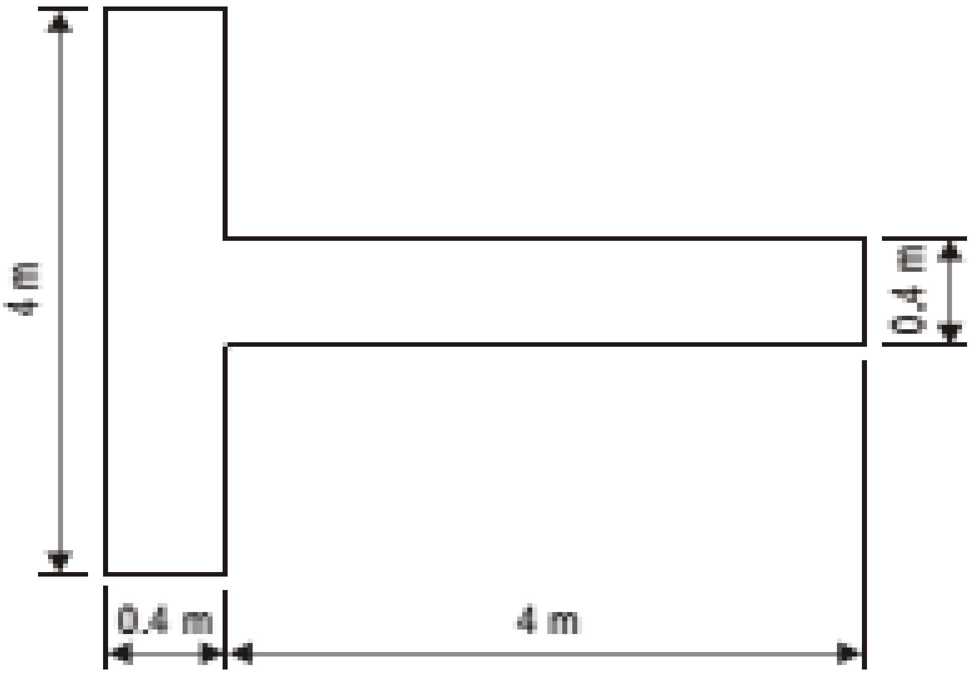


Figure 12. 1 Landing direction indicator

1.2 The shape and minimum dimensions of a landing "T" must be as shown in Figure 12.1. The colour of the landing "T" must be either white or orange, the choice being dependent on the colour that contrasts best with the background against which the indicator will be viewed. Where required for use at night the landing "T" must either be illuminated or outlined by white lights

139.12.4 Signaling lamp

1.1 A signaling lamp provided at a controlled aerodrome in the aerodrome control tower be capable of producing red, green and white signals, and of:

(a) being aimed manually at any target as required;

(b) giving a signal in any one colour followed by a signal in either of the two other colours; and

(c) transmitting a message in any one of the three colours by Morse Code up to a speed of at least four words per minute.

When selecting the green light, use must be made of the restricted boundary of green as specified in *note 1*.

Note 1: 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 $y = 0.390 – 0.171x$

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

139.12.5 Signal panels and signal area

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

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

1.3 The colour of the signal area must be chosen to contrast with the colours of the signal panels used, and it must be surrounded by a white border not less than 0.3 m wide.

139.12.6 Markings

1. Introduction

1.1 *Interruption of runway markings*

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

1.1.2 The order of importance of runways for the display of runway markings may be as follows:

1st — precision approach runway;

2nd — non-precision approach runway; and

3rd — non-instrument runway.

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

1.2 *Colour and conspicuity*

1.2.1 Runway markings must be white.

Compliance Note 1. It has been found that, on runway surfaces of light colour, the conspicuity of white markings can be improved by outlining them in black.

Compliance Note 2. It is preferable that the risk of uneven friction characteristics on markings be reduced in so far as practicable by the use of a suitable kind of paint.

Compliance Note 3. Markings may consist of solid areas or a series of longitudinal stripes providing an effect equivalent to the solid areas.

1.2.2 Taxiway markings, runway turn pad markings and aircraft stand markings must be yellow.

1.2.3 Apron safety lines must be of a conspicuous colour which must contrast with that used for aircraft stand markings.

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

1.3 *Unpaved taxiways*

1.3.1 An unpaved taxiway must be provided, so far as practicable, with the markings prescribed for paved taxiways.

2. Runway designation marking

2.1 A runway designation marking must be provided at the thresholds of a paved runway.

2.2 A runway designation marking may be provided, so far as practicable, at the thresholds of an unpaved runway.

2.3 A runway designation marking must be located at a threshold as shown in Figure 12.2 below as appropriate.

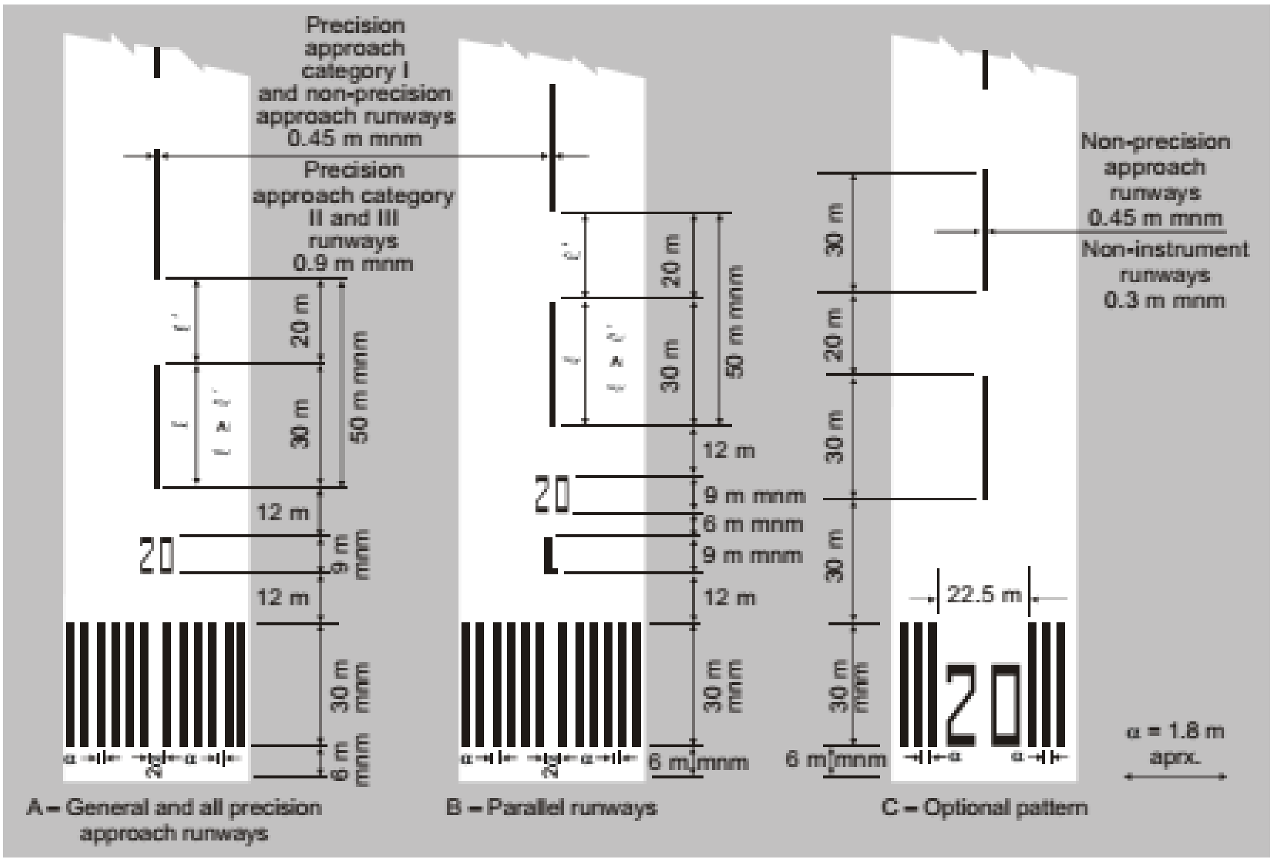


Figure 12. 2:Runway designation, centre line and threshold markings

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

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

- for two parallel runways: “L” “R”;
- for three parallel runways: “L” “C” “R”;
- for four parallel runways: “L” “R” “L” “R”;
- for five parallel runways: “L” “C” “R” “L” “R” or “L” “R” “L” “C” “R”; and
- for six parallel runways: “L” “C” “R” “L” “C” “R”.

2.6 The numbers and letters must be in the form and proportion shown in Figure 12.3. The dimensions must be not less than those shown in Figure 12.3, but where the numbers are incorporated in the threshold marking, larger dimensions must be used in order to fill adequately the gap between the stripes of the threshold marking.

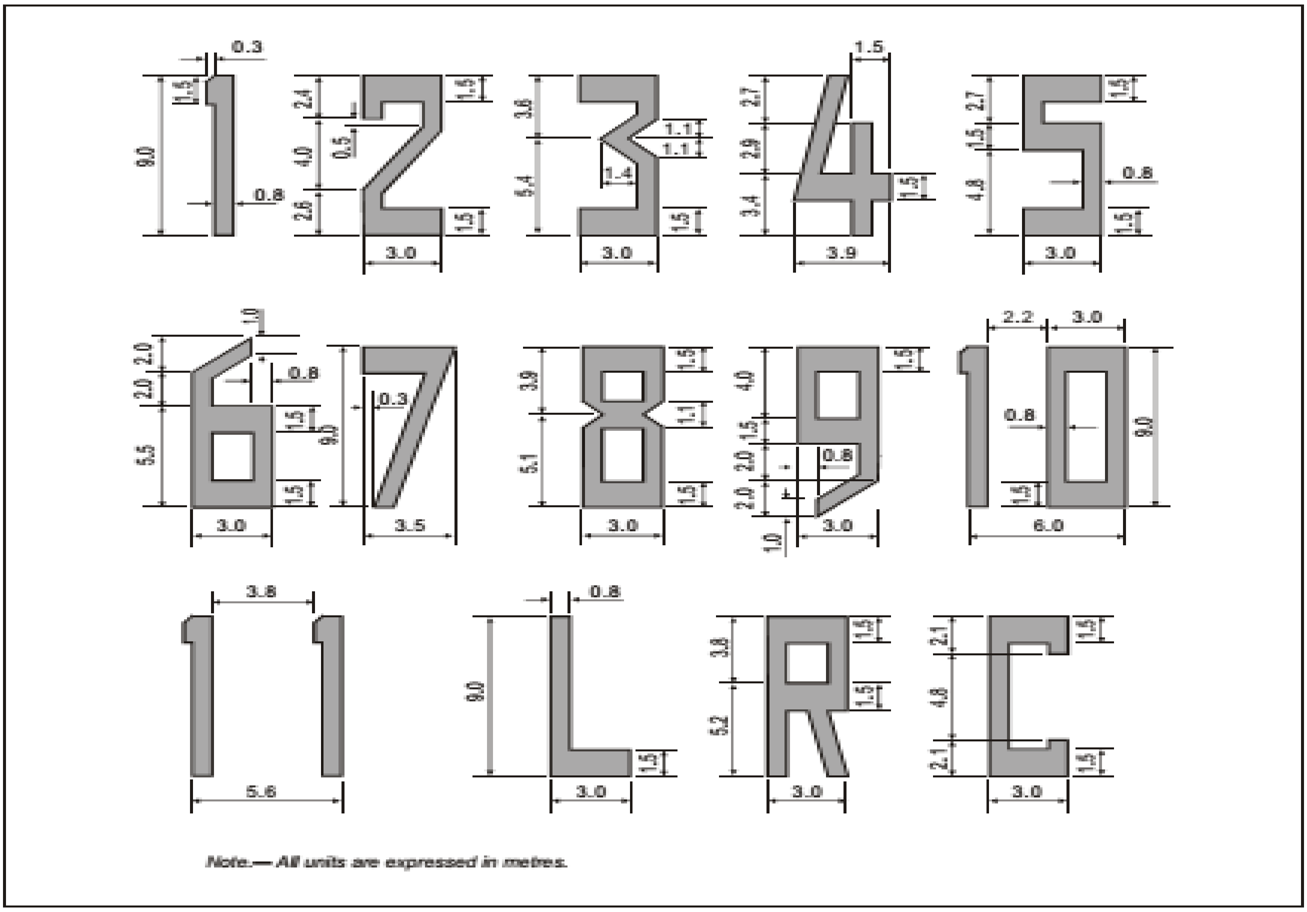


Figure 12. 3: Form and proportions of numbers and letters for runway designation markings

3. Runway centre line marking

3.1 A runway centre line marking must be provided on a paved runway.

3.2 A runway centre line marking must be located along the centre line of the runway between the runway designation markings as shown in Figure 12.2, except when interrupted in compliance with paragraph 1.1 above.

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

3.4 The width of the stripes must be not less than:

- 0.90 m on precision approach category II and III runways;
- 0.45 m on non-precision approach runways where the code number is 3 or 4, and precision approach category I runways; and
- 0.30 m on non-precision approach runways where the code number is 1 or 2, and on non-instrument runways.

4. Threshold marking

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

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

4.3 A threshold marking may be provided, so far as practicable, at the thresholds of an unpaved runway.

4.4 The stripes of the threshold marking must commence 6 m from the threshold.

4.5 A runway threshold marking must consist of a pattern of longitudinal stripes of uniform dimensions disposed symmetrically about the centre line of a runway as shown in Figure 12.2 (A) and (B) for a runway width of 45 m. The number of stripes must be in accordance with the runway width as follows:

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

except that on non-precision approach and non-instrument runways 45 m or greater in width, they may be as shown in Figure 12.2 (C).

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

Transverse stripe

4.7 Where a threshold is displaced from the extremity of a runway or where the extremity of a runway is not square with the runway centre line, a transverse stripe as shown in Figure 12.4 (B) must be added to the threshold marking.

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

Arrows

4.9 Where a runway threshold is permanently displaced, arrows conforming to Figure 12.4 (B) must be provided on the portion of the runway before the displaced threshold.

4.10 When a runway threshold is temporarily displaced from the normal position, it must be marked as shown in Figure 12.4(A) or 12.4 (B) and all markings prior to the displaced threshold must be obscured except the runway centre line marking, which must be converted to arrows.

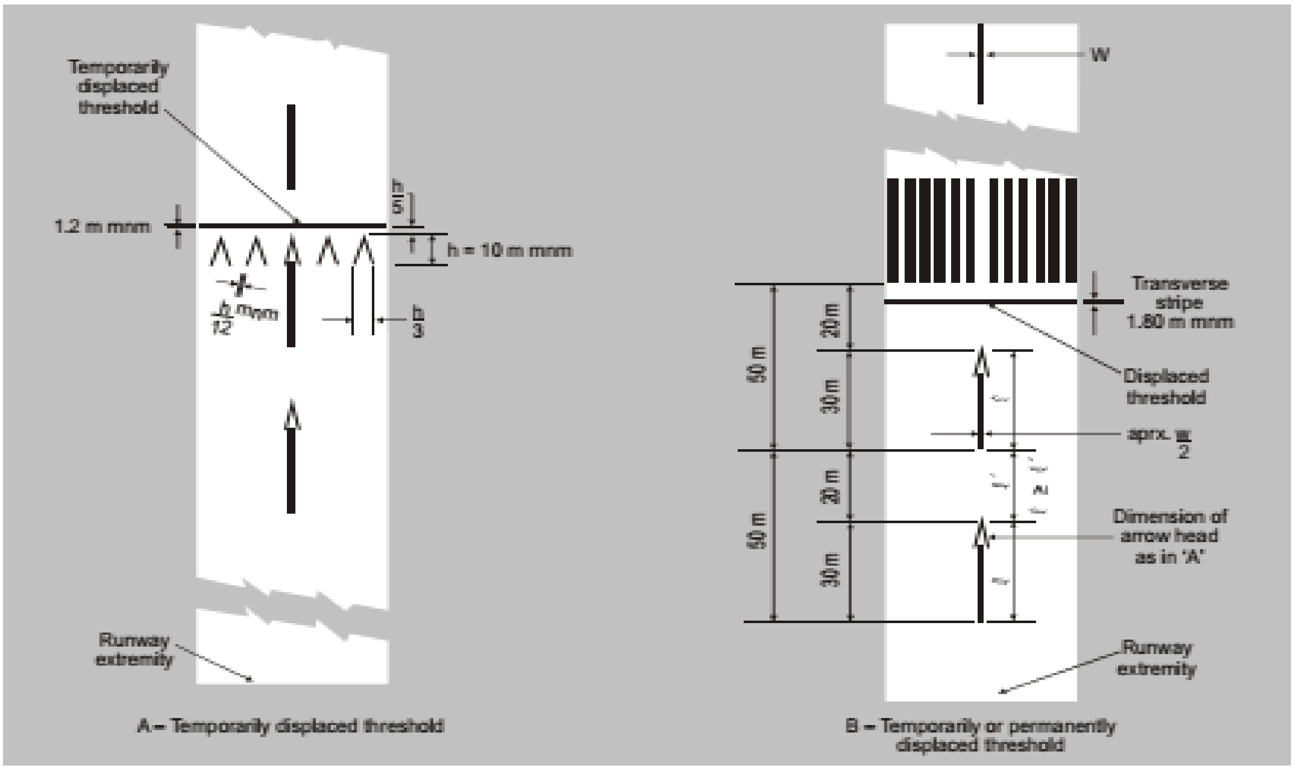


Figure 12. 4: Displaced threshold marking

Note 1. In the case where a threshold is temporarily displaced for only a short period of time, it has been found satisfactory to use markers in the form and colour of a displaced threshold marking rather than attempting to paint this marking on the runway.

Note 2. When the runway before a displaced threshold is unfit for the surface movement of aircraft, closed markings, are required to be provided.

5. Aiming point marking

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

5.2 An aiming point marking may be provided at each approach end of:

(a) a paved non-instrument runway where the code number is 3 or 4;
(b) a paved instrument runway where the code number is 1;

when additional conspicuity of the aiming point is desirable.

5.3 The aiming point marking must commence no closer to the threshold than the distance indicated in the appropriate column of Table 12.1 below, except that, on a runway equipped with a visual approach slope indicator system, the beginning of the marking must be coincident with the visual approach slope origin.

Table 12. 1: Location and dimensions of aiming point marking

	Landing distance available			
Location and dimensions	Less than 800 m	800 m up to but not including 1200 m	1200 m up to but not including 2400 m	2400 m and above
(1)	(2)	(3)	(4)	(5)
Distance from threshold to beginning of marking	150m	250m	300m	400m
Length of stripe [a]	30 – 45m	30 – 45m	45 – 60m	45 – 60m
Width of stripe	4m	6m	6-10m [b]	6-10m [b]
Lateral spacing between inner	6m [c]	9m [c]	18 – 22.5m	18 – 22.5m

sides of stripes
a. The greater dimensions of the specified ranges are intended to be used where increased conspicuity is required. b. The lateral spacing may be varied within these limits to minimize the contamination of the marking by rubber deposits. c. These figures were deduced by reference to the outer main gear wheel span which is element 2 of the aerodrome reference code at Table 10.1.

5.4 An aiming point marking must consist of two conspicuous stripes. The dimensions of the stripes and the lateral spacing between their inner sides must be in accordance with the provisions of the appropriate column of Table 12.1. Where a touchdown zone marking is provided, the lateral spacing between the markings must be the same as that of the touchdown zone marking.

6. Touchdown zone marking

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

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

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

Landing distance available or the distance between thresholds	*Pair(s) of markings*
less than 900 m	1
900 m up to but not including1 200 m	2
1 200 m up to but not including 1 500 m	3
1 500 m up to but notincluding2 400 m	4
2 400 m or more	6

6.4 A touchdown zone marking must conform to either of the two patterns shown in Figure 5-5. For the pattern shown in Figure 5-5 (A), the markings must be not less than 22.5 m long and 3 m wide. For the pattern shown in Figure 5-5 (B), each stripe of each marking must be not less than 22.5 m long and 1.8 m wide with a spacing of 1.5 m between adjacent stripes. The lateral spacing between the inner sides of the rectangles must be equal to that of the aiming point marking where provided. Where an aiming point marking is not provided, the lateral spacing between the inner sides of the rectangles must correspond to the lateral spacing specified for the aiming point marking in Table 12.1 (columns 2, 3, 4 or 5, as appropriate). The pairs of markings must be provided at longitudinal spacings of 150 m beginning from the threshold, except that pairs of touchdown zone markings coincident with or located within 50 m of an aiming point marking must be deleted from the pattern.

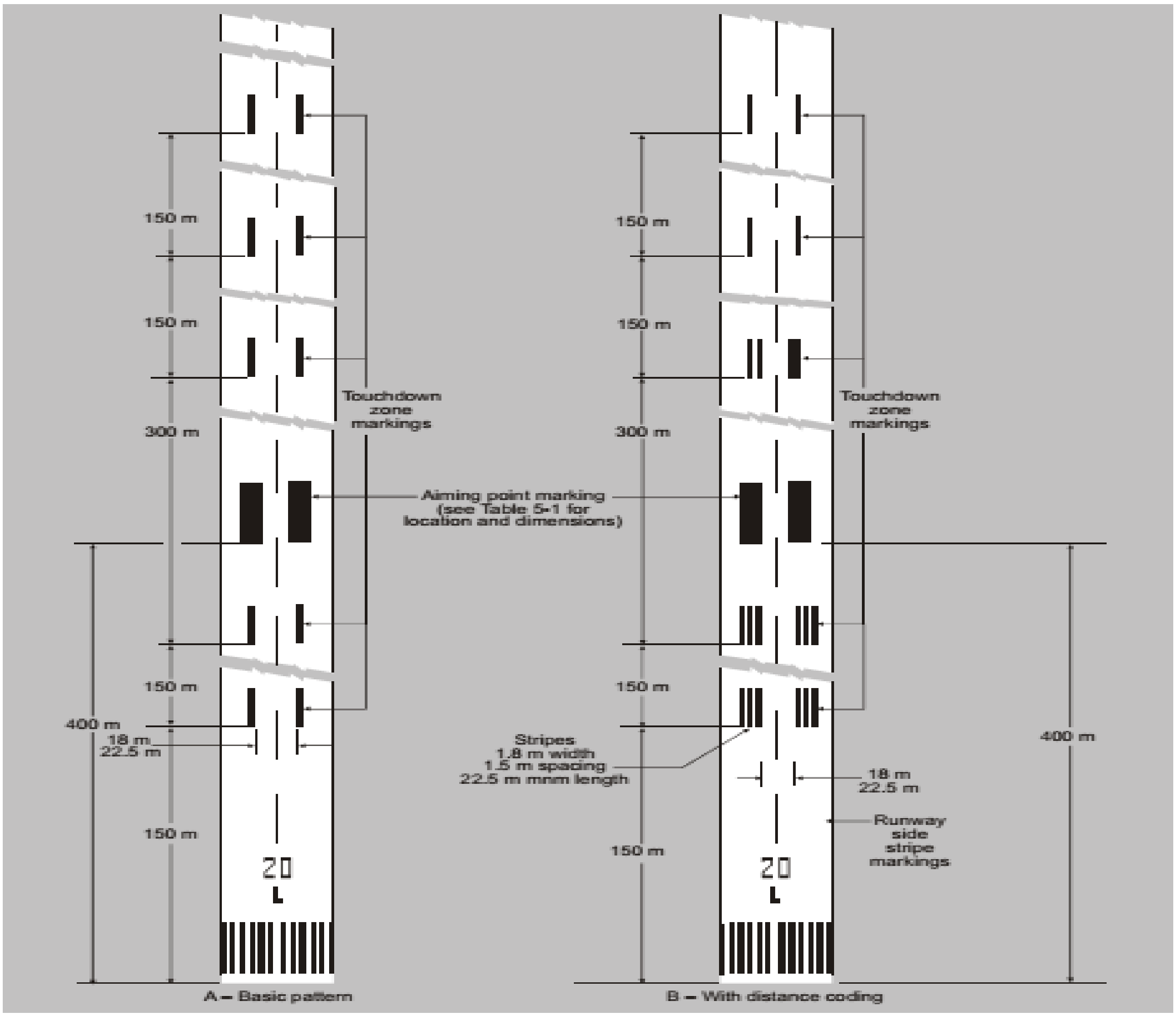


Figure 12. 5: Aiming point and touchdown zone markings

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

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

7. Runway side stripe marking

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

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

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

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

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

8. Taxiway centre line marking

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

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

8.3 Taxiway centre line marking must be provided on a paved runway when the runway is part of a standard taxi route and:

(a) there is no runway centre line marking; or
(b) where the taxiway centre line is not coincident with the runway centre line.

8.4 Where it is necessary to denote the proximity of a runway-holding position, enhanced taxiway centre line marking may be provided.

8.5 Where provided, enhanced taxiway centre line marking must be installed at each taxiway/runway intersection.

8.6 On a straight section of a taxiway the taxiway centre line marking when provided must be located along the taxiway centre line. On a taxiway curve the marking must continue from the straight portion of the taxiway at a constant distance from the outside edge of the curve.

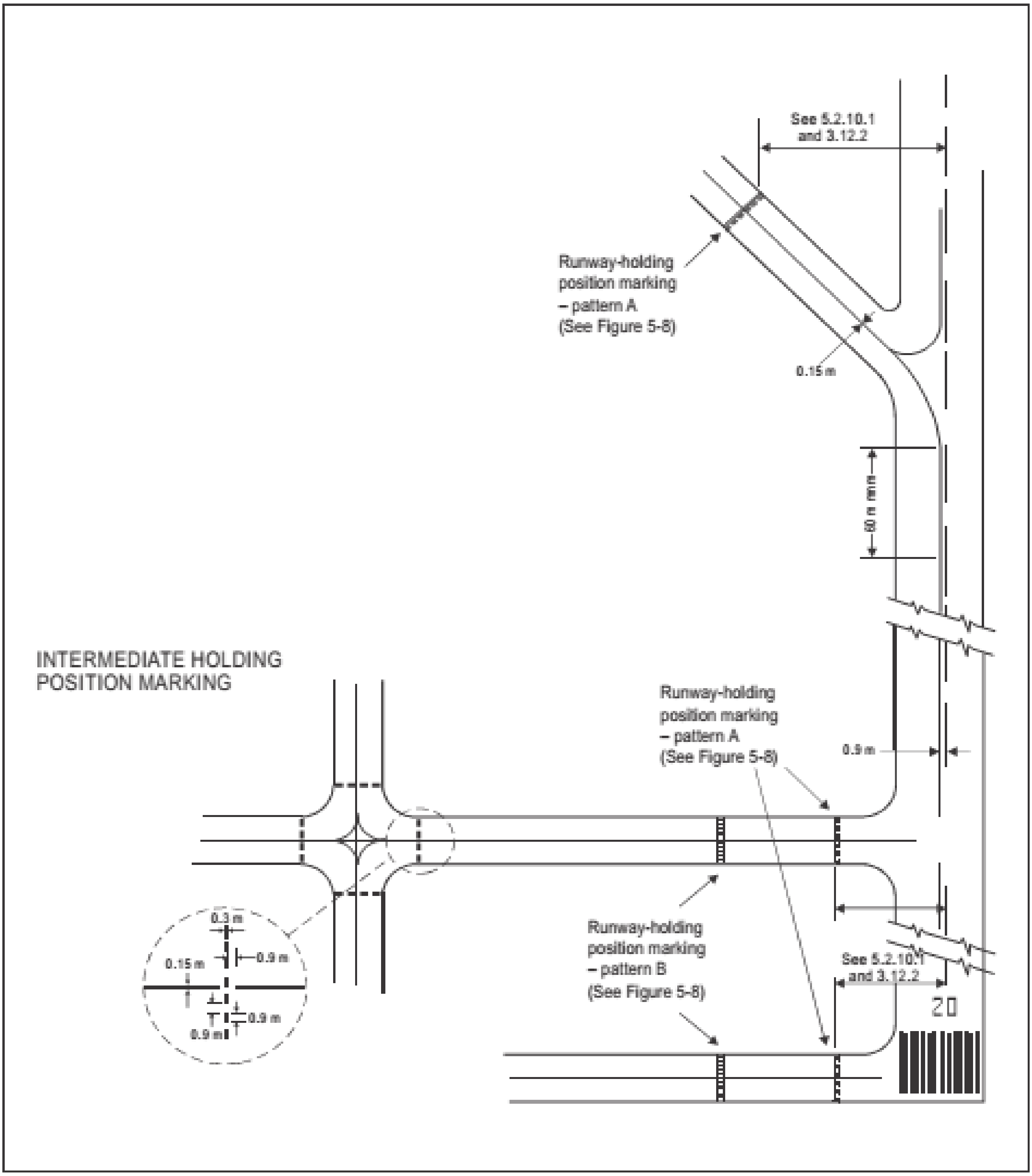


Figure 12. 6: Taxiway markings (shown with basic runway markings)

8.7 At an intersection of a taxiway with a runway where the taxiway serves as an exit from the runway, the taxiway centre line marking when provided, must be curved into the runway centre line marking as shown in Figures 12.6 and 12.26. The taxiway centre line marking must be extended parallel to the runway centre line marking for a distance of at least 60 m beyond the point of tangency where the code number is 3 or 4, and for a distance of at least 30 m where the code number is 1 or 2.

8.8 Where taxiway centre line marking is provided on a runway in accordance with 8.3, the marking must be located on the centre line of the designated taxiway.

8.9 Where provided:

(a) An enhanced taxiway centre line marking must extend from the runway-holding position Pattern A (as defined in Figure 12.6, Taxiway markings) to a distance of up to 47 m in the direction of travel away from the runway. See Figure 12.7 (a).

(b) If the enhanced taxiway centre line marking intersects another runway-holding position marking, such as for a precision approach category II or III runway that is located within 47 m of the first runway-holding position marking, the enhanced taxiway centre line marking must be interrupted 0.9 m prior to and after the intersected runway-holding position marking. The enhanced taxiway centre line marking must continue beyond the intersected runway-holding position marking for at least three dashed line segments or 47 m from start to finish, whichever is greater. See Figure 12.7 (b).

(c) If the enhanced taxiway centre line marking continues through a taxiway/taxiway intersection that is located within 47 m of the runway-holding position marking, the enhanced taxiway centre line marking must be interrupted 1.5 m prior to and after the point where the intersected taxiway centre line crosses the enhanced taxiway centre line. The enhanced taxiway centre line marking must continue beyond the taxiway/taxiway intersection for at least three dashed line segments or 47 m from start to finish, whichever is greater. See Figure 12.7 (c).

(d) Where two taxiway centre lines converge at or before the runway-holding position marking, the inner dashed line must not be less than 3 m in length. See Figure 12.7 (d).

(e) Where there are two opposing runway-holding position markings and the distance between the markings is less than 94 m, the enhanced taxiway centre line markings must extend over this entire distance. The enhanced taxiway centre line markings must not extend beyond either runway-holding position marking. See Figure 12.7 (e).

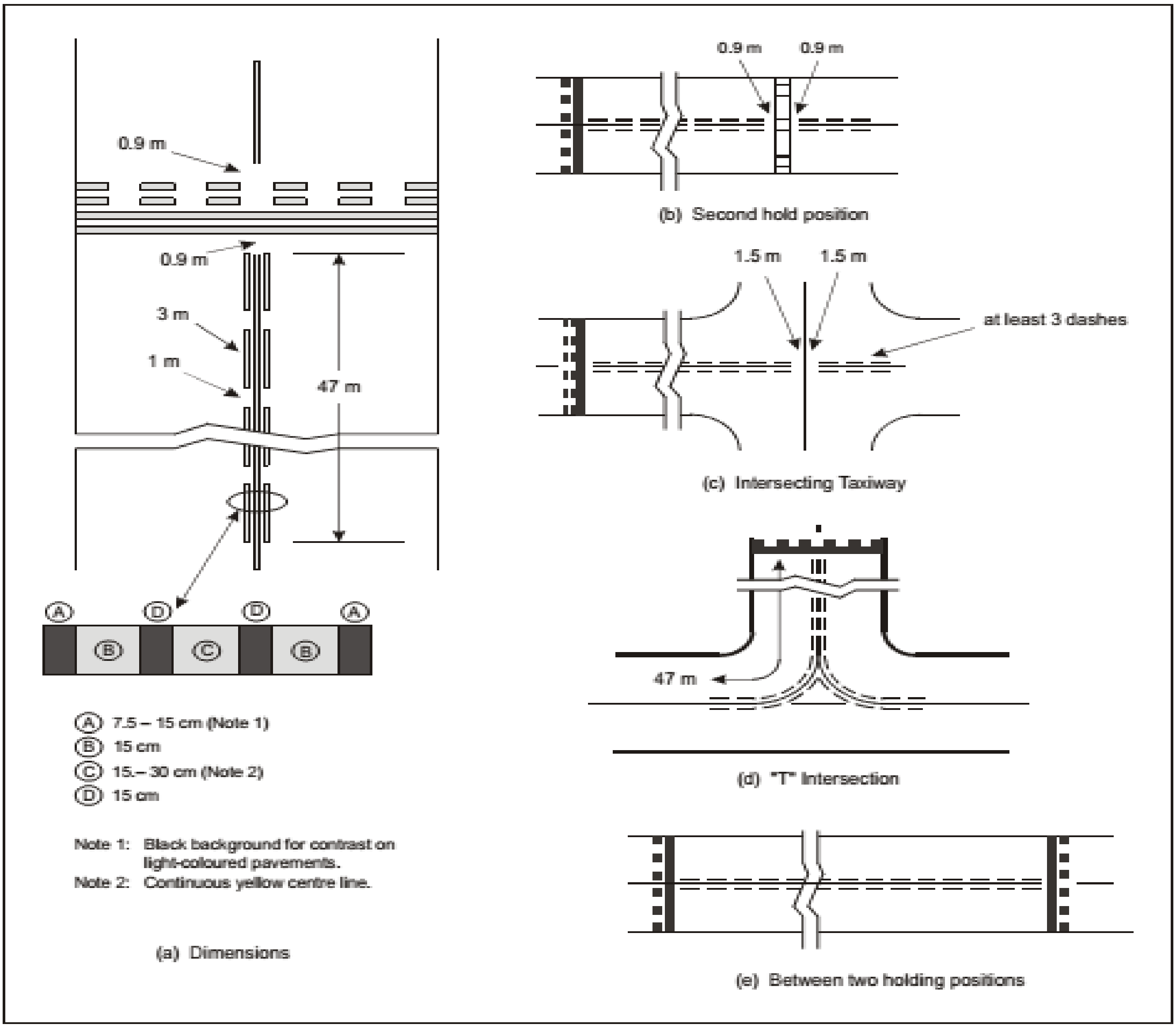


Figure 12. 7: Enhanced taxiway centre line marking

8.10 A taxiway centre line marking must be at least 15 cm in width and continuous in length except where it intersects with a runway-holding position marking or an intermediate holding position marking as shown in Figure 12.6.

8.11 Enhanced taxiway centre line marking must be as shown in Figure 12.7.

9. Runway turn pad marking

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

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

9.3 The runway turn pad marking must be extended parallel to the runway centre line marking for a distance of at least 60 m beyond the point of tangency where the code number is 3 or 4, and for a distance of at least 30 m where the code number is 1 or 2.

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

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

9.6 The design of the turn pad marking must be such that, when the cockpit of the aeroplane remains over the runway turn pad marking, the clearance distance between any wheel of the aeroplane landing gear and the edge of the runway turn pad must be not less than those specified in the following:

Code letter	*Clearance*
A	1.5 m

B	2.25 m
C	3 m if the turn pad is intended to be used by aeroplanes with a wheelbase less than 18 m; 4.5 m if the turn pad is intended to be used by aeroplanes with a wheelbase equal to or greater than 18 m.
D	4.5 m
E	4.5 m
F	4.5 m

Compliance Note. For ease of maneuvering, consideration may be given to providing a larger wheel-to-edge clearance for codes E and F aeroplanes.

9.7 A runway turn pad marking must be at least 15 cm in width and continuous in length.

10. Runway-holding position marking

10.1 A runway-holding position marking must be displayed along a runway-holding position.

10.2 At an intersection of a taxiway and a non-instrument, non-precision approach or take-off runway, the runway holding position marking must be as shown in Figure 12.6, pattern A.

10.3 Where a single runway-holding position is provided at an intersection of a taxiway and a precision approach category I, II or III runway, the runway-holding position marking must be as shown in Figure 12.6, pattern A. Where two or three runway-holding positions are provided at such an intersection, the runway-holding position marking closer (closest) to the runway must be as shown in Figure 12.6, pattern A and the markings farther from the runway must be as shown in Figure 12.6, pattern B.

10.4 The runway-holding position marking displayed at a runway-holding position must be as shown in Figure 12.6, pattern A.

10.5 Until 26 November 2026, the dimensions of runway-holding position markings must be as shown in Figure 12.8, pattern A1 (or A2) or pattern B1 (or B2), as appropriate.

10.6 As of 26 November 2026, the dimensions of runway-holding position markings must be as shown in Figure 12.8, pattern A2 or pattern B2, as appropriate.

10.7 Where increased conspicuity of the runway-holding position is required, the dimensions of runway-holding position marking must be as shown in Figure 12.8, pattern A2 or pattern B2, as appropriate.

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

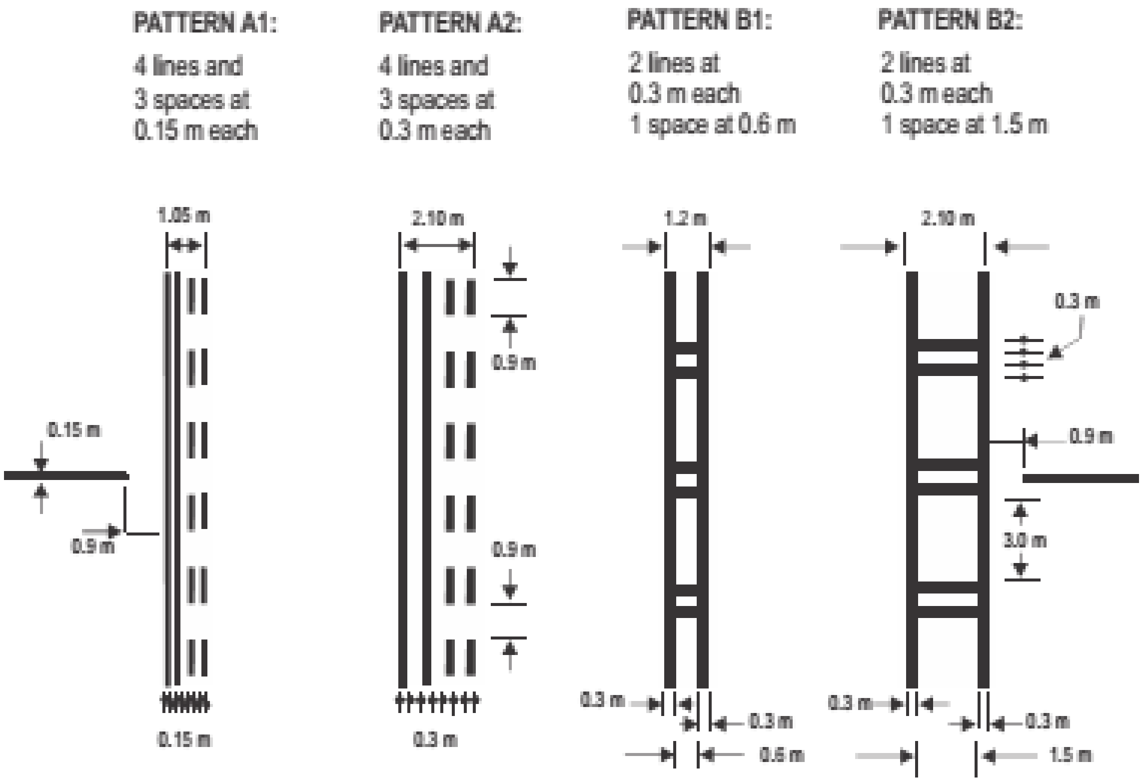


Figure 12. 8: Runway-holding position markings

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

10.9 The runway-holding position marking displayed at a runway/runway intersection must be perpendicular to the centre line of the runway forming part of the standard taxi-route. The pattern of the marking must be as shown in Figure 12.8, pattern A2.

11. Intermediate holding position marking

11.1 An intermediate holding position marking may be displayed along an intermediate holding position.

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

11.3 An intermediate holding position marking must consist of a single broken line as shown in Figure 12.6.

12. VOR aerodrome checkpoint marking

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

12.2 *Site selection* 12.2.1 The signal strength of the nearby VOR must be sufficient to ensure satisfactory operation of a typical aircraft VOR installation. In particular, full flag action (no flag showing) must be ensured.

12.2.2 The check-points should, within the limits of operating convenience, be located away from buildings or other reflecting objects (fixed or moving) which are likely to degrade the accuracy or stability of the VOR signal.

12.2.3 The observed VOR bearing at any selected point should ideally be within plus or minus 1.5 degrees of the bearing accurately determined by survey or chart plotting.

Note.— The figure of plus or minus 1.5 degrees has no direct operational significance in that the observed bearing becomes the published bearing; however, where a larger difference is observed, there is some possibility of poor stability
.

12.2.4 The VOR information at a selected point should be used operationally only if found to be consistently within plus or minus 2 degrees of the published bearing. The stability of the VOR information at a selected point should be checked periodically with a calibrated receiver to ensure that the plus or minus 2-degree tolerance is satisfied, irrespective of the orientation of the VOR receiving antenna.

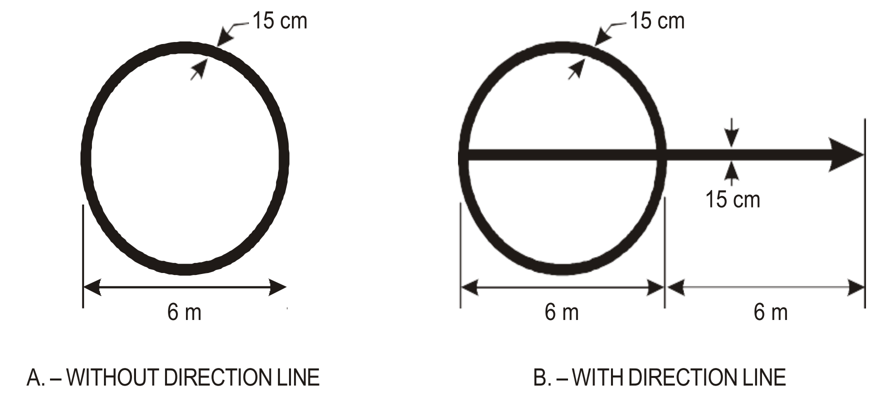
Note.— The tolerance of plus or minus 2 degrees relates to the consistency of the information at the selected point and includes a small tolerance for the accuracy of the calibrated VOR receiver used in checking the point. The 2-degree figure does not relate to any figure for acceptance or rejection of an aircraft VOR installation, this being a matter for determination by Administrations and users in the light of the operation to be performed.

12.2.5 Check-points which can satisfy the foregoing requirements should be selected in consultation with the operators concerned. Provision of check-points in holding bays, at runway ends and in maintenance and loading areas, is usually desirable.

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

12.4 A VOR aerodrome checkpoint marking must consist of a circle 6 m in diameter and have a line width of 15 cm (see Figure 12.9 (A)).

12.5 When it is preferable for an aircraft to be aligned in a specific direction, a line must be provided that passes through the centre of the circle on the desired azimuth. The line must extend 6 m outside the circle in the desired direction of heading and terminate in an arrowhead. The width of the line must be 15 cm (see Figure 12.9 (B)).



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

Figure 12. 9: VOR aerodrome checkpoint marking

12.6 A VOR aerodrome checkpoint marking must preferably be white in colour but must differ from the colour used for the taxiway markings.

Compliance Note. To provide contrast, markings may be bordered with black.

13. Aircraft stand marking

13.1 Aircraft stand markings must be provided for designated parking positions on a paved apron.

13.2 Aircraft stand markings on a paved apron must be located so as to provide the required clearances when the nose wheel follows the stand marking.

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

13.3.1 Lead-in lines

These lines provide guidance from apron taxiways into specific aircraft stands. They may be required to enable taxiing aircraft to maintain a prescribed clearance from other aircraft on the apron. They may be considered as important as the turning line to align the aircraft axis with the predetermined final position. For nose-in stands, the lead-in lines will mark the stand centre line to the aircraft stopping position. There will be no lead-out lines, and the tractor drivers will use the lead-in lines for guidance during the push-back manoeuvre.

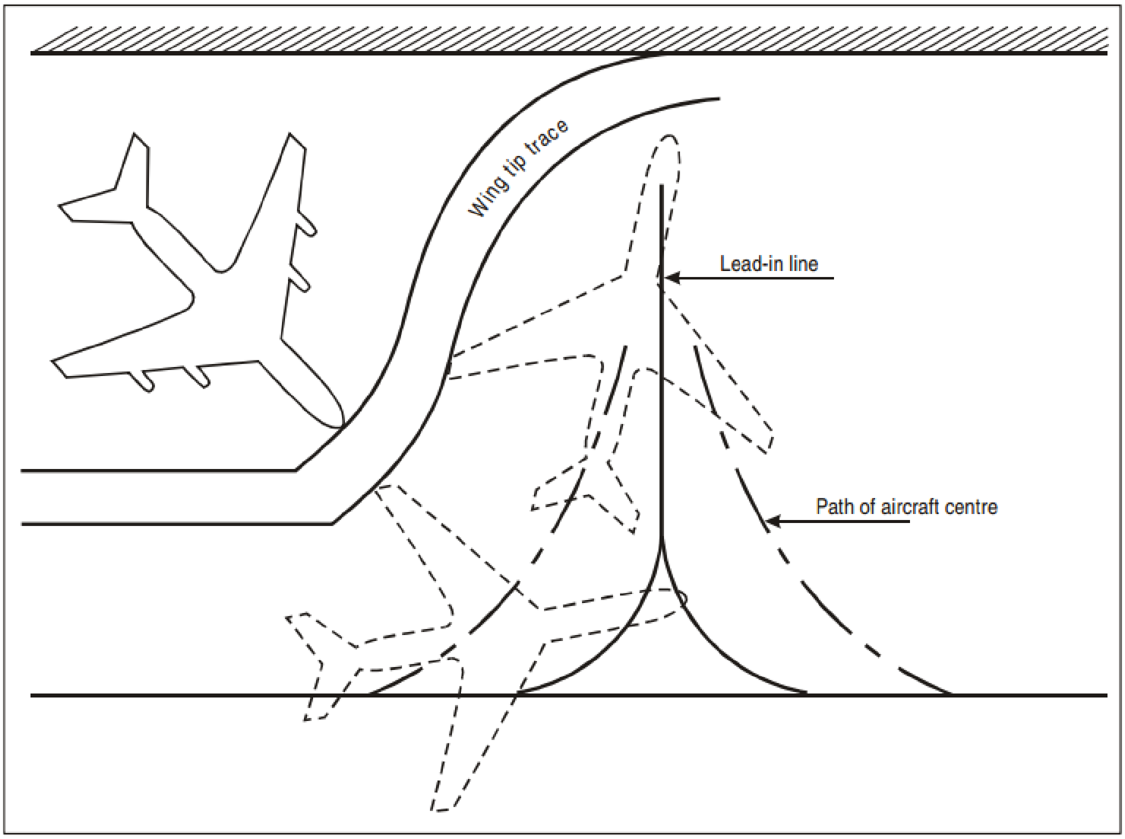


Figure 12. 10: Simple nose-wheel lead-in line

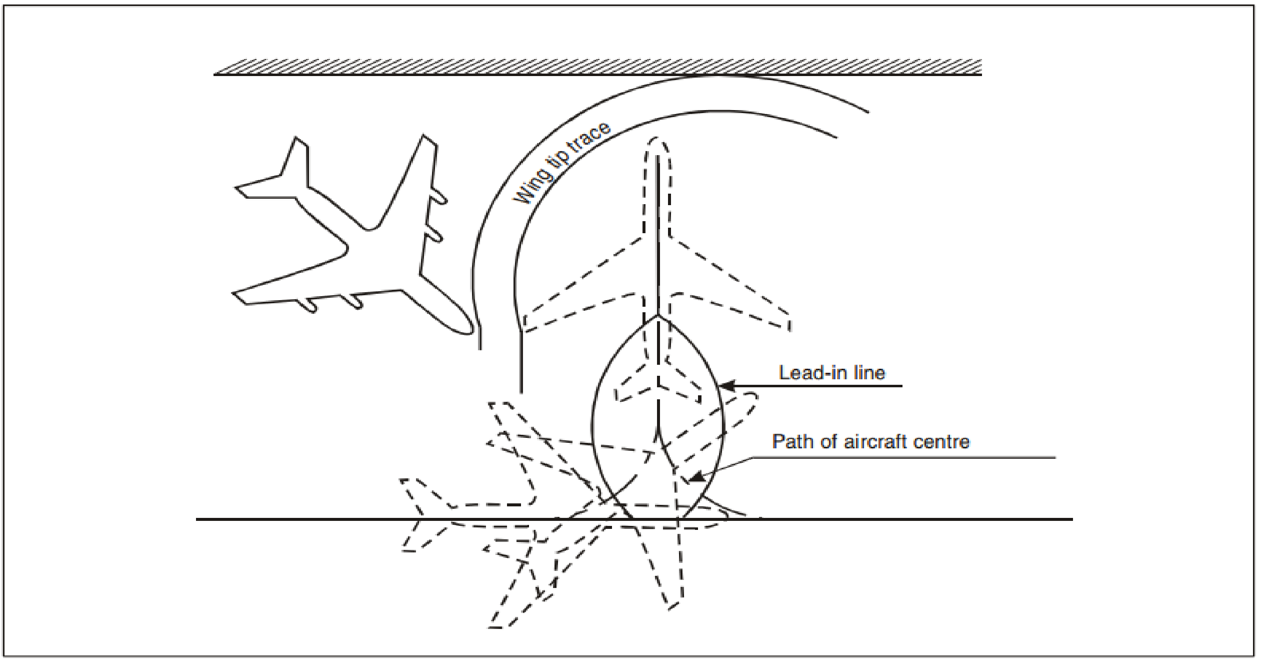


Figure 12. 11: Offset nose-wheel lead-in line

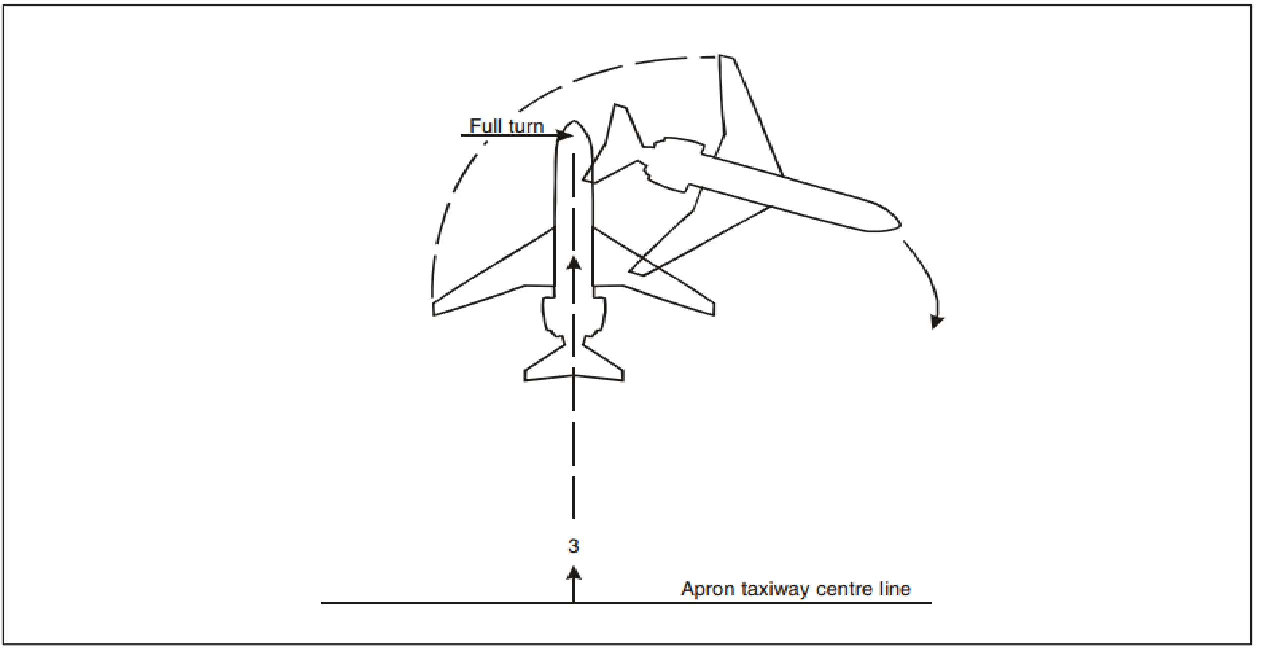


Figure 12. 12: Straight lead-in line

13.3.2 Turning lines

Where the aircraft is required to make a turn on the stand prior to stopping or after "break away", a turning line may be needed for the aircraft to follow. The primary purpose of this line is to limit the turning of aircraft within the designated area so as to keep aircraft clear of obstacles and to aid in accurate positioning of the aircraft. The former is of special importance where clearances between the stand and near structures or other stands are marginal.

The turning line should incorporate a straight portion at least 3 m in length at the final aircraft position. This provides a 1.5 m section prior to the final stopping position to relieve pressure on the landing gear and at the same time to correct the aircraft alignment, and a section 1.5 m long after the stopping position to reduce the thrust required and, thereby , blast on "break away". The length of the straight portion referred to above can be reduced to 1.5 m in the case of stands meant for small aircraft.

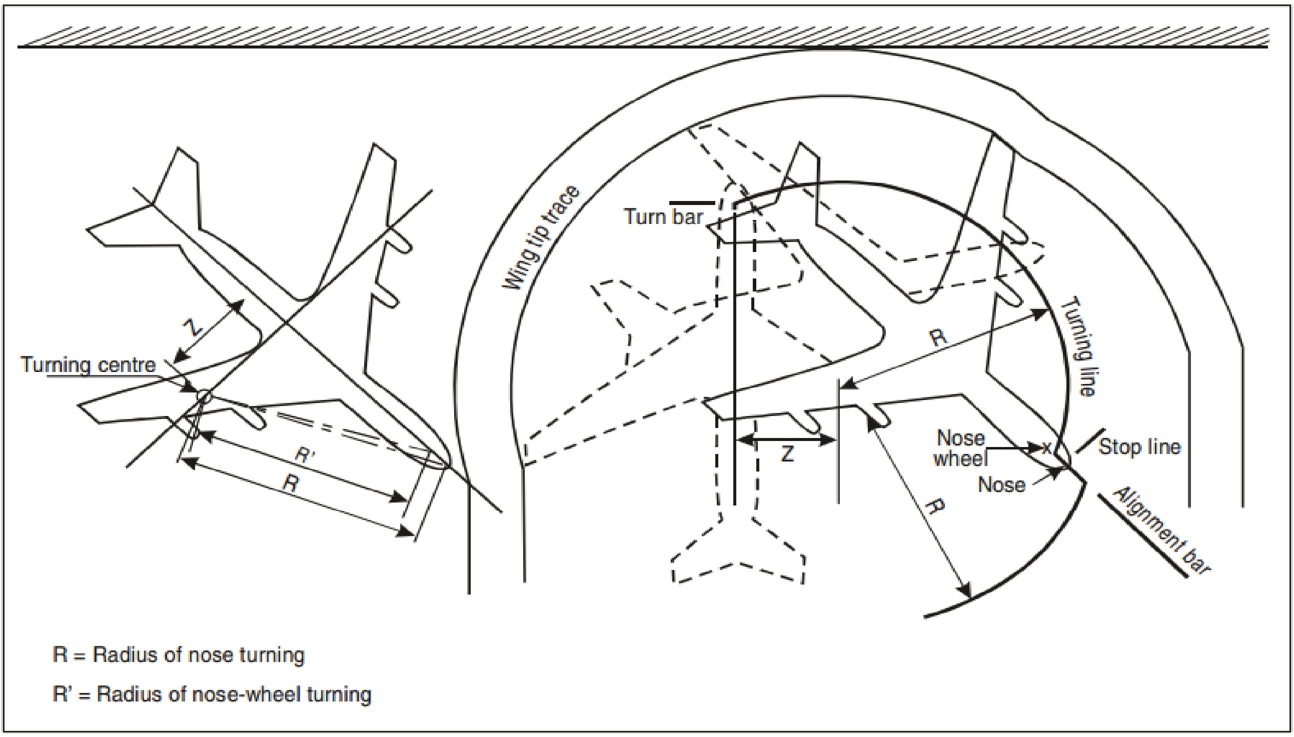


Figure 12. 13: Turning line and reference bars

13.3.3 Lead-out lines

These lines provide guidance from stands to taxiways and ensure that the prescribed clearance from other aircraft and obstacles is maintained. These lines are shown in Figure 12.14. Where aircraft have to make a turn prior to leaving the stand to keep clear of the adjacent obstacles, the lead-out line may be as shown in Figure 12.14 a). Where the clearance from the adjacent stand is less marginal, the lead-out line of Figure 12.14 b) or c) might be practical. Offset nose-wheel lead-out lines as shown in Figure 12.15 may be needed where clearances are marginal.

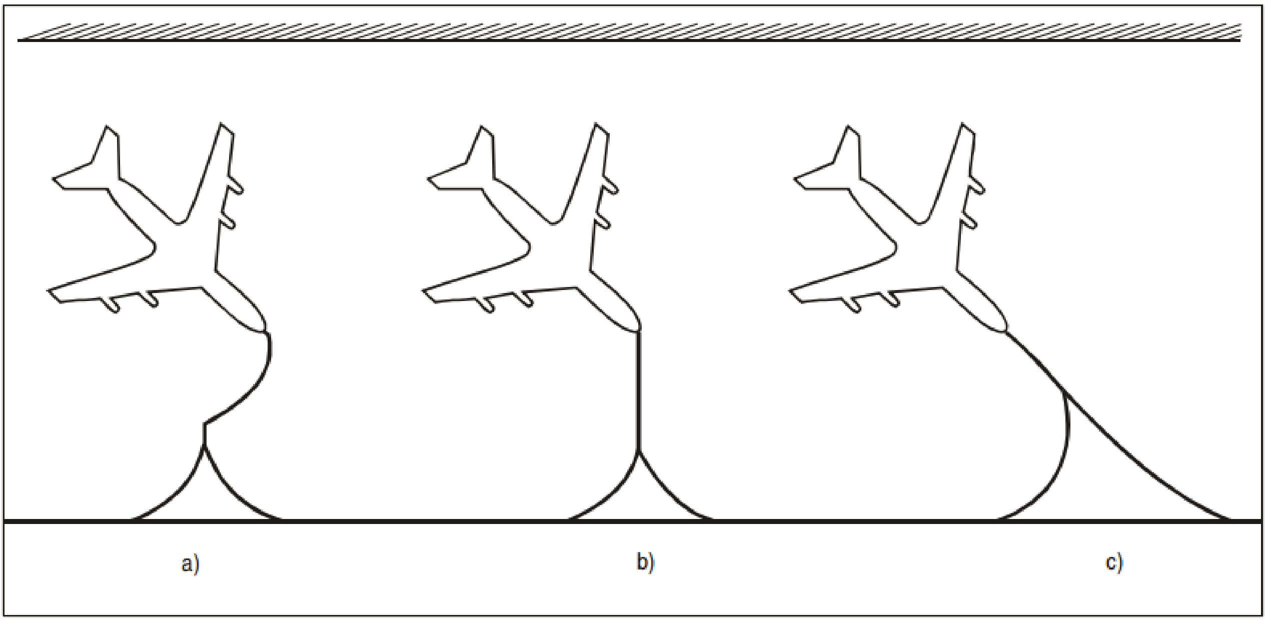


Figure 12. 14: Simple nose-wheel out-in line

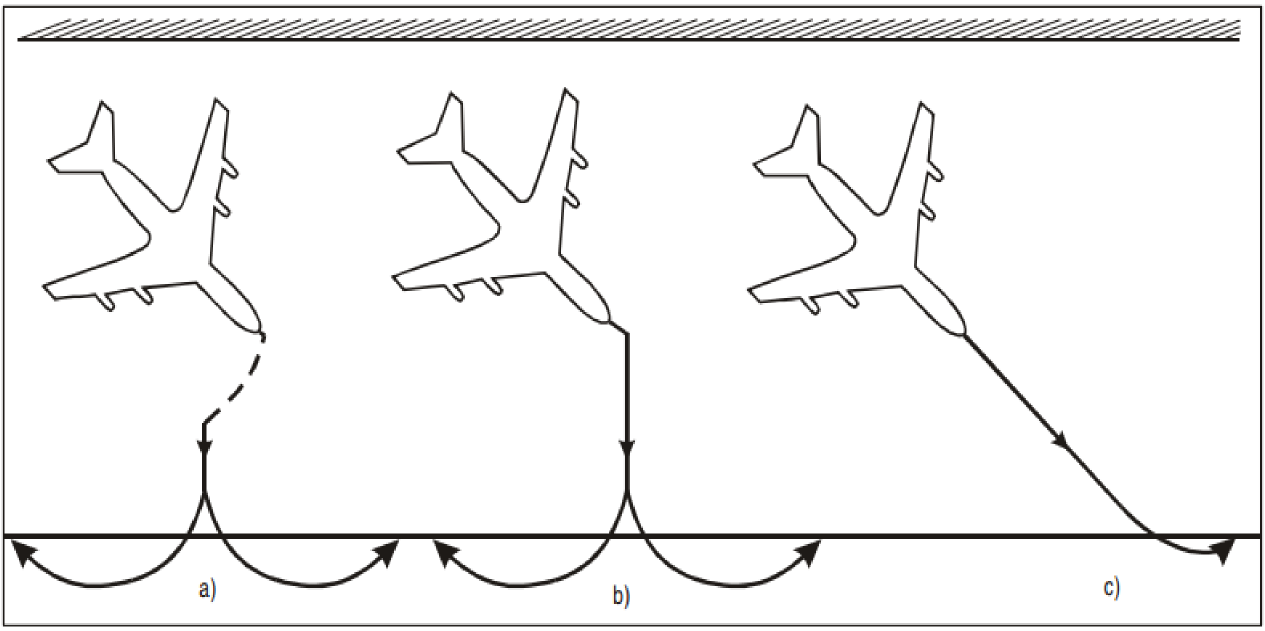
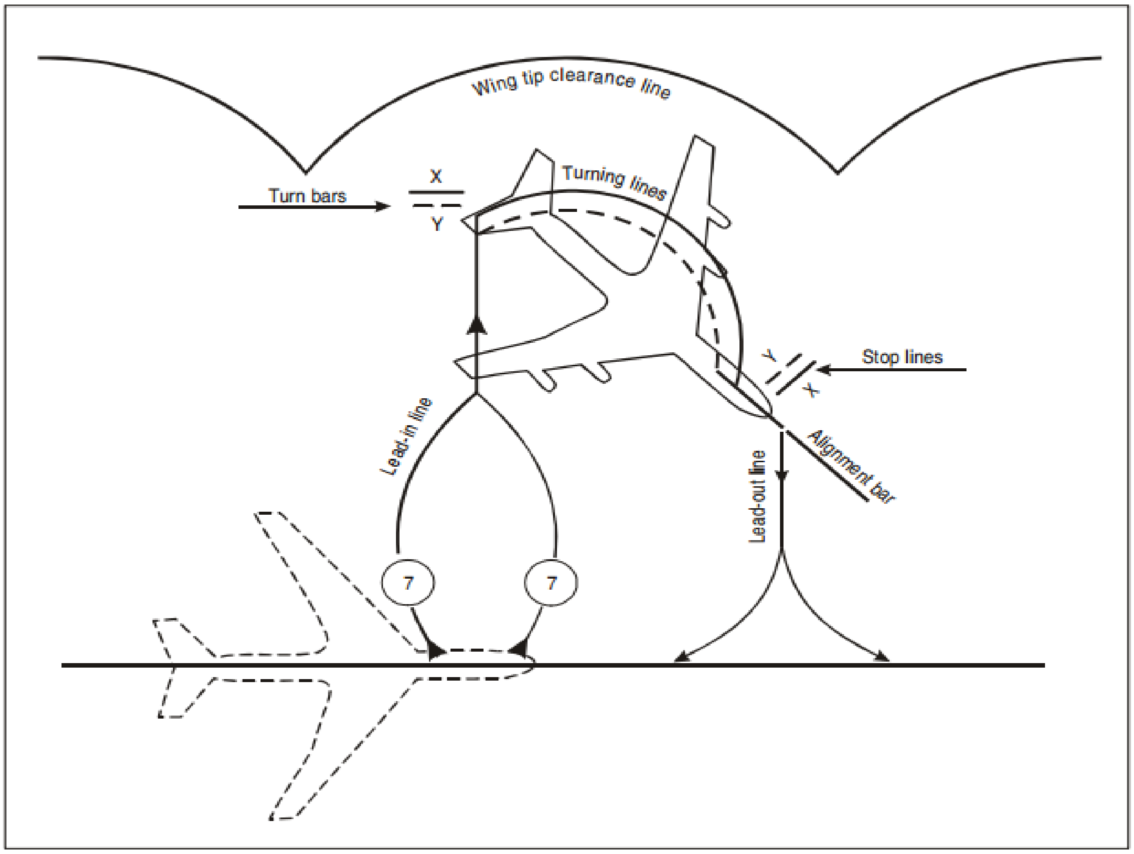


Figure 12. 15: Offset nose-wheel out-in line

13.3.4 Guide lines

The guide lines should normally be continuous solid yellow lines at least 15 cm, but preferably 30 cm, in width. However , where a secondary guide line is provided, it should be a broken line to distinguish it from the primary line. Additionally, the type of aircraft that is to follow each line should be clearly indicated.

Where it is considered necessary to distinguish between lead-in lines and lead-out lines, arrow heads indicating the directions to be followed should be added to the lines. The designation number/letter of the stand should be incorporated in the lead-in line (see Figure 15-16). Additionally, a stand identification sign should be provided at the back of the stand, e.g. on the building or a pole, so as to be clearly visible from the cockpit of an aeroplane.



NOTES:

1. The number "7" is the aircraft stand number.
2. Solid lines and bars are for aircraft X and dotted lines and bars for aircraft Y.
3. Alignment bar is for all types of aircraft using the gate position.

Figure 12. 16: Examples of reference bars

13.3.5 Reference bars

Examples of reference bars and their functions are:

a) turn bar (indicates the point at which to begin a turn);

b) stop line (indicates the point at which to stop); and

c) alignment bar (assists in aligning the aircraft on the desired angle).

Figure 12.16 shows an example of the use of a), b) and c).

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

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

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

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

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

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

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

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

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

14. Apron safety lines

14.1 Apron safety lines may be provided on a paved apron as required by the parking configurations and ground facilities.

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

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

14.4 An apron safety line must be continuous in length and at least 10 cm in width.

15. Road-holding position marking

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

15.2 The road-holding position marking must be located across the road at the holding position.

15.3 The road-holding position marking must be in accordance with the Namibia road traffic regulations.

16. Mandatory instruction marking

16.1 Where it is impracticable to install a mandatory instruction sign, a mandatory instruction marking must be provided on the surface of the pavement

16.2 Where operationally required, such as on taxiways exceeding 60 m in width, or to assist in the prevention of a runway incursion, a mandatory instruction sign may be supplemented by a mandatory instruction marking.

16.3 The mandatory instruction marking on taxiways where the code letter is A, B, C or D must be located across the taxiway equally placed about the taxiway centre line and on the holding side of the runway-holding position marking as shown in Figure 12.10 (A). The distance between the nearest edge of the marking and the runway-holding position marking or the taxiway centre line marking must be not less than 1 m.

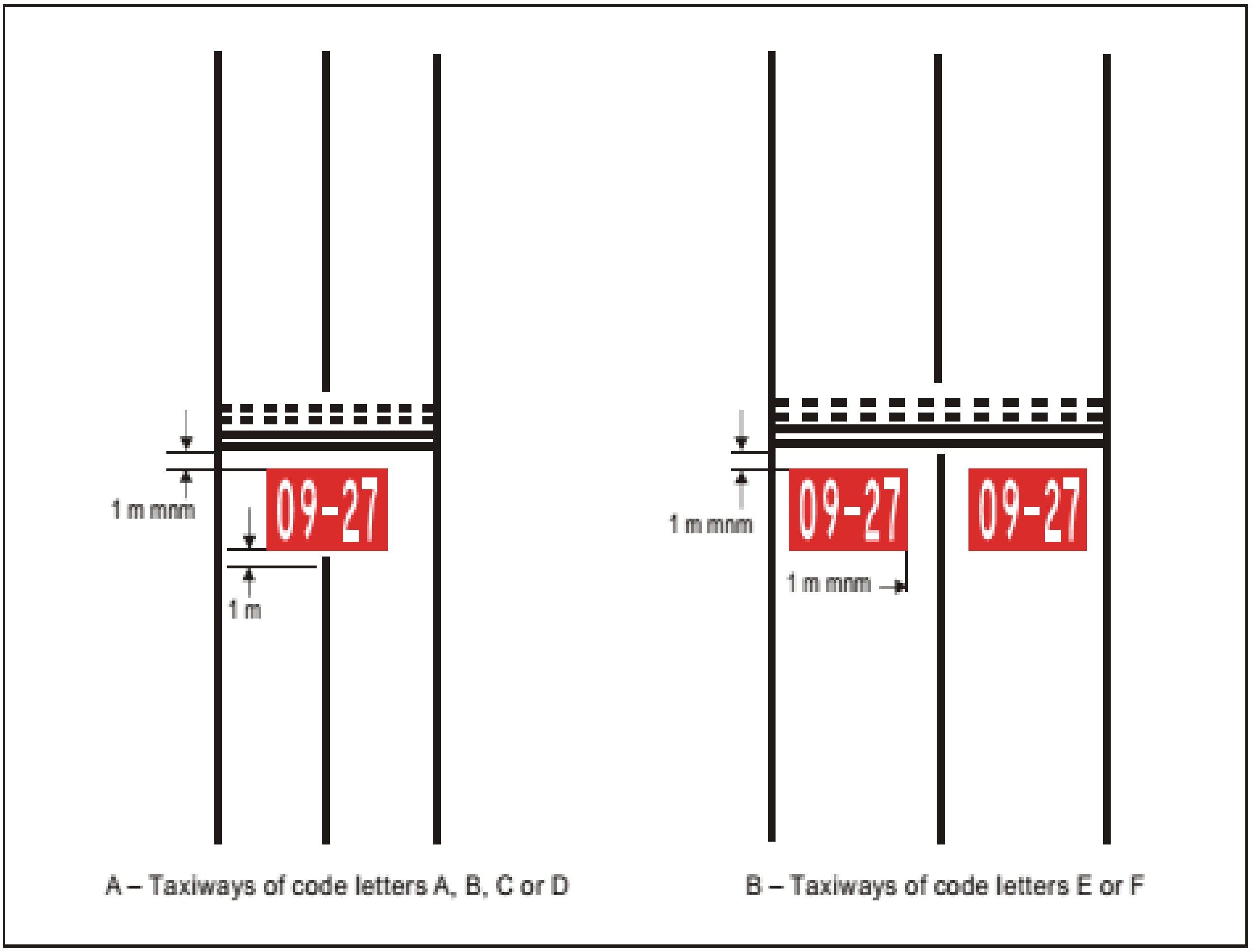


Figure 12. 17: Mandatory instruction marking

16.4 The mandatory instruction marking on taxiways where the code letter is E or F must be located on both sides of the taxiway centre line marking and on the holding side of the runway-holding position marking as shown in Figure 12.17 (B). The distance between the nearest edge of the marking and the runway-holding position marking or the taxiway centre line marking must be not less than 1 m.

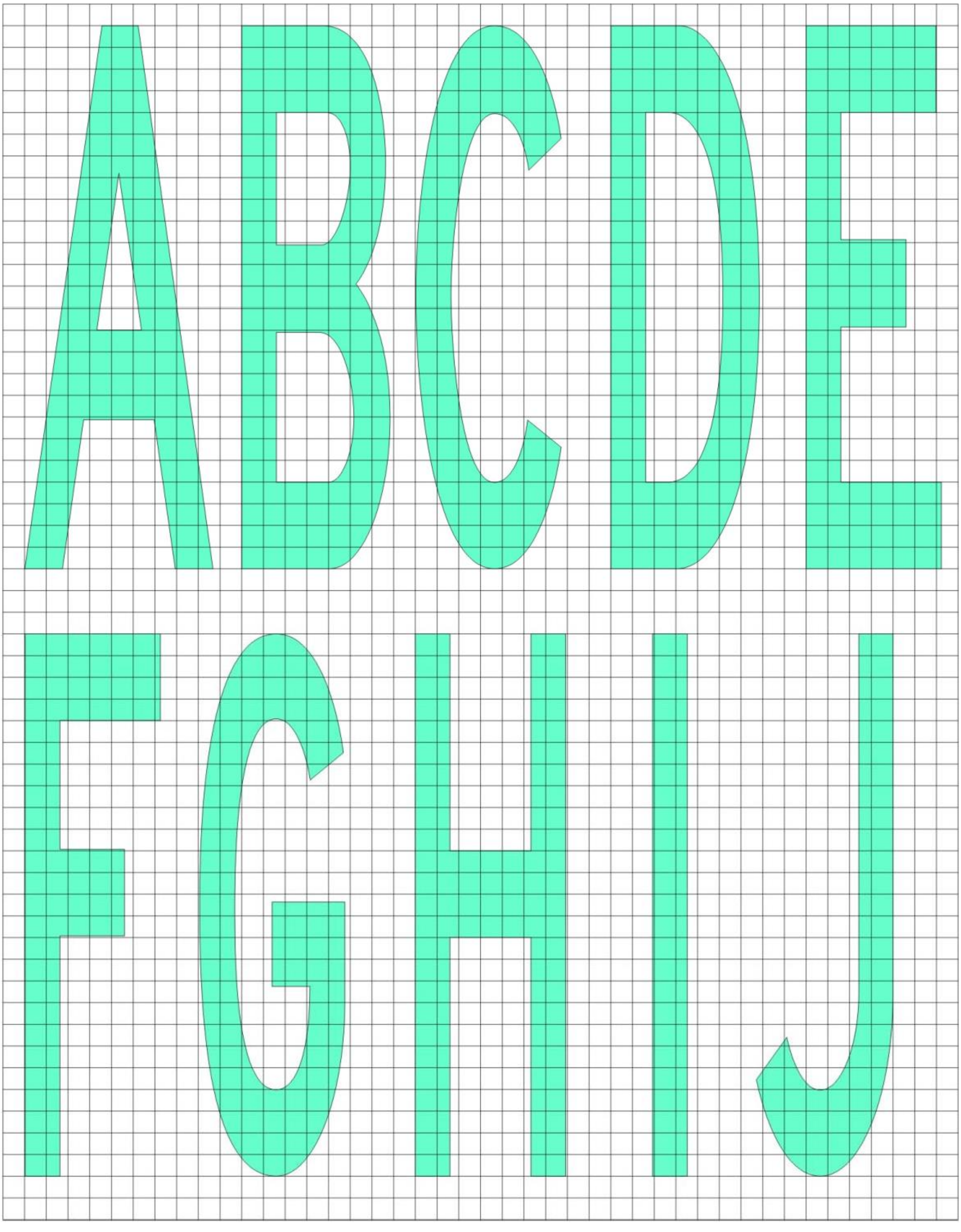
16.5 Except where operationally required, a mandatory instruction marking must not be located on a runway.

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

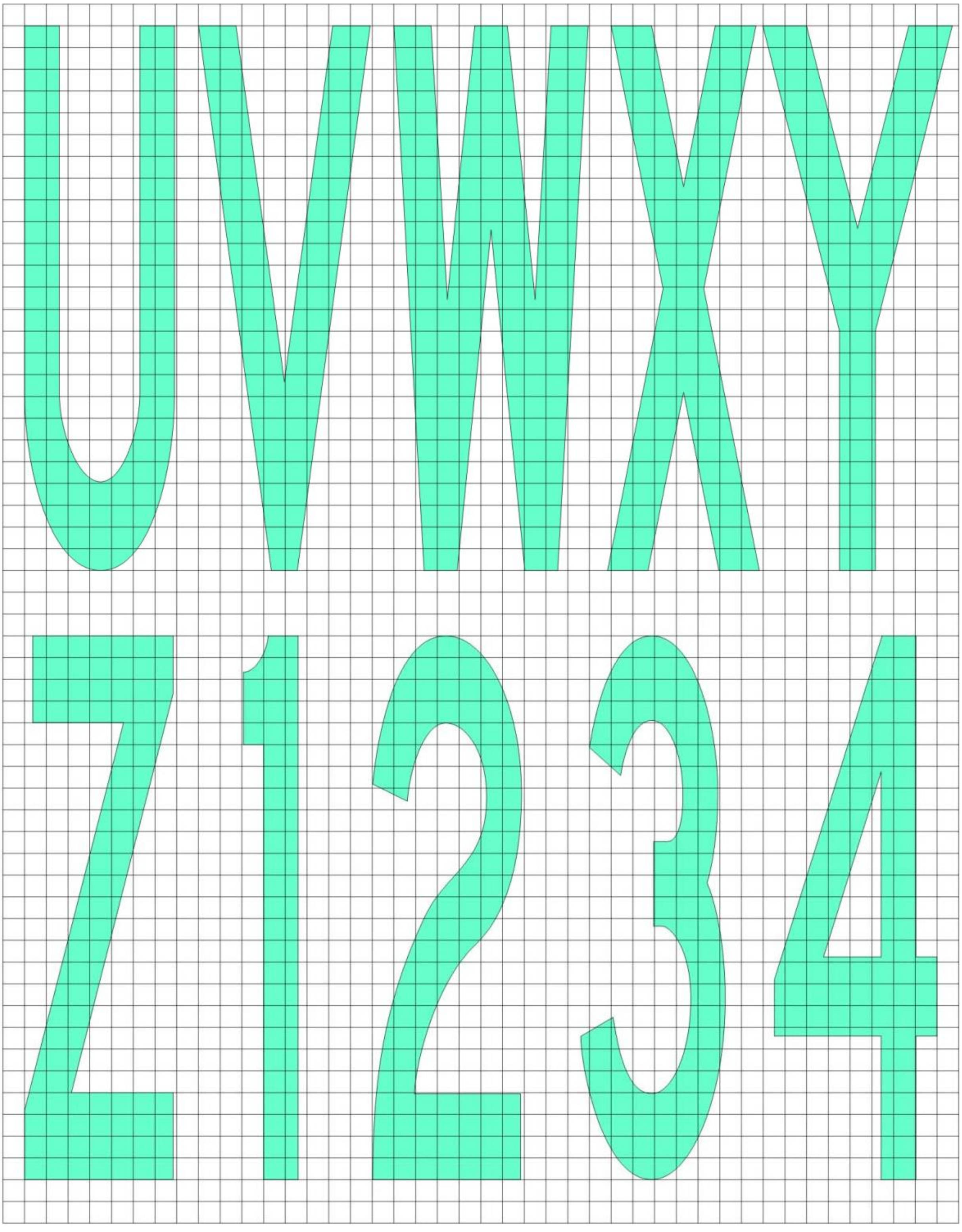
16.7 A NO ENTRY marking must consist of an inscription in white reading NO ENTRY on a red background.

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

16.9 The character height must be 4 m for inscriptions where the code letter is C, D, E or F, and 2 m where the code letter is A or B. The inscriptions must be in the form and proportions shown in fig 12.18:


ABCDE
FGHIJ

KLMNO
PQRST


UVWXY
Z1234

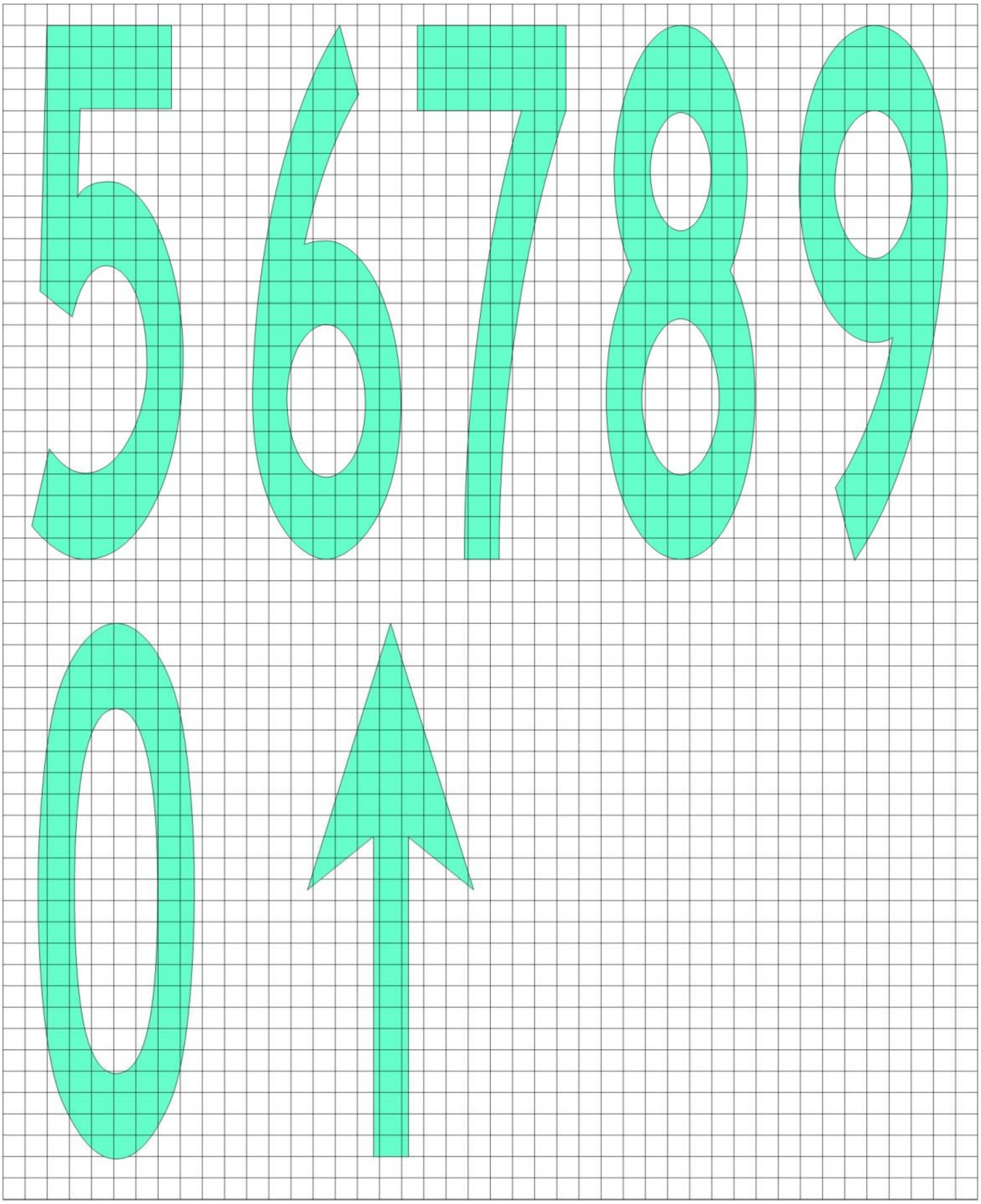


Figure 12. 18: Forms of characters

16.10 The background must be rectangular and extend a minimum of 0.5 m laterally and vertically beyond the extremities of the inscription

17. Information marking

17.1 Where an information sign would normally be installed and is impractical to install, as determined by the aerodrome operator, an information marking must be displayed on the surface of the pavement.

17.2 Where operationally required an information sign may be supplemented by an information marking.

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

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

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

17.6 An information marking must consist of:

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

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

17.7 Where there is insufficient contrast between the marking background and the pavement surface, the marking must include:

(a) a black border where the inscriptions are in black; and
(b) a yellow border where the inscriptions are in yellow.

17.8 The character height must be 4 m. The inscriptions must be in the form and proportions shown in *16.9*

139.12.7 Lights

1. General

1.1 *Lights which may endanger the safety of aircraft*

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

Compliance Note. See also NAMCARs Part 139.01.13.

1.2 *Laser emissions which may endanger the safety of aircraft*

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

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

Compliance Note 1. Figures 12.11, 12.12 and 12.13 may be used to determine the exposure levels and distances that adequately protect flight operations.

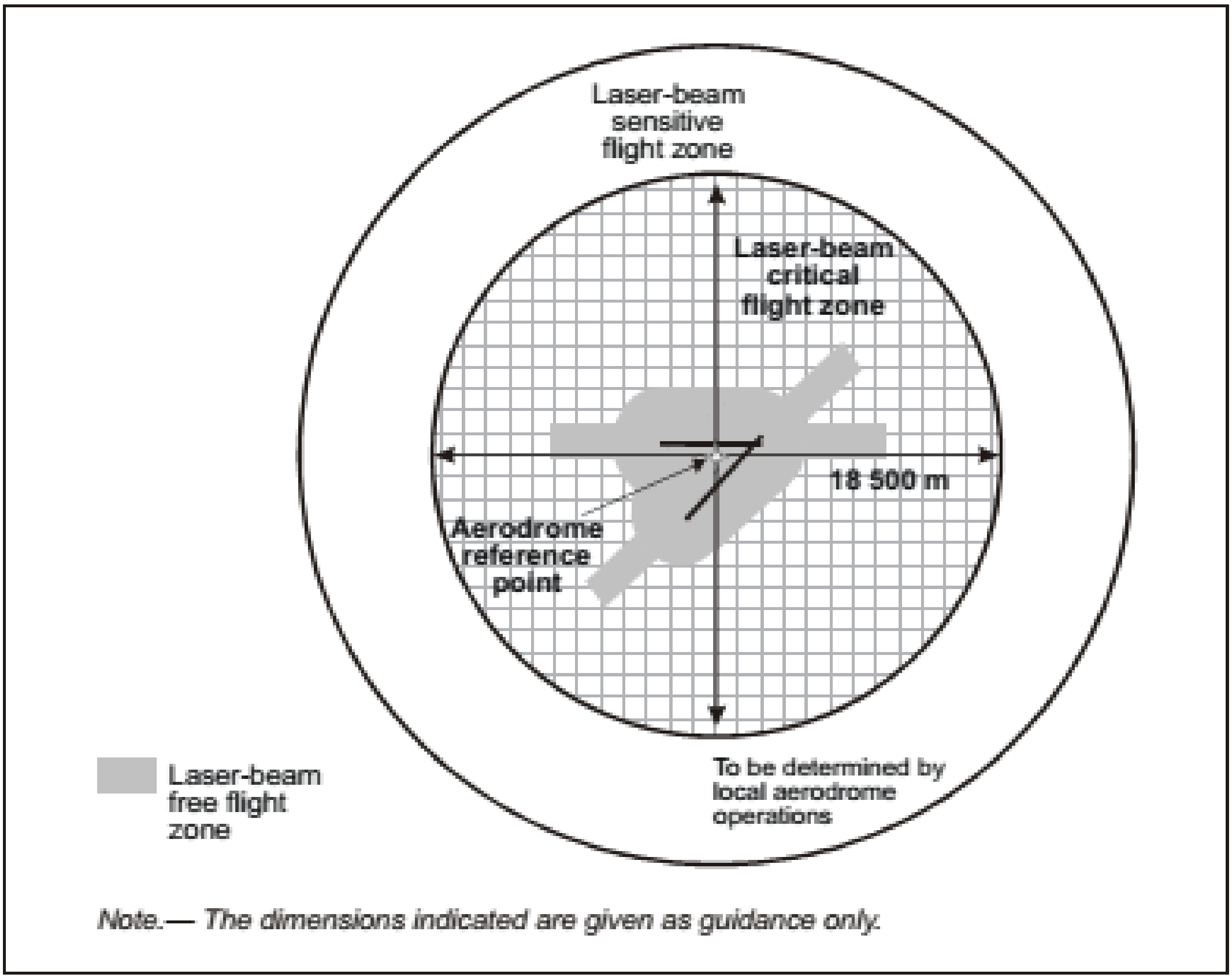


Figure 12. 19: Protected flight zones

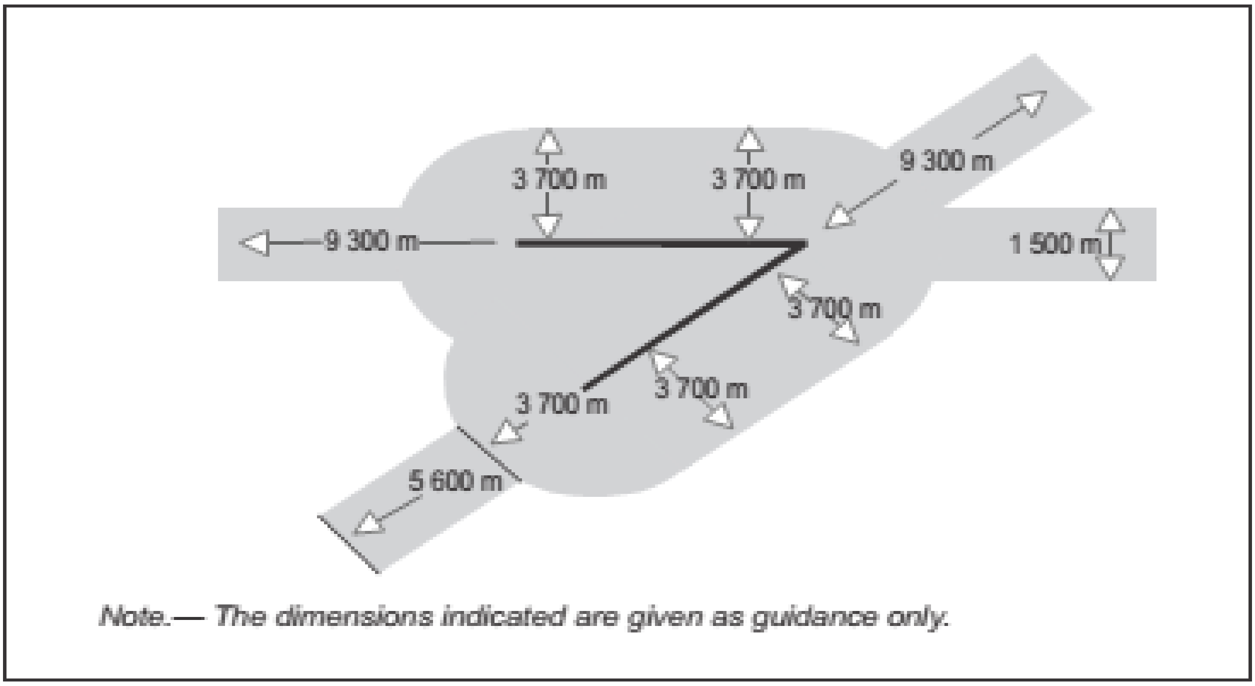


Figure 12. 20: Multiple runway laser-beam free flight zone

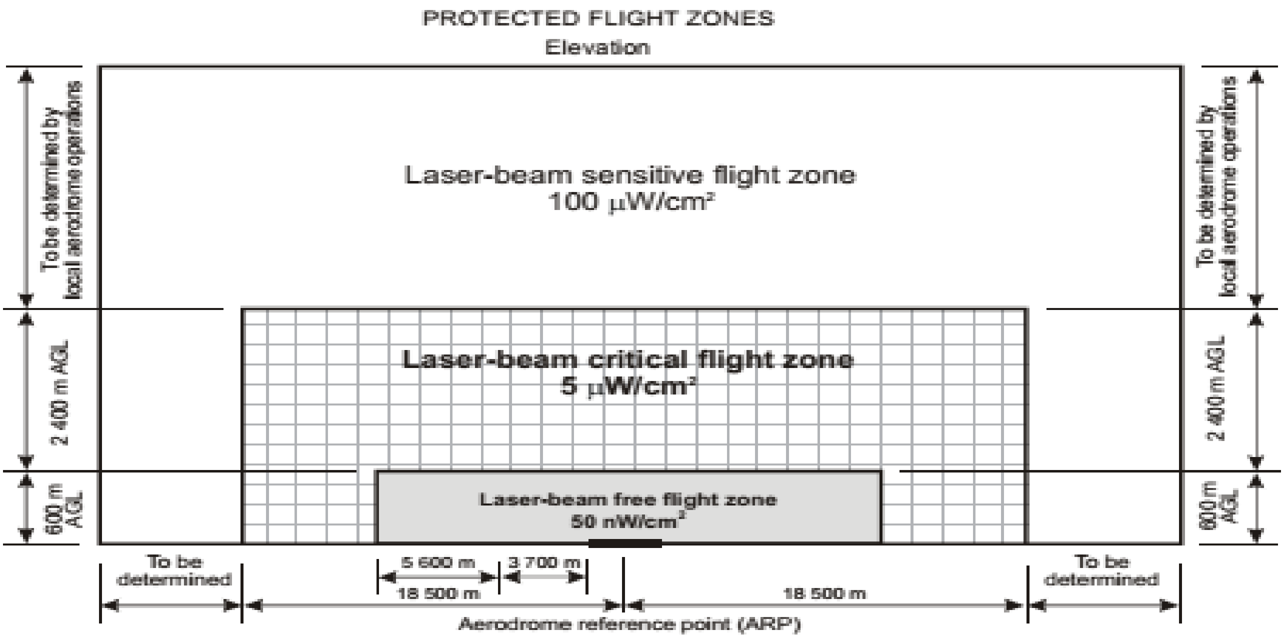


Figure 12. 21: *Protected flight zones with indication of maximum irradiance levels for visible laser beams*

Compliance Note 2. The restrictions on the use of laser beams in the three protected flight zones, LFFZ, LCFZ and LSFZ, refer to visible laser beams only. Laser emitters operated by the authorities in a manner compatible with flight safety are excluded. In all navigable airspace, the irradiance level of any laser beam, visible or invisible, is expected to be less than or equal to the maximum permissible exposure (MPE) unless such emission has been notified to the authority and permission obtained.

Compliance Note 3. The protected flight zones are established in order to mitigate the risk of operating laser emitters in the vicinity of aerodromes.

1.3 *Lights which may cause confusion*

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

(a) Instrument runway — code number 4:

within the areas before the threshold and beyond the end of the runway extending at least 4 500 m in length from the threshold and runway end and 750 m either side of the extended runway centre line in width.

(b) Instrument runway — code number 2 or 3:

as in (a), except that the length must be at least 3 000 m.

(c) Instrument runway — code number 1;

and non-instrument runway:

within the approach area.

1.4 *Aeronautical ground lights which may cause confusion to mariners*

Compliance Note. In the case of aeronautical ground lights near navigable waters, consideration needs to be given to ensuring that the lights do not cause confusion to mariners.

1.5 *Light fixtures and supporting structures*

1.6 *Elevated approach light*

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

(a) where the height of a supporting structure exceeds 12 m, the frangibility requirement must apply to the top 12 m only; and
(b) where a supporting structure is surrounded by non-frangible objects, only that part of the structure that extends above the surrounding objects must be frangible.

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

1.7 *Elevated lights*

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

1.8 *Surface lights*

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

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

1.9 *Light intensity and control*

Compliance Note. In dusk or poor visibility conditions by day, lighting can be more effective than marking. For lights to be effective in such conditions or in poor visibility by night, they must be of adequate intensity. To obtain the required intensity, it will usually be necessary to make the light directional, in which case the arcs over which the light shows will have to be adequate and so orientated as to meet the operational requirements. The runway lighting system will have to be considered as a whole, to ensure that the relative light intensities are suitably matched to the same end.

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

Compliance Note. While the lights of an approach lighting system may be of higher intensity than the runway lighting, it is good practice to avoid abrupt changes in intensity as these could give a pilot a false impression that the visibility is changing during approach.

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

- approach lighting system;
- runway edge lights;
- runway threshold lights;
- runway end lights;
- runway centre line lights;
- runway touchdown zone lights; and
- taxiway centre line lights.

1.9.3 On the perimeter of and within the ellipse defining the main beam, the maximum light intensity value must not be greater than three times the minimum light intensity value measured in accordance with Appendix 2, collective notes for Figures A2-1 toA2-11 and A2-26, Note 2.

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

2. Emergency lighting

2.1 At an aerodrome provided with runway lighting and without a secondary power supply, sufficient emergency lights must be conveniently available for installation on at least the primary runway in the event of failure of the normal lighting system.

Compliance Note. Emergency lighting may also be useful to mark obstacles or delineate taxiways and apron areas.

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

2.3 The colour of the emergency lights must conform to the colour requirements for runway lighting, except that, where the provision of coloured lights at the threshold and the runway end is not practicable, all lights may be variable white or as close to variable white as practicable

3. Aeronautical beacons

3.1 Where operationally necessary an aerodrome beacon or an identification beacon must be provided at each aerodrome intended for use at night.

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

3.3 *Aerodrome beacon*

3.3.1 Where operationally necessary an aerodrome beacon or an identification beacon must be provided at each aerodrome intended for use at night.

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

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

(a) aircraft navigate predominantly by visual means;
(b) reduced visibilities are frequent; or
(c) it is difficult to locate the aerodrome from the air due to surrounding lights or terrain.

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

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

3.3.6 The aerodrome beacon must show either coloured flashes alternating with white flashes, or white flashes only. The frequency of total flashes must be from 20 to 30 per minute. Where used, the coloured flashes emitted by beacons at land aerodromes must be green, and coloured flashes emitted by beacons at water aerodromes must be yellow. In the case of a combined water and land aerodrome, coloured flashes, if used, must have the colour characteristics of whichever section of the aerodrome is designated as the principal facility.

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

Compliance Note. At locations where a high ambient background lighting level cannot be avoided, the effective intensity of the flash may be required to be increased by a factor up to a value of 10.

3.8 *Identification beacon*

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

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

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

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

Compliance Note. At locations where a high ambient background lighting level cannot be avoided, the effective intensity of the flash may be required to be increased by a factor up to a value of 10.

3.8.5 An identification beacon must show flashing-green at a land aerodrome and flashing-yellow at a water aerodrome.

3.8.6 The identification characters must be transmitted in the International Morse Code.

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

4. Approach lighting systems

4.1 *Application*

A— Non-instrument runway

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

Compliance Note. A simple approach lighting system can also provide visual guidance by day.

B— Non-precision approach runway

Where physically practicable, a simple approach lighting system as specified in 4.2 below must be provided to serve a non-precision approach runway, except when the runway is used only in conditions of good visibility or sufficient guidance is provided by other visual aids.

Compliance Note. It is advisable to give consideration to the installation of a precision approach category I lighting system or to the addition of a runway lead-in lighting system.

C— Precision approach runway category I

Where physically practicable, a precision approach category I lighting system as specified in 4.3 below must be provided to serve a precision approach runway category I.

D— Precision approach runway categories II and III

A precision approach category II and III lighting system as specified in 4.4 below must be provided to serve a precision approach runway category II or III.

4.2 *Simple approach lighting system*

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

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

Note 1. Spacings for the crossbar lights between 1 m and 4 m are in use. Gaps on each side of the centre line may improve directional guidance when approaches are made with a lateral error, and facilitate the movement of rescue and firefighting vehicles.

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

4.2.4 If it is not physically possible to provide a centre line extending for a distance of 420 m from the threshold, it may be extended to 300 m so as to include the crossbar. If this is not possible, the centre line lights may be extended as far as practicable, and each centre line light must then consist of a barrette at least 3 m in length. Subject to the approach system having a crossbar at 300 m from the threshold, an additional crossbar may be provided at 150 m from the threshold.

4.2.5 The system must lie as nearly as practicable in the horizontal plane passing through the threshold, provided that:

(a) no object other than an ILS or MLS azimuth antenna must protrude through the plane of the approach lights within a distance of 60 m from the centre line of the system; and
(b) no light other than a light located within the central part of a crossbar or a centre line barrette (not their extremities) must be screened from an approaching aircraft.

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

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

(a) a single source; or
(b) a barrette at least 3 m in length.

Compliance Note 1. When the barrette as in b) is composed of lights approximating to point sources, a spacing of 1.5 m between adjacent lights in the barrette has been found satisfactory.

Compliance Note 2. It may be advisable to use barrettes 4 m in length if it is anticipated that the simple approach lighting system will be developed into a precision approach lighting system.

Compliance Note 3. At locations where identification of the simple approach lighting system is difficult at night due to surrounding lights, sequence flashing lights installed in the outer portion of the system may resolve this problem.

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

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

4.3 *Precision approach category I lighting system*

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

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

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

4.3.4 The system must lie as nearly as practicable in the horizontal plane passing through the threshold, provided that:

(a) no object other than an ILS or MLS azimuth antenna must protrude through the plane of the approach lights within a distance of 60 m from the centre line of the system; and
(b) no light other than a light located within the central part of a crossbar or a centre line barrette (not their extremities) must be screened from an approaching aircraft.

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

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

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

(b) a barrette.

4.3.6 Where the serviceability level of the approach lights specified as a maintenance objective in 10.5.10 can be demonstrated, each centre line light position may consist of either:

(a) a single light source; or

(b) a barrette.

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

4.3.8 If the centre line consists of barrettes as described in 4.3.5 b) or 4.3.6 b), each barrette may be supplemented by a flashing light, except where such lighting is considered unnecessary taking into account the characteristics of the system and the nature of the meteorological conditions.

4.3.9 Each flashing light as described in 4.3.8 must be flashed twice a second in sequence, beginning with the outermost light and progressing toward the threshold to the innermost light of the system. The design of the electrical circuit must be such that these lights can be operated independently of the other lights of the approach lighting system.

4.3.10 If the centre line consists of lights as described in 4.3.5 a) or 4.3.6 a) above, additional crossbars of lights to the crossbar provided at 300 m from the threshold must be provided at 150 m, 450 m, 600 m and 750 m from the threshold. The lights forming each crossbar must be as nearly as practicable in a horizontal straight line at right angles to, and bisected by, the line of the centre line lights. The lights must be spaced so as to produce a linear effect, except that gaps may be left on each side of the centre line. These gaps must be kept to a minimum to meet local requirements and each must not exceed 6 m.

4.3.11 Where the additional crossbars described in 4.3.10 above are incorporated in the system, the outer ends of the crossbars must lie on two straight lines that either are parallel to the line of the centre line lights or converge to meet the runway centre line 300 m from threshold.

4.3.12 The lights must be in accordance with the specifications of Appendix 2 to this Document NAM-CATS-AH, Figure A2-1. The flight path envelopes used in the design of these lights are given in Attachment A to this Document NAM-CATS-AH, Figure A- 6).

4.4 *Precision approach category II and III lighting system*

4.4.1 The approach lighting system must consist of a row of lights on the extended centre line of the runway, extending, wherever possible, over a distance of 900 m from the runway threshold. In addition, the system must have two side rows of lights, extending 270 m from the threshold, and two crossbars, one at 150 m and one at 300 m from the threshold, all as shown in Figure 12.22. Where the serviceability level of the approach lights specified as maintenance objectives in NAMCATs-AH subpart 139.17.6, can be demonstrated, the system may have two side rows of lights, extending 240 m from the threshold, and two crossbars, one at 150 m and one at 300 m from the threshold, all as shown in Figure 12.23.

Compliance Note. The length of 900 m is based on providing guidance for operations under category I, II and III conditions. Reduced lengths may support category II and III operations but may impose limitations on category I operations.

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

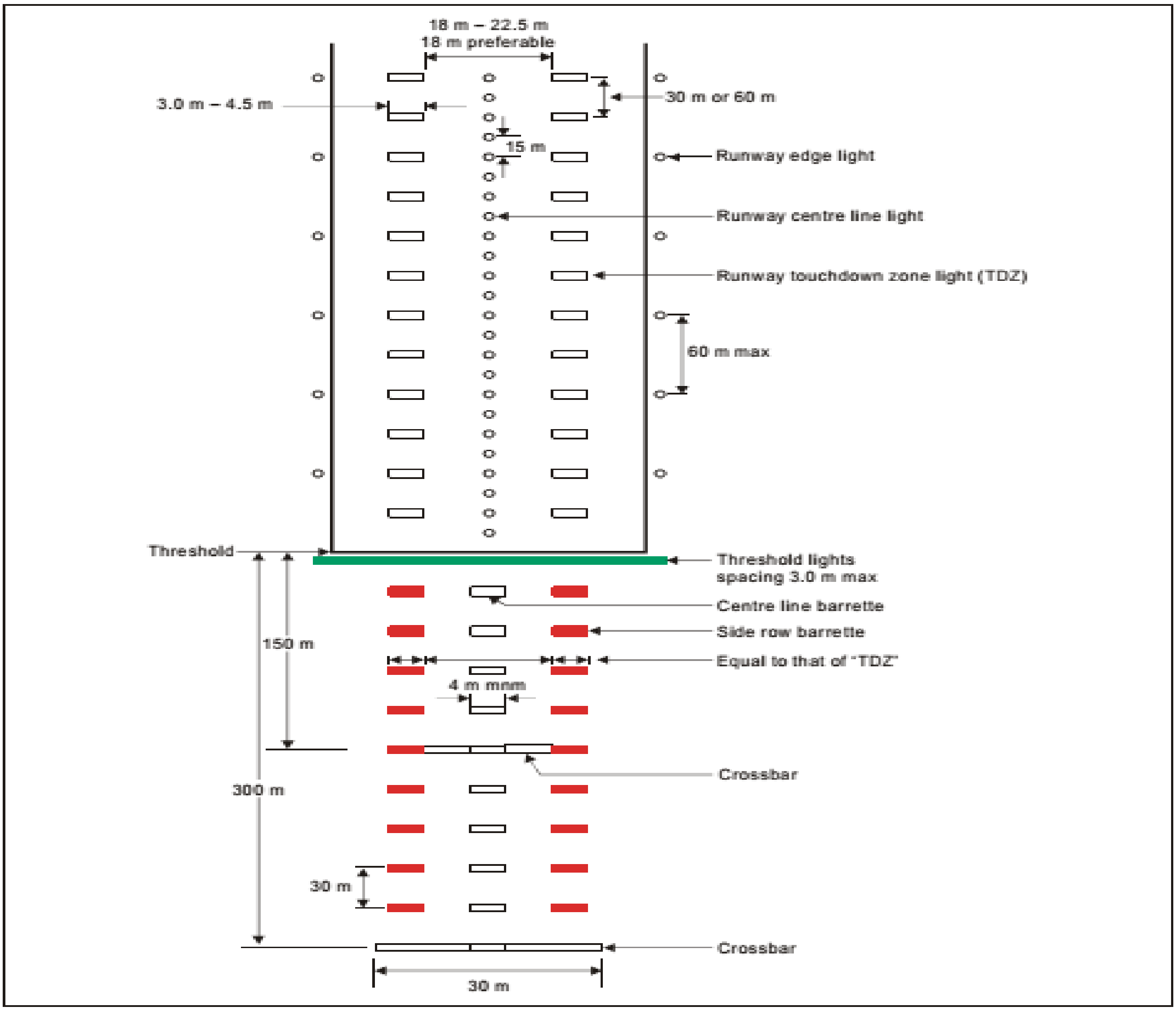


Figure 12. 22: Inner 300 m approach and runway lighting for precision approach runways, categories II and II

4.4.3 The lights forming the side rows must be placed on each side of the centre line, at a longitudinal spacing equal to that of the centre line lights and with the first light located 30 m from the threshold. Where the serviceability level of the approach lights specified as maintenance objectives in NAMCATs-AH subpart 139.17.6 can be demonstrated, lights forming the side rows may be placed on each side of the centre line, at a longitudinal spacing of 60 m with the first light located 60 m from the threshold. The lateral spacing (or gauge) between the innermost lights of the side rows must be not less than 18 m nor more than 22.5 m, and preferably 18 m, but in any event must be equal to that of the touchdown zone lights.

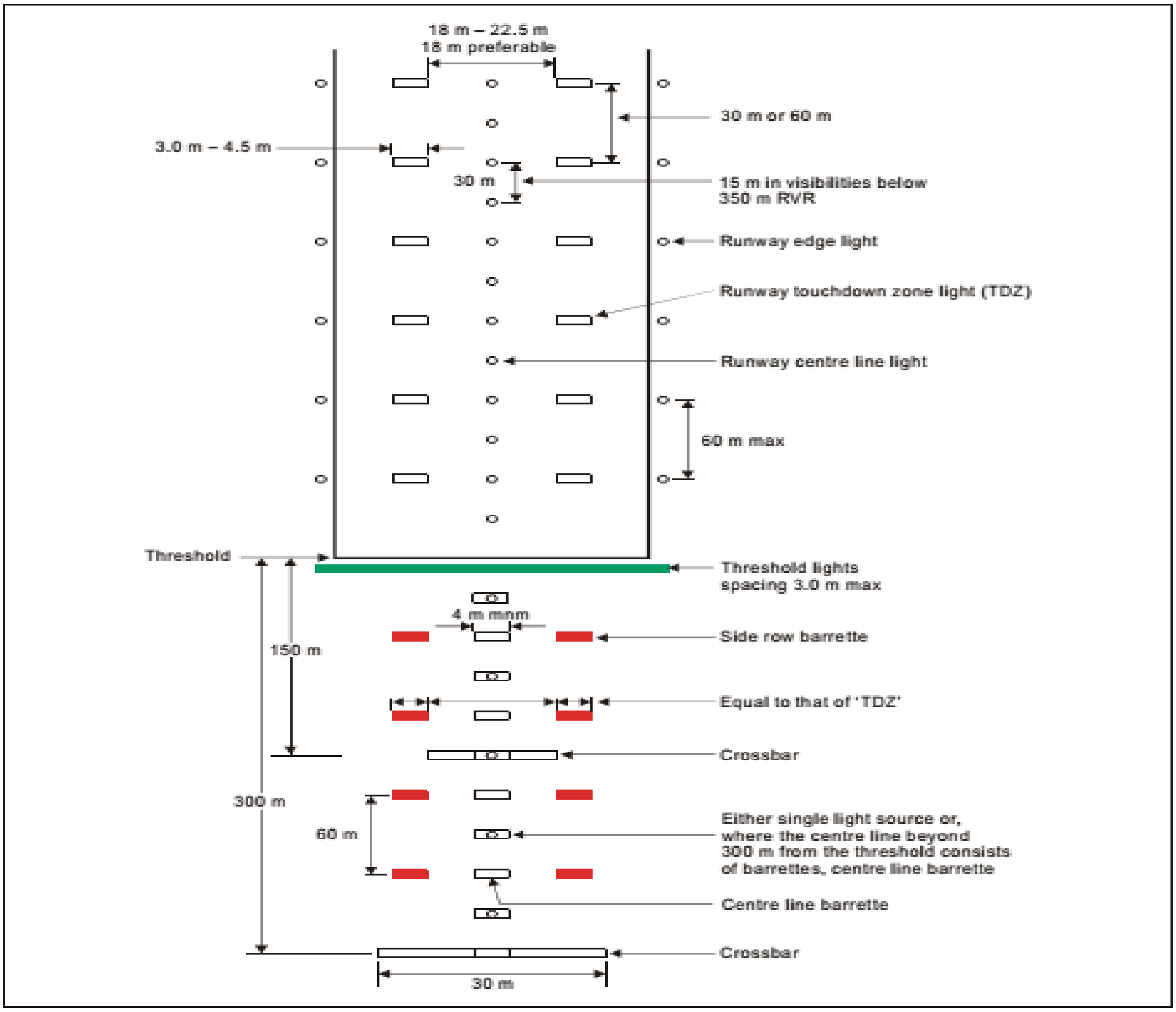


Figure 12. 23: Inner 300 m approach and runway lighting for precision approach runways,

categories II and III, where the serviceability levels of the lights specified as maintenance objectives in 139.17.6, sub-paragraph 1.7 can be demonstrated

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

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

4.4.6 If the centre line beyond a distance of 300 m from the threshold consists of lights as described in 4.4.10 (b) or 4.4.11 (b), additional crossbars of lights must be provided at 450 m, 600 m and 750 m from the threshold.

4.4.7 Where the additional crossbars described in 4.4.6 above are incorporated in the system, the outer ends of these crossbars must lie on two straight lines that either are parallel to the centre line or converge to meet the runway centre line 300 m from the threshold.

4.4.8 The system must lie as nearly as practicable in the horizontal plane passing through the threshold, provided that:

(a) no object other than an ILS or MLS azimuth antenna must protrude through the plane of the approach lights within a distance of 60 m from the centre line of the system; and
(b) no light other than a light located within the central part of a crossbar or a centre line barrette (not their extremities) must be screened from an approaching aircraft.

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

4.4.9 The centre line of a precision approach category II and III lighting system for the first 300 m from the threshold must consist of barrettes showing variable white, except that, where the threshold is displaced 300 m or more, the centre line may consist of single light sources showing variable white. Where the serviceability level of the approach lights specified as maintenance objectives in NAMCATs-AH subpart 139.17.6 can be demonstrated, the centre line of a precision approach category II and III lighting system for the first 300 m from the threshold may consist of either:

(a) barrettes, where the centre line beyond 300 m from the threshold consists of barrettes as described in 4.4.11 (a); or

(b) alternate single light sources and barrettes, where the centre line beyond 300 m from the threshold consists of single light sources as described in 4.4.11.(b), with the innermost single light source located 30 m and the innermost barrette located 60 m from the threshold; or

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

all of which must show variable white.

4.4.10 Beyond 300 m from the threshold each centre line light position must consist of either:

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

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

all of which must show variable white.

4.4.11 Where the serviceability level of the approach lights specified as maintenance objectives in NAMCATs-AH Subpart 139.17.6 can be demonstrated, beyond 300 m from the threshold each centre line light position may consist of either:

(a) a barrette; or

(b) a single light source;

all of which must show variable white.

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

4.4.13 If the centre line beyond 300 m from the threshold consists of barrettes as described in 4.4.10 (a) or 4.4.11 (a), each barrette beyond 300 m may be supplemented by a flashing light, except where such lighting is considered unnecessary taking into account the characteristics of the system and the nature of the meteorological conditions.

4.4.14 Each flashing light as described in 4.4.13 above must be flashed twice a second in sequence, beginning with the outermost light and progressing toward the threshold to the innermost light of the system. The design of the electrical circuit must be such that these lights can be operated independently of the other lights of the approach lighting system.

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

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

4.4.17 The intensity of the red lights must be compatible with the intensity of the white lights.

4.4.18 The lights must be in accordance with the specifications of Appendix 2 to this NAM-CATS-AH, Figures A2-1 and A2-2.

5. Visual approach slope indicator systems

5.1 *Application*

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

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

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

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

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

(c) the presence of objects in the approach area may involve serious hazard if an aeroplane descends below the normal approach path, particularly if there are no non-visual or other visual aids to give warning of such objects;

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

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

5.1.2 The standard visual approach slope indicator systems must consist of the following:

(a) T-VASIS and AT-VASIS conforming to the specifications contained in this section inclusive;

(b) PAPI and APAPI systems conforming to the specifications contained in this section; as shown in Figure 12.24.

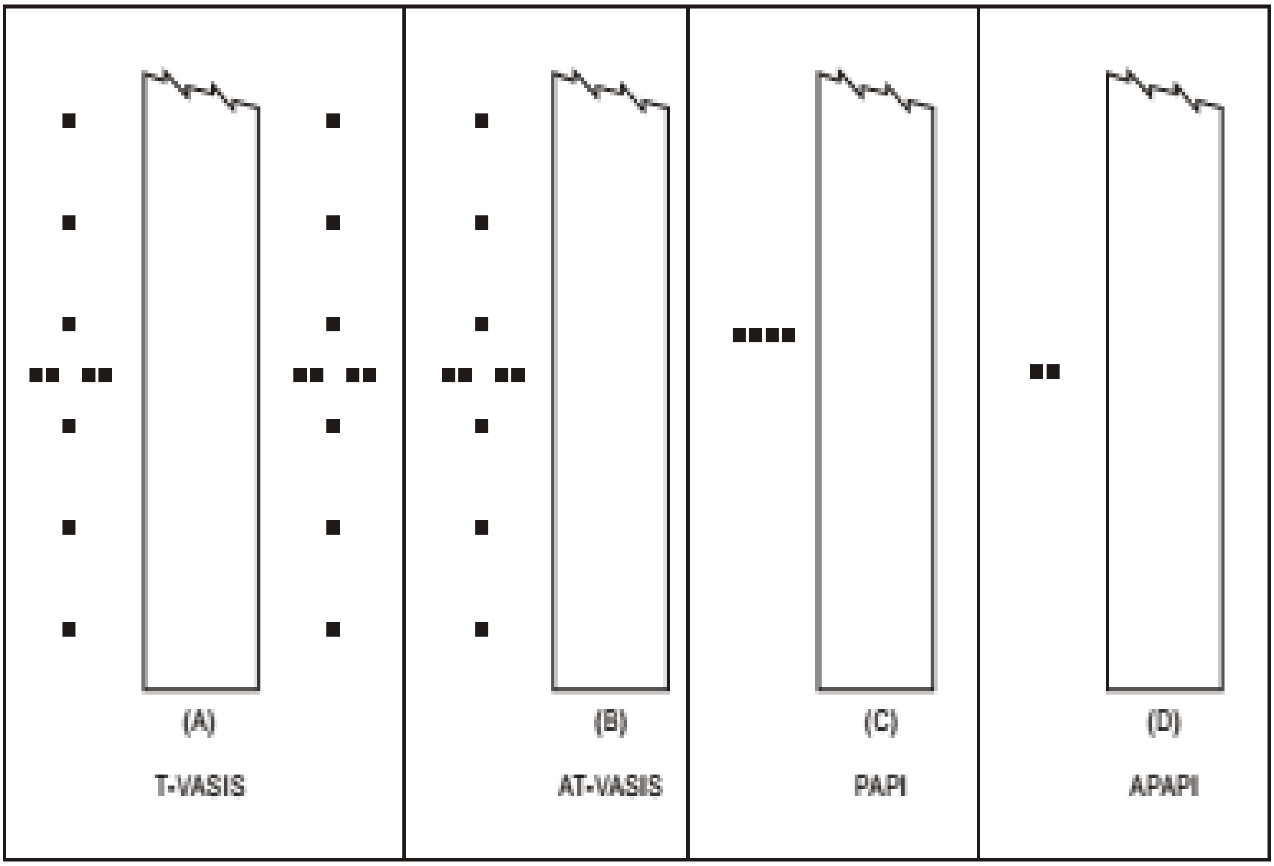


Figure 12. 24: Visual approach slope indicator systems

5.1.3 PAPI, T-VASIS or AT-VASIS must be provided where the code number is 3 or 4 when one or more of the conditions specified in 5.1.1 above exist.

5.1.4 As of 1 January 2020, the use of T-VASIS and AT-VASIS as standard visual approach slope indicator systems must be discontinued.

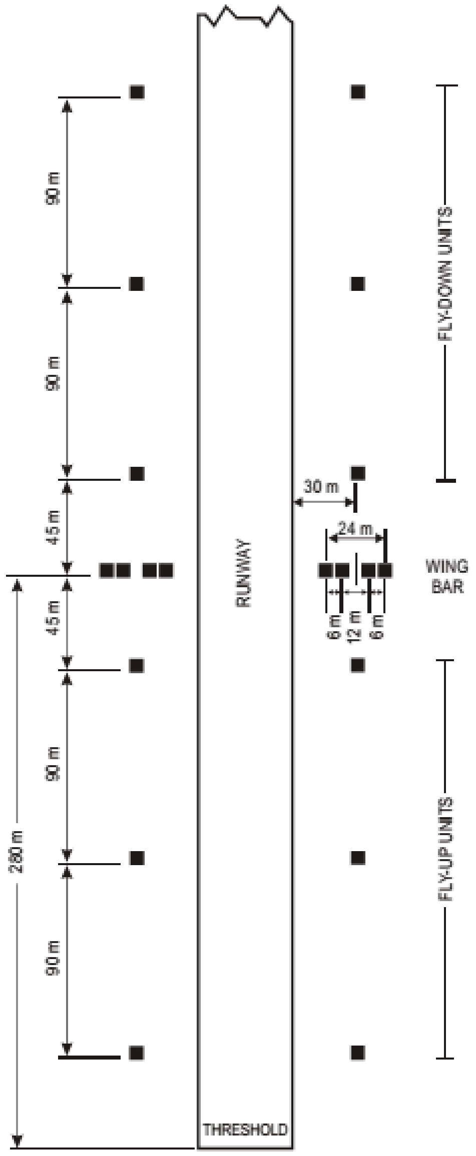
5.1.5 PAPI or APAPI must be provided where the code number is 1 or 2 when one or more of the conditions specified in 5.1.1 above exist.

5.1.6 Where a runway threshold is temporarily displaced from the normal position and one or more of the conditions specified in 5.1.1 exist, a PAPI may be provided except that where the code number is 1 or 2 an APAPI may be provided.

5.2 *T-VASIS and AT-VASIS*

5.2.1 The T-VASIS must consist of twenty light units symmetrically disposed about the runway centre line in the form of two wing bars of four light units each, with bisecting longitudinal lines of six lights, as shown in Figure 12.25.

	INSTALLATION TOLERANCES *The aerodrome operator may:* *a) vary the nominal eye height over the threshold of the on-slope signal between the limits of 12 m and 16 m, except in cases where a standard ILS glide path and/or MLS minimum glide path is available; the height over threshold should be varied to avoid any conflict between the visual approach slope indications and the usable portion of the ILS glide path and/or MLS minimum glide path indications;* *b) vary the longitudinal distance between individual light units or the overall length of the system by not more than 10 per cent;*



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

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

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

e) *where there is a transverse slope in the ground, adjust the longitudinal distance of two light units or two wing bars to compensate for the difference in level between them as necessary to meet the requirements of 5.2.11 below..*

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

a) *the selected approach slope;*
b) *the longitudinal slope of the runway; and*
c) *the selected nominal eye height over the threshold.*

Figure 12. 25: Siting of light units for T-VASIS (Edit figure)

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

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

(a) when above the approach slope, see the wing bar(s) white, and one, two or three fly-down lights, the more fly-down lights being visible the higher the pilot is above the approach slope;
(b) when on the approach slope, see the wing bar(s) white; and
(c) when below the approach slope, see the wing bar(s) and one, two or three fly-up lights white, the more fly-up lights being visible the lower the pilot is below the approach slope; and when well below the approach slope, see the wing bar(s) and the three fly-up lights red.

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

5.2.4 The light units must be located as shown in Figure 12.25, subject to the installation tolerances given therein.

Compliance Note. The siting of T-VASIS will provide, for a 3° slope and a nominal eye height over the threshold of 15 m (see 5.2.1 and 5.3.2), a pilot's eye height over threshold of 13 m to 17 m when only the wing bar lights are visible. If increased eye height at the threshold is required (to provide adequate wheel clearance), then the approaches may be flown with one or more fly-down lights visible. The pilot's eye height over the threshold is then of the following order:

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

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

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

5.2.5 The systems must be suitable for both day and night operations.

5.2.6 The light distribution of the beam of each light unit must be of fan shape showing over a wide arc in azimuth in the approach direction. The wing bar light units must produce a beam of white light from 1°54’ vertical angle up to 6° vertical angle and a beam of red light from 0° to 1°54’ vertical angle. The fly-down light units must produce a white beam extending from an elevation of 6° down to approximately the approach slope, where it must have a sharp cut-off. The fly-up light units must produce a white beam from approximately the approach slope down to 1°54’ vertical angle and a red beam below a 1°54’ vertical angle. The angle of the top of the red beam in the wing bar units and fly-up units may be increased to comply with 5.3.4.

5.2.7 The light intensity distribution of the fly-down, wing bar and fly-up light units must be as shown in Appendix 2 of this Document NAM-CATS-AH, Volume I, Figure A2-22.

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

5.2.9 At full intensity the red light must have a Y coordinate not exceeding 0.320.

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

5.2.11 The light units forming the wing bars, or the light units forming a fly-down or a fly-up matched pair, must be mounted so as to appear to the pilot of an approaching aeroplane to be substantially in a horizontal line. The light units must be mounted as low as possible and must be frangible.

5.2.12 The light units must be so designed that deposits of condensation, dirt, etc., on optically transmitting or reflecting surfaces must interfere to the least possible extent with the light signals and must in no way affect the elevation of the beams or the contrast between the red and white signals. The construction of the light units must be such as to minimize the probability of the slots being wholly or partially blocked by snow or ice where these conditions are likely to be encountered.

5.3 *Approach slope and elevation setting of light beams*

5.3.1 The approach slope must be appropriate for use by the aeroplanes using the approach.

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

5.3.3 The elevation of the beams of the wing bar light units on both sides of the runway must be the same. The elevation of the top of the beam of the fly-up light unit nearest to each wing bar, and that of the bottom of the beam of the fly down light unit nearest to each wing bar, must be equal and must correspond to the approach slope. The cut-off angle of the top of the beams of successive fly-up light units must decrease by 5’ of arc in angle of elevation at each successive unit away from the wing bar. The cut-in angle of the bottom of the beam of the fly-down light units must increase by 7’ of arc at each successive unit away from the wing bar (see Figure 12.26).

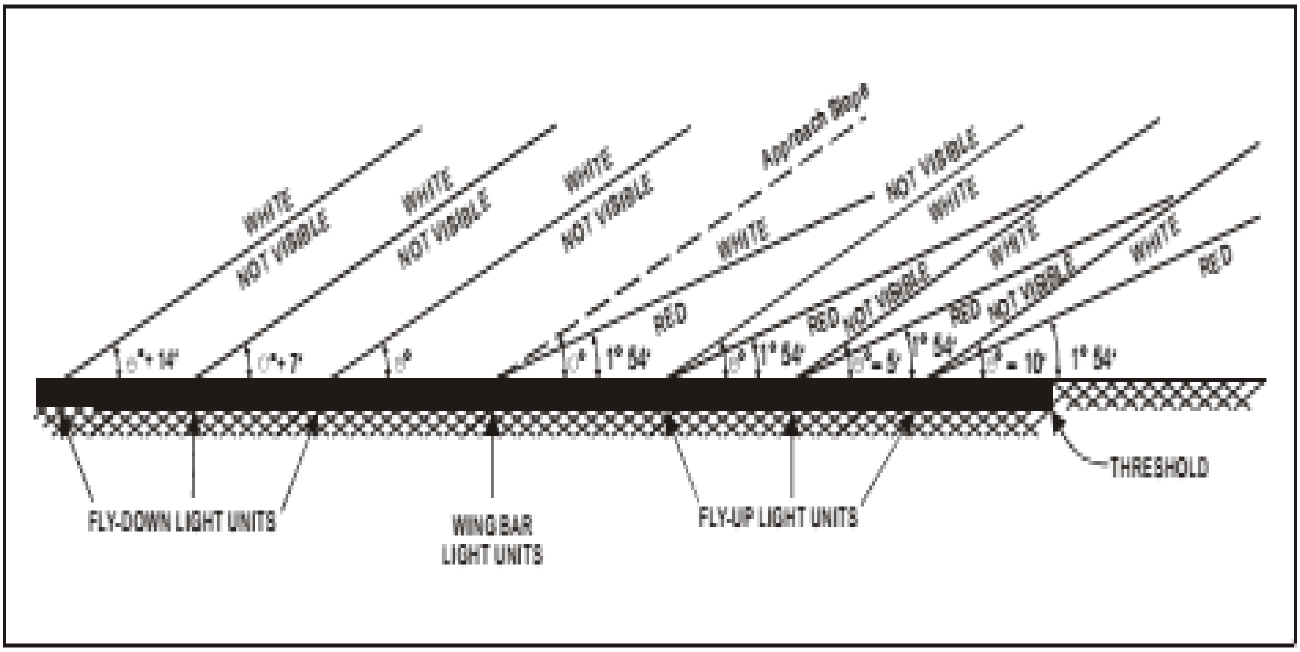


Figure 12. 26: Light beams and elevation settings of T-VASIS and AT-VASIS

5.3.4 The elevation setting of the top of the red light beams of the wing bar and fly-up light units must be such that, during an approach, the pilot of an aeroplane to whom the wing bar and three fly-up light units are visible would clear all objects in the approach area by a safe margin if any such light did not appear red.

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

5.4 *PAPI and APAPI*

Description

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

Compliance Note. Where a runway is used by aircraft requiring visual roll guidance which is not provided by other external means, then a second wing bar may be provided on the opposite side of the runway.

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

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

(a) when on or close to the approach slope, see the two units nearest the runway as red and the two units farthest from the runway as white;

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

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

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

(a) when on or close to the approach slope, see the unit nearer the runway as red and the unit farther from the runway as white;
(b) when above the approach slope, see both the units as white; and
(c) when below the approach slope, see both the units as red.

Siting

5.4.5 The light units must be located as in the basic configuration illustrated in Figure 5-19, subject to the installation tolerances given therein. The units forming a wing bar must be mounted so as to appear to the pilot of an approaching aeroplane to be substantially in a horizontal line. The light units must be mounted as low as possible and must be frangible.

Characteristics of the light unit

5.4.6 The system must be suitable for both day and night operations.

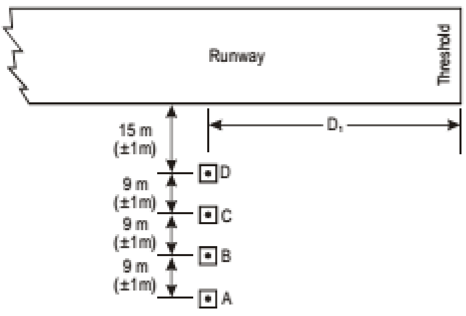
5.4.7 The colour transition from red to white in the vertical plane must be such as to appear to an observer, at a distance of not less than 300 m, to occur within a vertical angle of not more than 3’.

5.4.8 At full intensity the red light must have a Y coordinate not exceeding 0.320.

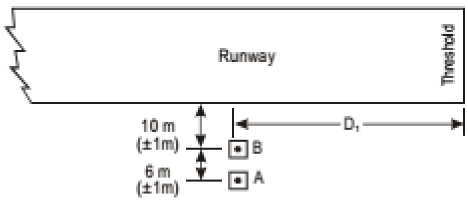
5.4.9 The light intensity distribution of the light units must be as shown in Appendix 2 to NAM-CATS-AH, Figure A2-23.

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

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



Typical PAPI wing bar



Typical APAPI wing bar

INSTALLATION TOLERANCES

(a) Where a PAPI or APAPI is installed on a runway not equipped with an ILS or MLS, the distance D1 must be calculated to ensure that the lowest height at which a pilot will see a correct approach path indication (Figure 5-20, angle B for a PAPI and angle A for an APAPI) provides the wheel clearance over the threshold specified in Table 5-2 for the most demanding amongst aeroplanes regularly using the runway.

(b) Where a PAPI or APAPI is installed on a runway equipped with an ILS and/or MLS, the distance D1 must 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 must 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 must be such that in no case will the wheel clearance over the threshold be lower than that specified in column (3) of Table 5-2.

(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 must 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 must be used on code numbers 1 and 2. In such an event, the inner PAPI unit must 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 must be located 15 m (±1 m) from the runway edge.

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Figure 12. 27: Siting of PAPI and APAPI

5.4.12 The light units must be so designed to ensure that deposits of dirt, etc., on optically transmitting or reflecting surfaces do not, as far as possible, interfere with the light signals and do not affect the contrast between the red and white signals and the elevation of the transition sector.

5.5 *Approach slope and elevation setting of light units*

5.5.1 The approach slope as defined in Figure 12.28 must be appropriate for use by the aeroplanes using the approach.

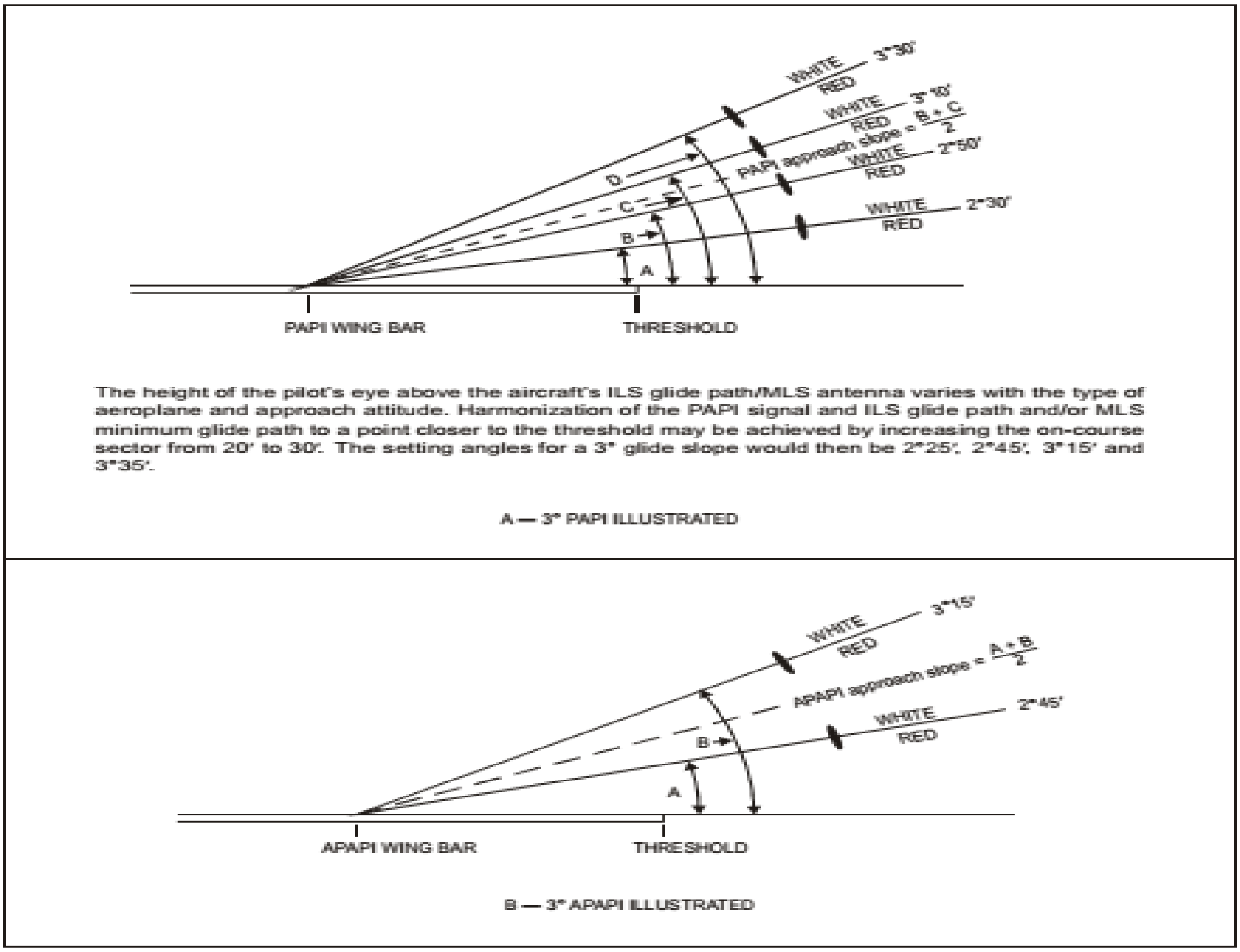


Figure 12. 28: Light beams and angle of elevation setting of PAPI and APAPI

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

5.5.3 The angle of elevation settings of the light units in a PAPI wing bar must be such that, during an approach, the pilot of an aeroplane observing a signal of one white and three reds will clear all objects in the approach area by a safe margin (see Table 12.2).

Table 12. 2: Wheel clearance over threshold for PAPI and APAPI

Eye-to-wheel height of aeroplane in the approach configuration[a] (1)	Desired wheel clearance (metres)[b], (2)	Minimum wheel clearance (metres)[d] (3)
up to but not including 3 m 6	6	3[c]
3 m up to but not including 5 m	9	4
5 m up to but not including 8 m	9	5
8 m up to but not including 14 m	9	6

a. In selecting the eye-to-wheel height group, only aeroplanes meant to use the system on a regular basis must be considered. The most demanding amongst such aeroplanes must determine the eye-to-wheel height group.
b. Where practicable the desired wheel clearances shown in column (2) must be provided.
c. The wheel clearances in column (2) may be reduced to no less than those in column(3) where an aeronautical study indicates that such reduced wheel clearances are acceptable.
d. When a reduced wheel clearance is provided at a displaced threshold it must be ensured that the corresponding desired wheel clearance specified in column (2) will be available when an aeroplane at the top end of the eye-to-wheel height group chosen overflies the extremity of the runway.
e. This wheel clearance may be reduced to 1.5 m on runways used mainly by light-weight non-turbojet aeroplanes.

5.5.4 The angle of elevation settings of the light units in an APAPI wing bar must be such that, during an approach, the pilot of an aeroplane observing the lowest on slope signal, i.e. one white and one red, will clear all objects in the approach area by a safe margin (see Table 12.2).

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

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

5.6 *Obstacle protection surface*

Compliance Note. The following specifications apply to T-VASIS, AT-VASIS, PAPI and APAPI.

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

5.6.2 The characteristics of the obstacle protection surface, i.e. origin, divergence, length and slope, must correspond to those specified in the relevant column of Table 5-3 and in Figure 5-21.

5.6.3 New objects or extensions of existing objects must not be permitted above an obstacle protection surface except when, in the opinion of the Executive Director, the new object or extension would be shielded by an existing immovable object.

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

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

(a) remove the object;
(b) suitably raise the approach slope of the system;
(c) reduce the azimuth spread of the system so that the object is outside the confines of the beam;
(d) displace the axis of the system and its associated obstacle protection surface by no more than 5°; and
(e) suitably displace the system upwind of the threshold such that the object no longer penetrates the OPS.

Table 12. 3: Dimensions and slopes of the obstacle protection surface

	Runway type/code number							
	Non-instrument Code number				Instrument Code number			
Surface dimensions	1	2	3	4	1	2	3	4

Length of inner edge	60m	80m[a]	150m	150m	150m	150m	300m	300m
Distance from the visual approach slope indicator system	D_1+30m	D_1+60m	D_1+60 m	D_1+60 m	D_1+60m	D_1+60m	D_1+60 m	D_1+60 m
Divergence (each side)	10%	10%	10%	10%	15%	15%	15%	15%
Total length	7500m	7500m	15000m	15000m	7500m	7500m	15000m	15000m
Slope								
a) T-VASIS and AT-VASIS	– [c]	1.9º	1.9º	1.9º	-	1.9º	1.9º	1.9º
b) PAPI [d]	-	A–0.57°	A–0.57°	A–0.57°	A–0.57°	A–0.57°	A–0.57°	A–0.57°
c) APAPI [d]	A–0.9°	A–0.9°	-	-	A–0.9°	A–0.9°	-	-

a. This length is to be increased to 150 m for a T-VASIS or AT-VASIS.
b. This length is to be increased to 15 000 m for a T-VASIS or AT-VASIS.
c. No slope has been specified if a system is unlikely to be used on runway type/code number indicated.
d. Angles as indicated in Figure 5-20.
e. D1is the distance of the visual approach slope indicator system from threshold prior to any displacement to remedy object penetration of the OPS (refer Figure 5-19). The start of the OPS is fixed to the visual approach slope indicator system location, such that displacement of the PAPI results in an equal displacement of the start of the OPS.

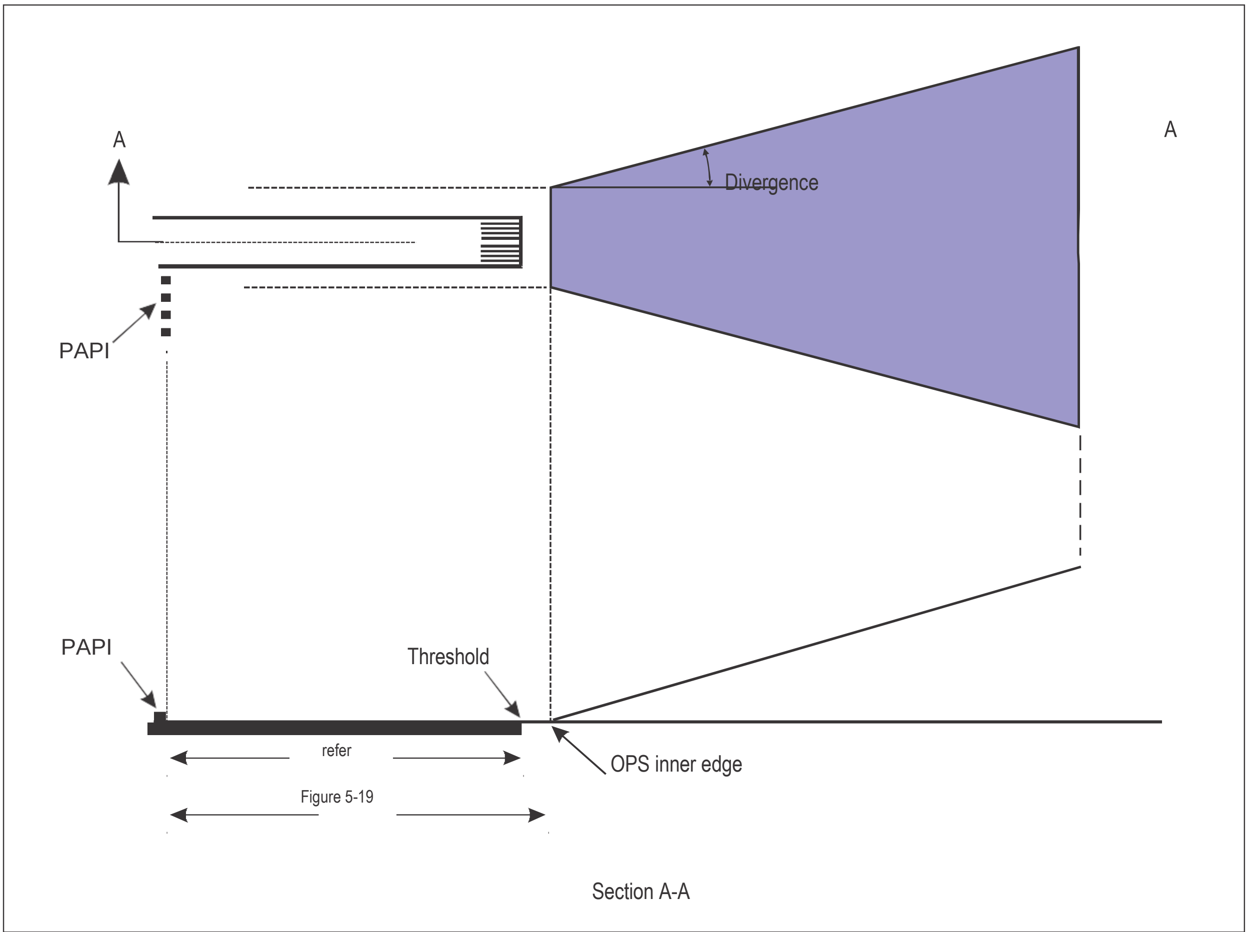


Figure 12. 29: Obstacle protection surface for visual approach slope indicator systems

6. Circling guidance lights

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

6.2 The location and number of circling guidance lights must be adequate to enable a pilot, as appropriate, to:

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

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

6.3 Circling guidance lights must consist of:

(a) lights indicating the extended centre line of the runway and/or parts of any approach lighting system; or

(b) lights indicating the position of the runway threshold; or

(c) lights indicating the direction or location of the runway;

or a combination of such lights as is appropriate to the runway under consideration.

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

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

7. Runway lead-in lighting systems

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

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

7.3 A runway lead-in lighting system must extend from a point as determined by the aerodrome operator, up to a point where the approach lighting system, if provided, or the runway or the runway lighting system is in view.

7.4 Each group of lights of a runway lead-in lighting system must consist of at least three flashing lights in a linear or cluster configuration. The system may be augmented by steady burning lights where such lights would assist in identifying the system.

7.5 The flashing lights and the steady burning lights must be white.

7.6 Where practicable, the flashing lights in each group must flash in sequence towards the runway.

8. Runway threshold identification lights

8.1 Runway threshold identification lights may be installed:

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

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

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

8.3 Runway threshold identification lights must be flashing white lights with a flash frequency between 60 and 120 per minute.

8.4 The lights must be visible only in the direction of approach to the runway.

9. Runway edge lights

9.1 Runway edge lights must be provided for a runway intended for use at night or for a precision approach runway intended for use by day or night.

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

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

9.4 Runway edge lights must be placed along the edges of the area declared for use as the runway or outside the edges of the area at a distance of not more than 3 m.

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

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

9.7 Runway edge lights must be fixed lights showing variable white, except that:

(a) in the case of a displaced threshold, the lights between the beginning of the runway and the displaced threshold must show red in the approach direction; and
(b) a section of the lights 600 m or one-third of the runway length, whichever is the less, at the remote end of the runway from the end at which the take-off run is started, may show yellow.

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

9.9 In all angles of azimuth required in 9.8 above, runway edge lights must show at angles up to 15° above the horizontal with an intensity adequate for the conditions of visibility and ambient light in which use of the runway for take-off or landing is intended. In any case, the intensity must be at least 50 cd except that at an aerodrome without extraneous lighting, the intensity of the lights may be reduced to not less than 25 cd to avoid dazzling the pilot.

9.10 Runway edge lights on a precision approach runway must be in accordance with the specifications of Appendix 2 to this NAM-CATS-AH, Figure A2-9 or A2-10.

10. Runway threshold and wing bar lights (see Figure 12.30)

Application of runway threshold lights

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

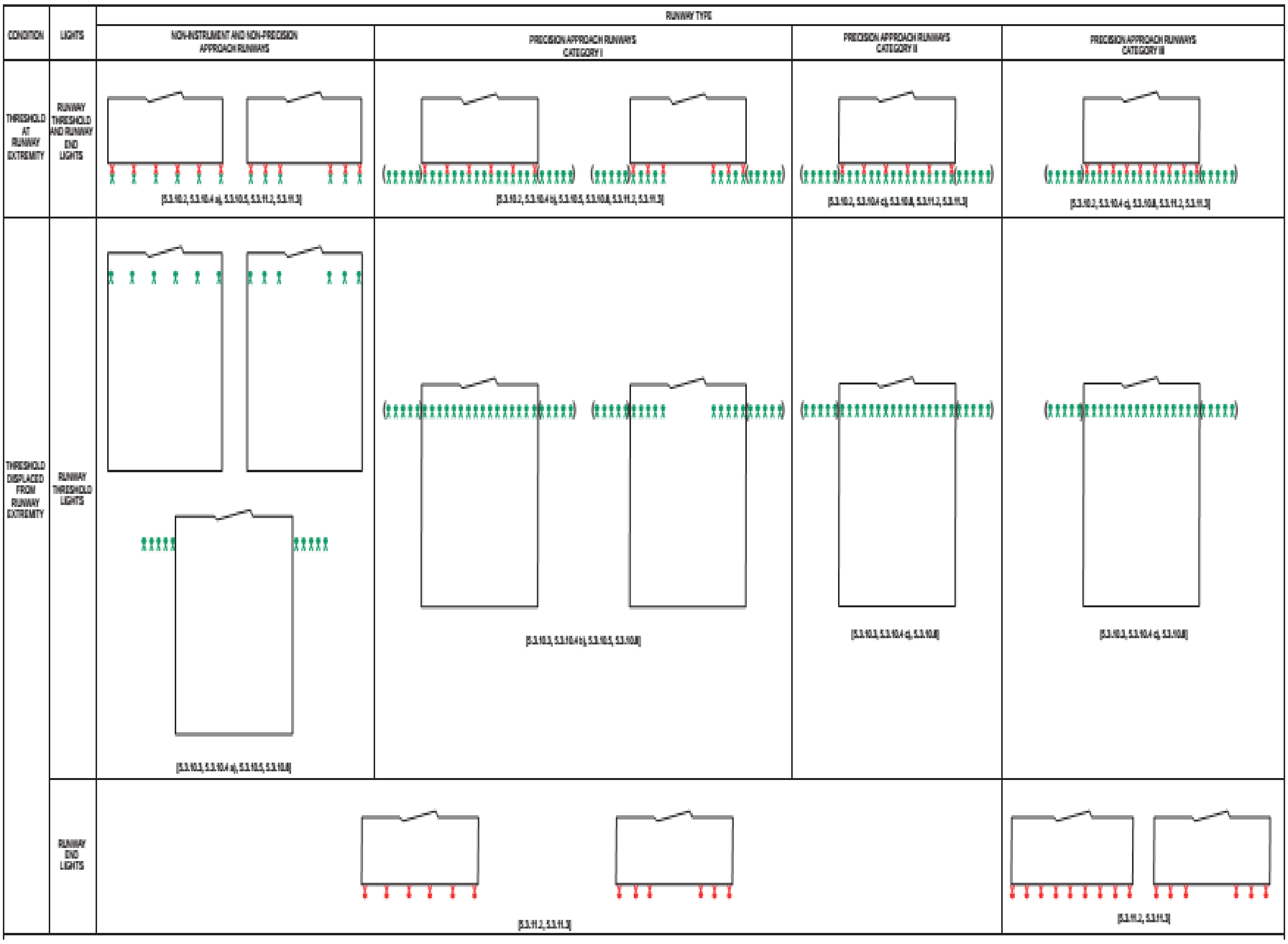
Location of runway threshold light

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

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

10.4 Threshold lighting must consist of:

(a) on a non-instrument or non-precision approach runway, at least six lights;
(b) on a precision approach runway category I, at least the number of lights that would be required if the lights were uniformly spaced at intervals of 3 m between the rows of runway edge lights; and
(c) on a precision approach runway category II or III, lights uniformly spaced between the rows of runway edge lights at intervals of not more than 3 m.



<u>LEGEND</u>

UNDIRECTIONAL LIGHT

DIRECTIONAL LIGHT

( ) CONDITIONAL RECOMMENDATION

Figure 12. 30: Arrangement of runway threshold and runway end lights

Compliance Note. The minimum number of lights are shown for a runway 45 m wide with runway edge lights installed at the edge.

10.5 The lights prescribed in 10.4 (a) and (b) may be either:

(a) equally spaced between the rows of runway edge lights; or

(b) symmetrically disposed about the runway centre line in two groups, with the lights uniformly spaced in each group and with a gap between the groups equal to the gauge of the touchdown zone marking or lighting, where such is provided, or otherwise not more than half the distance between the rows of runway edge lights.

Application of wing bar lights

10.6 Wing bar lights may be provided on a precision approach runway when additional conspicuity is considered desirable.

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

Location of wing bar lights

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

Characteristics of runway threshold and wing bar lights

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

10.10 Runway threshold lights on a precision approach runway must be in accordance with the specifications of Appendix 2 to this Document NAM-CATS-AH, Figure A2-3.

10.11 Threshold wing bar lights on a precision approach runway must be in accordance with the specifications of Appendix 2 to this Document NAM-CATS-AH, Figure A2-4.

11. Runway end lights (see Figure 12.30)

11.1 Runway end lights must be provided for a runway equipped with runway edge lights.

Compliance Note. When the threshold is at the runway extremity, fittings serving as threshold lights may be used as runway end lights.

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

11.3 Runway end lighting must consist of at least six lights. The lights may be either:

(a) equally spaced between the rows of runway edge lights; or

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

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

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

11.5 Runway end lights on a precision approach runway must be in accordance with the specifications of Appendix 2 to this Document NAM-CATS-AH, Figure A2-8.

12. Runway centre line lights

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

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

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

12.4 Runway centre line lights may be provided on a runway intended to be used for takeoff with an operating minimum of an RVR of the order of 400 m or higher when used by aeroplanes with a very high take-off speed, particularly where the width between the runway edge lights is greater than 50 m.

12.5 Runway centre line lights must be located along the centre line of the runway, except that the lights may be uniformly offset to the same side of the runway centre line by not more than 60 cm where it is not practicable to locate them along the centre line. The lights must be located from the threshold to the end at longitudinal spacing of approximately 15 m. Where the serviceability level of the runway centre line lights specified as maintenance objectives in NAMCARs-AH part 139.17.6 can be demonstrated and the runway is intended for use in runway visual range conditions of 350 m or greater, the longitudinal spacing may be approximately 30 m.

Compliance Note. Existing centre line lighting where lights are spaced at 7.5 m need not be replaced.

12.6 Centre line guidance for take-off from the beginning of a runway to a displaced threshold may be provided by:

(a) an approach lighting system if its characteristics and intensity settings afford the guidance required during take-off and it does not dazzle the pilot of an aircraft taking off; or
(b) runway centre line lights; or
(c) barrettes of at least 3 m in length and spaced at uniform intervals of 30 m, as shown in Figure 12.31, designed so that their photometric characteristics and intensity setting afford the guidance required during take-off without dazzling the pilot of an aircraft taking off.

Where necessary, provision may be made to extinguish those centre line lights specified in b) or reset the intensity of the approach lighting system or barrettes when the runway is being used for landing. In no case must only the single source runway centre line lights show from the beginning of the runway to a displaced threshold when the runway is being used for landing.

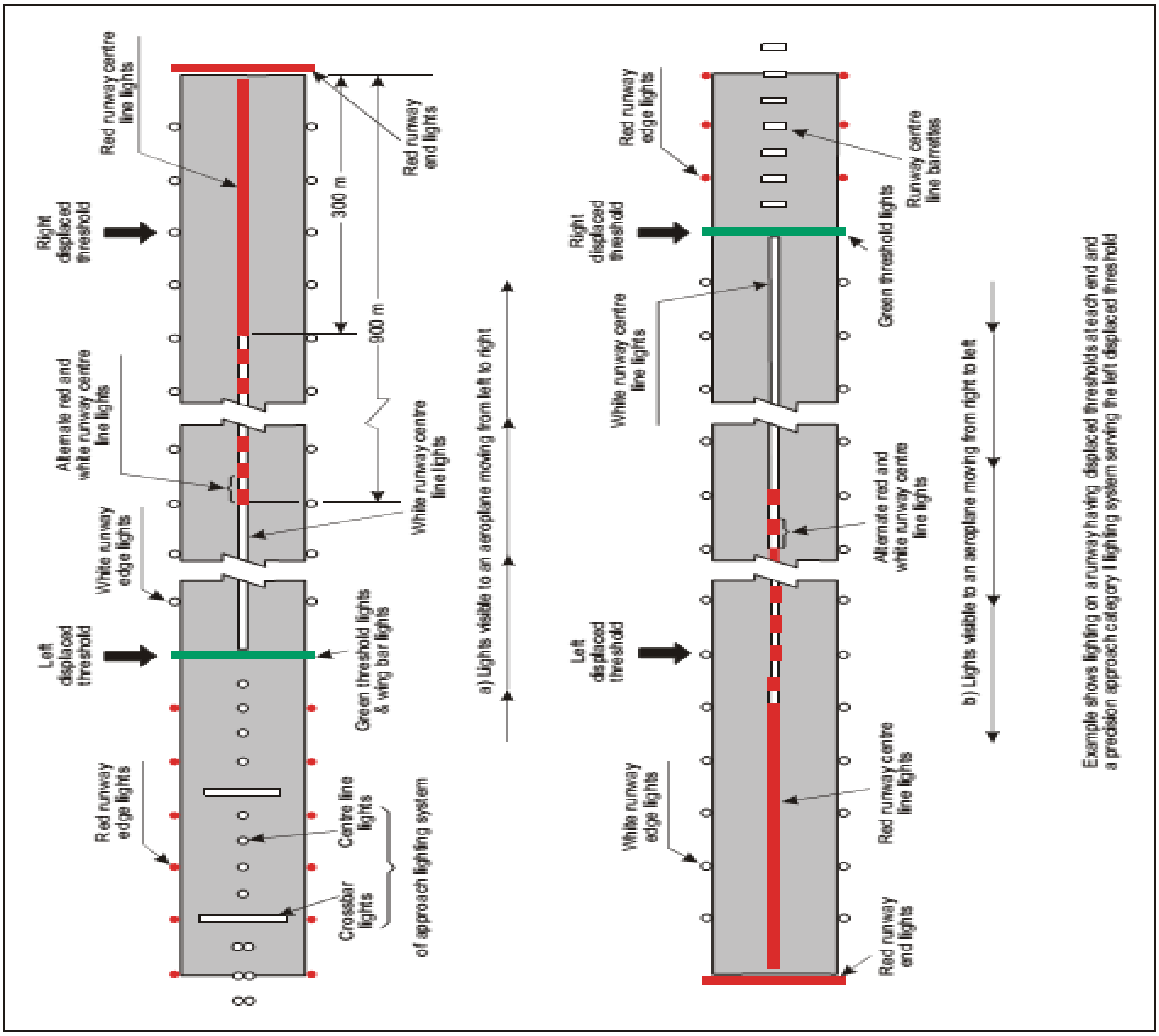


Figure 12. 31: Example of approach and runway lighting

for runway with displaced thresholds

12.7 Runway centre line lights must be fixed lights showing variable white from the threshold to the point 900 m from the runway end; alternate red and variable white from 900 m to 300 m from the runway end; and red from 300 m to the runway end, except that for runways less than 1 800 m in length, the alternate red and variable white lights must extend from the midpoint of the runway usable for landing to 300 m from the runway end.

Compliance Note. Care is required in the design of the electrical system to ensure that failure of part of the electrical system will not result in a false indication of the runway distance remaining.

12.8 Runway centre line lights must be in accordance with the specifications of Appendix 2 to this Document NAMCATS-AH, Figure A2-6 or A2-7.

13. Runway touchdown zone lights

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

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

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

13.4 A barrette must be not less than 3 m nor more than 4.5 m in length.

13.5 Touchdown zone lights must be fixed unidirectional lights showing variable white.

13.6 Touchdown zone lights must be in accordance with the specifications of Appendix 2 to this Document NAM-CATS-AH, Figure A2-5.

14. Simple touchdown zone lights

14.1 Except where TDZ lights are provided in accordance with paragraphs 13.1 to 13.6 above, simple touchdown zone lights may be provided 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.

14.2 Simple touchdown zone lights must be a pair of lights located on each side of the runway centre line 0.3 m beyond the upwind edge of the final touchdown zone marking. The lateral spacing between the inner lights of the two pairs of lights must be equal to the lateral spacing selected for the touchdown zone marking. The spacing between the lights of the same pair must not be more than 1.5 m or half the width of the touchdown zone marking, whichever is greater. (See Figure 5-24.).

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

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

14.5 Simple touchdown zone lights must be in accordance with the specifications in Appendix 2 to this Document NAMCATS-AH, Figure A2-5.

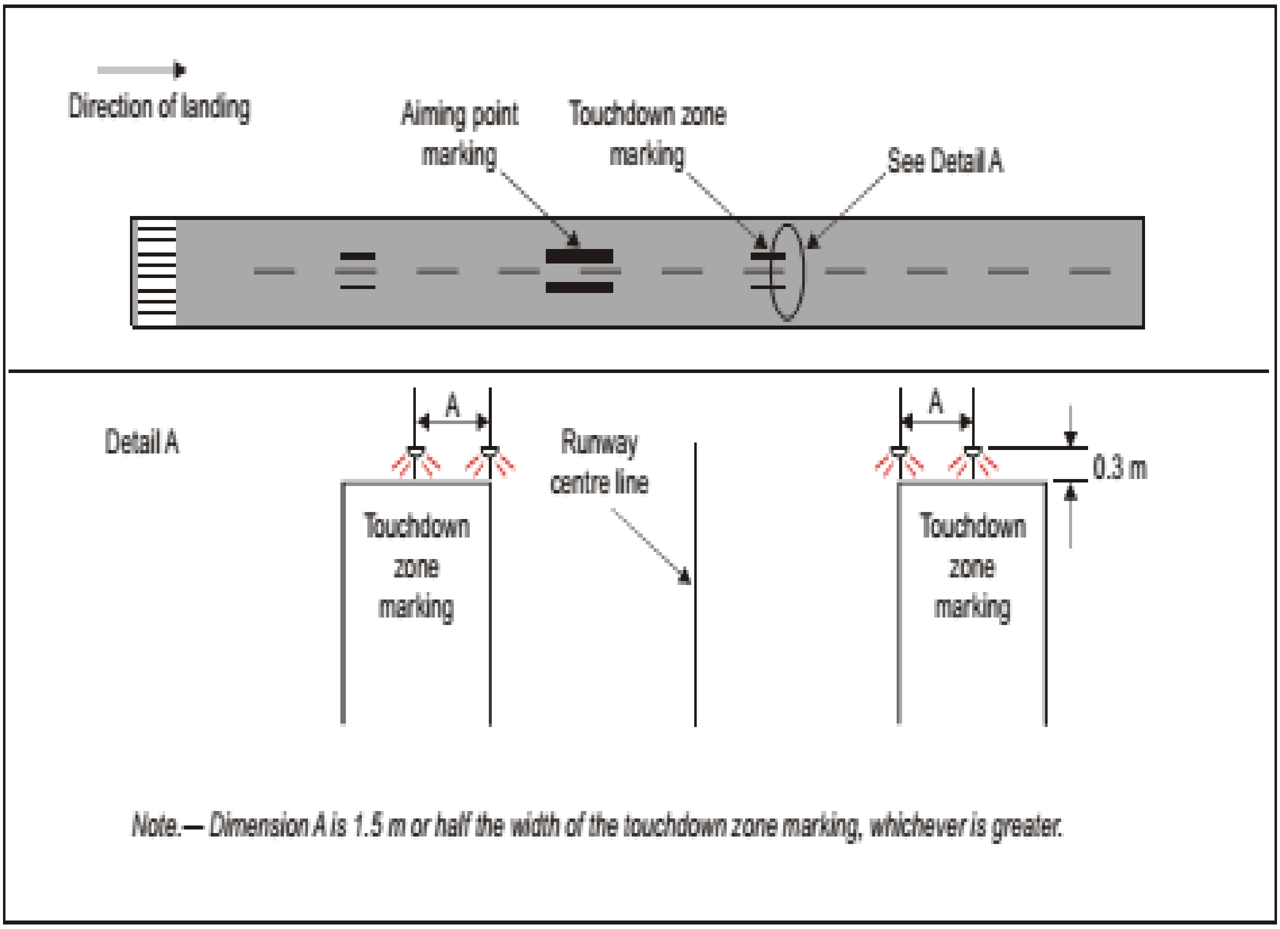


Figure 12. 32: Simple touchdown zone lighting

15. Rapid exit taxiway indicator lights

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

15.2 Rapid exit taxiway indicator lights must not be displayed in the event of any lamp failure or other failure that prevents the display of the light pattern depicted in Figure 5-25, in full.

15.3 A set of rapid exit taxiway indicator lights must be located on the runway on the same side of the runway centre line as the associated rapid exit taxiway, in the configuration shown in Figure 5-25. In each set, the lights must be located 2 m apart and the light nearest to the runway centre line must be displaced 2 m from the runway centre line.

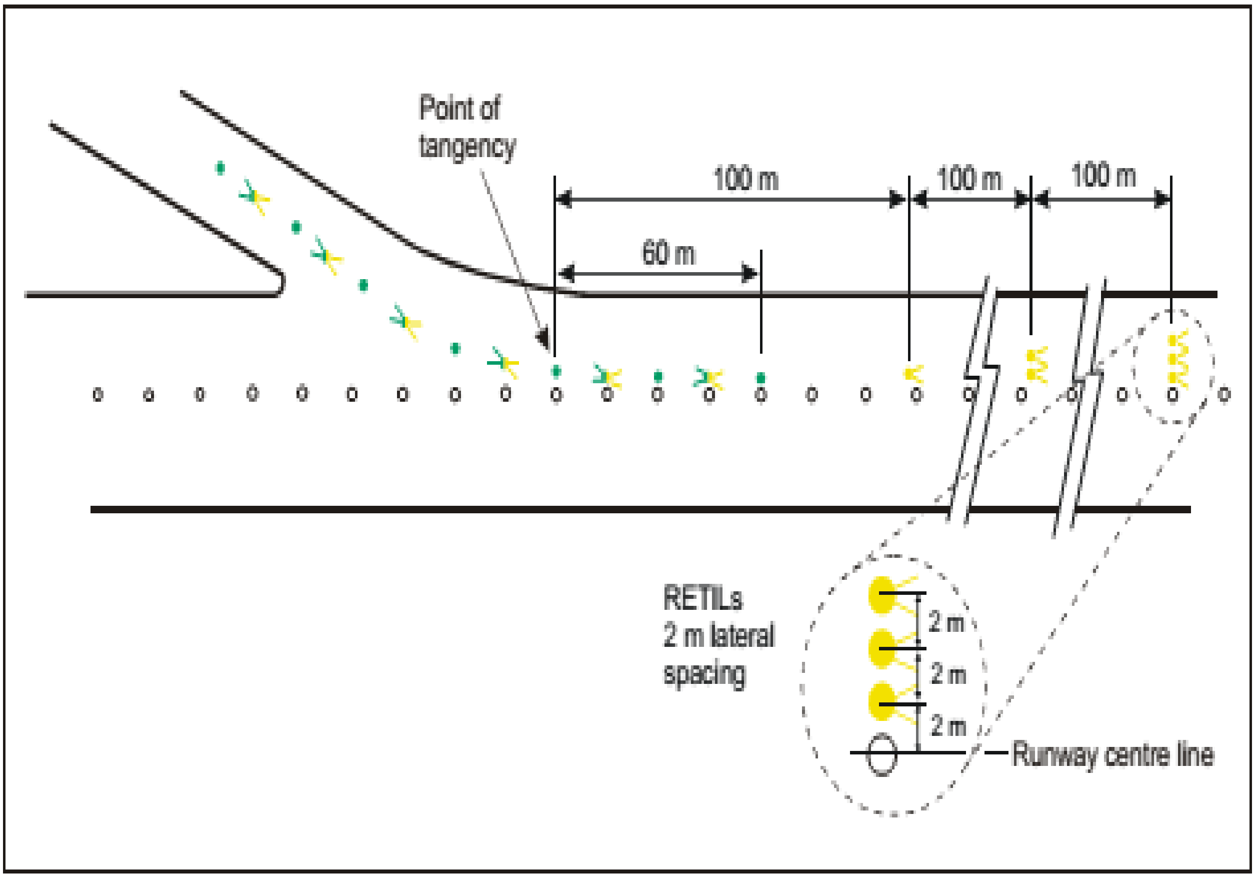


Figure 12. 33: Rapid exit taxiway indicator lights (RETILS)

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

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

15.6 Rapid exit taxiway indicator lights must be in accordance with the specifications in Appendix 2 to this Document NAMCATS-AH, Figure A2-6 or Figure A2-7, as appropriate.

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

15.8 Rapid exit taxiway indicator lights (RETILs) comprise a set of yellow unidirectional lights installed in the runway adjacent to the centre line. The lights are positioned in a 3-2-1 sequence at 100 m intervals prior to the point of tangency of the rapid exit taxiway centre line. They are intended to give an indication to pilots of the location of the next available rapid exit taxiway.

15.9 In low visibility conditions, RETILs provide useful situational awareness cues while allowing the pilot to concentrate on keeping the aircraft on the runway centre line.

15.10 Following a landing, runway occupancy time has a significant effect on achievable runway capacity. RETILs allow pilots to maintain a good roll-out speed until it is necessary to decelerate to an appropriate speed for the turn into a rapid exit turn-off. A roll-out speed of 60 knots until the first RETIL (three-light barrette) is reached is seen as the optimum.

16. Stopway lights

16.1 Stopway lights must be provided for a stopway intended for use at night.

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

16.3 Stopway lights must be fixed unidirectional lights showing red in the direction of the runway.

17. Taxiway centre line lights

Application

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

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

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

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

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

Characteristics

17.6 Except as provided for in 17.8 below, taxiway centre line lights on a taxiway other than an exit taxiway and on a runway forming part of a standard taxi-must be fixed lights showing green with beam dimensions such that the light is visible only from aeroplanes on or in the vicinity of the taxiway.

17.7 Taxiway centre line lights on an exit taxiway must be fixed lights. Alternate taxiway centre line lights must show green and yellow from their beginning near the runway centre line to the perimeter of the ILS/MLS critical/sensitive area or the lower edge of the inner transitional surface, whichever is farthest from the runway; and thereafter all lights must show green (Figure 12.34). The first light in the exit centre line must always show green, and the light nearest to the perimeter must always show yellow.

17.8 Where it is necessary to denote the proximity to a runway, taxiway centre line lights must be fixed lights showing alternating green and yellow from the perimeter of the ILS/MLS critical/sensitive area or the lower edge of the inner transitional surface, whichever is farthest from the runway, to the runway and continue alternating green and yellow until:

(a) their end point near the runway centre line; or

(b) in the case of the taxiway centre line lights crossing the runway, to the opposite perimeter of the ILS/MLS critical/sensitive area or the lower edge of the inner transitional surface, whichever is farthest from the runway.

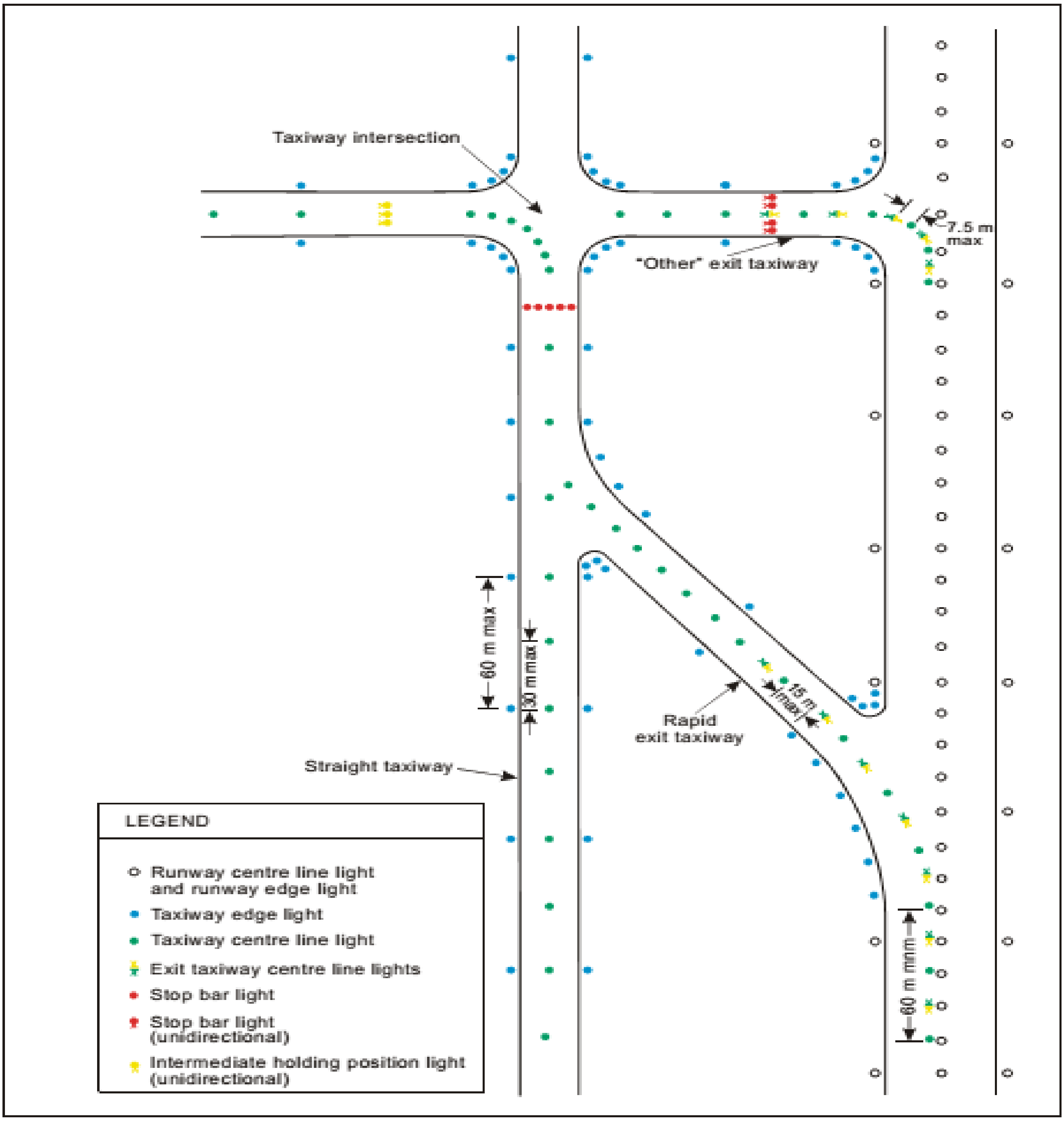


Figure 12. 34: Taxiway lighting

17.9 Taxiway centre line lights must be in accordance with the specifications of:

(a) Appendix 2 to this Document NAMCATS-AH, Figure A2-12, A2-13, or A2-14, for taxiways intended for use in runway visual range conditions of less than a value of 350 m; and

(b) Appendix 2 to this Document NAMCATS-AH, Volume, I Figure A2-15 or A2-16, for other taxiways.

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

17.11 Where taxiway centre line lights are specified as components of an advanced surface movement guidance and control system and where, from an operational point of view, higher intensities are required to maintain ground movements at a certain speed in very low visibilities or in bright daytime conditions, taxiway centre line lights must be in accordance with the specifications of Appendix 2 to this Document NAMCATS-AH, Figure A2-17, A2-18 or A2-19.

Location

17.12 Taxiway centre line lights, when provided, must be located on the taxiway centre line marking, except that they may be offset by not more than 30 cm where it is not practicable to locate them on the marking

Taxiway centre line lights on taxiways

17.13 Taxiway centre line lights on a straight section of a taxiway must be spaced at longitudinal intervals of not more than 30 m, except that:

(a) larger intervals not exceeding 60 m may be used where, because of the prevailing meteorological conditions, adequate guidance is provided by such spacing;
(b) intervals less than 30 m must be provided on short straight sections; and
(c) on a taxiway intended for use in RVR conditions of less than a value of 350 m, the longitudinal spacing must not exceed 15 m.

17.14 Taxiway centre line lights on a taxiway curve, when provided, must continue from the straight portion of the taxiway at a constant distance from the outside edge of the taxiway curve. The lights must be spaced at intervals such that a clear indication of the curve is provided.

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

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

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

Taxiway centre line lights on rapid exit taxiways

17.16 Taxiway centre line lights on a rapid exit taxiway must commence at a point at least 60 m before the beginning of the taxiway centre line curve and continue beyond the end of the curve to a point on the centre line of the taxiway where an aeroplane can be expected to reach normal taxiing speed. The lights on that portion parallel to the runway centre line must always be at least 60 cm from any row of runway centre line lights, as shown in Figure 12.35.

17.17 The lights must be spaced at longitudinal intervals of not more than 15 m, except that, where runway centre line lights are not provided, a greater interval not exceeding 30 m may be used

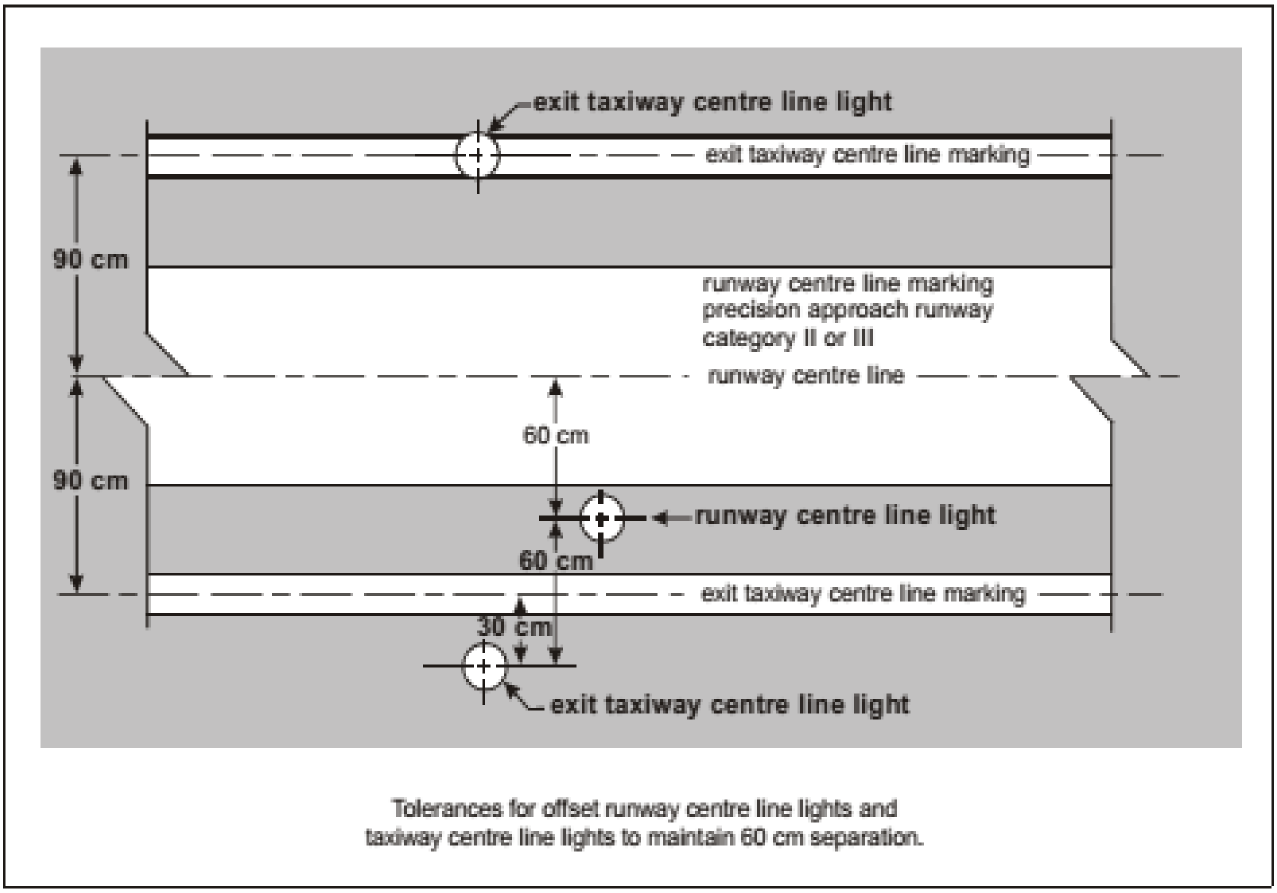


Figure 12. 35: Offset runway and taxiway centre line lights

Taxiway centre line lights on runways

17.18 Taxiway centre line lights on exit taxiways other than rapid exit taxiways must commence at the point where the taxiway centre line marking begins to curve from the runway centre line, and follow the curved taxiway centre line marking at least to the point where the marking leaves the runway. The first light must be at least 60 cm from any row of runway centre line lights, as shown in Figure 12.35.

17.19 The lights must be spaced at longitudinal intervals of not more than 7.5 m.

Taxiway centre line lights on runways

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

18. Taxiway edge lights

18.1 Taxiway edge lights must be provided at the edges of a runway turn pad, holding bay, apron, etc., intended for use at night and on a taxiway not provided with taxiway centre line lights and intended for use at night, except that taxiway edge lights need not be provided where, considering the nature of the operations, adequate guidance can be achieved by surface illumination or other means.

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

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

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

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

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

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

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

19. Runway turn pad lights

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

19.2 Runway turn pad lights must be provided on a runway turn pad intended for use at night.

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

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

19.5 Runway turn pad lights on a curved section of the runway turn pad marking must not exceed a spacing of 7.5 m.

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

19.7 Runway turn pad lights must be in accordance with the specifications of Appendix 2 to this Document NAMCATS-AH, Figure A2-13, A2-14 or A2-15, as appropriate.

20. Stop bars

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

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

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

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

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

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

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

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

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

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

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

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

20.5 Stop bars must be located across the taxiway at the point where it is desired that traffic stop. Where the additional lights specified in 20.7 below are provided, these lights must be located not less than 3 m from the taxiway edge.

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

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

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

20.9 Where the additional lights specified in 20.7 above must be visible to approaching aircraft up to the stop bar position.

20.10 The intensity in red light and beam spreads of stop bar lights must be in accordance with the specifications in Appendix 2 to this Document NAMCATS-AH, Figures A2-12 through A2-16, as appropriate.

20.11 Where stop bars are specified as components of an advanced surface movement guidance and control system and where, from an operational point of view, higher intensities are required to maintain ground movements at a certain speed in very low visibilities or in bright daytime conditions, the intensity in red light and beam spreads of stop bar lights must be in accordance with the specifications of Appendix 2 to this Document NAMCATS-AH, Figure A2-17, A2-18 or A2-19.

20.12 Where a wide beam fixture is required, the intensity in red light and beam spreads of stop bar lights must be in accordance with the specifications of Appendix 2 to this Document NAMCATS-AH, Figure A2-17 or A2-19.

20.13 The lighting circuit must be designed so that:

(a) stop bars located across entrance taxiways are selectively switchable;
(b) stop bars located across taxiways intended to be used only as exit taxiways are switchable selectively or in groups;
(c) when a stop bar is illuminated, any taxiway centre line lights installed beyond the stop bar must be extinguished for a distance of at least 90 m; and

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

21. Intermediate holding position lights

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

21.2 Intermediate holding position lights may be provided at an intermediate holding position where there is no need for stop-and-go signals as provided by a stop bar.

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

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

22. Runway guard lights

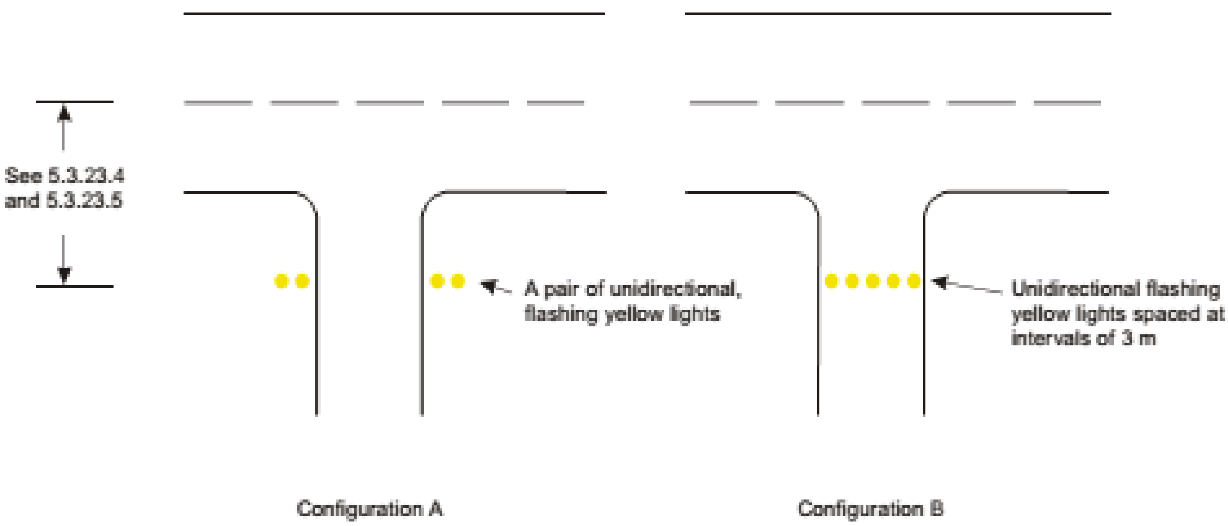


Figure 12. 36: Runway guard lights

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

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

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

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

22.3 Configuration B runway guard lights must not be collocated with a stop bar.

22.4 Runway guard lights, Configuration A, must be located at each side of the taxiway at a distance from the runway centre line not less than that specified for a take-off runway in Table 10.6.

22.5 Runway guard lights, Configuration B, must be located across the taxiway at a distance from the runway centre line not less than that specified for a take-off runway in Table 10.6.

22.6 Runway guard lights, Configuration A, must consist of two pairs of yellow lights.

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

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

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

22.10 The intensity in yellow light and beam spreads of lights of Configuration A must be in accordance with the specifications in Appendix 2 to this Document NAMCATS-AH, Figure A2-24.

22.11 Where runway guard lights are intended for use during the day, the intensity in yellow light and beam spreads of lights of Configuration A must be in accordance with the specifications in Appendix 2 to this Document NAMCATS-AH, Figure A2-25.

22.12 Where runway guard lights are specified as components of an advanced surface movement guidance and control system where higher light intensities are required, the intensity in yellow light and beam spreads of lights of Configuration A must be in accordance with the specifications in Appendix 2 to this Document NAMCATS-AH, Figure A2-25.

22.13 The intensity in yellow light and beam spreads of lights of Configuration B must be in accordance with the specifications in Appendix 2 to this Document NAMCATS-AH, Figure A2-12.

22.14 Where runway guard lights are intended for use during the day, the intensity in yellow light and beam spreads of lights of Configuration B must be in accordance with the specifications in Appendix 2 to this Document NAMCATS-AH, Volume, I, Figure A2-20.

22.15 Where runway guard lights are specified as components of an advanced surface movement guidance and control system where higher light intensities are required, the intensity in yellow light and beam spreads of lights of Configuration B must be in accordance with the specifications in Appendix 2 to this Document NAMCATS-AH, Figure A2-20.

22.16 The lights in each unit of Configuration A must be illuminated alternately.

22.17 For Configuration B, adjacent lights must be alternately illuminated and alternative lights must be illuminated in unison.

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

23. Apron floodlighting

23.1 Apron floodlighting must be provided on an apron and on a designated isolated aircraft parking position intended to be used at night.

23.2 Apron floodlights must be located so as to provide adequate illumination on all apron service areas, with a minimum of glare to pilots of aircraft in flight and on the ground, aerodrome and apron controllers, and personnel on the apron. The arrangement and aiming of floodlights must be such that an aircraft stand receives light from two or more directions to minimize shadows.

23.3 The spectral distribution of apron floodlights must be such that the colours used for aircraft marking connected with routine servicing, and for surface and obstacle marking, can be correctly identified.

23.4 The average illuminance must be at least the following:

Aircraft stand:

- horizontal illuminance — 20 lux with a uniformity ratio (average to minimum) of not more than 4 to 1; and
- vertical illuminance — 20 lux at a height of 2 m above the apron in relevant directions.

Other apron areas:

- horizontal illuminance — 50 per cent of the average illuminance on the aircraft stands with a uniformity ratio (average to minimum) of not more than 4 to 1.

24. Visual docking guidance system

Application

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

Characteristics

24.2 The system must provide both azimuth and stopping guidance.

24.3 The azimuth guidance unit and the stopping position indicator must be adequate for use in all weather, visibility, background lighting and pavement conditions for which the system is intended, both by day and night, but must not dazzle the pilot.

24.4 The azimuth guidance unit and the stopping position indicator must be of a design such that:

(a) a clear indication of malfunction of either or both is available to the pilot; and
(b) they can be turned off.

24.5 The azimuth guidance unit and the stopping position indicator must be located in such a way that there is continuity of guidance between the aircraft stand markings, the aircraft stand manoeuvring guidance lights, if present, and the visual docking guidance system.

24.6 The accuracy of the system must be adequate for the type of loading bridge and fixed aircraft servicing installations with which it is to be used.

24.7 The system must be usable by all types of aircraft for which the aircraft stand is intended, preferably without selective operation.

24.8 If selective operation is required to prepare the system for use by a particular type of aircraft, then the system must provide an identification of the selected aircraft type to both the pilot and the system operator as a means of ensuring that the system has been set properly.

Azimuth guidance unit

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

24.10 The azimuth guidance unit must be aligned for use by the pilots occupying both the left and right seats.

24.11 The azimuth guidance unit must provide unambiguous left/right guidance which enables the pilot to acquire and maintain the lead-in line without over-controlling.

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

Stopping position indicator

24.13 The stopping position indicator must be located in conjunction with, or sufficiently close to, the azimuth guidance unit so that a pilot can observe both the azimuth and stop signals without turning the head.

24.14 The stopping position indicator must be usable at least by the pilot occupying the left seat.

24.15 Subject to 24.14 above, the stopping position indicator may be usable by both the pilots occupying both the left and right seats.

24.16 The stopping position information provided by the indicator for a particular aircraft type must account for the anticipated range of variations in pilot eye height and/or viewing angle.

24.17 The stopping position indicator must show the stopping position for the aircraft for which guidance is being provided and must provide closing rate information to enable the pilot to gradually decelerate the aircraft to a full stop at the intended stopping position.

24.18 The stopping position indicator must provide closing rate information over a distance of at least 10 m.

24.19 When stopping guidance is indicated by colour change, green must be used to show that the aircraft can proceed and red to show that the stop point has been reached, except that for a short distance prior to the stop point a third colour may be used to warn that the stopping point is close.

25. Advanced visual docking guidance system

25.1 An A-VDGS may be provided where it is operationally desirable to confirm the correct aircraft type for which guidance is being provided and/or to indicate the stand centre line in use, where more than one is provided for.

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

25.3 The A-VDGS must be used only in conditions in which its operational performance is specified.

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

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

25.6 The A-VDGS must provide, at minimum, the following guidance information at the appropriate stage of the docking manoeuvre:

(a) an emergency stop indication;
(b) the aircraft type and model for which the guidance is provided;
(c) an indication of the lateral displacement of the aircraft relative to the stand centre line;
(d) the direction of azimuth correction needed to correct a displacement from the stand centre line;
(e) an indication of the distance to the stop position;

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

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

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

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

25.9 The information on displacement of the aircraft relative to the stand centre line and distance to the stopping position, when displayed, must be provided with the accuracy specified in Table 5-4.

Table 12. 4: A-VDGS recommended displacement accuracy

Guidance information	Maximum deviation at stop position (stop area)	Maximum deviation at 9 m from stop position	Maximum deviation at 15 m from stop position	Maximum deviation at 25 m from stop position
Azimuth	±250 mm	±340 mm	±400 mm	±500 mm

Distance	±500 mm	±1 000 mm	±1 300 mm	Not specified

25.10 Symbols and graphics used to depict guidance information must be intuitively representative of the type of information provided.

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

25.12 Continuous closure distance and closure rate must be provided from at least 15 m prior to the stop position.

25.13 Where provided, closure distance displayed in numerals must be provided in metre integers to the stop position and displayed to 1 decimal place at least 3 m prior to the stop position.

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

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

25.16 The word “stop” in red characters must be displayed when an immediate cessation of the docking manoeuvre is required.

26. Aircraft stand manoeuvring guidance lights

26.1 Aircraft stand manoeuvring guidance lights may be provided to facilitate the positioning of an aircraft on an aircraft stand on a paved apron intended for use in poor visibility conditions, unless adequate guidance is provided by other means.

26.2 Aircraft stand manoeuvring guidance lights must be collocated with the aircraft stand markings.

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

26.4 The lights used to delineate lead-in, turning and lead-out lines must be spaced at intervals of not more than 7.5 m on curves and 15 m on straight sections.

26.5 The lights indicating a stop position must be fixed unidirectional lights showing red.

26.6 The intensity of the lights must be adequate for the condition of visibility and ambient light in which the use of the aircraft stand is intended.

26.7 The lighting circuit must be designed so that the lights may be switched on to indicate that an aircraft stand is to be used and switched off to indicate that it is not to be used.

27. Road-holding position light

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

27.2 A road-holding position light must be provided at each road-holding position serving a runway when it is intended that the runway will be used in runway visual range conditions of values between 350 m and 550 m.

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

27.4 The road-holding position light must comprise:

(a) a controllable red (stop)/green (go) traffic light; or
(b) a flashing-red light.

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

27.6 The intensity of the light beam must be adequate for the conditions of visibility and ambient light in which the use of the holding position is intended, but must not dazzle the drive.

27.7 The flash frequency of the flashing-red light must be between 30 and 60 flashes per minute.

28. No-entry bar

28.1 A no-entry bar must 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.

28.2 Where provided, a no-entry bar must 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.

28.3 A no-entry bar must 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.

28.4 A pair of elevated lights must be added to each end of the no-entry bar where the in-pavement no entry bar lights might be obscured from a pilot's view, for example, by rain, 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.

28.5 The intensity in red light and beam spreads of no-entry bar lights must be in accordance with the specifications in Appendix 2 to this Document NAM-CATS-AH, Figures A2-12 through A2-16, as appropriate.

28.6 Where no-entry bars are specified as components of an advanced surface movement guidance and control system and where, from an operational point of view, higher intensities are required to maintain ground movements at a certain speed in very low visibilities or in bright daytime conditions, the intensity in red light and beam spreads of no-entry bar lights must be in accordance with the specifications of Appendix 2 to this Document NAMCATS-AH, Figure A2-17, A2-18 or A2-19.

28.7 Where a wide beam fixture is required, the intensity in red light and beam spreads of no-entry bar lights must be in accordance with the specifications of Appendix 2 of this Document NAMCATS-AH, Volume I, Figure A2-17 or A2-19.

28.8 The lighting circuit must be designed so that:

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

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

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

29. Runway status lights

Introductory Note. Runway status lights (RWSL) is a type of autonomous runway incursion warning system (ARIWS). The two basic visual components of RWSL are runway entrance lights (RELs) and take-off hold lights (THLs). Either component may be installed by itself, but the two components are designed to be complementary to each other.

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

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

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

29.4 Where provided, RELs must consist of a single line of fixed in pavement lights showing red in the direction of aircraft approaching the runway

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

29.6 Intensity and beam spread of RELs must be in accordance with the specifications of Appendix 2 to this Document NAMCATS-AH, Figures A2-12 and A2-14.

29.7 Where provided, THLs must consist of two rows of fixed in pavement lights showing red facing the aircraft taking off.

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

29.9 Intensity and beam spread of THLs must be in accordance with the specifications of Appendix 2 to this Document NAMCATS-AH, Figure A2-26.

29.10 RELs and THLs must be automated to the extent that the only control over each system will be to disable one or both systems.

139.12.8 Signs

1. General

1.1 Signs must be provided to convey a mandatory instruction, information on a specific location or destination on a movement area, or to provide other information to meet the requirements of 139.16.9 (Surface movement guidance and control systems).

1.2 A variable message sign may be provided where:

(a) the instruction or information displayed on the sign is relevant only during a certain period of time; and/or

(b) there is a need for variable predetermined information to be displayed on the sign to meet the requirements of 139.16.9 (Surface movement guidance and control systems).

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

Table 12. 5: Location distances for taxiing guidance signs including runway exit signs

Sign height (mm				Perpendicular distance from defined taxiway pavement edge	Perpendicular distance from defined runway pavement edge to near side of sig
Code number	Legend	Face (min.)	Installed (max.)		
1 or 2	200	400	700	5–11 m	3–10 m
1 or 2	300	600	900	5–11 m	3–10 m
3 or 4	300	600	900	11–21 m	8–15 m
3 or 4	400	800	1100	11–21 m	8–15 m

1.4 Signs must be rectangular, as shown in Figures 12.37 and 12.38 with the longer side horizontal.

1.5 The only signs on the movement area utilizing red must be mandatory instruction signs.

1.6 The inscriptions on a sign must be in accordance with the provisions of Appendix 4 to this Document NAMCATS-AH.

1.7 Signs must be illuminated in accordance with the provisions of Appendix 4 to this Document NAMCATS-AH when intended for use:

(a) in runway visual range conditions less than a value of 800 m; or
(b) at night in association with instrument runways; or
(c) at night in association with non-instrument runways where the code number is 3 or 4.

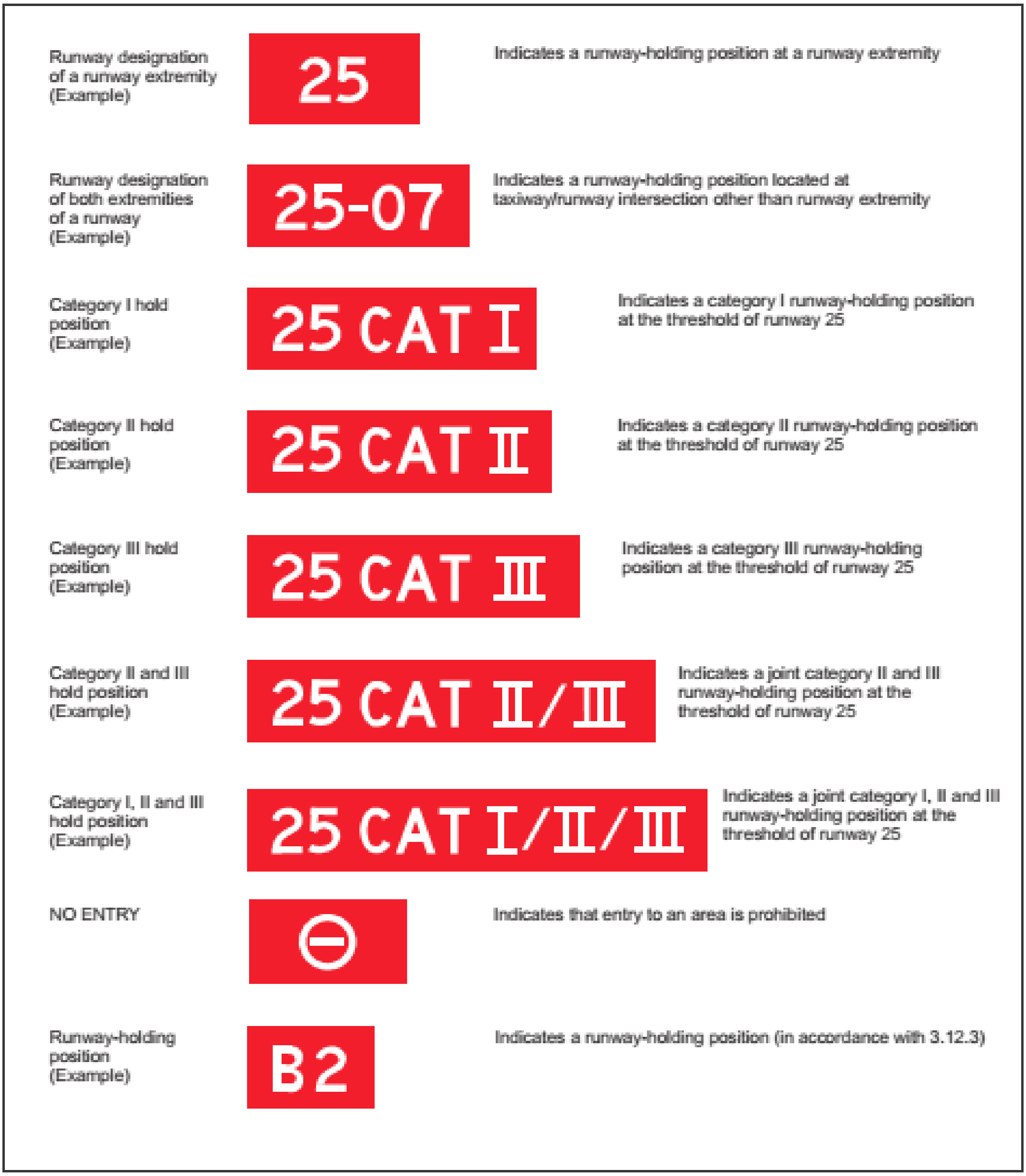


Figure 12. 37: Mandatory instruction signs

1.8 Signs must be retroreflective and/or illuminated in accordance with the provisions of Appendix 4 to this Document NAMCATS-AH, when intended for use at night in association with non-instrument runways where the code number is 1 or 2.

1.9 A variable message sign must show a blank face when not in use.

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

1.11 The time interval to change from one message to another on a variable message sign must be as short as practicable and must not exceed 5 seconds.

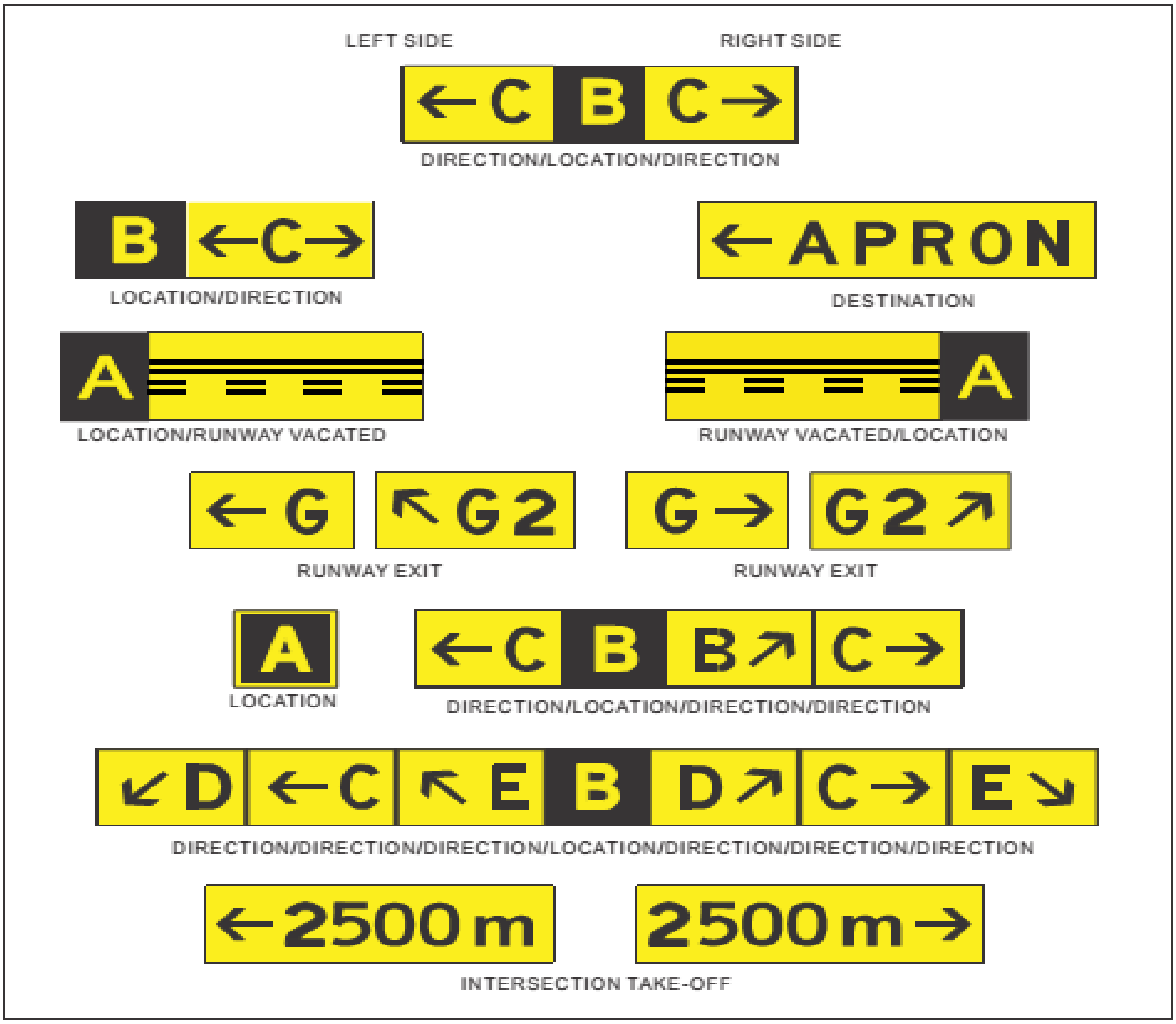


Figure 12. 38: Information signs

2. Mandatory instruction signs

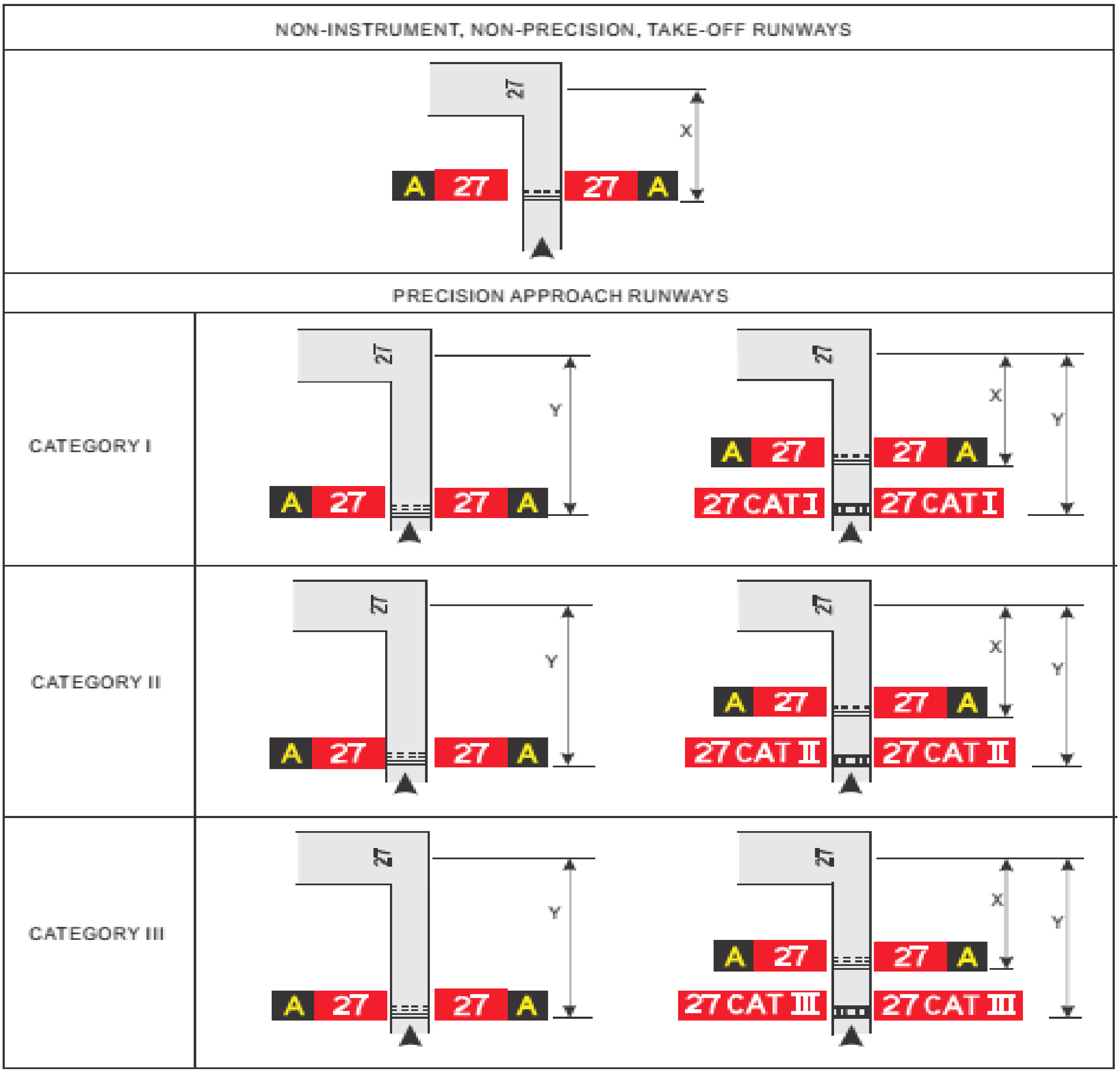


Figure 12. 39: Examples of sign positions at taxiway/runway intersections

Compliance Note. Distance X is established in accordance with Table 10.6. Distance Y is established at the edge of the ILS/MLS critical/sensitive area

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

2.2 Mandatory instruction signs must include runway designation signs, category I, II or III holding position signs, runway-holding position signs, road-holding position signs and NO ENTRY signs.

2.3 A pattern "A" runway-holding position marking must be supplemented at a taxiway/runway intersection or a runway/runway intersection with a runway designation sign.

2.4 A pattern "B" runway-holding position marking must be supplemented with a category I, II or III holding position sign.

2.5 A pattern "A" runway-holding position marking at a runway-holding position established in accordance with 2.3 must be supplemented with a runway-holding position sig.

2.6 A runway designation sign at a taxiway/runway intersection may be supplemented with a location sign in the outboard (farthest from the taxiway) position, as appropriate.

2.7 A NO ENTRY sign must be provided when entry into an area is prohibited.

2.8 A runway designation sign at a taxiway/runway intersection or a runway/runway intersection must be located on each side of the runway-holding position marking facing the direction of approach to the runway.

2.9 A category I, II or III holding position sign must be located on each side of the runway-holding position marking facing the direction of the approach to the critical area.

2.10 A NO ENTRY sign must be located at the beginning of the area to which entrance is prohibited on each side of the taxiway as viewed by the pilot.

2.11 A runway-holding position sign must be located on each side of the runway-holding position facing the approach to the obstacle limitation surface or ILS/MLS critical/sensitive area, as appropriate.

2.12 A mandatory instruction sign must consist of an inscription in white on a red background.

2.13 Where, owing to environmental or other factors, the conspicuity of the inscription on a mandatory instruction sign needs to be enhanced, the outside edge of the white inscription must be supplemented by a black outline measuring 10 mm in width for runway code numbers 1 and 2, and 20 mm in width for runway code numbers 3 and 4.

2.14 The inscription on a runway designation sign must consist of the runway designations of the intersecting runway properly oriented with respect to the viewing position of the sign, except that a runway designation sign installed in the vicinity of a runway extremity may show the runway designation of the concerned runway extremity only.

2.15 The inscription on a category I, II, III, joint II/III or joint I/II/III holding position sign must consist of the runway designator followed by CAT I, CAT II, CAT III, CAT II/III or CAT I/II/III, as appropriate.

2.16 The inscription on a NO ENTRY sign must be in accordance with Figure 12.37.

2.17 The inscription on a runway-holding position sign at a runway-holding position must consist of the taxiway designation and a number.

2.18 Where installed, the inscriptions/symbol of Figure 12.37 must be used.

3. Information sign

Compliance Note. See Figure 12.38 for pictorial representations of information signs.

3.1 An information sign must be provided where there is an operational need to identify by a sign, a specific location, or routing (direction or destination) information.

3.2 Information signs must include: direction signs, location signs, destination signs, runway exit signs, runway vacated signs and intersection take-off signs.

3.3 A runway exit sign must be provided where there is an operational need to identify a runway exit.

3.4 A runway vacated sign must be provided where the exit taxiway is not provided with taxiway centre line lights and there is a need to indicate to a pilot leaving a runway the perimeter of the ILS/MLS critical/sensitive area or the lower edge of the inner transitional surface, whichever is farther from the runway centre line.

3.5 An intersection take-off sign may be provided when there is an operational need to indicate the remaining take-off run available (TORA) for intersection take-offs.

3.6 Where necessary, a destination sign may be provided to indicate the direction to a specific destination on the aerodrome, such as cargo area, general aviation, etc.

3.7 A combined location and direction sign must be provided when it is intended to indicate routing information prior to a taxiway intersection.

3.8 A direction sign must be provided when there is an operational need to identify the designation and direction of taxiways at an intersection.

3.9 A location sign may be provided at an intermediate holding position.

3.10 A location sign must be provided in conjunction with a runway designation sign except at a runway/runway intersection.

3.11 A location sign must be provided in conjunction with a direction sign, except that it may be omitted where an aeronautical study indicates that it is not needed.

3.12 Where necessary, a location sign may be provided to identify taxiways exiting an apron or taxiways beyond an intersection.

3.13 Where a taxiway ends at an intersection such as a ‘‘T’’ and it is necessary to identify this, a barricade, direction sign and/or other appropriate visual aid may be used.

3.14 Except as specified in 3.16 and 3.24 below, information signs must, wherever practicable, be located on the left-hand side of the taxiway in accordance with Table 12.5.

3.15 At a taxiway intersection, information signs must be located prior to the intersection and in line with the intermediate holding position marking. Where there is no intermediate holding position marking, the signs must be installed at least 60 m from the centre line of the intersecting taxiway where the code number is 3 or 4, and at least 40 m where the code number is 1 or 2.

Compliance Note. A location sign installed beyond a taxiway intersection may be installed on either side of a taxiway.

3.16 A runway exit sign must be located on the same side of the runway as the exit is located (i.e. left or right) and positioned in accordance with Table 12.5.

3.17 A runway exit sign must be located prior to the runway exit point in line with a position at least 60 m prior to the point of tangency where the code number is 3 or 4, and at least 30 m where the code number is 1 or 2.

3.18 A runway vacated sign must be located at least on one side of the taxiway. The distance between the sign and the centre line of a runway must be not less than the greater of the following:

(a) the distance between the centre line of the runway and the perimeter of the ILS/MLS critical/sensitive area; or
(b) the distance between the centre line of the runway and the lower edge of the inner transitional surface.

3.19 Where provided in conjunction with a runway vacated sign, the taxiway location sign must be positioned outboard of the runway vacated sign.

3.20 An intersection take-off sign must be located at the left-hand side of the entry taxiway. The distance between the sign and the centre line of the runway must be not less than 60m where the code number is 3 or 4, and not less than 45 m where the code number is 1 or 2.

3.21 A taxiway location sign installed in conjunction with a runway designation sign must be positioned outboard of the runway designation sign.

3.22 A destination sign must not normally be collocated with a location or direction sign.

3.23 An information sign other than a location sign must not be collocated with a mandatory instruction sign.

3.24 A direction sign, barricade and/or other appropriate visual aid used to identify a ‘‘T’’ intersection may be located on the opposite side of the intersection facing the taxiway.

3.25 An information sign other than a location sign must consist of an inscription in black on a yellow background.

3.26 A location sign must consist of an inscription in yellow on a black background and where it is a stand-alone sign must have a yellow border.

3.27 The inscription on a runway exit sign must consist of the designator of the exit taxiway and an arrow indicating the direction to follow.

3.28 The inscription on a runway vacated sign must depict the pattern A runway-holding position marking as shown in Figure 12.38.

3.29 The inscription on an intersection take-off sign must consist of a numerical message indicating the remaining take-off run available in metres plus an arrow, appropriately located and oriented, indicating the direction of the take-off as shown in Figure 12.38.

3.30 The inscription on a destination sign must comprise an alpha, alphanumerical or numerical message identifying the destination plus an arrow indicating the direction to proceed as shown in Figure12.38.

3.31 The inscription on a direction sign must comprise an alpha or alphanumerical message identifying the taxiway(s) plus an arrow or arrows appropriately oriented as shown in Figure12.38.

3.32 The inscription on a location sign must comprise the designation of the location taxiway, runway or other pavement the aircraft is on or is entering and must not contain arrows.

3.33 Where it is necessary to identify each of a series of intermediate holding positions on the same taxiway, the location sign must consist of the taxiway designation and a number.

3.34 Where a location sign and direction signs are used in combination:

(a) all direction signs related to left turns must be placed on the left side of the location sign, and all direction signs related to right turns must be placed on the right side of the location sign, except that where the junction consists of one intersecting taxiway, the location sign may alternatively be placed on the left-hand side;
(b) the direction signs must be placed such that the direction of the arrows departs increasingly from the vertical with increasing deviation of the corresponding taxiway;
(c) an appropriate direction sign must be placed next to the location sign where the direction of the location taxiway changes significantly beyond the intersection; and
(d) adjacent direction signs must be delineated by a vertical black line as shown in Figure 12.38.

3.35 A taxiway must be identified by a designator comprising a letter, letters or a combination of a letter or letters followed by a number.

3.36 When designating taxiways, the use of the letters I, O or X and the use of words such as inner and outer must be avoided wherever possible to avoid confusion with the numerals 1, 0 and closed marking.

3.37 The use of numbers alone on the manoeuvring area must be reserved for the designation of runways.

4. VOR aerodrome checkpoint sign

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

4.2 A VOR aerodrome checkpoint sign must be located as near as possible to the checkpoint and so that the inscriptions are visible from the cockpit of an aircraft properly positioned on the VOR aerodrome checkpoint marking.

4.3 A VOR aerodrome checkpoint sign must consist of an inscription in black on a yellow background.

4.4 The inscriptions on a VOR checkpoint sign must be in accordance with one of the alternatives shown in Figure 12.40 in which:

VOR is an abbreviation identifying this as a VOR checkpoint;

116.3 is an example of the radio frequency of the VOR concerned;

147° is an example of the VOR bearing, to the nearest degree, which must be indicated at the VOR checkpoint; and

4.3 NM is an example of the distance in nautical miles to a DME collocated with the VOR concerned.

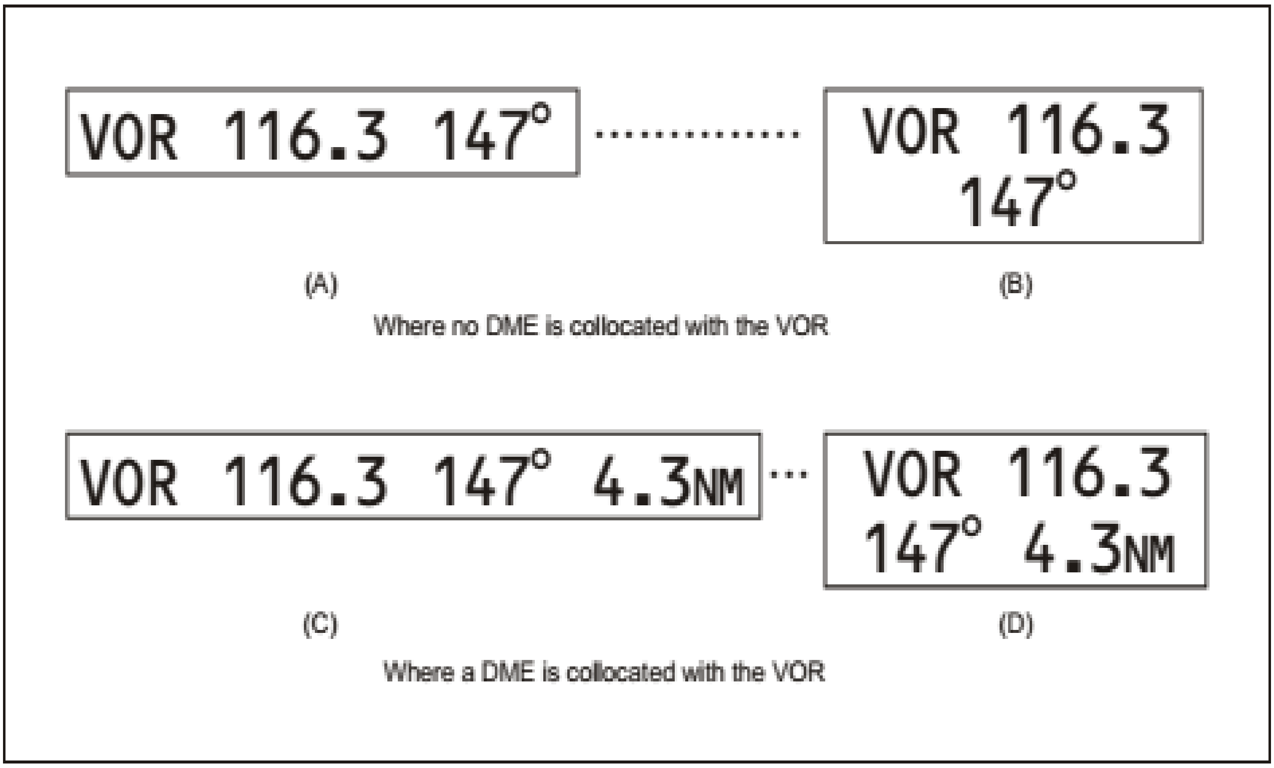


Figure 12. 40: VOR aerodrome checkpoint sign

Compliance Note. A checkpoint can only be used operationally when periodic checks show it to be consistently within ±2 degrees of the stated bearing.

5. Aerodrome identification sign

5.1 An aerodrome identification sign must be provided at an aerodrome where there is insufficient alternative means of visual identification.

5.2 The aerodrome identification sign must be placed on the aerodrome so as to be legible, in so far as is practicable, at all angles above the horizontal.

5.3 The aerodrome identification sign must consist of the name of the aerodrome.

5.4 The colour selected for the sign must give adequate conspicuity when viewed against its background.

5.5 The characters must have a height of not less than 3 m.

6. Aircraft stand identification signs

6.1 An aircraft stand identification marking may be supplemented with an aircraft stand identification sign where feasible.

6.2 An aircraft stand identification sign must be located so as to be clearly visible from the cockpit of an aircraft prior to entering the aircraft stand.

6.3 An aircraft stand identification sign must consist of an inscription in black on a yellow background.

7. Road-holding position sign

7.1 A road-holding position sign must be provided at all road entrances to a runway.

7.2 The road-holding position sign must be located 1.5 m from one edge of the road (left or right as appropriate to the local traffic regulations) at the holding position.

7.3 A road-holding position sign must consist of an inscription in white on a red background.

7.4 The inscription on a road-holding position sign must be in the national language, be in conformity with the local traffic regulations and include the following:

(a) a requirement to stop; and
(b) where appropriate:
   (i) requirement to obtain ATC clearance; and
   (ii) location designator.

Figure 12. 41: Example of a road-holding position sign

7.5 A road-holding position sign intended for night use must be retroreflective or illuminated.

139.12.9 Markers

1. General

1.1 Markers must be frangible. Those located near a runway or taxiway must be sufficiently low to preserve clearance for propellers and for the engine pods of jet aircraft.

Compliance Note 1. Anchors or chains, to prevent markers which have broken from their mounting from blowing away, are sometimes used.

2. Unpaved runway edge markers

2.1 Markers may be provided when the extent of an unpaved runway is not clearly indicated by the appearance of its surface compared with that of the surrounding ground.

2.2 Where runway lights are provided, the markers must be incorporated in the light fixtures. Where there are no lights, markers of flat rectangular or conical shape must be placed so as to delimit the runway clearly.

2.3 The flat rectangular markers must have a minimum size of 1 m by 3 m and must be placed with their long dimension parallel to the runway centre line. The conical markers must have a height not exceeding 50 cm.

3. Stopway edge markers

3.1 Stopway edge markers may be provided when the extent of a stopway is not clearly indicated by its appearance compared with that of the surrounding ground.

3.2 The stopway edge markers must be sufficiently different from any runway edge markers used to ensure that the two types of markers cannot be confused.

Compliance Note. Markers consisting of small vertical boards camouflaged on the reverse side, as viewed from the runway, have proved operationally acceptable.

4. Taxiway edge markers

4.1 Taxiway edge markers may be provided on a taxiway where the code number is 1 or 2 and taxiway centre line or edge lights or taxiway centre line markers are not provided.

4.2 Taxiway edge markers may be installed at least at the same locations as would the taxiway edge lights had they been used.

4.3 A taxiway edge marker must be retroreflective blue.

4.4 The marked surface as viewed by the pilot must be a rectangle and must have a minimum viewing area of 150 cm^2.

4.5 Taxiway edge markers must be frangible. Their height must be sufficiently low to preserve clearance for propellers and for the engine pods of jet aircraft.

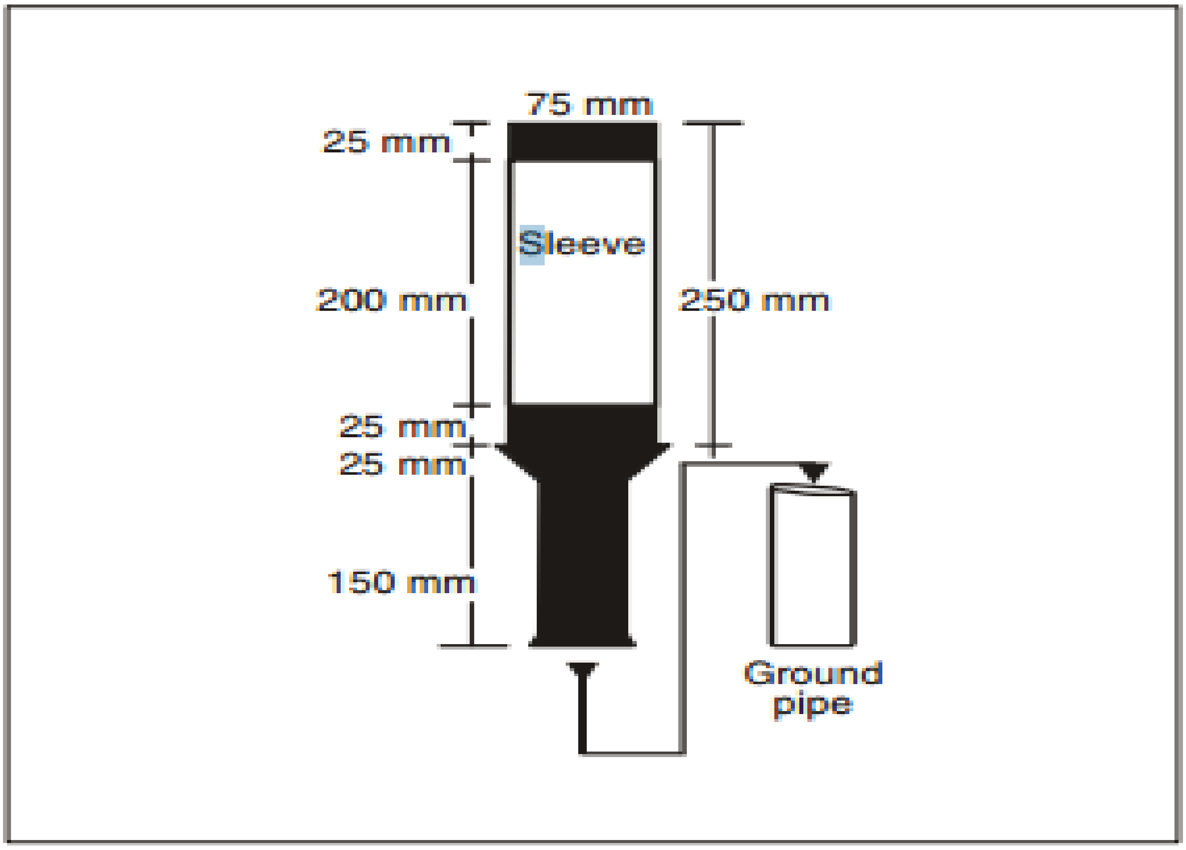


Figure 12. 42: Taxiway edge marker

5. Taxiway centre line markers

5.1 Taxiway centre line markers may be provided on a taxiway where the code number is 1 or 2 and taxiway centre line or edge lights or taxiway edge markers are not provided.

5.2 Taxiway centre line markers may be provided on a taxiway where the code number is 3 or 4 and taxiway centre line lights are not provided if there is a need to improve the guidance provided by the taxiway centre line marking.

5.3 Taxiway centre line markers may be installed at least at the same location as would taxiway centre line lights had they been used.

5.4 Taxiway centre line markers may normally be located on the taxiway centre line marking except that they may be offset by not more than 30 cm where it is not practicable to locate them on the marking.

5.5 A taxiway centre line marker must be retroreflective green.

5.6 The marked surface as viewed by the pilot must be a rectangle and must have a minimum viewing area of 20 cm ^{2}.

5.7 Taxiway centre line markers must be so designed and fitted as to withstand being run over by the wheels of an aircraft without damage either to the aircraft or to the markers themselves.

6. Unpaved taxiway edge markers

6.1 Where the extent of an unpaved taxiway is not clearly indicated by its appearance compared with that of the surrounding ground, markers may be provided.

6.2 Where taxiway lights are provided, the markers may be incorporated in the light fixtures. Where there are no lights, markers of conical shape may be placed so as to delimit the taxiway clearly.

7. Boundary markers

7.1 Boundary markers must be provided at an aerodrome where the landing area has no runway.

7.2 Boundary markers must be spaced along the boundary of the landing area at intervals of not more than 200 m, if the type shown in Figure 5-34 is used, or approximately 90 m, if the conical type is used with a marker at any corner.

7.3 Boundary markers must be of a form similar to that shown in Figure 5-34, or in the form of a cone not less than 50 cm high and not less than 75 cm in diameter at the base. The markers must be coloured to contrast with the background against which they will be seen. A single colour, orange or red, or two contrasting colours, orange and white or alternatively red and white, may be used, except where such colours merge with the background.

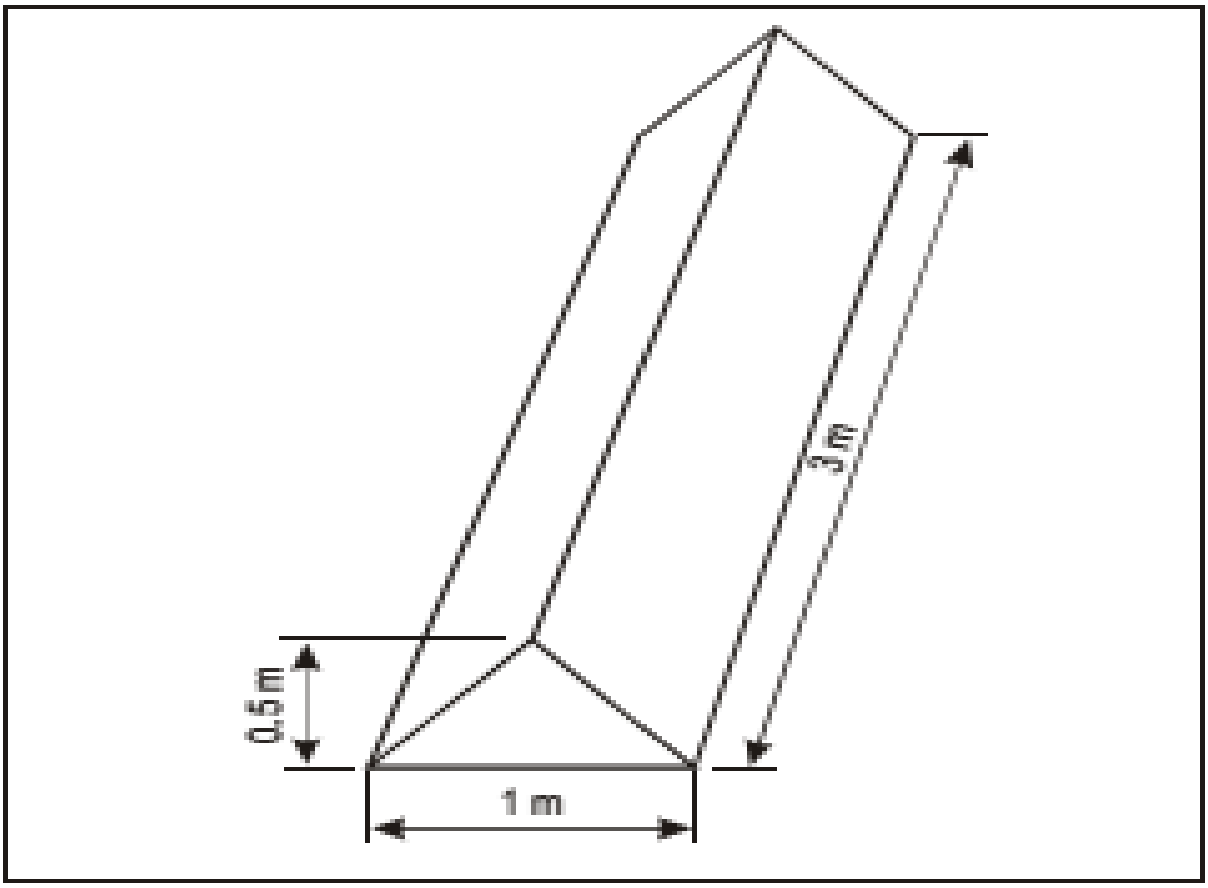


Figure 12. 43: Boundary markers

SUBPART 13 - VISUAL AIDS FOR DENOTING OBSTACLES

139.13.2 Objects to be marked or lighted

Note. The marking and/or lighting of obstacles is intended to reduce hazards to aircraft by indicating the presence of the obstacles. It does not necessarily reduce operating limitations which may be imposed by an obstacle.

1. **Objects within the lateral boundaries of the obstacle limitation surface**

1.1 Vehicles and other mobile objects, excluding aircraft, on the movement area of an aerodrome are obstacles and must be marked and, if the vehicles and aerodrome are used at night or in conditions of low visibility, lighted, except that aircraft servicing equipment and vehicles used only on aprons may be exempt.

1.2 Elevated aeronautical ground lights within the movement area must be marked so as to be conspicuous by day. Obstacle lights must not be installed on elevated ground lights or signs in the movement area.

1.3 All obstacles within the distance specified in Table 10.5 of NAMCATS -AH Subpart 10, column 11 or 12, from the centre line of a taxiway, an apron taxiway or aircraft stand taxilane must be marked and, if the taxiway, apron taxiway or aircraft stand taxilane is used at night, lighted.

1.4 A fixed obstacle that extends above a take-off climb su -rface within 3 000 m of the inner edge of the take-off climb surface must be marked and, if the runway is used at night, lighted, except that:

(a) such marking and lighting may be omitted when the obstacle is shielded by another fixed obstacle;
(b) the marking may be omitted when the obstacle is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m;
(c) the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day; and
(d) the lighting may be omitted where the obstacle is a lighthouse and an aeronautical study indicates the lighthouse light to be sufficient.

1.5 A fixed object, other than an obstacle, adjacent to a take-off climb surface must be marked and, if the runway is used at night, lighted, if such marking and lighting is considered necessary to ensure its avoidance, except that the marking may be omitted when:

(a) the object is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m; or
(b) the object is lighted by high-intensity obstacle lights by day.

1.6 A fixed obstacle that extends above an approach surface within 3 000 m of the inner edge or above a transitional surface must be marked and, if the runway is used at night, lighted, except that:

(a) such marking and lighting may be omitted when the obstacle is shielded by another fixed obstacle;
(b) the marking may be omitted when the obstacle is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m;
(c) the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day; and
(d) the lighting may be omitted where the obstacle is a lighthouse and an aeronautical study indicates the lighthouse light to be sufficient.

1.7 A fixed obstacle that extends above a horizontal surface must be marked and, if the aerodrome is used at night, lighted, except that:

(a) such marking and lighting may be omitted when:
   (i) the obstacle is shielded by another fixed obstacle; or
   (ii) for a circuit extensively obstructed by immovable objects or terrain, procedures have been established to ensure safe vertical clearance below prescribed flight paths; or
   (iii) an aeronautical study shows the obstacle not to be of operational significance;

(b) the marking may be omitted when the obstacle is lighted by medium-intensity obstacle lights, Type A, by day and its height above the level of the surrounding ground does not exceed 150 m;

(c) the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day; and

(d) the lighting may be omitted where the obstacle is a lighthouse and an aeronautical study indicates the lighthouse light to be sufficient.

1.8 A fixed object that extends above an obstacle protection surface must be marked and, if the runway is used at night, lighted.

1.9 Other objects inside the obstacle limitation surfaces must be marked and/or lighted if an aeronautical study indicates that the object could constitute a hazard to aircraft (this includes objects adjacent to visual routes e.g. waterway or highway).

1.10 Overhead wires, cables, etc., crossing a river, waterway, valley or highway must be marked and their supporting towers marked and lighted if an aeronautical study indicates that the wires or cables could constitute a hazard to aircraft.

2. Objects outside the lateral boundaries of the obstacle limitation surfaces

2.1 Obstacles outside the lateral boundaries of the obstacle limitation surface must be marked and lighted, except that the marking may be omitted when the obstacle is lighted by high-intensity obstacle lights by day.

2.2 Other objects outside the obstacle limitation surfaces must be marked and/or lighted if an aeronautical study indicates that the object could constitute a hazard to aircraft (this includes objects adjacent to visual routes e.g. waterway, highway).

2.3 Overhead wires, cables, etc., crossing a river, waterway, valley or highway must be marked and their supporting towers marked and lighted if an aeronautical study indicates that the wires or cables could constitute a hazard to aircraft.

139.13.3 Marking and lighting of objects

1. General

1.1 The presence of objects which must be lighted, as specified in NAMCARs 139.13.2, must be indicated by low-, medium- or high intensity obstacle lights, or a combination of such lights.

1.2 Low-intensity obstacle lights, Types A B, C, D and E, medium-intensity obstacle lights, Types A, B and C, high-intensity obstacle lights Type A and B, must be in accordance with the specifications in Table 13.1 and Appendix 1.

1.3 The number and arrangement of low-, medium- or high-intensity obstacle lights at each level to be marked must be such that the object is indicated from every angle in azimuth. Where a light is shielded in any direction by another part of the object, or by an adjacent object, additional lights must be provided on that adjacent object or the part of the object that is shielding the light, in such a way as to retain the general definition of the object to be lighted. If the shielded light does not contribute to the definition of the object to be lighted, it may be omitted.

Table 13. 1: Characteristics of obstacle lights

1	2	3	4	5	6	7
Light Type	Colour	Signal type/ (flash rate)	Peak intensity (cd) at given Background Luminance (b)			Light Distribution Table
			Day (Above 500 cd/m^2)	Twilight (50-500 cd/m^2)	Night (Below 50 cd/m^2)	
Low-intensity, Type A (fixed obstacle)	Red	Fixed	N/A	N/A	10	Table 13.2
Low-intensity, Type B (fixed obstacle)	Red	Fixed	N/A	N/A	32	Table 13.2
Low-intensity, Type C (mobile obstacle)	Yellow/Blue (a)	Flashing (60-90 fpm)	N/A	40	40	Table 13.2
Low-intensity, Type D (follow-me vehicle)	Yellow	Flashing (60-90 fpm)	N/A	200	200	Table 13.2
Low-intensity, Type E	Red	Flashing (c)	N/A	N/A	32	Table 13.2 (Type B)

Medium-intensity, Type A	White	Flashing (20–60 fpm)	200,00	20,000	2,000	Table 13.3
Medium-intensity, Type B	Red	Flashing (20–60 fpm)	N/A	N/A	2,000	Table 13.3
Medium-intensity, Type C	Red	Fixed	N/A	N/A	2,000	Table 13.3
High-intensity, Type A	White	Flashing (40–60 fpm)	200,000	200,00	2,000	Table 13.3
High-intensity, Type B	White	Flashing (40–60 fpm)	100,000	20,000	2,000	Table 13.3
a. See 2.6 b. For wind turbine application, to flash at the same rate as the lighting on the nacelle.						

Table 13. 2:Light distribution for low-intensity obstacle lights

	Minimum intensity (a)	Maximum intensity (a)	Vertical beam spread (f)	
			Minimum beam spread	Intensity
Type A	10 cd (b)	N/A	10°	5 cd
Type B	32 cd (b)	N/A	10°	16 cd
Type C	40 cd (b)	400 cd	12° (d)	20 cd
Type D	200 cd (c)	400 cd	N/A (e)	N/A

Table 13. 3:Light distribution for medium- and high-intensity obstacle lights according to benchmark intensities of Table 13.1

Benchmark intensity	Minimum requirements					Recommendations				
	Vertical elevation angle (b)			Vertical beam spread (c)		Vertical elevation angle (b)			Vertical beam spread (c)	
	0°		-1°			0°	-1°	-10°		
	Minimum average intensity (a)	Minimum intensity (a)	Minimum intensity (a)	Minimum beam spread	Intensity (a)	Maximum intensity (a)	Maximum intensity (a)	Maximum intensity (a)	Maximum beam spread	Intensity (a)
200 000	200 000	150 000	75 000	3°	75 000	250 000	112 500	7 500	7°	75 000
100 000	100 000	75 000	37 500	3°	37 500	125 000	56 250	3 750	7°	37 500
20 000	20 000	15 000	7 500	3°	7 500	25 000	11 250	750	N/A	N/A
2 000	2 000	1 500	750	3°	750	2 500	1 125	75	N/A	N/A

2. Mobile objects

Marking

2.1 All mobile objects to be marked must be coloured or display flags.

Marking by colour

2.2 When mobile objects are marked by colour, a single conspicuous colour, preferably red or yellowish green for emergency vehicles and yellow for service vehicles, must be used.

Marking by flags

2.3 Flags used to mark mobile objects must be displayed around, on top of, or around the highest edge of the object. Flags must not increase the hazard presented by the object they mark.

2.4 Flags used to mark mobile objects must not be less than 0.9 m on each side and must consist of a chequered pattern, each square having sides of not less than 0.3 m. The colours of the pattern must contrast each with the other and with the background against which they will be seen. Orange and white or alternatively red and white must be used, except where such colours merge with the background.

Lighting

2.5 Low-intensity obstacle lights, Type C, must be displayed on vehicles and other mobile objects excluding aircraft.

2.6 Low-intensity obstacle lights, Type C, displayed on vehicles associated with emergency or security must be flashing-blue and those displayed on other vehicles must be flashing-yellow.

2.7 Low-intensity obstacle lights, Type D, must be displayed on follow-me vehicles.

2.8 Low-intensity obstacle lights on objects with limited mobility such as aerobridges must be fixed-red, and as a minimum be in accordance with the specifications for low-intensity obstacle lights, Type A, in Table 13.1. The intensity of the lights must be sufficient to ensure conspicuity considering the intensity of the adjacent lights and the general levels of illumination against which they would normally be viewed.

3. Fixed objects

Note. The fixed objects of wind turbines are addressed separately in sub-section 4 below and the fixed objects of overhead wires, cables, etc., and supporting towers are addressed separately in sub-section 5 below.

Marking

3.1 All fixed objects to be marked must, whenever practicable, be coloured, but if this is not practicable, markers or flags must be displayed on or above them, except that objects that are sufficiently conspicuous by their shape, size or colour need not be otherwise marked

Marking by colour

3.2 An object must be coloured to show a chequered pattern if it has essentially unbroken surfaces and its projection on any vertical plane equals or exceeds 4.5 m in both dimensions. The pattern must consist of rectangles of not less than 1.5 m and not more than 3 m on a side, the corners being of the darker colour. The colours of the pattern must contrast each with the other and with the background against which they will be seen. Orange and white or alternatively red and white must be used, except where such colours merge with the background. (See Figure 13.1.).

3.3 An object may be coloured to show alternating contrasting bands if:

(a) it has essentially unbroken surfaces and has one dimension, horizontal or vertical, greater than 1.5 m, and the other dimension, horizontal or vertical, less than 4.5 m; or

(b) it is of skeletal type with either a vertical or a horizontal dimension greater than 1.5 m.

The bands must be perpendicular to the longest dimension and have a width approximately 1/7 of the longest dimension or 30 m, whichever is less. The colours of the bands must contrast with the background against which they will be seen. Orange and white must be used, except where such colours are not conspicuous when viewed against the background. The bands on the extremities of the object must be of the darker colour. (See Figures 13.1 and 13.2.)

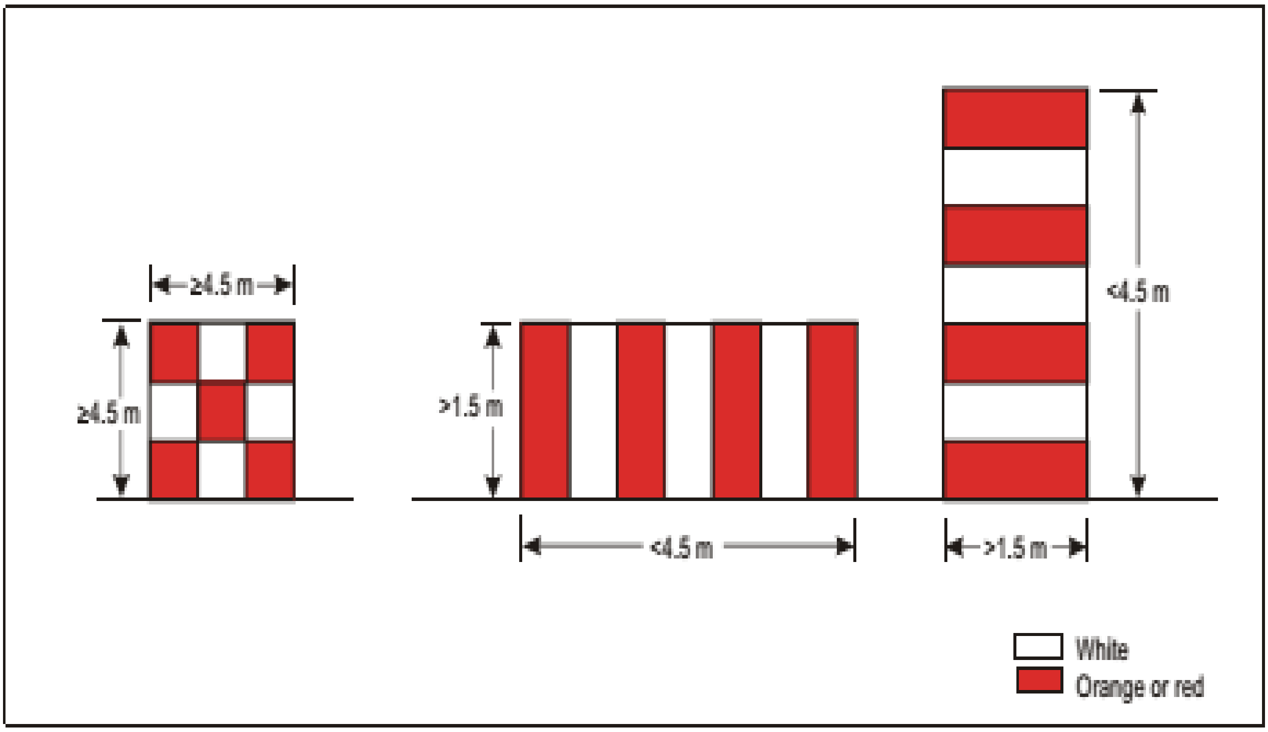


Figure 13. 1: Basic marking patterns

Note. Table 13.4 shows a formula for determining band widths and for having an odd number of bands, thus permitting both the top and bottom bands to be of the darker colour.

Table 13. 4: Marking band widths

Longest dimension		
Greater than	Not exceeding	Band width
1.5 m	210 m	1/7 of longest dimension
210 m	270 m	1/9 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

3.4 An object must be coloured in a single conspicuous colour if its projection on any vertical plane has both dimensions less than 1.5 m. Orange or red must be used, except where such colours merge with the background.

Note. Against some backgrounds it may be found necessary to use a different colour from orange or red to obtain sufficient contrast.

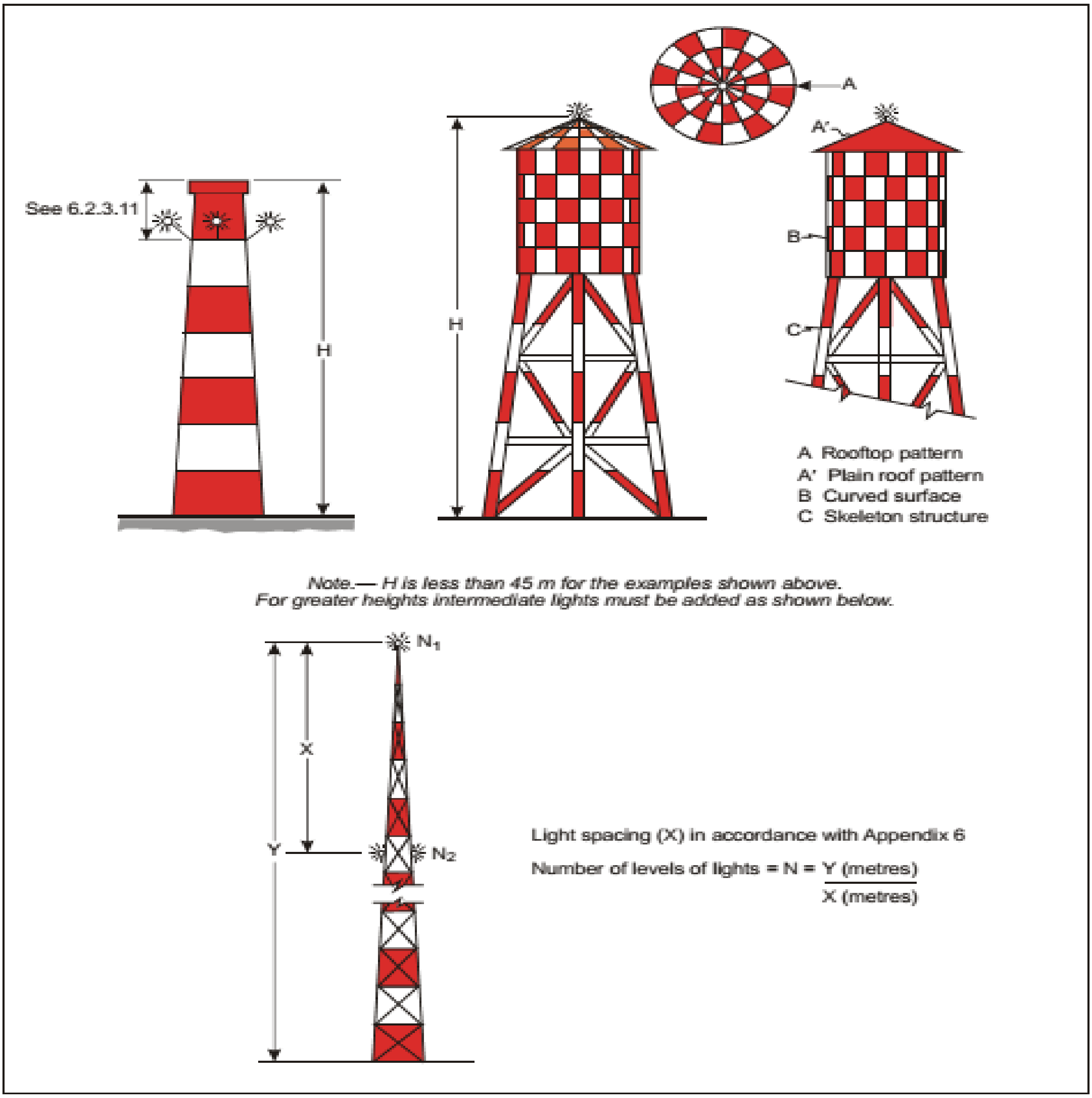


Figure 13. 2: Examples of marking and lighting of tall structures

Marking by flags

3.5 Flags used to mark fixed objects must be displayed around, on top of, or around the highest edge of, the object. When flags are used to mark extensive objects or groups of closely spaced objects, they must be displayed at least every 15 m. Flags must not increase the hazard presented by the object they mark.

3.6 Flags used to mark fixed objects must not be less than 0.6 m on each side.

3.7 Flags used to mark fixed objects must be orange in colour or a combination of two triangular sections, one orange and the other white, or one red and the other white, except that where such colours merge with the background, other conspicuous colours may be used.

Marking by markers

3.8 Markers displayed on or adjacent to objects must be located in conspicuous positions so as to retain the general definition of the object and must be recognizable in clear weather from a distance of at least 1 000 m for an object to be viewed from the air and 300 m for an object to be viewed from the ground in all directions in which an aircraft is likely to approach the object. The shape of markers must be distinctive to the extent necessary to ensure that they are not mistaken for markers employed to convey other information, and they must be such that the hazard presented by the object they mark is not increased.

3.9 A marker must be of one colour. When installed, white and red, or white and orange markers must be displayed alternately. The colour selected must contrast with the background against which it will be seen.

Lighting

3.10 In the case of an object to be lighted, one or more low-, medium- or high-intensity obstacle lights must be located as close as practicable to the top of the object.

3.11 In the case of chimney or other structure of like function, the top lights must be placed sufficiently below the top so as to minimize contamination by smoke, etc. (See Figure 13.2)

3.12 In the case of a tower or antenna structure indicated by high-intensity obstacle lights by day with an appurtenance, such as a rod or an antenna, greater than 12 m where it is not practicable to locate a high-intensity obstacle light on the top of the appurtenance, such a light must be located at the highest practicable point and, if practicable, a medium-intensity obstacle light, Type A, mounted on the top.

3.13 In the case of an extensive object or of a group of closely spaced objects to be lighted that are:

(a) penetrating a horizontal obstacle limitation surface (OLS) or located outside an OLS, the top lights must be so arranged as to at least indicate the points or edges of the object highest in relation to the obstacle limitation surface or above the ground, and so as to indicate the general definition and the extent of the objects; and

(b) penetrating a sloping OLS, the top lights must be so arranged as to at least indicate the points or edges of the object highest in relation to the OLS, and so as to indicate the general definition and the extent of the objects. If two or more edges are of the same height, the edge nearest the landing area must be marked.

3.14 When the obstacle limitation surface concerned is sloping and the highest point above the OLS is not the highest point of the object, additional obstacle lights must be placed on the highest point of the object.

3.15 Where lights are applied to display the general definition of an extensive object or a group of closely spaced objects, and

(a) low-intensity lights are used, they must be spaced at longitudinal intervals not exceeding 45 m;
(b) medium-intensity lights are used, they must be spaced at longitudinal intervals not exceeding 900 m.

3.16 High-intensity obstacle lights, Type A, and medium-intensity obstacle lights, Types A and B, located on an object must flash simultaneously.

3.17 The installation setting angles for high-intensity obstacle lights, Type A, must be in accordance with Table 13.5.

Table 13. 5: Installation setting angles for high-intensity obstacle lights

Height of light unit above terrain (AGL		Angle of the peak of the beam above the horizontal
Greater than	Not exceeding	
151 m		0º
122 m	151 m	1 º
92 m	122 m	2 º
	92 m	3 º

3.18 Where, in the opinion of the aerodrome operator, the use of high-intensity obstacle lights, Type A, or medium-intensity obstacle lights, Type A, at night may dazzle pilots in the vicinity of an aerodrome (within approximately 10 000 m radius) or cause significant environmental concerns, a dual obstacle lighting system may be provided. This system must be composed of high-intensity obstacle lights, Type A, or medium-intensity obstacle lights, Type A, as appropriate, for daytime and twilight use and medium-intensity obstacle lights, Type B or C, for night-time use.

Lighting of objects with a height less than 45 m above ground level

3.19 Low-intensity obstacle lights, Type A or B, may be used where the object is a less extensive one and its height above the surrounding ground is less than 45 m.

3.20 Where the use of low-intensity obstacle lights, Type A or B, would be inadequate or an early special warning is required, then medium- or high-intensity obstacle lights may be used.

3.21 Low-intensity obstacle lights, Type B, may be used either alone or in combination with medium-intensity obstacle lights, Type B, in accordance with 3.22 below.

3.22 Medium-intensity obstacle lights, Type A, B or C, may be used where the object is an extensive one. Medium-intensity obstacle lights, Types A and C, may be used alone, whereas medium-intensity obstacle lights, Type B, may be used either alone or in combination with low-intensity obstacle lights, Type B.

Note. A group of buildings is regarded as an extensive object.

Lighting of objects with a height 45 m to a height less than 150 m above ground level

3.23 Medium-intensity obstacle lights, Type A, B or C, must be used. Medium-intensity obstacle lights, Types A and C, must be used alone, whereas medium-intensity obstacle lights, Type B, may be used either alone or in combination with low-intensity obstacle lights, Type B.

3.24 Where an object is indicated by medium-intensity obstacle lights, Type A, and the top of the object is more than 105 m above the level of the surrounding ground or the elevation of tops of nearby buildings (when the object to be marked is surrounded by buildings), additional lights must be provided at intermediate levels. These additional intermediate lights must be spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 105 m.

3.25 Where an object is indicated by medium-intensity obstacle lights, Type B, and the top of the object is more than 45 m above the level of the surrounding ground or the elevation of tops of nearby buildings (when the object to be marked is surrounded by buildings), additional lights must be provided at intermediate levels. These additional intermediate lights must be alternately low-intensity obstacle lights, Type B, and medium-intensity obstacle lights, Type B, and must be spaced as equally as practicable between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 52 m.

3.26 Where an object is indicated by medium-intensity obstacle lights, Type C, and the top of the object is more than 45 m above the level of the surrounding ground or the elevation of tops of nearby buildings (when the object to be marked is surrounded by buildings), additional lights must be provided at intermediate levels. These additional intermediate lights must be spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 52 m.

3.27 Where high-intensity obstacle lights, Type A, are used, they must be spaced at uniform intervals not exceeding 105 m between the ground level and the top light(s) specified in 3.10, except that where an object to be marked is surrounded by buildings, the elevation of the tops of the buildings may be used as the equivalent of the ground level when determining the number of light levels.

Lighting of objects with a height 150 m or more above ground level

3.28 High-intensity obstacle lights, Type A, must be used to indicate the presence of an object if its height above the level of the surrounding ground exceeds 150 m and an aeronautical study indicates such lights to be essential for the recognition of the object by day.

3.29 Where high-intensity obstacle lights, Type A, are used, they must be spaced at uniform intervals not exceeding 105 m between the ground level and the top light(s) specified in 3.10 above, except that where an object to be marked is surrounded by buildings, the elevation of the tops of the buildings may be used as the equivalent of the ground level when determining the number of light levels.

3.30 Where, in the opinion of the aerodrome operator, the use of high-intensity obstacle lights, Type A, at night may dazzle pilots in the vicinity of an aerodrome (within approximately 10 000 m radius) or cause significant environmental concerns, medium-intensity obstacle lights, Type C, must be used alone, whereas medium intensity obstacle lights, Type B, may be used either alone or in combination with low-intensity obstacle lights, Type B.

3.31 Where an object is indicated by medium-intensity obstacle lights, Type A, additional lights must be provided at intermediate levels. These additional intermediate lights must be spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 105 m.

3.32 Where an object is indicated by medium-intensity obstacle lights, Type B, additional lights must be provided at intermediate levels. These additional intermediate lights must be alternately low-intensity obstacle lights, Type B, and medium-intensity obstacle lights, Type B, and must be spaced as equally as practicable between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 52 m.

3.33 Where an object is indicated by medium-intensity obstacle lights, Type C, additional lights must be provided at intermediate levels. These additional intermediate lights must be spaced as equally as practicable, between the top lights and ground level or the level of tops of nearby buildings, as appropriate, with the spacing not exceeding 52 m.

4. Wind Turbines

4.1 A wind turbine must be marked and/or lighted if it is determined to be an obstacle.

Marking

4.2 The rotor blades, nacelle and upper 2/3 of the supporting mast of wind turbines must be painted white, unless otherwise indicated by an aeronautical study.

Lighting

4.3 When lighting is deemed necessary, in the case of a wind farm, i.e. a group of two or more wind turbines, the wind farm must be regarded as an extensive object and the lights must be installed:

(a) to identify the perimeter of the wind farm;
(b) respecting the maximum spacing between the lights along the perimeter, unless a dedicated assessment shows that a greater spacing can be used;
(c) so that, where flashing lights are used, they flash simultaneously throughout the wind farm;
(d) so that, within a wind farm, any wind turbines of significantly higher elevation are also identified wherever they are located; and
(e) at locations prescribed in (a), (b) and (d) above, 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 must 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 must be provided in case of failure of the operating light. The lights must 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, as specified in 1.3 above, must 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 4.3 (e) does not address wind turbines of more than 315 m of overall height. For such wind turbines, additional marking and lighting may be required as determined by an aeronautical study.

4.4 The obstacle lights must be installed on the nacelle in such a manner as to provide an unobstructed view for aircraft approaching from any direction.

4.5 Where lighting is deemed necessary for a single wind turbine or short line of wind turbines, the installation must be in accordance with 4.3 (e) or as determined by an aeronautical study.

5. Overhead wires, cables, etc., and supporting towers

Marking

5.1 The wires, cables, etc., to be marked must be equipped with markers; the supporting tower must be coloured.

Marking by colours

5.2 The supporting towers of overhead wires, cables, etc., that require marking must be marked in accordance with 3.1 to 3.4, except that the marking of the supporting towers may be omitted when they are lighted by high-intensity obstacle lights by day.

Marking by markers

5.3 Markers displayed on or adjacent to objects must be located in conspicuous positions so as to retain the general definition of the object and must be recognizable in clear weather from a distance of at least 1 000 m for an object to be viewed from the air and 300 m for an object to be viewed from the ground in all directions in which an aircraft is likely to approach the object. The shape of markers must be distinctive to the extent necessary to ensure that they are not mistaken for markers employed to convey other information, and they must be such that the hazard presented by the object they mark is not increased.

5.4 A marker displayed on an overhead wire, cable, etc., must be spherical and have a diameter of not less than 60 cm.

5.5 The spacing between two consecutive markers or between a marker and a supporting tower must be appropriate to the diameter of the marker, but in no case must the spacing exceed:

(a) 30 m where the marker diameter is 60 cm progressively increasing with the diameter of the marker to –
(b) 35 m where the marker diameter is 80 cm and further progressively increasing to a maximum of –
(c) 40 m where the marker diameter is of at least 130 cm.

Where multiple wires, cables, etc., are involved, a marker must be located not lower than the level of the highest wire at the point marked.

5.6 A marker must be of one colour. When installed, white and red, or white and orange markers must be displayed alternately. The colour selected must contrast with the background against which it will be seen.

5.7 When it has been determined that an overhead wire, cable, etc., needs to be marked but it is not practicable to install markers on the wire, cable, etc., then high-intensity obstacle lights, Type B, must be provided on their supporting towers.

Lighting

5.8 High-intensity obstacle lights, Type B, must be used to indicate the presence of a tower supporting overhead wires, cables, etc., where:

(a) an aeronautical study indicates such lights to be essential for the recognition of the presence of wires, cables, etc.; or
(b) it has not been found practicable to install markers on the wires, cables, etc.

5.9 Where high-intensity obstacle lights, Type B, are used, they must be located at three levels:

- at the top of the tower;
- at the lowest level of the catenary of the wires or cables; and
- at approximately midway between these two levels.

Compliance Note. In some cases, this may require locating the lights off the tower.

5.10 High-intensity obstacle lights, Type B, indicating the presence of a tower supporting overhead wires, cables, etc., must flash sequentially; first the middle light, second the top light and last, the bottom light. The intervals between flashes of the lights must approximate the following ratios:

Flash interval between	*Ratio of cycle time*
middle and top light	1/13
top and bottom light	2/13
bottom and middle light	10/13.

Note. High-intensity obstacle lights are intended for day use as well as night use. Care is needed to ensure that these lights do not create disconcerting dazzle. For objects extending more than 150 m above the surrounding ground level, high-intensity obstacle lights will normally be used to meet the operational requirements.

5.11 Where, in the opinion of the aerodrome operator, the use of high-intensity obstacle lights, Type B, at night may dazzle pilots in the vicinity of an aerodrome (within approximately 10 000 m radius) or cause significant environmental concerns, a dual obstacle lighting system may be provided. This system must be composed of high-intensity obstacle lights, Type B, for daytime and twilight use and medium-intensity obstacle lights, Type B, for nighttime use. Where medium-intensity lights are used they must be installed at the same level as the high-intensity obstacle light Type B.

5.12 The installation setting angles for high-intensity obstacle lights, Type B, must be in accordance with Table 13.5.

5.13 High-intensity obstacle lights require a power input of approximately 200 W per light. Wire size on the structure should be based on 400 V/A average input per light. If transformers must be used, they should be designed to 600 V/A in order to prevent core saturation during peak current demands. High-intensity obstacle lights are usually operated at 240 V or 480 V to minimize wire and conduit size, but voltages as low as 120 V can be used. Both 50Hz and 60 Hz systems are available.

SUBPART 14 - VISUAL AIDS FOR DENOTING RESTRICTED USE AREAS

139.14.2 Closed runways and taxiways or parts thereof

1.1 A closed marking must be displayed on a runway or taxiway or portion thereof which is permanently closed to the use of all aircraft.

1.2 A closed marking must be displayed on a temporarily closed runway or taxiway or portion thereof, except that such marking may be omitted when the closing is of short duration and adequate warning by air traffic services is provided.

1.3 On a runway a closed marking must be placed at each end of the runway, or portion thereof, declared closed, and additional markings must be so placed that the maximum interval between markings does not exceed 300 m. On a taxiway a closed marking must be placed at least at each end of the taxiway or portion thereof closed.

1.4 The closed marking must be of the form and proportions as detailed in Figure 14.1, Illustration a), when displayed on a runway, and must be of the form and proportions as detailed in Figure 14.1, Illustration b), when displayed on a taxiway. The marking must be white when displayed on a runway and must be yellow when displayed on a taxiway.

Compliance Note. When an area is temporarily closed, frangible barriers or markings utilizing materials other than paint or other suitable means may be used to identify the closed area.

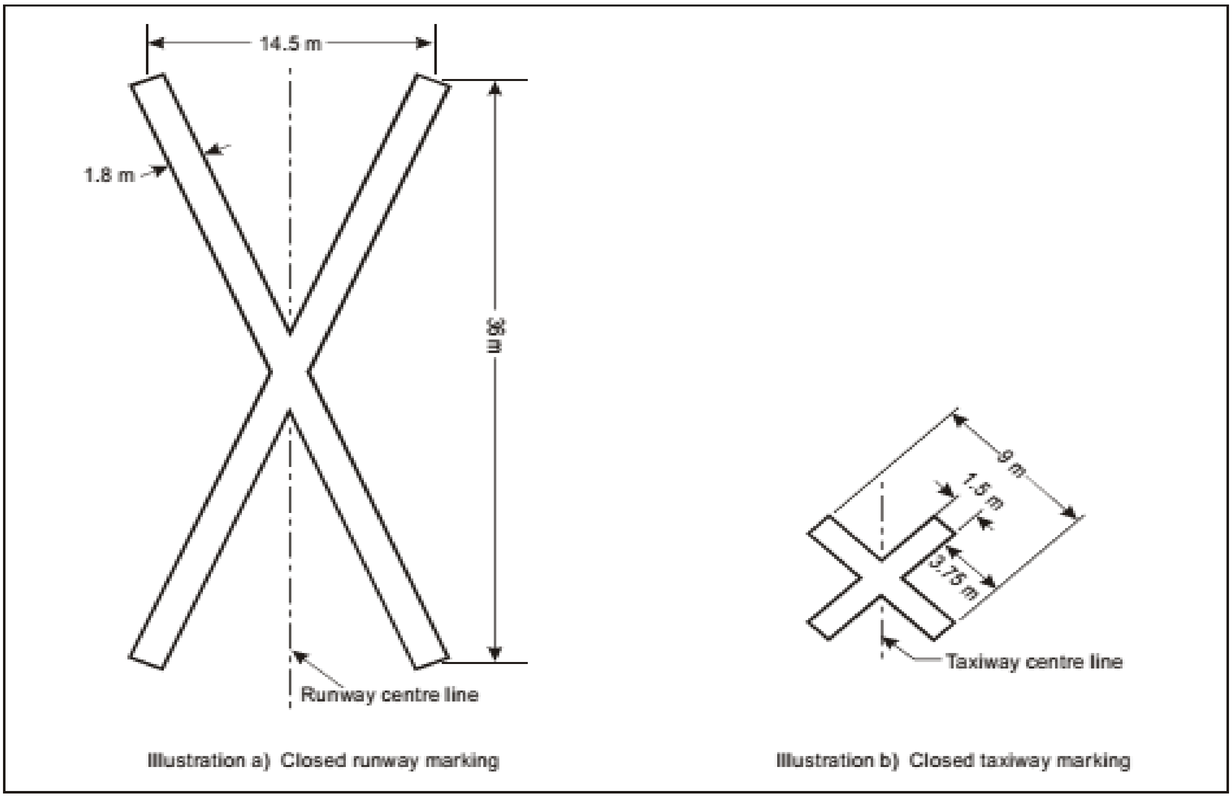


Figure 14. 1: Closed runway and taxiway markings

1.5 When a runway or taxiway or portion thereof is permanently closed, all normal runway and taxiway markings must be obliterated.

1.6 Lighting on a closed runway or taxiway or portion thereof must not be operated, except as required for maintenance purposes.

1.7 In addition to closed markings, when the runway or taxiway or portion thereof closed is intercepted by a usable runway or taxiway which is used at night, unserviceability lights must be placed across the entrance to the closed area at intervals not exceeding 3 m.

139.14.3 Non-load-bearing surface

1.1 Shoulders for taxiways, runway turn pads, holding bays and aprons and other non-load-bearing surfaces which cannot readily be distinguished from load-bearing surfaces and which, if used by aircraft, might result in damage to the aircraft must have the boundary between such areas and the load-bearing surface marked by a taxi side stripe marking.

1.2 A taxi side stripe marking must be placed along the edge of the load-bearing pavement, with the outer edge of the marking approximately on the edge of the load-bearing pavement.

1.3 A taxi side stripe marking must consist of a pair of solid lines, each 15 cm wide and spaced 15 cm apart and the same colour as the taxiway centre line marking.

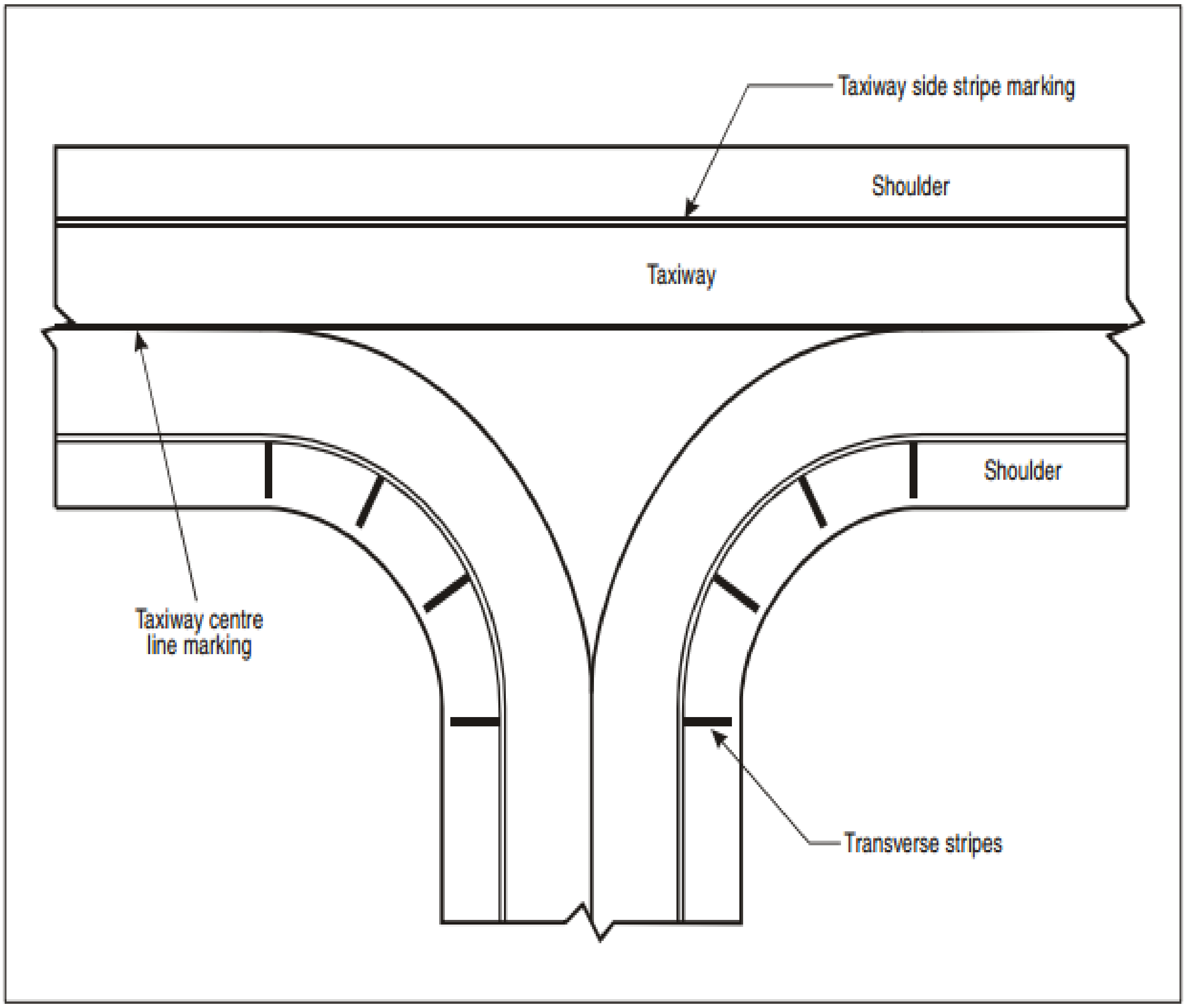


Figure 14. 2: Taxiway side strip marking and transverse stripes

139.14.4 Pre-threshold area

1.1 When the surface before a threshold is paved and exceeds 60 m in length and is not suitable for normal use by aircraft, the entire length before the threshold must be marked with a chevron marking.

1.2 A chevron marking must point in the direction of the runway and be placed as shown in Figure 14.2.

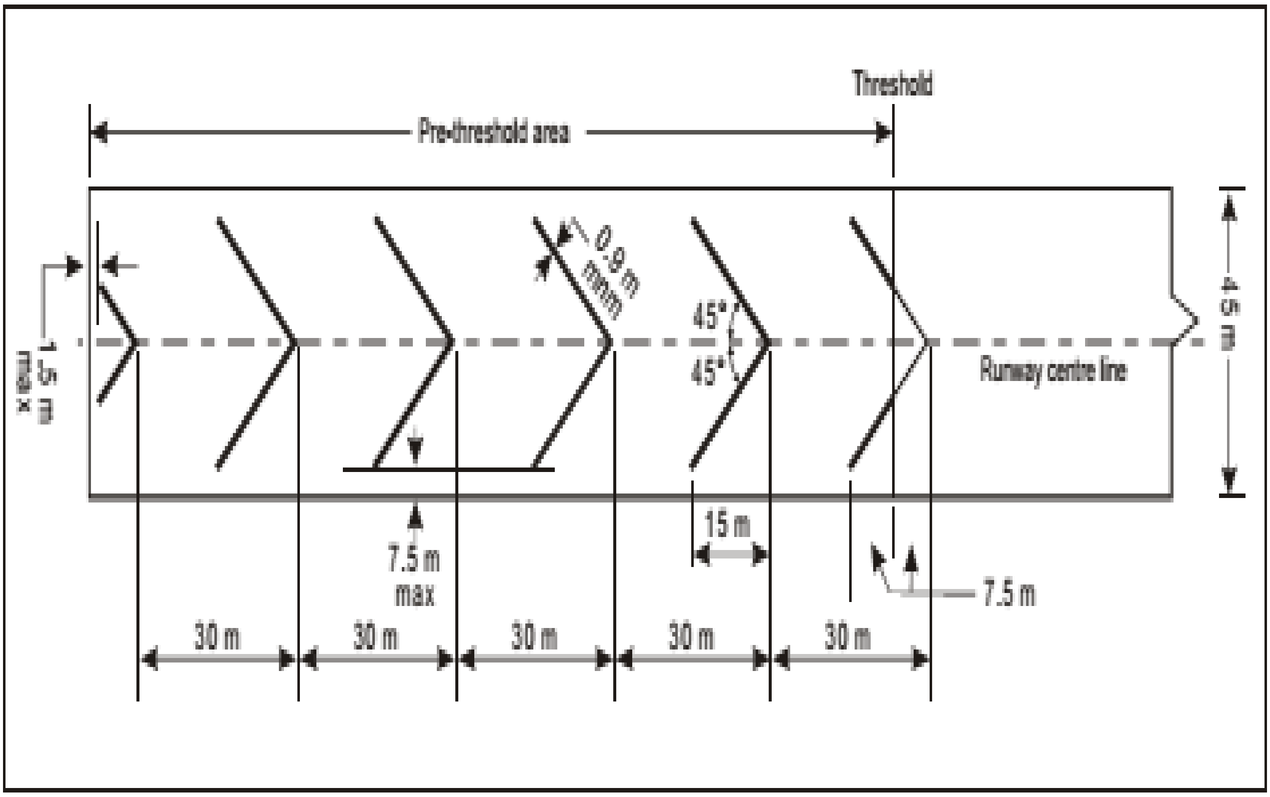


Figure 14. 3: Pre-threshold marking

1.3 A chevron marking must be of conspicuous colour and contrast with the colour used for the runway markings; it must preferably be yellow. It must have an overall width of at least 0.9 m.

139.14.5 Unserviceable areas

Application

1.1 Unserviceability markers must be displayed wherever any portion of a taxiway, apron or holding bay is unfit for the movement of aircraft but it is still possible for aircraft to bypass the area safely. On a movement area used at night, unserviceability lights must be used.

Location

1.2 Unserviceability markers and lights must be placed at intervals sufficiently close so as to delineate the unserviceable area.

1.2.1 Where a temporarily unserviceable area exists, it may be marked with fixed-red lights:

(a) These lights must mark the most potentially dangerous extremities of the area;

(b) A minimum of four such lights must be used, except where the area is triangular in shape where a minimum of three lights may be employed;

(c) The number of lights must be increased when the area is large or of unusual configuration;

(d) At least one light must be installed for each 7.5 m of peripheral distance of the area;

(e) If the lights are directional, they must be orientated so that as far as possible their beams are aligned in the direction from which aircraft or vehicles will approach; and

(f) Where aircraft or vehicles will normally approach from several directions, consideration must be given to adding extra lights or using omnidirectional lights to show the area from these directions.

1.2.2 Unserviceable area lights must be frangible. Their height must be sufficiently low to preserve clearance for propellers and for engine pods of jet aircraft.

Characteristics of unserviceability markers

1.3 Unserviceability markers must consist of conspicuous upstanding devices such as flags, cones or marker boards.

Characteristics of unserviceability lights

1.4 An unserviceability light must consist of a red fixed light. The light must have an intensity sufficient to ensure conspicuity considering the intensity of the adjacent lights and the general level of illumination against which it would normally be viewed. In no case must the intensity be less than 10 cd of red light.

Characteristics of unserviceability cones

1.5 An unserviceability cone must be at least 0.5 m in height and red, orange or yellow or any one of these colours in combination with white.

Characteristics of unserviceability flags

1.6 An unserviceability flag must be at least 0.5 m square and red, orange or yellow or any one of these colours in combination with white.

Characteristics of unserviceability marker boards

1.7 An unserviceability marker board must be at least 0.5 m in height and 0.9 m in length, with alternate red and white or orange and white vertical stripes.

SUBPART 15 - ELECTRICAL SYSTEMS

139.15.2 Electrical power supply system for air navigation facilities

Introductory Note. The safety of operations at aerodromes depends on the quality of the supplied electrical power. The total electrical power supply system may include connections to one or more external sources of electrical power supply, one or more local generating facilities and to a distribution network including transformers and switchgears. Many other aerodrome facilities supplied from the same system need to be taken into account while planning the electrical power system at aerodromes.

1.1 Adequate primary electrical power supply must be available at aerodromes for the safe functioning of air navigation facilities.

1.2 The design and provision of electrical power systems for aerodrome visual and radio navigation aids must be such that an equipment failure will not leave the pilot with inadequate visual and non-visual guidance or misleading information.

Note. The design and installation of the electrical systems need to take into consideration factors that can lead to malfunction, such as electromagnetic disturbances, line losses, power quality, etc.

1.3 Electrical power supply connections to those facilities for which secondary or ”standby” power is required must be so arranged that the facilities are automatically connected to the secondary power supply on failure of the primary source of power.

1.4 The time interval between failure of the primary source of power and the complete restoration of the services required by 1.10 must be as short as practicable, except that for visual aids associated with non-precision, precision approach or take-off runways the requirements of Table 15.1 for maximum switch-over times must apply.

Table 15. 1: Secondary power supply requirements

Runway	Lighting aids requiring power	Maximum switch-over time
Non-instrument	Visual approach slope indicators [a] Runway edge [b] Runway threshold [b] Runway end [b] Obstacle [a]	See 1.4 and 1.9
Non-precision approach	Approach lighting system Visual approach slope indicators [a,d] Runway edge [d] Runway threshold [d] Runway end Obstacle [a]	15 seconds 15 seconds 15 seconds 15 seconds 15 seconds 15 seconds
Precision approach category I	Approach lighting system Runway edge [d] Visual approach slope indicators [a,d] Runway threshold [d] Runway end Essential taxiway [a] Obstacle [a]	15 seconds 15 seconds 15 seconds 15 seconds 15 seconds 15 seconds 15 seconds

Precision approach category II/III	Inner 300 m of the approach lighting system	1 second
	Other parts of the approach lighting system	15 seconds
	Obstacle [a]	15 seconds
	Runway edge	15 seconds
	Runway threshold	1 second
	Runway end	1 second
	Runway centre line	1 second
	Runway touchdown zone	1 second
	All stop bars	1 second
	Essential taxiway	15 seconds
Runway meant for take-off in runway visual range conditions less than a value of 800 m	Runway edge	15 seconds [c]
	Runway end	1 second
	Runway centre line	1 second
	All stop bars	1 second
	Essential taxiway [a]	15 second
	Obstacle [a]	15 second

a. Supplied with secondary power when their operation is essential to the safety of flight operation.
b. See NAMCARs 139.12.7, sub-section 2 regarding the use of emergency lighting.
c. One second where no runway centre line lights are provided.
d. One second where approaches are over hazardous or precipitous terrain.

1.5 The provision of a definition of switch-over time must not require the replacement of an existing secondary power supply before 1 January 2010. However, for a secondary power supply installed after 4 November 1999, the electric power supply connections to those facilities for which secondary power is required must be so arranged that the facilities are capable of meeting the requirements of Table 15.1 for maximum switch-over times.

Visual aids

1.6 For a precision approach runway, a secondary power supply capable of meeting the requirements of Table 15.1 for the appropriate category of precision approach runway must be provided. Electric power supply connections to those facilities for which secondary power is required must be so arranged that the facilities are automatically connected to the secondary power supply on failure of the primary source of power.

1.7 For a runway meant for take-off in runway visual range conditions less than a value of 800 m, a secondary power supply capable of meeting the relevant requirements of Table 15.1 must be provided.

1.8 At an aerodrome where the primary runway is a non-precision approach runway, a secondary power supply capable of meeting the requirements of Table 15.1 must be provided except that a secondary power supply for visual aids need not be provided for more than one non-precision approach runway.

1.9 At an aerodrome where the primary runway is a non-instrument runway, a secondary power supply capable of meeting the requirements of 1.4 must be provided, except that a secondary power supply for visual aids need not be provided when an emergency lighting system is provided and capable of being deployed in 15 minutes.

1.10 The following aerodrome facilities must be provided with a secondary power supply capable of supplying power when there is a failure of the primary power supply:

(a) the signalling lamp and the minimum lighting necessary to enable air traffic services personnel to carry out their duties;

Compliance Note. The requirement for minimum lighting may be met by other than electrical means. e.g. through portable battery operated or rechargeable lighting systems. Lighting fixtures and design shall provide the lighting levels, visual comfort, color rendering and aesthetics to complement the area where it is installed.

(b) all obstacle lights which, in the opinion of the aerodrome operator, are essential to ensure the safe operation of aircraft;
(c) approach, runway and taxiway lighting;
(d) meteorological equipment;
(e) essential security lighting, if provided;
(f) essential equipment and facilities for the aerodrome responding emergency agencies;
(g) floodlighting on a designated isolated aircraft parking position if provided; and
(h) illumination of apron areas over which passengers may walk.

10.11 Power supply switch-over times for ground-based radio aids used in the vicinity of aerodromes:

The power supply switch-over times for radio navigation aids and ground elements of communication systems are dependent on the type of runway and aircraft operations to be supported. Table 15.2 indicates representative switch-over times which may be met by power supply systems currently available:

Table 15. 2: Power supply switch-over times for ground-based radio aids used at aerodromes

Type of runway	Aids requiring power	Maximum switch-over times (seconds)
Instrument approach	SRE	15
	VOR	15
	NDB	15
	D/F facility	15
Precision approach, Category I	ILS localizer	10
	ILS glide path	10
	ILS middle marker	10
	ILS outer marker	10
	PAR	10
Precision approach, Category II	ILS localizer	0
	ILS glide path	0
	ILS inner marker	1
	ILS middle marker	1
	ILS outer marker	10
Precision approach, Category III	(same as Category II)	

1.11 Requirements for a secondary power supply may be met by either of the following:

- independent public power, which is a source of power supplying the aerodrome service from a substation other than the normal substation through a transmission line following a route different from the normal power supply route and such that the possibility of a simultaneous failure of the normal and independent public power supplies is extremely remote; or
- standby power unit(s), which are engine generators, batteries, etc., from which electric power can be obtained.

- *Note: Localizer, glideslope, and other instrument landing aids (such as microwave transmitters) are both high power consumers and mission-critical, and cannot be reliably operated from a battery supply, even for short periods. Hence, when absolute reliability* *is required (such as when Category 3 operations are in force at the airport) it is usual to run the system from a diesel generator with automatic switchover to the mains supply should the generator fail. The emergency power system shall be fed from an on-site diesel driven emergency generator set through automatic transfer switch(es).*

139.15.3 Sytems design

1.1 For a runway meant for use in runway visual range conditions less than a value of 550 m, the electrical systems for the power supply, lighting and control of the lighting systems included in Table 15.1 must be so designed that an equipment failure will not leave the pilot with inadequate visual guidance or misleading information.

1.2 Where the secondary power supply of an aerodrome is provided by the use of duplicate feeders, such supplies must be physically and electrically separate so as to ensure the required level of availability and independence.

1.3 Where a runway forming part of a standard taxi-route is provided with runway lighting and taxiway lighting, the lighting systems must be interlocked to preclude the possibility of simultaneous operation of both forms of lighting.

139.15.4 Monitoring

1.1 A system of monitoring must be employed to indicate the operational status of the lighting systems.

1.2 Where lighting systems are used for aircraft control purposes, such systems must be monitored automatically so as to provide an indication of any fault which may affect the control functions. This information must be automatically relayed to the air traffic services unit and/or maintenance crew.

1.3 Where a change in the operational status of lights has occurred, an indication must be provided within two seconds for a stop bar at a runway-holding position and within five seconds for all other types of visual aids.

1.4 For a runway meant for use in runway visual range conditions less than a value of 550 m, the lighting systems detailed in Table 8-1 must be monitored automatically so as to provide an indication when the serviceability level of any element falls below the minimum serviceability level specified in 139.17.6. This information must be automatically relayed to the maintenance crew.

1.5 For a runway meant for use in runway visual range conditions less than a value of 550 m, the lighting systems detailed in Table 8-1 must be monitored automatically to provide an indication when the serviceability level of any element falls below the minimum level specified by the aerodrome operator below which operations must not continue. This information must be automatically relayed to the air traffic services unit and displayed in a prominent position.

SUBPART 16 - AERODROME OPERATIONAL SERVICES, EQUIPMENT AND INSTALLATIONS

139.16.2 Aerodrome emergency planning

1. Introduction

1.1 An aerodrome emergency plan must be established at an aerodrome, commensurate with the aircraft operations and other activities conducted at the aerodrome.

1.2 The aerodrome emergency plan must provide for the coordination of the actions to be taken in an emergency occurring at an aerodrome or in its vicinity.

Note 1. Examples of emergencies are aircraft emergencies, sabotage including bomb threats, unlawfully seized aircraft, dangerous goods occurrences, building fires, natural disaster and public health emergencies.

1.3 The plan must coordinate the response or participation of all existing agencies which, in the opinion of the aerodrome operator, could be of assistance in responding to an emergency.

Note. Examples of agencies but not limited:

- *on the aerodrome: air traffic control units, aerodrome rescue and firefighting services, aerodrome administration, medical and ambulance services, aircraft operators, security services, and police;*
- *off the aerodrome: local authorities fire departments, police, health authorities (including medical, ambulance, hospital and public health services), military, and harbour patrol or coast guard.*

Compliance Note 2. Public health services include planning to minimize adverse effects to the community from health-related events and deal with population health issues rather than provision of health services to individuals.

1.4 The plan must provide for cooperation and coordination with the rescue coordination centre, as necessary.

1.5 The aerodrome emergency plan document must include at least the following:

(a) types of emergencies planned for;

(b) agencies involved in the plan;

(c) responsibility and role of each agency, the emergency operations centre and the command post, for each type of emergency;

(d) information on names and telephone numbers of offices or people to be contacted in the case of a particular emergency; and

(e) a grid map of the aerodrome and its immediate vicinity.

1.6 The plan must observe Human Factors principles to ensure optimum response by all existing agencies participating in emergency operations.

2. Emergency operations centre and mobile command post

2.1 A fixed emergency operations centre and a mobile command post must be available for use during an emergency.

2.2 The emergency operations centre must be a part of the aerodrome facilities and must be responsible for the overall coordination and general direction of the response to an emergency.

2.3 The command post must be a facility capable of being moved rapidly to the site of an emergency, when required, and must undertake the local coordination of those agencies responding to the emergency.

2.4 A person must be assigned to assume control of the emergency operations centre and, when appropriate, another person the command post.

3. Communication system

3.1 Adequate communication systems linking the command post and the emergency operations centre with each other and with the participating agencies must be provided in accordance with the plan and consistent with the particular requirements of the aerodrome.

4. Aerodrome emergency exercise

4.1 The aerodrome emergency plan must contain procedures for periodic testing of the adequacy of the plan and for reviewing the results in order to improve its effectiveness.

Note. The plan includes all participating agencies and associated equipment.

4.2 The plan must be tested by conducting:

(a) 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

(b) a series of modular tests (Tabletop exercises) commencing in the first year and concluding in a full-scaleaerodrome 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.

4.3 Submit a comprehensive written report to the Executive Director within 14 days from the date on which:

(a) a full-scale aerodrome emergency exercise referred to in paragraph (4.2)(a); or

(b) a series of modular tests (Tabletop exercises) referred to in paragraph (4.2)(b), has been undertaken or arranged;

(c) as well as after an actual emergency; and

(d) after activation of the aerodrome emergency plan.

4.4 The written comprehensive report shall include but not limited to:

(a) Review of the incident/accident;
(b) Short comings identified;
(c) Recommendations on the short comings identified; and/or
(d) Proposed actions.

5. Emergencies in difficult environments

5.1 The plan must include the ready availability of, and coordination with, appropriate specialist rescue services to be able to respond to emergencies where an aerodrome is located close to water, sand dunes, mountainous terrain and/or swampy areas and where a significant portion of approach or departure operations takes place over these areas.

5.2 At those aerodromes located close to water and/or swampy areas, or difficult terrain, the aerodrome emergency plan must include the establishment, testing and assessment at regular intervals of a predetermined response for the specialist rescue services.

5.3 An assessment of the approach and departure areas within 1 000 m of the runway threshold must be carried out to determine the options available for intervention.

139.16.3 Rescue and firefighting services

1. Introduction

Compliance Note. The principal objective of a rescue and firefighting service is to save lives in the event of an aircraft accident or incident occurring at, or in the immediate vicinity of, an *aerodrome. The rescue and firefighting service is provided to create and maintain survivable conditions, to provide egress routes for occupants and to initiate the rescue of those occupants unable to make their escape without direct aid. The rescue may require the use of equipment and personnel other than those assessed primarily for rescue and firefighting purposes.*

The most important factors bearing on effective rescue in a survivable aircraft accident are: the training received, the effectiveness of the equipment and the speed with which personnel and equipment designated for rescue and firefighting purposes can be put into use.

Requirements to combat building and fuel farm fires, or to deal with foaming of runways, are not taken into account.

2. Application

2.1. Rescue and firefighting equipment and services must be provided at an aerodrome.

2.2. Public or private organizations, suitably located and equipped, may be designated to provide the rescue and firefighting service. It is intended that the fire station housing these organizations be normally located on the aerodrome, although an off-aerodrome location is not precluded provided the response time can be met.

2.3. Where an aerodrome is located close to water/swampy areas, or difficult terrain, and where a significant portion of approach or departure operations takes place over these areas, specialist rescue services and firefighting equipment appropriate to the hazard and risk must be available.

3. Level of protection to be provided

3.1 The level of protection provided at an aerodrome for rescue and firefighting must be appropriate to the aerodrome category determined using the principles in 3.3 and 3.4 below, except that, where the number of movements of the aeroplanes in the highest category normally using the aerodrome is less than 700 in the busiest consecutive three months, the level of protection provided must be not less than one category below the determined category.

3.2 The level of protection provided at an aerodrome for rescue and firefighting must be equal to the aerodrome category determined using the principles in 3.3 and 3.4 below.

3.3 The aerodrome category must be determined from Table 16.1 and must be based on the longest aeroplanes normally using the aerodrome and their fuselage width.

3.4 If, after selecting the category appropriate to the longest aeroplane's overall length, that aeroplane's fuselage width is greater than the maximum width in Table 16.1, column 3, for that category, then the category for that aeroplane must actually be one category higher.

3.5 During anticipated periods of reduced activity, the level of protection available must be no less than that needed for the highest category of aeroplane planned to use the aerodrome during that time irrespective of the number of movements.

Table 16. 1: Aerodrome category for rescue and firefighting

Aerodrome category (1)	Aeroplane overall length (2)	Maximum fuselage width (3)
1	0 m up to but not including 9 m	2 m
2	9 m up to but not including 12 m	2 m
3	12 m up to but not including 18 m	3 m
4	18 m up to but not including 24 m	4 m
5	24 m up to but not including 28 m	4 m
6	28 m up to but not including 39 m	5 m
7	39 m up to but not including 49 m	5 m
8	49 m up to but not including 61 m	7 m
9	61 m up to but not including 76 m	7 m
10	76 m up to but not including 90 m	8 m

4. Extinguishing agents

4.1 Both principal and complementary agents shall be provided at an aerodrome.

4.2 The principal extinguishing agent shall be:

(a) a foam meeting the minimum performance level A; or

(b) a foam meeting the minimum performance level B; or

(c) a foam meeting the minimum performance level C; or

(d) a combination of these agents;

except that the principal extinguishing agent for aerodromes in categories 1 to 3 must preferably meet a performance level B or C foam.

Compliance note: Frequency of the foam test must be determined based on the manufacturers specifications and provided with Material Safety Data Sheet (MSDS).

4.3 The complementary extinguishing agent must be a dry chemical powder suitable for extinguishing hydrocarbon fires.

Compliance Note 1. When selecting dry chemical powders for use with foam, care must be exercised to ensure compatibility.

4.4 The amounts of water for foam production and the complementary agents to be provided on the rescue and firefighting vehicles must be in accordance with the aerodrome category determined under 3.1, 3.2, 3.3, 3.4 above and Table 16.2 below, except that for aerodrome categories 1 and 2, up to 100 per cent of the water may be substituted with complementary agent.

For the purpose of agent substitution, 1 kg of complementary agent must be taken as equivalent to 1.0 L of water for production of a foam meeting performance level A.

Compliance Note. 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 3.75 L/min/m2 for a foam meeting performance level C.

Compliance Note. When any other complementary agent is used, the substitution ratios need to be checked.

Table 16. 2: Minimum usable amounts of extinguishing agents

	Foam meeting performance level A		Foam meeting performance level B		Foam meeting performance level C		Complementary agents	
Aerodrome category	Water (L)	Discharge rate foam solution/ minute (L)	Water (L)	Discharge rate foam solution/ minute (L)	Water (L)	Discharge rate foam solution/ minute (L)	Dry chemical powders (kg)	Discharge Rate (kg/second)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	350	350	230	230	160	160	45	2.25
2	1000	800	670	550	460	360	90	2.25
3	1800	1300	1200	900	820	630	135	2.25
4	3600	2600	2400	1800	1700	1100	135	2.25

5	8100	4500	5400	3000	3900	2200	180	2.25
6	11800	6000	7900	4000	5800	2900	225	2.25
7	18200	7900	12100	5300	8800	3800	225	2.25
8	27300	10800	18200	7200	12800	5100	450	4.5
9	36400	13500	24300	9000	17100	6300	450	4.5
10	48200	16600	32300	11200	22800	7900	450	4.5
Note. The quantities of water shown in columns 2, 4 and 6 are based on the average overall length of aeroplanes in a given category								

4.5 At aerodromes where operations by aeroplanes larger than the average size in a given category are planned, the quantities of water must be recalculated and the amount of water for foam production and the discharge rates for foam solution must be increased accordingly.

4.6 From 1 January 2015, at aerodromes where operations by aeroplanes larger than the average size in a given category are planned, the quantities of water must be recalculated and the amount of water for foam production and the discharge rates for foam solution must be increased accordingly.

4.7 The quantity of foam concentrates separately provided on vehicles for foam production must be in proportion to the quantity of water provided and the foam concentrate selected.

4.8 The amount of foam concentrate provided on a vehicle must be sufficient to produce at least two loads of foam solution.

4.9 Supplementary water supplies, for the expeditious replenishment of rescue and firefighting vehicles at the scene of an aircraft accident, must be provided.

4.10 When a combination of different performance level foams are provided at an aerodrome, the total amount of water to be provided for foam production must be calculated for each foam type and the distribution of these quantities must be documented for each vehicle and applied to the overall rescue and firefighting requirement.

4.11 The discharge rate of the foam solution must not be less than the rates shown in Table 16.2.

4.12 The complementary agents must comply with the appropriate specifications of the International Organization for Standardization (ISO).

4.13 The discharge rate of complementary agents must be no less than the values shown in Table 16.2.

4.14 Dry chemical powders must only be substituted with an agent that has equivalent or better firefighting capabilities for all types of fires where complementary agent is expected to be used.

4.15 A reserve supply of foam concentrate, equivalent to 200 per cent of the quantities identified in Table 16.2, must be maintained on the aerodrome for vehicle replenishment purposes.

Compliance Note. Foam concentrate carried on fire vehicles in excess of the quantity identified in Table 16.2 can contribute to the reserve.

4.16 A reserve supply of complementary agent, equivalent to 100 per cent of the quantity identified in Table 16.2, must be maintained on the aerodrome for vehicle replenishment purposes.

4.17 Category 1 and 2 aerodromes that have replaced up to 100 per cent of the water with complementary agent must hold a reserve supply of complementary agent of 200 per cent.

4.18 Where a major delay in the replenishment of the supplies is anticipated, the amount of reserve supply in 4.15, 4.16 and 4.17 must be increased as determined by a risk assessment.

5. Rescue equipment

5.1 Aerodrome operators must provide on the rescue and firefighting vehicle(s) at least the following equipment for rescue at the scene of any aircraft accident:

Table 16. 3: Minimum Rescue Equipment list

Equipment scope	*Equipment item*	*Airport category*			
		1-2	3-5	6-7	8-10
Forcible entry tools	Prying tool (hooligan, biel type)	1	1	1	2
	Crowbar 95cm	1	1	1	2
	Axe, rescue small non wedge type	1	1	1	2
	Axe, rescue small non wedge or aircraft type	1	2	2	4
	Cutter bolt 61 cm	1	1	2	2
	Hammer 1.8kg – lump or club type	1	1	2	2
	Chisel cold 2.5 cm	1	1	2	2
A suitable range of rescue/cut-in equipment including powered rescue tools	Hydraulic/electrical (or combination) portable rescue equipment	1	1	1	2
	Powered rescue saw complete with minimum 406 mm diameter spare blades	1	1	1	2
	Reciprocating/oscillating saw	1	1	1	2
A range of equipment for the delivery of firefighting agent	Delivery hoses 30 m lengths x 50 and 64 mm diameters	6	10	16	22
	Foam branches (nozzles)	1	1	2	3
	Water branches (nozzles)	1	2	4	6

	Coupling adaptors	1	1	2	3
	Portable fire extinguishers CO^2				
	DCP	1	1	2	3
		1	1	2	3
Self-contained breathing apparatus – *sufficient to maintain prolonged internal operations* *Note: Ideally one BA set per crew member*	Breathing apparatus (BA) set complete with facemask and air cylinder				
	BA spare air cylinder				
	BA spare facemask				
		Airport category			
Equipment scope	*Equipment item*	*1-2*	*3-5*	*6-7*	*8-10*
Respirators	Full faced respirators complete with filters	One per responding firefighter			
A range of ladders	Extension ladder, rescue and suitable for critical aircraft	-	1	2	3
	Ladder general purpose – rescue capable	1	1	2	3

Protective clothing	Firefighting helmet, coats, over trousers (complete with braces), boots and gloves as a minimum	One set per operational firefighter plus a percentage of reserve stock			
Additional items for personal protection	Protective goggles	1	1	2	3
	Flash hoods	One per operational firefighter			
	Surgical gloves	1 box	1 box	1 box	1 box
	Blanket fire resisting	1	1	2	2
Rope lines	Rope line rescue 45 m	1	1	2	2
	Rope line general use 30 m	1	1	2	2
	Rope line pocket 6 m	One per operational firefighter			
Communication equipment	Portable transceivers (hand help and intrinsically safe)	1	2	2	3
	Mobile transceivers (vehicle)	One for each fire vehicle			
A range of hand-held/portable lighting equipment	Hand-held flashlight (intrinsically safe)	1	2	4	4
	Portable lighting – spot or flood (intrinsically safe)	1	1	2	3
A range of general hand tools	Shovel overhaul	1	1	2	2
	Hammer, claw 0.6 kg				
	Cutters, cable 1.6 cm				
	Socket set				

<table>
<tr><td rowspan="9"></td><td>Hacksaw, heavy duty complete with spare blades</td><td rowspan="9">1</td><td rowspan="9">1</td><td rowspan="9">2</td><td rowspan="9">3</td></tr>
<tr><td>Wrecking bar 30 cm</td></tr>
<tr><td>Screwdriver set – slotted and Phillips heads</td></tr>
<tr><td>Pliers, insulated
Combination 20 cm
Side cutting 20 cm
Slip joint – multi-grip 25 cm</td></tr>
<tr><td>Seat belt/harness cutting tool</td></tr>
<tr><td>Seat belt/harness cutting tool</td></tr>
<tr><td>Wrench, adjustable 30 cm</td></tr>
<tr><td>Spanners, combination 10 mm – 21 mm</td></tr>
<tr></tr>
<tr><td rowspan="3">First aid equipment</td><td>Medical first-aid kit</td><td>1</td><td>1</td><td>2</td><td>3</td></tr>
<tr><td>Automated Eternal Defibrillator (AED)</td><td>1</td><td>1</td><td>2</td><td>3</td></tr>
<tr><td>Oxygen Resuscitation Equipment (ORE)</td><td>1</td><td>1</td><td>2</td><td>3</td></tr>
<tr><td rowspan="3">Miscellaneous equipment</td><td>Chocks and wedges – various sizes</td><td colspan="4"></td></tr>
<tr><td>Tarpaulin – lightweight</td><td>1</td><td>1</td><td>2</td><td>3</td></tr>
<tr><td>Thermal imaging camera</td><td>-</td><td>-</td><td>1</td><td>2</td></tr>
</table>

5.2 In addition to the rescue equipment list in Table 16.3, the aerodrome operator shall determine the quantities of each type of rescue equipment using a Task Resource Analysis.

Compliance Note. Advisory Pamphlet AGA-AP139/06 provides guidance on the conduct of a task resources analysis by an aerodrome operator.

6. Response time

6.1 The operational objective of the rescue and firefighting service must be to achieve a response time of two (2) minutes, but not exceeding three (3) minutes to any point of each operational runway, in optimum visibility and surface conditions.

6.2 The operational objective of the rescue and firefighting service must be to achieve a response time of two (2) minutes, but not exceeding three (3) minutes to any other part of the movement area, in optimum visibility and surface conditions.

Compliance Note 1. Response time is considered to be the time between the initial call to the rescue and firefighting service, and the time when the first responding vehicle(s) is (are) in position to apply foam at a rate of at least 50 per cent of the discharge rate specified in Table 16.2.

Compliance Note 2. Optimum visibility and surface conditions are defined as daytime, good visibility, no precipitation with normal response route free of surface contamination, e.g. water.

6.3 To meet the operational objective as nearly as possible in less than optimum conditions of visibility, especially during low visibility operations, suitable guidance, equipment and/or procedures for rescue and firefighting services must be provided.

6.4 Any vehicles, other than the first responding vehicle(s), required to deliver the amounts of extinguishing agents specified in Table 16.2 must ensure continuous agent application and must arrive no more than four minutes from the initial call.

6.5 A system of preventive maintenance of rescue and firefighting vehicles must be employed to ensure effectiveness of the equipment and compliance with the specified response time throughout the life of the vehicle as per NAMCARs 139.17.2.

7. Emergency access roads

7.1 Emergency access roads may be provided on an aerodrome where terrain conditions permit their construction, so as to facilitate achieving minimum response times. Particular attention must be given to the provision of ready access to approach areas up to 1 000 m from the threshold, or at least within the aerodrome boundary. Where a fence is provided, the need for convenient access to outside areas must be taken into account.

Compliance Note. Aerodrome service roads may serve as emergency access roads when they are suitably located and constructed.

7.2 Emergency access roads , where provided, shall be capable of supporting the heaviest vehicles, and be usable in all weather conditions. Roads within 90 m of a runway must be surfaced to prevent surface erosion and the transfer of debris to the runway. Sufficient vertical clearance must be provided from overhead obstructions for the largest vehicles.

7.3 When the surface of the road is indistinguishable from the surrounding area, edge markers must be placed at intervals of about 10 m.

8. Fire Stations

8.1 All rescue and firefighting vehicles must be housed in a fire station. Satellite fire stations must be provided whenever the response time cannot be achieved from a single fire station.

8.2 The fire station must be located so that the access for rescue and firefighting vehicles into the runway area is direct and clear, requiring a minimum number of turns.

8.3 The range and extent of facilities may vary between those necessary in the main fire station and those appropriate to a satellite station, but in general should include:

a) adequate accommodation for the garaging of fire vehicles, which may include other specialist vehicles such as aerial vehicles or water rescue craft and for the conduct of in-service (minor) maintenance;

b) domestic and administrative facilities for the personnel required to operate these fire vehicles;

c) communications and alarm systems which will ensure the immediate and effective deployment of fire vehicles in any emergency; and

d) appropriate storage and technical support facilities as are necessary to protect and maintain the equipment and reserves of extinguishing agents held at each fire station or nearby facility.

9. Communication and alerting systems

9.1 A discrete communication system must be provided linking a fire station with the control tower, any other fire station on the aerodrome and the rescue and firefighting vehicles.

9.2 An alerting system for rescue and firefighting personnel, capable of being operated from that station, must be provided at a fire station, any other fire station on the aerodrome and the aerodrome control tower.

10. Number of rescue and firefighting vehicles

10.1 The minimum number of rescue and firefighting vehicles provided at an aerodrome must be in accordance with the following tabulation, however a task resource analysis shall be used to determine adequacy of vehicles.

Table 16. 4: minimum number of rescue and firefighting vehicles

Aerodrome category	Rescue and firefighting vehicles
1	1
2	1
3	1
4	1
5	1

6	2
7	2
8	3
9	3
10	3

11. Personnel

11.1 All rescue and firefighting personnel must be properly trained to perform their duties in an efficient manner and must participate in live fire drills commensurate with the types of aircraft and type of rescue and firefighting equipment in use at the aerodrome, including pressure-fed fuel fires. However, a task resource analysis shall be used to determine the adequacy of personnel.

11.2 The training curriculum should include initial and recurrent instruction in at least the following areas:

a) airport familiarization;

b) aircraft familiarization;

c) rescue and firefighting personnel safety;

d) emergency communications systems on the aerodrome, including aircraft fire-related alarms;

e) use of the fire hoses, nozzles, turrets and other appliances required for compliance

f) application of the types of extinguishing agents required for compliance

g) emergency aircraft evacuation assistance;

h) firefighting operations;

i) adaptation and use of structural rescue and firefighting equipment for aircraft rescue and firefighting;

j) dangerous goods; k) familiarization with firefighters' duties under the aerodrome emergency plan; and

l) protective clothing and respiratory protection.

11.3 The rescue and firefighting personnel training programme must include training in human performance, including team coordination.

11.4 During flight operations, sufficient trained and competent personnel must be designated to be readily available to ride the rescue and firefighting vehicles and to operate the equipment at maximum capacity. These personnel must 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 must also be given for personnel to use hand lines, ladders and other rescue and firefighting equipment normally associated with aircraft rescue and firefighting operations.

11.5 In determining the minimum number of rescue and firefighting personnel required, a task resource analysis must be completed, and the level of staffing documented in the Aerodrome Manual.

11.6 All responding rescue and firefighting personnel must be provided with protective clothing and respiratory equipment to enable them to perform their duties in an effective manner.

139.16.4 Disabled aircraft removal

1.1 A plan for the removal of a disabled aircraft on, or adjacent to, the movement area must be established for an aerodrome, and a coordinator designated to implement the plan, when necessary.

1.2 The disabled aircraft removal plan must be based on the characteristics of the aircraft that may normally be expected to operate at the aerodrome, and include among other things:

(a) Procedure for notification of the appropriate aeronautical information service units

(b) a list of equipment and personnel on, or in the vicinity of, the aerodrome which would be available for such purpose (Use a Task Resource Analysis) to determine the quantities of equipment for Category A, B and C aerodromes (Category A aerodromes must use the minimum list provided in table 16.5 below:

Compliance Note. Advisory Pamphlet AGA-AP139/06 provides guidance on the conduct of a task resources analysis by an aerodrome operator.

(c) arrangements for the rapid receipt of aircraft recovery equipment kits available from other aerodromes;

(d) a list of nominated agents acting on behalf of each operator at the aerodrome;

(e) a statement of the airlines arrangements for the use of pooled specialist equipment;

(f) a list of local contractors (with names and telephone numbers) able to supply heavy removal equipment on hire; and

(g) contact information concerning the office of the aerodrome coordinator of operations for the removal of a disabled aircraft be made available, on request, to aircraft operators.

139.16.5 Wildlife hazard management

1.1 The bird and wildlife strike hazard must be assessed through:

(a) the established procedure for recording and reporting wildlife strikes to aircraft;

(b) the collection of information from aircraft operators, aerodrome personnel and other sources on the presence of wildlife on or around the aerodrome constituting a potential hazard to aircraft operations; and

(c) an ongoing evaluation of the wildlife hazard by competent personnel.

Compliance Note: Guidance to the conduct of Bird and wildlife assessment is contained in AGA-AP139-07 (Wildlife hazard assessment).

Bird and wildlife strike reports must be collected and forwarded to the Executive Director incidents@ncaa.com.na for onward transmission to ICAO for inclusion in the ICAO Bird Strike Information System (IBIS) database.

1.2 The aerodrome operator must monitor and record, on a regular basis, the presence of bird and wildlife (birds or animals) on or in the vicinity of the aerodrome. Monitoring personnel must be suitably trained for this purpose.

1.3 Where regular monitoring confirms existence of a bird and wildlife hazard to aircraft operations, or when the Executive Director so directs, the aerodrome operator must produce a bird and wildlife hazard management plan, which must be included as part of the Aerodrome Manual.

1.4 The bird and wildlife management plan must be prepared by a suitably qualified person such as an ornithologist or a biologist.

1.5 The bird and wildlife management plan must address:

(a) hazard assessment, including monitoring action and analysis;

(b) pilot notification;

(c) liaison and working relationships with land use planning authorities;

(d) on-aerodrome bird and animal attractors which provide food, water or shelter;

(e) suitable harassment methods; and

(f) an ongoing strategy for bird and animal hazard reduction, including provision of appropriate fencing.

1.6 The bird and wildlife hazard management plan must be reviewed for effectiveness, on a regular basis, at least as part of each technical inspection.

1.7 Where the presence of birds or animals is assessed as constituting an ongoing hazard to aircraft, the aerodrome operator must notify the AIS in writing, to include an appropriate warning notice in the AIP.

1.8 Where a bird and wildlife hazard is assessed as acute, of short term or seasonal nature, additional warning must be given to pilots by NOTAM.

139.16.6 Apron management service

1. Introduction

1.1 When warranted by the volume of traffic and operating conditions, an appropriate apron management service must be provided on an apron by an aerodrome ATS unit, by another aerodrome operating authority, or by a cooperative combination of these, in order to:

(a) regulate movement with the objective of preventing collisions between aircraft, and between aircraft and obstacles;

(b) regulate entry of aircraft into, and coordinate exit of aircraft from, the apron with the aerodrome control tower; and

(c) ensure safe and expeditious movement of vehicles and appropriate regulation of other activities.

1.2 When the aerodrome control tower does not participate in the apron management service, procedures must be established to facilitate the orderly transition of aircraft between the apron management unit and the aerodrome control tower.

1.3 An apron management service must be provided with radiotelephony communications facilities.

1.4 Where low visibility procedures are in effect, persons and vehicles operating on an apron must be restricted to the essential minimum.

1.5 An emergency vehicle responding to an emergency must be given priority over all other surface movement traffic.

1.6 A vehicle operating on an apron must:

(a) give way to an emergency vehicle; an aircraft taxiing, about to taxi, or being pushed or towed; and

(b) give way to other vehicles in accordance with local regulations.

1.7 An aircraft stand must be visually monitored to ensure that the recommended clearance distances are provided to an aircraft using the stand.

2. Mitigating congestion

2.1 The aerodrome operator must include in the aerodrome manual particulars of the procedures for aircraft parking control, on aprons, to ensure the safety of aircraft during ground maneuvering.

2.2 Appropriate apron safety procedures must be developed by the aerodrome operator where apron congestion is a problem. The apron safety procedures must be developed in conjunction with relevant organisations such as the airlines, ground handlers and caterers etc; and monitored for compliance, on a regular basis. Written agreements and contracts may be a useful measure in mitigating congestion.

3. Apron Safety Management

3.1 Aerodrome operators must ensure that, irrespective of who is responsible for aircraft parking, procedures are in place and documented for aircraft docking, ground servicing, engine start and push back operations.

3.2 Apron safety management procedures must:

(a) ensure that people involved in providing the service are appropriately trained and experienced; and

(b) ensure that persons engaged apron management activities are provided with appropriate equipment such as communications, high visibility garments and fire extinguishing equipment suitable for at least initial intervention in the event of a fuel fire.

3.3 If apron operational activities are undertaken by organisation(s) other than the aerodrome operator, then the aerodrome operator must ensure the apron safety management procedures established by the aerodrome operator are followed.

139.16.7 Ground servicing of aircraft

1.1 Fire extinguishing equipment suitable for at least initial intervention in the event of a fuel fire and personnel trained in its use must be readily available during the ground servicing of an aircraft, and there must be a means of quickly summoning the rescue and firefighting service in the event of a fire or major fuel spill.

1.2 When aircraft refueling operations take place while passengers are embarking, on board or disembarking, ground equipment must be positioned so as to allow:

(a) the use of a sufficient number of exits for expeditious evacuation; and

(b) a ready escape route from each of the exits to be used in an emergency.

139.16.8 Aerodrome vehicle operations

1. Aerodrome operator procedures

1.1 The aerodrome operator must have procedures in place requiring a vehicle operating on the maneuvering area of an aerodrome and which does not have radio communication, to have an accompanying escort vehicle that has two-way radio communications with the aerodrome control service.

1.2 When an aerodrome control service is not in operation at the aerodrome, the procedures required in 1.1 above must provide for ground vehicles operating on the movement area of the aerodrome to be controlled by signs or prearranged signals.

1.3 The procedures required by sub-regulation (1) above must ensure that each employee, tenant, or contractor who operates a ground vehicle on any portion of the aerodrome which has access to the movement area of the aerodrome is familiar with, and complies with, the procedures established by the aerodrome operator for the operation of ground vehicles on the aerodrome.

2. Training of vehicle drivers

2.1 Drivers operating vehicles on the movement area must be properly trained qualified. The training may include, as appropriate to the driver's function, knowledge of:

(a) the geography of the aerodrome;
(b) aerodrome signs, markings and lights;
(c) radiotelephone operating procedures;
(d) terms and phrases used in aerodrome control including the ICAO spelling alphabet;
(e) rules of air traffic services as they relate to ground operations;
(f) aerodrome rules and procedures; and
(g) specialist functions as required, for example, in rescue and firefighting.

2.2 The vehicle driver must be able to demonstrate competency, as appropriate, in:

(a) the operation or use of vehicle transmit/receive equipment;

(b) understanding and complying with air traffic control and local procedures;

(c) vehicle navigation on the aerodrome; and

(d) special skills required for the particular function.

In addition, as required for any specialist function, the driver must be the holder of a driver's licence, and a radio operator's licence or other licences issued by the relevant government authorities of Namibia.

2.3 The above must be applied as is appropriate to the function to be performed by the operator, and it is not necessary that all operators be trained to the same level, for example, operators whose functions are restricted to the apron.

2.4 If special procedures apply for operations in low visibility conditions, the driver's knowledge of the procedures must be verified through periodic checks.

139.16.9 Surface movement guidance and control systems

1.1 A surface movement guidance and control system (SMGCS) must be provided at an aerodrome.

1.2 The design of an SMGCS must take into account:

(a) the density of air traffic;

(b) the visibility conditions under which operations are intended;

(c) the need for pilot orientation;

(d) the complexity of the aerodrome layout; and

(e) movements of vehicles.

1.3 The visual aid components of an SMGCS, i.e. markings, lights and signs, must be designed to conform with the relevant specifications in NAMCARs Part 139.12 of this Document.

1.4 An SMGCS must be designed to assist in the prevention of –

(a) inadvertent incursions of aircraft and vehicles onto an active runway; and

(b) collisions between aircraft, and between aircraft and vehicles or objects, on any part of the movement area.

1.5 Where an SMGCS is provided by selective switching of stop bars and taxiway centre line lights, the following requirements must be met:

(a) taxiway routes which are indicated by illuminated taxiway centre line lights must be capable of being terminated by an illuminated stop bar;

(b) the control circuits must be so arranged that when a stop bar located ahead of an aircraft is illuminated, the appropriate section of taxiway centre line lights beyond it is suppressed; and

(c) the taxiway centre line lights are activated ahead of an aircraft when the stop bar is suppressed.

1.6 Surface movement radar for the maneuvering area may be provided at an aerodrome –

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

(b) other than that in (a) above when traffic density and operating conditions are such that regularity of traffic flow cannot be maintained by alternative procedures and facilities.

139.16.10 Siting of equipment and installations on operational areas

1.1 Unless its function requires it to be there for air navigation or for aircraft safety purposes, no equipment or installation must be:

(a) on a runway strip, a runway end safety area, a taxiway strip or within the distances specified in Table 10.5, column 11, if it would endanger an aircraft; or

(b) on a clearway if it would endanger an aircraft in the air.

1.2 Any equipment or installation required for air navigation or for aircraft safety purposes which must be located:

(a) on that portion of a runway strip within:

(i) 75 m of the runway centre line where the code number is 3 or 4; or

(ii) 45 m of the runway centre line where the code number is 1 or 2; or

(b) on a runway end safety area, a taxiway strip or within the distances specified in Table 10.5; or

(c) on a clearway and which would endanger an aircraft in the air;

must be frangible and mounted as low as possible.

1.3 Any equipment or installation required for air navigation or for aircraft safety purposes which must be located on the non-graded portion of a runway strip must be regarded as an obstacle and must be frangible and mounted as low as possible.

1.4 Unless its function requires it to be there for air navigation or for aircraft safety purposes, no equipment or installation may be located within 240 m from the end of the strip and within:

(a) 60 m of the extended centre line where the code number is 3 or 4; or

(b) 45 m of the extended centre line where the code number is 1 or 2;

of a precision approach runway category I, II or III.

1.5 Any equipment or installation required for air navigation or for aircraft safety purposes which must be located on or near a strip of a precision approach runway category I, II or III and which:

(a) is situated on that portion of the strip within 77.5 m of the runway centre line where the code number is 4 and the code letter is F; or

(b) is situated within 240 m from the end of the strip and within:

(i) 60 m of the extended runway centre line where the code number is 3 or 4; or

(ii) 45 m of the extended runway centre line where the code number is 1 or 2; or

(c) penetrates the inner approach surface, the inner transitional surface or the balked landing surface;

must be frangible and mounted as low as possible.

1.6 Any equipment or installation required for air navigation or for aircraft safety purposes which is an obstacle of operational significance must be frangible and mounted as low as possible.

139.16.11 Fencing

1.1 A fence or other suitable barrier must be provided on an aerodrome to prevent the entrance to the movement area of animals large enough to be a hazard to aircraft.

1.2 A fence or other suitable barrier must be provided on an aerodrome to deter the inadvertent or premeditated access of an unauthorized person onto a non-public area of the aerodrome.

1.3 Suitable means of protection must be provided to deter the inadvertent or premeditated access of unauthorized persons into ground installations and facilities essential for the safety of civil aviation located off the aerodrome.

1.4 The fence or barrier must be located so as to separate the movement area and other facilities or zones on the aerodrome vital to the safe operation of aircraft from areas open to public access.

1.5 When greater security is thought necessary, a cleared area may be provided on both sides of the fence or barrier to facilitate the work of patrols and to make trespassing more difficult. Consideration must be given to the provision of a perimeter road inside the aerodrome fencing for the use of both maintenance personnel and security patrols.

139.16.12 Security lighting

1.1 At an aerodrome where it is deemed desirable for security reasons, a fence or other barrier provided for the protection of international civil aviation and its facilities may be illuminated at a minimum essential level. Consideration must be given to locating lights so that the ground area on both sides of the fence or barrier, particularly at access points, is illuminated.

139.16.13 Autonomous runway incursion warning system (ARIWS)

1.1 Where an ARIWS is installed at an aerodrome:

(a) it must provide autonomous detection of a potential incursion or of the occupancy of an active runway and a direct warning to a flight crew or vehicle operator;

(b) it must function and be controlled independently of any other visual system on the aerodrome;

(c) its visual aid components, i.e. lights, must be designed to conform with the relevant specifications in NAMCARs Part 139.12; and

(d) failure of part or all of it must not interfere with normal aerodrome operations. To this end, provision must be made to allow the ATC unit to partially or entirely shut down the system.

1.3 Where an ARIWS is installed at an aerodrome, information on its characteristics and status must be provided to the appropriate aeronautical information services for promulgation in the

AIP with the description of the aerodrome surface movement guidance and control system and markings as specified in NAMCARs Part 175.

SUBPART 17 - AERODROME MAINTENANCE

139.17.2 Maintenance programme

1.1. The maintenance programme must—

(a) provide for the surface of paved maneuvering areas to be kept clear of any loose objects or debris that might endanger aircraft operations; and

(b) provide for the surface of paved runways to be maintained in a condition that provides good surface friction characteristics and low rolling resistance for aircraft; and

(c) provide for the measurement and provision of real-time surface condition reporting when a runway is contaminated using standardised reporting methods; and

(d) provide maintenance of aerodrome vehicle and equipment.

Note : Preventive maintenance is work programmed maintenance work done in order to prevent a failure or degradation of facilities.

Note: "Facilities" are intended to include such items as pavements, visual aids, fencing, drainage systems, electrical systems and buildings.

1.2. The design and application of the maintenance programme must observe Human Factors principles.

139.17.3 Maintenance of pavements and fricition measurement

1.1. A maintenance programme, including preventive maintenance where appropriate, must be established at an aerodrome to maintain facilities in a condition which does not impair the safety, regularity or efficiency of air navigation.

1.2. The design and application of the maintenance programme must observe Human Factors principles.

2. Pavements and Friction Measurements

2.1. The surfaces of all movement areas including pavements (runways, taxiways and aprons) and adjacent areas must be inspected and their conditions monitored regularly as part of an aerodrome preventive and corrective maintenance programme with the objective of avoiding and eliminating any foreign object debris (FOD) that might cause damage to aircraft or impair the operation of aircraft systems.

2.2. The surface of a runway must be maintained in a condition such as to prevent formation of harmful irregularities.

2.3. A paved runway must be maintained in a condition so as to provide surface friction characteristics at or above the specified minimum friction level.

2.4. Pavement surface friction otherwise known as skid resistance or surface roughness is the main pavement surface characteristics that provide resistance between the aircraft tire and the ground to minimize uncontrolled aircraft movement and controlled stops.

2.5. When runway surface friction measurements are made for maintenance purposes the friction values or levels are measured by Continuous Friction Measuring Equipments (CFME) and can be used as guidelines for evaluating the pavement surface friction, deterioration of the pavement and current maintenance needs. The friction values or levels are determined depending on the test equipments, test tires, test speed and test water depth.

2.6. Runway surface friction characteristics for maintenance purposes must be periodically measured with a continuous friction measuring device using self-wetting features and documented. The frequency of these measurements must be sufficient to determine the trend of the surface friction characteristics of the runway.

2.7. Personnel measuring runway surface friction required in 2.5 above must be trained to fulfil their duties.

2.8. Written instructions must be provided for the guidance of personnel involved in friction measurement irrespective of the type of equipment deployed by an aerodrome operator for the friction measurement. The written instructions must cover the following:

a. the person who initiates the requirements for a measurement (air traffic control, aerodrome operator, pilots);

b. the person who undertakes the measurement;

c. the circumstances leading to the need for measurement - including an after-accident report when runway conditions may be a factor;

d. operation of the equipment and calculation of the results;

e. testing and calibration of the equipment;

f. storage and servicing of the equipment;

g. training of operatives; and

h. record keeping.

2.9. The surface of a paved runway must be maintained in a condition so as to provide good friction characteristics and low rolling resistance. All contaminants including, ice, standing water, mud, dust, sand, oil and rubber must be removed completely and as soon as possible to minimize accumulation.

2.10. Friction measurements of paved runways must be made with a continuous friction measuring device provided with a smooth tread tire. The device should use self-wetting features to allow measurements of the surface friction characteristics to be made at a water depth of 1 mm. Continuous Friction Measuring Equipments (CFME) that may be used in Namibia for runway surface friction measurements are indicated in Table 17.1 and 17.2 below:

Table 17.1 Description of the Continuous Friction Measuring Equipments (CFME)

Test Equipment	Description
Mu-Meter trailer	A trailer designed to measure side force friction generated between the friction measuring tires passing over the runway pavement surface at an included angle of 15 degrees.
Surface Friction Tester	A trailer/automobile which uses a third/fifth wheel with a tire made to measure the coefficient of friction.

GRIPTESTER Trailer	A lightweight, three-wheel trailer which measures friction using the braked wheel fixed slip principle. It has a single measuring wheel fitted with a smooth tread tire made to measure dynamic friction.

2.11. The Minimum Friction Levels are depicted in column 8 of table 17.2 for each CFME.

Table 17.2 Runway Surface Condition Levels

Test Equipment	Test tire		Test Speed (km/h)	Test Water depth (mm)	Design Level for new surfac	Maintenance Planning Level	Minimum Friction Level
	Type	Pressure (kPa)					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mu-meter Trailer	A A	70 70	65 95	1.0 1.0	0.72 0.66	0.52 0.38	0.42 0.26
Surface Friction Tester	B B	210 210	65 95	1.0 1.0	0.82 0.74	0.60 0.47	0.50 0.34
GRIPTESTER Trailer	C C	140 140	65 95	1.0 1.0	0.74 0.64	0.53 0.36	0.43 0.24

2.12. Maintenance Planning Level

- When the friction level is below the required maintenance planning level, then maintenance should be arranged to restore the friction level to a value or level equal or greater than the required design levels those in column 6 of table 17.2.

- The Maintenance Planning Levels are those in column 7 of table 17.2, for each CFME.

2.13. Friction measurements are taken at time intervals that will ensure the identification of runways in need of maintenance or of special surface treatment before their condition becomes serious. The time intervals and mean frequency of measurements depend on factors such as: aircraft type and frequency of usage, climatic conditions, pavement type, and pavement service and maintenance requirements.

Table 17.3 Friction maintenance programme schedule

Daily turbo-jet aeroplane landing for runway end	Minimum friction survey frequency	Minimum rubber removal frequency
Less than 15	Once per year	Once every 2 years
Above 15	Once every 6 month	Once every year

2.14. Runway surface friction characteristics need to be determined under the following circumstances:

a) The dry runway case, where only infrequent measurements may be needed in order to assess surface texture, wear and restoration requirements,

b) The wet runway case, where only periodical measurements of the runway surface friction characteristics are required to determine that they are above a maintenance planning level and/or minimum acceptable level. In this context, it is to be noted that serious reduction of friction coefficient in terms of viscous aquaplaning can result from contamination of the runway, when wet, by rubber deposits,

c) The presence of a significant depth of water on the runway, in which case the need for determination of the aquaplaning tendency must be recognized,

d) The slippery runway under unusual conditions, where additional measurements should be made when such conditions occur.

2.15 Aerodrome operators must keep records of all runway surface friction assessments. The following items should be recorded for each assessment, and made available upon request to the Executive Director:

- Date and time of assessment.
- Runway assessed.
- Run number and runway direction.
- Distance from the centreline and on which side of centreline the run was performed.
- Constant run speed (km/h) for each run.
- Run length.
- Self-wetting system on/off (refers to check runs only).
- Surface condition.
- Average friction level per run.
- Friction levels for each portion of the pavement.
- Overall friction level.

2.16 When the friction of any portion of a runway is found to be below the minimum friction level, then such information is promulgated in a NOTAM specifying which portion of the runway is below the minimum friction level and its location on the runway.

2.17 Corrective maintenance action must be taken to prevent the runway surface friction characteristics for either the entire runway or a portion thereof from falling below a specified minimum friction level.

2.18 The runway surface may be visually assessed, as necessary, under natural or simulated rain conditions for ponding or poor drainage and where required, corrective maintenance action taken.

2.119 When a taxiway is used by turbine-engined aeroplanes, the surface of the taxiway shoulders must be maintained so as to be free of any loose stones or other objects that could be ingested by the aeroplane engines.

2.20 When there is reason to believe that the drainage characteristics of a runway, or portions thereof, are poor due to slopes or depressions, then the runway surface friction characteristics must be assessed under natural or simulated conditions that are representative of local rain, and corrective maintenance action must be taken as necessary.

3. Maintenance and Reporting Practices

3.1 The procedures on pavement maintenance to ensure that the friction levels do not fall below the required levels must be included in the Aerodrome Manual.

3.2 It is the obligation of the aerodrome operator to devise engineering means for restoration of the friction levels at or above the stated minimum friction levels.

3.3 The procedures for reporting friction levels that are found to be below the Minimum Friction and coverage of water on the runway must be included in the Aerodrome Manual.

139.17.4 Removal of contaminants

1.1 Standing water, mud, dust, sand, oil, rubber deposits and other contaminants must be removed from the surface of runways in use as rapidly and completely as possible to minimize accumulation.

1.2 The presence of water within the central half of the width of a runway must be reported and an assessment of the water depth must be determined where possible.

1.3 To be able to report with some accuracy on the conditions of the runway, the following terms and associated descriptions should be used:

- **DAMP** – The surface shows a change of colour due to moisture
- **WET** – The surface is soaked but there is no standing water
- **WET PATCHES** – Significant patches of standing water is visible
- **FLOODED** – Extensive standing water is visible.

1.4 When the runway or portion thereof must be determined as being slippery when wet when the runway surface friction characteristics as measured by a continuous friction measuring device are below the minimum friction level specified in table 17.2, then such information is promulgated in a NOTAM to notify the potentially hazardous condition.

1.5 Taxiways must be kept clear of standing water, mud, dust, sand, oil, rubber deposits and other contaminants to the extent necessary to enable aircraft to be taxied to and from an operational runway.

1.6 Aprons must be kept clear of standing water, mud, dust, sand, oil, rubber deposits and other contaminants to the extent necessary to enable aircraft to manoeuvre safely or, where appropriate, to be towed or pushed.

1.7 Whenever the clearance of standing water, mud, dust, sand, oil, rubber deposits and other contaminants from the various parts of the movement area cannot be carried out simultaneously, the order of priority after the runway(s) in use must be set in consultation with the affected parties such as rescue and firefighting service.

1.8 Chemicals which may have harmful effects on aircraft or pavements, or chemicals which may have toxic effects on the aerodrome environment, must not be used at an aerodrome.

139.17.5 Runway pavement overlays

1.1 The longitudinal slope of the temporary ramp, measured with reference to the existing runway surface or previous overlay course, must be:

(a) 0.5 to 1.0 per cent for overlays up to and including 5 cm in thickness; and

(b) not more than 0.5 per cent for overlays more than 5 cm in thickness.

1.2 Overlaying must proceed from one end of the runway toward the other end so that based on runway utilisation most aircraft operations will experience a down ramp.

1.3 The entire width of the runway must be overlaid during each work session.

1.4 Where the entire width of the runway cannot be overlaid during a work session, then at least the central two-third width of the runway is to be overlaid. In this case, a temporary transverse ramp of between 0.8 and 1.0 per cent must be provided between the edge of the new overlay surface and the existing runway surface or previous overlay course; when the difference in level exceeds 25 mm.

1.5 Before a runway being overlaid is returned to a temporary operational status, a runway centreline marking conforming to the specifications NAMCATS 139.12.6, section 3 must be provided. Additionally, the location of any temporary threshold must be identified by a 3.6 m wide transverse stripe.

1.6 The overlay must be constructed and maintained above the minimum friction level specified in accordance with 139.17.3, section 2.3.

139.17.6 Maintenance of visual aids for navigation

1.1. A light must be deemed to be unserviceable when the main beam average intensity is less than 50 per cent of the value specified in the appropriate figure in Appendix 2 to this Document NAMCATS-AH. For light units where the designed main beam average intensity is above the value shown in Appendix 2 to this Document NAMCATS-AH, the 50 per cent value must be related to that design value.

1.2. A system of preventive maintenance of visual aids must be employed to ensure lighting and marking system reliability.

1.3. The system of preventive maintenance employed for a precision approach runway category II or III may include at least the following checks:

(a) visual inspection and in-field measurement of the intensity, beam spread and orientation of lights included in the approach and runway lighting systems;

(b) control and measurement of the electrical characteristics of each circuitry included in the approach and runway lighting systems; and

(c) control of the correct functioning of light intensity settings used by air traffic control.

1.4. In-field measurement of intensity, beam spread and orientation of lights included in approach and runway lighting systems for a precision approach runway category II or III may be undertaken by measuring all lights, as far as practicable, to ensure conformance with the applicable specifications in Appendix 2 to this Document NAM-CATS-AH.

1.5. Measurement of intensity, beam spread and orientation of lights included in approach and runway lighting systems for a precision approach runway category II or III may be undertaken using a mobile measuring unit of sufficient accuracy to analyse the characteristics of the individual lights.

1.6. The frequency of measurement of lights for a precision approach runway category II or III may be based on traffic density, the local pollution level, the reliability of the installed lighting equipment and the continuous assessment of the results of the in-field measurements but, in any event, must not be less than twice a year for in-pavement lights and not less than once a year for other lights.

1.7. The system of preventive maintenance employed for a precision approach runway category II or III must have as its objective that, during any period of category II or III operations, all approach and runway lights are serviceable and that, in any event, at least:

(a) 95 per cent of the lights are serviceable in each of the following particular significant elements:

(i) precision approach category II and III lighting system, the inner 450 m;

(ii) runway centre line lights;

(iii) runway threshold lights; and

(iv) runway edge lights;

(b) 90 per cent of the lights are serviceable in the touchdown zone lights;

(c) 85 per cent of the lights are serviceable in the approach lighting system beyond 450 m; and

75 per cent of the lights are serviceable in the runway end lights.

In order to provide continuity of guidance, the allowable percentage of unserviceable lights must not be permitted in such a way as to alter the basic pattern of the lighting system. Additionally, an unserviceable light must not be permitted adjacent to another unserviceable light, except in a barrette or a crossbar where two adjacent unserviceable lights may be permitted.

Compliance Note. With respect to barrettes, crossbars and runway edge lights, lights are considered to be adjacent if located consecutively and:

— laterally: in the same barrette or crossbar; or

— *longitudinally: in the same row of edge lights or barrettes.*

1.8. The system of preventive maintenance employed for a stop bar provided at a runway-holding position used in conjunction with a runway intended for operations in runway visual range conditions less than a value of 350 m must have the following objectives:

(a) no more than two lights will remain unserviceable; and

(b) two adjacent lights will not remain unserviceable unless the light spacing is significantly less than that specified.

1.9. The system of preventive maintenance employed for a taxiway intended for use in runway visual range conditions less than a value of 350 m must have as its objective that no two adjacent taxiway centre line lights be unserviceable.

1.10. The system of preventive maintenance employed for a precision approach runway category I must have as its objective that, during any period of category I operations, all approach and runway lights are serviceable and that, in any event, at least 85 per cent of the lights are serviceable in each of the following:

(a) precision approach category I lighting system;

(b) runway threshold lights;

(c) runway edge lights; and

(d) runway end lights.

In order to provide continuity of guidance an unserviceable light must not be permitted adjacent to another unserviceable light unless the light spacing is significantly less than that specified.

1.11. The system of preventive maintenance employed for a runway meant for take-off in runway visual range conditions less than a value of 550 m must have as its objective that, during any period of operations, all runway lights are serviceable and that in any event:

(a) at least 95 per cent of the lights are serviceable in the runway centre line lights (where provided) and in the runway edge lights; and

(b) at least 75 per cent of the lights are serviceable in the runway end lights.

In order to provide continuity of guidance, an unserviceable light must not be permitted adjacent to another unserviceable light.

1.12. The system of preventive maintenance employed for a runway meant for take-off in runway visual range conditions of a value of 550 m or greater must have as its objective that, during any period of operations, all runway lights are serviceable and that, in any event, at least 85 per cent of the lights are serviceable in the runway edge lights and runway end lights. In order to provide continuity of guidance, an unserviceable light must not be permitted adjacent to another unserviceable light.

1.13. During low visibility procedures the aerodrome operator must restrict construction or maintenance activities in the proximity of aerodrome electrical systems.

SUBPART 18 - REQUIREMENTS SPECIFIC TO HELIPORTS

1. Introduction

1.1 Volume II of this Document NAM-CATS-AH provides requirements that are specific to Heliports. It contains standards that prescribe physical characteristics and obstacle limitation surfaces to be provided for at heliports, and certain facilities and technical services normally provided at a heliport. It is not intended that these specifications limit or regulate the operation of an aircraft.

1.2 When designing a heliport, the critical design helicopter, having the largest set of dimensions and the greatest maximum take-off mass (MTOM) the heliport is intended to serve, would need to be considered.

1.3 This Document does not include the provisions for helicopter flight operations as contained in Part III of Annex 6 to the Convention on International Civil Aviation.

2. Common reference systems

2.1 Horizontal reference system

2.2.1 World Geodetic System — 1984 (WGS-84) must be used as the horizontal (geodetic) reference system. Reported aeronautical geographical coordinates (indicating latitude and longitude) must be expressed in terms of the WGS-84 geodetic reference datum.

2.2 Vertical reference system

2.2.1 Mean sea level (MSL) datum, which gives the relationship of gravity-related height (elevation) to a surface known as the geoid, must be used as the vertical reference system.

2.3 Temporal reference system

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

2.3.2 When a different temporal reference system is used, this must be indicated in GEN 2.1.2 of the Aeronautical Information Publication (AIP);

3. Aeronautical Data

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

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

4. Coordination between Aeronautical Information Services and Heliport authorities

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

(d) information on the status of certificate/license/approval of heliport and heliport conditions;
(e) the operational status of associated facilities, services and navigation aids within their area of responsibility; and
(f) any other information considered to be of operational significance.

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

4.3 Of a particular importance are changes to aeronautical information that affect charts and/or computer-based navigation systems which qualify to be notified by the aeronautical information regulation and control (AIRAC) system, as specified in Part 175. The predetermined, internationally agreed AIRAC effective dates must be observed by the responsible aerodrome services when submitting the raw information/data to aeronautical information services.

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

5. Abbreviations and Symbols

5.1 Abbreviations

APAPI	Abbreviated precision approach path indicator
ASPSL	Arrays of segmented point source lighting
cd	Candela
cm	Centimetre
FATO	Final approach and take-off area
ft	Foot
GNSS	Global navigation satellite system
HAPI	Helicopter approach path indicator
HFM	Helicopter flight manual
Hz	Hertz
kg	Kilogram
km/h	Kilometre per hour
kt	Knot
L	Litre
lb	Pounds
LDAH	Landing distance available
L/min	Litre per minute
LOA	Limited obstacle area
LOS	Limited obstacle sector
LP	Luminescent panel

m	Metre
MAPt	Missed approach point
MTOM	Maximum take-off mass
OFS	Obstacle-free sector
PAPI	Precision approach path indicator
PinS	Point-in-space
R/T	Radiotelephony or radio communications
RTODAH	Rejected take-off distance available
s	Second
t	Tonne (1 000 kg)
TLOF	Touchdown and lift-off area
TODAH	Take-off distance available
UCW	Undercarriage width
VSS	Visual segment surface

5.2 Symbols

°	Degree
=	Equals
%	Percentage
±	Plus or minus

139.18.1 Applicability

Compliance Note. The dimensions discussed in this Document are based on consideration of single-main-rotor helicopters. For tandem-rotor helicopters the heliport design will be based on a case-by-case review of the specific models using the basic requirement for a safety area and protection areas specified in this Document. The specifications of the main chapters of this Document are applicable for visual heliports that may or may not incorporate the use of a Point-in-space approach or departure. Additional specifications for instrument heliports with non-precision and/or precision approaches and instrument departures are detailed in the Appendix to this Document NAM-CATS-AH, Volume II. The specifications of this Document are not applicable for water heliports (touchdown or lift-off on the surface of the water).

1. General

1.1 The interpretation of some of the specifications in the Document expressly requires the exercising of discretion, the taking of a decision or the performance of a function by the aerodrome operator. In other specifications, the expression aerodrome operator does not actually appear although its inclusion is implied. In both cases, the responsibility for whatever determination or action is necessary rests with the aerodrome operator having jurisdiction over the heliport.

1.2 The specifications in this Document NAM-CATS-AH Volume II, must apply to all heliports intended to be used by helicopters in international civil aviation. They must apply equally to areas for the exclusive use of helicopters at an aerodrome primarily meant for the use of aeroplanes. Where relevant, the provisions of the NAM-CATS-AH Volume I, must apply to the helicopter operations being conducted at such an aerodrome.

1.3 Unless otherwise specified, the specification for a colour referred to within this Document NAM-CATS-AH Volume II must be that contained in Document NAM-CATS-AH Volume I.

139.18.2 Definitions for this Subpart

1.1 The following list contains definitions of terms that are used only in subpart 18, with the meanings given below:

D. The largest overall dimension of the helicopter when rotor(s) are turning measured from the most forward position of the main rotor tip path plane to the most rearward position of the tail rotor tip path plane or helicopter structure.

Compliance Note. "D" is sometimes referred to in the text using the terminology "D-value".

Declared distances — heliports.

(a) *Take-off distance available (TODAH).*The length of the FATO plus the length of helicopter clearway (if provided) declared available and suitable for helicopters to complete the take-off.
(b) *Rejected take-off distance available (RTODAH)*.The length of the FATO declared available and suitable for helicopters operated in performance class 1 to complete a rejected take-off.
(c) *Landing distance available (LDAH)*.The length of the FATO plus any additional area declared available and suitable for helicopters to complete the landing manoeuvre from a defined height.

Dynamic load-bearing surface. A surface capable of supporting the loads generated by a helicopter conducting an emergency touchdown on it.

Elevated heliport. A heliport located on a raised structure on land.

Final approach and take-off area (FATO). A defined area over which the final phase of the approach manoeuvre to hover or landing is completed and from which the take-off manoeuvre is commenced. Where the FATO is to be used by helicopters operated in performance class 1, the defined area includes the rejected take-off area available.

Helicopter air taxiway. A defined path on the surface established for the air taxiing of helicopters.

Helicopter clearway. A defined area on the ground or water, selected and/or prepared as a suitable area over which a helicopter operated in performance class 1 may accelerate and achieve a specific height.

Helicopter ground taxiway. A ground taxiway intended for the ground movement of wheeled undercarriage helicopters.

Helicopter stand. An aircraft stand which provides for parking a helicopter and where ground taxi operations are completed or where the helicopter touches down and lifts off for air taxi operations.

Helicopter taxi-route. A defined path established for the movement of helicopters from one part of a heliport to another. A taxi-route includes a helicopter air or ground taxiway which is centred on the taxi-route.

Helideck. A heliport located on a fixed or floating offshore facility such as an exploration and/or production unit used for the exploitation of oil or gas.

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

Heliport elevation. The elevation of the highest point of the FATO.

Heliport reference point (HRP). The designated location of a heliport or a landing location.

Landing location. A marked or unmarked area that has the same physical characteristics as a visual heliport final approach and take-off area (FATO).

Obstacle. All fixed (whether temporary or permanent) and mobile objects, or parts thereof, that:

(a) are located on an area intended for the surface movement of aircraft; or
(b) extend above a defined surface intended to protect aircraft in flight; or
(c) stand outside those defined surfaces and that have been assessed as being a hazard to air navigation.

Point-in-space approach (PinS). The Point-in-space approach is based on GNSS and is an approach procedure designed for helicopter only. It is aligned with a reference point located to permit subsequent flight manoeuvring or approach and landing using visual manoeuvring in adequate visual conditions to see and avoid obstacles.

Point-in-space (PinS) visual segment. This is the segment of a helicopter PinS approach procedure from the MAPt to the landing location for a PinS “proceed visually” procedure. This visual segment connects the Point-in-space (PinS) to the landing location.

Protection area. An area within a taxi-route and around a helicopter stand which provides separation from objects, the FATO, other taxi-routes and helicopter stands, for safe manoeuvring of helicopters.

Rejected take-off area. A defined area on a heliport suitable for helicopters operating in performance class 1 to complete a rejected take-off.

Runway-type FATO. A FATO having characteristics similar in shape to a runway.

Safety area. A defined area on a heliport surrounding the FATO which is free of obstacles, other than those required for air navigation purposes, and intended to reduce the risk of damage to helicopters accidentally diverging from the FATO.

Shipboard heliport. A heliport located on a ship that may be purpose or non-purpose-built. A purpose-built shipboard heliport is one designed specifically for helicopter operations. A non-purpose-built shipboard heliport is one that utilizes an area of the ship that is capable of supporting a helicopter but not designed specifically for that task.

Static load-bearing surface. A surface capable of supporting the mass of a helicopter situated upon it.

Surface-level heliport. A heliport located on the ground or on a structure on the surface of the water.

Touchdown and lift-off area (TLOF). An area on which a helicopter may touch down or lift off.

Winching area. An area provided for the transfer by helicopter of personnel or stores to or from a ship.

139.18.4 Heliport elevations

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

1.2 The elevation of the TLOF and/or the elevation and geoid undulation of each threshold of the FATO (where appropriate) must be measured and reported to the aeronautical information services authority to the accuracy of one-half metre or foot.

139.18.5 Heliport dimensions and related information

1.1 The following data must be measured or described, as appropriate, for each facility provided on a heliport:

(a) heliport type — surface-level, elevated, shipboard or helideck;
(b) TLOF — dimensions to the nearest metre or foot, slope, surface type, bearing strength in tonnes (1000 kg);
(c) FATO — type of FATO, true bearing to one-hundredth of a degree, designation number (where appropriate), length and width to the nearest metre or foot, slope, surface type;
(d) safety area — length, width and surface type;
(e) helicopter ground taxiway and helicopter air taxiway — designation, width, surface type;
(f) apron — surface type, helicopter stands;
(g) clearway — length, ground profile; and
(h) visual aids for approach procedures, marking and lighting of FATO, TLOF, helicopter ground taxiways, helicopter air taxiways and helicopter stands.

1.2 The geographical coordinates of the geometric centre of the TLOF and/or of each threshold of the FATO (where appropriate) must be measured and reported to the aeronautical information services authority in degrees, minutes, seconds and hundredths of seconds.

1.3 The geographical coordinates of appropriate centre line points of helicopter ground taxiways and helicopter air taxiways must be measured and reported to the aeronautical information services authority in degrees, minutes, seconds and hundredths of seconds.

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

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

139.18.7 Physical characteristics of surface-level heliports

Compliance Note 1. The provisions given in this section are based on the design assumption that no more than one helicopter will be in the FATO at the same time.

Compliance Note 2. The design provisions given in this section assume when conducting operations to a FATO in proximity to another FATO, these operations will not be simultaneous. If simultaneous helicopter operations are required, appropriate separation distances between FATOs need to be determined, giving due regard to such issues as rotor downwash and airspace, and ensuring the flight paths for each FATO, do not overlap.

Compliance Note 3. The specifications for ground taxi-routes and air taxi-routes are intended for the safety of simultaneous operations during the manoeuvring of helicopters. However, the wind velocity induced by the rotor downwash might have to be considered.

1. Final approach and take-off areas

1.1 A surface-level heliport must be provided with at least one final approach and take-off area (FATO).

Compliance Note. A FATO may be located on or near a runway strip or taxiway strip.

1.2 A FATO must be obstacle free.

1.3 The dimensions of a FATO must be:

(a) where intended to be used by helicopters operated in performance class 1, as prescribed in the helicopter flight manual (HFM) except that, in the absence of width specifications, the width must be not less than the greatest overall dimension (D) of the largest helicopter the FATO is intended to serve;

(b) where intended to be used by helicopters operated in performance class 2 or 3, of sufficient size and shape to contain an area within which can be drawn a circle of diameter not less than:

(i) 1 D of the largest helicopter when the maximum take-off mass (MTOM) of helicopters the FATO is intended to serve is more than 3 175 kg;

(ii) 0.83 D of the largest helicopter when the MTOM of helicopters the FATO is intended to serve is 3 175 kg or less.

Compliance Note. The term FATO is not used in the HFM. The minimum landing/take-off area specified in the HFM for the appropriate performance class 1 flight profile is necessary to determine the size of the FATO. However, for vertical take-off procedures in performance class 1, the required rejected take-off area is not normally quoted in the HFM, and it will be necessary to obtain information which includes complete containment — this figure will always be greater than 1 D.

1.4 Where intended to be used by helicopters operated in performance class 2 or 3 with MTOM of 3 175 kg or less, the FATO must be of sufficient size and shape to contain an area within which can be drawn a circle of diameter not less than 1 D.

1.5 The FATO must provide rapid drainage but the mean slope in any direction must not exceed 3 per cent. No portion of a FATO must have a local slope exceeding:

(a) 5 per cent where the heliport is intended to be used by helicopters operated in performance class 1; and
(b) 7 per cent where the heliport is intended to be used by helicopters operated in performance class 2 or 3.

1.6 The surface of the FATO must:

(a) be resistant to the effects of rotor downwash;
(b) be free of irregularities that would adversely affect the take-off or landing of helicopters; and
(c) have bearing strength sufficient to accommodate a rejected take-off by helicopters operated in performance class 1.

1.7 The surface of a FATO surrounding a touchdown and lift-off area (TLOF) intended for use by helicopters operated in performance classes 2 and 3 must be static load-bearing.

1.8 The FATO must provide ground effect.

1.9 The FATO must be located so as to minimize the influence of the surrounding environment, including turbulence, which could have an adverse impact on helicopter operations.

2. Helicopter clearways

2.1 When a helicopter clearway is provided, it must be located beyond the end of the FATO

2.3 The width of a helicopter clearway must not be less than that of the associated safety area. (See Figure 3-1.)

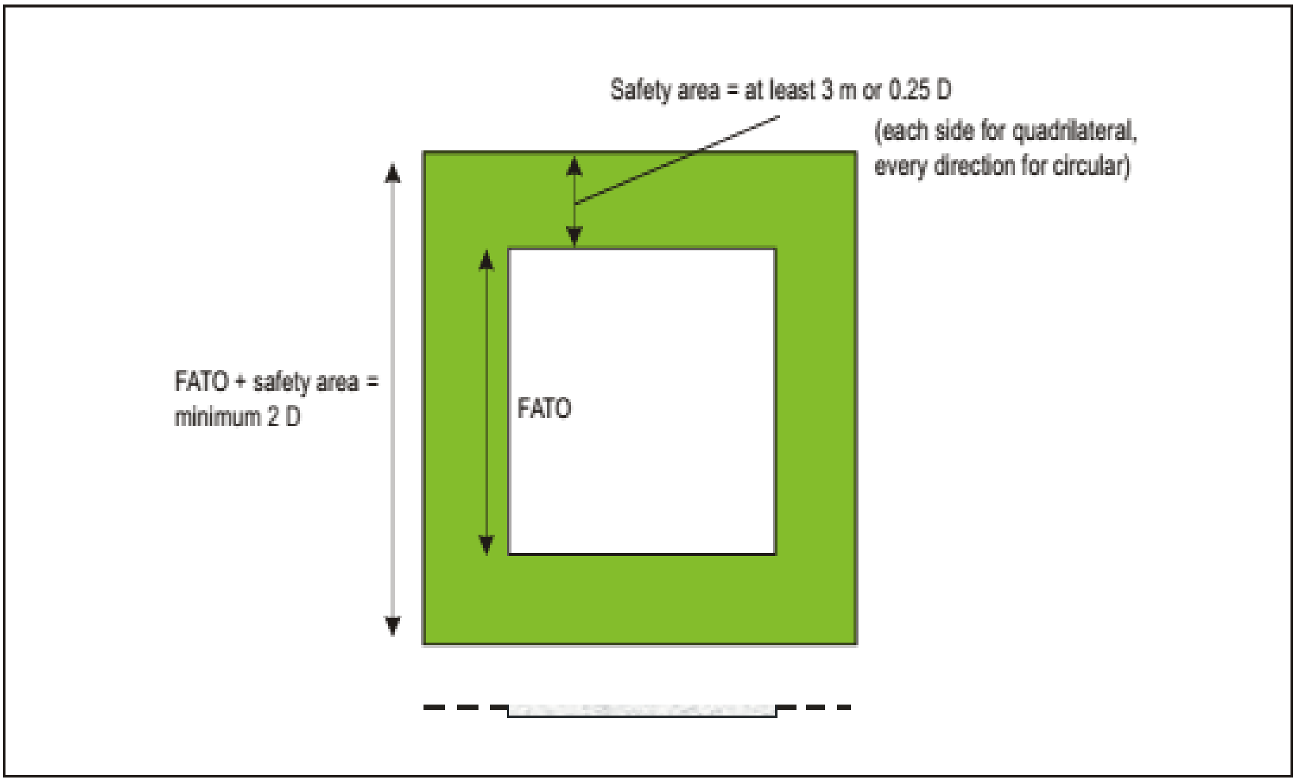


Figure 3-1. FATO and associated safety area

2.3 The ground in a helicopter clearway must not project above a plane having an upward slope of 3 per cent, the lower limit of this plane being a horizontal line which is located on the periphery of the FATO.

2.4 An object situated in a helicopter clearway, which may endanger helicopters in the air, must be regarded as an obstacle and must be removed.

3. Touchdown and lift-off areas

3.1 At least one TLOF must be provided at a heliport.

3.2 One TLOF must be located within the FATO or one or more TLOFs must be collocated with helicopter stands. For runway-type FATOs, additional TLOFs located in the FATO are acceptable.

3.3 The TLOF must be of sufficient size to contain a circle of diameter of at least 0.83 D of the largest helicopter the area is intended to serve.

3.4 Slopes on a TLOF must be sufficient to prevent accumulation of water on the surface of the area, but must not exceed 2 per cent in any direction.

3.5 Where the TLOF is within the FATO, the TLOF must be dynamic load-bearing.

3.6 Where a TLOF is collocated with a helicopter stand, the TLOF must be static load-bearing and be capable of withstanding the traffic of helicopters that the area is intended to serve.

3.7 Where a TLOF is located within a FATO which can contain a circle of diameter more than 1 D, the centre of the TLOF must be located not less than 0.5 D from the edge of the FATO.

4. Safety areas

4.1 A FATO must be surrounded by a safety area which need not be solid.

4.2 A safety area surrounding a FATO must extend outwards from the periphery of the FATO for a distance of at least 3 m or 0.25 D, whichever is greater, of the largest helicopter the FATO is intended to serve and:

(a) each external side of the safety area must be at least 2 D where the FATO is quadrilateral; or
(b) the outer diameter of the safety area must be at least 2 D where the FATO is circular.

4.3 There must be a protected side slope rising at 45 degrees from the edge of the safety area to a distance of 10 m, whose surface must not be penetrated by obstacles, except that when obstacles are located to one side of the FATO only, they may be permitted to penetrate the side slope surface.

Compliance Note. When only a single approach and take-off climb surface is provided, the need for specific protected side slopes would be addressed in an aeronautical study.

4.4 No fixed object must be permitted above the plane of the FATO on a safety area, except for frangible objects, which, because of their function, must be located on the area. No mobile object must be permitted on a safety area during helicopter operations.

4.5 Objects whose function requires them to be located on the safety area must not:

(a) if located at a distance of less than 0.75 D from the centre of the FATO, penetrate a plane at a height of 5 cm above the plane of the FATO; and

(b) if located at a distance of 0.75 D or more from the centre of the FATO, penetrate a plane originating at a height of 25 cm above the plane of the FATO and sloping upwards and outwards at a gradient of 5 per cent.

4.6 The surface of the safety area, when solid, must not exceed an upward slope of4 per cent outwards from the edge of the FATO.

4.7 Where applicable, the surface of the safety area must be treated to prevent flying debris caused by rotor downwash.

4.8 When solid, the surface of the safety area abutting the FATO must be continuous with the FATO.

5. Helicopter ground taxiways and helicopter ground taxi-routes

Compliance Note 1. A helicopter ground taxiway is intended to permit the surface movement of a wheeled helicopter under its own power.

Compliance Note 2. When a taxiway is intended for use by aeroplanes and helicopters, the provisions for taxiways for aeroplanes and helicopter ground taxiways will be taken into consideration and the more stringent requirements will be applied.

5.1 The width of a helicopter ground taxiway must not be less than 1.5 times the largest width of the undercarriage (UCW) of the helicopters the helicopter ground taxiway is intended to serve. (See Figure 3-2.)

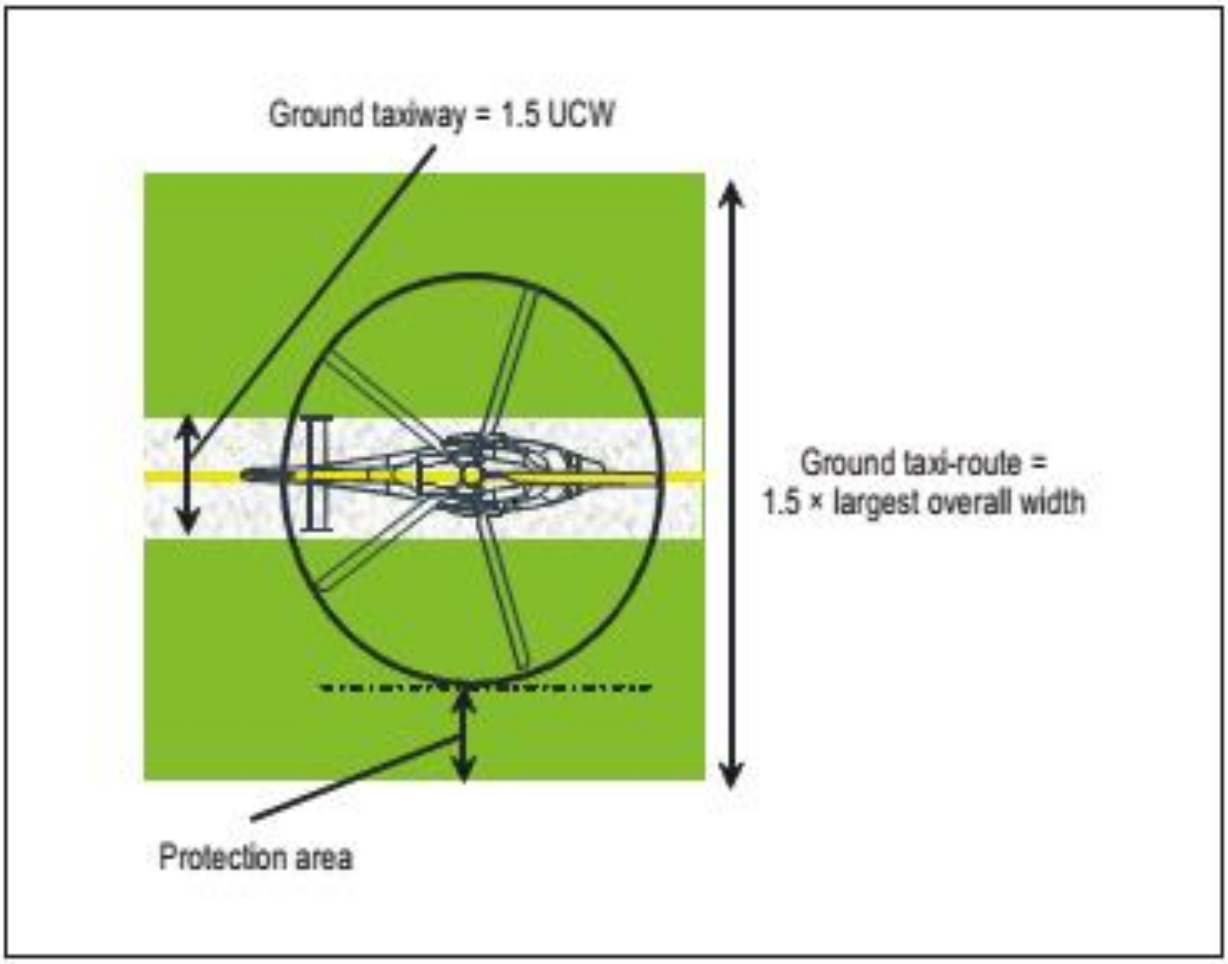


Figure 3-2. Helicopter ground taxi-route/taxiway

5.2 The longitudinal slope of a helicopter ground taxiway must not exceed 3 per cent.

5.3 A helicopter ground taxiway must be static load-bearing and be capable of withstanding the traffic of the helicopters the helicopter ground taxiway is intended to serve.

5.4 A helicopter ground taxiway must be centred on a ground taxi-route.

5.5 A helicopter ground taxi-route must extend symmetrically on each side of the centre line for at least 0.75 times the largest overall width of the helicopters it is intended to serve.

Compliance Note. The part of the helicopter ground taxi-route that extends symmetrically on each side of the centre line from 0.5 times the largest overall width of the helicopters it is intended to serve to the outermost limit of the helicopter ground taxi-route is its protection area.

5.6 No fixed object must be permitted above the surface of the ground on a helicopter ground taxi-route, except for frangible objects, which, because of their function, must be located thereon. No mobile object must be permitted on a ground taxi-route during helicopter movements.

5.7 Objects whose function requires them to be located on a helicopter ground taxi-route must not:

(a) be located at a distance of less than 50 cm from the edge of the helicopter ground taxiway; and
(b) penetrate a plane originating at a height of 25 cm above the plane of the helicopter ground taxiway, at a distance of 50 cm from the edge of the helicopter ground taxiway and sloping upwards and outwards at a gradient of 5 per cent.

5.8 The helicopter ground taxiway and the helicopter ground taxi-route must provide rapid drainage but the helicopter ground taxiway transverse slope must not exceed 2 per cent.

5.9 The surface of a helicopter ground taxi-route must be resistant to the effect of rotor downwash.

5.10 For simultaneous operations, the helicopter ground taxi-routes must not overlap.

6. Helicopter air taxiways and helicopter air taxi-routes

Compliance Note. A helicopter air taxiway is intended to permit the movement of a helicopter above the surface at a height normally associated with ground effect and at ground speed less than 37km/h (20 kt).

6.1 The width of a helicopter air taxiway must be at least two times the largest width of the undercarriage (UCW) of the helicopters that the helicopter air taxiway is intended to serve. (See Figure 3-3.)

6.2 The surface of a helicopter air taxiway must be static load-bearing.

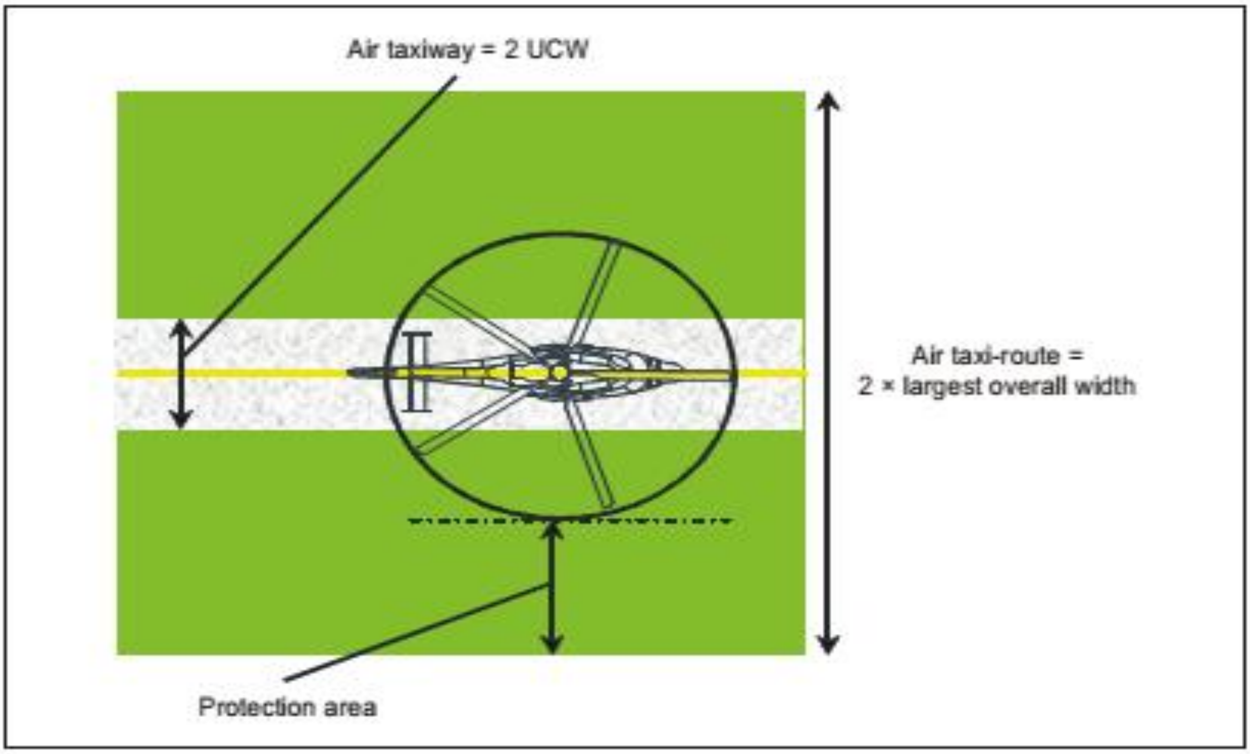


Figure 3-3. Helicopter air taxi-route/taxiway

6.3 The slopes of the surface of a helicopter air taxiway must not exceed the slope landing limitations of the helicopters the helicopter air taxiway is intended to serve. In any event the transverse slope must not exceed 10 per cent and the longitudinal slope must not exceed 7 per cent.

6.4 A helicopter air taxiway must be centred on an air taxi-route.

6.5 A helicopter air taxi-route must extend symmetrically on each side of the centre line for a distance at least equal to the largest overall width of the helicopters it is intended to serve.

Compliance Note. The part of the helicopter air taxi-route that extends symmetrically on each side of the centre line from 0.5 times the largest overall width of the helicopters it is intended to serve to the outermost limit of the helicopter air taxi-route is its protection area.

6.6 No fixed object must be permitted above the surface of the ground on an air taxi-route, except for frangible objects, which, because of their function, must be located thereon. No mobile object must be permitted on an air taxi-route during helicopter movements.

6.7 Objects above ground level whose function requires them to be located on a helicopter air taxi-route must not:

(a) be located at a distance of less than 1 m from the edge of the helicopter air taxiway; and
(b) penetrate a plane originating at a height of 25 cm above the plane of the helicopter air taxiway, at a distance of 1 m from the edge of the helicopter air taxiway and sloping upwards and outwards at a gradient of 5 per cent.

6.8 N/A

6.9 The surface of a helicopter air taxi-route must be resistant to the effect of rotor downwash.

6.10 The surface of a helicopter air taxi-route must provide ground effect.

6.11 For simultaneous operations, the helicopter air taxi-routes must not overlap.

7. Helicopter stands

7.1 When a TLOF is collocated with a helicopter stand, the protection area of the stand must not overlap the protection area of any other helicopter stand or associated taxi route.

7.2 The helicopter stand must provide rapid drainage but the slope in any direction must not exceed 2 per cent.

Compliance Note. The requirements on the dimensions of helicopter stands assume the helicopter will turn in a hover when operating over a stand.

7.3 A helicopter stand intended to be used by helicopters turning in a hover must be of sufficient size to contain a circle of diameter of at least 1.2 D of the largest helicopter the stand is intended to serve. (See Figure 3-4.)

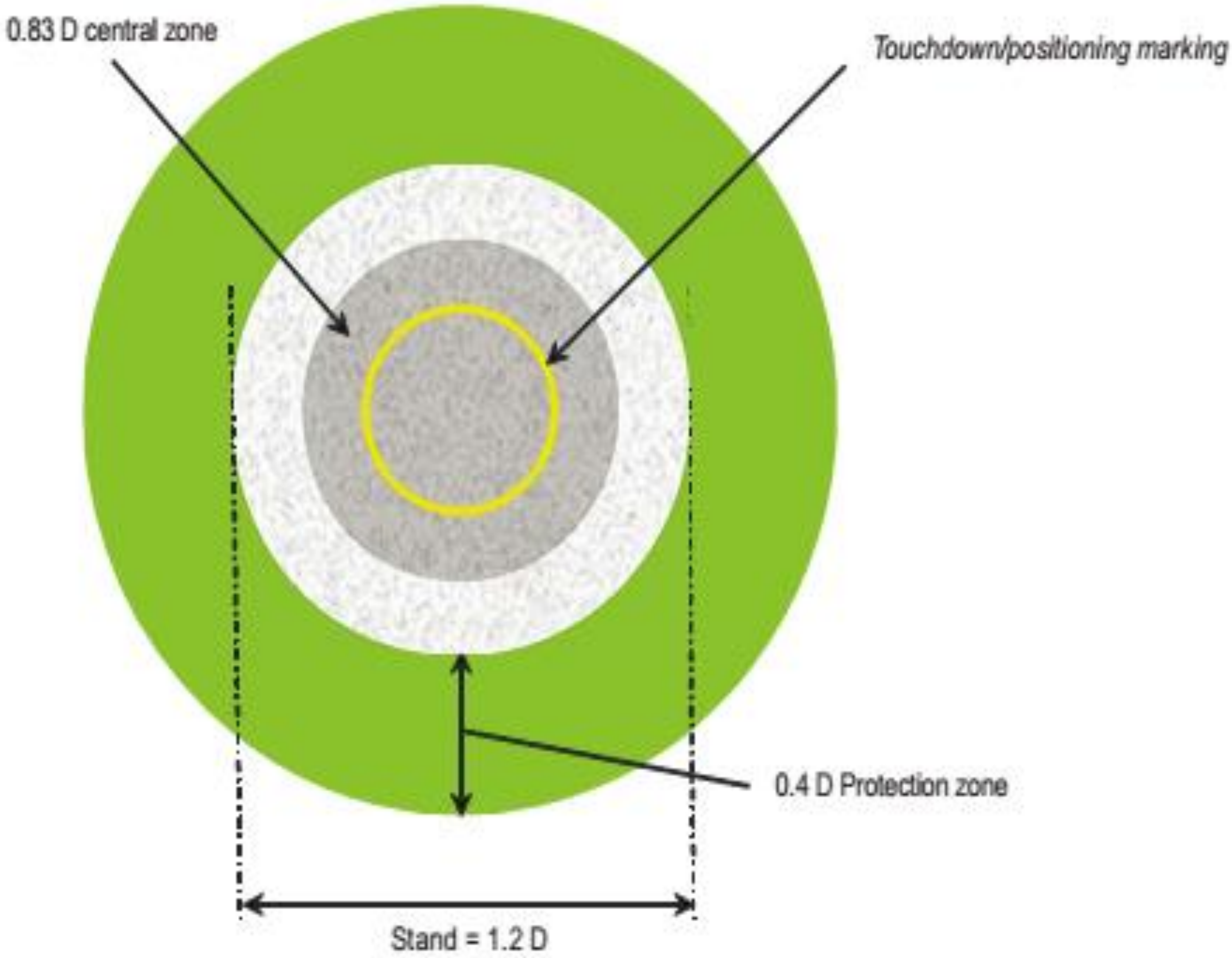


Figure 3-4. Helicopter stand and associated protection area

7.4 Where a helicopter stand is intended to be used for taxi-through and where the helicopter using the stand is not required to turn, the minimum width of the stand and associated protection area must be that of the taxi-route.

7.5 Where a helicopter stand is intended to be used for turning, the minimum dimension of the stand and protection area must be not less than 2 D.

7.6 Where a helicopter stand is intended to be used for turning, it must be surrounded by a protection area which extends for a distance of 0.4 D from the edge of the helicopter stand.

7.7 For simultaneous operations, the protection areas of helicopter stands and their associated taxi-routes must not overlap. (See Figure 3-5.)

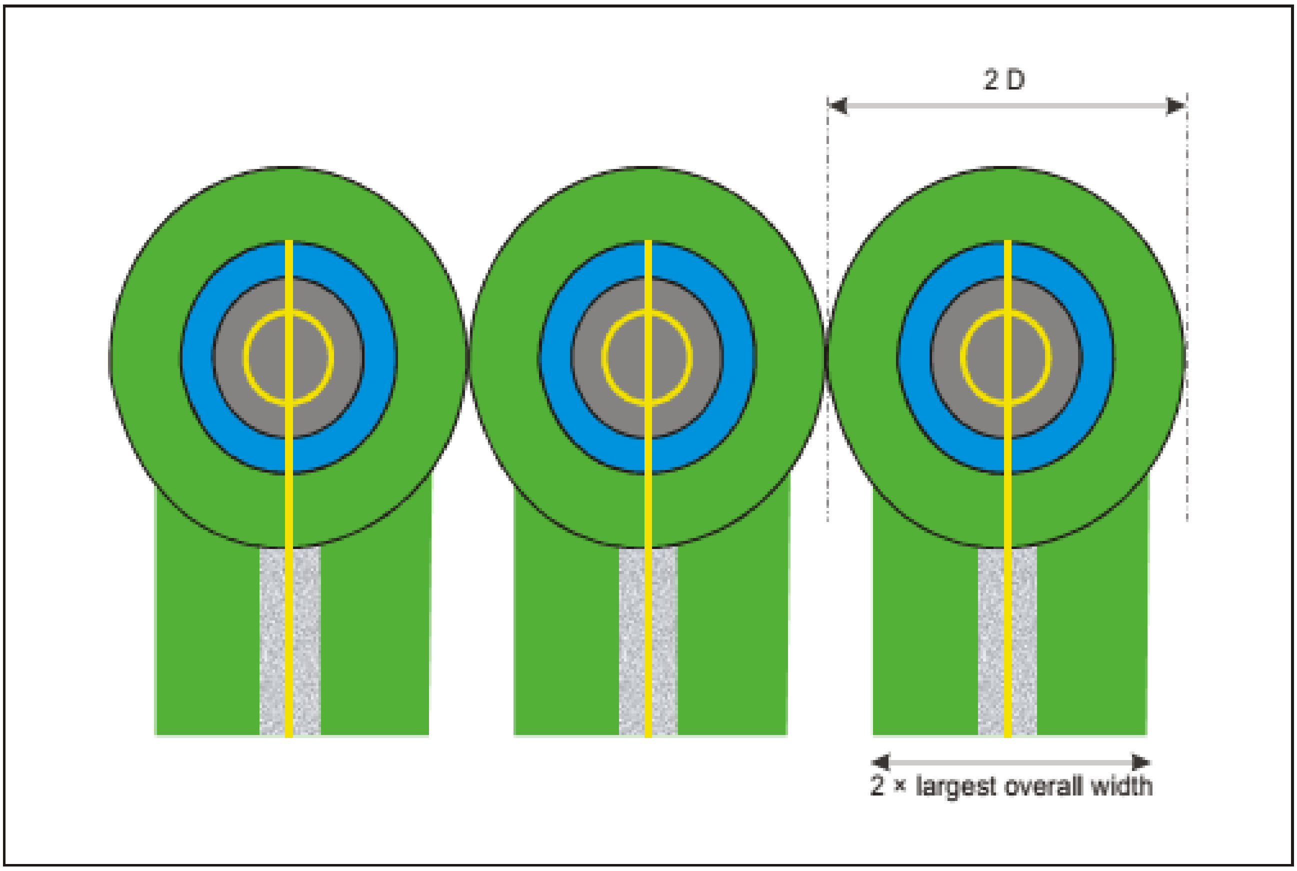


Figure 3-5. Helicopter stands designed for hover turns with air taxi-routes/taxiways — simultaneous operations

Compliance Note. Where non-simultaneous operations are envisaged, the protection areas of helicopter stands and their associated taxi-routes may overlap. (See Figure 3-6.)

7.8 A helicopter stand and associated protection area intended to be used for air taxiing must provide ground effect.

7.9 No fixed object must be permitted above the surface of the ground on a helicopter stand.

7.10 No fixed object must be permitted above the surface of the ground in the protection area around a helicopter stand except for frangible objects, which because of their function, must be located there.

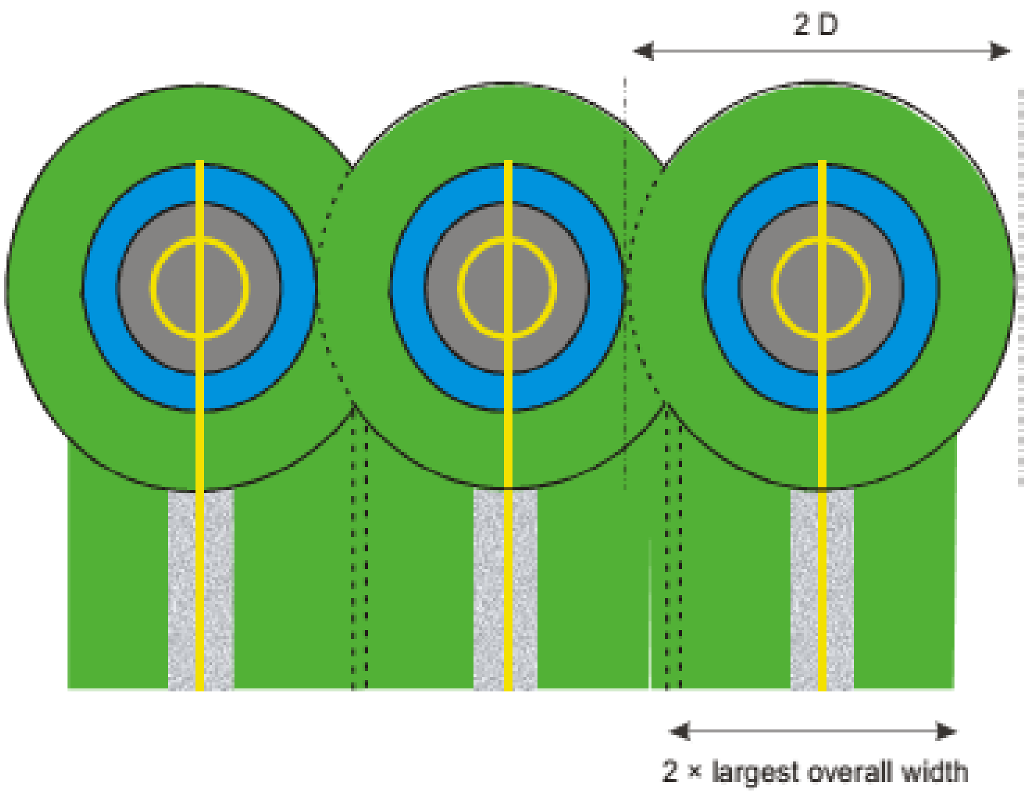


Figure 3-6. Helicopter stands designed for hover turns with

air taxi-routes/taxiways — non-simultaneous operations

7.11 No mobile object must be permitted on a helicopter stand and the associated protection area during helicopter movements.

7.12 Objects whose function requires them to be located in the protection area must not:

(a) if located at a distance of less than0.75 D from the centre of the helicopter stand, penetrate a plane at a height of 5 cm above the plane of the central zone; and

(b) if located at a distance of 0.75 D or more from the centre of the helicopter stand, penetrate a plane at a height of 25 cm above the plane of the central zone and sloping upwards and outwards at a gradient of 5 per cent.

7.13 The central zone of a helicopter stand must be capable of withstanding the traffic of helicopters it is intended to serve and have a static load-bearing area:

(a) of diameter not less than 0.83 D of the largest helicopter it is intended to serve; or

(b) for a helicopter stand intended to be used for taxi-through, and where the helicopter using the stand is not required to turn, the same width as the helicopter ground taxiway.

8. Location of a final approach and take-off area in relation to a runway or taxiway

8.1 Where a FATO is located near a runway or taxiway, and where simultaneous operations are planned, the separation distance between the edge of a runway or taxiway and the edge of a FATO must not be less than the appropriate dimension in Table 3-1.

Table 3-1. FATO minimum separation distance

If aeroplane mass and/or helicopter mass are	Distance between FATO edge and runway edge or taxiway edge
up to but not including 3 175 kg	60 m
3 175 kg up to but not including 5 760 kg	120 m
5 760 kg up to but not including 100 000 kg	180 m
100 000 kg and over	250 m

8.2 A FATO must not be located:

(a) near taxiway intersections or holding points where jet engine efflux is likely to cause high turbulence; or

(b) near areas where aeroplane vortex wake generation is likely to exist.

139.18.8 Physical characteristics of elevated heliports

1. General

Compliance Note 1. The dimensions of the taxi-routes and helicopter stands include a protection area.

1.1 In the case of elevated heliports, design considerations of the different elements of the heliport must take into account additional loading resulting from the presence of personnel, freight, refuelling, firefighting equipment, etc.

2. Final approach and take-off areas and touchdown and lift-off areas

Compliance Note. On elevated heliports it is presumed that the FATO and one TLOF will be coincidental.

2.1 An elevated heliport must be provided with one FATO.

2.2 A FATO must be obstacle free.

2.3 The dimensions of the FATO must be:

(a) where intended to be used by helicopters operated in performance class 1, as prescribed in the helicopter flight manual (HFM) except that, in the absence of width specifications, the width must be not less than 1 D of the largest helicopter the FATO is intended to serve;

(b) where intended to be used by helicopters operated in performance class 2 or 3, of sufficient size and shape to contain an area within which can be drawn a circle of diameter not less than:

(i) 1 D of the largest helicopter when the MTOM of helicopters the FATO is intended to serve is more than 3 175 kg;

(ii) 0.83 D of the largest helicopter when the MTOM of helicopters the FATO is intended to serve is 3 175 kg or less.

2.4 Where intended to be used by helicopters operated in performance class 2 or 3 with MTOM of 3 175 kg or less, the FATO must be of sufficient size and shape to contain an area within which can be drawn a circle of diameter not less than 1 D.

2.5 Slopes on a FATO at an elevated heliport must be sufficient to prevent accumulation of water on the surface of the area, but must not exceed 2 per cent in any direction.

2.6 The FATO must be dynamic load-bearing.

2.7 The surface of the FATO must be:

(a) resistant to the effects of rotor downwash; and
(b) free of irregularities that would adversely affect the take-off or landing of helicopters.

2.8 The FATO must provide ground effect

3. Helicopter clearways

3.1 When a helicopter clearway is provided, it must be located beyond the end of the rejected take-off area available.

3.2 The width of a helicopter clearway must not be less than that of the associated safety area.

3.3 When solid, the surface of the helicopter clearway must not project above a plane having an upward slope of 3 per cent, the lower limit of this plane being a horizontal line which is located on the periphery of the FATO.

3.4 An object situated on a helicopter clearway which may endanger helicopters in the air must be regarded as an obstacle and must be removed.

4. Touchdown and lift-off areas

4.1 One TLOF must be coincidental with the FATO.

Compliance Note. Additional TLOFs may be collocated with helicopter stands.

4.2 For a TLOF coincidental with the FATO, the dimensions and the characteristics of the TLOF must be the same as those of the FATO.

4.3 When the TLOF is collocated with a helicopter stand, the TLOF must be of sufficient size to contain a circle of diameter of at least 0.83 D of the largest helicopter the area is intended to serve.

4.4 Slopes on a TLOF collocated with a helicopter stand must be sufficient to prevent accumulation of water on the surface of the area, but must not exceed 2 per cent in any direction.

4.5 When the TLOF is collocated with a helicopter stand and intended to be used by ground taxiing helicopters only, the TLOF must at least be static load-bearing and be capable of withstanding the traffic of the helicopters the area is intended to serve.

4.6 When the TLOF is collocated with a helicopter stand and intended to be used by air taxiing helicopters, the TLOF must have a dynamic load-bearing area.

5. Safety areas

5.1 The FATO must be surrounded by a safety area which need not be solid.

5.2 A safety area surrounding a FATO intended to be used by helicopters operated in performance class 1 in

visual meteorological conditions (VMC) must extend outwards from the periphery of the FATO for a distance of at least 3 m or 0.25 D, whichever is greater, of the largest helicopter the FATO is intended to serve and:

(a) each external side of the safety area must be at least 2 D where the FATO is quadrilateral; or
(b) the outer diameter of the safety area must be at least 2 D where the FATO is circular.

5.3 A safety area surrounding a FATO intended to be used by helicopters operated in performance class 2 or 3 in visual meteorological conditions (VMC) must extend outwards from the periphery of the FATO for a distance of at least 3 m or 0.5 D, whichever is the greater, of the largest helicopter the FATO is intended to serve and:

(a) each external side of the safety area must be at least 2 D where the FATO is quadrilateral; or
(b) the outer diameter of the safety area must be at least 2 D where the FATO is circular.

5.4 There must be a protected side slope rising at 45 degrees from the edge of the safety area to a distance of 10 m, whose surface must not be penetrated by obstacles, except that when obstacles are located to one side of the FATO only, they may be permitted to penetrate the side slope surface.

5.5 No fixed object must be permitted on a safety area, except for frangible objects, which, because of their function, must be located on the area. No mobile object must be permitted on a safety area during helicopter operations.

5.6 Objects whose function require them to be located on the safety area must not exceed a height of 25 cm when located along the edge of the FATO nor penetrate a plane originating at a height of 25 cm above the edge of the FATO and sloping upwards and outwards from the edge of the FATO at a gradient of 5 per cent.

5.7 In the case of a FATO of diameter less than 1 D, the maximum height of the objects whose functions require them to be located on the safety area must not exceed a height of 5 cm.

5.8 The surface of the safety area, when solid, must not exceed an upward slope of4 per cent outwards from the edge of the FATO.

5.9 Where applicable, the surface of the safety area must be prepared in a manner to prevent flying debris caused by rotor downwash.

5.10 The surface of the safety area abutting the FATO must be continuous with the FATO.

6. Helicopter ground taxiways and ground taxi-routes

Compliance Note. The following specifications are intended for the safety of simultaneous operations during the manoeuvring of helicopters. However, the wind velocity induced by the rotor downwash might have to be considered.

6.1 The width of a helicopter ground taxiway must not be less than 2 times the largest width of the undercarriage (UCW) of the helicopters the ground taxiway is intended to serve.

6.2 The longitudinal slope of a helicopter ground taxiway must not exceed 3 per cent.

6.3 A helicopter ground taxiway must be static load-bearing and be capable of withstanding the traffic of the helicopters the helicopter ground taxiway is intended to serve.

6.4 A helicopter ground taxiway must be centred on a ground taxi-route.

6.5 A helicopter ground taxi-route must extend symmetrically on each side of the centre line to a distance not less than the largest overall width of the helicopters it is intended to serve.

6.6 No objects must be permitted on a helicopter ground taxi-route, except for frangible objects, which, because of their function, must be located there.

6.7 The helicopter ground taxiway and the ground taxi-route must provide rapid drainage but the helicopter ground taxiway transverse slope must not exceed 2 per cent.

6.8 The surface of a helicopter ground taxi-route must be resistant to the effect of rotor downwash.

7. Helicopter air taxiways and air taxi-routes

Compliance Note. A helicopter air taxiway is intended to permit the movement of a helicopter above the surface at a height normally associated with ground effect and at ground speed less than 37 km/h (20 kt).

7.1 The width of a helicopter air taxiway must be at least three times the largest width of the undercarriage (UCW) of the helicopters the air taxiway is intended to serve.

7.2 The surface of a helicopter air taxiway must be dynamic load-bearing.

7.3 The transverse slope of the surface of a helicopter air taxiway must not exceed 2 per cent and the longitudinal slope must not exceed 7 per cent. In any event, the slopes must not exceed the slope landing limitations of the helicopters the air taxiway is intended to serve.

7.4 A helicopter air taxiway must be centred on an air taxi-route.

7.5 A helicopter air taxi-route must extend symmetrically on each side of the centre line to a distance not less than the largest overall width of the helicopters it is intended to serve.

7.6 No objects must be permitted on an air taxi-route, except for frangible objects, which, because of their function, must be located thereon.

7.7 The surface of an air taxi-route must be resistant to the effect of rotor downwash.

7.8 The surface of an air taxi-route must provide ground effect.

8. Aprons

8.1 The slope in any direction on a helicopter stand must not exceed 2 per cent.

8.2 A helicopter stand must be of sufficient size to contain a circle of diameter of at least 1.2 D of the largest helicopters the stand is intended to serve.

8.3 If a helicopter stand is used for taxi-through, the minimum width of the stand and associated protection area must be that of the taxi-route.

8.4 When a helicopter stand is used for turning, the minimum dimension of the stand and protection area must be not less than 2 D.

8.5 When a helicopter stand is used for turning, it must be surrounded by a protection area which extends for a distance of 0.4 D from the edge of the helicopter stand.

8.6 For simultaneous operations, the protection area of helicopter stands and their associated taxi-routes must not overlap.

Compliance Note. Where non-simultaneous operations are envisaged, the protection area of helicopter stands and their associated taxi-routes may overlap.

8.7 When intended to be used for ground taxi operations by wheeled helicopters, the dimensions of a helicopter stand must take into account the minimum turn radius of the wheeled helicopters the stand is intended to serve.

8.8 A helicopter stand and associated protection area intended to be used for air taxiing must provide ground effect.

8.9 No fixed objects must be permitted on a helicopter stand and the associated protection area.

8.10 The central zone of the helicopter stand must be capable of withstanding the traffic of the helicopters it is intended to serve and have a load-bearing area:

(a) of diameter not less than 0.83 D of the largest helicopter it is intended to serve; or
(b) for a helicopter stand intended to be used for ground taxi-through, the same width as the ground taxiway.

8.11 The central zone of a helicopter stand intended to be used for ground taxiing only must be static load-bearing.

8.12 The central zone of a helicopter stand intended to be used for air taxiing must be dynamic load-bearing.

Compliance Note. For a helicopter stand intended to be used for turning on the ground, the dimension of the central zone might have to be increased.

139.18.9 Physical characteristics of helidecks

Compliance Note. The following specifications are for helidecks located on structures engaged in such activities as mineral exploitation, research or construction. See 139.18.10 for shipboard heliport provisions.

1. Final approach and take-off areas and touchdown and lift-off areas

Compliance Note 1. For helidecks that have a 1 D or larger FATO it is presumed that the FATO and the TLOF will always occupy the same space and have the same load bearing characteristics so as to be coincidental. For helidecks that are less than 1 D, the reduction in size is only applied to the TLOF which is a load bearing area. In this case, the FATO remains at 1 D but the portion extending beyond the TLOF perimeter need not be load bearing for helicopters. The TLOF and the FATO may be assumed to be collocated.

1.1 The specifications in paragraphs 1.14 and 1.15 below must be applicable for helidecks completed on or after 1 January 2012.

1.2 A helideck must be provided with one FATO and one coincident or collocated TLOF.

1.3 A FATO may be any shape but must be of sufficient size to contain an area within which can be accommodated a circle of diameter of not less than 1 D of the largest helicopter the helideck is intended to serve.

1.4 A TLOF may be any shape but must be of sufficient size to contain:

(a) for helicopters with an MTOM of more than 3 175 kg, an area within which can be accommodated a circle of diameter not less than 1 D of the largest helicopter the helideck is intended to serve; and
(b) for helicopters with an MTOM of 3 175 kg or less, an area within which can be accommodated a circle of diameter not less than 0.83 D of the largest helicopter the helideck is intended to serve.

1.5 For helicopters with a MTOM of 3 175 kg or less, the TLOF must be of sufficient size to contain an area within which can be accommodated a circle of diameter of not less than 1 D of the largest helicopter the helideck is intended to serve.

1.6 A helideck must be arranged to ensure that a sufficient and unobstructed air-gap is provided which encompasses the full dimensions of the FATO.

1.7 The FATO must be located so as to avoid, as far as is practicable, the influence of environmental effects, including turbulence, over the FATO, which could have an adverse impact on helicopter operations.

1.8 The TLOF must be dynamic load-bearing.

1.9 The TLOF must provide ground effect.

1.10 No fixed object must be permitted around the edge of the TLOF except for frangible objects, which, because of their function, must be located thereon.

1.11 For any TLOF 1 D or greater and any TLOF designed for use by helicopters having a D-value of greater than

16.0 m, objects installed in the obstacle-free sector whose function requires them to be located on the edge of the TLOF must not exceed a height of 25 cm.

1.12 For any TLOF 1 D or greater and any TLOF designed for use by helicopters having a D-value of greater than 16.0 m, objects installed in the obstacle-free sector whose function requires them to be located on the edge of the TLOF must be as low as possible and in any case not exceed a height of 15 cm.

1.13 For any TLOF designed for use by helicopters having a D-value of 16.0 m or less, and any TLOF having dimensions of less than 1 D, objects installed in the obstacle-free sector whose function requires them to be located on the edge of the TLOF, must not exceed a height of 5 cm.

Compliance Note. Lighting that is mounted at a height of less than 25 cm is typically assessed for adequacy of visual cues before and after installation.

1.14 Objects whose function requires them to be located within the TLOF (such as lighting or nets) must not exceed a height of 2.5 cm. Such objects must only be present if they do not represent a hazard to helicopters.

Compliance Note. Examples of potential hazards include nets or raised fittings on the deck that might induce dynamic rollover for helicopters equipped with skids.

1.15 Safety devices such as safety nets or safety shelves must be located around the edge of a helideck but must not exceed the height of the TLOF.

1.16 The surface of the TLOF must be skid-resistant to both helicopters and persons and be sloped to prevent pooling of water.

139.18.10 Physical characteristics of shipboard heliports

1.1 The specifications in paragraphs 1.16 and 1.17 must be applicable to shipboard heliports completed on or after 1 January 2012 and 1 January 2015, respectively.

1.2 When helicopter operating areas are provided in the bow or stern of a ship or are purpose-built above the ship's structure, they must be regarded as purpose-built shipboard heliports.

Final approach and take-off areas and touchdown and lift-off areas

1.3 A shipboard heliport must be provided with one FATO and one coincidental or collocated TLOF.

1.4 A FATO may be any shape but must be of sufficient size to contain an area within which can be accommodated a circle of diameter of not less than 1 D of the largest helicopter the heliport is intended to serve.

1.5 The TLOF of a shipboard heliport must be dynamic load-bearing.

1.6 The TLOF of a shipboard heliport must provide ground effect.

1.7 For purpose-built shipboard heliports provided in a location other than the bow or stern, the TLOF must be of sufficient size to contain a circle with a diameter not less than1 D of the largest helicopter the heliport is intended to serve.

1.8 For purpose-built shipboard heliports provided in the bow or stern of a ship, the TLOF must be of sufficient size to:

(a) contain a circle with a diameter not less than 1 D of the largest helicopter the heliport is intended to serve; or
(b) for operations with limited touchdown directions, contain an area within which can be accommodated two opposing arcs of a circle with a diameter of not less than 1 D in the helicopter's longitudinal direction. The minimum width of the heliport must be not less than 0.83 D. (See Figure 3-7.)

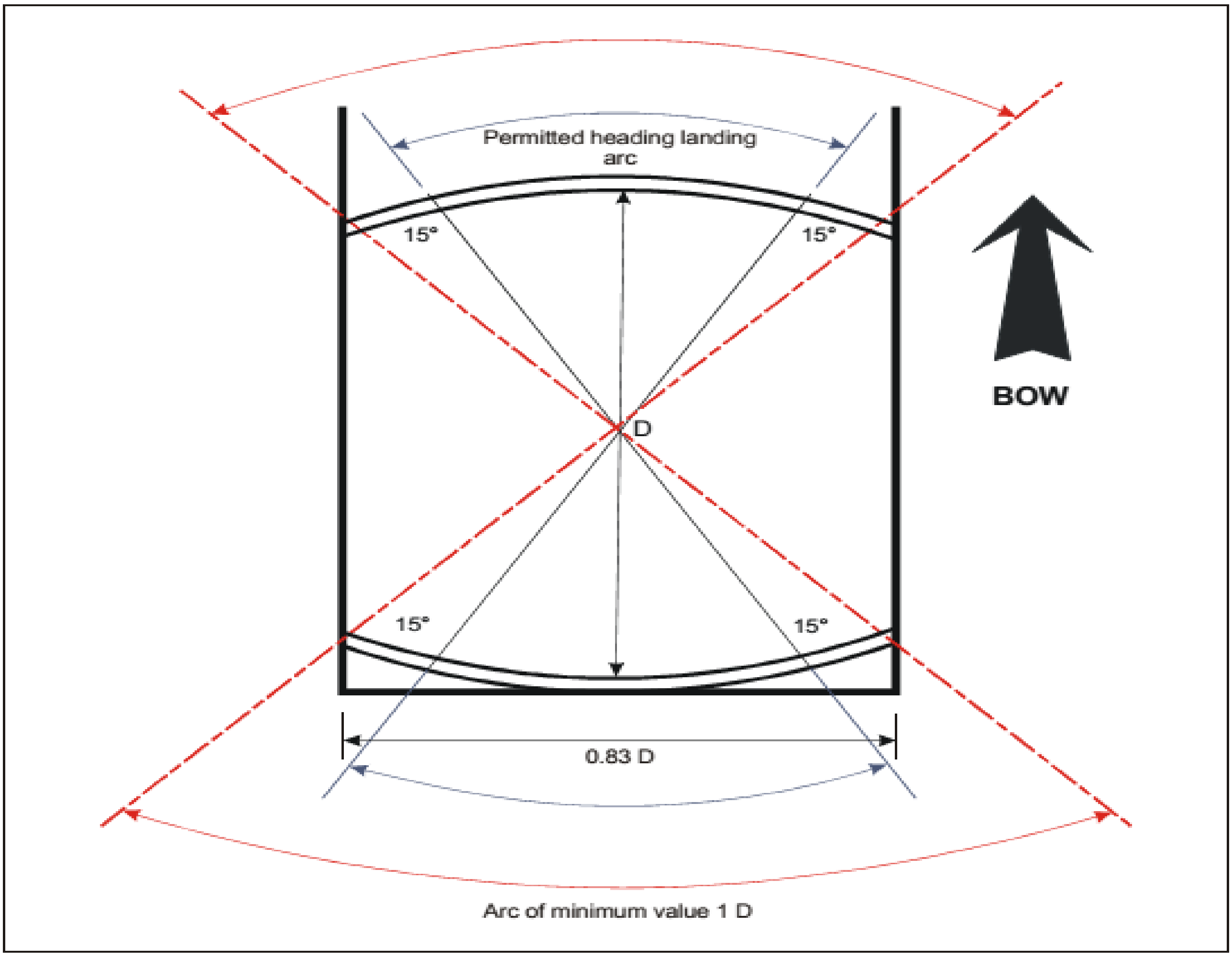


Figure 3-7. Shipboard permitted landing headings for limited heading operations

Compliance Note 1. The ship will need to be maneuvered to ensure that the relative wind is appropriate to the direction of the helicopter touchdown heading.

Compliance Note 2. The touchdown heading of the helicopter is limited to the angular distance subtended by the 1 D arc headings, minus the angular distance which corresponds to 15 degrees at each end of the arc.

1.9 For non-purpose-built shipboard heliports, the TLOF must be of sufficient size to contain a circle with a diameter not less than 1 D of the largest helicopter the heliport is intended to serve.

1.10 A shipboard heliport must be arranged to ensure that a sufficient and unobstructed air-gap is provided which encompasses the full dimensions of the FATO.

1.11 The FATO must be located so as to avoid, as far as is practicable, the influence of environmental effects, including turbulence, over the FATO, which could have an adverse impact on helicopter operations.

1.12 No fixed object must be permitted around the edge of the TLOF except for frangible objects, which, because of their function, must be located thereon.

1.13 For any TLOF 1D or greater and any TLOF designed for use by helicopters having a D-value of greater than

16.0 m, objects installed in the obstacle-free sector whose function requires them to be located on the edge of the TLOF must not exceed a height of 25 cm.

1.14 For any TLOF 1 D or greater and any TLOF designed for use by helicopters having a D-value of greater than 16.0 m, objects installed in the obstacle-free sector whose function requires them to be located on the edge of the TLOF must be as low as possible and in any case not exceed a height of 15 cm.

1.15 For any TLOF designed for use by helicopters having a D-value of 16.0 m or less, and any TLOF having dimensions of less than 1 D, objects in the obstacle-free sector, whose function requires them to be located on the edge of the TLOF, must not exceed a height of 5 cm.

1.16 Objects whose function requires them to be located within the TLOF (such as lighting or nets) must not exceed a height of 2.5 cm. Such objects must only be present if they do not represent a hazard to helicopters.

1.17 Safety devices such as safety nets or safety shelves must be located around the edge of a shipboard heliport, except where structural protection exists, but must not exceed the height of the TLOF.

1.18 The surface of the TLOF must be skid-resistant to both helicopters and persons.

139.18.11 Obstacle limitation surfaces and sectors

Compliance Note. The specifications for obstacle environment describe the airspace around heliports so as to permit intended helicopter operations to be conducted safely and to prevent, heliports from becoming unusable by the growth of obstacles around them. This is achieved by establishing a series of obstacle limitation surfaces that define the limits to which objects may project into the airspace.

1. Approach surface

1.1 *Description*. An inclined plane or a combination of planes or, when a turn is involved, a complex surface sloping upwards from the end of the safety area and centred on a line passing through the centre of the FATO.

Compliance Note. See Figures 4-1, 4-2, 4-3 and 4-4 for depiction of surfaces. See Table 4-1 for dimensions and slopes of surfaces.

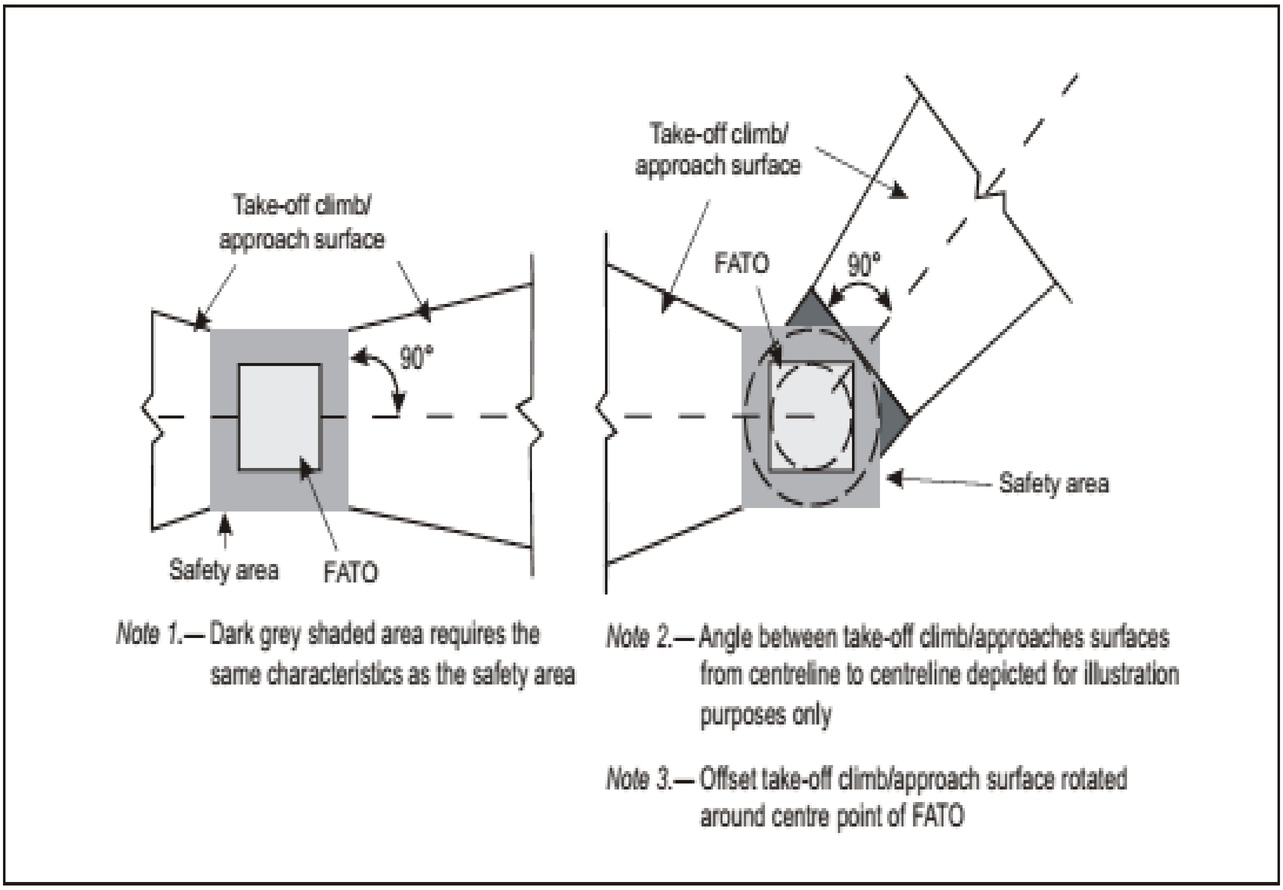


Figure 4-1. Obstacle limitation surfaces — Take-off climb and approach surface

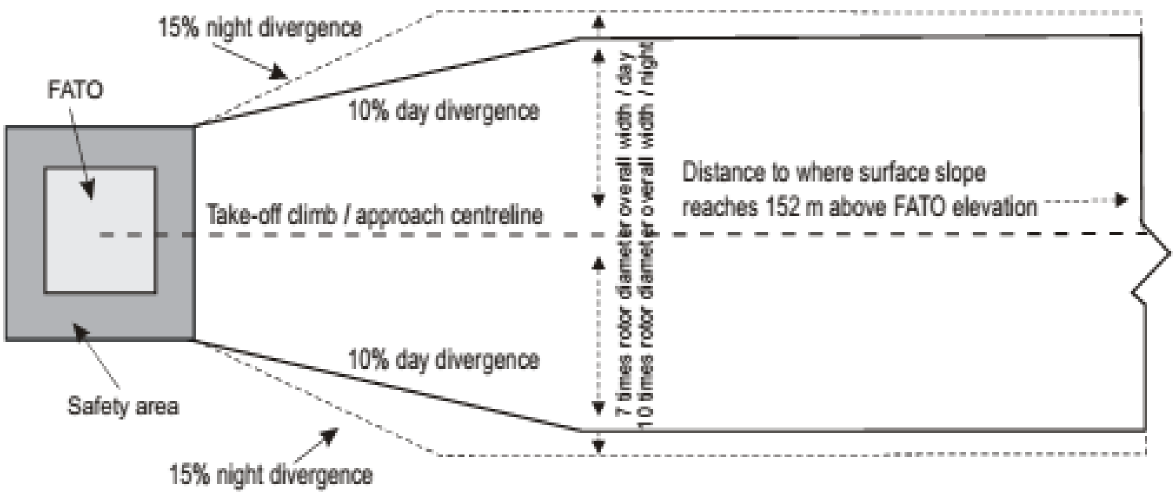
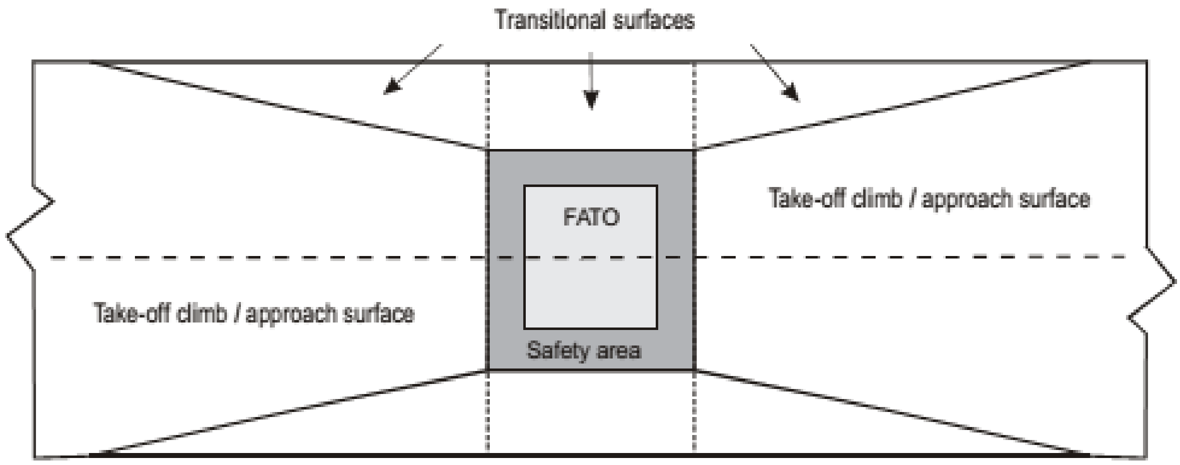


Figure 4-2. Take-off climb/Approach surface width



Note 1.— For single take-off climb / approach surface. Transition surface extends perpendicular to far side of Safety Area.
Note 2.— PANS-OPS, Doc 8168, Volume II, Part IV Helicopters, details procedure design criteria.
Note 3.— This figure shows a square FATO for illustration purposes only. For a circular FATO the transitional surface lower and upper edges would also be circular.

Figure 4-3. Transitional surface for a FATO with a PinS approach procedure with a VSS

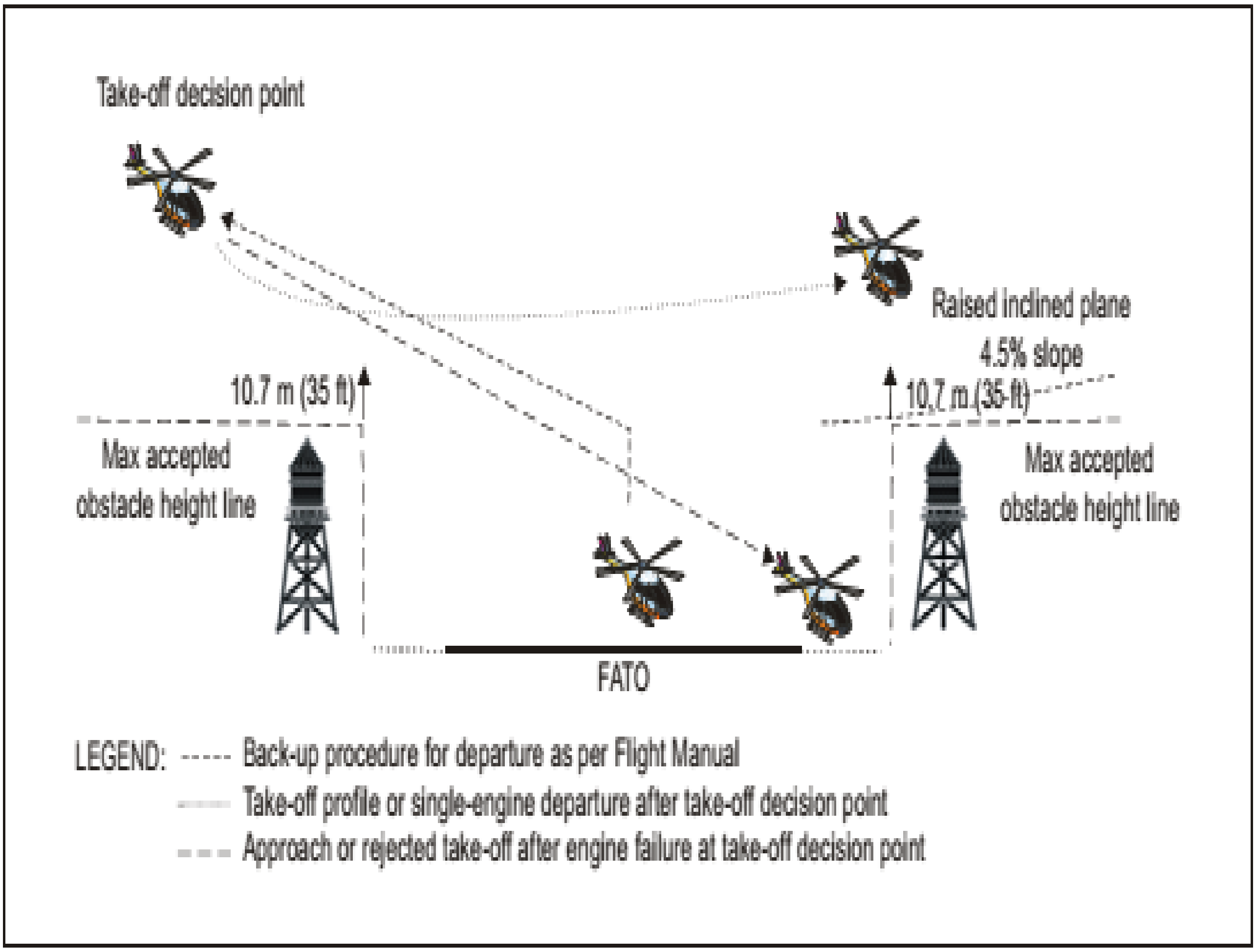


Figure 4-4. Example of raised inclined plane during operations in Performance Class 1

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

for all visual FATOs

SURFACE and DIMENSIONS	SLOPE DESIGN CATEGORIES		
	A	B	C
APPROACH and TAKE-OFF CLIMB SURFACE:			

Length of inner edge	Width of safety area	Width of safety area	Width of safety area
Location of inner edge	Safety area boundary (Clearway boundary if provided)	Safety area boundary	Safety area boundary
Divergence:(1st and 2nd section)			
Day use only	10%	10%	10%
Night use	15%	15%	15%
First Section:			
Length	3386 m	245 m	1220 m
Slope	4.55 (1:22.2)	8% (1:12.5)	12.5% (1.8)
Outer Width	(b)	N/A	(b)
Second Section:			
Length	N/A	830 m	N/A
Slope	N/A	16% (1:6.25)	N/A
Outer Width	N/A	(b)	N/A
Total Length from inner edge(a)			
Transitional Surface: (FATOs with a PinS approach procedure with VSS)			
Slope	50% (1:2)	50% (1:2)	50% (1:2)
Height	45 m	45 m	45 m

(a) The approach and take-off climb surface lengths of 3 386 m, 1 075 m and 1 220 m associated with the respective slopes, brings the helicopter to 152 m (500 ft) above FATO elevation.

(b) Seven rotor diameters overall width for day operations or 10 rotor diameters overall width for night operations.

Compliance Note. The slope design categories in Table 4-1 may not be restricted to a specific performance class of operation and may be applicable to more than one performance class of operation. The slope design categories depicted in Table 4-1 represent minimum design slope angles and not operational slopes. Slope category "A" generally corresponds with helicopters operated in performance class 1; slope category "B" generally corresponds with helicopters operated in performance class 3; and slope category "C" generally corresponds with helicopters operated in performance class 2. Consultation with helicopter operators will help to determine the appropriate slope category to apply according to the heliport environment and the most critical helicopter type for which the heliport is intended.

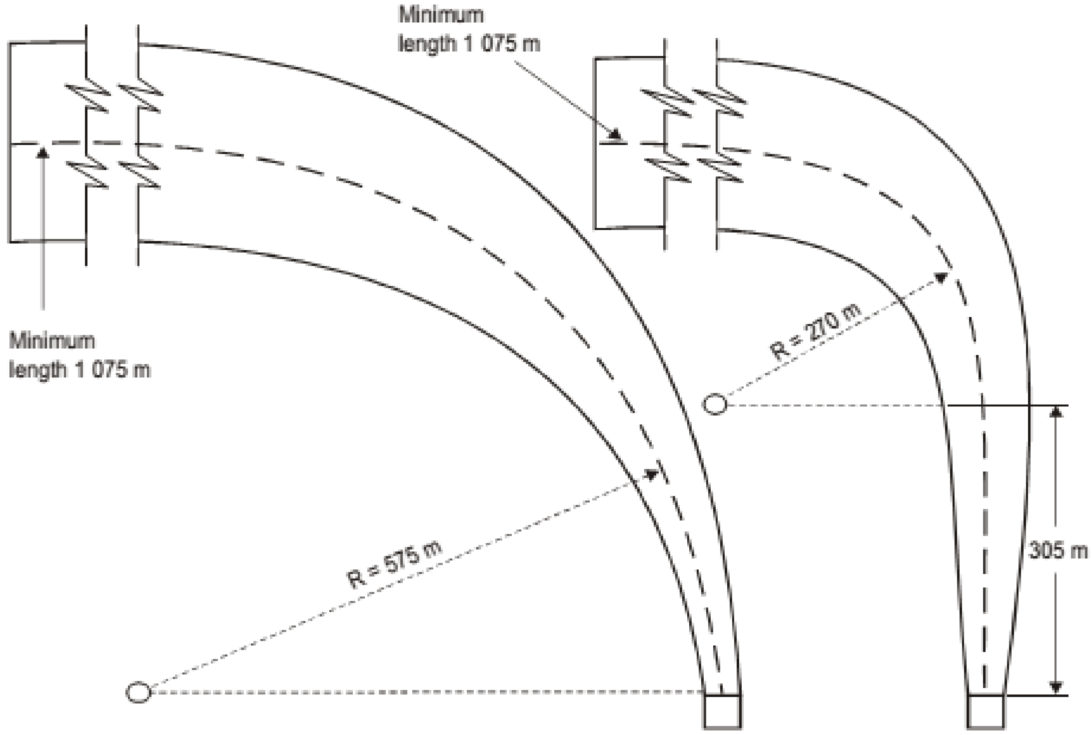
1.2 *Characteristics*. The limits of an approach surface must comprise:

(a) an inner edge horizontal and equal in length to the minimum specified width/diameter of the FATO plus the safety area, perpendicular to the centre line of the approach surface and located at the outer edge of the safety area;
(b) two side edges originating at the ends of the inner edge diverging uniformly at a specified rate from the vertical plane containing the centre line of the FATO; and:
(c) an outer edge horizontal and perpendicular to the centre line of the approach surface and at a specified height of 152 m (500 ft) above the elevation of the FATO.

1.3 The elevation of the inner edge must be the elevation of the FATO at the point on the inner edge that is intersected by the centre line of the approach surface. For heliports intended to be used by helicopters operated in performance class 1 and when approved by the CAA, the origin of the inclined plane may be raised directly above the FATO.

1.4 The slope(s) of the approach surface must be measured in the vertical plane containing the centre line of the surface.

1.5 In the case of an approach surface involving a turn, the surface must be a complex surface containing the horizontal normals to its centre line and the slope of the centre line must be the same as that for a straight approach surface. (See Figure 4-5).



Note 1.— Any combination of curve and straight portion may be established using the following formula: S+R ≥ 575 m and R ≥ 270 m where S = 305 m, where S is the length of the straight portion and R is the radius of turn. Note any combination ≥ 575 m will work.

Note 2.— The minimum length of the centre line of the curve and straight portion is 1 075 m but may be longer depending upon the slope used. See Table 4-1 for longer lengths.

Note 3.— Helicopter take-off performance is reduced in a curve and as such a straight portion along the take-off climb surface prior to the start of the curve should be considered to allow for acceleration.

Figure 4-5. Curved approach and take-off climb surface for all FATOs

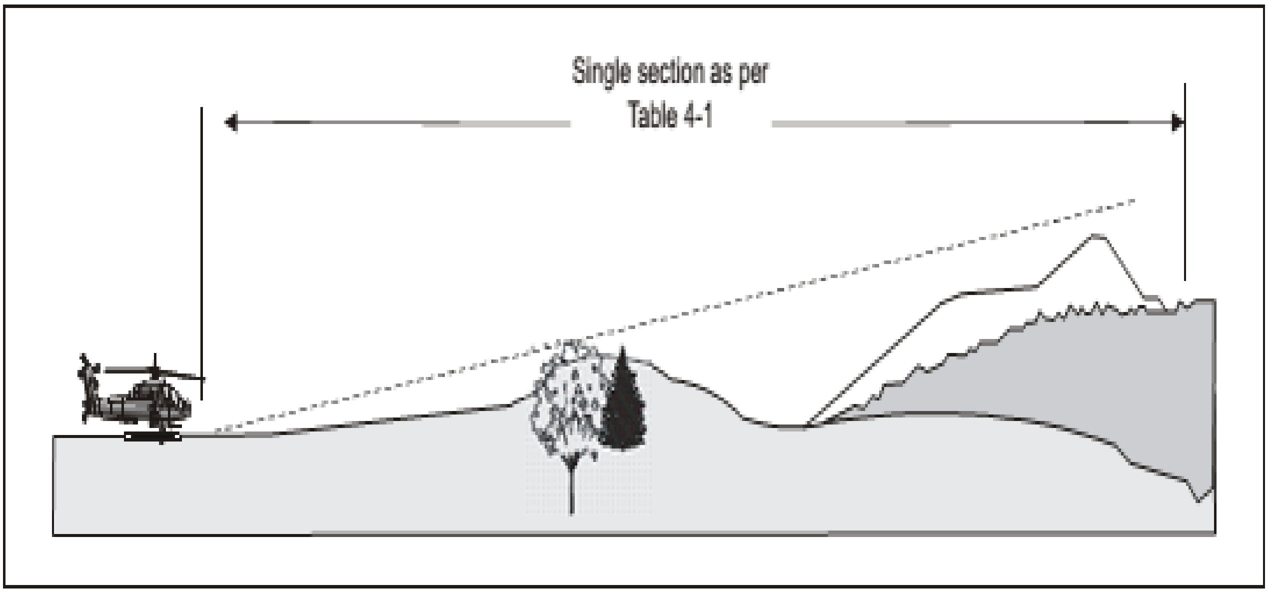
1.6 In the case of an approach surface involving a turn, the surface must not contain more than one curved portion.

1.7 Where a curved portion of an approach surface is provided, the sum of the radius of arc defining the centre line of the approach surface and the length of the straight portion originating at the inner edge must not be less than 575 m.

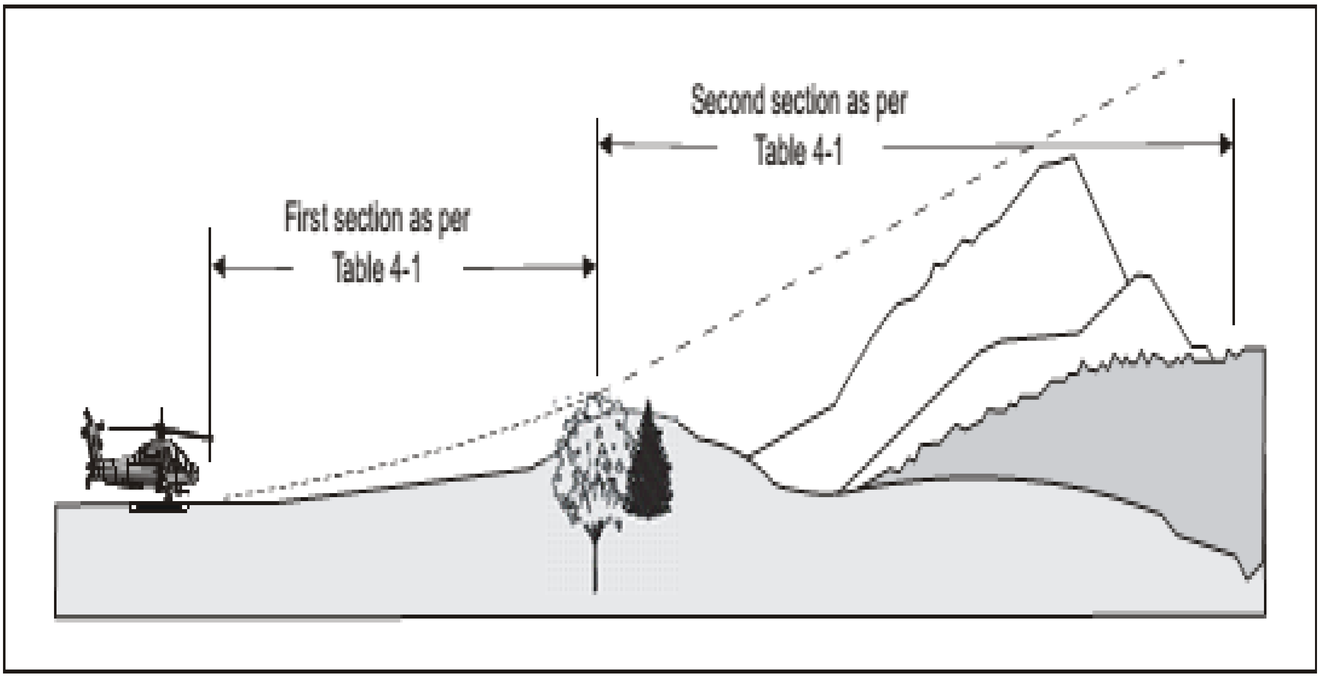
1.8 Any variation in the direction of the centre line of an approach surface must be designed so as not to necessitate a turn radius less than 270 m.

Compliance Note. For heliports intended to be used by helicopters operated in performance class 2 and 3, it is good practice for the approach paths to be selected so as to permit safe forced landing or one-engine-inoperative landings such that, as a minimum requirement, injury to persons on the ground or water or damage to property are minimized. The most critical helicopter type for which the heliport is intended and the ambient conditions may be factors in determining the suitability of such areas.

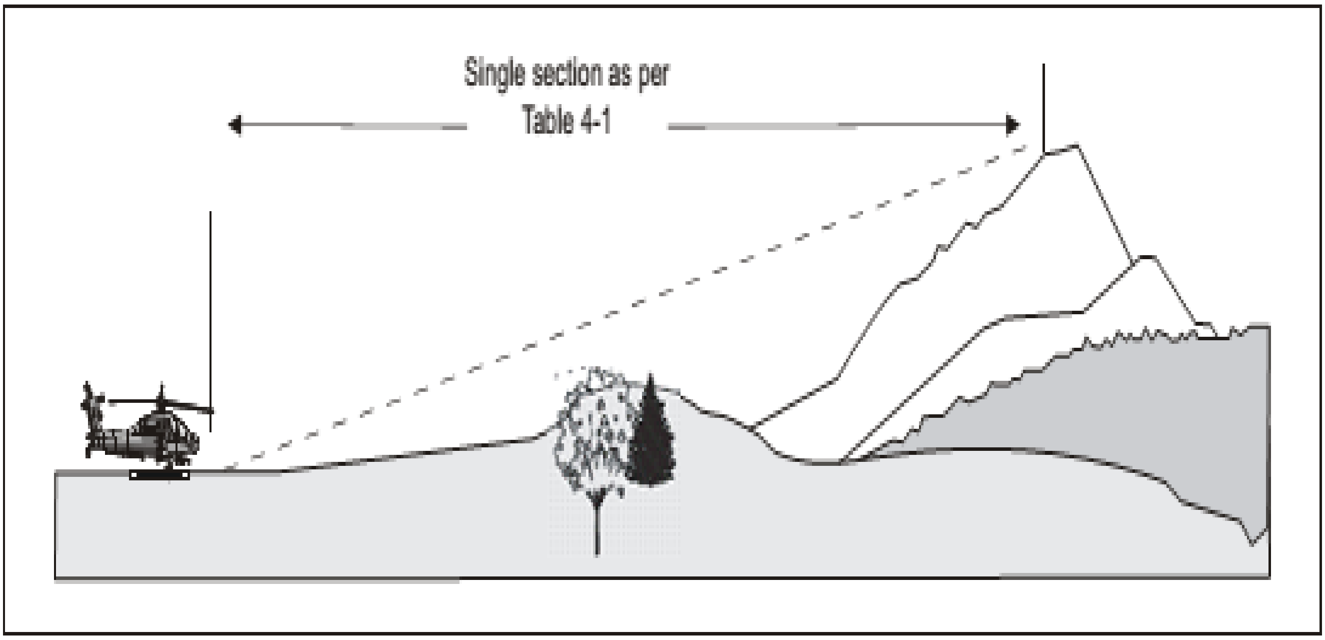
Figure 4-6. Approach and take-off climb surfaces with different slope design categories



a) Approach and take-off climb surfaces - “A” slope profile - 4.5% design



b) Approach and take-off climb surfaces - “B” slope profile - 8% and 16% design



c) Approach and take-off climb surfaces - “C” slope profile - 12.5% design

2. Transitional surface

Compliance Note. For a FATO at a heliport without a PinS approach incorporating a visual segment surface (VSS) there is no requirement to provide transitional surfaces.

2.1 *Description*. A complex surface along the side of the safety area and part of the side of the approach/take-off climb surface, that slopes upwards and outwards to a predetermined height of 45 m (150 ft).

Compliance Note. See Figure 4-3. See Table 4-1 for dimensions and slopes of surfaces.

2.2 *Characteristics*. The limits of a transitional surface must comprise:

(a) a lower edge beginning at a point on the side of the approach/take-off climb surface at a specified height above the lower edge extending down the side of the approach/take-off climb surface to the inner edge of the approach/takeoff climb surface and from there along the length of the side of the safety area parallel to the centre line of the FATO; and

(b) an upper edge located at a specified height above the lower edge as set out in Table 4-1.

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

(a) along the side of the approach/take-off climb surface — equal to the elevation of the approach/take-off climb surface at that point; and

(b) along the safety area — equal to the elevation of the inner edge of the approach/take-off climb surface.

Compliance Note 1. If the origin of the inclined plane of the approach/take-off climb surface is raised as approved by the CAA, the elevation of the origin of the transitional surface will be raised accordingly.

Compliance Note 2.— As a result of b) the transitional surface along the safety area will be curved if the profile of the FATO is curved, or a plane if the profile is a straight line.

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

3. Take-off climb surface

3.1 *Description*. An inclined plane, a combination of planes or, when a turn is involved, a complex surface sloping upwards from the end of the safety area and centred on a line passing through the centre of the FATO.

Compliance Note. See Figures 4-1, 4-2, 4-3 and 4-4 for depiction of surfaces. See Table 4-1 for dimensions and slopes of surfaces.

3.2 *Characteristics*. The limits of a take-off climb surface must comprise:

(a) an inner edge horizontal and equal in length to the minimum specified width/diameter of the FATO plus the safety area, perpendicular to the centre line of the take-off climb surface and located at the outer edge of the safety area;
(b) two side edges originating at the ends of the inner edge and diverging uniformly at a specified rate from the vertical plane containing the centre line of the FATO; and
(c) an outer edge horizontal and perpendicular to the centre line of the take-off climb surface and at a specified height of 152 m (500 ft) above the elevation of the FATO.

3.3 The elevation of the inner edge must be the elevation of the FATO at the point on the inner edge that is intersected by the centre line of the take-off climb surface. For heliports intended to be used by helicopters operated in performance class 1 and when approved by the Executive Director, the origin of the inclined plane may be raised directly above the FATO.

3.4 Where a clearway is provided the elevation of the inner edge of the take-off climb surface must be located at the outer edge of the clearway at the highest point on the ground based on the centre line of the clearway.

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

3.6 In the case of a take-off climb surface involving a turn, the surface must be a complex surface containing the horizontal normals to its centre line and the slope of the centre line must be the same as that for a straight take-off climb surface. (See Figure 4-5)

3.7 In the case of a take-off climb surface involving a turn, the surface must not contain more than one curved portion.

3.8 Where a curved portion of a take-off climb surface is provided the sum of the radius of arc defining the centre line of the take-off climb surface and the length of the straight portion originating at the inner edge must not be less than 575 m.

3.9 Any variation in the direction of the centre line of a take-off climb surface must be designed so as not to necessitate a turn of radius less than 270 m.

Compliance Note 1. Helicopter take-off performance is reduced in a curve and as such a straight portion along the take-off climb surface prior to the start of the curve allows for acceleration.

Compliance Note 2. For heliports intended to be used by helicopters operated in performance class 2 and 3 it is good practice for the departure paths to be selected so as to permit safe forced landings or one-engine-inoperative landings such that, as a minimum requirement, injury to persons on the ground or water or damage to property are minimized. The most critical helicopter type for which the heliport is intended and the ambient conditions may be factors in determining the suitability of such areas.

4. Obstacle-free sector/surface — helidecks

4.1 *Description*. A complex surface originating at and extending from, a reference point on the edge of the FATO of a helideck. In the case of a TLOF of less than 1 D, the reference point must be located not less than 0.5 D from the centre of the TLOF.

4.2 *Characteristics*. An obstacle-free sector/surface must subtend an arc of specified angle.

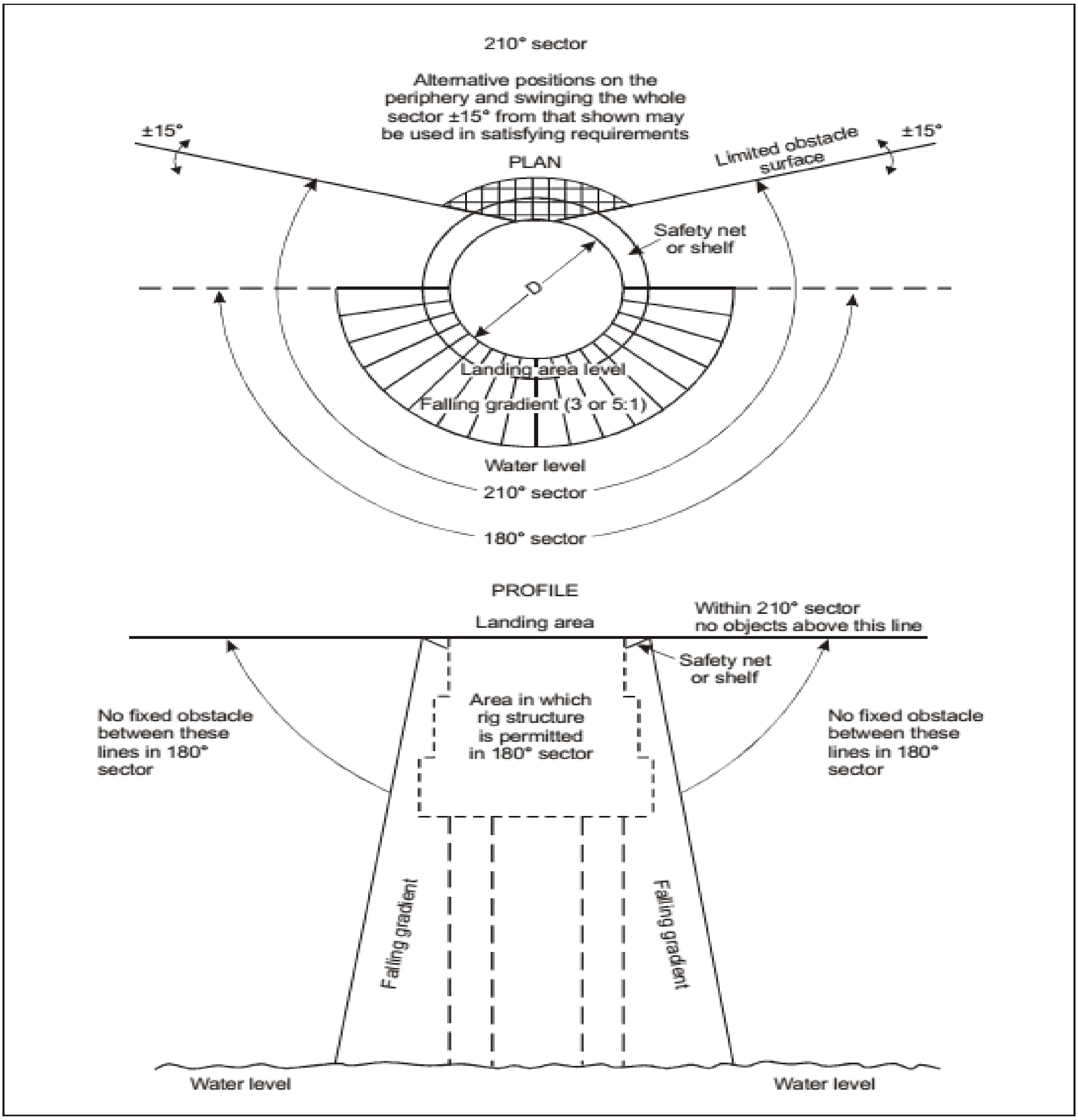


Figure 4-7. Helideck obstacle-free sector

4.3 A helideck obstacle-free sector must comprise of two components, one above and one below helideck level: (See Figure 4-7).

(a) *Above helideck level*. The surface must be a horizontal plane level with the elevation of the helideck surface that subtends an arc of at least 210 degrees with the apex located on the periphery of the D circle extending outwards to a distance that will allow for an unobstructed departure path appropriate to the helicopter the helideck is intended to serve.

(b) *Below helideck level*. Within the (minimum) 210-degree arc, the surface must additionally extend downward from the edge of the FATO below the elevation of the helideck to water level for an arc of not less than 180 degrees that passes through the centre of the FATO and outwards to a distance that will allow for safe clearance from the obstacles below the helideck in the event of an engine failure for the type of helicopter the helideck is intended to serve.

Compliance Note. For both the above obstacle-free sectors for helicopters operated in performance class 1 or 2, the horizontal extent of these distances from the helideck will be compatible with the one-engine-inoperative capability of the helicopter type to be used.

5. Limited obstacle sector/surface — helidecks

Compliance Note. Where obstacles are necessarily located on the structure, a helideck may have a limited obstacle sector (LOS).

5.1 *Description*. A complex surface originating at the reference point for the obstacle-free sector and extending over the arc not covered by the obstacle-free sector within which the height of obstacles above the level of the TLOF will be prescribed.

5.2 *Characteristics*. A limited obstacle sector must not subtend an arc greater than 150 degrees. Its dimensions and location must be as indicated in Figure 4-8 for a 1 D FATO with coincidental TLOF and Figure 4-9 for a 0.83 D TLOF.

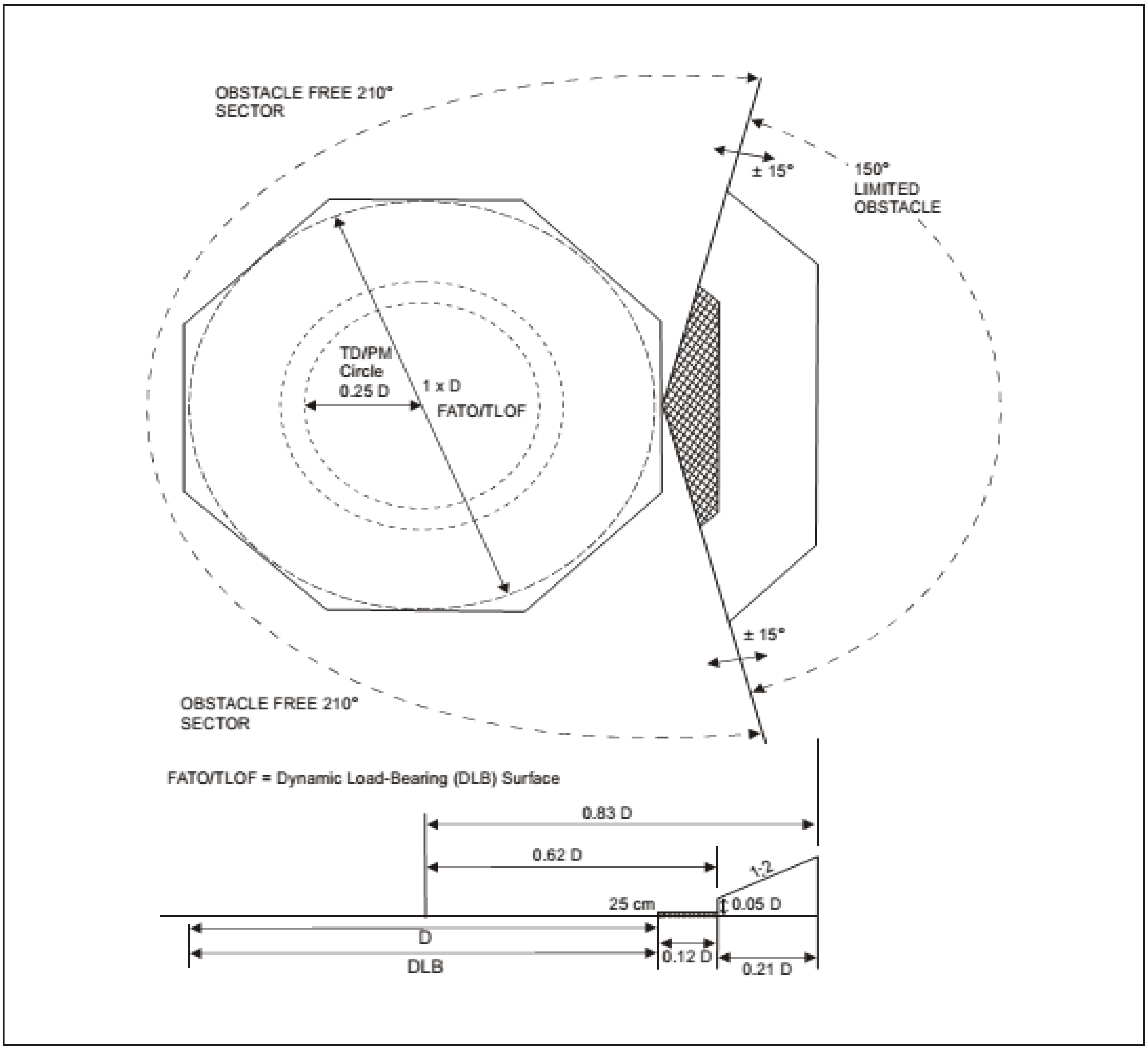


Figure 4-8. Helideck obstacle limitation sectors and surfaces for a FATO and coincidental TLOF of 1 D and larger

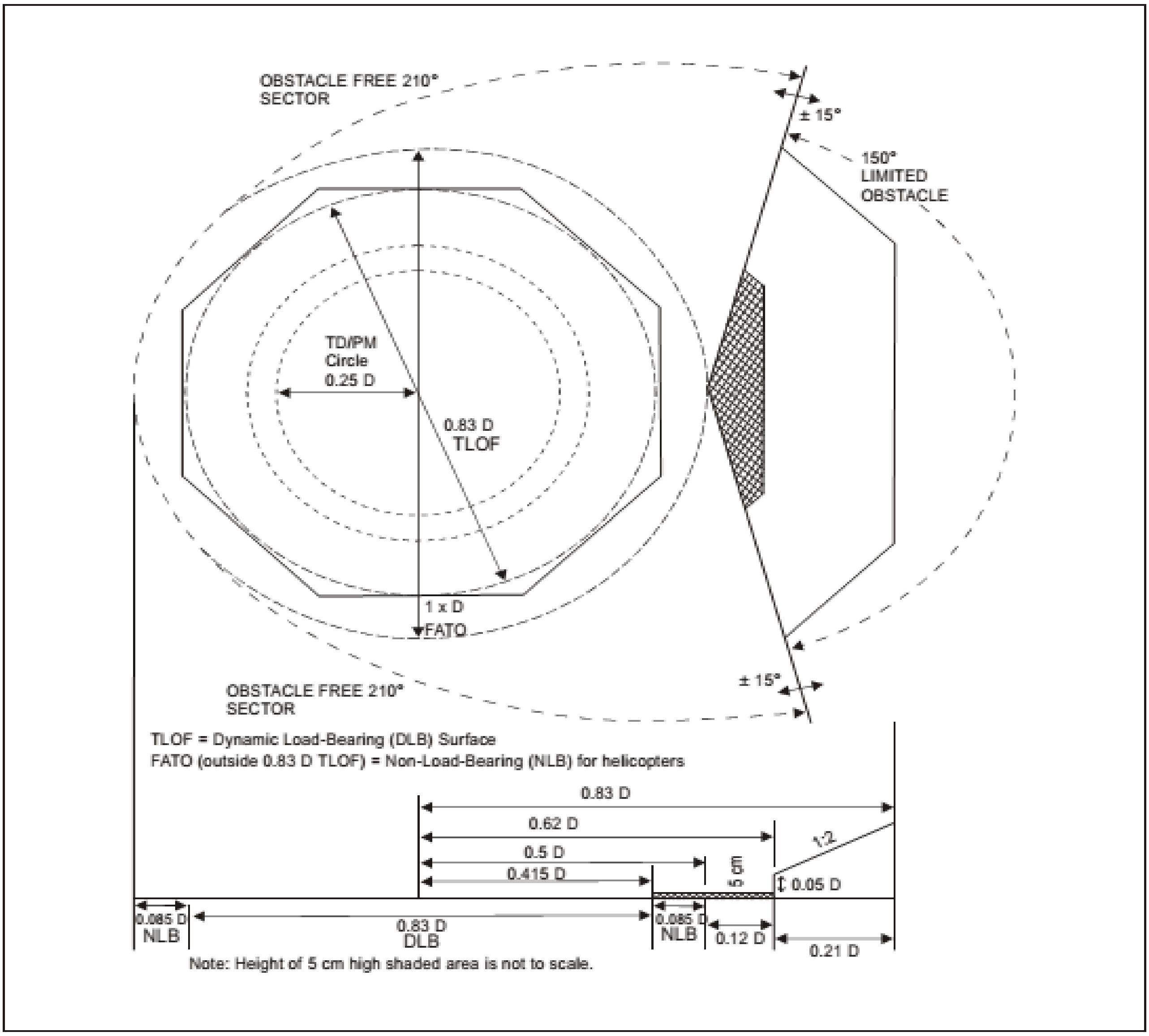


Figure 4-9. Helideck obstacle limitation sectors and surfaces for

a TLOF of 0.83 D and larger

139.18.12 Obstacle limitation requirements

Compliance Note 1. The requirements for obstacle limitation surfaces are specified on the basis of the intended use of a FATO, i.e. approach manoeuvre to hover or landing, or take-off manoeuvre and type of approach, and are intended to be applied when such use is made of the FATO. In cases where operations are conducted to or from both directions of a FATO, then the function of certain surfaces may be nullified because of more stringent requirements of another lower surface.

Compliance Note 2. If a visual approach slope indicator (VASI) is installed, there are additional obstacle protection surfaces that need to be considered and may be more demanding than the obstacle limitation surfaces prescribed in Table 4-1.

1. Obstacle limitation requirements for Surface level heliports

1.1 The following obstacle limitation surfaces must be established for a FATO at heliports with a PinS approach procedure utilizing a visual segment surface:

(a) take-off climb surface
(b) approach surface; and
(c) transitional surfaces.

Compliance Note 1. See Figure 4-3.

1.2 The following obstacle limitation surfaces must be established for a FATO at heliports, other than specified in 1.1, including heliports with a PinS approach procedure where a visual segment surface is not provided:

(a) take-off climb surface; and
(b) approach surface.

1.3 The slopes of the obstacle limitation surfaces must not be greater than, and their other dimensions not less than, those specified in Table 4-1 and must be located as shown in Figures 4-1, 4-2 and 4-6.

1.4 For heliports that have an approach/take-off climb surface with a 4.5 per cent slope design, objects must be permitted to penetrate the obstacle limitation surface, if the results of an aeronautical study approved by the Executive Director have reviewed the associated risks and mitigation measures.

Compliance Note 1. The identified objects may limit the heliport operation.

1.5 New objects or extensions of existing objects must not be permitted above any of the surfaces in 1.1 and 1.2 above except when shielded by an existing immovable object or after an aeronautical study approved by the Executive Director determines that the object will not adversely affect the safety or significantly affect the regularity of operations of helicopters.

1.6 Existing objects above any of the surfaces in 1.1 and 1.2 above must, as far as practicable, be removed except when the object is shielded by an existing immovable object or after an aeronautical study approved by the CAA determines that the object will not adversely affect the safety or significantly affect the regularity of operations of helicopters.

Compliance Note. The application of curved approach or take-off climb surfaces may alleviate the problems created by objects infringing these surfaces.

1.7 A surface-level heliport must have at least one approach and take-off climb surface. An aeronautical study must be undertaken when only a single approach and take-off climb surface is provided considering as a minimum, the following factors:

(a) the area/terrain over which the flight is being conducted;

(b) the obstacle environment surrounding the heliport;

(c) the performance and operating limitations of helicopters intending to use the heliport; and

(d) the local meteorological conditions including the prevailing winds.

1.8 A surface-level heliport may have at least two approach and take-off climb surfaces to avoid downwind conditions, minimize crosswind conditions and permit for a balked landing.

2. Obstacle limitation requirements for Elevated heliports

2.1 The obstacle limitation surfaces for elevated heliports must conform to the requirements for surface-level heliports.

2.2 An elevated heliport must have at least one approach and take-off climb surface. An aeronautical study must be undertaken when only a single approach and take-off climb surface is provided considering as a minimum, the following factors:

(a) the area/terrain over which the flight is being conducted;

(b) the obstacle environment surrounding the heliport;

(c) the performance and operating limitations of helicopters intending to use the heliport; and

(d) the local meteorological conditions including the prevailing winds.

2.4 An elevated heliport may have at least two approach and take-off climb surfaces to avoid downwind conditions, minimize crosswind conditions and permit for a balked landing.

3. Obstacle limitation requirements for Helidecks

3.1 A helideck must have an obstacle-free sector.

Compliance Note. A helideck may have a LOS.

3.2 There must be no fixed obstacles within the obstacle-free sector above the obstacle-free surface.

3.3 In the immediate vicinity of the helideck, obstacle protection for helicopters must be provided below the helideck level. This protection must extend over an arc of at least 180 degrees with the origin at the centre of the FATO, with a descending gradient having a ratio of one unit horizontally to five units vertically from the edges of the FATO within the 180-degree sector. This descending gradient may be reduced to a ratio of one unit horizontally to three units vertically within the 180-degree sector for multi-engine helicopters operated in performance class 1 or 2. (See Figure 4-7.)

Compliance Note. Where there is a requirement to position, at sea surface level, one or more offshore support vessel(s) (e.g. a Standby Vessel) essential to the operation of a fixed or floating offshore facility, but located within the proximity of the fixed or floating offshore facility, any offshore support vessel(s) would need to be positioned so as not to compromise the safety of helicopter operations during take-off departure and/or approach to landing.

3.4 For a TLOF of 1 D and larger, within the 150-degree limited obstacle surface/sector out to a distance of 0.12 D measured from the point of origin of the limited obstacle sector, objects must not exceed a height of 25 cm above the TLOF. Beyond that arc, out to an overall distance of a further 0.21 D measured from the end of the first sector, the limited obstacle surface rises at a rate of one unit vertically for each two units horizontally originating at a height 0.05 D above the level of the TLOF. (See Figure 4-8.)

3.5 For a TLOF less than 1 D within the 150-degree limited obstacle surface/sector out to a distance of 0.62 D and commencing from a distance 0.5 D, both measured from the centre of the TLOF, objects must not exceed a height of 5 cm above the TLOF. Beyond that arc, out to an overall distance of 0.83 D from the centre of the TLOF, the limited obstacle surface rises at a rate of one unit vertically for each two units horizontally originating at a height 0.05 D above the level of the TLOF. (See Figure 4-9.)

4. Obstacle limitation requirements for Shipboard heliports

4.1 The specifications in 4.4 and 4.6 below must be applicable for shipboard heliports completed on or after 1 January 2012.

Purpose-built heliports located forward or aft

4.2 When helicopter operating areas are provided in the bow or stern of a ship they must apply the obstacle criteria for helidecks.

Amidships location — purpose-built and non-purpose-built

4.3 Forward and aft of a TLOF of 1 D and larger must be two symmetrically located sectors, each covering an arc of 150 degrees, with their apexes on the periphery of the TLOF. Within the area enclosed by these two sectors, there must be no objects rising above the level of the TLOF, except those aids essential for the safe operation of a helicopter and then only up to a maximum height of 25 cm.

4.4 Objects whose function requires them to be located within the TLOF (such as lighting or nets) must not exceed a height of 2.5 cm. Such objects must only be present if they do not represent a hazard to helicopters.

Compliance Note. Examples of potential hazards include nets or raised fittings on the deck that might induce dynamic rollover for helicopters equipped with skids.

4.5 To provide further protection from obstacles fore and aft of the TLOF, rising surfaces with gradients of one unit vertically to five units horizontally must extend from the entire length of the edges of the two 150-degree sectors. These surfaces must extend for a horizontal distance equal to at least 1 D of the largest helicopter the TLOF is intended to serve and must not be penetrated by any obstacle. (See Figure 4-10.)

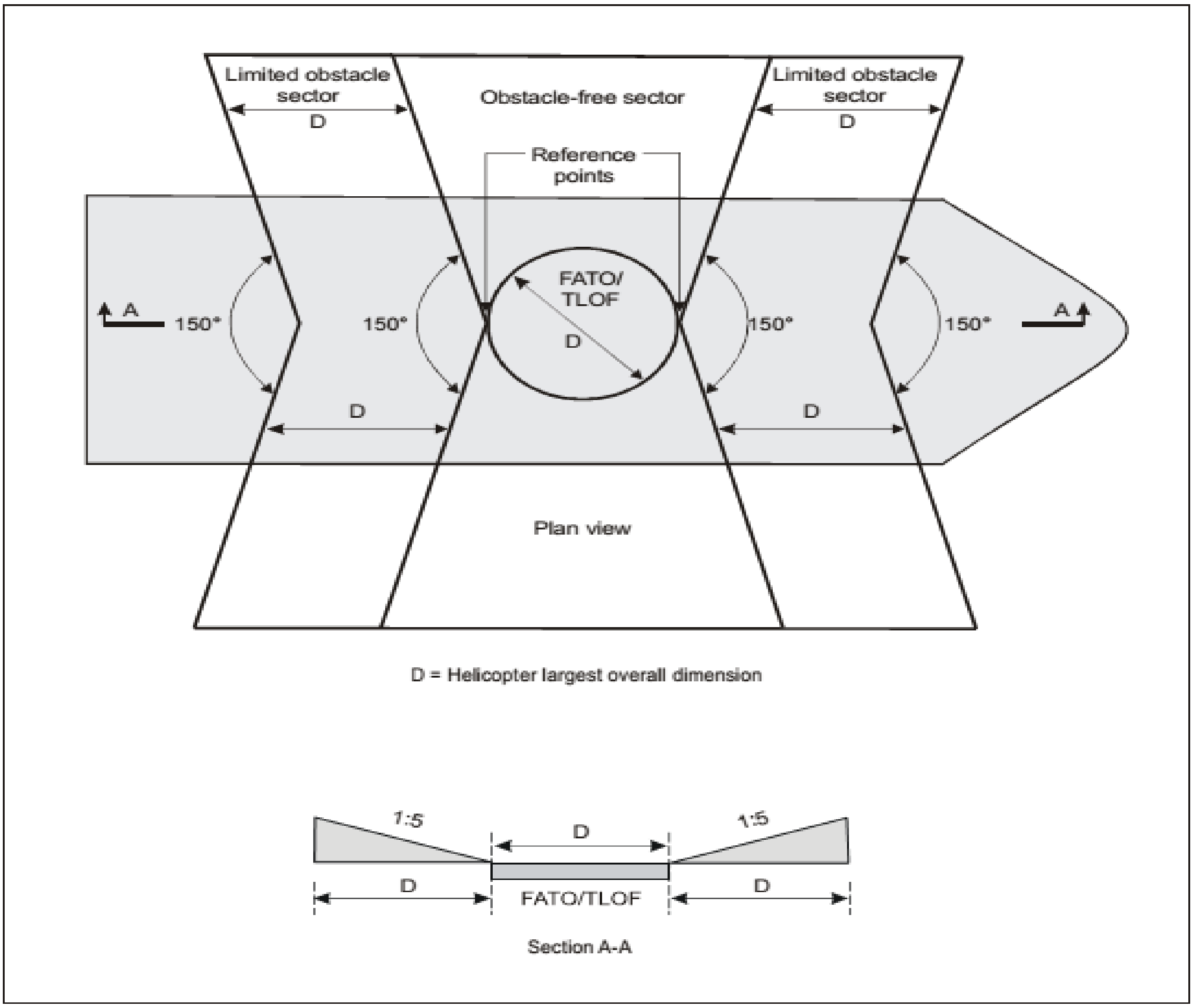


Figure 4-10. Amidship's location — Shipboard heliport obstacle limitation surfaces

Non-purpose-built heliports

Ship's side location

4.6 No objects must be located within the TLOF except those aids essential for the safe operation of a helicopter (such as nets or lighting) and then only up to a maximum height of 2.5 cm. Such objects must only be present if they do not represent a hazard to helicopters.

4.7 From the fore and aft mid-points of the D circle in two segments outside the circle, limited obstacle areas must extend to the ship's rail to a fore and aft distance of 1.5 times the fore-to-aft-dimension of the TLOF, located symmetrically about the athwartships bisector of the D circle. Within these areas there must be no objects rising above a maximum height of 25 cm above the level of the TLOF. (See Figure 4-11.) Such objects must only be present if they do not represent a hazard to helicopters.

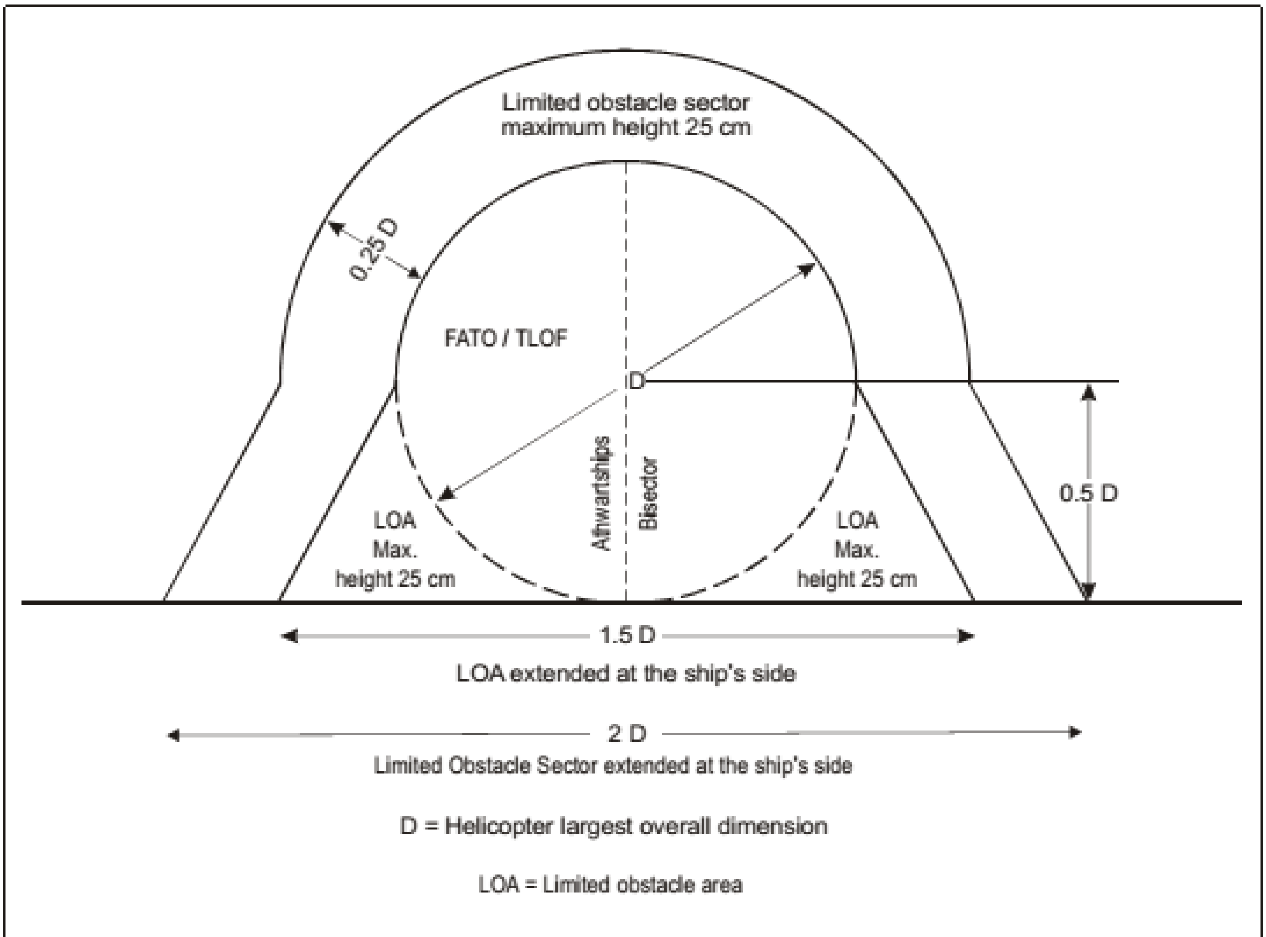


Figure 4-11. Ships-side non-purpose-built heliport obstacle limitation sectors and surfaces

4.8 A limited obstacle sector horizontal surface must be provided, at least 0.25 D beyond the diameter of the D circle, which must surround the inboard sides of the TLOF to the fore and aft mid-points of the D circle The limited obstacle sector must continue to the ship's rail to a fore and aft distance of 2.0 times the fore-to-aft dimension of the TLOF, located symmetrically about the athwartships bisector of the D circle. Within this sector there must be no objects rising above a maximum height of 25 cm above the level of the TLOF.

Winching areas

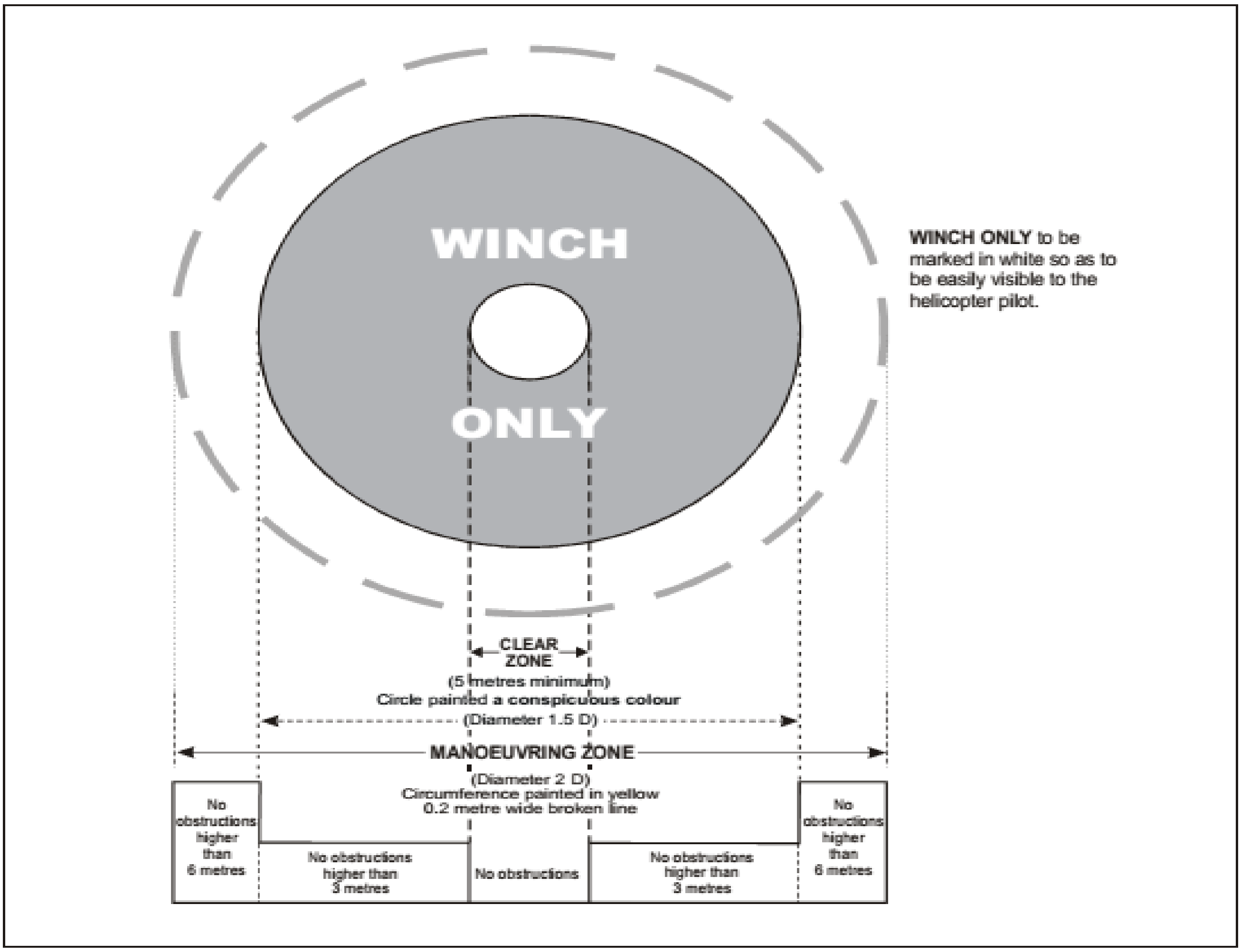


Figure 4-12. Winching area of a ship

4.9 An area designated for winching on-board ships must be comprised of a circular clear zone of diameter 5 m and extending from the perimeter of the clear zone, a concentric manoeuvring zone of diameter 2 D. (See Figure 4-12 above).

4.10 The manoeuvring zone must be comprised of two areas:

(a) the inner manoeuvring zone extending from the perimeter of the clear zone and of a circle of diameter not less than 1.5 D; and
(b) the outer manoeuvring zone extending from the perimeter of the inner manoeuvring zone and of a circle of diameter not less than 2 D.

4.11 Within the clear zone of a designated winching area, no objects must be located above the level of its surface.

4.12 Objects located within the inner manoeuvring zone of a designated winching area must not exceed a height of 3 m.

4.13 Objects located within the outer manoeuvring zone of a designated winching area must not exceed a height of 6 m.

139.18.13 Visual Aids

Compliance Note 1. The procedures used by some helicopters require that they utilize a FATO having characteristics similar in shape to a runway for fixed wing aircraft. For the purpose of this chapter a FATO having characteristics similar in shape to a runway is considered as satisfying the concept for a "runway-type FATO". For such arrangements it is sometimes necessary to provide specific markings to enable a pilot to distinguish a runway-type FATO during an approach. Appropriate markings are contained within sub-sections entitled

"Runway-type FATOs". The requirements applicable to all other types of FATOs are given within sub-sections entitled "All FATOs except runway-type FATOs".

Compliance Note 2. It has been found that, on surfaces of light colour, the conspicuity of white and yellow markings can be improved by outlining them in black.

Compliance Note 3. For a non-purpose-built heliport located on a ship's side the surface colour of the main deck can vary from ship to ship and therefore some discretion may need to be exercised in the colour selection of heliport paint schemes; the objective being to ensure that the markings are conspicuous against the surface of the ship and the operating background.

139.18.14 Wind direction indicator

1.1 A heliport must be equipped with at least one wind direction indicator.

1.2 A wind direction indicator must be located so as to indicate the wind conditions over the FATO and TLOF and in such a way as to be free from the effects of airflow disturbances caused by nearby objects or rotor downwash. It must be visible from a helicopter in flight, in a hover or on the movement area.

1.3 Where a TLOF and/or FATO may be subject to a disturbed airflow, then additional wind direction indicators located close to the area must be provided to indicate the surface wind on the area.

1.4 A wind direction indicator must be constructed so that it gives a clear indication of the direction of the wind and a general indication of the wind speed.

1.5 An indicator must be a truncated cone made of lightweight fabric and must have the following minimum dimensions:

	Surface-level heliports	*Elevated heliports and helidecks*
Length	2.4 m	1.2 m
Diameter (larger end)	0.6 m	0.3 m
Diameter (smaller end)	0.3 m	0.15 m

1.6 The colour of the wind direction indicator must be so selected as to make it clearly visible and understandable from a height of at least 200 m (650 ft) above the heliport, having regard to background. Where practicable, a single colour, preferably white or orange, must be used. Where a combination of two colours is required to give adequate conspicuity against changing backgrounds, they must preferably be orange and white, red and white, or black and white, and must be arranged in five alternate bands the first and last band being the darker colour.

1.7 A wind direction indicator at a heliport intended for use at night must be illuminated.

139.18.15 Markings and markers

1. Winching area marking

1.1 Winching area markings must be provided at a designated winching area. (See Figure 4-12.)

1.2 Winching area markings must be located so that their centre(s) coincides with the centre of the clear zone of the winching area. (See Figure 4-12.)

1.3 Winching area markings must comprise a winching area clear zone marking and a winching area manoeuvring zone marking.

1.4 A winching area clear zone marking must consist of a solid circle of diameter not less than 5 m and of a conspicuous colour.

1.5 A winching area manoeuvring zone marking must consist of a broken circle line of 30 cm in width and of a diameter not less than 2 D and be marked in a conspicuous colour. Within it “WINCH ONLY” must be marked to be easily visible to the pilot.

2. Heliport identification marking

Application

2.1 Heliport identification markings must be provided at a heliport.

Location — All FATOs except runway-type FATOs

2.2 A heliport identification marking must be located at or near the centre of the FATO.

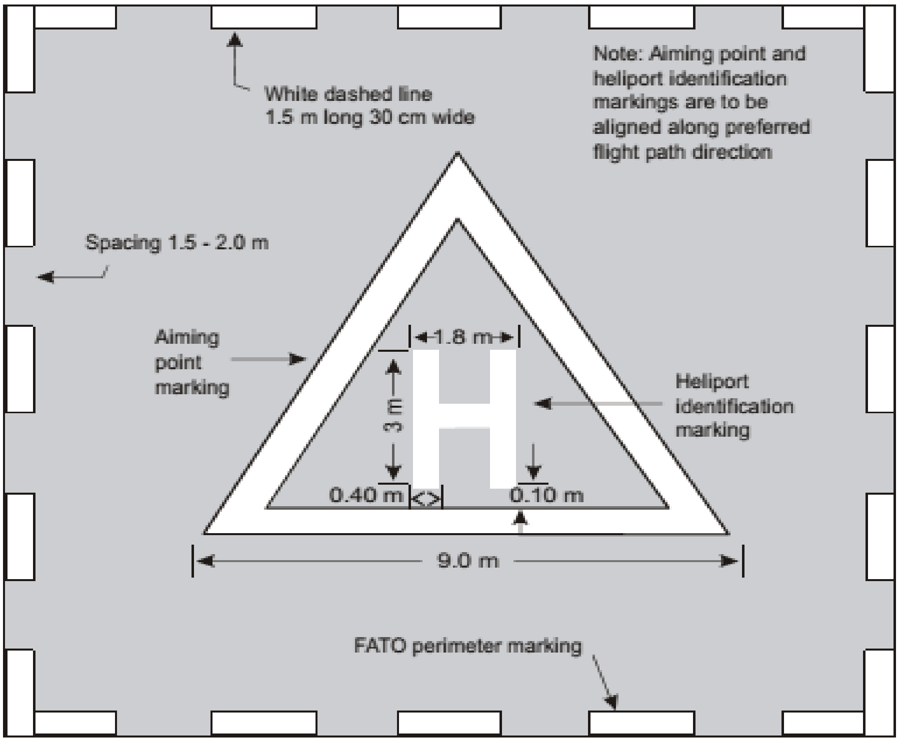
Compliance Note 1. If the touchdown/positioning marking is offset on a helideck, the heliport identification marking is established in the centre of the touchdown/positioning marking.

Compliance Note 2. On a FATO, which does not contain a TLOF and which is marked with an aiming point marking, except for a heliport at a hospital, the heliport identification marking is established in the centre of the aiming point marking as shown in Figure 5-1.

2.3 On a FATO which contains a TLOF, a heliport identification marking must be located in the FATO so the position of it coincides with the centre of the TLOF.

Location — Runway-type FATOs

2.4 A heliport identification marking must be located in the FATO and when used in conjunction with FATO designation markings, must be displayed at each end of the FATO as shown in Figure 5-2.



Note: *The aiming point, heliport identification and FATO perimeter markings are white and may be edged with a 10 cm black border to improve contrast*

Figure 5-1. Combined heliport identification, aiming point and FATO perimeter marking

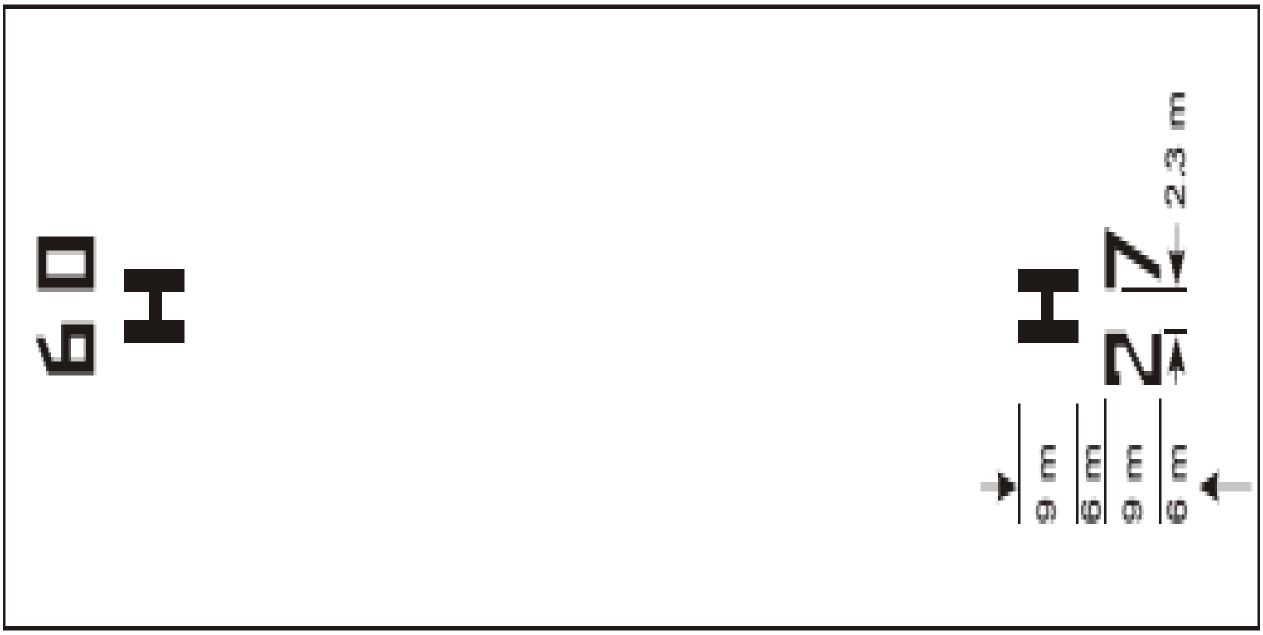


Figure 5-2. FATO designation marking and heliport identification marking for a runway-type FATO

Characteristics

2.5 A heliport identification marking, except for a heliport at a hospital, must consist of a letter H, white in colour. The dimensions of the H marking must be no less than those shown in Figure 5-3 and where the marking is used for a runway-type FATO, its dimensions must be increased by a factor of 3 as shown in Figure 5-2.

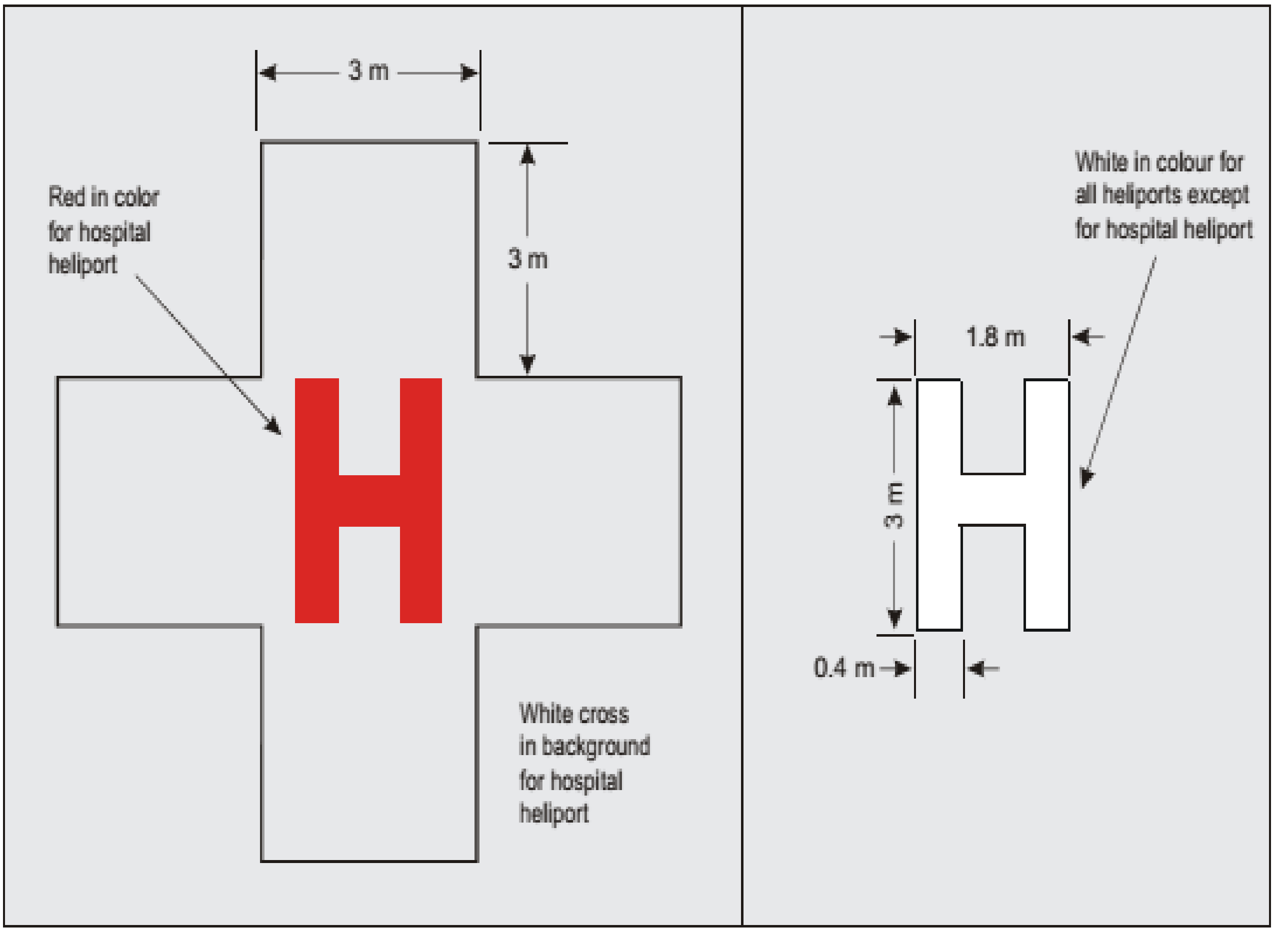


Figure 5-3. Hospital heliport identification and heliport identification marking

2.6 A heliport identification marking for a heliport at a hospital must consist of a letter H, red in colour, on a white cross made of squares adjacent to each of the sides of a square containing the H as shown in Figure 5-3.

2.7 A heliport identification marking must be oriented with the cross arm of the H at right angles to the referred final approach direction. For a helideck the cross arm must be on or parallel to the bisector of the obstacle-free sector. For a non-purpose-built shipboard heliport located on a ship's side, the cross arm must be parallel with the side of the ship.

2.8 On a helideck or a shipboard heliport where the D-value is 16.0 m or larger, the size of the heliport identification H marking must have a height of 4 m with an overall width not exceeding 3 m and a stroke width not exceeding 0.75 m. Where the D-value is less than 16.0 m, the size of the heliport identification H marking must have a height of 3 m with an overall width not exceeding 2.25 m and a stroke width not exceeding 0.5 m.

3. Maximum allowable mass marking

3.1 A maximum allowable mass marking must be displayed at an elevated heliport, a helideck and a shipboard heliport.

3.2 A maximum allowable mass marking may be displayed at a surface-level heliport.

3.3 A maximum allowable mass marking must be located within the TLOF or FATO and so arranged as to be readable from the preferred final approach direction.

3.4 A maximum allowable mass marking must consist of a one-, two- or three-digit number.

3.5 The maximum allowable mass must be expressed in tonnes (1 000 kg) rounded down to the nearest 1 000 kg followed by a letter “t”.

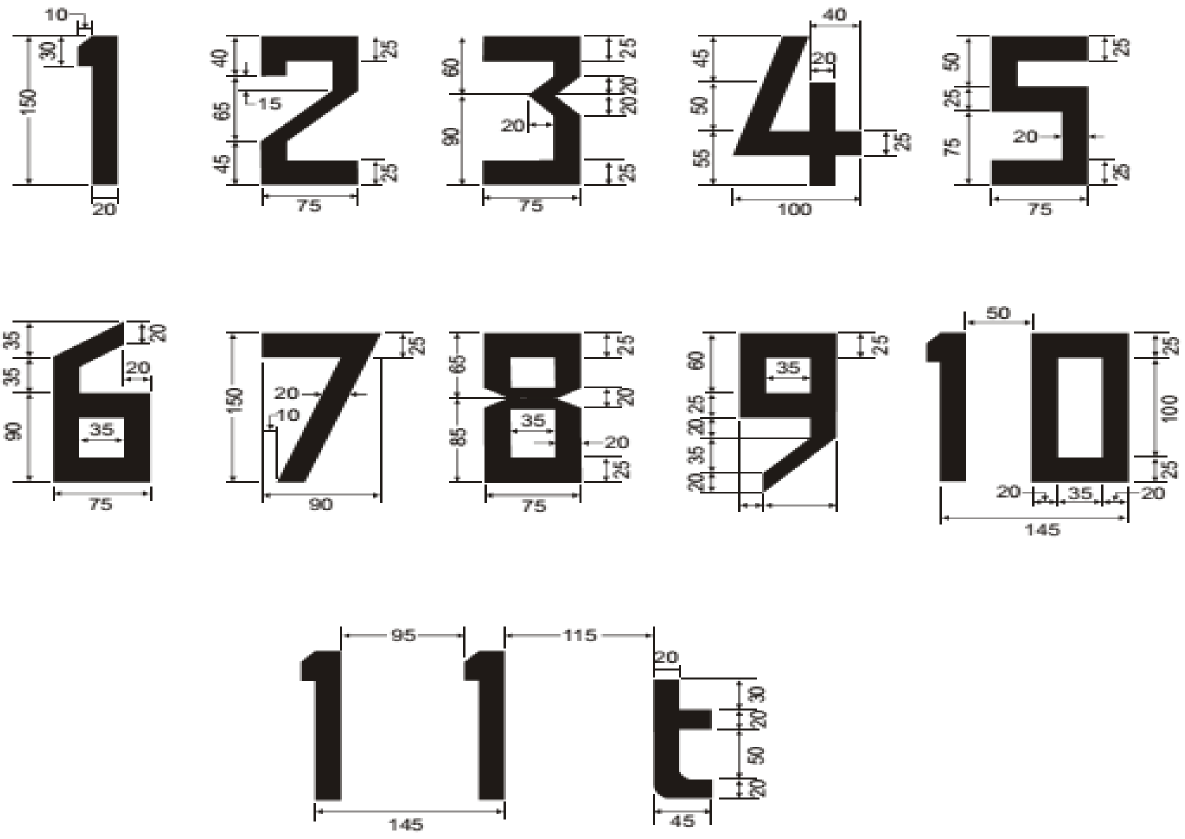
3.6 The maximum allowable mass may be expressed to the nearest 100 kg. The marking must be presented to one decimal place and rounded to the nearest 100 kg followed by the letter “t”.

3.7 When the maximum allowable mass is expressed to 100 kg, the decimal place must be preceded with a decimal point marked with a 30 cm square.

All FATOs except runway-type FATOs

3.8 The numbers and the letter of the marking must have a colour contrasting with the background and must be in the form and proportion shown in Figure 5-4 for a FATO with a dimension of more than 30 m. For a FATO with a dimension of between 15 m to 30 m the height of the numbers and the letter of the marking must be a minimum of 90 cm, and for a FATO with a dimension of less than 15 m the height of the numbers and the letter of the marking must be a minimum of 60 cm, each with a proportional reduction in width and thickness.

Runway-type FATOs



Note.— All units are expressed in centimetres.

Figure 5-4. Form and proportions of numbers and letters

3.9 The numbers and the letter of the marking must have a colour contrasting with the background and must be in the form and proportion shown in Figure 5-4.

4. D-value marking

Application

All FATOs except runway-type FATOs

4.1 The D-value marking must be displayed at a helideck and at a shipboard heliport.

Runway-type FATOs

Compliance Note. The D-value is not required to be marked on a heliport with a runway-type FATO.

4.2 The D-value marking must be displayed at surface-level and elevated heliports designed for helicopters operated in Performance Class 2 or 3.

Location

4.3 A D-value marking must be located within the TLOF or FATO and so arranged as to be readable from the preferred final approach direction.

4.4 Where there is more than one approach direction, additional D-value markings must be provided such that at least one D-value marking is readable from the final approach directions. For a non-purpose-built heliport located on a ship's side, D-value markings must be provided on the perimeter of the D circle at the 2 o'clock, 10 o'clock and 12 o'clock positions when viewed from the side of the ship facing towards the centre line.

Characteristics

4.5 The D-value marking must be white. The D-value marking must be rounded to the nearest whole metre or foot with 0.5 rounded down.

4.6 The numbers of the marking must have a colour contrasting with the background and must be in the form and proportion shown in Figure 5-4 for a FATO with a dimension of more than 30 m. For a FATO with a dimension of between 15 m to 30 m the height of the numbers of the marking must be a minimum of 90 cm, and for a FATO with a dimension of less than 15 m the height of the numbers of the marking must be a minimum of 60 cm, each with a proportional reduction in width and thickness.

5. Final approach and take-off area dimension(s) marking

5.1 The actual dimension(s) of the FATO intended to be used by helicopters operated in performance class 1 must be marked on the FATO.

5.2 If the actual dimension(s) of the FATO to be used by helicopters operated in performance class 2 or 3 is less than 1 D, the dimension(s) must be marked on the FATO.

5.3 A FATO dimension marking must be located within the FATO and so arranged as to be readable from the preferred final approach direction.

5.4 The dimension(s) must be rounded to the nearest metre or foot.

Compliance Note. If the FATO is rectangular both the length and width of the FATO relative to the preferred final approach direction is indicated.

All FATOs except runway-type FATOs

5.5 The numbers of the marking must have a colour contrasting with the background and must be in the form and proportion shown in Figure 5-4 for a FATO with a dimension of more than 30 m. For a FATO with a dimension between 15 m to 30 m the height of the numbers of the marking must be a minimum of 90 cm, and for a FATO with a dimension of less than 15 m the height of the numbers of the marking must be a minimum of 60 cm, each with a proportional reduction in width and thickness.

Runway-type FATOs

5.6 The numbers of the marking must have a colour contrasting with the background and must be in the form and proportion shown in Figure 5-4.

6. Final approach and take-off area perimeter marking or markers for surface-level heliports

6.1 FATO perimeter marking or markers must be provided at a surface-level heliport where the extent of the FATO is not self-evident.

6.2 The FATO perimeter marking or markers must be located on the edge of the FATO.

Characteristics — Runway-type FATO

6.3 The perimeter of the FATO must be defined with markings or markers spaced at equal intervals of not more than 50 m with at least three markings or markers on each side including a marking or marker at each corner.

6.4 A FATO perimeter marking must be a rectangular stripe with a length of 9 m or one-fifth of the side of the FATO which it defines and a width of 1 m.

6.5 FATO perimeter markings must be white.

6.6 A FATO perimeter marker must have dimensional characteristics as shown in Figure 5-5.

6.7 FATO perimeter markers must be of colour(s) that contrast effectively against the operating background.

6.8 FATO perimeter markers must be a single colour, orange or red, or two contrasting colours, orange and white or, alternatively, red and white must be used except where such colours would merge with the background.

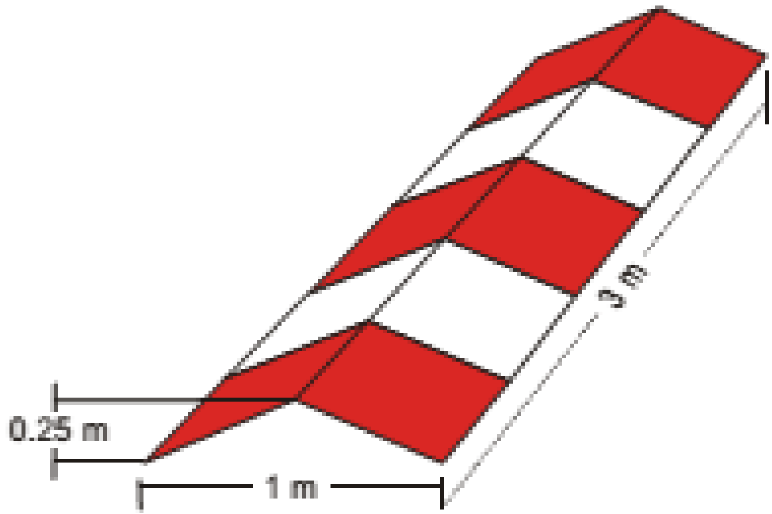


Figure 5-5. Runway-type FATO edge marker

Characteristics — All FATOs except runway-type FATOs

6.9 For an unpaved FATO the perimeter must be defined with flush in-ground markers. The FATO perimeter markers must be 30 cm in width, 1.5 m in length, and with end-to-end spacing of not less than 1.5 m and not more than 2 m. The corners of a square or rectangular FATO must be defined.

6.10 For a paved FATO the perimeter must be defined with a dashed line. The FATO perimeter marking segments must be 30 cm in width, 1.5 m in length, and with end-to-end spacing of not less than 1.5 m and not more than 2 m. The corners of the square or rectangular FATO must be defined.

6.11 FATO perimeter markings and flush in-ground markers must be white.

7. Final approach and take-off area designation markings for runway-type FATOs

7.1 A FATO designation marking may be provided at a heliport where it is necessary to designate the FATO to the pilot.

7.2 A FATO designation marking must be located at the beginning of the FATO as shown in Figure 5-2.

7.3 A FATO designation marking must consist of a two-digit number. The two-digit number must be the whole number nearest the one-tenth of the magnetic North when viewed from the direction of approach. When the above rule would give a single digit number, it must be preceded by a zero. The marking as shown in Figure 5-2, must be supplemented by the heliport identification marking.

8. Aiming point marking

Application

8.1 An aiming point marking must be provided at a heliport where it is necessary for a pilot to make an approach to a particular point above a FATO before proceeding to a TLOF.

Location — Runway-type FATO

8.2 The aiming point marking must be located within the FATO.

Location — All FATOs except runway-type FATOs

8.3 The aiming point marking must be located within the FATO.

Characteristics

8.4 The aiming point marking must be an equilateral triangle with the bisector of one of the angles aligned with the preferred approach direction. The marking must consist of continuous white lines, and the dimensions of the marking must conform to those shown in Figure 5-6.

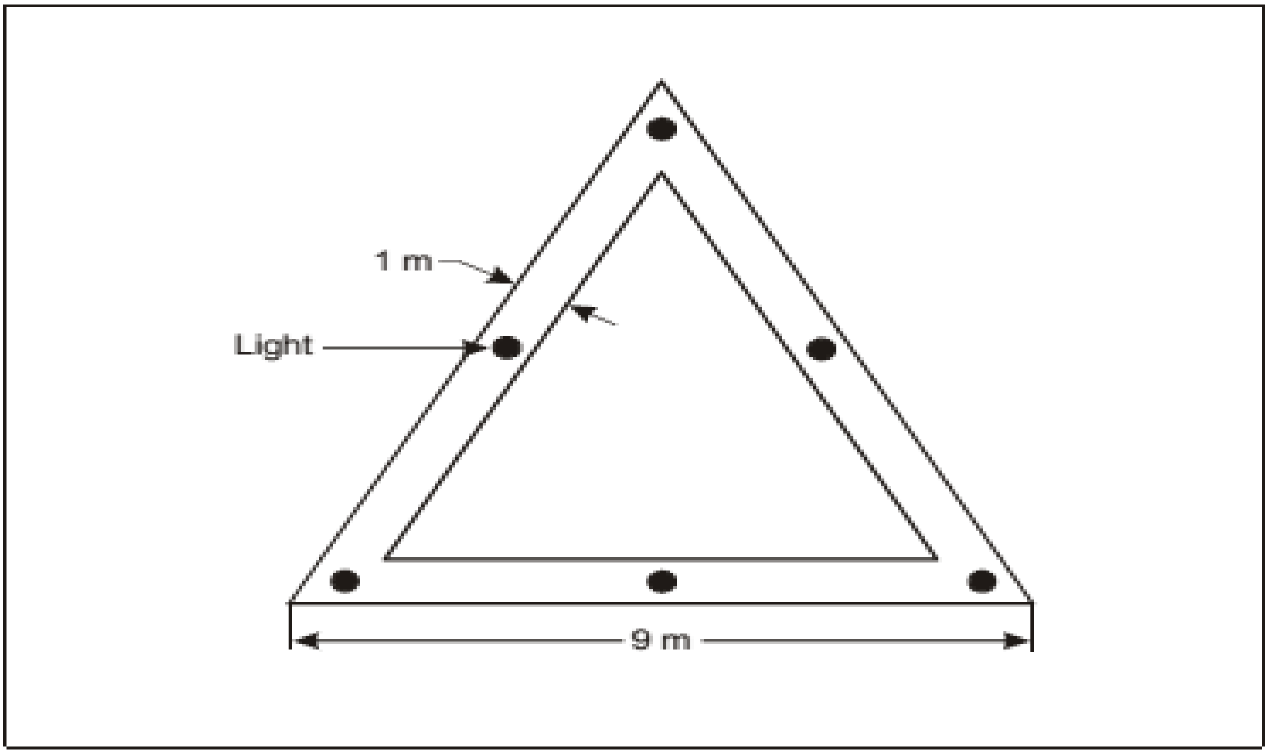


Figure 5-6. Aiming point marking

9. Touchdown and lift-off area perimeter marking

9.1 A TLOF perimeter marking must be displayed on a TLOF located in a FATO at a surface-level heliport if the perimeter of the TLOF is not self-evident.

9.2 A TLOF perimeter marking must be displayed on an elevated heliport, a helideck and a shipboard heliport.

9.3 A TLOF perimeter marking must be provided on each TLOF collocated with a helicopter stand at a surface-level heliport.

9.4 The TLOF perimeter marking must be located along the edge of the TLOF.

9.5 A TLOF perimeter marking must consist of a continuous white line with a width of at least 30 cm.

10. Touchdown/positioning marking

10.1 A touchdown/positioning marking must be provided where it is necessary for a helicopter to touch down and/or be accurately positioned by the pilot. A touchdown/positioning marking must be provided on a helicopter stand designed for turning.

10.2 A touchdown/positioning marking must be located so that when the pilot's seat is over the marking, the whole of the undercarriage will be within the TLOF and all parts of the helicopter will be clear of any obstacle by a safe margin.

10.3 On a heliport the centre of the touchdown/positioning marking must be located at the centre of the TLOF, except the centre of the touchdown/positioning marking may be offset away from the centre of the TLOF where an aeronautical study indicates such offsetting to be necessary and providing that a marking so offset would not adversely affect safety. For a helicopter stand designed for hover turning, the touchdown/positioning marking must be located in the centre of the central zone. (See Figure 3-4.)

10.4 On a helideck the centre of the touchdown marking must be located at the centre of the FATO, except that the marking may be offset away from the origin of the obstacle-free sector by no more than 0.1 D where an aeronautical study indicates such offsetting to be necessary and that a marking so offset would not adversely affect the safety.

10.5 A touchdown positioning marking must be a yellow circle and have a line width of at least 0.5 m. For a helideck or a purpose-built shipboard heliport with a D-value of16.0 m or larger, the line width must be at least 1 m.

10.6 The inner diameter of the touchdown/positioning marking must be 0.5 D of the largest helicopter the TLOF and/or the helicopter stand is intended to serve.

11. Heliport name marking

11.1 A heliport name marking must be provided at a heliport and helideck where there is insufficient alternative means of visual identification.

11.2 The heliport name marking must be displayed on the heliport so as to be visible, as far as practicable, at all angles above the horizontal. Where an obstacle sector exists on a helideck the marking must be located on the obstacle side of the heliport identification marking. For a non-purpose-built heliport located on a ship's side the marking must be located on the inboard side of the heliport identification marking in the area between the TLOF perimeter marking and the boundary of the LOS.

11.3 A heliport name marking must consist of the name or the alphanumeric designator of the heliport as used in the radio (R/T) communications.

11.4 A heliport name marking intended for use at night or during conditions of poor visibility must be illuminated, either internally or externally.

Runway-type FATOs

11.5 The characters of the marking must be not less than 3 m in height. All FATOs except runway-type FATOs.

11.6 The characters of the marking must be not less than 1.5 m in height at surface-level heliports and not less than 1.2 m on elevated heliports, helidecks and shipboard heliports. The colour of the marking must contrast with the background and preferably be white.

12. Helideck obstacle-free sector (chevron) marking

12.1 A helideck with adjacent obstacles that penetrate above the level of the helideck must have an obstacle-free sector marking.

12.2 A helideck obstacle-free sector marking must be located, where practicable, at a distance from the centre of the TLOF equal to the radius of the largest circle that can be drawn in the TLOF or 0.5 D, whichever is greater.

12.3 The helideck obstacle-free sector marking must indicate the location of the obstacle-free sector and the directions of the limits of the sector.

12.4 The height of the chevron must not be less than 30 cm.

12.5 The chevron must be marked in a conspicuous colour.

12.6 The colour of the chevron must be black.

13. Helideck and shipboard heliport surface marking

13.1 A surface marking must be provided to assist the pilot to identify the location of the helideck or shipboard heliport during an approach by day.

13.2 A surface marking must be applied to the dynamic load bearing area bounded by the TLOF perimeter marking.

13.3 The helideck or shipboard heliport surface bounded by the TLOF perimeter marking must be of dark green using a high friction coating.

Compliance Note. Where the application of a surface coating may have a degrading effect on friction qualities the surface might not be painted. In such cases the best operating practice to enhance the conspicuity of markings is to outline deck markings with a contrasting colour.

14. Helideck prohibited landing sector markings

14.1 Helideck prohibited landing sector markings must be provided where it is necessary to prevent the helicopter from landing within specified headings.

14.2 The prohibited landing sector markings must be located on the touchdown/positioning marking to the edge of the TLOF, within the relevant headings.

14.3 The prohibited landing sector markings must be indicated by white and red hatched markings as shown in Figure 5-7.

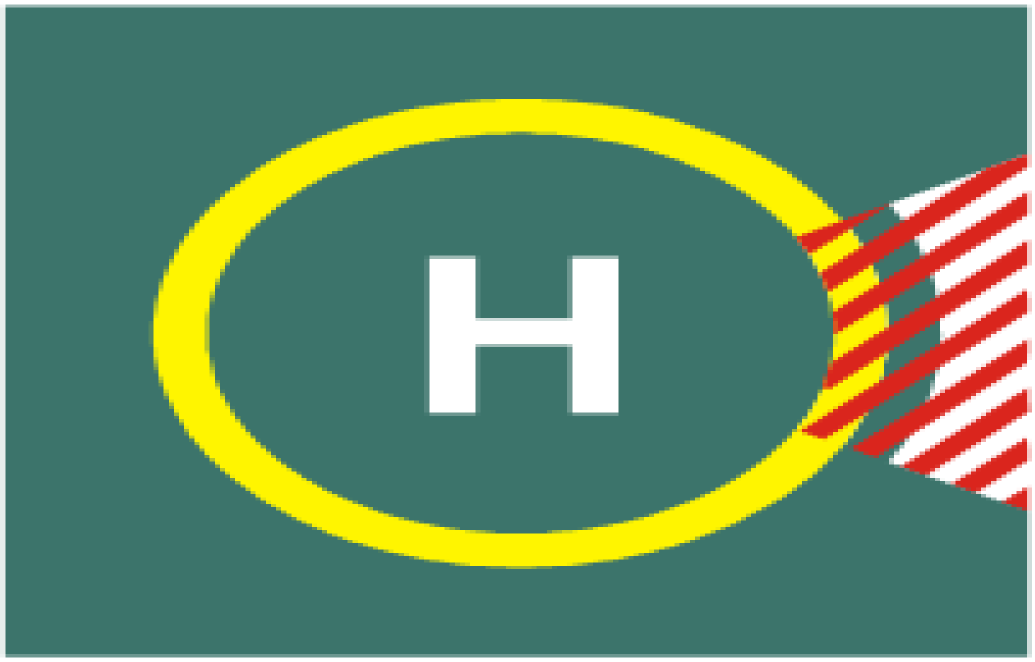


Figure 5-7. Helideck prohibited landing sector marking

Compliance Note. Prohibited landing sector markings, where deemed necessary, are applied to indicate a range of helicopter headings that are not to be used by a helicopter when landing.

This is to ensure that the nose of the helicopter is kept clear of the hatched markings during the manoeuvre to land.

15. Helicopter ground taxiway markings and markers

Compliance Note 1. The specifications for taxi-holding position markings in NAM-CATS-AH, Volume I, are equally applicable to taxiways intended for ground taxiing of helicopters.

Compliance Note 2. Ground taxi-routes are not required to be marked.

15.1 The centre line of a helicopter ground taxiway must be identified with a marking, and the edges of a helicopter ground taxiway, if not self-evident, must be identified with markers or markings.

15.2 Helicopter ground taxiway markings must be along the centre line and, if required, along the edges of a helicopter ground taxiway.

15.3 Helicopter ground taxiway edge markers must be located at a distance of 0.5 m to 3 m beyond the edge of the helicopter ground taxiway.

15.4 Helicopter ground taxiway edge markers, where provided, must be spaced at intervals of not more than 15 m on each side of straight sections and 7.5 m on each side of curved sections with a minimum of four equally spaced markers per section.

15.5 A helicopter ground taxiway centre line marking must be a continuous yellow line 15 cm in width.

15.6 Helicopter ground taxiway edge markings must be a continuous double yellow line, each 15 cm in width, and spaced 15 cm apart (nearest edge to nearest edge).

Note. Signage may be required on an aerodrome where it is necessary to indicate that a helicopter ground taxiway is suitable only for the use of helicopters.

15.7 A helicopter ground taxiway edge marker must be frangible.

15.8 A helicopter ground taxiway edge marker must not exceed a plane originating at a height of 25 cm above the plane of the helicopter ground taxiway, at a distance of 0.5 m from the edge of the helicopter ground taxiway and sloping upwards and outwards at a gradient of 5 per cent to a distance of 3 m beyond the edge of the helicopter ground taxiway.

15.9 A helicopter ground taxiway edge marker must be blue.

Compliance Note 2. If blue markers are used on an aerodrome, signage may be required to indicate that the helicopter ground taxiway is suitable only for helicopters.

15.10 If the helicopter ground taxiway is to be used at night, the edge markers must be internally illuminated or retro-reflective.

16. Helicopter air taxiway markings and markers

Compliance Note. Air taxi-routes are not required to be marked.

16.1 The centre line of a helicopter air taxiway or, if not self-evident, the edges of a helicopter air taxiway must be identified with markers or markings.

16.2 A helicopter air taxiway centre line marking or flush in-ground centre line marker must be located along the centre line of the helicopter air taxiway.

16.3 Helicopter air taxiway edge markings must be located along the edges of a helicopter air taxiway.

16.4 Helicopter air taxiway edge markers must be located at a distance of 1 m to 3 m beyond the edge of the helicopter air taxiway.

16.5 Helicopter air taxiway edge markers must not be located at a distance of less than 0.5 times the largest overall width of the helicopter for which it is designed from the centre line of the helicopter air taxiway.

16.6 A helicopter air taxiway centre line, when on a paved surface, must be marked with a continuous yellow line 15 cm in width.

16.7 The edges of a helicopter air taxiway, when on a paved surface, must be marked with continuous double yellow lines each 15 cm in width, and spaced 15 cm apart (nearest edge to nearest edge).

Compliance Note. Where there is potential for a helicopter air taxiway to be confused with a helicopter ground taxiway, signage may be required to indicate the mode of taxi operations that are permitted.

16.8 A helicopter air taxiway centre line, when on an unpaved surface that will not accommodate painted markings, must be marked with flush in-ground 15 cm wide and approximately 1.5 m in length yellow markers, spaced at intervals of not more than 30 m on straight sections and not more than 15 m on curves, with a minimum of four equally spaced markers per section.

16.9 Helicopter air taxiway edge markers, where provided, must be spaced at intervals of not more than 30 m on each side of straight sections and not more than 15 m on each side of curves, with a minimum of four equally spaced markers per section.

16.10 Helicopter air taxiway edge markers must be frangible.

16.11 Helicopter air taxiway edge markers must not penetrate a plane originating at a height of 25 cm above the plane of the helicopter air taxiway, at a distance of 1 m from the edge of the helicopter air taxiway and sloping upwards and outwards at a gradient of 5 per cent to a distance of 3 m beyond the edge of the helicopter air taxiway.

16.12 Helicopter air taxiway edge markers must not penetrate a plane originating at a height of 25 cm above the plane of the helicopter air taxiway, at a distance of 0.5 times the largest overall width of the helicopter for which it is designed from the centre line of the helicopter air taxiway, and sloping upwards and outwards at a gradient of 5 per cent.

16.13 A helicopter air taxiway edge marker must be of colour(s) that contrast effectively against the operating background. The colour red must not be used for markers.

16.14 If the helicopter air taxiway is to be used at night, helicopter air taxiway edge markers must be either internally illuminated or retro-reflective.

17. Helicopter stand markings

17.1 A helicopter stand perimeter marking must be provided on a helicopter stand designed for turning. If a helicopter stand perimeter marking is not practicable, a central zone perimeter marking must be provided instead if the perimeter of the central zone is not self-evident.

17.2 For a helicopter stand intended to be used for taxi-through and which does not allow the helicopter to turn, a stop line must be provided.

17.3 Alignment lines and lead-in/lead-out lines must be provided on a helicopter stand.

Compliance Note 1. See Figure 5-8.

Compliance Note 2. Helicopter stand identification markings may be provided where there is a need to identify individual stands.

17.4 A helicopter stand perimeter marking on a helicopter stand designed for turning or, a central zone perimeter marking, must be concentric with the central zone of the stand.

17.5 For a helicopter stand intended to be used for taxi-through and which does not allow the helicopter to turn, a stop line must be located on the helicopter ground taxiway axis at right angles to the centre line.

17.6 Alignment lines and lead-in/lead-out lines must be located as shown in Figure 5-8.

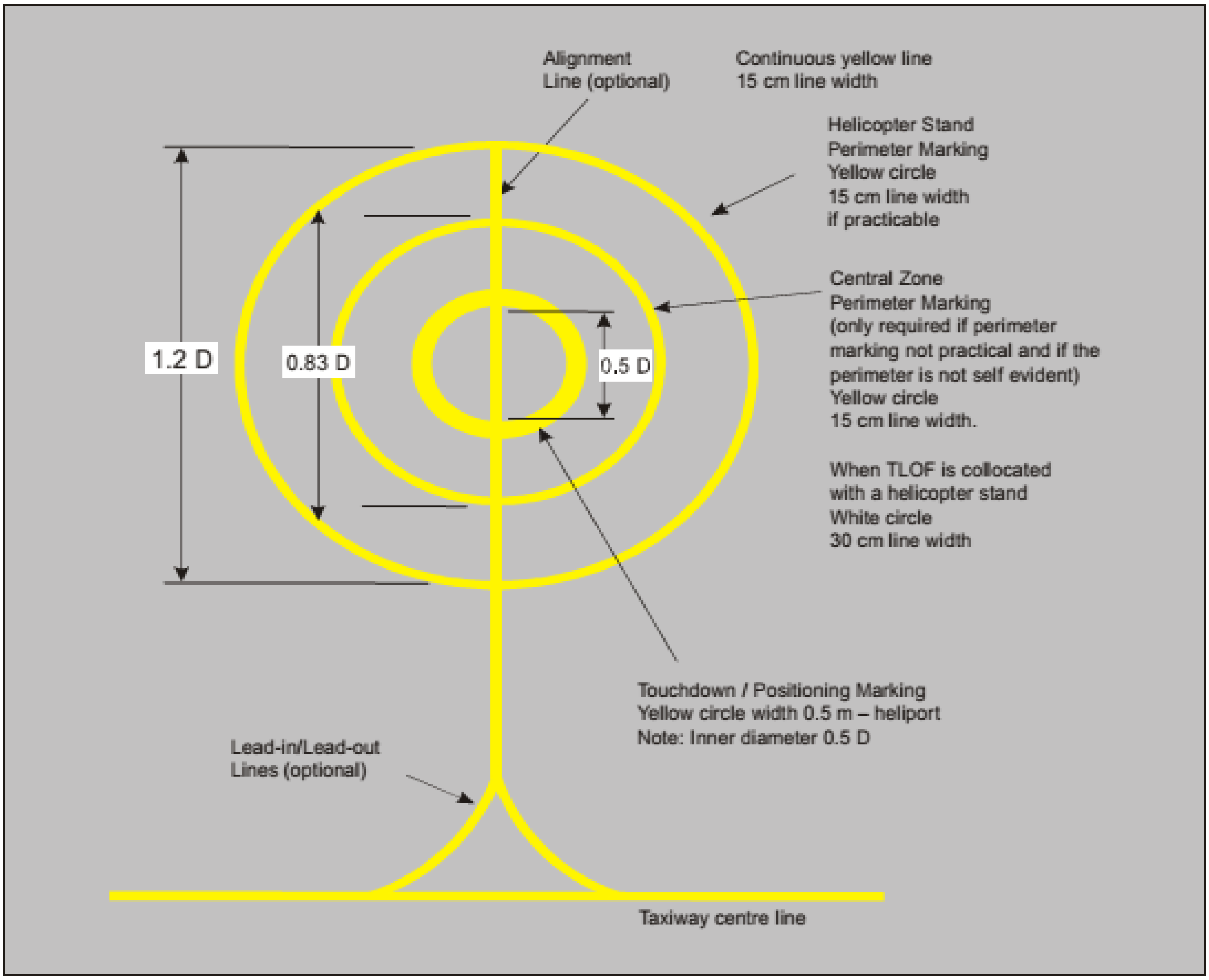


Figure 5-8. Helicopter stand markings

17.7 A helicopter stand perimeter marking must be a yellow circle and have a line width of 15 cm.

17.8 A central zone perimeter marking must be a yellow circle and have a line width of 15 cm, except when the TLOF is collocated with a helicopter stand, the characteristics of the TLOF perimeter markings must apply.

17.9 For a helicopter stand intended to be used for taxi-through and which does not allow the helicopter to turn, a yellow stop line must not be less than the width of the helicopter ground taxiway and have a line thickness of 50 cm.

17.10 Alignment lines and lead-in/lead-out lines must be continuous yellow lines and have a width of 15 cm.

17.11 Curved portions of alignment lines and lead-in/lead-out lines must have radii appropriate to the most demanding helicopter type the helicopter stand is intended to serve.

17.12 Stand identification markings must be marked in a contrasting colour so as to be easily readable.

Note 1. Where it is intended that helicopters proceed in one direction only, arrows indicating the direction to be followed may be added as part of the alignment lines.

Note 2. The characteristics of markings related to the stand size and alignment and lead-in/lead-out lines are illustrated in Figure 5-8.

18. Flight path alignment guidance marking

18.1 Flight path alignment guidance marking(s) must be provided at a heliport where it is desirable and practicable to indicate available approach and/or departure path direction(s).

Compliance Note. The flight path alignment guidance marking can be combined with a flight path alignment guidance lighting system.

18.2 The flight path alignment guidance marking must be located in a straight line along the direction of approach and/or departure path on one or more of the TLOF, FATO, safety area or any suitable surface in the immediate vicinity of the FATO or safety area.

18.3 A flight path alignment guidance marking must consist of one or more arrows marked on the TLOF, FATO and/or safety area surface as shown in Figure 5-9. The stroke of the arrow(s) must be 50 cm in width and at least 3 m in length. When combined with a flight path alignment guidance lighting system it must take the form shown in Figure 5-9 which includes the scheme for marking 'heads of the arrows' which are constant regardless of stroke length.

Compliance Note. In the case of a flight path limited to a single approach direction or single departure direction, the arrow marking may be unidirectional. In the case of a heliport with only a single approach/departure path available, one bidirectional arrow is marked.

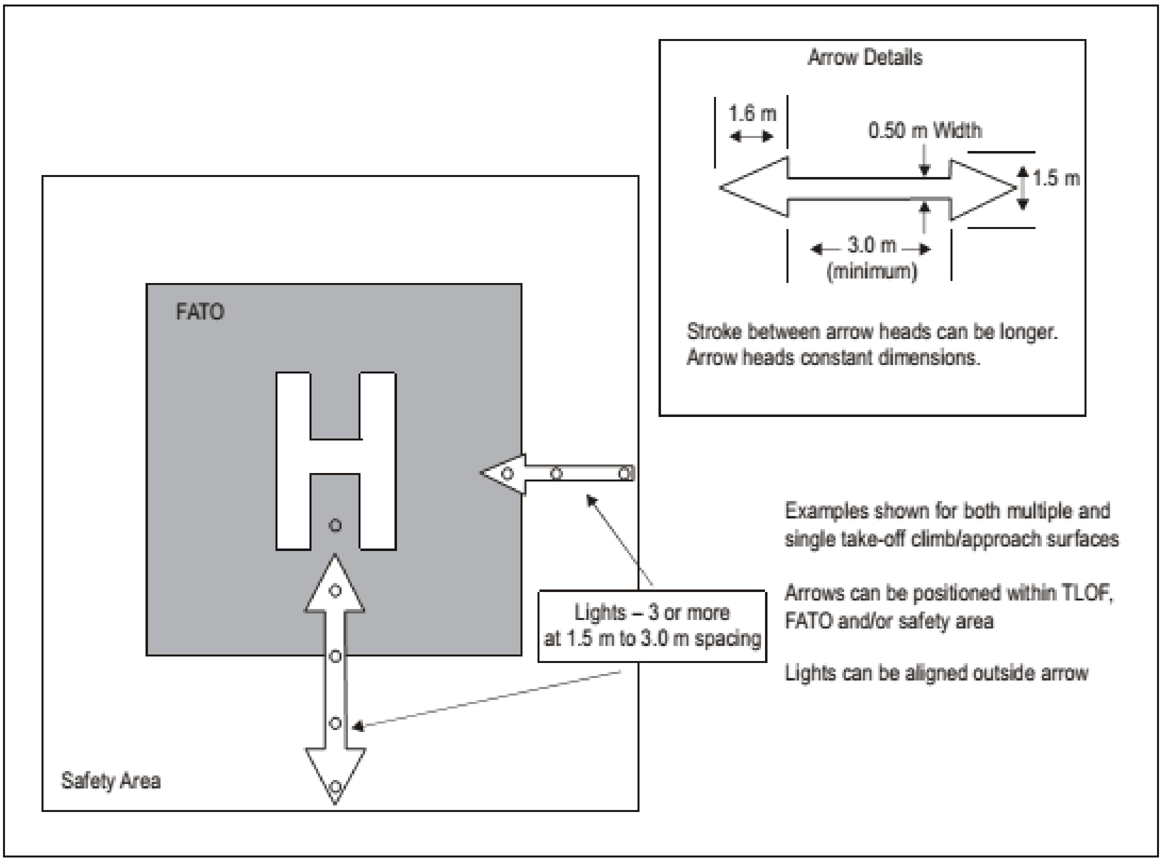


Figure 5-9. Flight path alignment guidance markings and lights

18.4 The markings must be in a colour which provides good contrast against the background colour of the surface on which they are marked, preferably white.

139.18.16 Lights

1. General

Note 1. See NAM-CATS-AH, Volume 1, concerning specifications on screening of non-aeronautical ground lights, and design of elevated and inset lights.

Compliance Note 2. In the case of helidecks and heliports located near navigable waters, consideration needs to be given to ensuring that aeronautical ground lights do not cause confusion to mariners.

Compliance Note 3. As helicopters will generally come very close to extraneous light sources, it is particularly important to ensure that, unless such lights are navigation lights exhibited in accordance with international regulations, they are screened or located so as to avoid direct and reflected glare.

2. Heliport beacon

2.1 A heliport beacon must be provided at a heliport where:

(a) long-range visual guidance is considered necessary and is not provided by other visual means; or

(b) identification of the heliport is difficult due to surrounding lights

2.2 The heliport beacon must be located on or adjacent to the heliport preferably at an elevated position and so that it does not dazzle a pilot at short range.

Compliance Note. Where a heliport beacon is likely to dazzle pilots at short range, it may be switched off during the final stages of the approach and landing.

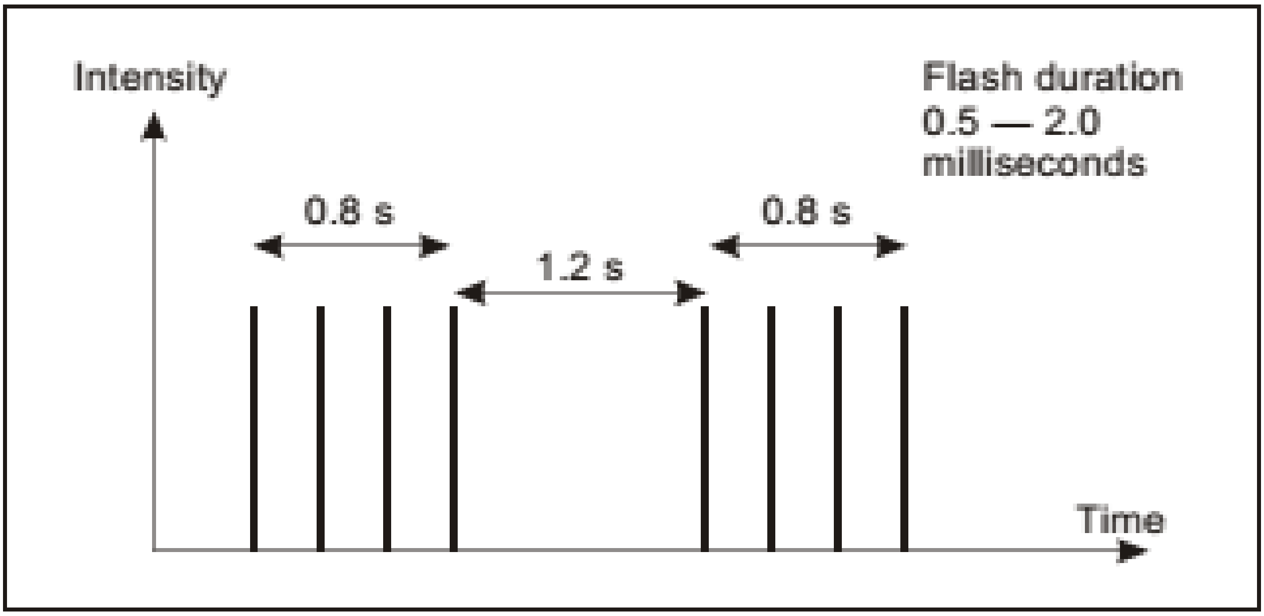


Figure 5-10. Heliport beacon flash characteristics

2.3 The heliport beacon must emit repeated series of equispaced short duration white flashes in the format in Figure 5-10.

2.4 The light from the beacon must show at all angles of azimuth.

2.5 The effective light intensity distribution of each flash must be as shown in Figure 5-11, Illustration 1.

Compliance Note. Where brilliancy control is desired, settings of 10 per cent and 3 per cent have been found to be satisfactory. In addition, shielding may be necessary to ensure that pilots are not dazzled during the final stages of the approach and landing.

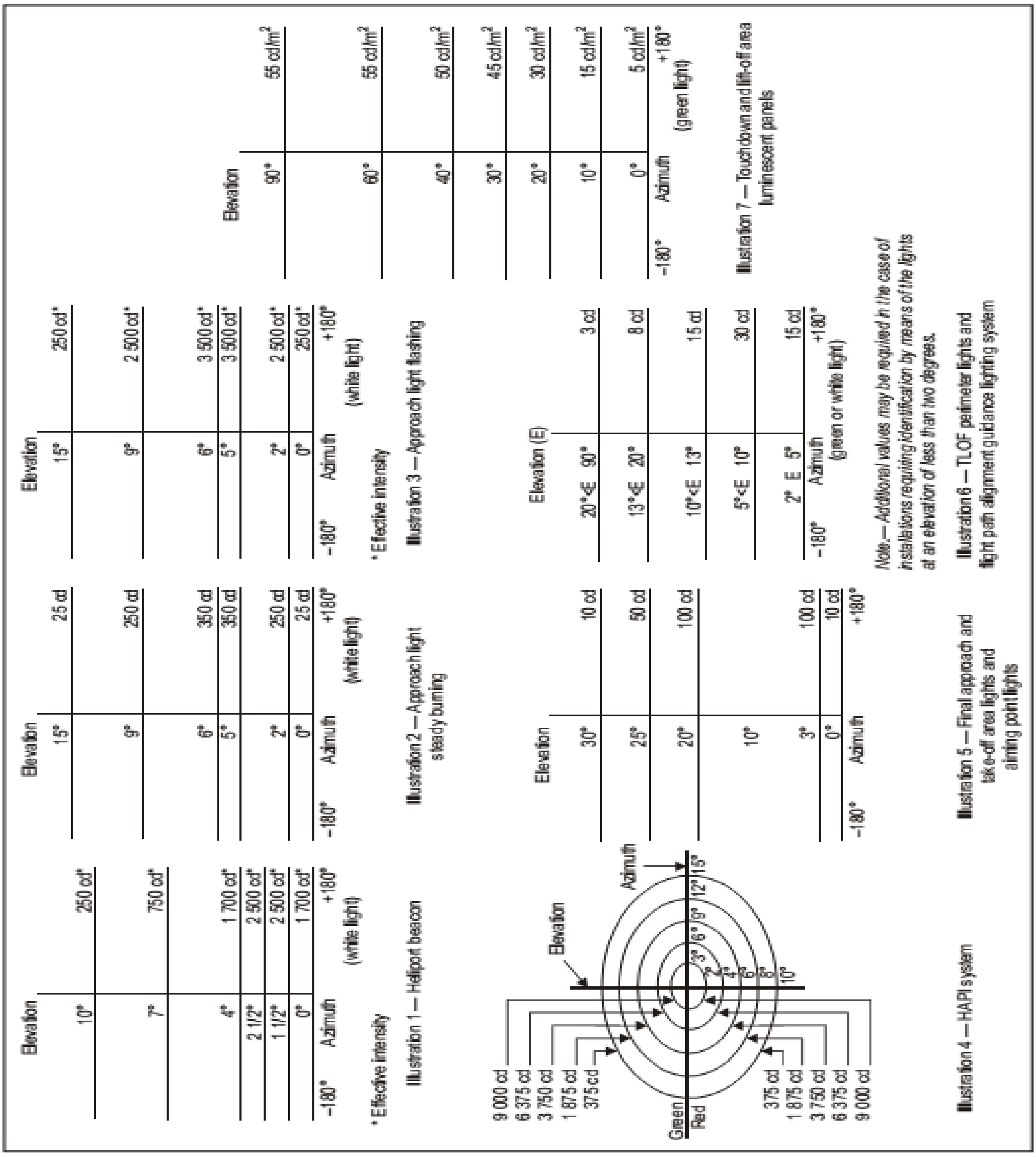


Figure 5-11. Isocandela diagram

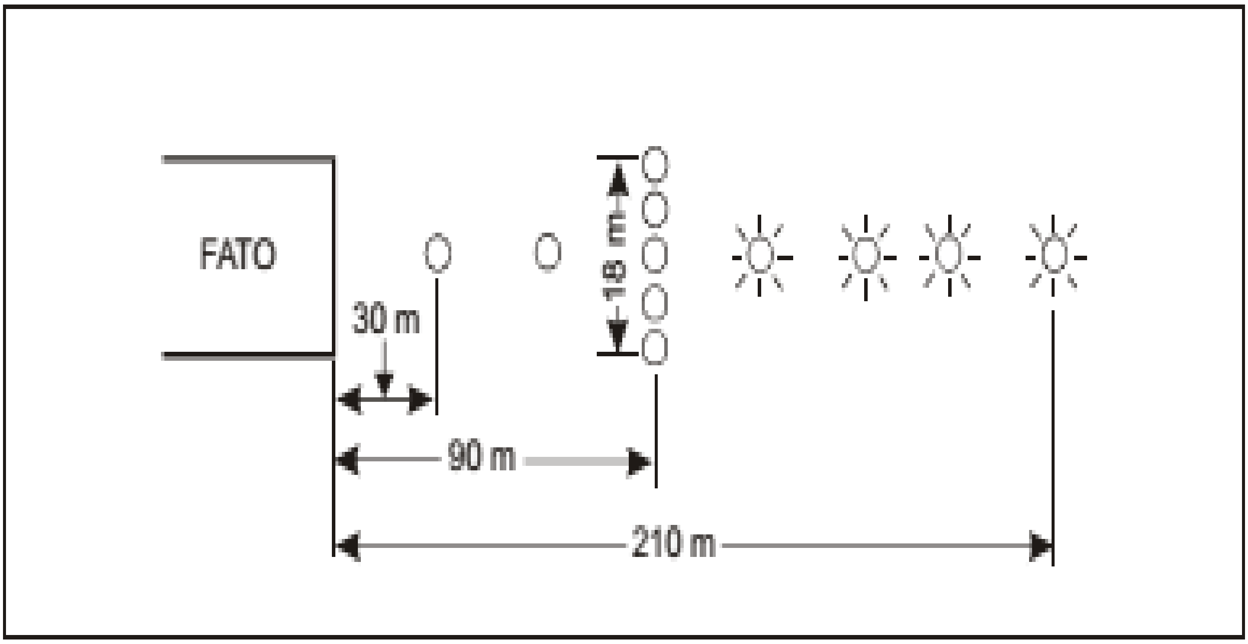


Figure 5-12. Approach lighting system

3. Approach lighting system

3.1 An approach lighting system must be provided at a heliport where it is desirable and practicable to indicate a preferred approach direction.

3.2 The approach lighting system must be located in a straight line along the preferred direction of approach.

3.3 An approach lighting system must consist of a row of three lights spaced uniformly at 30 m intervals and of a crossbar 18 m in length at a distance of 90 m from the perimeter of the FATO as shown in Figure 5-12. The lights forming the crossbar must be as nearly as practicable in a horizontal straight line at right angles to, and bisected by, the line of the centre line lights and spaced at 4.5 m intervals. Where there is the need to make the final approach course more conspicuous, additional lights spaced uniformly at 30 m intervals must be added beyond the crossbar. The lights beyond the crossbar may be steady or sequenced flashing, depending upon the environment.

Compliance Note. Sequenced flashing lights may be useful where identification of the approach lighting system is difficult due to surrounding lights.

3.4 The steady lights must be omnidirectional white lights.

3.5 Sequenced flashing lights must be omnidirectional white lights.

3.6 The flashing lights must have a flash frequency of one per second and their light distribution must be as shown in Figure 5-11, Illustration 3. The flash sequence must commence from the outermost light and progress towards the crossbar.

3.7 A suitable brilliancy control must be incorporated to allow for adjustment of light intensity to meet the prevailing conditions.

Compliance Note. The following intensity settings have been found suitable:

(a) steady lights — 100 per cent, 30 per cent and 10 per cent; and
(b) flashing lights — 100 per cent, 10 per cent and 3 per cent

4. Flight path alignment guidance lighting system

4.1 Flight path alignment guidance lighting system(s) must be provided at a heliport where it is desirable and practicable to indicate available approach and/or departure path direction(s).

Compliance Note. The flight path alignment guidance lighting can be combined with a flight path alignment guidance marking(s).

4.2 The flight path alignment guidance lighting system must be in a straight line along the direction(s) of approach and/or departure path on one or more of the TLOF, FATO, safety area or any suitable surface in the immediate vicinity of the FATO, TLOF or safety area.

4.3 If combined with a flight path alignment guidance marking, as far as is practicable the lights must be located inside the “arrow” markings.

4.4 A flight path alignment guidance lighting system must consist of a row of three or more lights spaced uniformly a total minimum distance of 6 m. Intervals between lights must not be less than 1.5 m and must not exceed 3 m. Where space permits there must be 5 lights. (See Figure 5-9.)

Compliance Note. The number of lights and spacing between these lights may be adjusted to reflect the space available. If more than one flight path alignment system is used to indicate available approach and/or departure path direction(s), the characteristics for each system are typically kept the same. (See Figure 5-9.)

4.5 The lights must be steady omnidirectional inset white lights.

4.6 The distribution of the lights must be as indicated in Figure 5-11, Illustration 6.

4.7 A suitable control must be incorporated to allow for adjustment of light intensity to meet the prevailing conditions and to balance the flight path alignment guidance lighting system with other heliport lights and general lighting that may be present around the heliport.

5. Visual alignment guidance system

5.1 A visual alignment guidance system must be provided to serve the approach to a heliport where one or more of the following conditions exist especially at night:

(a) obstacle clearance, noise abatement or traffic control procedures require a particular direction to be flown;
(b) the environment of the heliport provides few visual surface cues; and
(c) it is physically impracticable to install an approach lighting system.

5.2 The visual alignment guidance system must be located such that a helicopter is guided along the prescribed track towards the FATO.

5.3 The system must be located at the downwind edge of the FATO and aligned along the preferred approach direction.

5.4 The light units must be frangible and mounted as low as possible.

5.5 Where the lights of the system need to be seen as discrete sources, light units must be located such that at the extremes of system coverage the angle subtended between units as seen by the pilot must not be less than 3 minutes of arc.

Signal format

5.6 The angles subtended between light units of the system and other units of comparable or greater intensities must also be not less than 3 minutes of arc.

Compliance Note. Requirements of 5.5 and 5.6 can be met for lights on a line normal to the line of sight if the light units are separated by 1 m for every kilometre of viewing range.

5.7 The signal format of the alignment guidance system must include a minimum of three discrete signal sectors providing “offset to the right”, “on track” and “offset to the left” signals.

5.8 The divergence of the “on track” sector of the system must be as shown in Figure 5-13.

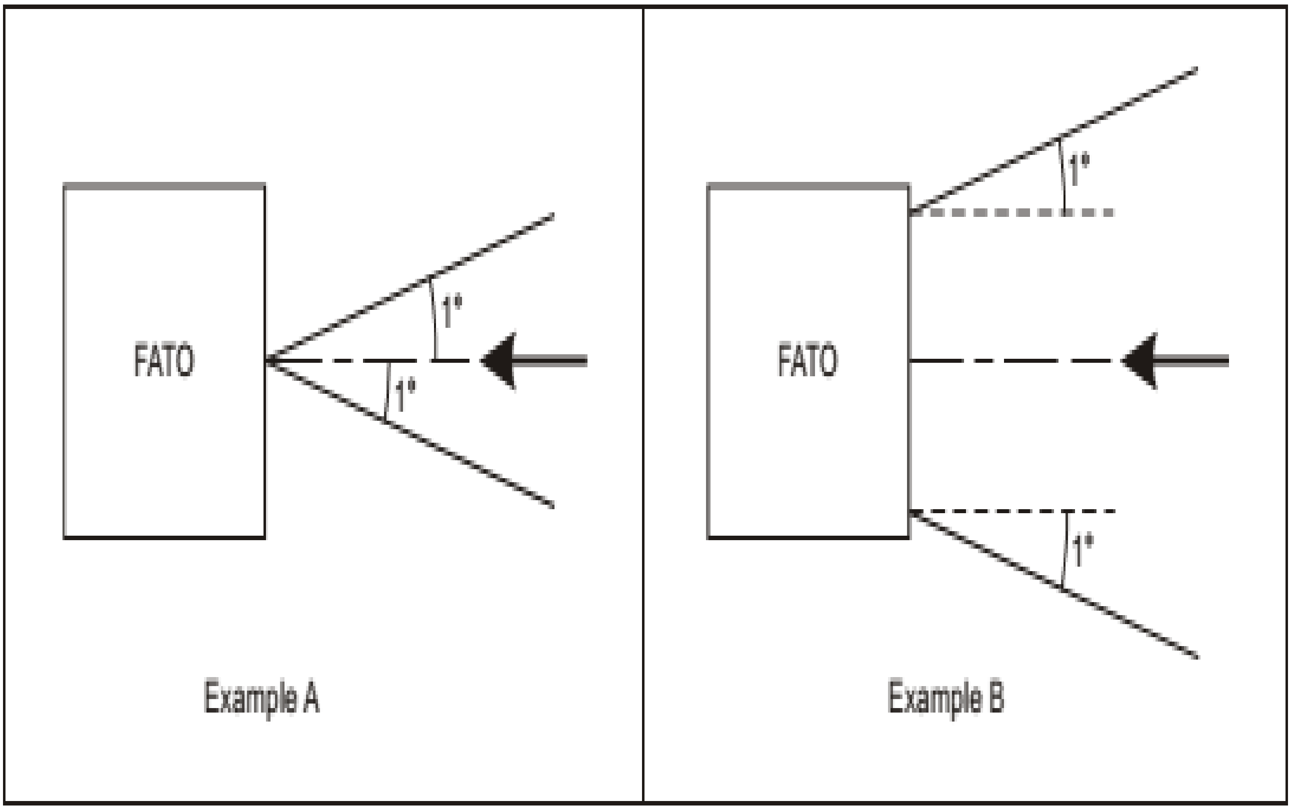


Figure 5-13. Divergence of the “on track” sector

5.9 The signal format must be such that there is no possibility of confusion between the system and any associated visual approach slope indicator or other visual aids.

5.10 The system must avoid the use of the same coding as any associated visual approach slope indicator.

5.11 The signal format must be such that the system is unique and conspicuous in all operational environments

5.12 The system must not significantly increase the pilot workload.

Light distribution

5.13 The usable coverage of the visual alignment guidance system must be equal to or better than that of the visual approach slope indicator system with which it is associated.

5.14 A suitable intensity control must be provided so as to allow adjustment to meet the prevailing conditions and to avoid dazzling the pilot during approach and landing.

Approach track and azimuth setting

5.15 A visual alignment guidance system must be capable of adjustment in azimuth to within ±5 minutes of arc of the desired approach path.

5.16 The angle of the azimuth guidance system must be such that during an approach the pilot of a helicopter at the boundary of the "on track" signal will clear all objects in the approach area by a safe margin.

5.17 The characteristics of the obstacle protection surface specified in 6.23, Table 5-1 and Figure 5-14 must equally apply to the system.

Table 5-1. Dimensions and slopes of the obstacle protection surface

SURFACE AND DIMENSIONS	FATO	
Length of inner edge	Width of safety area	
Distance from end of FATO	3 m minimum	
Divergence	10%	
Total length	2500 m	
Slope	PAPI	A[a]– 0.57°
	HAPI	A[b]– 0.65°
	APAPI	A[a]– 0.9°
a. As indicated in NAM-CATS-AH Volume I, Figure 5-19. b. The angle of the upper boundary of the "below slope" signal		

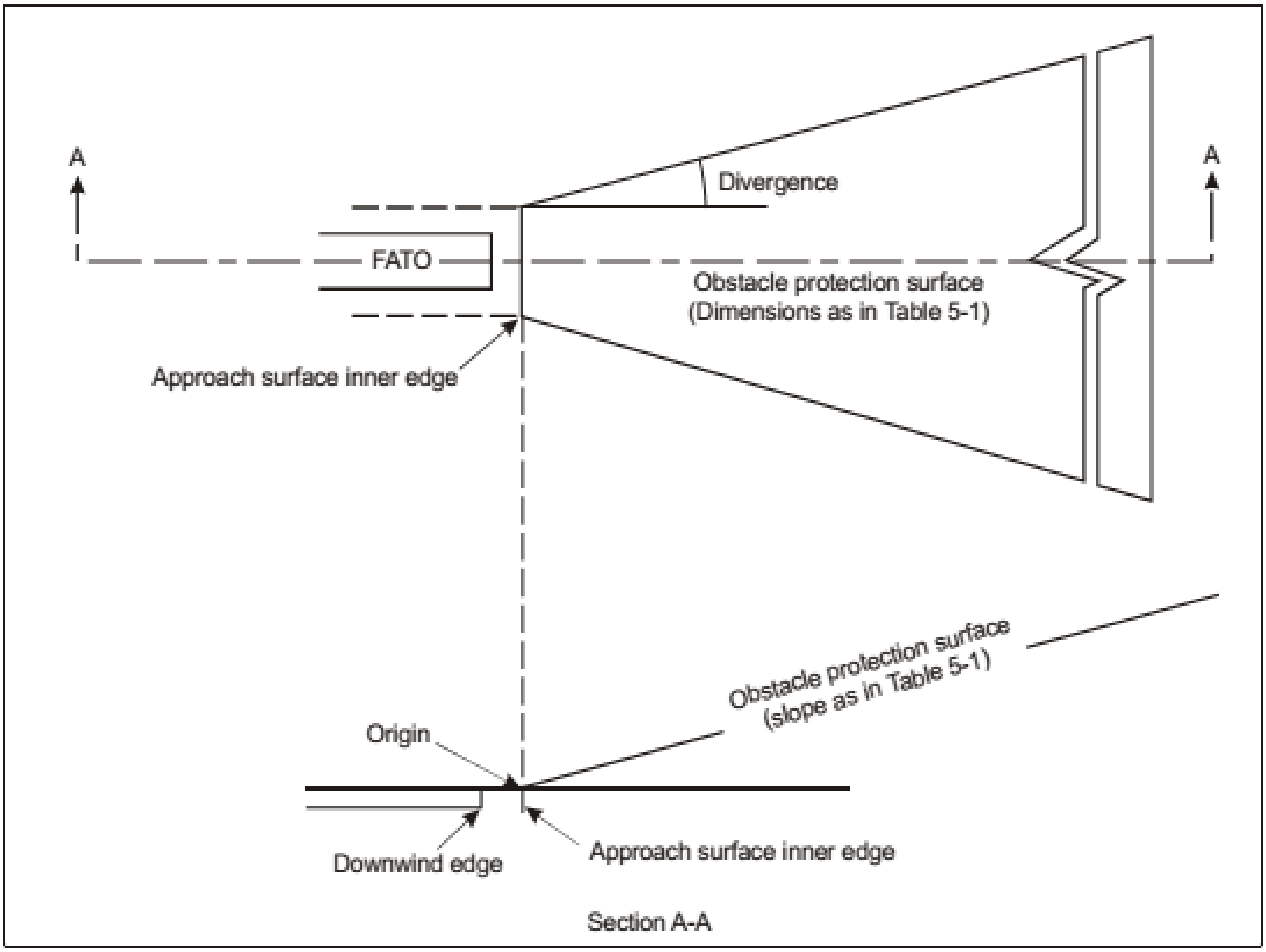


Figure 5-14. Obstacle protection surface for visual approach slope indicator systems

Characteristics of the visual alignment guidance system

5.18 In the event of the failure of any component affecting the signal format the system must be automatically switched off.

5.19 The light units must be so designed that deposits of condensation, ice, dirt, etc., on optically transmitting or reflecting surfaces will interfere to the least possible extent with the light signal and will not cause spurious or false signals to be generated.

6. Visual approach slope indicator

6.1 A visual approach slope indicator must be provided to serve the approach to a heliport, whether or not the heliport is served by other visual approach aids or by non-visual aids, where one or more of the following conditions exist especially at night:

(a) obstacle clearance, noise abatement or traffic control procedures require a particular slope to be flown;
(b) the environment of the heliport provides few visual surface cues; and
(c) the characteristics of the helicopter require a stabilized approach.

6.2 The standard visual approach slope indicator systems for helicopter operations must consist of the following:

(a) PAPI and APAPI systems conforming to the specifications contained in NAM-CATS-AH, Volume I. except that the angular size of the on-slope sector of the systems must be increased to 45 minutes; or
(b) helicopter approach path indicator (HAPI) system conforming to the specifications in 6.6 to 6.21 below, inclusive.

6.3 A visual approach slope indicator must be located such that a helicopter is guided to the desired position within the FATO and so as to avoid dazzling the pilot during final approach and landing.

6.4 A visual approach slope indicator must be located adjacent to the nominal aiming point and aligned in azimuth with the preferred approach direction.

6.5 The light unit(s) must be frangible and mounted as low as possible.

HAPI signal format

6.6 The signal format of the HAPI must include four discrete signal sectors, providing an “above slope”, an “on slope”, a “slightly below” and a “below slope” signal.

6.7 The signal format of the HAPI must be as shown in Figure 5-15, Illustrations A and B.

Compliance Note. Care is required in the design of the unit to minimize spurious signals between the signal sectors and at the azimuth coverage limits.

Sector	Format
Above	Flashing green
On slope	Green
Slightly below	Red
Below	Flashing red

Illustration A

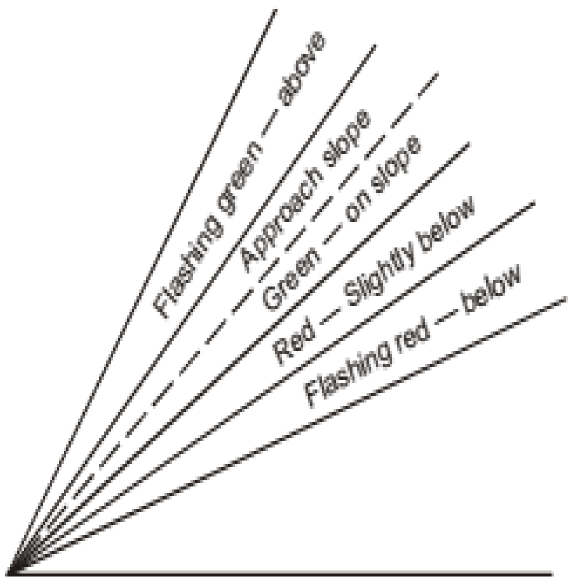


Illustration B

Figure 5-15. HAPI signal format

6.8 The signal repetition rate of the flashing sector of the HAPI must be at least 2 Hz

6.9 The on-to-off ratio of pulsing signals of the HAPI must be 1 to 1, and the modulation depth must be at least 80 per cent.

6.10 The angular size of the "on-slope" sector of the HAPI must be 45 minutes.

6.11 The angular size of the "slightly below" sector of the HAPI must be 15 minutes.

Light distribution

6.12 The light intensity distribution of the HAPI in red and green colours must be as shown in Figure 5-11, Illustration 4.

Compliance Note. A larger azimuth coverage can be obtained by installing the HAPI system on a turntable.

6.13 Colour transition of the HAPI in the vertical plane must be such as to appear to an observer at a distance of not less than 300 m to occur within a vertical angle of not more than three minutes.

6.14 The transmission factor of a red or green filter must be not less than 15 per cent at the maximum intensity setting.

6.15 At full intensity the red light of the HAPI must have a Y-coordinate not exceeding 0.320, and the green light must be within the boundaries specified in NAM-CATS-AH, Volume I, Appendix 1, 2.1.3.

6.16 A suitable intensity control must be provided so as to allow adjustment to meet the prevailing conditions and to avoid dazzling the pilot during approach and landing.

Approach slope and elevation setting

6.17 A HAPI system must be capable of adjustment in elevation at any desired angle between 1 degree and 12 degrees above the horizontal with an accuracy of ±5 minutes of arc.

6.18 The angle of elevation setting of HAPI must be such that during an approach, the pilot of a helicopter observing the upper boundary of the “below slope” signal will clear all objects in the approach area by a safe margin.

Characteristics of the light unit

6.19 The system must be so designed that:

(a) in the event the vertical misalignment of a unit exceeds ±0.5 degrees (±30 minutes), the system will switch off automatically; and
(b) if the flashing mechanism fails, no light will be emitted in the failed flashing sector(s).

6.20 The light unit of the HAPI must be so designed that deposits of dirt, etc., on optically transmitting or reflecting surfaces will interfere to the least possible extent with the light signal and will not cause spurious or false signals to be generated.

6.21 A HAPI system intended for installation on a floating helideck must afford a stabilization of the beam to an accuracy of ± 1/4 degree within ± 3-degree pitch and roll movement of the heliport.

Obstacle protection surface

Compliance Note. The following specifications apply to PAPI, APAPI and HAPI.

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

6.23 The characteristics of the obstacle protection surface, i.e. origin, divergence, length and slope, must correspond to those specified in the relevant column of Table 5-1 and in Figure 5-14.

6.24 New objects or extensions of existing objects must not be permitted above an obstacle protection surface except when, in the opinion of the Executive Director, the new object or extension would be shielded by an existing immovable object.

6.25 Existing objects above an obstacle protection surface must be removed except when, in the opinion of the Executive Director, the object is shielded by an existing immovable object, or after aeronautical study it is determined that the object would not adversely affect the safety of operations of helicopters.

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

(a) suitably raise the approach slope of the system;
(b) reduce the azimuth spread of the system so that the object is outside the confines of the beam;
(c) displace the axis of the system and its associated obstacle protection surface by no more than 5 degrees;
(d) suitably displace the FATO; and

(e) install a visual alignment guidance system specified in sub-section 5 above.

7. Final approach and take-off area lighting systems for surface-level heliports

7.1 Where a FATO is established at a surface-level heliport on ground intended for use at night, FATO lights must be provided except that they may be omitted where the FATO and the TLOF are nearly coincidental or the extent of the FATO is self-evident.

7.2 FATO lights must be placed along the edges of the FATO. The lights must be uniformly spaced as follows:

(a) for an area in the form of a square or rectangle, at intervals of not more than 50 m with a minimum of four lights on each side including a light at each corner; and
(b) for any other shaped area, including a circular area, at intervals of not more than 5 m with a minimum of ten lights.

7.3 FATO lights must be fixed omnidirectional lights showing white. Where the intensity of the lights is to be varied the lights must show variable white.

7.4 The light distribution of FATO lights must be as shown in Figure 5-11, Illustration 5

7.5 The lights must not exceed a height of 25cm and must be inset when a light extending above the surface would endanger helicopter operations. Where a FATO is not meant for lift-off or touchdown, the lights must not exceed a height of 25 cm above ground or snow level.

8. Aiming point lights

8.1 Where an aiming point marking is provided at a heliport intended for use at night, aiming point lights must be provided.

8.2 Aiming point lights must be collocated with the aiming point marking.

8.3 Aiming point lights must form a pattern of at least six omnidirectional white lights as shown in Figure 5-6. The lights must be inset when a light extending above the surface could endanger helicopter operations.

8.4 The light distribution of aiming point lights must be as shown in Figure 5-11, Illustration 5.

9. Touchdown and lift-off area lighting system

9.1 A TLOF lighting system must be provided at a heliport intended for use at night.

9.2 The TLOF lighting system for a surface-level heliport must consist of one or more of the following:

(a) perimeter lights; or
(b) floodlighting; or
(c) arrays of segmented point source lighting (ASPSL) or luminescent panel (LP) lighting to identify the TLOF when a) and b) are not practicable and FATO lights are available.

9.3 The TLOF lighting system for an elevated heliport or helideck must consist of:

(a) perimeter lights; and

(b) ASPSL and/or LPs to identify the touchdown marking where it is provided and/or floodlighting to illuminate the TLOF.

Compliance Note. At elevated heliports and helidecks, surface texture cues within the TLOF are essential for helicopter positioning during the final approach and landing. Such cues can be provided using various forms of lighting (ASPSL, LP, floodlights or a combination of these lights, etc.) in addition to perimeter lights. Best results have been demonstrated by the combination of perimeter lights and ASPSL in the form of encapsulated strips of light emitting diodes (LEDs) to identify the touchdown and heliport identification markings.

9.4 TLOF ASPSL and/or LPs to identify the touchdown marking and/ or floodlighting must be provided at a surface-level heliport intended for use at night when enhanced surface texture cues are required.

9.5 TLOF perimeter lights must be placed along the edge of the area designated for use as the TLOF or within a distance of 1.5 m from the edge. Where the TLOF is a circle the lights must be:

(a) located on straight lines in a pattern which will provide information to pilots on drift displacement; and
(b) where a) is not practicable, evenly spaced around the perimeter of the TLOF at the appropriate interval, except that over a sector of 45 degrees the lights must be spaced at half spacing.

9.6 TLOF perimeter lights must be uniformly spaced at intervals of not more than 3 m for elevated heliports and helidecks and not more than 5 m for surface-level heliports. There must be a minimum number of four lights on each side including a light at each corner. For a circular TLOF, where lights are installed in accordance with 9.5 b) there must be a minimum of fourteen lights.

9.7 The TLOF perimeter lights must be installed at an elevated heliport or fixed helideck such that the pattern cannot be seen by the pilot from below the elevation of the TLOF.

9.8 The TLOF perimeter lights must be installed at a floating helideck, such that the pattern cannot be seen by the pilot from below the elevation of the TLOF when the helideck is level.

9.9 On surface-level heliports, ASPSL or LPs, if provided to identify the TLOF, must be placed along the marking designating the edge of the TLOF. Where the TLOF is a circle, they must be located on straight lines circumscribing the area.

9.10 On surface-level heliports the minimum number of LPs on a TLOF must be nine. The total length of LPs in a pattern must not be less than 50 per cent of the length of the pattern. There must be an odd number with minimum number of three panels on each side of the TLOF including a panel at each corner. LPs must be uniformly spaced with a distance between adjacent panel ends of not more than 5 m on each side of the TLOF.

9.11 When LPs are used on an elevated heliport or helideck to enhance surface texture cues, the panels must not be placed adjacent to the perimeter lights. They must be placed around a touchdown marking where it is provided or coincident with heliport identification marking.

9.12 TLOF floodlights must be located so as to avoid glare to pilots in flight or to personnel working on the area.

The arrangement and aiming of floodlights must be such that shadows are kept to a minimum.

Compliance Note. ASPSL and LPs used to designate the touchdown and/or heliport identification marking have been shown to provide enhanced surface texture cues when compared to low-level floodlights. Due to the risk of misalignment, if floodlights are used, there *will be a need for them to be checked periodically to ensure they remain within the specifications contained herein.*

9.13 The TLOF perimeter lights must be fixed omnidirectional lights showing green.

9.14 At a surface-level heliport, ASPSL or LPs must emit green light when used to define the perimeter of the TLOF.

9.15 The chromaticity and luminance of colours of LPs must conform to the provisions of NAM-CATS-AH Volume I, Appendix 1, paragraph 3.4.

9.16 An LP must have a minimum width of 6 cm. The panel housing must be the same colour as the marking it defines.

9.17 The perimeter lights must not exceed a height of 25 cm and must be inset when a light extending above the surface could endanger helicopter operations.

9.18 When located within the safety area of a heliport or within the obstacle-free sector of a helideck, the TLOF floodlights must not exceed a height of 25 cm

9.19 The LPs must not extend above the surface by more than 2.5 cm.

9.20 The light distribution of the perimeter lights must be as shown in Figure 5-11, Illustration 6.

9.21 The light distribution of the LPs must be as shown in Figure 5-11, Illustration 7.

9.22 The spectral distribution of TLOF area floodlights must be such that the surface and obstacle marking can be correctly identified.

9.23 The average horizontal illuminance of the floodlighting must be at least 10 lux, with a uniformity ratio (average to minimum) of not more than 8:1 measured on the surface of the TLOF.

9.24 Lighting used to identify the touchdown marking must comprise a segmented circle of omnidirectional ASPSL strips showing yellow. The segments must consist of ASPSL strips, and the total length of the ASPSL strips must not be less than 50 per cent of the circumference of the circle.

9.25 If utilized, the heliport identification marking lighting must be omnidirectional showing green.

10. Winching area floodlighting

10.1 Winching area floodlighting must be provided at a winching area intended for use at night.

10.2 Winching area floodlights must be located so as to avoid glare to pilots in flight or to personnel working on the area. The arrangement and aiming of floodlights must be such that shadows are kept to a minimum.

10.3 The spectral distribution of winching area floodlights must be such that the surface and obstacle markings can be correctly identified.

10.4 The average horizontal illuminance must be at least 10 lux, measured on the surface of the winching area.

11. Taxiway lights

Compliance Note. The specifications for taxiway centre line lights and taxiway edge lights in NAM-CATS-AH Volume I, are equally applicable to taxiways intended for ground taxiing of helicopters.

12. Visual aids for denoting obstacles

Compliance Note. The specifications for marking and lighting of obstacles included in NAM-CATS-AH, Volume I, are equally applicable to heliports and winching areas.

13. Floodlighting of obstacles

13.1 At a heliport intended for use at night, obstacles must be floodlighted if it is not possible to display obstacle lights on them.

13.2 Obstacle floodlights must be arranged so as to illuminate the entire obstacle and as far as practicable in a manner so as not to dazzle the helicopter pilots.

13.3 Obstacle floodlighting must be such as to produce a luminance of at least 10 cd/m^2.

139.18.17 Heliport emergency planning

Introductory Note.

Heliport emergency planning is the process of preparing a heliport to cope with an emergency that takes place at the heliport or in its vicinity. Examples of emergencies include crashes on or off the heliport, medical emergencies, dangerous goods occurrences, fires and natural disasters.

The purpose of heliport emergency planning is to minimize the impact of an emergency by saving lives and maintaining helicopter operations.

The heliport emergency plan sets out the procedures for coordinating the response of heliport agencies or services (air traffic services unit, firefighting services, heliport administration, medical and ambulance services, aircraft operators, security services and police) and the response of agencies in the surrounding community (fire departments, police, medical and ambulance services, hospitals, military, and harbour patrol or coast guard) that could be of assistance in responding to the emergency.

1.1 A heliport emergency plan must be established commensurate with the helicopter operations and other activities conducted at the heliport.

1.2 The plan must identify agencies which could be of assistance in responding to an emergency at the heliport or in its vicinity.

1.3 The heliport emergency plan must provide for the coordination of the actions to be taken in the event of an emergency occurring at a heliport or in its vicinity;

1.4 Where an approach/departure path at a heliport is located over water identify which agency is responsible for coordinating rescue in the event of a helicopter ditching and indicate how to contact that agency.

1.5 The plan must include as a minimum, the following information –

(a) the types of emergencies planned for;

(b) how to initiate the plan for each emergency specified;

(c) the name of agencies on and off the heliport to contact for each type of emergency with telephone numbers or other contact information;

(d) the role of each agency for each type of emergency;

(e) a list of pertinent on-heliport services available with telephone numbers or other contact information;

(f) copies of any written agreements with other agencies for mutual aid and the provision of emergency services; and

(g) a grid map of the heliport and its immediate vicinity.

1.6 The heliport emergency plan must provide for consultation with all agencies identified in the plan.

1.7 The plan must be reviewed and the information in it updated at least yearly or, if deemed necessary, after an actual emergency, so as to correct any deficiency found during an actual emergency.

1.8 A test of the emergency plan must be carried out at least once every three years.

139.18.18 Rescue and firefighting

1. General

Introductory Note.

These specifications apply to surface-level heliports and elevated heliports only. The specifications complement those in NAM-CATS-AH, Volume I, 139.16.3, concerning rescue and firefighting requirements at aerodromes.

The principal objective of a rescue and firefighting service is to save lives. For this reason, the provision of means of dealing with a helicopter 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 for saving lives. This must assume at all times the possibility of, and need for, extinguishing a fire which may occur either immediately following a helicopter accident or incident or at any time during rescue operations.

The most important factors bearing on effective rescue in a survivable helicopter accident are the training received, the effectiveness of the equipment and the speed with which personnel and equipment designated for rescue and firefighting purposes can be put into use.

For an elevated heliport, requirements to protect any building or structure on which the heliport is located are not taken into account.

2. Level of protection to be provided

2.1 The level of protection to be provided for rescue and firefighting must based on the overall length of the longest helicopter normally using the heliport and in accordance with the heliport firefighting category determined from Table 6-1, except at an unattended heliport with a low movement rate.

Table 6-1. Heliport firefighting category

Category	Helicopter overall length [a]

H1	up to but not including 15 m
H2	from 15 m up to but not including 24 m
H3	from 24 m up to but not including 35 m

a. Helicopter length, including the tail boom and the rotors.

Compliance Note. Guidance to assist the operator in providing rescue and firefighting equipment and services at surface-level and elevated heliports is given in the Heliport Manual (Doc 9261).

2.2 During anticipated periods of operations by smaller helicopters, the heliport firefighting category may be reduced to that of the highest category of helicopter planned to use the heliport during that time.

3. Extinguishing agents

3.1 The principal extinguishing agent must be a foam meeting the minimum performance level B.

3.2 The amounts of water for foam production and the complementary agents to be provided must be in accordance with the heliport firefighting category determined under 2.1 and Table 6-2 or Table 6-3, as appropriate.

Compliance Note. The amounts of water specified for elevated heliports do not have to be stored on or adjacent to the heliport if there is a suitable adjacent pressurized water main system capable of sustaining the required discharge rate.

Table 6-2. Minimum usable amounts of extinguishing agents for surface-level heliports

	Foam meeting performance level B		Complementary agents				
Category	Water (L)	Discharge rate foam solution (L/min)	Dry chemical powders (kg)	or	Halons (kg)	or	CO2 (kg)
(1)	(2)	(3)	(4)		(5)		(6)
H1	500	250	23		23		45
H2	1000	500	45		45		90
H3	1600	800	90		90		180

Table 6-2. Minimum usable amounts of extinguishing agents for elevated heliports

	Foam meeting performance level B		Complementary agents				
Category	Water (L)	Discharge rate foam solution (L/min)	Dry chemical powders (kg)	or	Halons (kg)	or	CO2 (kg)
(1)	(2)	(3)	(4)		(5)		(6)
H1	2500	250	45		45		90
H2	5000	500	45		45		90
H3	8600	800	45		45		90

3.3 At a surface-level heliport it is permissible to replace all or part of the amount of water for foam production by complementary agents.

3.4 The discharge rate of the foam solution must not be less than the rates shown in Table 6-2 or Table 6-3, as appropriate. The discharge rate of complementary agents must be selected for optimum effectiveness of the agent used.

3.5 At an elevated heliport, at least one hose spray line capable of delivering foam in a jet spray pattern at 250 L/min must be provided. Additionally at elevated heliports in categories 2 and 3, at least two monitors must be provided each having a capability of achieving the required discharge rate and positioned at different locations around the heliports so as to ensure the application of foam to any part of the heliport under any weather condition and to minimize the possibility of both monitors being impaired by a helicopter accident.

4. Rescue equipment

4.1 At an elevated heliport, rescue equipment must be stored adjacent to the heliport.

5. Response time

5.1 At a surface-level heliport, the operational objective of the rescue and firefighting service must be to achieve response times not exceeding two minutes in optimum conditions of visibility and surface conditions.

Compliance Note. Response time is considered to be the time between the initial call to the rescue and firefighting service and the time when the first responding vehicle(s) (the service) is (are) in position to apply foam at a rate of at least 50 per cent of the discharge rate specified in Table 6-2.

5.2 At an elevated heliport, the rescue and fire fighting service must be immediately available on or in the vicinity of the heliport while helicopter movements are taking place.

APPENDIX TO SUBPART 18

INTERNATIONAL STANDARDS FOR INSTRUMENT HELIPORTS WITH NON-PRECISION AND/OR PRECISION APPROACHES AND INSTRUMENT DEPARTURES

1. GENERAL

Introductory Note 1. Subpart 18, contains Standards (specifications) that prescribe the physical characteristics and obstacle limitation surfaces to be provided for at heliports, and certain facilities and technical services normally provided at a heliport. It is not intended that these specifications limit or regulate the operation of an aircraft.

Introductory Note 2. The specifications in this appendix describe additional conditions beyond those found in the main sections of subpart 18, that apply to instrument heliports with non-precision and/or precision approaches. All specifications contained within the NAM-CATS-AH, Volume II, are equally applicable to instrument heliports, but with reference to further provisions described in this Appendix.

2. HELIPORT DATA

2.1 Heliport elevation

The elevation of the TLOF and/or the elevation and geoid undulation of each threshold of the FATO (where appropriate) must be measured and reported to the aeronautical information services to the accuracy of:

(a) one-half metre or foot for non-precision approaches; and
(b) one-quarter metre or foot for precision approaches.

Compliance Note. Geoid undulation must be measured in accordance with the appropriate system of coordinates.

2.2 Heliport dimensions and related information

The following additional data must be measured or described, as appropriate, for each facility provided on an instrument heliport:

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

3. PHYSICAL CHARACTERISTICS

3.1 Surface-level and elevated heliports

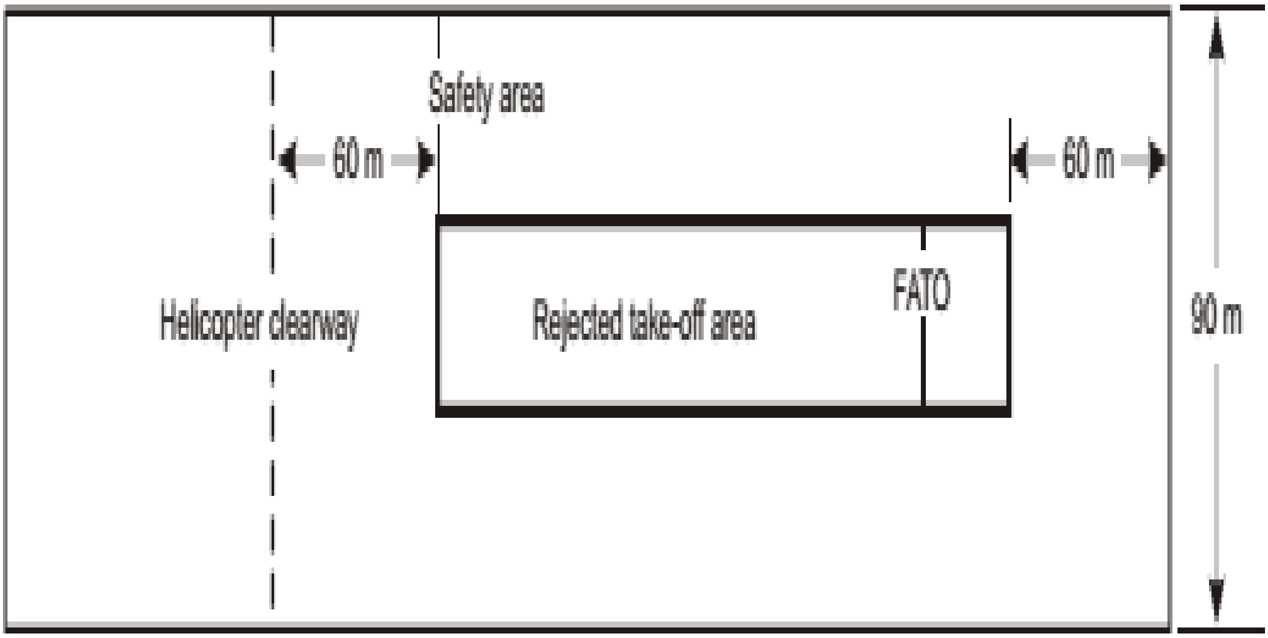
Safety areas

A safety area surrounding an instrument FATO must extend:

(a) laterally to a distance of at least 45 m on each side of the centre line; and
(b) longitudinally to a distance of at least 60 m beyond the ends of the FATO.

Note. See Figure A2-1.

Figure A2-1. Safety area for instrument FATO



4. OBSTACLE ENVIRONMENT

4.1 Obstacle limitation surfaces and sectors

Approach surface

Characteristics. The limits of an approach surface must comprise:

(a) an inner edge horizontal and equal in length to the minimum specified width of the FATO plus the safety area, perpendicular to the centre line of the approach surface and located at the outer edge of the safety area;

(b) two side edges originating at the ends of the inner edge;

(i) for an instrument FATO with a non-precision approach, diverging uniformly at a specified rate from the vertical plane containing the centre line of the FATO;

(ii) for an instrument FATO with a precision approach, diverging uniformly at a specified rate from the vertical plane containing the centre line of the FATO, to a specified height above FATO, and then diverging uniformly at a specified rate to a specified final width and continuing thereafter at that width for the remaining length of the approach surface; and

(c) an outer edge horizontal and perpendicular to the centre line of the approach surface and at a specified height above the elevation of the FATO.

4.2 Obstacle limitation requirements

4.2.1 The following obstacle limitation surfaces must be established for an instrument FATO with a non-precision and/or precision approach:

(a) take-off climb surface;
(b) approach surface; and
(c) transitional surfaces.

Compliance Note. See Figure A2-2 to A2-5.

4.2.2 The slopes of the obstacle limitation surfaces must not be greater than, and their other dimensions not less than, those specified in Tables A2-1 to A2-4.

Figure A2-2. Take-off climb surface for instrument FATO

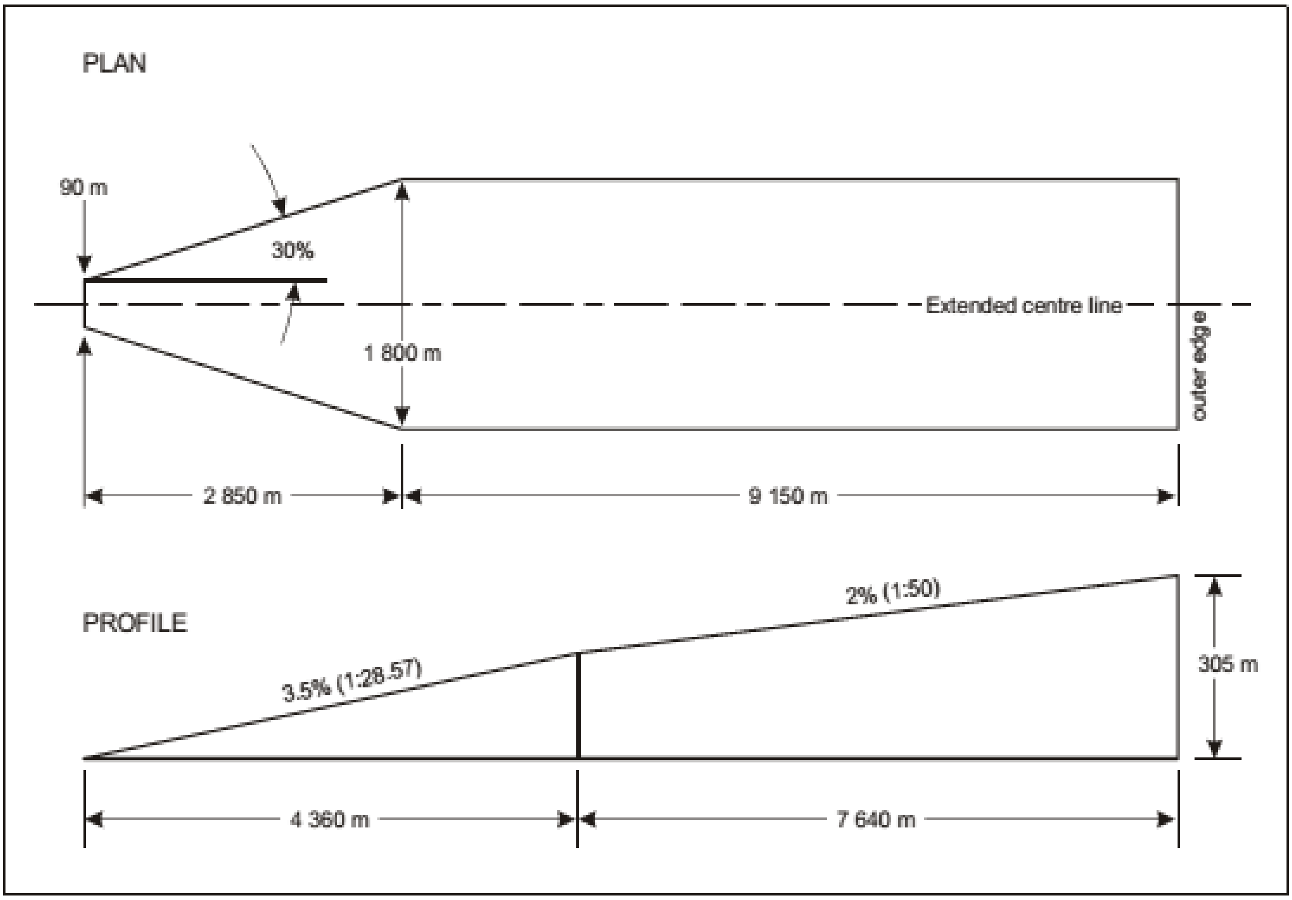


Figure A2-3. Approach surface for precision approach FATO

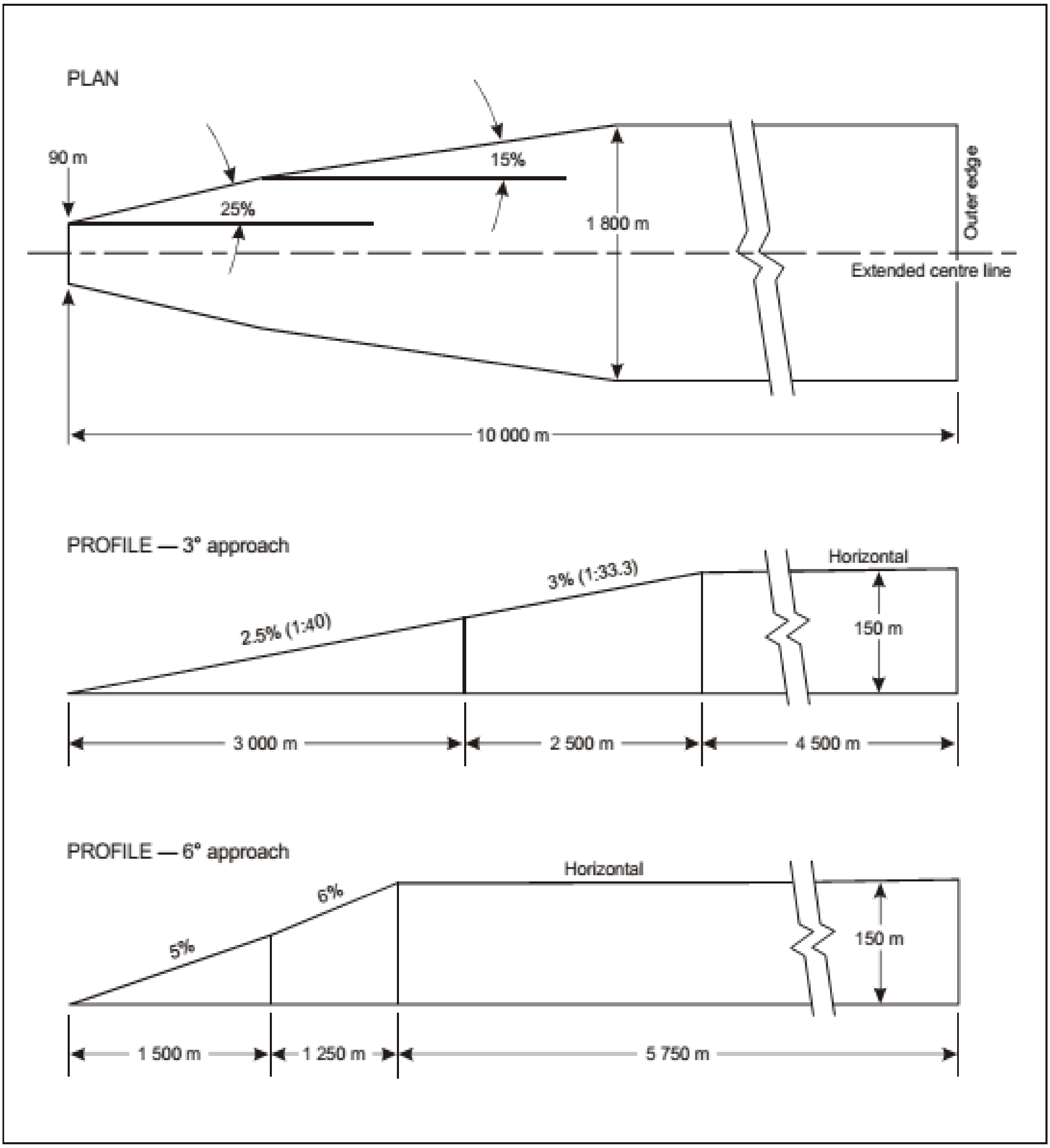


Figure A2-4. Approach surface for non-precision approach FATO

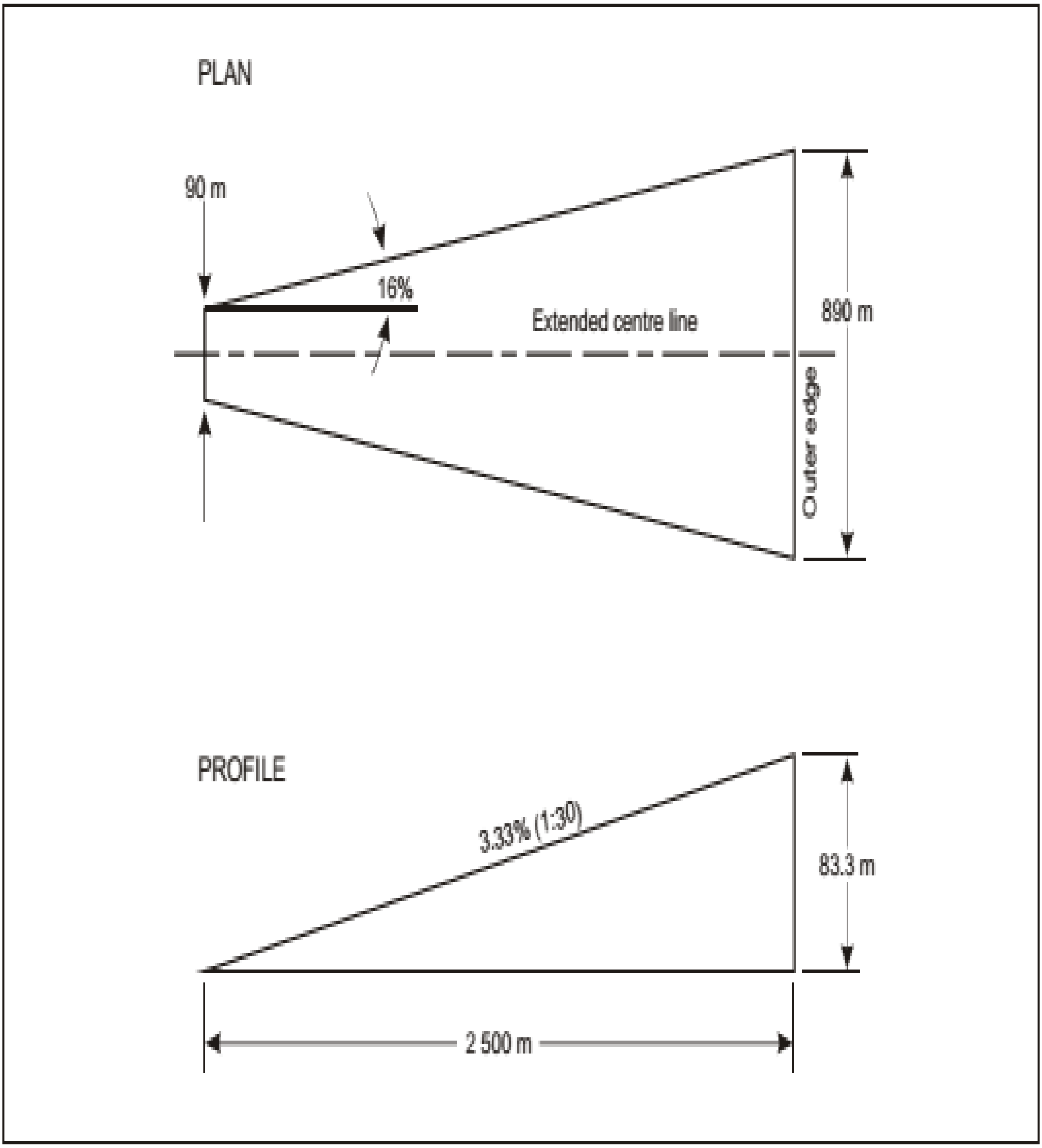
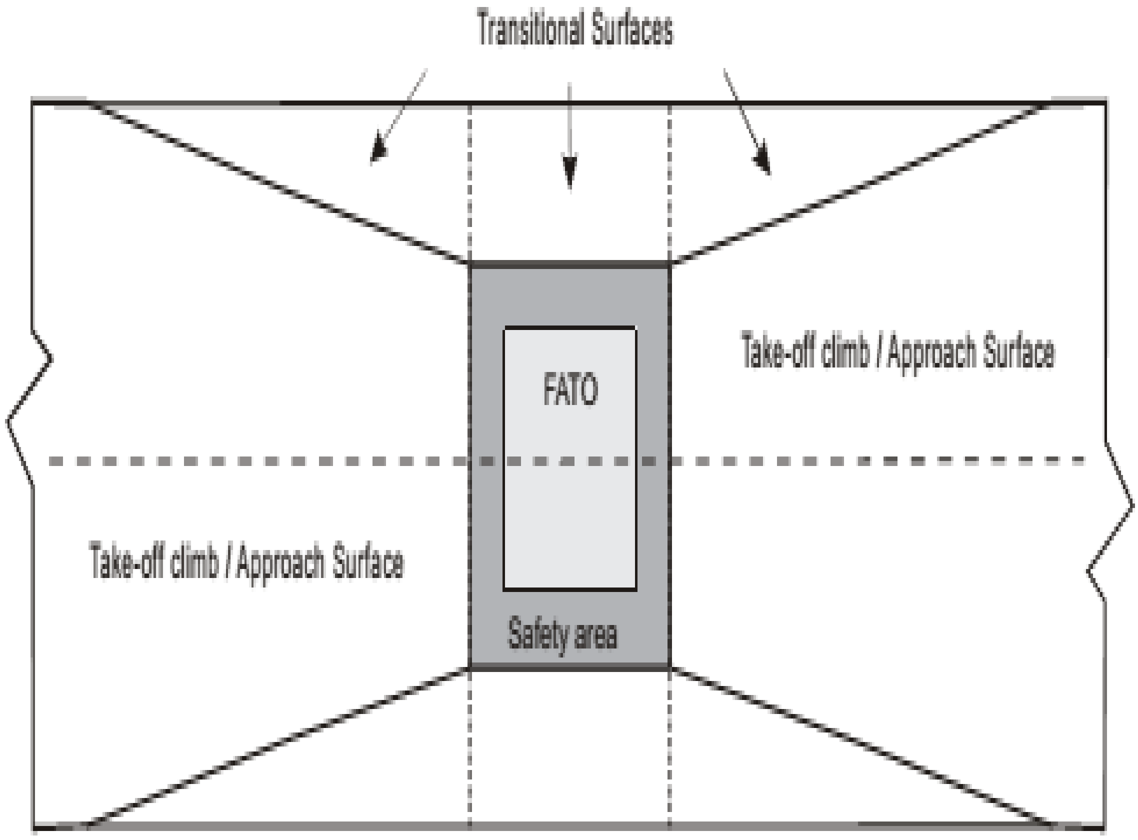


Figure A2-5. Transitional surfaces for an instrument FATO with a non-precision and/or precision approach



Note 1.– For single Take-off climb / Approach Surface. Transition surface extends perpendicular to far side of Safety Area.

Note 2.– Doc 8168, Vol II, Part IV, Helicopters, details further obstacle limitation surface requirements associated with a VSS.

Table A2-1. Dimensions and slopes of obstacle limitation surfaces

Instrument (Non-precision) FATO

SURFACE and DIMENSIONS		
APPROACH SURFACE		Width of safety area
Width of inner edge		boundary
Location of inner edge		
First Section		
Divergence	— day	16%
	— night	
Length	— day	2 500 m
	— night	
Outer width	— day	890 m
	— night	
Slope (maximum)		3.33%
Second Section		
Divergence	— day	—
	— night	
Length	— day	—
	— night	
Outer width	— day	—
	— night	
Slope (maximum)		—
Third Section		
Divergence		—
Length	— day	—
	— night	
Outer width	— day	—
	— night	
Slope (maximum)		—

TRANSITIONAL	
Slope	20%
Height	45%

Table A2-2. Dimensions and slopes of obstacle limitation surfaces

Instrument (Precision) FATO

	3° approach Height above FATO				*6° approach Height above FATO*			
Surface and dimensions	*90 m (300 ft)*	*60 m (200 ft)*	*45 m (150 ft)*	*30 m (100 ft)*	*90 m (300 ft)*	*60 m (200 ft)*	*45 m (150 ft)*	*30 m (100 ft)*
APPROACH SURFACE								
Length of inner edge	90 m	90 m	90 m	90 m	90 m	90 m	90 m	90 m
Distance from end of FATO	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m
Divergence each side to height above FATO	25%	25%	25%	25%	25%	25%	25%	25%
Distance to height above FATO	1745 m	1163 m	872 m	581 m	870 m	580 m	435 m	290 m
Width at height above FATO	962 m	671 m	526 m	380 m	521 m	380 m	307.5 m	235 m
Divergence to parallel section	15%	15%	15%	15%	15%	15%	15%	15%
Distance to parallel section	2793 m	3763 m	4 246 m	4 733 m	4 250 m	4 733 m	4 975 m	5 217 m

Width of parallel section	1 800 m	1 800 m	1 800 m	1 800 m	1 800 m	1 800 m	1 800 m	1 800 m
Distance to outer edge	5 462 m	5 074 m	4 882 m	4 686 m	3 380 m	3 187 m	3 090 m	2 993 m
Width at outer edge	1 800 m	1 800 m	1 800 m	1 800 m	1 800 m	1 800 m	1 800 m	1 800 m
Slope of first section	2.5% (1:40)	2.5% (1:40)	2.5% (1:40)	2.5% (1:40)	5% (1:20)	5% (1:20)	5% (1:20)	5% (1:20)
Length of first section	3 000 m	3 000 m	3 000 m	3 000 m	1 500 m	1 500 m	1 500 m	1 500 m
Slope of second section	3% (1:33.3)	3% (1:33.3)	3% (1:33.3)	3% (1:33.3)	6% (1:16.66)	6% (1:16.66)	6% (1:16.66)	6% (1:16.66)
Length of second section	2 500 m	2 500 m	2 500 m	2 500 m	1 250 m	1 250 m	1 250 m	1 250 m
Total length of surface	10000 m	10000 m	10000 m	10000 m	8 500 m	8 500 m	8 500 m	8 500 m
TRANSITIONAL								
Slope	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%
Height	45 m	45 m	45 m	45 m	45 m	45 m	45 m	45 m

Table A2-3. Dimensions and slopes of obstacle limitation surfaces

STRAIGHT TAKE-OFF

SURFACE and DIMENSIONS		*Instrument*
APPROACH SURFACE		
Width of inner edge		90 m
Location of inner edge		Boundary of end of clearway
First Section		
Divergence	— day	30%
	— night	
Length	— day	2 8500 m
	— night	
Outer width	— day	1800 m
	— night	
Slope (maximum)		3.5%
Second Section		
Divergence	— day	parallel
	— night	
Length	— day	1510 m
	— night	
Outer width	— day	1800 m
	— night	
Slope (maximum)		3.5%*
Third Section		
Divergence		parallel
Length	— day	7640 m

	— night	
Outer width	— day	1800 m
	— night	
Slope (maximum)		2%

* This slope exceeds the maximum mass one-engine-inoperative climb gradient of many helicopters which are currently operating.

Table A2-4. Dimensions and slopes of the obstacle protection surface

SURFACE AND DIMENSIONS	NON-PRECISION FATO	
Length of inner edge	Width of safety area	
Distance from end of FATO	60 M	
Divergence	15%	
Total length	2500 M	
Slope	PAPI	A[a] – 0.57°
	HAPI	A[b] – 0.65°
	APAPI	A[a] – 0.9°

a. As indicated in NAM-CATS-AH, Volume I, Figure 5-19.

b. The angle of the upper boundary of the “below slope” signal.

5. VISUAL AIDS

5.1 Lights

Approach Lighting Systems

5.1.1 Where an approach lighting system is provided for a non-precision FATO, the system must not be less than 210 m in length.

5.1.2 The light distribution of steady lights must be as indicated in Figure 5-11, Illustration 2 except that the intensity must be increased by a factor of three for a non-precision FATO.

ANNEXURE A

NAMIBIA CIVIL AVIATION AUTHORITY
P. Bag 12003
Ausspannplatz, Windhoek,
Namibia

Application form for the issuing, or renewal, or amendment of an aerodrome certificate or licence and certificate of intent

Mark the appropriate block:

☐ **Application for the issuing of an aerodrome certificate/licence**

☐ **Application for the renewal of an aerodrome certificate/licence**

☐ **Application for the amendment of an aerodrome certificate/licence**

☐ **Application for the issuance of certificate of intent**

1. PARTICULARS OF THE APPLICANT/HOLDER

1.1 Full name:

....

....

1.2 Trade name:

....

....

1.3 Physical address:	1.4 Postal address:
....	....
....	....
....	....

1.5 Telephone number:	1.6 Email address:
....	....
....	....

1.7 Legal status of applicant/holder (individual/corporation/company/trust/other - specify):

……

………

1.8 Registration number in the case of close corporation/company/trust:

……

………

1.9 Full particulars in respect of the individual / director/ shareholder/ partners/ members/ key personnel:

Name	Position	Identity Number	Nationality	Country of permanent resident
……………………	……………………	……………………	……………………	……………………
……………………	……………………	……………………	……………………	……………………
……………………	……………………	……………………	……………………	……………………
……………………	……………………	……………………	……………………	……………………
……………………	……………………	……………………	……………………	……………………
……………………	……………………	……………………	……………………	……………………
……………………	……………………	……………………	……………………	……………………
……………………	……………………	……………………	……………………	……………………

2. OWNERSHIP OF THE AERODROME SITE

2.1 Name and address of the owner:	2.2 Details of rights held in relation to the site (if the applicant is not the owner):
……………………………………………………… ………………………………………………………	……………………………………………………… ………………………………………………………

………………………………………………………… …………………………………………………………	…………………………………………………………

3. PARTICULARS OF THE AERODROME SITE

3.1 Aerodrome name: ………………………………………………… …………………………………………………	3.2 ICAO location indicator: ………………………………………………………… …………………………………………………………
3.3 Geographical coordinate of the aerodrome reference point in WGS-84 (degrees-minutes-seconds): Latitude ……………………………… Longitude ……………………………	**3.4** Direction and Distance to the nearest city, town or populous area (meters): ………………………………………………… …………………………………………………

4. RENEWAL AND AMENDMENT OF CERTIFICATE/LICENCE

4.1 Certificate/Licence number: ………………………………………………… …………………………………………………	4.2 Expiry date: ………………………………………………… …………………………………………………

4.3 Particulars of amendments applied for: ……………………………………………………………………………………………… ……………………………………………………………………………………………… ………………………………………………………………………………………………

5. CERTIFICATE OF INTENT

5.1 Full particulars of the area demarcated for the development of the aerodrome, and the location: ………………………………………………………………………………………………

…….............
……

6. AERODROME CATEGORY

6.1 Mark the appropriate aerodrome category being applied for:

☐ Category A ☐ Category B ☐ Category C

7. CRITICAL AIRCRAFT OR LARGEST AIRCRAFT INTENDED TO BE SERVED

7.1 Aircraft model and ICAO code:	7.2 Field length required (meters):	7.3 Wingspan (meters):	7.4 Aerodrome reference code:
…………………………	……………………	……………………	……………………
…………………………	……………………	……………………	……………………
…………………………	……………………	……………………	……………………

8. NON-COMPLIANCE AND DEVIATION

8.1 Particulars of non-compliance with, or deviation from aerodrome design, operations, maintenance and airspace classification requirements:
………
………
……

9. SUPPORTING DOCUMENTS

9.1 Mark the appropriate block:

☐ Aerodrome manual (not applicable for certificate of intent applications)

☐ Approval of the Local Authority

☐ Approval of interested Government institutions

☐ Environmental clearance certificate

☐ Layout plans of the aerodrome

☐ Proof of funding for the development of the aerodrome (applicable for certificate of intent applications)

☐ Proof of financial capability

☐ Deed of ownership (in relation to Section 2)

☐ Written permission from the owner of the aerodrome site (in relation to Section 2)

☐ Aeronautical study (in relations to Section 8)

10. DECLARATION OF THE APPLICANT

I hereby confirm that the information provided herein is accurate and complete and that the documents submitted along with this application form are authentic. I undertake to inform the Namibia Civil Aviation Authority ("Authority") in writing of any changes to the information already provided and to update the information on this form whenever requested to do so by the Authority.

....	....
Signature	Date

Notes:

i. *An application for the issuing of a certificate of intent must comply with the provisions of NAMCARs, Part 139, subpart 2.*

ii. *An application for the issuing of an aerodrome certificate, or renewal or amendment must comply with the provisions of NAMCARs, Part 139, subpart 3.*

iii. *An application for the issuing of an aerodrome licence, or renewal, or amendment must comply with the provisions of NAMCARs, Part 139, subpart 4.*

iv. *All sections must be completed if applicable to the application.*

v. *The form must be submitted to the Executive Director of Civil Aviation.*

vi. *Where the required information cannot be furnished in the space provided, the information must be submitted as a separate memorandum and attached hereto.*

vii. *Two copies of the aerodrome manual and other attached manuals must be submitted with the application* (not applicable for certificate of intent applications).

ANNEXURE B

NAMIBIA CIVIL AVIATION AUTHORITY

AERODROME CERTIFICATE OF INTENT

1. Certificate of Intent Number:	**2. Certificate of Intent Expiry Date:**

3. Aerodrome Category:	**4. Aerodrome Reference Code:**

5. Rescue and Firefighting Category:

6. Name of Certificate of Intent Holder:	**7. Name of Aerodrome:**

8. Geographical Coordinate of the Aerodrome Reference Point: **Latitude:** **Longitude:**	**9. Runway approach type:** **Primary:** **Secondary:**

10. Physical Address of Certificate of Intent Holder:	**11. Postal Address of Certificate of Intent Holder:**

12. Conditions and/or Restrictions to the Aerodrome Certificate of Intent:

13. I hereby certify that the certificate of intent holder has been duly certified in accordance with Civil Aviation Act of 2016 (Act no. 6 of 2016) read with Part 139 in NAMCARS, (2001), as amended.

... **………………………………..**

Executive Director of Civil Aviation **Date of Issue**

ANNEXURE C

NAMIBIA CIVIL AVIATION AUTHORITY

AERODROME CERTIFICATE

1. Certificate Number:	**2. Certificate Expiry Date:**

3. Aerodrome Category:	**4. Aerodrome Reference Code:**

5. Rescue and Firefighting Category:

6. Name of Certificate Holder:	**7. Name of Aerodrome:**

8.Geographical Coordinate of the Aerodrome Reference Point: **Latitude:** **Longitude:**	**9. Runway approach type:** **Primary:** **Secondary:**

10. Physical Address of Certificate Holder:	**11. Postal Address of Certificate Holder:**

12. Conditions and/or Restrictions to the Aerodrome Certificate:

14. I hereby certify that the certificate holder has been duly certified in accordance with Civil Aviation Act of 2016 (Act no. 6 of 2016) read with Part 139 in NAMCARS, (2001), as amended.

.... ……………………………….

Executive Director of Civil Aviation **Date of Issue**

ANNEXURE D

NAMIBIA CIVIL AVIATION AUTHORITY

AERODROME LICENCE

1. Licence Number:	**2. Licence Expiry Date:**

3. Aerodrome Category:	**4. Aerodrome Reference Code:**

5. Rescue and Firefighting Category:

6. Name of Licence Holder:	**7. Name of Aerodrome:**

8.Geographical Coordinate of the Aerodrome Reference Point: **Latitude:** **Longitude:**	**9. Runway approach type:** **Primary:** **Secondary:**

10. Physical Address of Licence Holder:	**11. Postal Address of Licence Holder:**

12. Conditions and/or Restrictions to the Aerodrome Licence:

15. I hereby certify that the licence holder has been duly licenced in accordance with Civil Aviation Act of 2016 (Act no. 6 of 2016) read with Part 139 in NAMCARS, (2001), as amended.

.. **…………………………………..**

Executive Director of Civil Aviation **Date of Issu**

ANNEXURE E

NAMIBIA CIVIL AVIATION AUTHORITY

AERODROME INTERIM CERTIFICATE

1. Interim Certificate Number:	**2. Interim Certificate Expiry Date:**

3. Aerodrome Category:	**4. Aerodrome Reference Code:**

5. Rescue and Firefighting Category:

6. Name of Interim Certificate Holder:	**7. Name of Aerodrome:**

8.Geographical Coordinate of the Aerodrome Reference Point: **Latitude:** **Longitude:**	**9. Runway approach type:** **Primary:** **Secondary:**

10. Physical Address of Interim Certificate Holder:	**11. Postal Address of Interim Certificate Holder:**

12. Conditions and/or Restrictions to the Aerodrome Interim Certificate:

16. I hereby certify that the interim certificate holder has been duly certified in accordance with Civil Aviation Act of 2016 (Act no. 6 of 2016) read with Part 139 in NAMCARS, (2001), as amended.

.. **………………………………..**

Executive Director of Civil Aviation **Date of Issu**

ANNEXURE F

NAMIBIA CIVIL AVIATION AUTHORITY

AERODROME INTERIM LICENCE

1. Interim Licence Number:	**2. Interim Licence Expiry Date:**

3. Aerodrome Category:	**4. Aerodrome Reference Code:**

5. Rescue and Firefighting Category:

6. Name of Interim Licence Holder:	**7. Name of Aerodrome:**

8.Geographical Coordinate of the Aerodrome Reference Point: **Latitude:** **Longitude:**	**9. Runway approach type:** **Primary:** **Secondary:**

10. Physical Address of Interim Licence Holder:	**11. Postal Address of Interim Licence Holder:**

12. Conditions and/or Restrictions to the Aerodrome Interim Licence:

17. I hereby certify that the interim licence holder has been duly licenced in accordance with Civil Aviation Act of 2016 (Act no. 6 of 2016) read with Part 139 in NAMCARS, (2001), as amended.

... **………………………………..**

Executive Director of Civil Aviation **Date of Issue**