APPENDIX 5

VISUAL AIDS FOR NAVIGATION

Contents

VISUAL AIDS FOR NAVIGATION

1. INTRODUCTION

1.1. This appendix expands on the requirements of SD-Aerodrome chapter 2 pertaining to the requirements for an aerodrome certificate or registration approval.

2. INDICATORS AND SIGNALLING DEVICES

2.1. Wind direction indicator

2.1.1. An aerodrome shall be equipped with at least one wind direction indicator. For land aerodromes, the aerodrome operator shall ensure that there is a wind direction indicator near the end of each runway.

2.1.2. A wind direction indicator shall be located so as to be visible from aircraft in flight or on the movement area and in such a way as to be free from the effects of air disturbances caused by nearby objects.

2.1.3. The wind direction indicator should be in the form of a truncated cone made of fabric and should have a length of not less than 3.6m and a diameter, at the larger end, of not less than 0.9 m. It should be constructed so that it gives a clear indication of the direction of the surface wind and a general indication of the wind speed. The colour or colours should be so selected as to make the wind direction indicator clearly visible and understandable from a height of at least 300m, having regard to background. Where practicable, a single colour, preferably white or orange, should be used. Where a combination of two colours is required to give adequate conspicuity against changing backgrounds, they should preferably be orange and white, red and white, or black and white, and should be arranged in five alternate bands, the first and last bands being the darker colour.

2.1.4. The location of at least one wind direction indicator should be marked by a circular band 15m in diameter and 1.2m wide. The band should be centred about the wind direction indicator support and should be in a colour chosen to give adequate conspicuity, preferably white.

2.1.5. Provision should be made for illuminating at least one wind indicator at an aerodrome intended for use at night.

2.2. Landing direction indicator

2.2.1. Where provided, a landing direction indicator shall be located in a conspicuous place on the aerodrome.

2.2.2. The landing direction indicator should be in the form of a “T”.

2.2.3. The shape and minimum dimensions of a landing "T" shall be as shown in Figure 1. The colour of the landing "T" shall 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" shall either be illuminated or outlined by white lights.

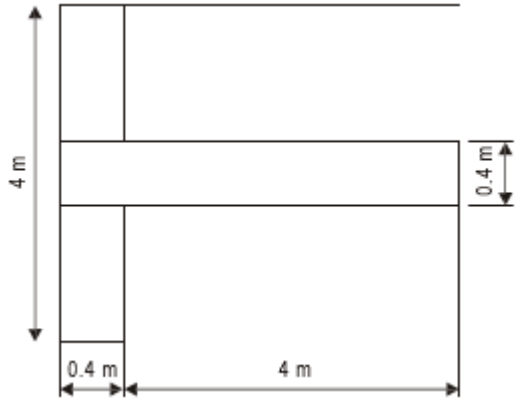


Figure 1 - Landing direction indicator

2.3. Signalling lamp

2.3.1 A signalling lamp shall be provided at a controlled aerodrome in the aerodrome control tower.

2.3.2 A signalling lamp *should* 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 *should* be made of the restricted boundary of green as specified in *Annex 14 appendix 1, 2.1.2*.

2.3.3 The beam spread *should* 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 *should* be not less than 6 000 cd.

2.4 Signal panels and signal area

Note. — The inclusion of detailed specifications for a signal area in this section is not intended to imply that one has to be provided. Annex 14 attachment A, Section 17, provides guidance on the need to provide ground signals. Annex 2, Appendix 1, specifies the shape, colour and use of visual ground signals. The Aerodrome Design Manual (Doc 9157), Part 4, provides guidance on their design.

2.4.1 Where provided, the signal area *should* be located so as to be visible for all angles of azimuth above an angle of 10° above the horizontal when viewed from a height of 300m.

2.4.2 The signal area shall be an even horizontal surface at least 9 m square.

2.4.3 The colour of the signal area *should* be chosen to contrast with the colours of the signal panels used, and it *should* be surrounded by a white border not less than 0.3m wide.

3.0 MARKINGS

3.1 Interruption of runway markings

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

3.1.2 The order of importance of runways for the display of runway markings *should* be as follows:

1st precision approach runway;
2nd non-precision approach runway; and
3rd non-instrument runway

3.1.3 At an intersection of a runway and taxiway, the markings of the runway shall be displayed and the markings of the taxiway interrupted, except that runway side stripe markings may be interrupted.

3.2 Colour and conspicuity

3.2.1 Runway markings shall be white.

Note 1. — It has been found that, on runway surfaces of light colour, the conspicuity of white markings can be improved by outlining them in black.

Note 2. — It is preferable that the risk of uneven friction characteristics on markings be reduced in so far as practicable by the use of a suitable paint.

Note 3. — Markings may consist of solid areas or a series of longitudinal stripes providing an effect equivalent to the solid areas.

3.2.2 Taxiway markings, runway turn pad markings and aircraft stand markings shall be yellow.

3.2.3 Apron safety lines shall be of a conspicuous colour which shall contrast with that used for aircraft stand markings.

3.2.4 At aerodromes where operations take place at night, pavement markings should be made with reflective materials designed to enhance the visibility of the markings.

Note. — Guidance on reflective materials is given in the ICAO Aerodrome Design Manual (Doc 9157), Part 4.

3.3 Unpaved taxiways

3.3.1 An unpaved taxiway *should* be provided, so far as practicable, with the markings prescribed for paved taxiways.

3.4 Runway designation marking

3.4.1 A runway designation marking shall be provided at the thresholds of a paved runway.

3.4.2 A runway designation marking *should* be provided, so far as practicable, at the thresholds of an unpaved runway.

3.4.3 A runway designation marking shall be located at a threshold as shown in Figure 2.

Note. — If the runway threshold is displaced from the extremity of the runway, a sign showing the designation of the runway may be provided for aeroplanes taking off.

3.4.4 A runway designation marking shall consist of a two-digit number and on parallel runways shall be supplemented with a letter. On a single runway, dual parallel runways and triple parallel runways the two-digit number shall 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 shall 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 shall be preceded by a zero.

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

(a) for two parallel runways: “L” “R”;
(b) for three parallel runways: “L” “C” “R”;
(c) for four parallel runways: “L” “R” “L” “R”;
(d) for five parallel runways: “L” “C” “R” “L” “R” or “L” “R” “L” “C” “R”; and
(e) for six parallel runways: “L” “C” “R” “L” “C” “R”.

3.4.6 The numbers and letters shall be in the form and proportion shown in Figure 3. The dimensions shall be not less than those shown in Figure 3, but where the numbers are incorporated in the threshold marking, larger dimensions shall be used in order to fill adequately the gap between the stripes of the threshold marking

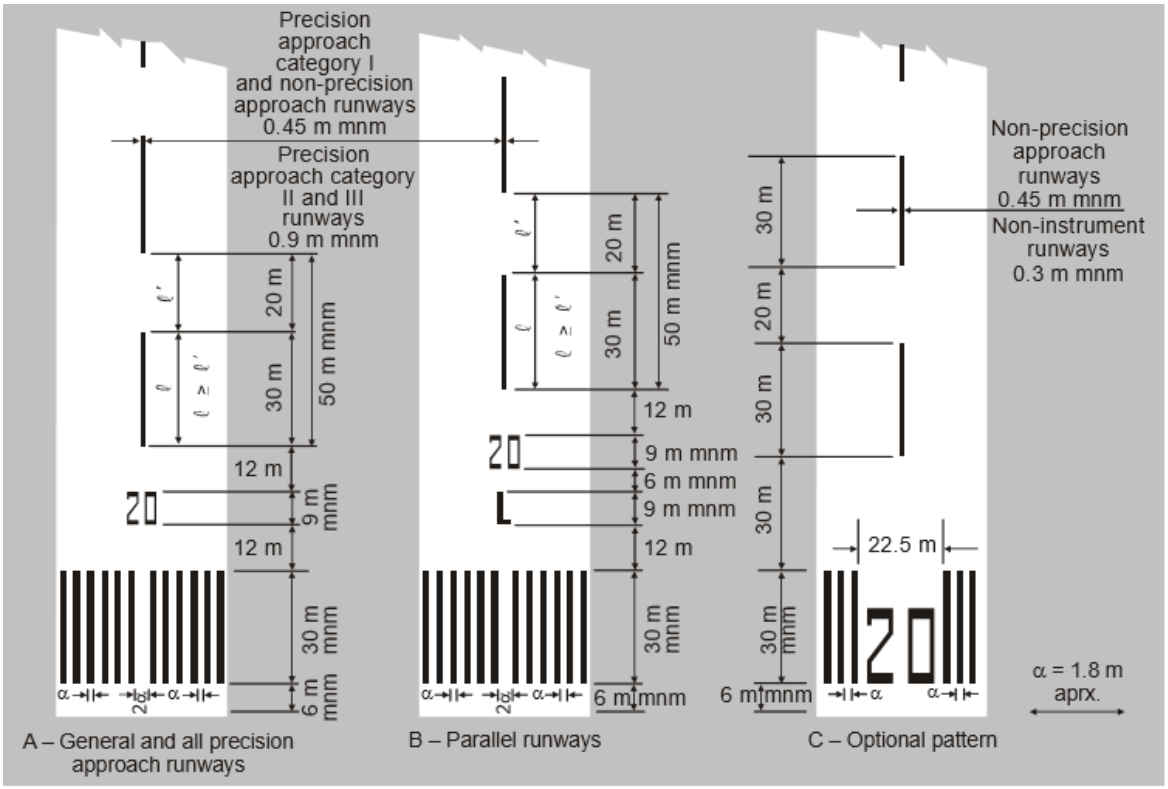


Figure 2 - Runway designation, centre line and threshold markings

3.5 Runway centre line marking

3.5.1 A runway centre line marking shall be provided on a paved runway.

3.5.2 A runway centre line marking shall be located along the centre line of the runway between the runway designation markings as shown in Figure 2, except when interrupted in compliance with 3.1.1.

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

3.5.4 The width of the stripes shall be not less than:

(a) 0.90m on precision approach category II and III runways;

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

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

3.6 Threshold marking

3.6.1 A threshold marking shall 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.

3.6.2 A threshold marking *should* be provided, so far as practicable, at the thresholds of an unpaved runway.

Note. — The Aerodrome Design Manual (Doc 9157), Part 4, shows a form of marking which has been found satisfactory for the marking of downward slopes immediately before the threshold.

3.6.3 The stripes of the threshold marking shall commence 6m from the threshold.

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

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

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

3.6.5 The stripes shall extend laterally to within 3 m of the edge of a runway or to a distance of 27m 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 shall 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 shall be continued across the runway. The stripes shall be at least 30m long and approximately 1.80m wide with spacing of approximately 1.80m between them except that, where the stripes are continued across a runway, a double spacing shall 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 shall be 22.5m.

3.6.6 *Transverse stripe*

3.6.6.1 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 4 (B) *should* be added to the threshold marking.

3.6.6.2 A transverse stripe shall be not less than 1.80m wide.

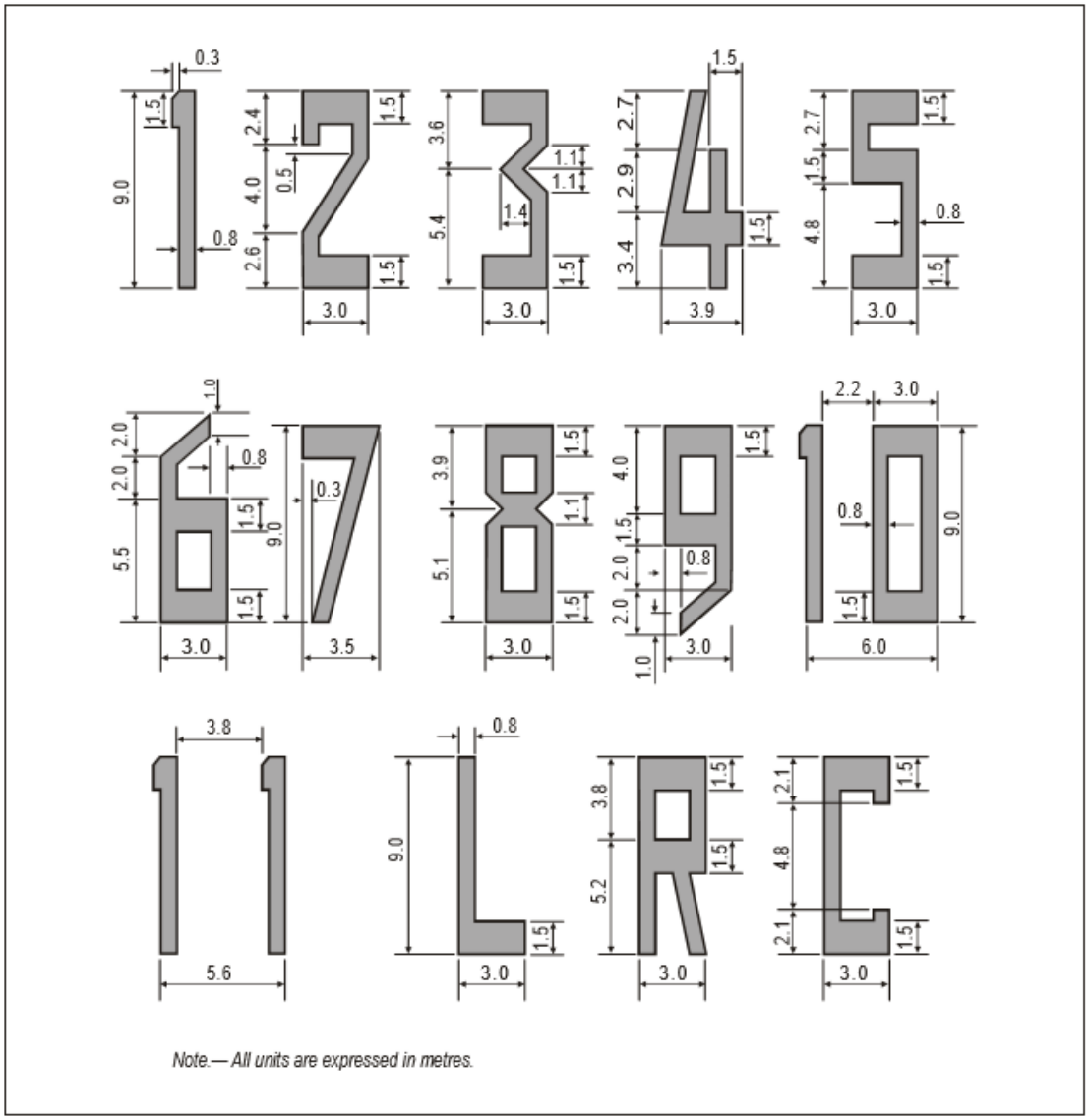


Figure 3 - Form and proportions of numbers and letters for runway designation markings

3.6.7 *Arrows*

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

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

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.

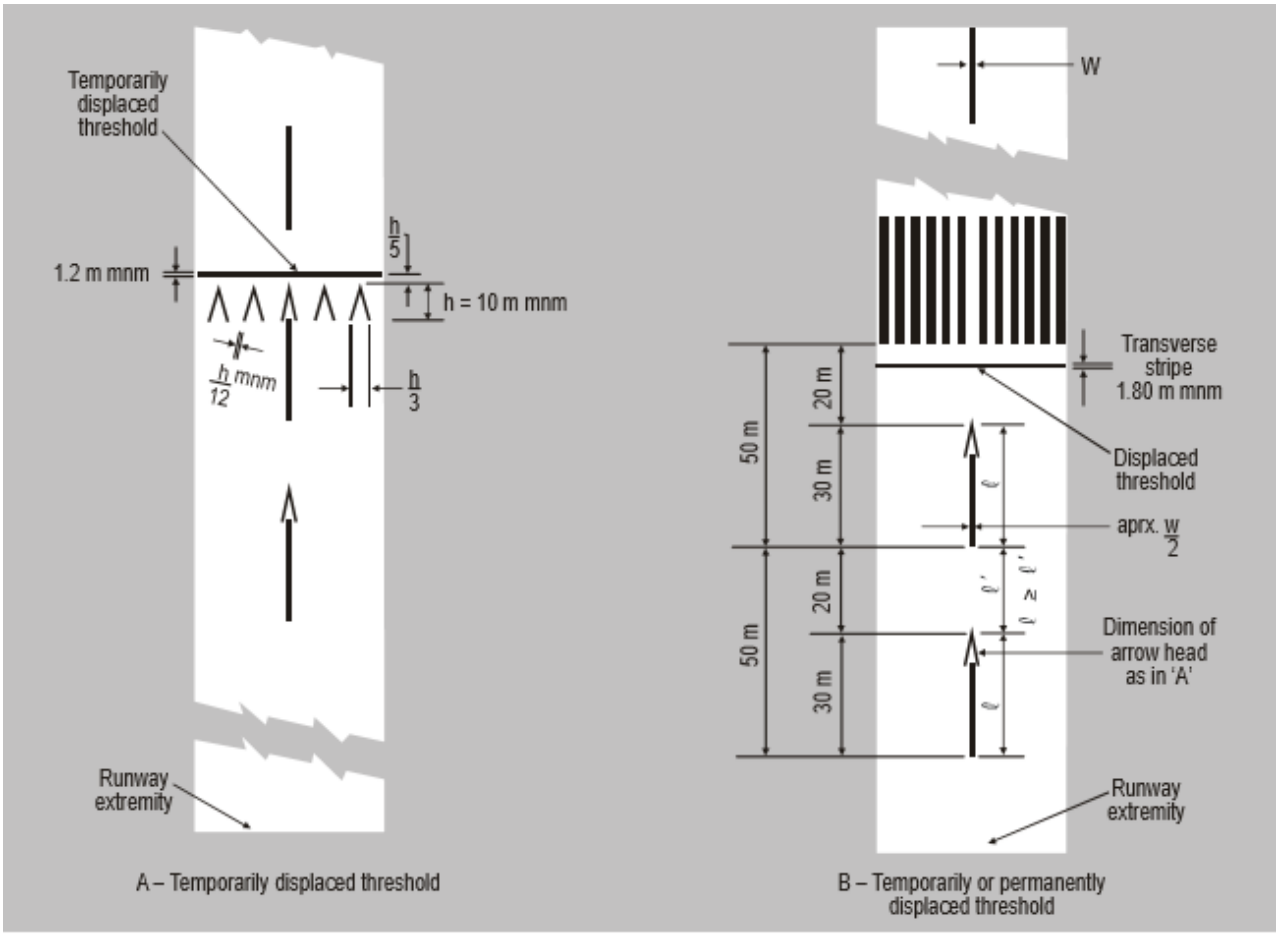


Figure 4 - Displaced threshold markings

3.7 Aiming point marking

3.7.1 An aiming point marking shall be provided at each approach end of a paved instrument runway where the code number is 2, 3 or 4.

3.7.2 An aiming point marking *should* 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.

3.7.3 The aiming point marking shall commence no closer to the threshold than the distance indicated in the appropriate column of Table 1, except that, on a runway equipped with a visual approach slope indicator system, the beginning of the marking shall be coincident with the visual approach slope origin.

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

3.8 Touchdown zone marking

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

3.8.2 A touchdown zone marking *should* 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.

Table 1 - Location and dimensions of aiming point marking

Location and dimensions (1)	Landing distance available			
	Less than 800m (2)	800m up to but not including 1200m (3)	1200m up to but not including 2400m (4)	2400m and above (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 sides of stripes	6m [c]	9m [c]	18-22.5m	18-22.5m

[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.

3.8.3 A touchdown zone marking shall 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 900m	1
900m up to but not including 1200m	2
1200m up to but not including 1500m	3
1500m up to but not including 2400m	4
2400m or more	6

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

3.8.5 On a non-precision approach runway where the code number is 2, an additional pair of touchdown zone marking stripes *should* be provided 150m beyond the beginning of the aiming point marking.

3.9 Runway side stripe marking

3.9.1 A runway side stripe marking shall be provided between the thresholds of a paved runway where there is a lack of contrast between the runway edges and the *should*ers or the surrounding terrain.

3.9.2 A runway side stripe marking *should* be provided on a precision approach runway irrespective of the contrast between the runway edges and the *should*ers or the surrounding terrain.

3.9.3 A runway side stripe marking *should* consist of two stripes, one placed along each edge of the runway with the outer edge of each stripe approximately on the edge of the runway, except that, where the runway is greater than 60m in width, the stripes *should* be located 30m from the runway centre line.

3.9.4 Where a runway turn pad is provided, the runway side stripe marking *should* be continued between the runway and the runway turn pad.

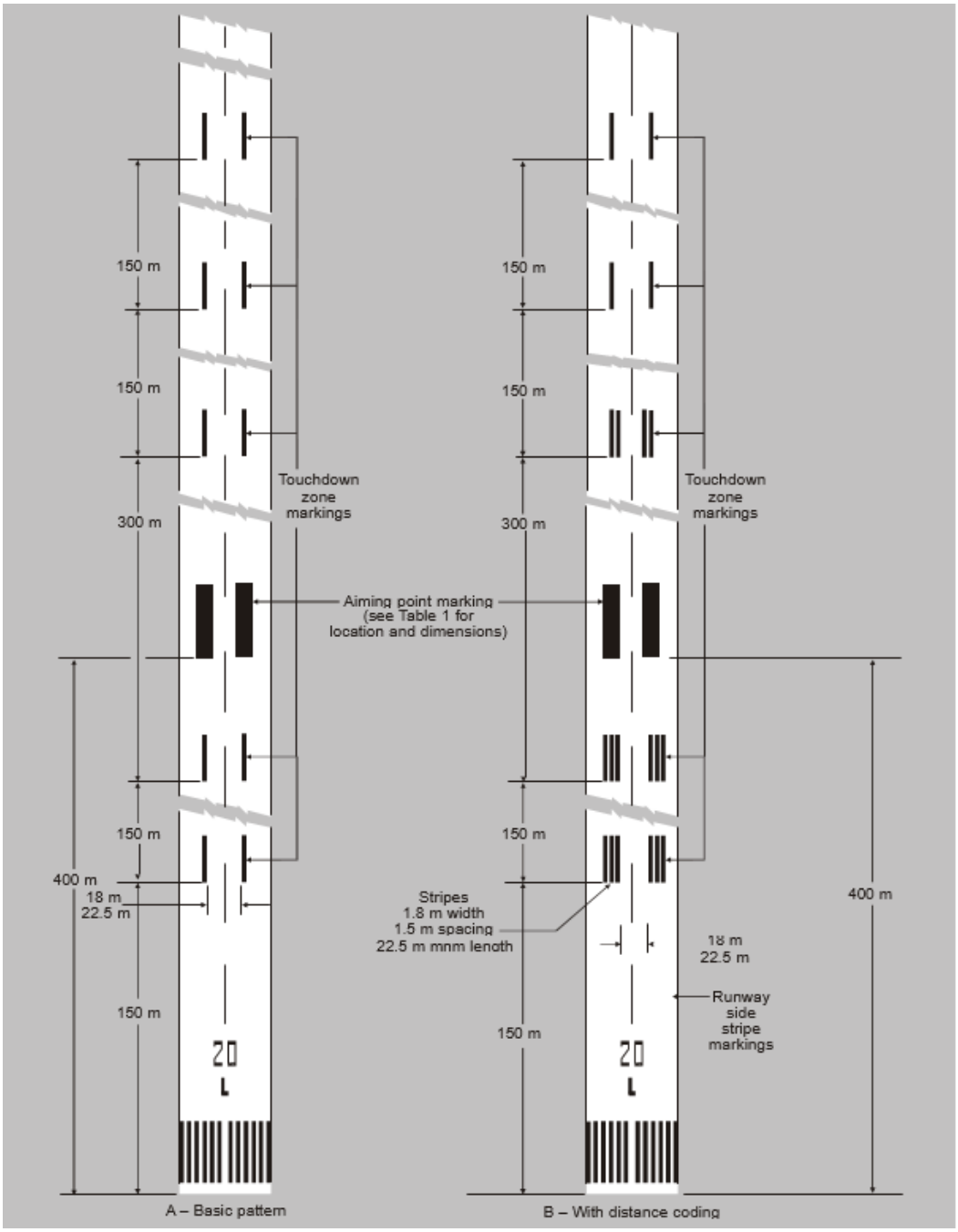


Figure 5 - Aiming point and touchdown zone markings

(Illustrated for a runway with a length of 2 400 m or more)

3.9.5 A runway side stripe *should* have an overall width of at least 0.9m on runways 30m or more in width and at least 0.45m on narrower runways.

3.10 Taxiway centre line marking

3.10.1 Taxiway centre line marking shall 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.

3.10.2 Taxiway centre line marking *should* be provided on a paved taxiway and apron where the code number is 1 or 2 in such a way as to provide continuous guidance between the runway centre line and aircraft stands.

3.10.3 Taxiway centre line marking shall 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.

3.10.4 Where it is necessary to denote the proximity of a runway-holding position, enhanced taxiway centre line marking *should* be provided.

Note. — The provision of enhanced taxiway centre line marking may form part of runway incursion prevention measures.

3.10.5 Where provided, enhanced taxiway centre line marking shall be installed at each taxiway/runway intersection.

3.10.6 On a straight section of a taxiway the taxiway centre line marking *should* be located along the taxiway centre line. On a taxiway curve the marking *should* continue from the straight portion of the taxiway at a constant distance from the outside edge of the curve.

3.10.7 At an intersection of a taxiway with a runway where the taxiway serves as an exit from the runway, the taxiway centre line marking *should* be curved into the runway centre line marking as shown in Figures 6 and 25. The taxiway centre line marking *should* be extended parallel to the runway centre line marking for a distance of at least 60m beyond the point of tangency where the code number is 3 or 4, and for a distance of at least 30m where the code number is 1 or 2.

3.10.8 Where taxiway centre line marking is provided on a runway in accordance with 3.10.3, the marking *should* be located on the centre line of the designated taxiway.

3.10.9 Where provided:

(a) An enhanced taxiway centre line marking shall extend from the runway-holding position Pattern A (as defined in Figure 6, Taxiway markings) to a distance of up to 47m in the direction of travel away from the runway. See Figure 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 47m of the first runway-holding position marking the enhanced taxiway centre line marking shall be interrupted 0.9m prior to and after the intersected runway-holding position marking. The enhanced taxiway centre line marking shall continue beyond the intersected runway-holding position marking for at least three dashed line segments or 47m from start to finish, whichever is greater. See Figure 7 (b).

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

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

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

3.10.10 A taxiway centre line marking shall be at least 15cm 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 6.

3.10.11 Enhanced taxiway centre line marking shall be as shown in Figure 7.

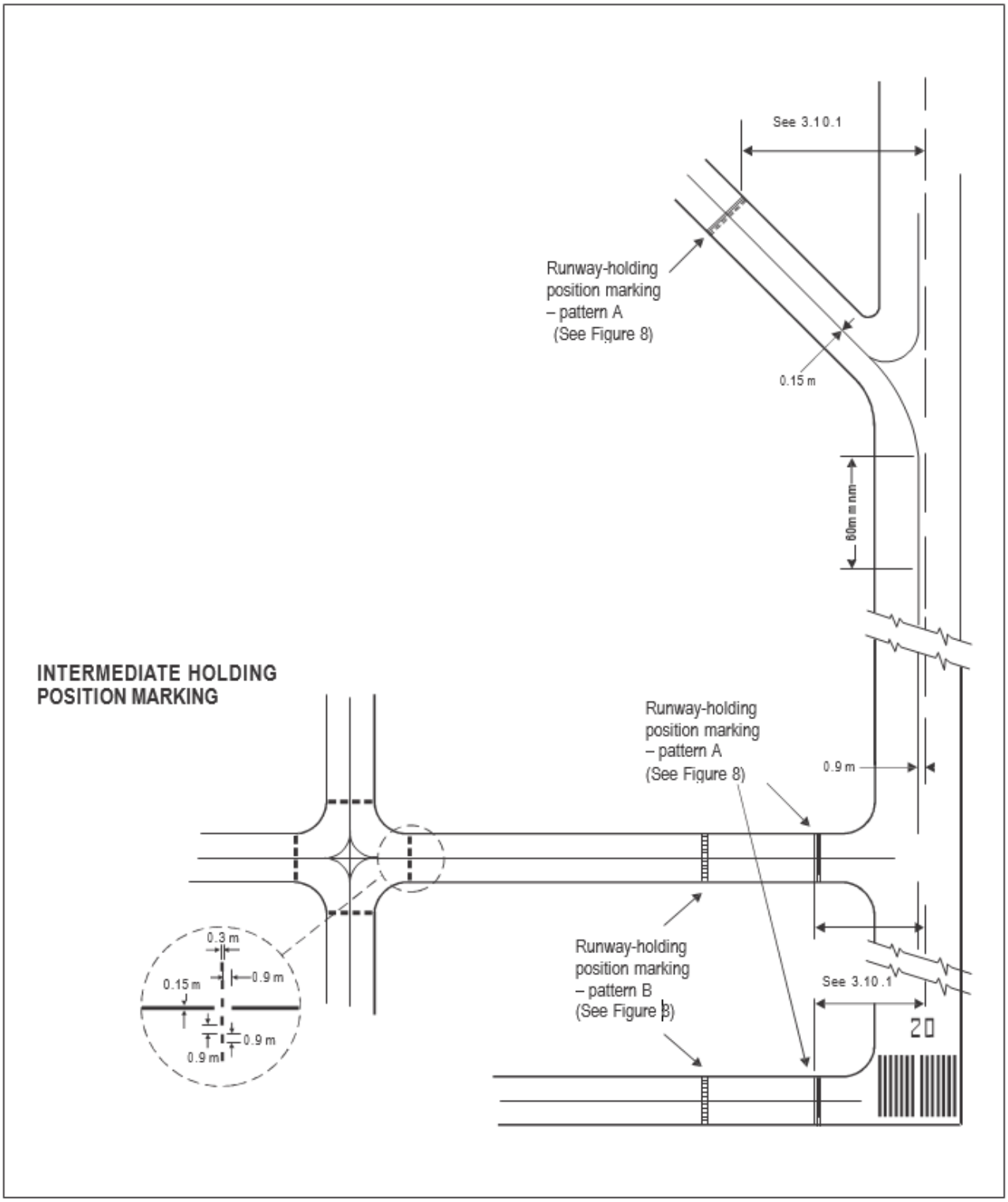


Figure 6 - Taxiway markings (shown with basic runway markings)

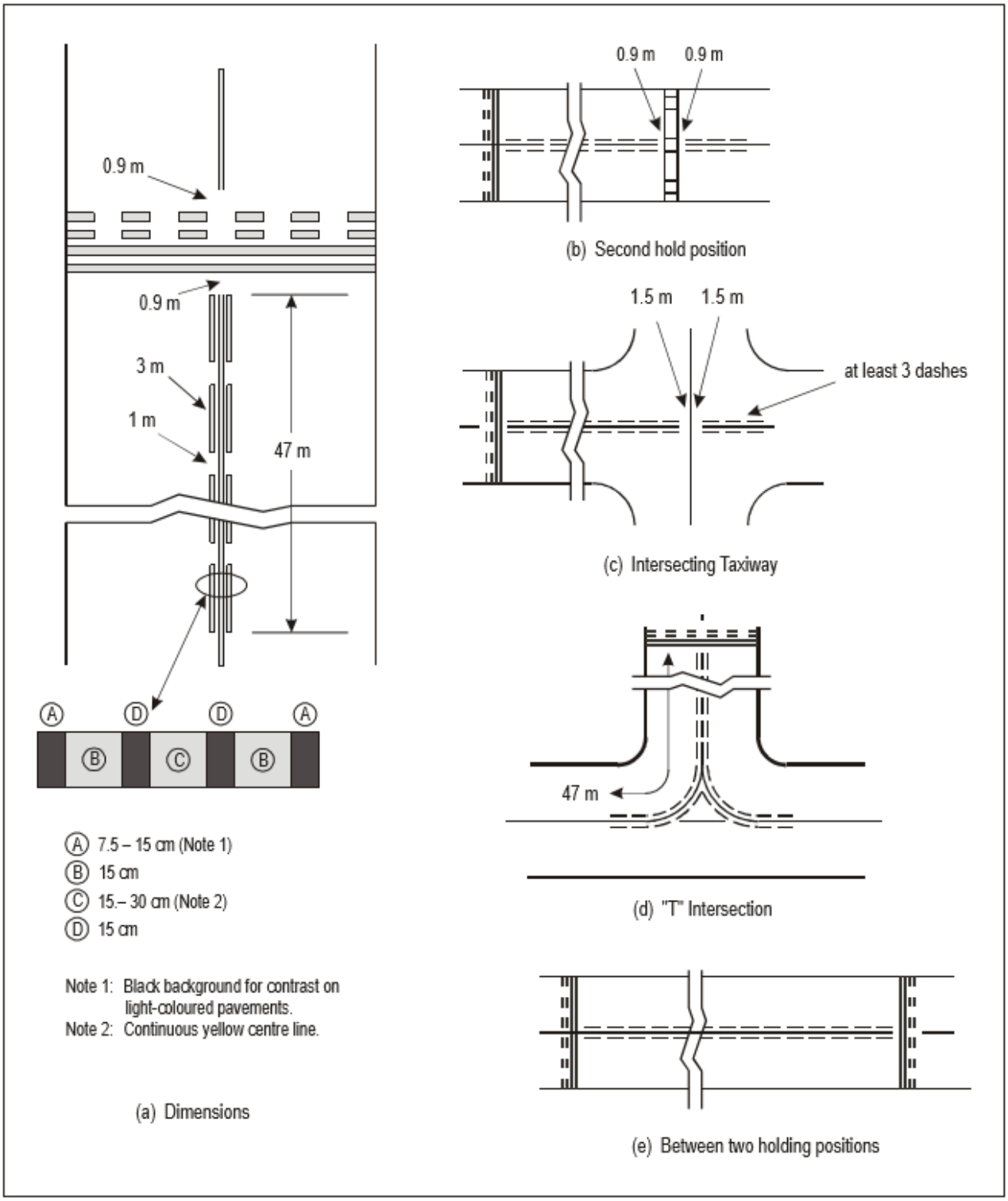


Figure 7 -Enhanced taxiway centre line marking

3.11 Runway turn pad marking

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

3.11.2 The runway turn pad marking *should* be curved from the runway centre line into the turn pad. The radius of the curve *should* be compatible with the manoeuvring capability and normal taxiing speeds of the aeroplanes for which the runway turn pad is intended. The intersection angle of the runway turn pad marking with the runway centre line *should* not be greater than 30 degrees.

3.11.3 The runway turn pad marking *should* be extended parallel to the runway centre line marking for a distance of at least 60m beyond the point of tangency where the code number is 3 or 4, and for a distance of at least 30m where the code number is 1 or 2.

3.11.4 A runway turn pad marking *should* guide the aeroplane in such a way as to allow a straight portion of taxiing before the point where a 180-degree turn is to be made. The straight portion of the runway turn pad marking *should* be parallel to the outer edge of the runway turn pad.

3.11.5 The design of the curve allowing the aeroplane to negotiate a 180-degree turn *should* be based on a nose wheel steering angle not exceeding 45 degrees.

3.11.6 The design of the turn pad marking *should* be such that, when the cockpit of the aeroplane remains over the runway turn pad marking, the clearance distance between any wheel of the aeroplane landing gear and the edge of the runway turn pad *should* be not less than those specified in SD-AD Appendix 2, 2.11.6.

Note. — For ease of manoeuvring, consideration may be given to providing a larger wheel-to-edge clearance for codes E and F aeroplanes. See SD-AD Appendix 2 section 2.11.7.

3.11.7 A runway turn pad marking shall be at least 15 cm in width and continuous in length.

3.12 Runway-holding position marking

3.12.1 A runway-holding position marking shall be displayed along a runway-holding position.

3.12.2 At an intersection of a taxiway and a non-instrument, non-precision approach or take-off runway, the runway- holding position marking shall be as shown in Figure 6, pattern A.

3.12.3 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 shall be as shown in Figure 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 shall be as shown in Figure 6, pattern A and the markings farther from the runway shall be as shown in Figure 6, pattern B.

3.12.4 The runway-holding position marking displayed at a runway-holding position established in accordance with SD-AD Appendix 3, 10.3 shall be as shown in Figure 6, pattern A.

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

3.12.6 From 26 November 2026, the dimensions of runway-holding position markings shall be as shown in Figure 8, pattern A2 or pattern B2, as appropriate.

3.12.7 Where increased conspicuity of the runway-holding position is required, the dimensions of runway-holding position marking *should* be as shown in Figure 8, pattern A2 or pattern B2, as appropriate.

Note. — An increased conspicuity of the runway-holding position can be required, notably to avoid incursion risks

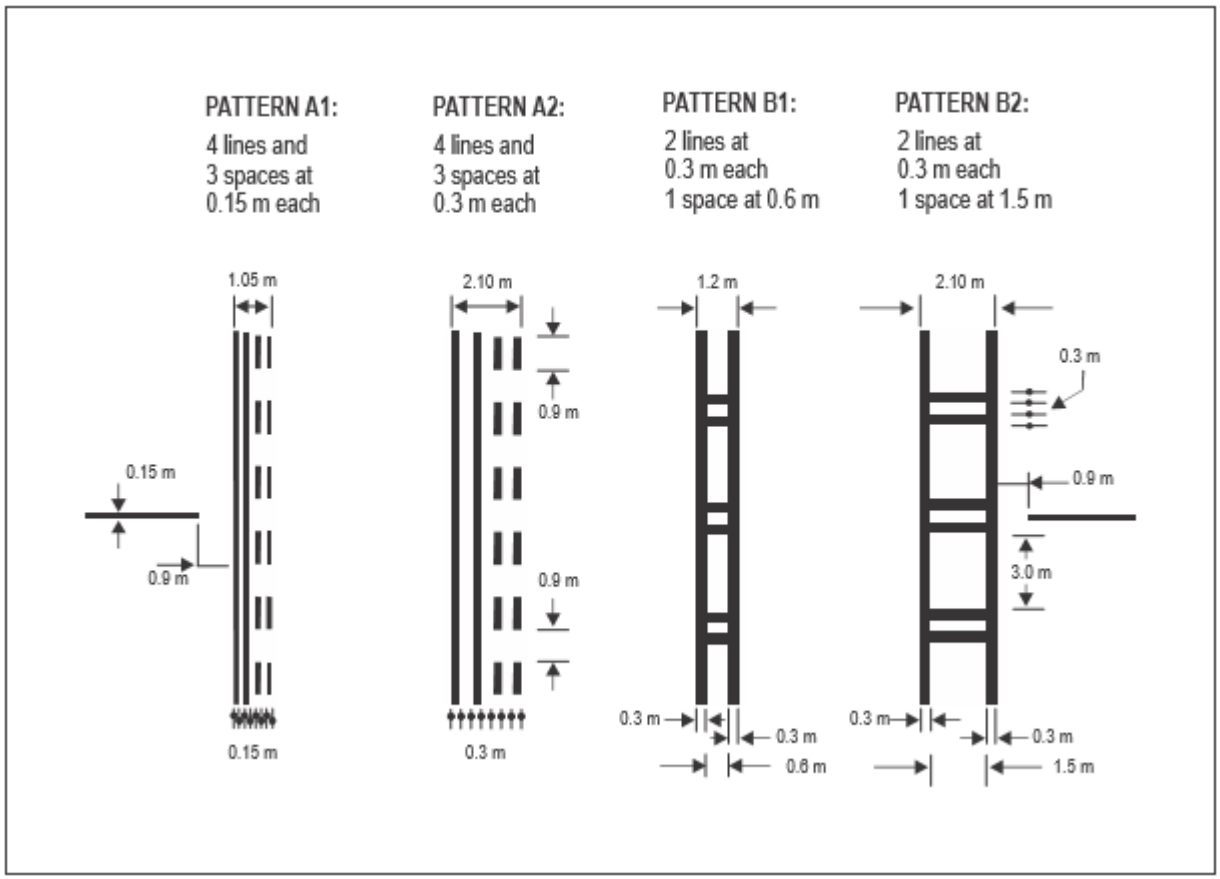


Figure 8 - Runway-holding position markings

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

3.12.8 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 *should* be marked on the surface at the ends of the runway-holding position marking and at equal intervals of 45m maximum between successive marks. The letters *should* be not less than 1.8m high and *should* be placed not more than 0.9m beyond the holding position marking.

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

3.13 Intermediate holding position marking

3.13.1 An intermediate holding position marking *should* be displayed along an intermediate holding position.

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

3.13.3 An intermediate holding position marking shall consist of a single broken line as shown in Figure 6.

3.14 VOR aerodrome checkpoint marking

3.14.1 When a VOR aerodrome checkpoint is established, it shall be indicated by a VOR aerodrome checkpoint marking and sign.

Note. — Guidance on the selection of sites for VOR aerodrome checkpoints is given in Annex 10, Volume I, Attachment E.

3.14.2 A VOR aerodrome checkpoint marking shall be centred on the spot at which an aircraft is to be parked to receive the correct VOR signal.

3.14.3 A VOR aerodrome checkpoint marking shall consist of a circle 6 m in diameter and have a line width of 15cm (see Figure 9 (A)).

3.14.4 When it is preferable for an aircraft to be aligned in a specific direction, a line *should* be provided that passes through the centre of the circle on the desired azimuth. The line *should* extend 6 m outside the circle in the desired direction of heading and terminate in an arrowhead. The width of the line *should* be 15cm (see Figure 9 (B)).

3.14.5 A VOR aerodrome checkpoint marking *should* preferably be white in colour but *should* differ from the colour used for the taxiway markings.

Note. — To provide contrast, markings may be bordered with black.

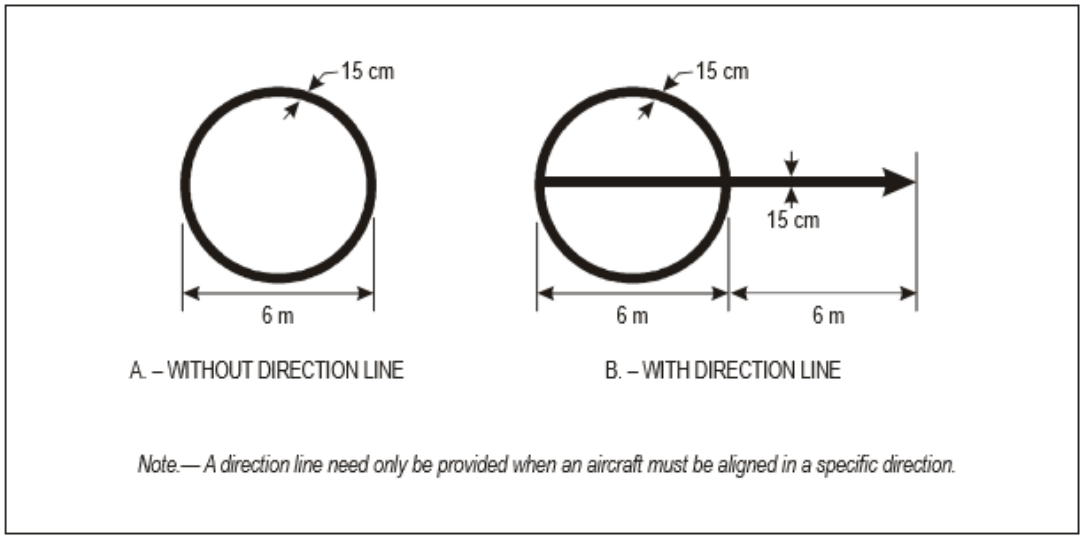


Figure 9 -VOR aerodrome checkpoint marking

3.15 Aircraft stand marking

Note. — Guidance on the layout of aircraft stand markings is contained in the Aerodrome Design Manual (Doc 9157), Part 4.

3.15.1 Aircraft stand markings *should* be provided for designated parking positions on a paved apron.

3.15.2 Aircraft stand markings on a paved apron *should* be located so as to provide the clearances specified in SD-AD Appendix 3, 11.6 when the nose wheel follows the stand marking.

3.15.3 Aircraft stand markings *should* include such elements as stand identification, lead-in line, turn bar, turning line, alignment bar, stop line and lead-out line, as are required by the parking configuration and to complement other parking aids.

3.15.4 An aircraft stand identification (letter and/or number) *should* be included in the lead-in line a short distance after the beginning of the lead-in line. The height of the identification *should* be adequate to be readable from the cockpit of aircraft using the stand.

3.15.5 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 *should* be followed, or safety would be impaired if the wrong marking was followed, then identification of the aircraft for which each set of markings is intended *should* be added to the stand identification.

Note. — Example: 2A-B747, 2B-F28.

3.15.6 Lead-in, turning and lead-out lines *should* normally be continuous in length and have a width of not less than 15 cm. Where one or more sets of stand markings are superimposed on a stand marking, the lines *should* be continuous for the most demanding aircraft and broken for other aircraft.

3.15.7 The curved portions of lead-in, turning and lead-out lines *should* have radii appropriate to the most demanding aircraft type for which the markings are intended.

3.15.8 Where it is intended that an aircraft proceed in one direction only, arrows pointing in the direction to be followed *should* be added as part of the lead-in and lead-out lines.

3.15.9 A turn bar *should* be located at right angles to the lead-in line, abeam the left pilot position at the point of initiation of any intended turn. It *should* have a length and width of not less than 6 m and 15 cm, respectively, and include an arrowhead to indicate the direction of turn.

Note. — The distances to be maintained between the turn bar and the lead-in line may vary according to different aircraft types, taking into account the pilot's field of view.

3.15.10 If more than one turn bar and/or stop line is required, they *should* be coded.

3.15.11 An alignment bar *should* be placed so as to be coincident with the extended centre line of the aircraft in the specified parking position and visible to the pilot during the final part of the parking manoeuvre. It *should* have a width of not less than 15cm.

3.15.12 A stop line *should* be located at right angles to the alignment bar, abeam the left pilot position at the intended point of stop. It *should* have a length and width of not less than 6m and 15cm, respectively.

Note. — The distances to be maintained between the stop line and the lead-in line may vary according to different aircraft types, taking into account the pilot's field of view.

3.16 Apron safety lines

3.16.1 Apron safety lines *should* be provided on a paved apron as required by the parking configurations and ground facilities.

3.16.2 Apron safety lines shall 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.

3.16.3 Apron safety lines *should* include such elements as wing tip clearance lines and service road boundary lines as required by the parking configurations and ground facilities.

3.16.4 An apron safety line *should* be continuous in length and at least 10cm in width.

Note. — Guidance on apron safety lines is contained in the Aerodrome Design Manual (Doc 9157), Part 4.

3.17 Road-holding position marking

3.17.1 A road-holding position marking shall be provided at all road entrances to a runway.

3.17.2 The road-holding position marking shall be located across the road at the holding position.

3.17.3 The road-holding position marking shall be in accordance with the local road traffic regulations.

3.18 Mandatory instruction marking

3.18.1 Where it is impracticable to install a mandatory instruction sign in accordance with this appendix, a mandatory instruction marking shall be provided on the surface of the pavement.

Note. — Guidance on mandatory instruction marking is given in the Aerodrome Design Manual (Doc 9157), Part 4

3.18.2 Where operationally required, such as on taxiways exceeding 60m in width, or to assist in the prevention of a runway incursion, a mandatory instruction sign *should* be supplemented by a mandatory instruction marking.

3.18.3 The mandatory instruction marking on taxiways where the code letter is A, B, C or D shall 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 10 (A). The distance between the nearest edge of the marking and the runway-holding position marking or the taxiway centre line marking shall be not less than 1m.

3.18.4 The mandatory instruction marking on taxiways where the code letter is E or F shall 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 10 (B). The distance between the nearest edge of the marking and the runway-holding position marking or the taxiway centre line marking shall be not less than 1m.

3.18.5 Except where operationally required, a mandatory instruction marking *should* not be located on a runway.

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

3.18.7 A NO ENTRY marking shall consist of an inscription in white reading NO ENTRY on a red background.

3.18.8 Where there is insufficient contrast between the marking and the pavement surface, the mandatory instruction marking shall include an appropriate border, preferably white or black.

3.18.9 The character height *should* be 4m for inscriptions where the code letter is C, D, E or F, and 2m where the code letter is A or B. The inscriptions *should* be in the form and proportions shown in *Annex 14 Appendix 3*.

3.18.10 The background *should* be rectangular and extend a minimum of 0.5m laterally and vertically beyond the extremities of the inscription.

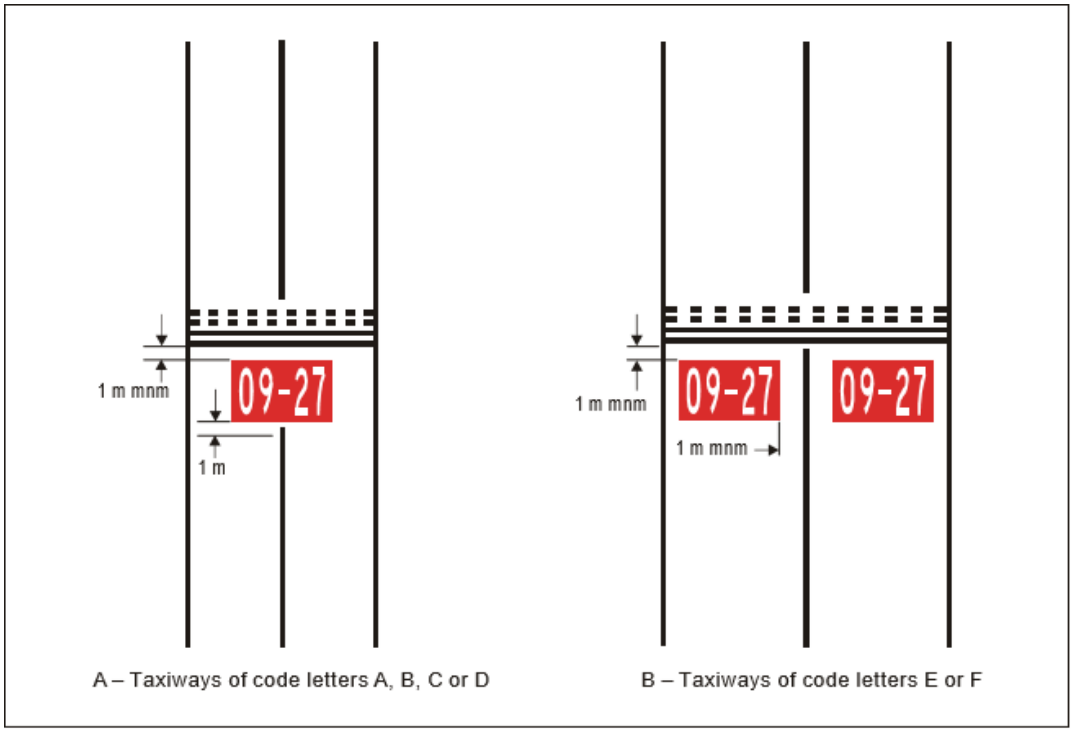


Figure 10 - Mandatory instruction marking

3.19 Information marking

Note. — Guidance on information marking is contained in the Aerodrome Design Manual (Doc 9157), Part 4.

3.19.1 Where an information sign would normally be installed and is impractical to install, as determined by the appropriate authority, an information marking shall be displayed on the surface of the pavement.

3.19.2 Where operationally required an information sign *should* be supplemented by an information marking.

3.19.3 An information (location/direction) marking *should* be displayed prior to and following complex taxiway intersections and where operational experience has indicated the addition of a taxiway location marking could assist flight crew ground navigation.

3.19.4 An information (location) marking *should* be displayed on the pavement surface at regular intervals along taxiways of great length.

3.19.5 The information marking *should* be displayed across the surface of the taxiway or apron where necessary and positioned so as to be legible from the cockpit of an approaching aircraft.

3.19.6 An information marking shall 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.

3.19.7 Where there is insufficient contrast between the marking background and the pavement surface, the marking shall include:

(a) a black border where the inscriptions are in black; and
(b) a yellow border where the inscriptions are in yellow.

3.19.8 The character height *should* be 4m. The inscriptions *should* be in the form and proportions shown in *Annex 14 Appendix 3.*

4.0 Lights

4.1 Lights which may endanger the safety of aircraft

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

4.2 Laser emissions which may endanger the safety of aircraft

4.2.1 To protect the safety of aircraft against the hazardous effects of laser emitters, the following protected zones shall be established around aerodromes:

(a) a laser-beam free flight zone (LFFZ)
(b) a laser-beam critical flight zone (LCFZ)
(c) a laser-beam sensitive flight zone (LSFZ).

Note 1. — Figures 11, 12 and 13 may be used to determine the exposure levels and distances that adequately protect flight operations.

Note 2. — The restrictions on the use of laser beams in the three protected flight zones, LFFZ, LCFZ and LSFZ, refer to visible laser beams only. Laser emitters operated by the authorities in a manner compatible with flight safety are excluded. In all navigable airspace, the irradiance level of any laser beam, visible or invisible, is expected to be less than or equal to the maximum permissible exposure (MPE) unless such emission has been notified to the authority and permission obtained.

Note 3. — The protected flight zones are established in order to mitigate the risk of operating laser emitters in the vicinity of aerodromes.

Note 4. — Further guidance on how to protect flight operations from the hazardous effects of laser emitters is contained in the Manual on Laser Emitters and Flight Safety (Doc 9815).

Note 5. — See also Annex 11 — Air Traffic Services, Chapter 2.

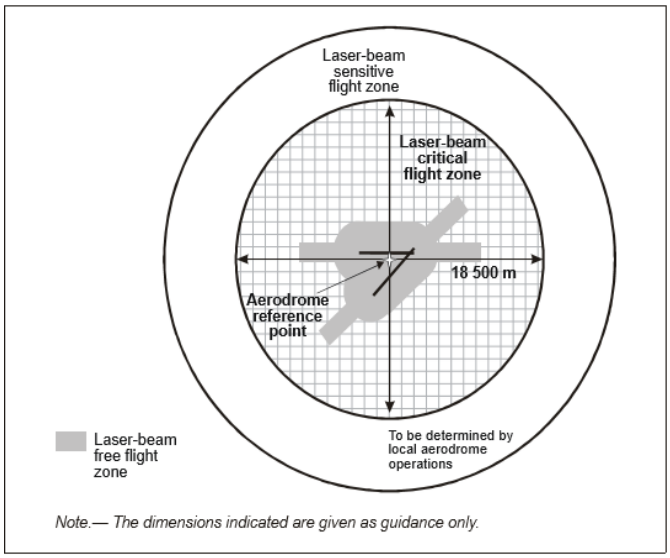


Figure 11 - ***Protected flight zones***

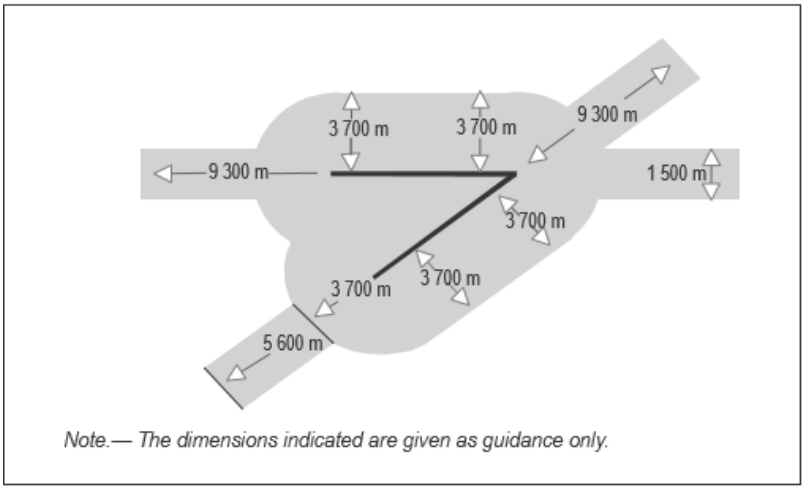


Figure 12 - ***Multiple runway laser-beam free flight zone***

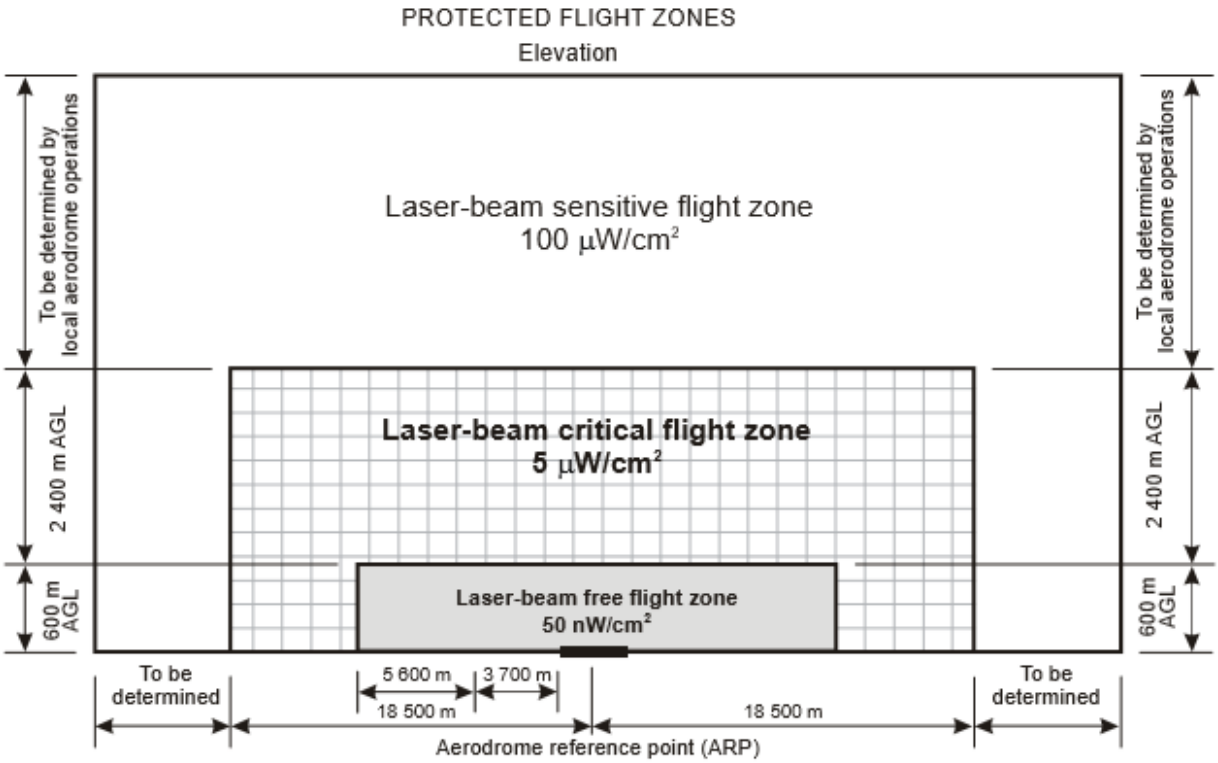


Figure 13 - ***Protected flight zones with indication of maximum irradiance levels for visible laser beams***

4.3 Lights which may cause confusion

4.3.1 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, shall be extinguished, screened or otherwise modified so as to eliminate such a possibility. In particular, attention shall 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 *should* be at least 3 000 m.

(c) Instrument runway — code number 1 and non-instrument runway:

within the approach area.

4.3.2 Aeronautical ground lights which may cause confusion to mariners are those aeronautical ground lights near navigable waters, therefore, consideration shall be given to ensuring that such lights do not cause confusion to mariners.

4.4 Elevated approach lights

4.4.1 Elevated approach lights and their supporting structures shall be frangible except that, in that portion of the approach lighting system beyond 300m from the threshold:

(a) where the height of a supporting structure exceeds 12m, the frangibility requirement shall apply to the top 12m 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 shall be frangible.

4.4.2 When an approach light fixture or supporting structure is not in itself sufficiently conspicuous, it shall be suitably marked.

4.5 Elevated lights

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

4.6 Surface lights

4.6.1 Light fixtures inset in the surface of runways, stopways, taxiways and aprons shall 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.

4.6.2 The temperature produced by conduction or radiation at the interface between an installed inset light and an aircraft tire *should* not exceed 160°C during a 10-minute period of exposure.

Note. — Guidance on measuring the temperature of inset lights is given in the Aerodrome Design Manual (Doc 9157), Part 4.

4.7 Light intensity and control

Note. — In dusk or poor visibility conditions by day, lighting can be more effective than marking. For lights to be effective in such conditions or in poor visibility by night, they must be of adequate intensity. To obtain the required intensity, it will usually be necessary to make the light directional, in which case the arcs over which the light shows will have to be adequate and so orientated as to meet the operational requirements. The runway lighting system will have to be considered as a whole, to ensure that the relative light intensities are suitably matched to the same end. (See Attachment A, Section 16, and the Aerodrome Design Manual (Doc 9157), Part 4).

4.7.1 The intensity of runway lighting shall 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.

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.

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

a) approach lighting system;
b) runway edge lights;
c) runway threshold lights;
d) runway end lights;
e) runway centre line lights;
f) runway touchdown zone lights; and
g) taxiway centre line lights.

4.7.3 On the perimeter of and within the ellipse defining the main beam in *Annex 14 Appendix 2, Figures A2-1 to A2-10,* the maximum light intensity value shall not be greater than three times the minimum light intensity value measured in accordance with *Annex 14 Appendix 2, collective notes for Figures A2-1 to A2-11 and A2-26, Note 2.*

4.7.4 On the perimeter of and within the rectangle defining the main beam in *Annex 14 Appendix 2, Figures A2-12 to A2-20*, the maximum light intensity value shall not be greater than three times the minimum light intensity value measured in accordance with *Annex 14 Appendix 2*, collective notes for *Figures A2-12 to A2-21, Note 2*.

4.8 Emergency lighting

4.8.1 At aerodromes with runway lighting and without a secondary power supply, sufficient emergency lights *should* be conveniently available for installation on at least the primary runway in the event of failure of the normal lighting system.

Note. — Emergency lighting may also be useful to mark obstacles or delineate taxiways and apron areas.

4.8.2 When installed on a runway the emergency lights *should*, as a minimum, conform to the configuration required for a non-instrument runway.

4.8.3 The colour of the emergency lights *should* conform to the colour requirements for runway lighting, except that, where the provision of coloured lights at the threshold and the runway end is not practicable, all lights may be variable white or as close to variable white as practicable

4.9 Aeronautical beacons

4.9.1 Where operationally necessary an aerodrome beacon or an identification beacon shall be provided at each aerodrome intended for use at night.

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

Aerodrome beacon

4.9.3 An aerodrome beacon shall 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.

4.9.4 The aerodrome beacon shall be located on or adjacent to the aerodrome in an area of low ambient background lighting.

4.9.5 The location of the beacon shall be such that the beacon is not shielded by objects in significant directions and does not dazzle a pilot approaching to land.

4.9.6 The aerodrome beacon shall show either coloured flashes alternating with white flashes, or white flashes only. The frequency of total flashes shall be from 20 to 30 per minute. Where used, the coloured flashes emitted by beacons at land aerodromes shall be green, and coloured flashes emitted by beacons at water aerodromes shall be yellow. In the case of a combined water and land aerodrome, coloured flashes, if used, shall have the colour characteristics of whichever section of the aerodrome is designated as the principal facility.

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

Note. — At locations where a high ambient background lighting level cannot be avoided, the effective intensity of the flash may be required to be increased by a factor up to a value of 10.

Identification beacon

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

4.9.9 The identification beacon shall be located on the aerodrome in an area of low ambient background lighting.

4.9.10 The location of the beacon *should* be such that the beacon is not shielded by objects in significant directions and does not dazzle a pilot approaching to land.

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

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.

4.9.12 An identification beacon shall show flashing-green at a land aerodrome and flashing-yellow at a water aerodrome.

4.9.13 The identification characters shall be transmitted in the International Morse Code.

4.9.14 The speed of transmission *should* be between six and eight words per minute, the corresponding range of duration of the Morse dots being from 0.15 to 0.2 seconds per dot.

4.10 Approach lighting systems

4.10.1 Application

A.— Non-instrument runway

Where physically practicable, a simple approach lighting system as specified in section 4.10.2 to 4.10.9 below *should* be provided to serve a non-instrument runway where the code number is 3 or 4 and intended for use at night, except when the runway is used only in conditions of good visibility and sufficient guidance is provided by other visual aids.

Note. — A simple approach lighting system can also provide visual guidance by day.

B.— Non-precision approach runway

Where physically practicable, a simple approach lighting system as specified in section 4.10.2 to 4.10.9 below shall 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.

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 section 4.10.10 to 4.10.21 below shall 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 specified in section 4.10.22 – 4.10.39 shall be provided to serve a precision approach runway category II or III.

Simple approach lighting system

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

4.10.3 The lights forming the crossbar shall 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 shall be spaced so as to produce a linear effect, except that, when a crossbar of 30m is used, gaps may be left on each side of the centre line. These gaps shall be kept to a minimum to meet local requirements and each shall not exceed 6m.

Note 1. — Spacings for the crossbar lights between 1 m and 4 m are in use. Gaps on each side of the centre line may improve directional guidance when approaches are made with a lateral error and facilitate the movement of rescue and firefighting vehicles.

Note 2. — See Annex 14 Attachment A, Section 12, for guidance on installation tolerances.

4.10.4 The lights forming the centre line shall 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 shall be located either 60m or 30m from the threshold, depending on the longitudinal interval selected for the centre line lights.

4.10.5 If it is not physically possible to provide a centre line extending for a distance of 420m from the threshold, it *should* be extended to 300m so as to include the crossbar. If this is not possible, the centre line lights *should* be extended as far as practicable, and each centre line light *should* then consist of a barrette at least 3m in length. Subject to the approach system having a crossbar at 300m from the threshold, an additional crossbar may be provided at 150m from the threshold.

4.10.6 The system shall 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 shall 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) shall be screened from an approaching aircraft.

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

4.10.7 The lights of a simple approach lighting system shall be fixed lights and the colour of the lights shall 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 shall consist of either:

(a) a single source; or
(b) a barrette at least 3m in length.

Note 1. — When the barrette as in b) is composed of lights approximating to point sources, a spacing of 1.5 m between adjacent lights in the barrette has been found satisfactory.

Note 2. — It may be advisable to use barrettes 4m in length if it is anticipated that the simple approach lighting system will be developed into a precision approach lighting system.

Note 3. — At locations where identification of the simple approach lighting system is difficult at night due to surrounding lights, sequence flashing lights installed in the outer portion of the system may resolve this problem.

4.10.8 Where provided for a non-instrument runway, the lights *should* show at all angles in azimuth necessary to a pilot on base leg and final approach. The intensity of the lights *should* be adequate for all conditions of visibility and ambient light for which the system has been provided.

4.10.9 Where provided for a non-precision approach runway, the lights *should* show at all angles in azimuth necessary to the pilot of an aircraft which on final approach does not deviate by an abnormal amount from the path defined by the non-visual aid. The lights *should* be designed to provide guidance during both day and night in the most adverse conditions of visibility and ambient light for which it is intended that the system *should* remain usable.

Precision approach category I lighting system

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

Note. — The installation of an approach lighting system of less than 900 m in length may result in operational limitations on the use of the runway. See Annex 14 Attachment A, Section 12.

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

Note 1. — Spacings for the crossbar lights between 1m and 4m are in use. Gaps on each side of the centre line may improve directional guidance when approaches are made with a lateral error and facilitate the movement of rescue and firefighting vehicles.

Note 2. — See Annex 14 Attachment A, Section 12, for guidance on installation tolerances.

4.10.12 The lights forming the centre line shall be placed at longitudinal intervals of 30m with the innermost light located 30m from the threshold.

4.10.13 The system shall 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 shall protrude through the plane of the approach lights within a distance of 60m 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) shall be screened from an approaching aircraft.

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

4.10.14 The centre line and crossbar lights of a precision approach category I lighting system shall be fixed lights showing variable white. Each centre line light position shall consist of either:

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

4.10.15 Where the serviceability level of the approach lights specified as a maintenance objective in Appendix 10 can be demonstrated, each centre line light position may consist of either:

a) a single light source; or
b) a barrette.

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

4.10.17 If the centre line consists of barrettes as described in 4.10.14 b) or 4.10.15 b), each barrette *should* be supplemented by a flashing light, except where such lighting is considered unnecessary taking into account the characteristics of the system and the nature of the meteorological conditions.

4.10.18 Each flashing light as described in 4.10.17 shall 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 shall be such that these lights can be operated independently of the other lights of the approach lighting system.

4.10.19 If the centre line consists of lights as described in 4.10.14 a) or 4.10.15 a), additional crossbars of lights to the crossbar provided at 300m from the threshold shall be provided at 150m, 450m, 600m and 750m from the threshold. The lights forming each crossbar shall 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 shall be spaced so as to produce a linear effect, except that gaps may be left on each side of the centre line. These gaps shall be kept to a minimum to meet local requirements and each shall not exceed 6m.

Note. — See Annex 14 Attachment A, Section 12, for detailed configuration.

4.10.20 Where the additional crossbars described in 4.10.19 are incorporated in the system, the outer ends of the crossbars shall 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.

4.10.21 The lights shall be in accordance with the specifications of *Annex* 14 *Appendix 2, Figure A2-1.*

Note. — The flight path envelopes used in the design of these lights are given in Annex 14 Attachment A, Figure A-6.

Precision approach category II and III lighting system

4.10.22 The approach lighting system shall consist of a row of lights on the extended centre line of the runway, extending, wherever possible, over a distance of 900m from the runway threshold. In addition, the system shall have two side rows of lights, extending 270m from the threshold, and two crossbars, one at 150m and one at 300m from the threshold, all as shown in Figure 14. Where the serviceability level of the approach lights specified as maintenance objectives in Appendix 10 can be demonstrated, the system may have two side rows of lights, extending 240m from the threshold, and two crossbars, one at 150m and one at 300m from the threshold, all as shown in Figure 15.

Note. — The length of 900m is based on providing guidance for operations under category I, II and III conditions. Reduced lengths may support category II and III operations but may impose limitations on category I operations. See Annex 14 Attachment A, Section 12.

4.10.23 The lights forming the centre line shall be placed at longitudinal intervals of 30 m with the innermost lights located 30 m from the threshold.

4.10.24 The lights forming the side rows shall 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 30m from the threshold. Where the serviceability level of the approach lights specified as maintenance objectives in Appendix 10 can be demonstrated, lights forming the side rows may be placed on each side of the centre line, at a longitudinal spacing of 60m with the first light located 60m from the threshold. The lateral spacing (or gauge) between the innermost lights of the side rows shall be not less than 18m nor more than 22.5m, and preferably 18m, but in any event shall be equal to that of the touchdown zone lights.

4.10.25 The crossbar provided at 150m from the threshold shall fill in the gaps between the centre line and side row lights.

4.10.26 The crossbar provided at 300m from the threshold shall extend on both sides of the centre line lights to a distance of 15m from the centre line.

4.10.27 If the centre line beyond a distance of 300m from the threshold consists of lights as described in 4.10.31 b) or 4.10.32 b), additional crossbars of lights shall be provided at 450m, 600m and 750m from the threshold.

4.10.28 Where the additional crossbars described in 4.10.27 are incorporated in the system, the outer ends of these crossbars shall lie on two straight lines that either are parallel to the centre line or converge to meet the runway centre line 300m from the threshold.

4.10.29 The system shall 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 shall protrude through the plane of the approach lights within a distance of 60m 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) shall be screened from an approaching aircraft.

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

4.10.30 The centre line of a precision approach category II and III lighting system for the first 300 m from the threshold shall 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 Appendix 10 can be demonstrated, the centre line of a precision approach category II and III lighting system for the first 300m from the threshold may consist of either:

(a) barrettes, where the centre line beyond 300m from the threshold consists of barrettes as described in 4.10.32 a); or

(b) alternate single light sources and barrettes, where the centre line beyond 300m from the threshold consists of single light sources as described in 4.10.32 b), with the innermost single light source located 30m and the innermost barrette located 60m from the threshold; or

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

all of which shall show variable white.

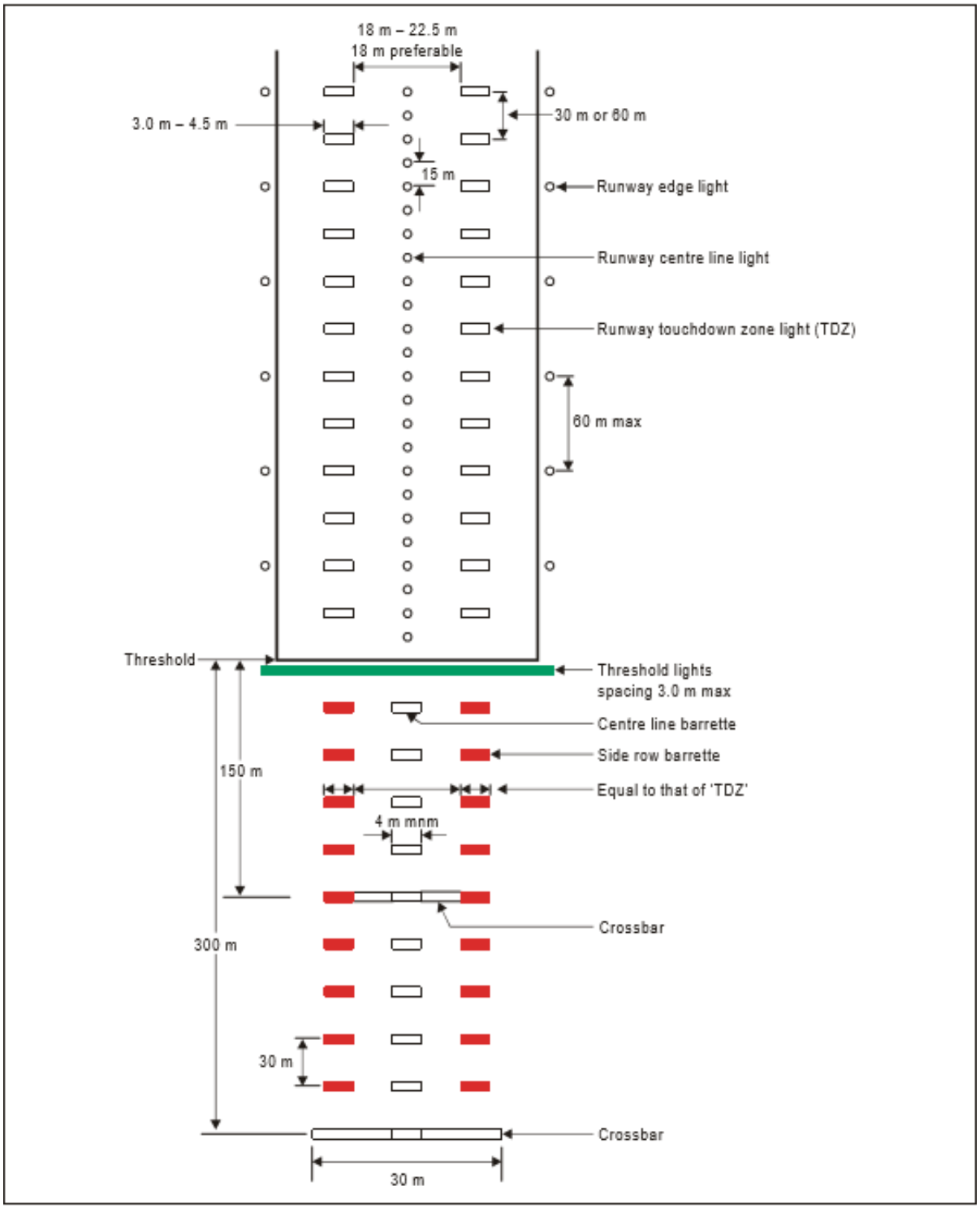


Figure 14 - ***Inner 300m approach and runway lighting for precision approach runways, categories II and III***

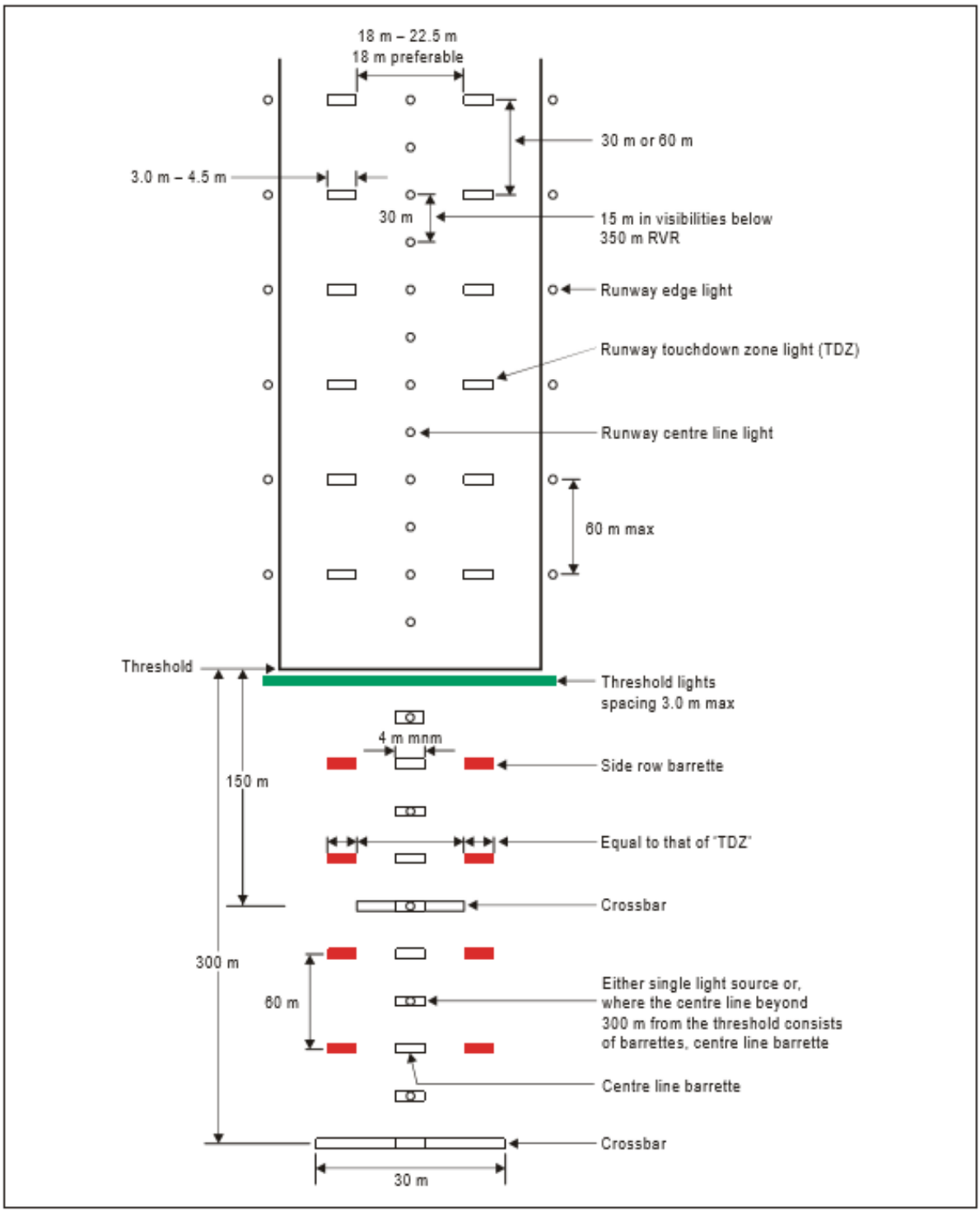


Figure 15 - Inner 300 m approach and runway lighting for precision approach runways, categories II and III, where the serviceability levels of the lights specified as maintenance objectives in SD-AD appendix 10 can be demonstrated

4.10.31 Beyond 300m from the threshold each centre line light position shall consist of either:

a) a barrette as used on the inner 300m; or
b) two light sources in the central 300m of the centre line and three light sources in the outer 300m of the centre line;

all of which shall show variable white.

4.10.32 Where the serviceability level of the approach lights specified as maintenance objectives in Appendix 10 can be demonstrated, beyond 300m from the threshold each centre line light position may consist of either:

a) a barrette; or
b) a single light source;

all of which shall show variable white.

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

4.10.34 If the centre line beyond 300m from the threshold consists of barrettes as described in 4.10.31 a) or 4.10.32 a), each barrette beyond 300m *should* be supplemented by a flashing light, except where such lighting is considered unnecessary taking into account the characteristics of the system and the nature of the meteorological conditions.

4.10.35 Each flashing light as described in 4.10.34 shall 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 shall be such that these lights can be operated independently of the other lights of the approach lighting system.

4.10.36 The side row shall consist of barrettes showing red. The length of a side row barrette and the spacing of its lights shall be equal to those of the touchdown zone light barrettes.

4.10.37 The lights forming the crossbars shall be fixed lights showing variable white. The lights shall be uniformly spaced at intervals of not more than 2.7m.

4.10.38 The intensity of the red lights shall be compatible with the intensity of the white lights.

4.10.39 The lights shall be in accordance with the specifications of *Annex 14 Appendix 2, Figures A2-1 and A2-2.*

Note. — The flight path envelopes used in the design of these lights are given in Annex 14 Attachment A, Figure A-6.

4.11 Visual approach slope indicator systems

4.11.1 A visual approach slope indicator system shall be provided to serve the approach to a runway whether or not the runway is served by 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:

1) 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
2) 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.

Note. — Guidance on the priority of installation of visual approach slope indicator systems is contained in Annex 14 Attachment A, Section 13.

4.11.2 The standard visual approach slope indicator systems shall consist of PAPI and APAPI systems conforming to the specifications contained in this appendix.

4.11.3 PAPI shall be provided where the code number is 3 or 4 when one or more of the conditions specified in 4.11.1 exist.

4.11.4 PAPI or APAPI shall be provided where the code number is 1 or 2 when one or more of the conditions specified in 4.11.1 exist.

4.11.5 Where a runway threshold is temporarily displaced from the normal position and one or more of the conditions specified in 4.11.1 exist, a PAPI *should* be provided except that where the code number is 1 or 2 an APAPI may be provided.

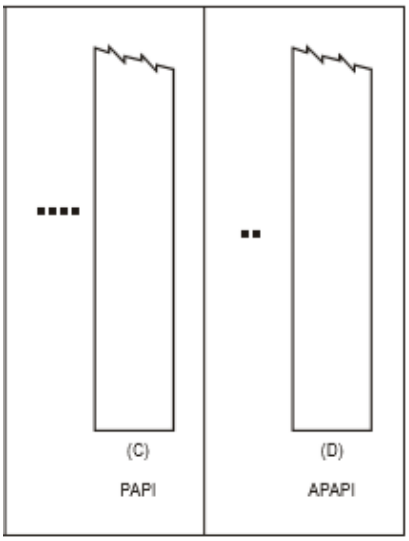


Figure 16 - Visual approach slope indicator systems

PAPI and APAPI

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

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.

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

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.

4.11.8 The wing bar of a PAPI shall 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.

4.11.9 The wing bar of an APAPI shall 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.

4.11.10 The light units shall be located as in the basic configuration illustrated in Figure 17, subject to the installation tolerances given therein. The units forming a wing bar shall be mounted so as to appear to the pilot of an approaching aeroplane to be substantially in a horizontal line. The light units shall be mounted as low as possible and shall be frangible.

4.11.11 The system shall be suitable for both day and night operations.

4.11.12 The colour transition from red to white in the vertical plane shall be such as to appear to an observer, at a distance of not less than 300m, to occur within a vertical angle of not more than 3’.

4.11.13 At full intensity the red light shall have a Y coordinate not exceeding 0.320.

4.11.14 The light intensity distribution of the light units shall be as shown in *Annex 14 Appendix 2, Figure A2-23.*

Note. — refer to the Aerodrome Design Manual (Doc 9157), Part 4, for additional guidance on the characteristics of light units.

4.11.15 Suitable intensity control shall be provided so as to allow adjustment to meet the prevailing conditions and to avoid dazzling the pilot during approach and landing.

4.11.16 Each light unit shall 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.

4.11.17 The light units shall be so designed that deposits of condensation, dirt, etc., on optically transmitting or reflecting surfaces shall interfere to the least possible extent with the light signals and shall not affect the contrast between the red and white signals and the elevation of the transition sector.

4.11.18 PAPI systems should be fed from two independent electrical supplies. This can be achieved by:-
(a) supplying each lamp in the unit from a separate circuit or
(b) placing 2 units side by side at each position, supplied from separate circuits.

Note. — option (b) has the advantages of increased range and one unit can be removed for maintenance whilst the system still remains functional.

Table 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,c] (2)	Minimum wheel clearance (metres) [d] (3)
up to but not including 3 m	6	3 [e]
3 m up to but not including 5 m	9	4
5 m up to but not including 8 m	9	5
8 m up to but not including 14 m	9	6

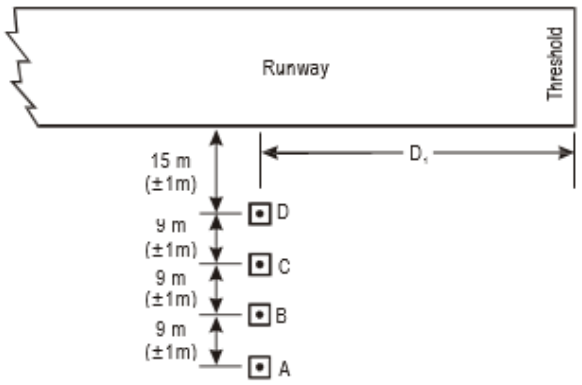
[a] In selecting the eye-to-wheel height group, only aeroplanes meant to use the system on a regular basis shall be considered. The most demanding amongst such aeroplanes shall determine the eye-to-wheel height group.

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

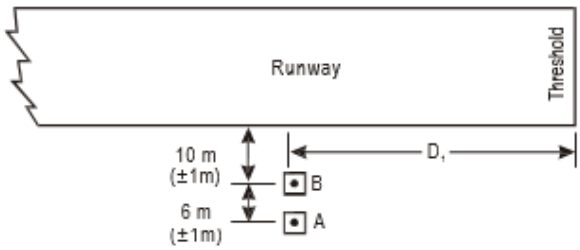
[c] The wheel clearances in column (2) may be reduced to no less than those in column (3) where an aeronautical study indicates that such reduced wheel clearances are acceptable.

[d] When a reduced wheel clearance is provided at a displaced threshold it shall be ensured that the corresponding desired wheel clearance specified in column (2) will be available when an aeroplane at the top end of the eye-to-wheel 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.



Typical PAPI wing bar



Typical APAPI wing bar

INSTALLATION TOLERANCES

a) Where a PAPI or APAPI is installed on a runway not equipped with an ILS or MLS, the distance D_1 shall be calculated to ensure that the lowest height at which a pilot will see a correct approach path indication (Figure 18, angle B for a PAPI and angle A for an APAPI) provides the wheel clearance over the threshold specified in Table 2 for the most demanding amongst aeroplanes regularly using the runway.

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

Note. — See Section 5.2.5 for specifications on aiming point marking. Guidance on the harmonization of PAPI, ILS and/or MLS signals is contained in the Aerodrome *Design Manual* (Doc 9157), Part 4.

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

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

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

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

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

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

Figure 17 - Siting of PAPI and APAPI

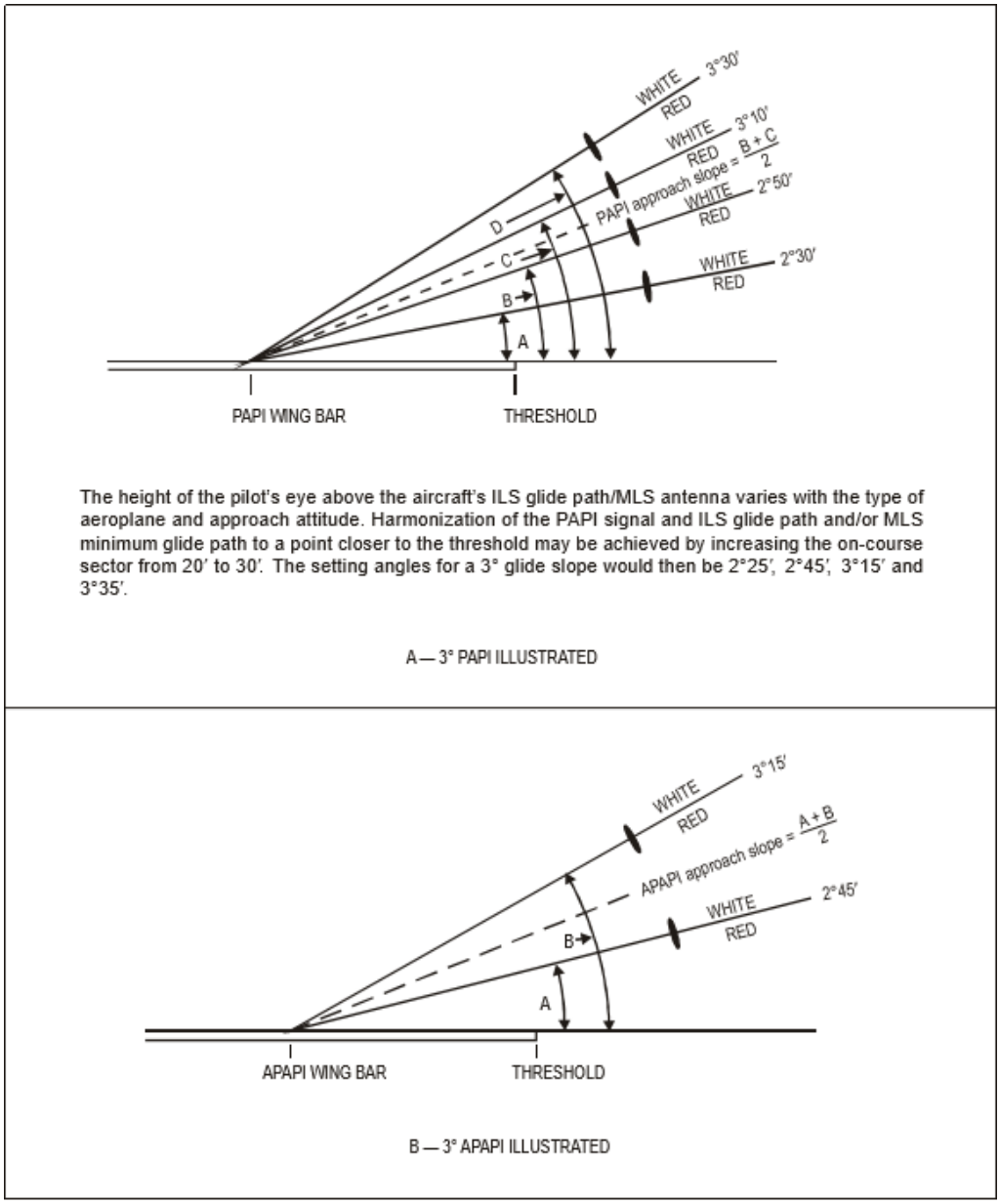


Figure 18 - Light beams and angle of elevation setting of PAPI and APAPI

Approach slope and elevation setting of light units

4.11.18 The approach slope as defined in Figure 18 shall be appropriate for use by the aeroplanes using the approach.

4.11.19 When the runway is equipped with an ILS and/or MLS, the siting and the angle of elevation of the light units shall 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.

4.11.20 The angle of elevation settings of the light units in a PAPI wing bar shall 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 2).

4.11.21 The angle of elevation settings of the light units in an APAPI wing bar shall 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 2).

4.11.22 The azimuth spread of the light beam shall 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 shall be such that the object remains outside the confines of the light beam.

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

Obstacle protection surface

4.11.24 An obstacle protection surface shall be established when it is intended to provide a visual approach slope indicator system.

4.11.25 The characteristics of the obstacle protection surface, i.e. origin, divergence, length and slope, shall correspond to those specified in the relevant column of Table 3 and in Figure 19.

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

Note. — Circumstances in which the shielding principle may reasonably be applied are described in the Airport Services Manual (Doc 9137), Part 6.

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

Table 3 - Dimensions and slopes of the obstacle protection surface

Surface dimensions	Non-instrument – Code number				Instrument – Code number			
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Length of inner edge	60m	90m	150m	150m	150m	150m	300m	300m
Distance from the visual approach slope indicator system [e]	D_1+30m	D_1+60m	D_1+60m	D_1+60m	D_1+60m	D_1+60m	D_1+60m	D_1+60m
Divergence (each side)	10%	10%	10%	10%	15%	15%	15%	15%
Total length	7500m	7500m	15000m	15000m	7500m	7500m	15000m	15000m
Slope								
PAPI [d]	-	A–0.57°	A–0.57°	A–0.57°	A–0.57°	A–0.57°	A–0.57°	A–0.57°
APAPI [d]	A–0.9°	A–0.9°	-	-	A–0.9°	A–0.9°	-	-

[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 18

[e.] D1 is the distance of the visual approach slope indicator system from threshold prior to any displacement to remedy object penetration of the OPS (refer Figure 17). 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. See 4.11.28 e).

4.11.28 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 shall 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.

Note 1. — Guidance on this issue is contained in the Aerodrome Design Manual (Doc 9157), Part 4.

Note 2. — The displacement of the system upwind of the threshold reduces the operational landing distance.

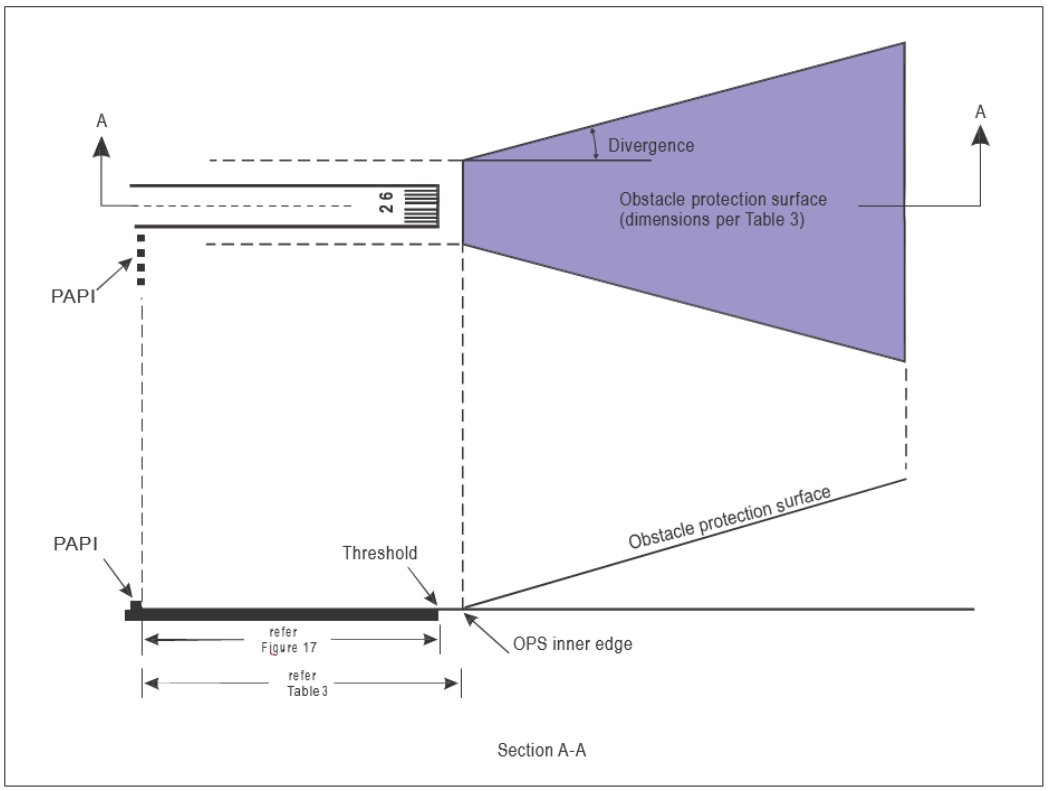


Figure 19 - Obstacle protection surface for visual approach slope indicator systems

4.12 Circling guidance lights

4.12.1 Circling guidance lights *should* be provided when existing approach and runway lighting systems do not satisfactorily permit identification of the runway and/or approach area to a circling aircraft in the conditions for which it is intended the runway be used for circling approaches.

4.12.2 The location and number of circling guidance lights *should* be adequate to enable a pilot, as appropriate, to:

(a) join the downwind leg or align and adjust the aircraft's track to the runway at a required distance from it and to distinguish the threshold in passing; and
(b) keep in sight the runway threshold and/or other features which will make it possible to judge the turn on to base leg and final approach, taking into account the guidance provided by other visual aids.

4.12.3 Circling guidance lights *should* consist of:

(a) lights indicating the extended centre line of the runway and/or parts of any approach lighting system; or
(b) lights indicating the position of the runway threshold; or
(c) lights indicating the direction or location of the runway;

or a combination of such lights as is appropriate to the runway under consideration.

Note. — Guidance on installation of circling guidance lights is given in the Aerodrome Design Manual (Doc 9157), Part 4.

4.12.4 Circling guidance lights *should* be fixed or flashing lights of an intensity and beam spread adequate for the conditions of visibility and ambient light in which it is intended to make visual circling approaches. The flashing lights *should* be white, and the steady lights either white or gaseous discharge lights.

4.12.5 The lights *should* be designed and be installed in such a manner that they will not dazzle or confuse a pilot when approaching to land, taking off or taxiing.

4.13 Runway lead-in lighting systems

4.13.1 A runway lead-in lighting system *should* be provided where it is desired to provide visual guidance along a specific approach path, for reasons such as avoiding hazardous terrain or for purposes of noise abatement.

Note. — Guidance on providing lead-in lighting systems is given in the Aerodrome Design Manual (Doc 9157), Part 4.

4.13.2 A runway lead-in lighting system *should* consist of groups of lights positioned so as to define the desired approach path and so that one group may be sighted from the preceding group. The interval between adjacent groups *should* not exceed approximately 1600m.

Note. — Runway lead-in lighting systems may be curved, straight or a combination thereof.

4.13.3 A runway lead-in lighting system *should* extend from a point as determined by the appropriate authority, up to a point where the approach lighting system, if provided, or the runway or the runway lighting system is in view.

4.13.4 Each group of lights of a runway lead-in lighting system *should* consist of at least three flashing lights in a linear or cluster configuration. The system may be augmented by steady burning lights where such lights would assist in identifying the system.

4.13.5 The flashing lights and the steady burning lights *should* be white.

4.13.6 Where practicable, the flashing lights in each group *should* flash in sequence towards the runway.

4.14 Runway threshold identification lights

4.14.1 Runway threshold identification lights *should* be installed:

(a) at the threshold of a non-precision approach runway when additional threshold conspicuity is necessary or where it is not practicable to provide other approach lighting aids; and

(b) where a runway threshold is permanently displaced from the runway extremity or temporarily displaced from the normal position and additional threshold conspicuity is necessary.

4.14.2 Runway threshold identification lights shall be located symmetrically about the runway centre line, in line with the threshold and approximately 10m outside each line of runway edge lights.

4.14.3 Runway threshold identification lights *should* be flashing white lights with a flash frequency between 60 and 120 per minute.

4.14.4 The lights shall be visible only in the direction of approach to the runway.

4.15 Runway edge lights

4.15.1 Runway edge lights shall be provided for a runway intended for use at night or for a precision approach runway intended for use by day or night.

4.15.2 Runway edge lights *should* be provided on a runway intended for take-off with an operating minimum below an RVR of the order of 800m by day.

4.15.3 Runway edge lights shall be placed along the full length of the runway and shall be in two parallel rows equidistant from the centre line.

4.15.4 Runway edge lights shall 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 3m.

4.15.5 Where the width of the area which could be declared as runway exceeds 60m, the distance between the rows of lights *should* be determined taking into account the nature of the operations, the light distribution characteristics of the runway edge lights, and other visual aids serving the runway.

4.15.6 The lights shall be uniformly spaced in rows at intervals of not more than 60m for an instrument runway, and at intervals of not more than 100m for a non-instrument runway. The lights on opposite sides of the runway axis shall 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.

4.15.7 Runway edge lights shall 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 shall show red in the approach direction; and
(b) a section of the lights 600m 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.

4.15.8 The runway edge lights shall 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 shall show at all angles in azimuth (see 4.12.1).

4.15.9 In all angles of azimuth required in 4.15.8, runway edge lights shall 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 shall 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.

4.15.10 Runway edge lights on a precision approach runway shall be in accordance with the specifications of *Annex 14 Appendix 2, Figure A2-9 or A2-10.*

4.16 Runway threshold and wing bar lights

(see Figure 20-21)

4.16.1 Runway threshold lights shall 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.

4.16.2 When a threshold is at the extremity of a runway, the threshold lights shall 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 3m outside the extremity.

4.16.3 When a threshold is displaced from the extremity of a runway, threshold lights shall be placed in a row at right angles to the runway axis at the displaced threshold.

4.16.4 Threshold lighting shall consist of:

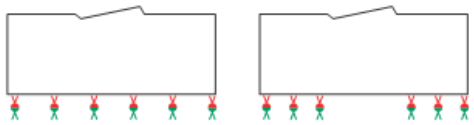
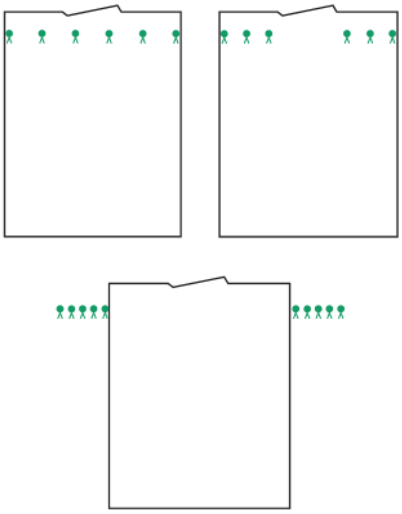
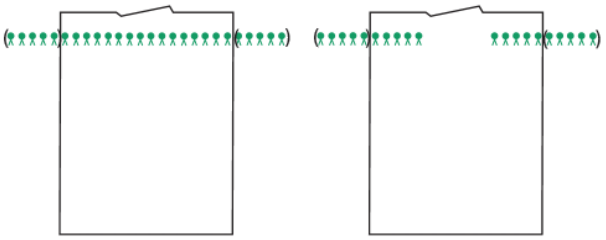
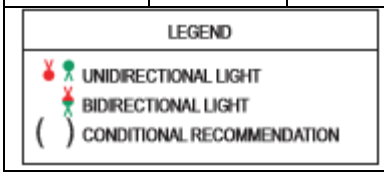
(a) on a non-instrument or non-precision approach runway, at least six lights;
(b) on a precision approach runway category I, at least the number of lights that would be required if the lights were uniformly spaced at intervals of 3 m between the rows of runway edge lights; and
(c) on a precision approach runway category II or III, lights uniformly spaced between the rows of runway edge lights at intervals of not more than 3 m.

4.16.5 The lights prescribed in 4.16.4 a) and b) *should* be either:

(a) equally spaced between the rows of runway edge lights; or
(b) symmetrically disposed about the runway centre line in two groups, with the lights uniformly spaced in each group and with a gap between the groups equal to the gauge of the touchdown zone marking or lighting, where such is provided, or otherwise not more than half the distance between the rows of runway edge lights.

4.16.6 Wing bar lights *should* be provided on a precision approach runway when additional conspicuity is considered desirable.

4.16.7 Wing bar lights shall 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.

<table>
<tr><th>Condition</th><th>Lights</th><th colspan="2">RUNWAY TYPE</th></tr>
<tr><td rowspan="2">Threshold at runway extremity</td><td rowspan="2">Runway threshold and runway end lights</td><td>NON-INSTRUMENT AND NON-PRECISION APPROACH RUNWAYS</td><td>PRECISION APPROACH RUNWAYS CATEGORY I</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td rowspan="2">Threshold displaced from runway extremity</td><td>Runway threshold lights</td><td>  </td><td>  </td></tr>
<tr><td>Runway end lights</td><td colspan="2">  </td></tr>
<tr><td colspan="4"> 

Note.— The minimum number of lights are shown for a runway 45 m wide with runway edge lights installed at the edge.</td></tr>
</table>

Figure 20 - Arrangement of Runway threshold and runway end lights (1)

4.16.8 Wing bar lights shall be symmetrically disposed about the runway centre line at the threshold in two groups, i.e. wing bars. Each wing bar shall be formed by at least five lights extending at least 10m 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.

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

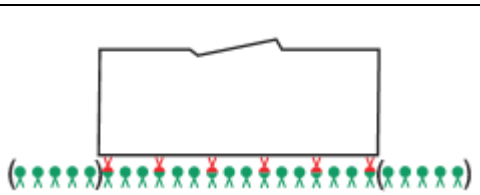
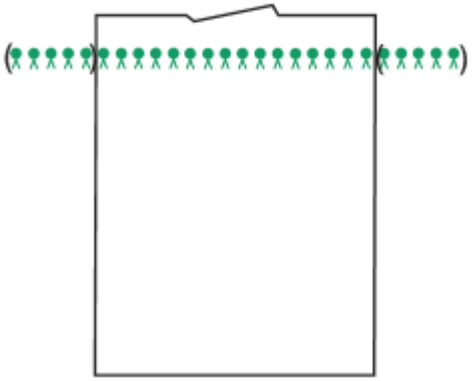
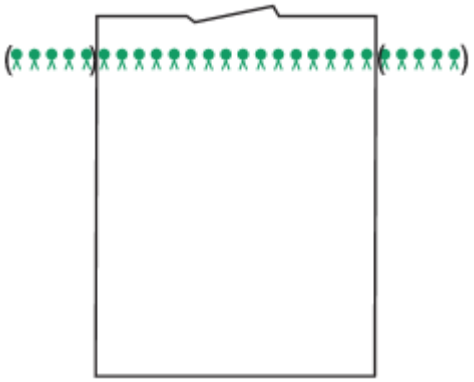
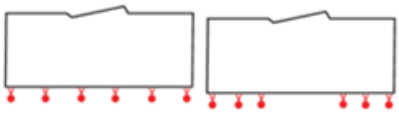
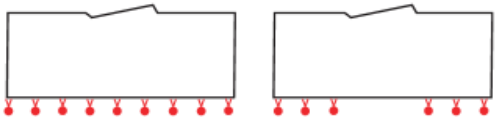
Condition	Lights	RUNWAY TYPE	
Threshold at runway extremity	**Runway threshold and runway end lights**	**PRECISION APPROACH RUNWAYS CATEGORY II**	**PRECISION APPROACH RUNWAYS CATEGORY III**
			
Threshold displaced from runway extremity	**Runway threshold lights**		
	Runway end lights		
LEGEND UNIDIRECTIONAL LIGHT BIDIRECTIONAL LIGHT ( ) CONDITIONAL RECOMMENDATION		**Note.— The minimum number of lights are shown for a runway 45 m wide with runway edge lights installed at the edge.**	

Figure 21 - Arrangement of Runway threshold and runway end lights (2)

4.16.10 Runway threshold lights on a precision approach runway shall be in accordance with the specifications of *Annex 14 Appendix 2, Figure A2-3*.

4.16.11 Threshold wing bar lights on a precision approach runway shall be in accordance with the specifications of *Annex 14 Appendix 2, Figure A2-4.*

4.17 Runway end lights

(see Figure 20-21)

4.17.1 Runway end lights shall be provided for a runway equipped with runway edge lights.

Note. — When the threshold is at the runway extremity, fittings serving as threshold lights may be used as runway end lights.

4.17.2 Runway end lights shall 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 3m outside the end.

4.17.3 Runway end lighting *should* consist of at least six lights. The lights *should* be either:

(a) equally spaced between the rows of runway edge lights; or
(b) symmetrically disposed about the runway centre line in two groups with the lights uniformly spaced in each group and with a gap between the groups of not more than half the distance between the rows of runway edge lights.

For a precision approach runway category III, the spacing between runway end lights, except between the two innermost lights if a gap is used, should not exceed 6 m.

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

4.17.5 Runway end lights on a precision approach runway shall be in accordance with the specifications of *Annex 14 Appendix 2, Figure A2-8.*

4.18 Runway centre line lights

4.18.1 Runway centre line lights shall be provided on a precision approach runway category II or III.

4.18.2 Runway centre line lights *should* be provided on a precision approach runway category I, particularly when the runway is used by aircraft with high landing speeds or where the width between the runway edge lights is greater than 50m.

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

4.18.4 Runway centre line lights *should* be provided on a runway intended to be used for take-off with an operating minimum of an RVR of the order of 400m 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 50m.

4.18.5 Runway centre line lights shall 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 shall be located from the threshold to the end at longitudinal spacing of approximately 15m. Where the serviceability level of the runway centre line lights specified as maintenance objectives in SD-AD Appendix 10, as appropriate, can be demonstrated and the runway is intended for use in runway visual range conditions of 350m or greater, the longitudinal spacing may be approximately 30m.

Note. — Existing centre line lighting where lights are spaced at 7.5m need not be replaced.

4.18.6 Centre line guidance for take-off from the beginning of a runway to a displaced threshold *should* be provided by:

(a) an approach lighting system if its characteristics and intensity settings afford the guidance required during take-off and it does not dazzle the pilot of an aircraft taking off; or
(b) runway centre line lights; or
(c) barrettes of at least 3m in length and spaced at uniform intervals of 30 m, as shown in Figure 20 and 21, designed so that their photometric characteristics and intensity setting afford the guidance required during take-off without dazzling the pilot of an aircraft taking off.

Where necessary, provision should be made to extinguish those centre line lights specified in b) or reset the intensity of the approach lighting system or barrettes when the runway is being used for landing. In no case should only the single source runway centre line lights show from the beginning of the runway to a displaced threshold when the runway is being used for landing.

4.18.7 Runway centre line lights shall be fixed lights showing variable white from the threshold to the point 900m from the runway end; alternate red and variable white from 900m to 300m from the runway end; and red from 300m to the runway end, except that for runways less than 1800m in length, the alternate red and variable white lights shall extend from the midpoint of the runway usable for landing to 300m from the runway end.

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.

4.18.8 Runway centre line lights shall be in accordance with the specifications of *Annex 14 Appendix 2, Figure A2-6 or A2-7.*

4.19 Runway touchdown zone lights

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

4.19.2 Touchdown zone lights shall extend from the threshold for a longitudinal distance of 900m, except that, on runways less than 1800m in length, the system shall be shortened so that it does not extend beyond the midpoint of the runway. The pattern shall 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 shall be equal to the lateral spacing selected for the touchdown zone marking. The longitudinal spacing between pairs of barrettes shall be either 30m or 60m.

Note. — To allow for operations at lower visibility minima, it may be advisable to use a 30m longitudinal spacing between barrettes.

4.19.3 A barrette shall be composed of at least three lights with a spacing between the lights of not more than 1.5m.

4.19.4 A barrette *should* be not less than 3m nor more than 4.5m in length.

4.19.5 Touchdown zone lights shall be fixed unidirectional lights showing variable white.

4.19.6 Touchdown zone lights shall be in accordance with the specifications of *Annex 14 Appendix 2, Figure A2-5.*

4.20 Simple touchdown zone lights

Note. — The purpose of simple touchdown zone lights is to provide pilots with enhanced situational awareness in all visibility conditions and to help enable pilots to decide whether to commence a go-around if the aircraft has not landed by a certain point on the runway. It is essential that pilots operating at aerodromes with simple touchdown zone lights be familiar with the purpose of these lights.

4.20.1 Except where TDZ lights are provided in accordance with section 4.19, at an aerodrome where the approach angle is greater than 3.5 degrees and/or the Landing Distance Available combined with other factors increases the risk of an overrun, simple touchdown zone lights *should* be provided.

4.20.2 Simple touchdown zone lights shall be a pair of lights located on each side of the runway centre line 0.3m beyond the upwind edge of the final touchdown zone marking. The lateral spacing between the inner lights of the two pairs of lights shall be equal to the lateral spacing selected for the touchdown zone marking. The spacing between the lights of the same pair shall not be more than 1.5 m or half the width of the touchdown zone marking, whichever is greater. (See Figure 22.)

4.20.3 Where provided on a runway without TDZ markings, simple touchdown zone lights *should* be installed in such a position that provides the equivalent TDZ information.

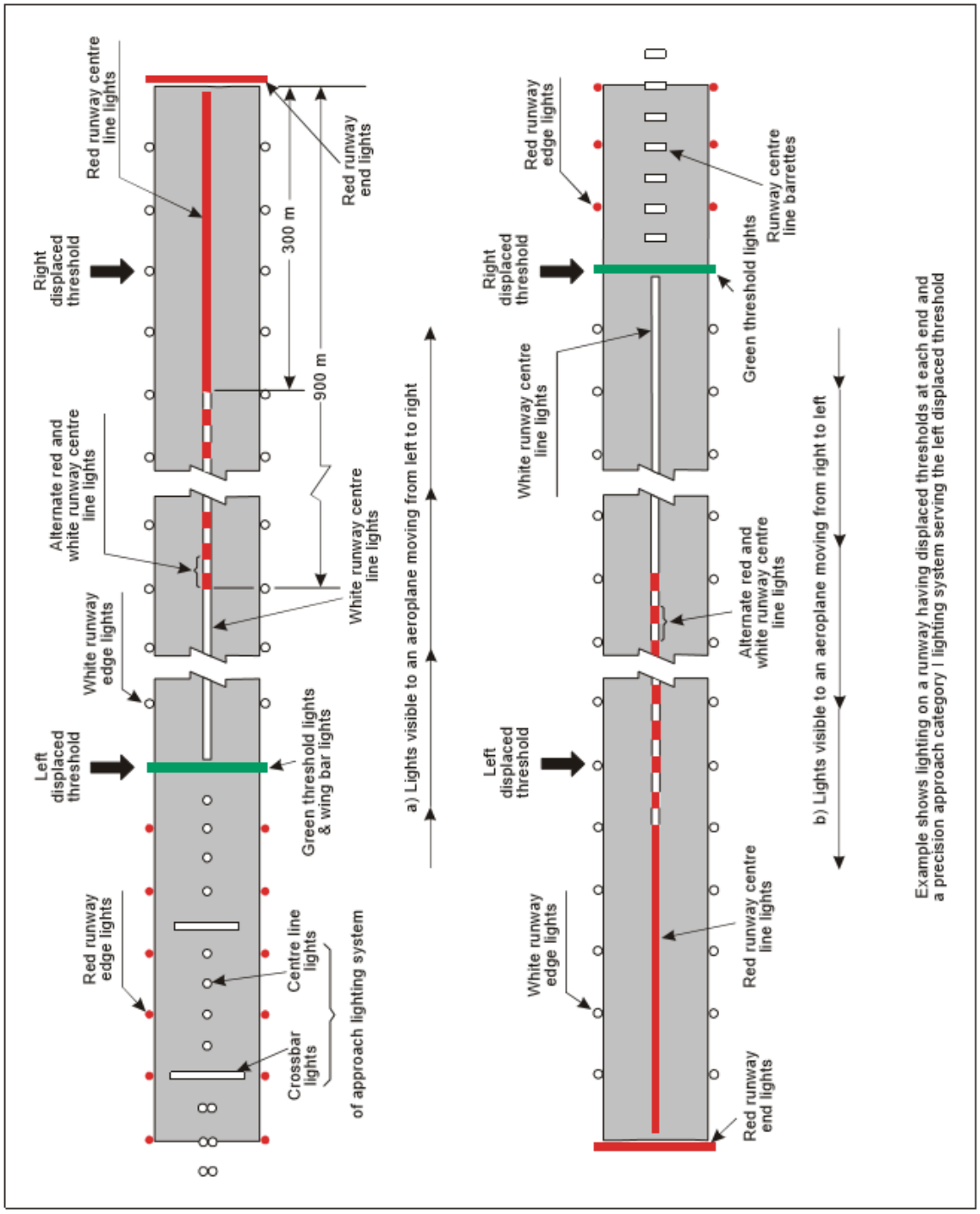


Figure 22 - Example of approach and runway lighting for runway with displaced threshold

4.20.4 Simple touchdown zone lights shall be fixed unidirectional lights showing variable white, aligned so as to be visible to the pilot of a landing aeroplane in the direction of approach to the runway.

4.20.5 Simple touchdown zone lights shall be in accordance with the specifications in *Annex 14 Appendix 2, Figure A2-5*.

Note. — As a good operating practice, simple touchdown zone lights are supplied with power on a separate circuit to other runway lighting so that they may be used when other lighting is switched off.

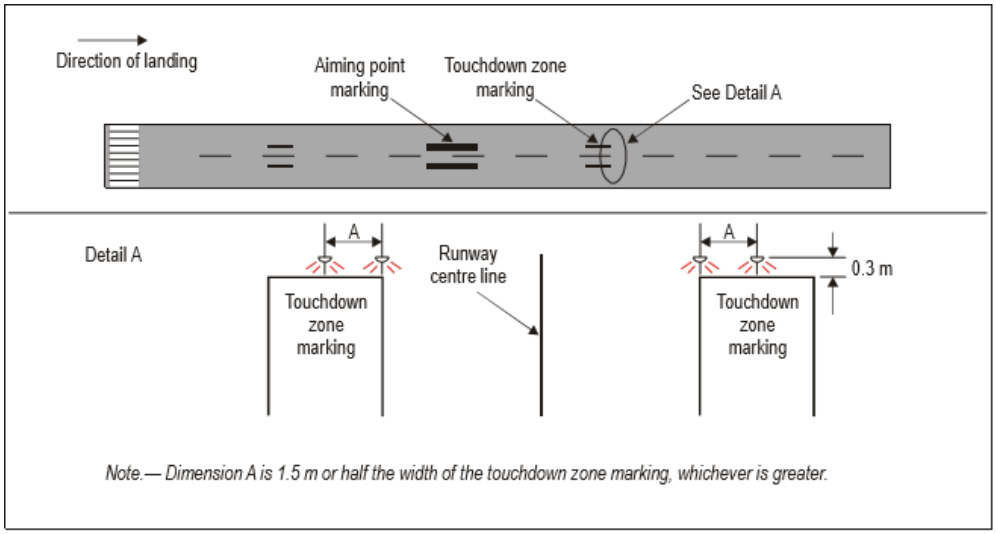


Figure 23 - Simple touchdown zone lighting

4.21 Rapid exit taxiway indicator lights

Note. — The purpose of rapid exit taxiway indicator lights (RETILs) is to provide pilots with distance-to-go information to the nearest rapid exit taxiway on the runway, to enhance situational awareness in low visibility conditions and enable pilots to apply braking action for more efficient roll-out and runway exit speeds. It is essential that pilots operating at aerodromes with runway(s) displaying rapid exit taxiway indicator lights be familiar with the purpose of these lights.

4.21.1 Rapid exit taxiway indicator lights *should* be provided on a runway intended for use in runway visual range conditions less than a value of 350m and/or where the traffic density is heavy.

Note. — See Annex 14 Attachment A, Section 15.

4.21.2 Rapid exit taxiway indicator lights shall not be displayed in the event of any lamp failure or other failure that prevents the display of the light pattern depicted in Figure 24, in full.

4.21.3 A set of rapid exit taxiway indicator lights shall 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 24. In each set, the lights shall be located 2m apart and the light nearest to the runway centre line shall be displaced 2m from the runway centre line.

4.21.4 Where more than one rapid exit taxiway exists on a runway, the set of rapid exit taxiway indicator lights for each exit shall not overlap when displayed.

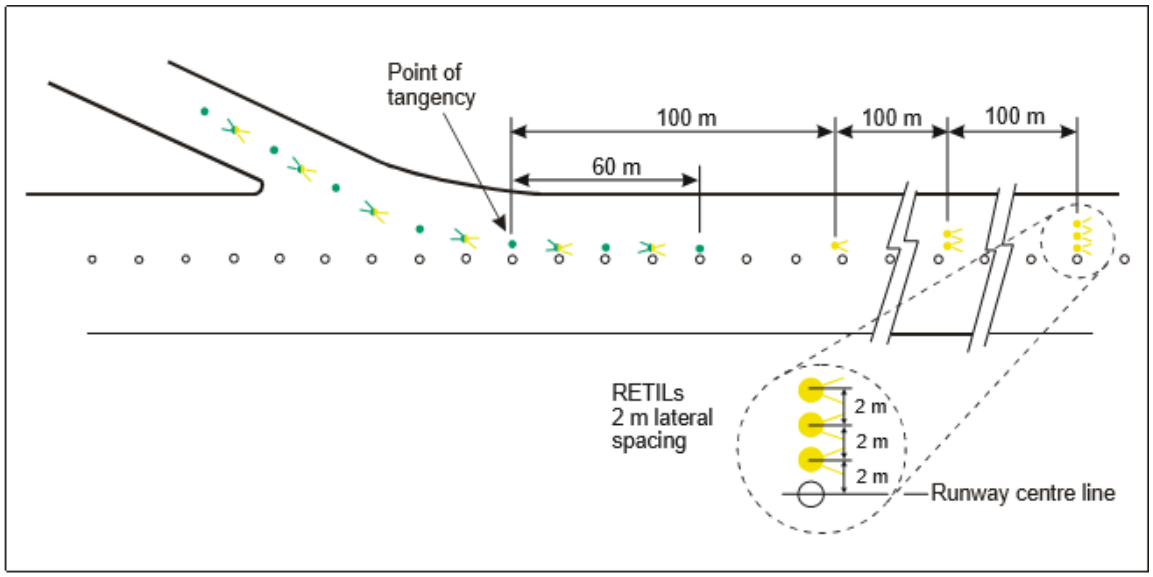


Figure 24- Rapid exit taxiway indicator lights (RETILS)

4.21.5 Rapid exit taxiway indicator lights shall 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.

4.21.6 Rapid exit taxiway indicator lights shall be in accordance with the specifications in *Annex 14 Appendix 2, Figure A2-6 or Figure A2-7*, as appropriate.

4.21.7 Rapid exit taxiway indicator lights *should* be supplied with power on a separate circuit to other runway lighting so that they may be used when other lighting is switched off.

4.22 Stopway lights

4.22.1 Stopway lights shall be provided for a stopway intended for use at night.

4.22.2 Stopway lights shall be placed along the full length of the stopway and shall be in two parallel rows that are equidistant from the centre line and coincident with the rows of the runway edge lights. Stopway lights shall 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 3m outside the end.

4.22.3 Stopway lights shall be fixed unidirectional lights showing red in the direction of the runway.

4.23 Taxiway centre line lights

4.23.1 Taxiway centre line lights shall be provided on an exit taxiway, taxiway and apron intended for use in runway visual range conditions less than a value of 350m 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.

4.23.2 Taxiway centre line lights *should* be provided on a taxiway intended for use at night in runway visual range conditions of 350m or greater, and particularly on complex taxiway intersections and exit taxiways, except that these lights need not be provided where the traffic density is light and taxiway edge lights and centre line marking provide adequate guidance.

Note. — Where there may be a need to delineate the edges of a taxiway, e.g. on a rapid exit taxiway, narrow taxiway or in snow conditions, this may be done with taxiway edge lights or markers.

4.23.3 Taxiway centre line lights *should* be provided on an exit taxiway, taxiway and apron in all visibility conditions where specified as components of an advanced surface movement guidance and control system in such a manner as to provide continuous guidance between the runway centre line and aircraft stands.

4.23.4 Taxiway centre line lights shall 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 350m, except that these lights need not be provided where the traffic density is light and taxiway edge lights and centre line marking provide adequate guidance.

Note. — See SD-AD Appendix 8 (3.3) for provisions concerning the interlocking of runway and taxiway lighting systems.

4.23.5 Taxiway centre line lights *should* be provided in all visibility conditions on a runway forming part of a standard taxi-route where specified as components of an advanced surface movement guidance and control system.

4.23.6 Except as provided for in 4.23.8, taxiway centre line lights on a taxiway other than an exit taxiway and on a runway forming part of a standard taxi-route shall 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.

4.23.7 Taxiway centre line lights on an exit taxiway shall be fixed lights. Alternate taxiway centre line lights shall 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 shall show green (Figure 25). The first light in the exit centre line shall always show green, and the light nearest to the perimeter shall always show yellow.

Note 1. — Care is necessary to limit the light distribution of green lights on or near a runway so as to avoid possible confusion with threshold lights.

Note 2. — For yellow filter characteristics see Annex 14 Appendix 1, 2.2.

Note 3. — The size of the ILS/MLS critical/sensitive area depends on the characteristics of the associated ILS/MLS and other factors. Guidance is provided in Annex 10, Volume I, Attachments C and G.

4.23.8 Where it is necessary to denote the proximity to a runway, taxiway centre line lights *should* be fixed lights showing alternating green and yellow from the perimeter of the ILS/MLS critical/sensitive area or the lower edge of the inner transitional surface, whichever is farthest from the runway, to the runway and continue alternating green and yellow until:

(a) their end point near the runway centre line; or
(b) in the case of the taxiway centre line lights crossing the runway, to the opposite perimeter of the ILS/MLS critical/sensitive area or the lower edge of the inner transitional surface, whichever is farthest from the runway.

Note 1. — Care is necessary to limit the light distribution of green lights on or near a runway so as to avoid possible confusion with threshold lights.

Note 2. — The provisions of 4.23.8 can form part of effective runway incursion prevention measures.

4.23.9 Taxiway centre line lights shall be in accordance with the specifications of:

(a) *Annex 14 appendix 2, Figure A2-12, A2-13, or A2-14*, for taxiways intended for use in runway visual range conditions of less than a value of 350 m; and

(b) *Annex 14 appendix 2, Figure A2-15 or A2-16*, for other taxiways.

4.23.10 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 350m *should* be in accordance with the specifications of *Annex 14 Appendix 2, Figure A2-12.* The number of levels of brilliancy settings for these lights *should* be the same as that for the runway centre line lights.

4.23.11 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 *should* be in accordance with the specifications of *Annex 14 appendix 2, Figure A2-17, A2-18 or A2-19*.

Note. — High-intensity centre line lights should only be used in case of an absolute necessity and following a specific study.

4.23.12 Taxiway centre line lights *should* normally be located on the taxiway centre line marking, except that they may be offset by not more than 30cm where it is not practicable to locate them on the marking.

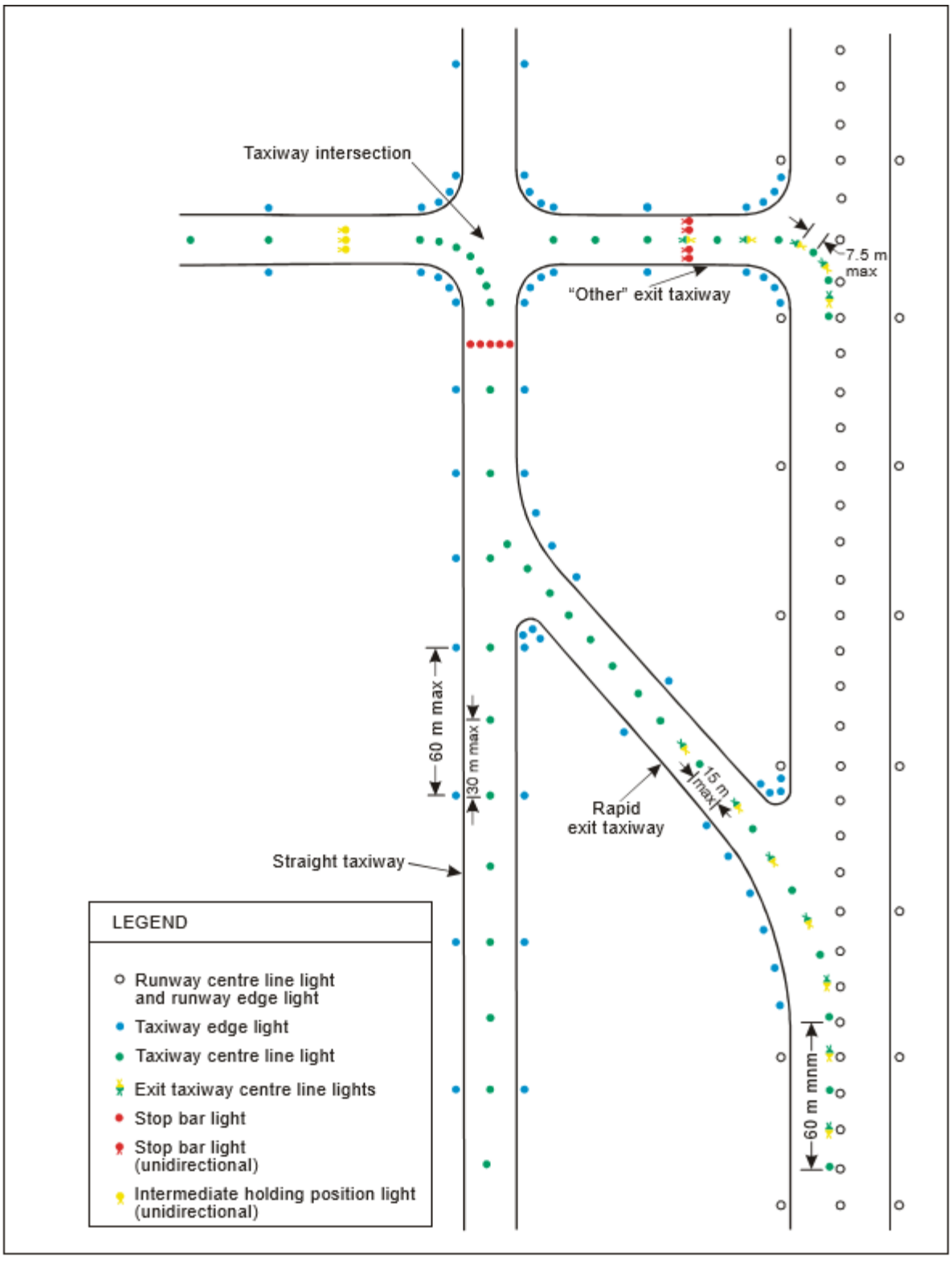


Figure 25 - Taxiway lighting

Taxiway centre line lights on taxiways

4.23.13 Taxiway centre line lights on a straight section of a taxiway *should* be spaced at longitudinal intervals of not more than 30m, except that:

(a) larger intervals not exceeding 60m may be used where, because of the prevailing meteorological conditions, adequate guidance is provided by such spacing;
(b) intervals less than 30m *should* be provided on short straight sections; and
(c) on a taxiway intended for use in RVR conditions of less than a value of 350m, the longitudinal spacing *should* not exceed 15m.

4.23.14 Taxiway centre line lights on a taxiway curve *should* continue from the straight portion of the taxiway at a constant distance from the outside edge of the taxiway curve. The lights *should* be spaced at intervals such that a clear indication of the curve is provided.

4.23.15 On a taxiway intended for use in RVR conditions of less than a value of 350m, the lights on a curve *should* not exceed a spacing of 15m, and on a curve of less than 400m radius the lights *should* be spaced at intervals of not greater than 7.5m. This spacing *should* extend for 60m before and after the curve.

Note 1. — Spacings on curves that have been found suitable for a taxiway intended for use in RVR conditions of 350 m or greater are:

Curve radius	***Light spacing***
up to 400 m	*7.5 m*
401 m to 899 m	*15 m*
900 m or greater	*30 m*

Note 2. — Refer SD-AD Appendix 3, 8.6 and Figure 2.

Taxiway centre line lights on rapid exit taxiways

4.23.16 Taxiway centre line lights on a rapid exit taxiway *should* commence at a point at least 60m before the beginning of the taxiway centre line curve and continue beyond the end of the curve to a point on the centre line of the taxiway where an aeroplane can be expected to reach normal taxiing speed. The lights on that portion parallel to the runway centre line *should* always be at least 60cm from any row of runway centre line lights, as shown in Figure 26.

4.23.17 The lights *should* be spaced at longitudinal intervals of not more than 15m, except that where runway centre line lights are not provided, a greater interval not exceeding 30m may be used.

Taxiway centre line lights on other exit taxiways

4.23.18 Taxiway centre line lights on exit taxiways other than rapid exit taxiways *should* commence at the point where the taxiway centre line marking begins to curve from the runway centre line and follow the curved taxiway centre line marking at least to the point where the marking leaves the runway. The first light *should* be at least 60 cm from any row of runway centre line lights, as shown in Figure 26.

4.23.19 The lights *should* be spaced at longitudinal intervals of not more than 7.5m.

Taxiway centre line lights on runways

4.23.20 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 350m *should* be spaced at longitudinal intervals not exceeding 15m.

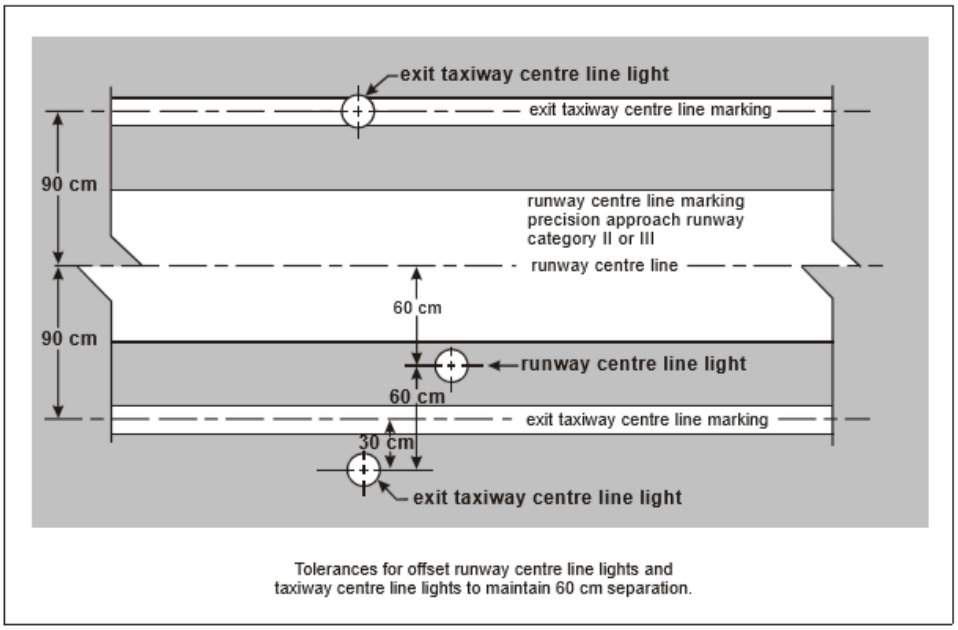


Figure 26 - Offset runway and taxiway centre line lights

4.24 Taxiway edge lights

4.24.1 Taxiway edge lights shall 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.

4.24.2 Taxiway edge lights shall 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.

Note. — See SD-AD Appendix 8 (3.3) for provisions concerning the interlocking of runway and taxiway lighting systems.

4.24.3 Taxiway edge lights on a straight section of a taxiway and on a runway forming part of a standard taxi-route *should* be spaced at uniform longitudinal intervals of not more than 60m. The lights on a curve *should* be spaced at intervals less than 60m so that a clear indication of the curve is provided.

Note. — Guidance on the spacing of taxiway edge lights on curves is given in the Aerodrome Design Manual (Doc 9157), Part 4.

4.24.4 Taxiway edge lights on a holding bay, apron, etc., *should* be spaced at uniform longitudinal intervals of not more than 60m.

4.24.5 Taxiway edge lights on a runway turn pad *should* be spaced at uniform longitudinal intervals of not more than 30m.

4.24.6 The lights *should* be located as near as practicable to the edges of the taxiway, runway turn pad, holding bay, apron or runway, etc., or outside the edges at a distance of not more than 3m.

4.24.7 Taxiway edge lights shall be fixed lights showing blue. The lights shall 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 shall 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.

4.24.8 The intensity of taxiway edge lights shall be at least 2 cd from 0° to 6° vertical, and 0.2 cd at any vertical angles between 6° and 75°.

4.25 Runway turn pad lights

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

4.25.2 Runway turn pad lights *should* be provided on a runway turn pad intended for use at night.

4.25.3 Runway turn pad lights *should* normally be located on the runway turn pad marking, except that they may be offset by not more than 30cm where it is not practicable to locate them on the marking.

4.25.4 Runway turn pad lights on a straight section of the runway turn pad marking *should* be spaced at longitudinal intervals of not more than 15m.

4.25.5 Runway turn pad lights on a curved section of the runway turn pad marking *should* not exceed a spacing of 7.5m.

4.25.6 Runway turn pad lights shall 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.

4.25.7 Runway turn pad lights shall be in accordance with the specifications of Annex 14 Appendix 2, Figure A2-13, A2-14 or A2-15, as appropriate.

4.26 Stop bars

Note 1. — A stop bar is intended to be controlled either manually or automatically by air traffic services.

Note 2. — Runway incursions may take place in all visibility or weather conditions. The provision of stop bars at runway holding positions and their use at night and in visibility conditions greater than 550m runway visual range can form part of effective runway incursion prevention measures.

4.26.1 A stop bar shall 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 350m, 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:

1) aircraft on the manoeuvring area to one at a time; and
2) vehicles on the manoeuvring area to the essential minimum.

4.26.2 A stop bar shall 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:

1) aircraft on the manoeuvring area to one at a time; and

2) vehicles on the manoeuvring area to the essential minimum.

4.26.3 Where there is more than one stop bar associated with a taxiway/runway intersection, only one shall be illuminated at any given time.

4.26.4 A stop bar should be provided at an intermediate holding position when it is desired to supplement markings with lights and to provide traffic control by visual means.

4.26.5 Stop bars shall be located across the taxiway at the point where it is desired that traffic stop. Where the additional lights specified in 5.3.20.7 are provided, these lights shall be located not less than 3 m from the taxiway edge.

4.26.6 Stop bars shall 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.

Note.— Where necessary to enhance conspicuity of an existing stop bar, extra lights are installed uniformly.

4.26.7 A pair of elevated lights should 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.

4.26.8 Stop bars installed at a runway-holding position shall be unidirectional and shall show red in the direction of approach to the runway.

4.26.9 Where the additional lights specified in 4.26.7 are provided, these lights shall have the same characteristics as the lights in the stop bar, but shall be visible to approaching aircraft up to the stop bar position.

4.26.10 The intensity in red light and beam spreads of stop bar lights shall be in accordance with the specifications in Annex 14 Appendix 2, Figures A2-12 through A2-16, as appropriate.

4.26.11 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 should be in accordance with the specifications of Annex 14 Appendix 2, Figure A2-17, A2-18 or A2-19.

Note.— High-intensity stop bars should only be used in case of an absolute necessity and following a specific study.

4.26.12 Where a wide beam fixture is required, the intensity in red light and beam spreads of stop bar lights should be in accordance with the specifications of Annex 14 Appendix 2, Figure A2-17 or A2-19.

4.26.13 The lighting circuit shall 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 shall 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.

Note.— Care is required in the design of the electrical system to ensure that all of the lights of a stop bar will not fail at the same time. Guidance on this issue is given in the Aerodrome Design Manual (Doc 9157), Part 5.

4.27 Intermediate holding position lights

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

4.27.2 Intermediate holding position lights *should* be provided at an intermediate holding position where there is no need for stop-and-go signals as provided by a stop bar.

4.27.3 Intermediate holding position lights shall be located along the intermediate holding position marking at a distance of 0.3 m prior to the marking.

4.27.4 Intermediate holding position lights shall 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 shall be disposed symmetrically about and at right angle to the taxiway centre line, with individual lights spaced 1.5m apart.

4.28 Runway guard lights

Note. — The purpose of runway guard lights is to warn pilots, and drivers of vehicles when they are operating on taxiways, that they are about to enter a runway. There are two standard configurations of runway guard lights as illustrated in Figure 27.

4.28.1 Runway guard lights, Configuration A, shall 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 550m where a stop bar is not installed; and
(b) runway visual range conditions of values between 550m and 1200m where the traffic density is heavy.

4.28.2 As part of runway incursion prevention measures, runway guard lights, Configuration A or B, *should* be provided at each taxiway/runway intersection where runway incursion hot spots have been identified, and used under all weather conditions during day and night.

4.28.3 Configuration B runway guard lights *should* not be collocated with a stop bar.

4.28.4 Runway guard lights, Configuration A, shall 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 2.

4.28.5 Runway guard lights, Configuration B, shall 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 2.

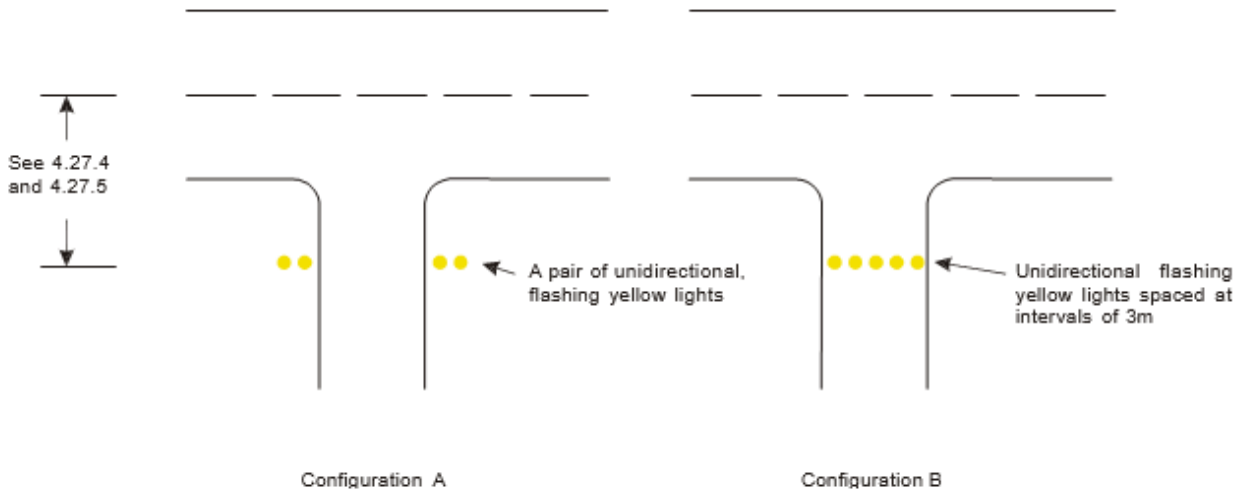


Figure 27 - Runway guard lights

4.28.6 Runway guard lights, Configuration A, shall consist of two pairs of yellow lights.

4.28.7 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 *should* be located above each lamp.

Note. — Some other device or design, e.g. specially designed optics, may be used in lieu of the visor.

4.28.8 Runway guard lights, Configuration B, shall consist of yellow lights spaced at intervals of 3m across the taxiway.

4.28.9 The light beam shall be unidirectional and aligned so as to be visible to the pilot of an aeroplane taxiing to the holding position.

4.28.10 The intensity in yellow light and beam spreads of lights of Configuration A *should* be in accordance with the specifications in *Annex 14 Appendix 2, Figure A2-24*.

4.28.11 Where runway guard lights are intended for use during the day, the intensity in yellow light and beam spreads of lights of Configuration A *should* be in accordance with the specifications in *Annex 14 Appendix 2, Figure A2-25*.

4.28.12 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 *should* be in accordance with the specifications in *Annex 14 Appendix 2, Figure A2-25*.

Note. — Higher light intensities may be required to maintain ground movement at a certain speed in low visibilities.

4.28.13 The intensity in yellow light and beam spreads of lights of Configuration B *should* be in accordance with the specifications in *Annex 14 Appendix 2, Figure A2-12*.

4.28.14 Where runway guard lights are intended for use during the day, the intensity in yellow light and beam spreads of lights of Configuration B *should* be in accordance with the specifications in *Annex 14 Appendix 2, Figure A2-20.*

4.28.15 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 *should* be in accordance with the specifications in *Annex 14 Appendix 2, Figure A2-20.*

4.28.16 The lights in each unit of Configuration A shall be illuminated alternately.

4.28.17 For Configuration B, adjacent lights shall be alternately illuminated and alternative lights shall be illuminated in unison.

4.28.18 The lights shall be illuminated between 30 and 60 cycles per minute and the light suppression and illumination periods shall be equal and opposite in each light.

Note. — The optimum flash rate is dependent on the rise and fall times of the lamps used. Runway guard lights, Configuration A, installed on 6.6 ampere series circuits have been found to look best when operated at 45 to 50 flashes per minute per lamp. Runway guard lights, Configuration B, installed on 6.6 ampere series circuits have been found to look best when operated at 30 to 32 flashes per minute per lamp.

4.29 Apron floodlighting

(see also 4.23.1 and 4.24.1)

4.29.1 Apron floodlighting shall be provided on an apron and on a designated isolated aircraft parking position intended to be used at night.

Note. — Further guidance on apron floodlighting is given in the Aerodrome Design Manual (Doc 9157), Part 4.

4.29.2 Apron floodlights *should* be located so as to provide adequate illumination on all apron service areas, with a minimum of glare to pilots of aircraft in flight and on the ground, aerodrome and apron controllers, and personnel on the apron. The arrangement and aiming of floodlights *should* be such that an aircraft stand receives light from two or more directions to minimize shadows.

4.29.3 The spectral distribution of apron floodlights shall be such that the colours used for aircraft marking connected with routine servicing, and for surface and obstacle marking, can be correctly identified.

4.29.4 The average illuminance *should* 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.*

4.30 Visual docking guidance system

4.30.1 A visual docking guidance system shall 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.

Note. — The factors to be considered in evaluating the need for a visual docking guidance system are in particular: the number and type(s) of aircraft using the aircraft stand, weather conditions, space available on the apron and the precision required for manoeuvring into the parking position due to aircraft servicing installation, passenger loading bridges, etc. See the Aerodrome Design Manual (Doc 9157), Part 4 — Visual Aids for guidance on the selection of suitable systems.

4.30.2 The system shall provide both azimuth and stopping guidance.

4.30.3 The azimuth guidance unit and the stopping position indicator shall 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 shall not dazzle the pilot.

Note. — Care is required in both the design and on-site installation of the system to ensure that reflection of sunlight, or other light in the vicinity, does not degrade the clarity and conspicuity of the visual cues provided by the system.

4.30.4 The azimuth guidance unit and the stopping position indicator shall 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.

4.30.5 The azimuth guidance unit and the stopping position indicator shall 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.

4.30.6 The accuracy of the system shall be adequate for the type of loading bridge and fixed aircraft servicing installations with which it is to be used.

4.30.7 The system *should* be usable by all types of aircraft for which the aircraft stand is intended, preferably without selective operation.

4.30.8 If selective operation is required to prepare the system for use by a particular type of aircraft, then the system shall 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

4.30.9 The azimuth guidance unit shall 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.

4.30.10 The azimuth guidance unit *should* be aligned for use by the pilots occupying both the left and right seats.

4.30.11 The azimuth guidance unit shall provide unambiguous left/right guidance which enables the pilot to acquire and maintain the lead-in line without over-controlling.

4.30.12 When azimuth guidance is indicated by colour change, green shall be used to identify the centre line and red for deviations from the centre line.

Stopping position indicator

4.30.13 The stopping position indicator shall 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.

4.30.14 The stopping position indicator shall be usable at least by the pilot occupying the left seat.

4.30.15 The stopping position indicator *should* be usable by the pilots occupying both the left and right seats.

4.30.16 The stopping position information provided by the indicator for a particular aircraft type shall account for the anticipated range of variations in pilot eye height and/or viewing angle.

4.30.17 The stopping position indicator shall show the stopping position for the aircraft for which guidance is being provided and shall provide closing rate information to enable the pilot to gradually decelerate the aircraft to a full stop at the intended stopping position.

4.30.18 The stopping position indicator *should* provide closing rate information over a distance of at least 10m.

4.30.19 When stopping guidance is indicated by colour change, green shall 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.

4.31 Advanced visual docking guidance system

Note 1. — Advanced visual docking guidance systems (A-VDGS) include those systems that, in addition to basic and passive azimuth and stop position information, provide pilots with active (usually sensor-based) guidance information, such as aircraft type indication (in accordance with Doc 8643 — Aircraft Type Designators), distance-to-go information and closing speed. Docking guidance information is usually provided on a single display unit.

Note 2. — An A-VDGS may provide docking guidance information in three stages: the acquisition of the aircraft by the system, the azimuth alignment of the aircraft, and the stopping position information.

4.31.1 An A-VDGS *should* be provided where it is operationally desirable to confirm the correct aircraft type for which guidance is being provided and/or to indicate the stand centre line in use, where more than one is provided for.

4.31.2 The A-VDGS shall be suitable for use by all types of aircraft for which the aircraft stand is intended.

4.31.3 The A-VDGS shall be used only in conditions in which its operational performance is specified.

Note 1. — The use of the A-VDGS in conditions such as weather, visibility and background lighting, both by day and night, would need to be specified.

Note 2. — Care is required in both the design and on-site installation of the system to ensure that glare, reflection of sunlight, or other light in the vicinity, does not degrade the clarity and conspicuity of the visual cues provided by the system.

4.31.4 The docking guidance information provided by an A-VDGS shall 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 shall be provided.

4.31.5 The A-VDGS shall 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.

Note. — Usually the pilot-in-command is responsible for the docking of the aircraft. However, in some circumstances, another person could be responsible and this person may be the driver of a vehicle that is towing the aircraft.

4.31.6 The A-VDGS shall 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.

4.31.7 The A-VDGS shall be capable of providing docking guidance information for all aircraft taxi speeds encountered during the docking manoeuvre.

Note. — See the Aerodrome Design Manual (Doc 9157), Part 4, for an indication of the maximum aircraft speeds relative to distance to the stopping position.

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

4.31.9 The information on displacement of the aircraft relative to the stand centre line and distance to the stopping position, when displayed, *should* be provided with the accuracy specified in Table 4.

4.31.10 Symbols and graphics used to depict guidance information shall be intuitively representative of the type of information provided.

Note. — The use of colour would need to be appropriate and need to follow signal convention, i.e. red, yellow and green mean hazard, caution and normal/correct conditions, respectively. The effects of colour contrasts would also need to be considered.

4.31.11 Information on the lateral displacement of the aircraft relative to the stand centre line shall be provided at least 25m prior to the stop position.

Note. — The indication of the distance of the aircraft from the stop position may be colour-coded and presented at a rate and distance proportional to the actual closure rate and distance of the aircraft approaching the stop point.

4.31.12 Continuous closure distance and closure rate shall be provided from at least 15m prior to the stop position.

4.31.13 Where provided, closure distance displayed in numerals *should* be provided in metre integers to the stop position and displayed to 1 decimal place at least 3m prior to the stop position.

Table 4 A-VDGS recommended displacement accuracy

Guidance information	Maximum deviation at stop position (stop area)	Maximum deviation at 9m from stop position	Maximum deviation at 15m from stop position	Maximum deviation at 25m from stop position
Azimuth	±250mm	±340mm	±400mm	±500mm
Distance	±500mm	±1000mm	±1300mm	Not specified

4.31.14 Throughout the docking manoeuvre, an appropriate means shall 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 shall be displayed.

4.31.15 Provision to initiate an immediate halt to the docking procedure shall be made available to personnel responsible for the operational safety of the stand.

4.31.16 The word “stop” in red characters *should* be displayed when an immediate cessation of the docking manoeuvre is required.

4.32 Aircraft stand manoeuvring guidance lights

4.32.1 Aircraft stand manoeuvring guidance lights *should* be provided to facilitate the positioning of an aircraft on an aircraft stand on a paved apron intended for use in poor visibility conditions, unless adequate guidance is provided by other means.

4.32.2 Aircraft stand manoeuvring guidance lights shall be collocated with the aircraft stand markings.

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

4.32.4 The lights used to delineate lead-in, turning and lead-out lines *should* be spaced at intervals of not more than 7.5m on curves and 15m on straight sections.

4.32.5 The lights indicating a stop position shall be fixed unidirectional lights showing red.

4.32.6 The intensity of the lights *should* be adequate for the condition of visibility and ambient light in which the use of the aircraft stand is intended.

4.32.7 The lighting circuit *should* be designed so that the lights may be switched on to indicate that an aircraft stand is to be used and switched off to indicate that it is not to be used.

4.33 Road-holding position light

4.33.1 A road-holding position light shall 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.

4.33.2 A road-holding position light *should* be provided at each road-holding position serving a runway when it is intended that the runway will be used in runway visual range conditions of values between 350 m and 550 m.

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

4.33.4 The road-holding position light shall comprise:

(a) a controllable red (stop)/green (go) traffic light; or
(b) a flashing-red light.

Note. — It is intended that the lights specified in sub-paragraph a) be controlled by the air traffic services.

4.33.5 The road-holding position light beam shall be unidirectional and aligned so as to be visible to the driver of a vehicle approaching the holding position.

4.33.6 The intensity of the light beam shall be adequate for the conditions of visibility and ambient light in which the use of the holding position is intended but shall not dazzle the driver.

Note. — The commonly used traffic lights are likely to meet the requirements in 4.33.5 and 4.33.6.

4.33.7 The flash frequency of the flashing-red light shall be between 30 and 60 flashes per minute.

4.34 No-entry bar

Note 1. — A no-entry bar is intended to be controlled manually by air traffic services.

Note 2. — Runway incursions may take place in all visibility or weather conditions. The provision of no-entry bars at taxiway/runway intersections and their use at night and in all visibility, conditions can form part of effective runway incursion prevention measures.

4.34.1 A no-entry bar *should* be provided across a taxiway which is intended to be used as an exit only taxiway to assist in preventing inadvertent access of traffic to that taxiway.

4.34.2 A no-entry bar *should* be located across the taxiway at the end of an exit only taxiway where it is desired to prevent traffic from entering the taxiway in the wrong direction.

4.34.3 A no-entry bar *should* consist of unidirectional lights spaced at uniform intervals of no more than 3m showing red in the intended direction(s) of approach to the runway.

Note. — Where necessary to enhance conspicuity, extra lights are installed uniformly.

4.34.4 A pair of elevated lights *should* be added to each end of the no-entry bar where the in-pavement no entry bar lights might be obscured from a pilot's view, for example, by snow or rain, or where a pilot may be required to stop the aircraft in a position so close to the lights that they are blocked from view by the structure of the aircraft.

4.34.5 The intensity in red light and beam spreads of no-entry bar lights shall be in accordance with the specifications in *Annex 14 Appendix 2, Figures A2-12 through A2-16*, as appropriate.

4.34.6 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 *should* be in accordance with the specifications of *Annex 14 Appendix 2, Figure A2-17, A2-18 or A2-19*.

Note. — High-intensity no-entry bars are typically used only in case of an absolute necessity and following a specific study.

4.34.7 Where a wide beam fixture is required, the intensity in red light and beam spreads of no-entry bar lights *should* be in accordance with the specifications of *Annex 14 Appendix 2, Figure A2-17 or A2-19*.

4.34.8 The lighting circuit shall 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, shall 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 shall be extinguished.

4.35 Runway status lights

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.

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

Note. — Where two or more runway-holding positions are provided, the runway-holding position referred is that closest to the runway.

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

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

Note. — Additional THLs may be similarly provided at the starting point of the take-off roll.

4.35.4 Where provided, RELs shall consist of a single line of fixed in pavement lights showing red in the direction of aircraft approaching the runway.

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

4.35.6 Intensity and beam spread of RELs shall be in accordance with the specifications of *Annex 14 Appendix 2, Figures A2-12 and A2-14.*

Note. — Consideration for reduced beam width may be required for some REL lights at acute angled runway/taxiway intersections to ensure the RELs are not visible to aircraft on the runway.

4.35.7 Where provided, THLs shall consist of two rows of fixed in pavement lights showing red facing the aircraft taking off.

4.35.8 THLs shall illuminate as an array on the runway less than two seconds after the system determines a warning is needed.

4.35.9 Intensity and beam spread of THLs shall be in accordance with the specifications of *Annex 14 Appendix 2, Figure A2-26.*

4.35.10 RELs and THLs *should* be automated to the extent that the only control over each system will be to disable one or both systems.

5.0 Signs

5.1 General

Note. — Signs shall be either fixed message signs or variable message signs. Additional guidance on signs is contained in the Aerodrome Design Manual (Doc 9157), Part 4.

5.1.1 Signs shall 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 a surface movement guidance and control system (SMGCS).

Note. — See 3.19 for specifications on information marking.

5.1.2 A variable message sign *should* be provided where:

(a) the instruction or information displayed on the sign is relevant only during a certain period of time; and/or
(b) there is a need for variable predetermined information to be displayed on the sign.

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

5.1.4 Signs shall be rectangular, as shown in Figures 28 and 29 with the longer side horizontal.

5.1.5 The only signs on the movement area utilizing red shall be mandatory instruction signs.

5.1.6 The inscriptions on a sign shall be in accordance with the provisions of Annex *14 Appendix 4*.

Table 5 - Location distances for taxiing guidance signs including runway exit signs

Sign height (mm)				Perpendicular distance from defined taxiway pavement edge to near side of sign	Perpendicular distance from defined runway pavement edge to near side of sign
Code number	Legend	Face (min)	Installed (max)		
1 or 2	200	400	700	5-11m	3-10m
1 or 2	300	600	900	5-11m	3-10m
3 or 4	300	600	900	11-21m	8-15m
3 or 4	400	800	1100	11-21m	8-15m

5.1.7 Signs shall be illuminated in accordance with the provisions of *Annex 14 Appendix 4* 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.

5.1.8 Signs shall be retroreflective and/or illuminated in accordance with the provisions of Annex 14 Appendix 4 when intended for use at night in association with non-instrument runways where the code number is 1 or 2.

5.1.9 A variable message sign shall show a blank face when not in use.

5.1.10 In case of failure, a variable message sign shall not provide information that could lead to unsafe action from a pilot or a vehicle driver.

5.1.11 The time interval to change from one message to another on a variable message sign *should* be as short as practicable and *should* not exceed 5 seconds.

5.2 Mandatory instruction signs

Note. — See Figure 28 for pictorial representation of mandatory instruction signs and Figure 30 for examples of locating signs at taxiway/runway intersections.

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

5.2.2 Mandatory instruction signs shall include runway designation signs, category I, II or III holding position signs, runway-holding position signs, road-holding position signs and NO ENTRY signs.

Note. — See 5.7 for specifications on road-holding position signs.

5.2.3 A pattern “A” runway-holding position marking shall be supplemented at a taxiway/runway intersection or a runway/runway intersection with a runway designation sign.

5.2.4 A pattern “B” runway-holding position marking shall be supplemented with a category I, II or III holding position sign.

5.2.5 A pattern “A” runway-holding position marking at a runway-holding position established in accordance with SD-AD appendix 2 shall be supplemented with a runway-holding position sign.

Note. — See 3.12 for specifications on runway-holding position marking.

5.2.6 A runway designation sign at a taxiway/runway intersection *should* be supplemented with a location sign in the outboard (farthest from the taxiway) position, as appropriate.

Note. — See 5.3 for characteristics of location signs.

5.2.7 A NO ENTRY sign shall be provided when entry into an area is prohibited.

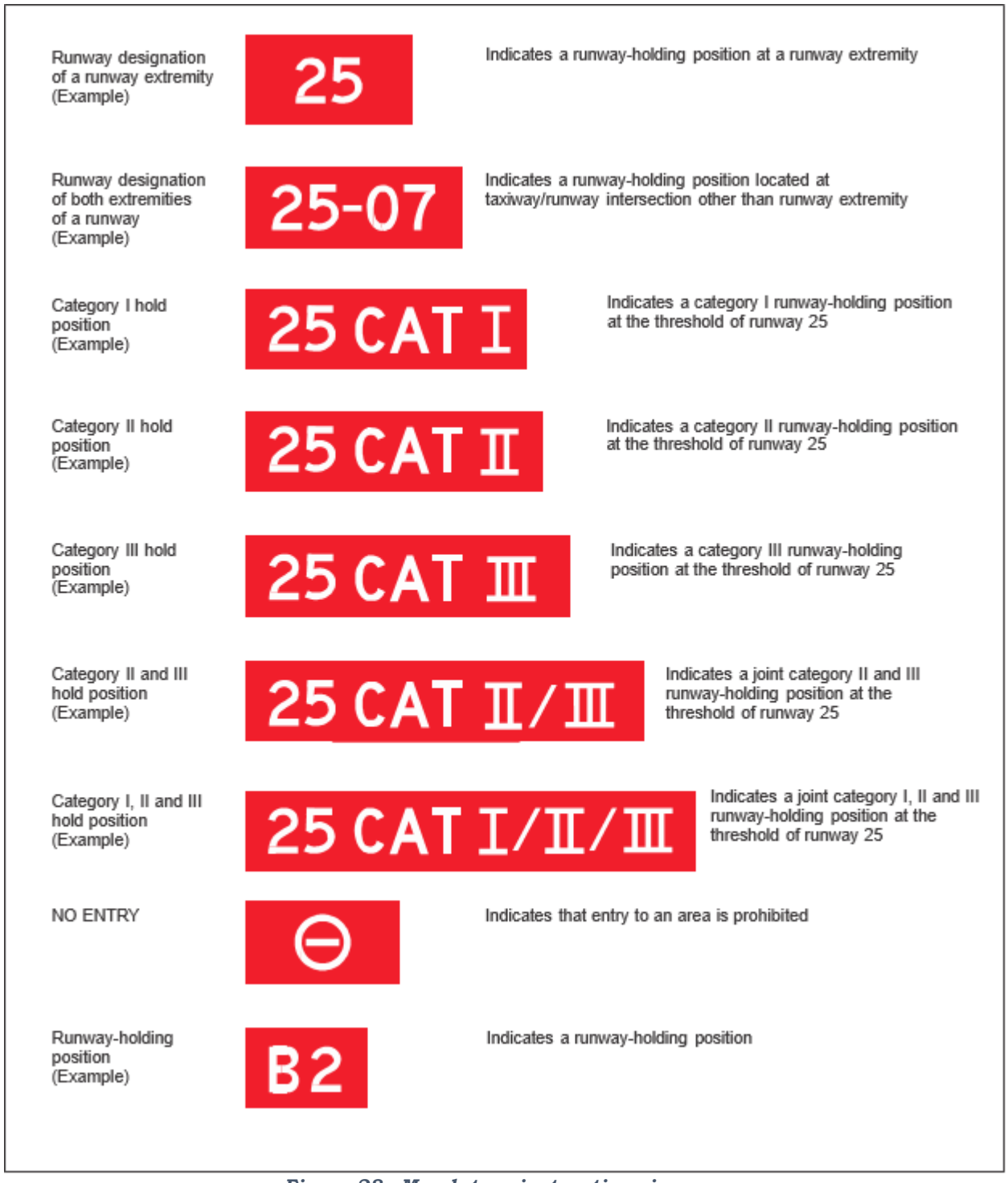


Figure 28 - Mandatory instruction signs

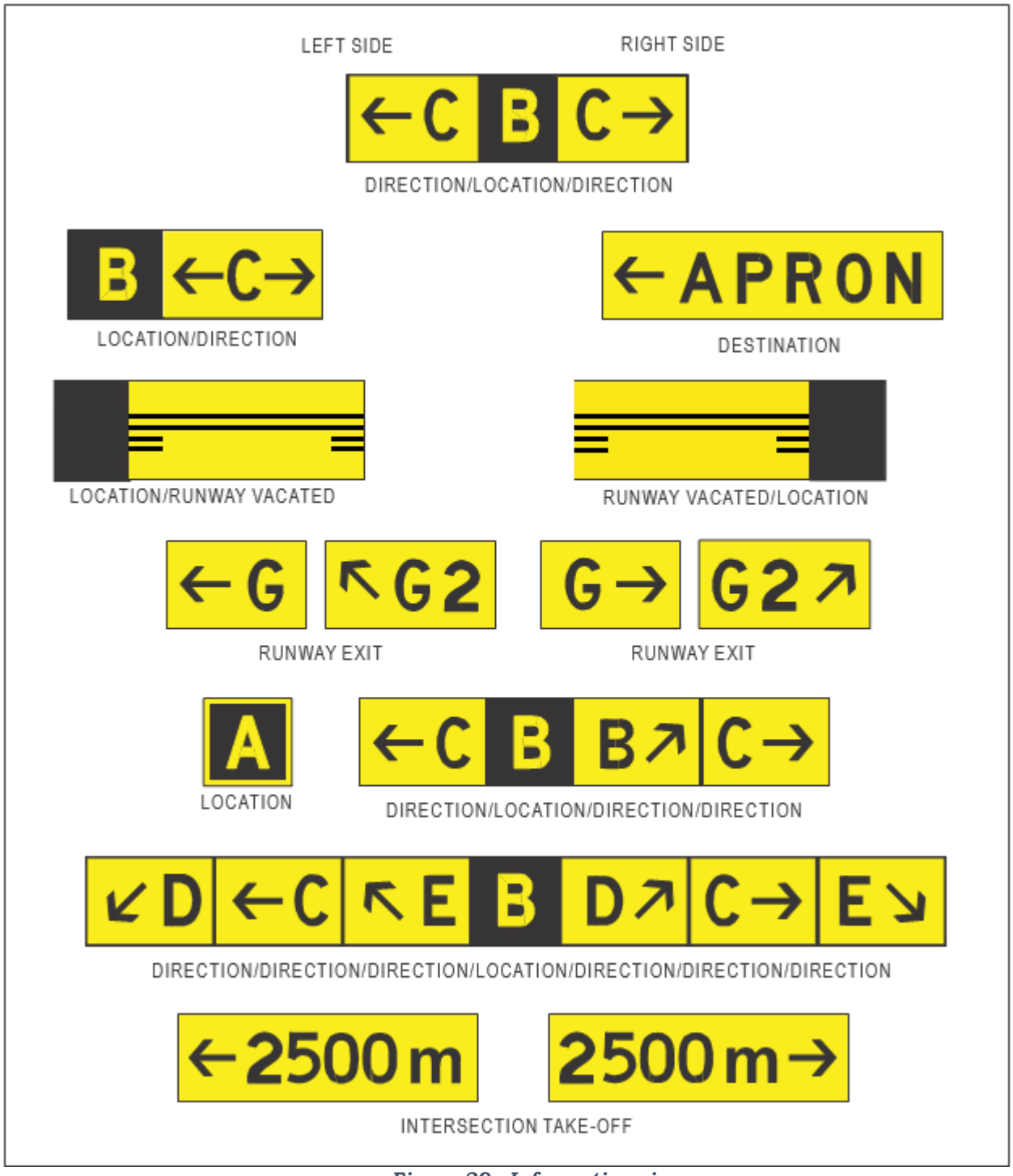


Figure 29 - Information signs

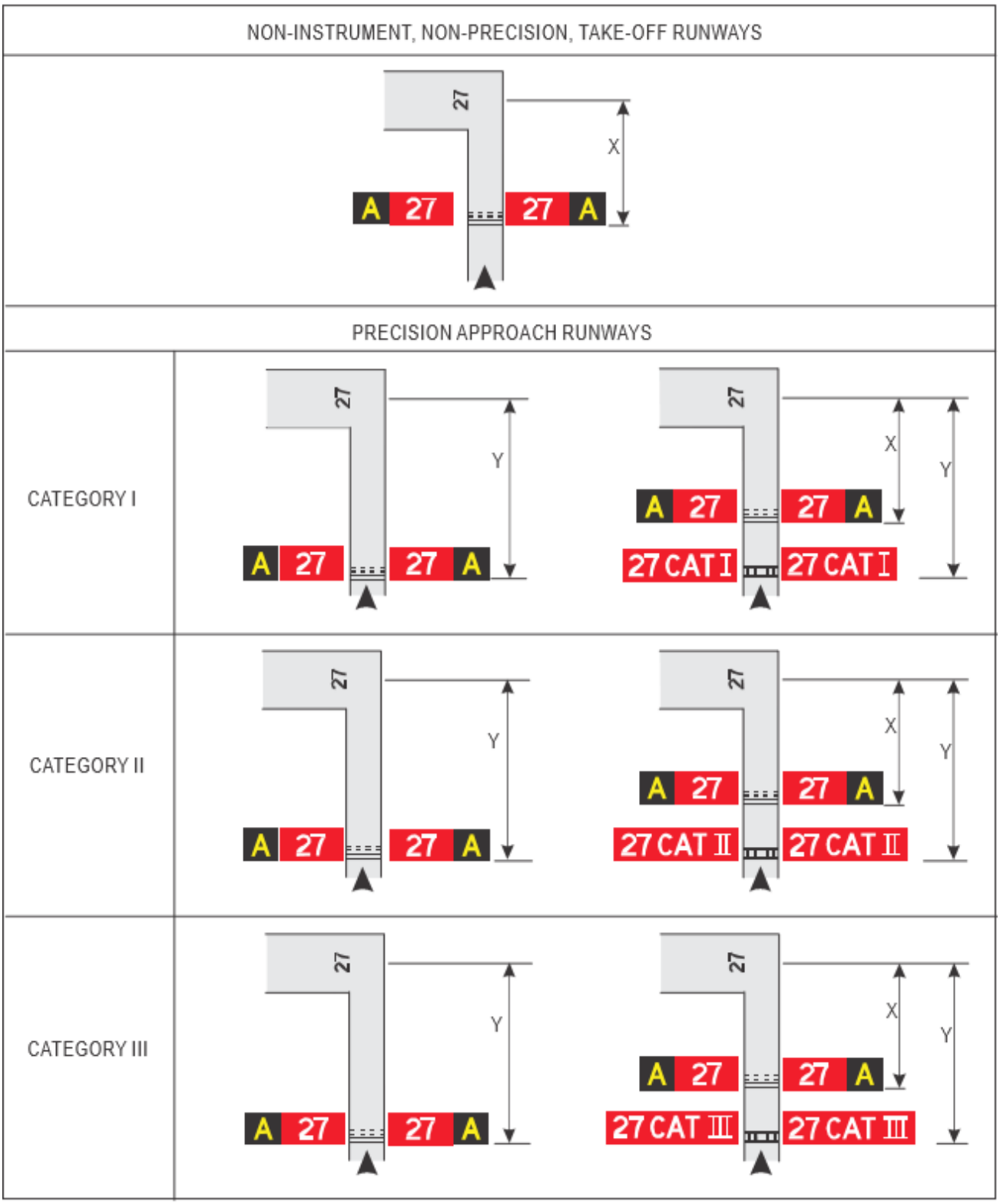


Figure 30 - Examples of sign positions at taxiway/runway intersections

Note - Distance X is established in accordance with SD-AD appendix 2 Table 2. Distance Y is established at the edge of the ILS/MLS critical/sensitive area.

5.2.8 A runway designation sign at a taxiway/runway intersection or a runway/runway intersection shall be located on each side of the runway-holding position marking facing the direction of approach to the runway.

5.2.9 A category I, II or III holding position sign shall be located on each side of the runway-holding position marking facing the direction of the approach to the critical area.

5.2.10 A NO ENTRY sign shall be located at the beginning of the area to which entrance is prohibited on each side of the taxiway as viewed by the pilot.

5.2.11 A runway-holding position sign shall be located on each side of the runway-holding position established in accordance with SD-AD Appendix 2 (10.3), facing the approach to the obstacle limitation surface or ILS/MLS critical/sensitive area, as appropriate.

5.2.12 A mandatory instruction sign shall consist of an inscription in white on a red background.

5.2.13 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 *should* be supplemented by a black outline measuring 10mm in width for runway code numbers 1 and 2, and 20mm in width for runway code numbers 3 and 4.

5.2.14 The inscription on a runway designation sign shall 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.

5.2.15 The inscription on a category I, II, III, joint II/III or joint I/II/III holding position sign shall consist of the runway designator followed by CAT I, CAT II, CAT III, CAT II/III or CAT I/II/III, as appropriate.

5.2.16 The inscription on a NO ENTRY sign shall be in accordance with Figure 28.

5.2.17 The inscription on a runway-holding position sign at a runway-holding position established in accordance with SD-AD appendix 2 shall consist of the taxiway designation and a number.

5.2.18 Where installed, the inscriptions/symbol of Figure 28 shall be used.

5.3 Information signs

Note. — See Figure 29 for pictorial representations of information signs.

5.3.1 An information sign shall be provided where there is an operational need to identify by a sign, a specific location, or routing (direction or destination) information.

5.3.2 Information signs shall include: direction signs, location signs, destination signs, runway exit signs, runway vacated signs and intersection take-off signs.

5.3.3 A runway exit sign shall be provided where there is an operational need to identify a runway exit.

5.3.4 A runway vacated sign shall 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.

Note. — See 4.23 for specifications on colour coding taxiway centre line lights.

5.3.5 An intersection take-off sign *should* be provided when there is an operational need to indicate the remaining take-off run available (TORA) for intersection take-offs.

5.3.6 Where necessary, a destination sign *should* be provided to indicate the direction to a specific destination on the aerodrome, such as cargo area, general aviation, etc.

5.3.7 A combined location and direction sign shall be provided when it is intended to indicate routing information prior to a taxiway intersection.

5.3.8 A direction sign shall be provided when there is an operational need to identify the designation and direction of taxiways at an intersection.

5.3.9 A location sign *should* be provided at an intermediate holding position.

5.3.10 A location sign shall be provided in conjunction with a runway designation sign except at a runway/runway intersection.

5.3.11 A location sign shall be provided in conjunction with a direction sign, except that it may be omitted where an aeronautical study indicates that it is not needed.

5.3.12 Where necessary, a location sign *should* be provided to identify taxiways exiting an apron or taxiways beyond an intersection.

5.3.13 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 *should* be used.

5.3.14 Except as specified in 5.3.16 and 5.3.24, information signs shall, wherever practicable, be located on the left-hand side of the taxiway in accordance with Table 5.

5.3.15 At a taxiway intersection, information signs shall 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 shall 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.

Note. — A location sign installed beyond a taxiway intersection may be installed on either side of a taxiway.

5.3.16 A runway exit sign shall 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 5.

5.3.17 A runway exit sign shall be located prior to the runway exit point in line with a position at least 60 m prior to the point of tangency where the code number is 3 or 4, and at least 30 m where the code number is 1 or 2.

5.3.18 A runway vacated sign shall be located at least on one side of the taxiway. The distance between the sign and the centre line of a runway shall 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.

5.3.19 Where provided in conjunction with a runway vacated sign, the taxiway location sign shall be positioned outboard of the runway vacated sign.

5.3.20 An intersection take-off sign shall be located at the left-hand side of the entry taxiway. The distance between the sign and the centre line of the runway shall be not less than 60 m where the code number is 3 or 4, and not less than 45 m where the code number is 1 or 2.

5.3.21 A taxiway location sign installed in conjunction with a runway designation sign shall be positioned outboard of the runway designation sign.

5.3.22 A destination sign *should* not normally be collocated with a location or direction sign.

5.3.23 An information sign other than a location sign shall not be collocated with a mandatory instruction sign.

5.3.24 A direction sign, barricade and/or other appropriate visual aid used to identify a ‘‘T’’ intersection *should* be located on the opposite side of the intersection facing the taxiway.

5.3.25 An information sign other than a location sign shall consist of an inscription in black on a yellow background.

5.3.26 A location sign shall consist of an inscription in yellow on a black background and where it is a stand-alone sign shall have a yellow border.

5.3.27 The inscription on a runway exit sign shall consist of the designator of the exit taxiway and an arrow indicating the direction to follow.

5.3.28 The inscription on a runway vacated sign shall depict the pattern A runway-holding position marking as shown in Figure 29.

5.3.29 The inscription on an intersection take-off sign shall 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 29.

5.3.30 The inscription on a destination sign shall comprise an alpha, alphanumerical or numerical message identifying the destination plus an arrow indicating the direction to proceed as shown in Figure 29.

5.3.31 The inscription on a direction sign shall comprise an alpha or alphanumerical message identifying the taxiway(s) plus an arrow or arrows appropriately oriented as shown in Figure 29.

5.3.32 The inscription on a location sign shall comprise the designation of the location taxiway, runway or other pavement the aircraft is on or is entering and shall not contain arrows.

5.3.33 Where it is necessary to identify each of a series of intermediate holding positions on the same taxiway, the location sign *should* consist of the taxiway designation and a number.

5.3.34 Where a location sign and direction signs are used in combination:

(a) All direction signs related to left turns shall be placed on the left side of the location sign, and all direction signs related to right turns shall 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 shall 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 shall be placed next to the location sign where the direction of the location taxiway changes significantly beyond the intersection; and
(d) adjacent direction signs shall be delineated by a vertical black line as shown in Figure 29.

5.3.35 A taxiway shall be identified by a designator comprising a letter, letters or a combination of a letter or letters followed by a number.

5.3.36 When designating taxiways, the use of the letters I, O or X and the use of words such as inner and outer *should* be avoided wherever possible to avoid confusion with the numerals 1, 0 and closed marking.

5.3.37 The use of numbers alone on the manoeuvring area shall be reserved for the designation of runways.

5.4 VOR aerodrome checkpoint sign

5.4.1 When a VOR aerodrome checkpoint is established, it shall be indicated by a VOR aerodrome checkpoint marking and sign.

Note. — See 3.14 for VOR aerodrome checkpoint marking.

5.4.2 A VOR aerodrome checkpoint sign shall 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.

5.4.3 A VOR aerodrome checkpoint sign shall consist of an inscription in black on a yellow background.

5.4.4 The inscriptions on a VOR checkpoint sign *should* be in accordance with one of the alternatives shown in Figure 31 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 should 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.*

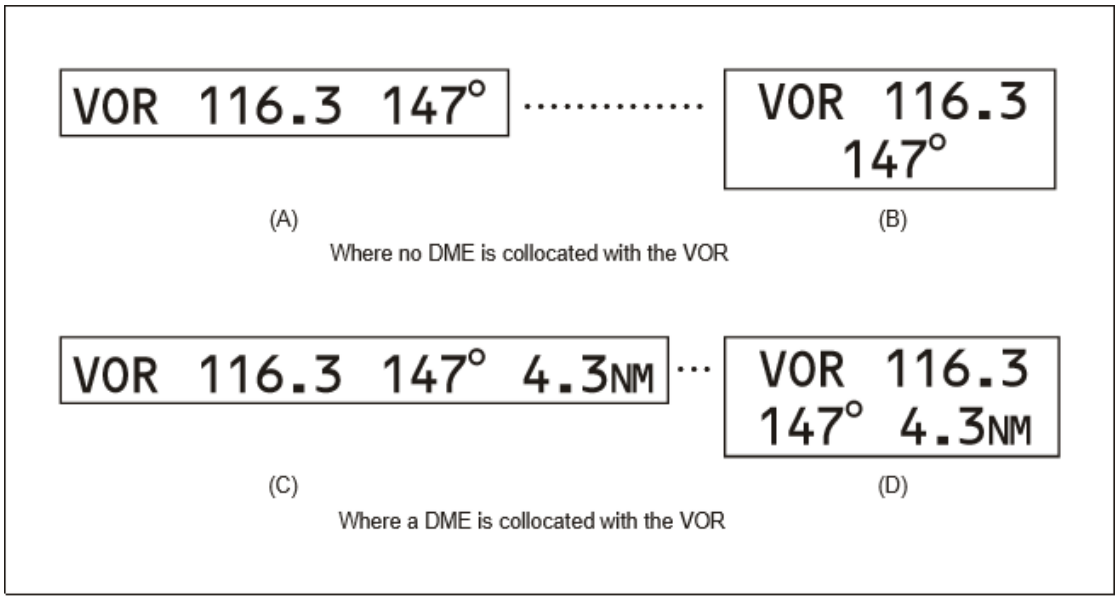


Figure 31 - VOR aerodrome checkpoint sign

Note. — Tolerances for the bearing value shown on the sign are given in Annex 10, Volume I, Attachment E. It will be noted that a checkpoint can only be used operationally when periodic checks show it to be consistently within ±2 degrees of the stated bearing.

5.5 Aerodrome identification sign

5.5.1 An aerodrome identification sign *should* be provided at an aerodrome where there is insufficient alternative means of visual identification.

5.5.2 The aerodrome identification sign *should* be placed on the aerodrome so as to be legible, in so far as is practicable, at all angles above the horizontal.

5.5.3 The aerodrome identification sign shall consist of the name of the aerodrome.

5.5.4 The colour selected for the sign *should* give adequate conspicuity when viewed against its background.

5.5.5 The characters *should* have a height of not less than 3m.

5.6 Aircraft stand identification signs

5.6.1 An aircraft stand identification marking *should* be supplemented with an aircraft stand identification sign where feasible.

5.6.2 An aircraft stand identification sign *should* be located so as to be clearly visible from the cockpit of an aircraft prior to entering the aircraft stand.

5.6.3 An aircraft stand identification sign *should* consist of an inscription in black on a yellow background.

5.7 Road-holding position sign

5.7.1 A road-holding position sign shall be provided at all road entrances to a runway.

5.7.2 The road-holding position sign shall 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.

5.7.3 A road-holding position sign shall consist of an inscription in white on a red background.

5.7.4 The inscription on a road-holding position sign shall 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:
    1) a requirement to obtain ATC clearance; and
    2) location designator.

Note. — Examples of road-holding position signs are contained in the Aerodrome Design Manual (Doc 9157), Part 4.

5.7.5 A road-holding position sign intended for night use shall be retroreflective or illuminated.

6.0 Markers

6.1 General

6.1.1 Markers shall be frangible. Those located near a runway or taxiway shall be sufficiently low to preserve clearance for propellers and for the engine pods of jet aircraft.

Note 1. — Anchors or chains, to prevent markers which have broken from their mounting from blowing away, are sometimes used.

Note 2. — Guidance on frangibility of markers is given in the Aerodrome Design Manual (Doc 9157), Part 6.

6.2 Unpaved runway edge and runway end markers

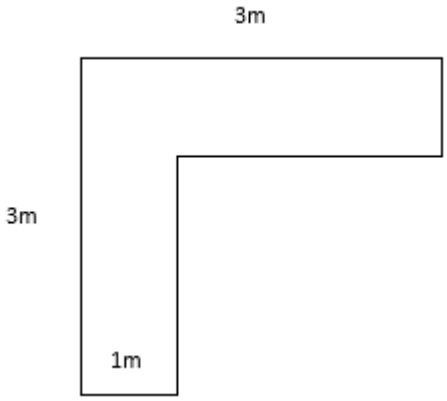
6.2.1 Markers should be provided when the extent of an unpaved runway is not clearly indicated by the appearance of its surface compared with that of the surrounding ground.

6.2.2 Where runway lights are provided, the markers *should* be incorporated in the light fixtures. Where there are no lights, markers of flat rectangular or conical shape *should* be placed so as to delimit the runway clearly.

6.2.3 The flat rectangular markers *should* have a minimum size of 1m by 3m and *should* be placed with their long dimension parallel to the runway centre line. The conical markers *should* have a height not exceeding 50cm.

6.2.4 Runway end markers shall be provided at the corner ends of an unpaved runway.

6.2.5 The markings should be flush and in the form of an “L”, white in colour and have a minimum size of 3m at its longest sides and 1m width.



6.3 Stopway edge markers

6.3.1 Stopway edge markers *should* be provided when the extent of a stopway is not clearly indicated by its appearance compared with that of the surrounding ground.

6.3.2 The stopway edge markers shall be sufficiently different from any runway edge markers used to ensure that the two types of markers cannot be confused.

Note. — Markers consisting of small vertical boards camouflaged on the reverse side, as viewed from the runway, have proved operationally acceptable.

6.4 Taxiway edge markers

6.4.1 Taxiway edge markers *should* be provided on a taxiway where the code number is 1 or 2 and taxiway centre line or edge lights or taxiway centre line markers are not provided.

6.4.2 Taxiway edge markers *should* be installed at least at the same locations as would the taxiway edge lights had they been used.

6.4.3 A taxiway edge marker shall be retroreflective blue.

6.4.4 The marked surface as viewed by the pilot *should* be a rectangle and *should* have a minimum viewing area of 150cm^2.

6.4.5 Taxiway edge markers shall be frangible. Their height shall be sufficiently low to preserve clearance for propellers and for the engine pods of jet aircraft.

6.5 Taxiway centre line markers

6.5.1 Taxiway centre line markers *should* be provided on a taxiway where the code number is 1 or 2 and taxiway centre line or edge lights or taxiway edge markers are not provided.

6.5.2 Taxiway centre line markers *should* be provided on a taxiway where the code number is 3 or 4 and taxiway centre line lights are not provided if there is a need to improve the guidance provided by the taxiway centre line marking.

6.5.3 Taxiway centre line markers *should* be installed at least at the same location as would taxiway centre line lights had they been used.

6.5.4 Taxiway centre line markers *should* normally be located on the taxiway centre line marking except that they may be offset by not more than 30cm where it is not practicable to locate them on the marking.

6.5.5 A taxiway centre line marker shall be retroreflective green.

6.5.6 The marked surface as viewed by the pilot *should* be a rectangle and *should* have a minimum viewing area of 20cm^2.

6.5.7 Taxiway centre line markers shall 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.

6.6 Unpaved taxiway edge markers

6.6.1 Where the extent of an unpaved taxiway is not clearly indicated by its appearance compared with that of the surrounding ground, markers *should* be provided.

6.6.2 Where taxiway lights are provided, the markers *should* be incorporated in the light fixtures. Where there are no lights, markers of conical shape *should* be placed so as to delimit the taxiway clearly.

6.7 Boundary markers

6.7.1 Boundary markers shall be provided at an aerodrome where the landing area has no runway.

6.7.2 Boundary markers shall be spaced along the boundary of the landing area at intervals of not more than 200m, if the type shown in Figure 32 is used, or approximately 90m, if the conical type is used with a marker at any corner.

6.7.3 Boundary markers *should* be of a form similar to that shown in Figure 32, or in the form of a cone not less than 50cm high and not less than 75cm in diameter at the base. The markers *should* be coloured to contrast with the background against which they will be seen. A single colour, orange or red, or two contrasting colours, orange and white or alternatively red and white, *should* be used, except where such colours merge with the background.

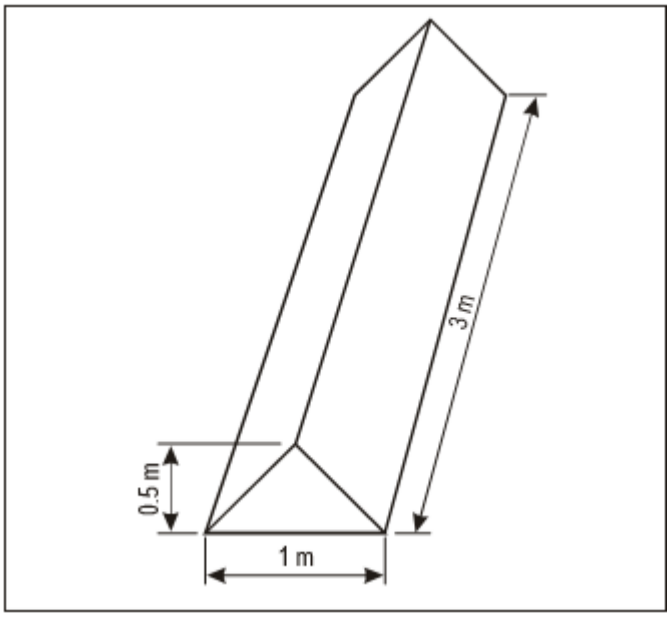


Figure 32 - Boundary markers