SIERRA LEONE CIVIL AVIATION AUTHORITY

ADVISORY CIRCULAR

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Visual Aids

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TABLE OF CONTENT

1 GENERAL

The Sierra Leone Civil Aviation Authority's Advisory Circulars contains information about standards, practices and procedures that the Authority has found to be an Acceptable Means of Compliance (AMC) with the associated Regulations.

An AMC is not intended to be the only means of compliance with a Regulation, and consideration will be given to other methods of compliance that may be presented to the Authority.

Information considered directive in nature is described in this AC in terms such as "shall" and "must", indicating the actions are mandatory. Guidance information is described in terms such as "should" and "may" indicating the actions are desirable or permissive, but not mandatory

1.1 Purpose

This Advisory Circular provides methods, acceptable to the Authority, for showing compliance with the Visual Aids requirements of the SLCAR Part 14A as well as explanatory and interpretative materials to assist in showing compliance.

1.2 Reference

(a) SLCAR's Part 14A – Aerodrome Design and Operations Standards

(b) SLCAR Part 14B - Heliports

(c) Doc 9137 – Part 4, Visual Aids

1.3 Status of this AC

This is the second AC to be issued on this subject.

2 OPERATING REQUIREMENTS

2.1 General

The operating requirements for visual aids varies according to the type of aircraft being flown, the meteorological conditions, the type of navigational aid used for the approach, the physical characteristics of the runway and taxiways, and whether or not landing information is available through radio communications.

2.2 Airport with Code Number 1 or 2

Airports designed for small single-engine and light-twin aircraft below 5,700 kg are often not provided with instrument approach aids or air traffic control facilities. Thus, at such airports, ground visual aids must satisfy all of the operating requirements of pilots. Some of these airports may not be provided with paved runway surfaces - a situation which adds to the problem of providing pilots with adequate visual aids.

The operating requirements are:

(i) airport location;

(ii) airport identification;

(iii) landing information:

a) wind direction and speed;

b) runway designation;

c) runway status - closed or usable;

(iv) circling guidance;

(v) final approach guidance to touchdown:

a) runway edge (where there is a lack on contrast between the runway edges and the shoulders, and for precision approach);

b) approach slope guidance;

c) aiming point guidance (paved instrument code 1 and 2);

d) runway centre line delineation;

Note - Runway centreline delineation is not feasible for unpaved runways. Such runways are normally used only in conditions of good visibility. Thus, centreline delineation is not as important as it is at airports where operations in low visibilities are authorized in conjunction with an instrument approach aid.

(vi) roll-out guidance:

a) runway centre line delineation

b) runway edge delineation(where there is a lack on contrast between the runway edges and the shoulders, and for precision approach);

c) exit taxiway location;

d) centre line delineation;

e) runway end indication (for night use);

(vii) taxiing guidance:

a) centre line delineation;

b) information signs to parking and servicing areas;

c) mandatory instruction signs;

(viii) departure information;

Note - the information needed is the same as that listed in (iii) above; however, pilots normally obtain all such information prior to leaving the Operations Office without reference to visual aids.

(ix) take-off guidance:

a) runway centre line delineation (see note under (v) d));

b) runway edge delineation;

c) runway end indication (for night use).

2.3 Airport with Code Number 3 or 4

(a) These airports are normally provided with radio navigation aids and air traffic control facilities requiring radio communications. When used in visual meteorological conditions (VMC) without these aids, the requirements for ground visual aids are required and are the same as those stated for Airports with code number 1 or 2. In addition, these airports should be provided with guidance systems to park aircraft on stands, as well as visual docking guidance systems at terminals equipped with passenger aerobridges. Effective apron illumination is needed, to assist in parking aircraft; to protect passengers moving to and from aircraft; and to facilitate aircraft servicing activities.

(b) Flights conducted in instrument meteorological conditions (IMC) require visual aids in addition to those listed above for Airport with code number 1 or 2. The visual aids together with non-visual guidance and control functions provide a complete approach, landing and taxiing system. Similarly, ground movements and departures are supported by a combination of visual and non-visual aids. The following additional operating requirements are related to the relevant visibility conditions applied to the four categories of instrument runways. For take-off operations there are additional considerations for runway edge and centre line lights.

2.3.1 Non-Precision Approach Runway

Final approach guidance to touchdown:

(i) Centre line alignment guidance for a distance of at least 420 m before the threshold.

(ii) An indication of distance 300 m before the threshold.

2.3.2 Precision Approach Runway - Category I

Final approach guidance to touchdown:

(i) Centre line alignment guidance for a distance of 900 m before the threshold.

(ii) An indication of distance 300 m before the threshold.

(iii)Touchdown zone guidance.

2.3.3 Precision Approach Runway - Category II

Final approach guidance to touchdown:

(i) Centre line alignment guidance for a distance of 900 m before the threshold.

(ii) Indications of distance 300 m and 150 m before the threshold.

(iii)Touchdown zone alignment guidance for a distance of 300 m before the threshold.

(iv)Touchdown zone guidance.

2.3.3.1 Roll-out guidance:

(i) Distance remaining information.

2.3.3.2 Taxiing guidance:

(i) Exit taxiway guidance including edge and centre line delineation.

(ii) Taxiway centre line delineation with change-of direction coding.

2.3.4 Precision Approach Runway - Category III

(a) The operating requirements for visual aids in Category III meteorological conditions are, from the standpoint of configuration for approach and landing, the same as those provided for Category II meteorological conditions. Photometric characteristics of lights adequate for Category I and II operations need to be modified to provide increased vertical coverage, especially for large “eye-to-wheel height” aircraft.

(b) Although pilots operating in Category III meteorological conditions are provided with the same visual aids used in Category II conditions, the time to obtain visual guidance from the system decreases in proportion to the lower meteorological conditions encountered during the approach. Visual guidance in the higher Category IIIA visibilities may be established with the approach lighting system, enabling the pilot to judge flight path with respect to alignment with the centre line. In Category IIIB and IIIC conditions, however, visual contact is not established until the aircraft is over or on the runway. It is not possible to judge the approach slope using visual aids in such low

(c) When operating on the surface in lower RVR conditions at major airports, additional visual signals are often needed. Two examples of these signals are stop bars and runway guard lights. This requirement also applies to major airports in better visibilities, but the requirement is stated in this section because the need is greatest when the visibility is lowest. Such systems are not visual guidance requirements but are aids to the control

of aircraft movements and help to prevent collisions between aircraft operating on the surface, with particular emphasis on separation of aircraft movements on the landing and take-off runways from other slow-moving taxiing aircraft.

3 AERONAUTICAL GROUND LIGHTING

3.1 General

Aeronautical Ground Lighting (AGL) is the generic term used to describe the various lighting systems that are provided on an aerodrome for the guidance of pilots operating aircraft both at night and in low visibility conditions. AGL systems vary in complexity from the basic patterns found at aerodromes where the code number is 1 or 2; in support of flight training operations, to the more advanced systems used in support of "all-weather operations", usually associated with an Instrument Landing System (ILS).

3.2 Aerodromes operated in compliance with the SLCAR Part 14A

Details of AGL, at these aerodromes, are notified in the Sierra Leone AIP and on the appropriate Instrument approach charts. Where the AGL provided at any of these aerodromes does not conform to the appropriate aerodrome entry in the Sierra Leone AIP or, if the deficiency is of a temporary nature, a Notice to Airmen (NOTAM) is issued detailing the AGL that is available.

AGLs should be inspected to ensure compliance with standards.

3.3 Colour and Intensity of Lights

(a) Unless otherwise indicated, AGL systems emit a steady white light. High intensity AGL systems that are provided in support of low visibility operations should have a facility to independently control the luminance intensity of each element of the system. The intensities are set up, usually by the air navigation service provider, to suit local conditions. A pilot may ask for the intensity of an element(s) of the system to be adjusted if found to be inappropriate for flight operations.

(b) The performance specification of high intensity lighting is defined by the need to provide guidance by day in low visibility conditions; the highest intensity settings are normally used in these conditions. Lower intensities are normally used by night.

(c) Low intensity systems are provided at those aerodromes at which operations are conducted at night but not in low visibility conditions; the luminance intensity of these systems is not normally adjustable.

3.4 Aerodrome Beacons

(a) An Aerodrome Beacon should be provided at those aerodromes that operate at night and where the level of background lighting, the surrounding terrain, the proximity of other aerodromes or lack of navigation aids would make the aerodrome difficult to locate or to identify. There are two types of Aerodrome Beacon: the Identification Beacon and the Location Beacon.

(b) An Identification Beacon flashing a two letter identification code in green would normally be provided at an aerodrome where a number of aerodromes in the same vicinity operate at night, and confusion could arise as to the aerodromes identity.

(c) A Location Beacon should be provided at an aerodrome that is situated well away from other aerodromes and where no confusion could exist as to its identification. The signal produced by a Location Beacon is determined by the amount of background lighting as follows:

(i) Where the aerodrome is also situated well away from areas of high background lighting, the Location Beacon would display a flashing light.

(ii) Where the aerodrome is situated in an area where there is a high level of background lighting, such as in the vicinity of a city where a flashing light would be difficult to see, the Location Beacon would display a green light flashing alternately with a white light.

3.5 Approach Lighting

(a) A variety of approach lighting systems based on the centre line and cross bar concept, is being used globally. These systems range from the simple low intensity centre line and cross bar-shown at Figure 1.1, intended to serve visual runways at night only, to the more CAT II/III approach lighting system comprising centreline and cross bars-shown at Figure 1.3 and 1.4 for day and night use on ILS equipped runways.

(b) Simple approach lighting systems normally commence 420m prior to the runway threshold whilst the full CAT II/III approach lighting system commences 900m prior to the runway threshold. Where, because of the geography of the approach, it is not possible to install a full system, a shortened system is employed and the Runway Visual Range (RVR) minima associated with the instrument approach procedure adjusted accordingly. Except where supplemented by red side barrettes as described below, approach lighting is white in colour.

Figure 1.1

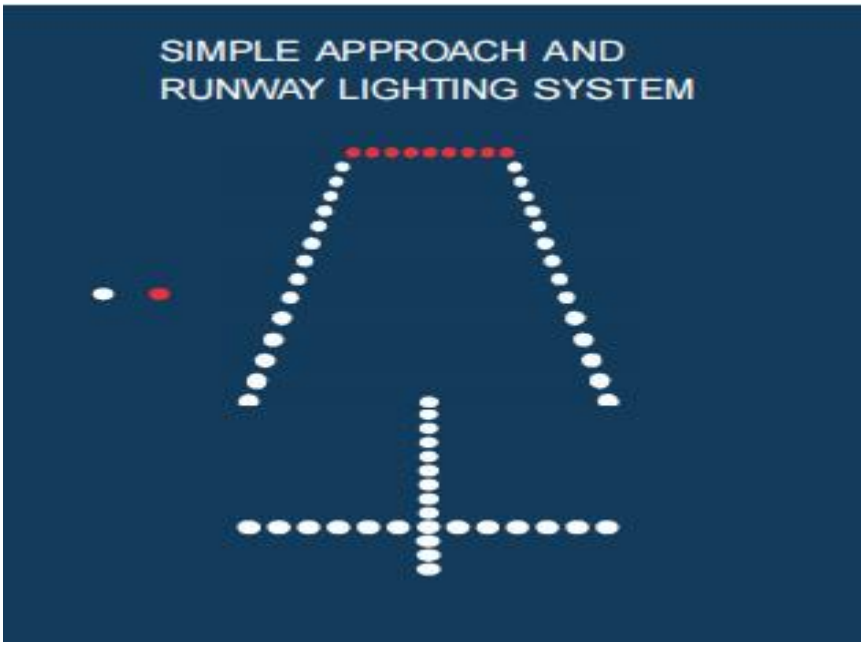


Figure 1.2

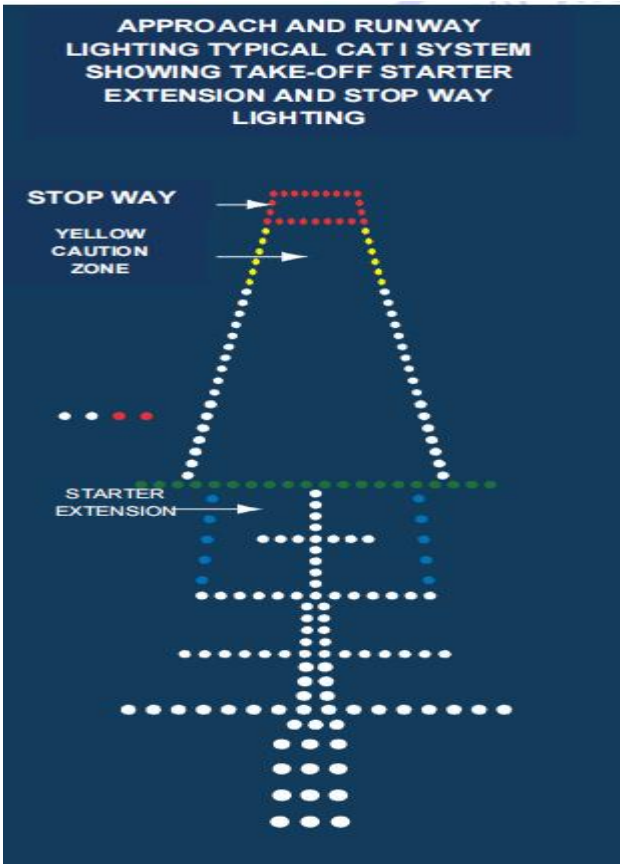
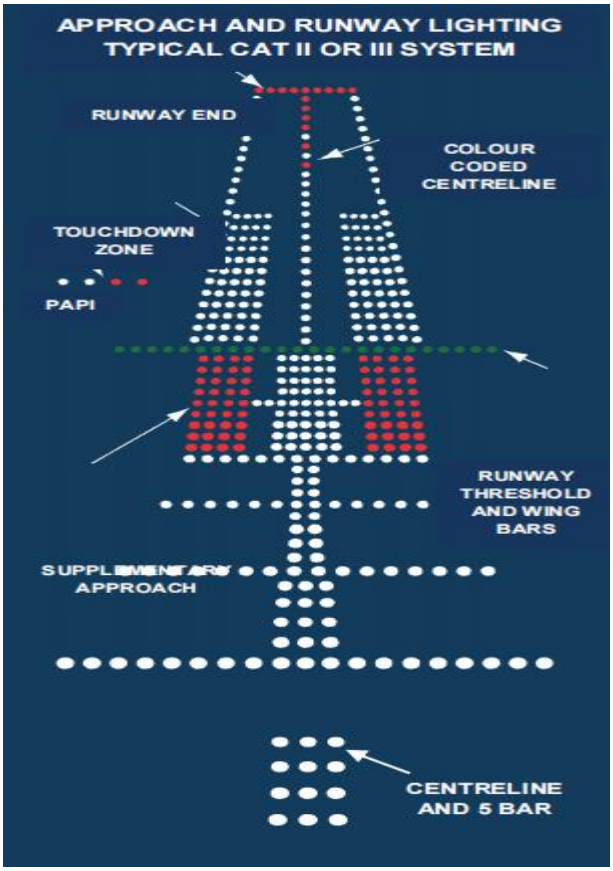


Figure 1.3



3.6 Supplementary Approach Lighting

(a) At those aerodromes where Category II and III approaches are conducted, Supplementary Approach Lighting consisting of centreline barrettes and two rows of red side barrettes, as shown in Figure 1.3, is installed in order to provide the pilot with enhanced visual cues over the last 300m of the approach.

Note **-** At certain aerodromes with displaced thresholds, the supplementary approach lighting is inset into the runway and in certain weather and ambient light conditions the centreline barrettes, at the higher intensities settings, can partially obscure the runway centreline lighting to pilots lining up for departure. Pilots experiencing problems of this nature should ask for the intensity of the supplementary lighting to be adjusted or extinguished.

3.7 Precision Approach Path Indicator (PAPI)

(a) This visual aid provides approach slope guidance by use of red and white light signals which are interpreted as illustrated at Figure 1.4. The PAPI normally comprises a single

row of 4 light units. The system is normally installed on the left side of the runway as seen from the approach.

(b) The PAPI signal is not designed to be used beyond 15° either side of the runway centreline.

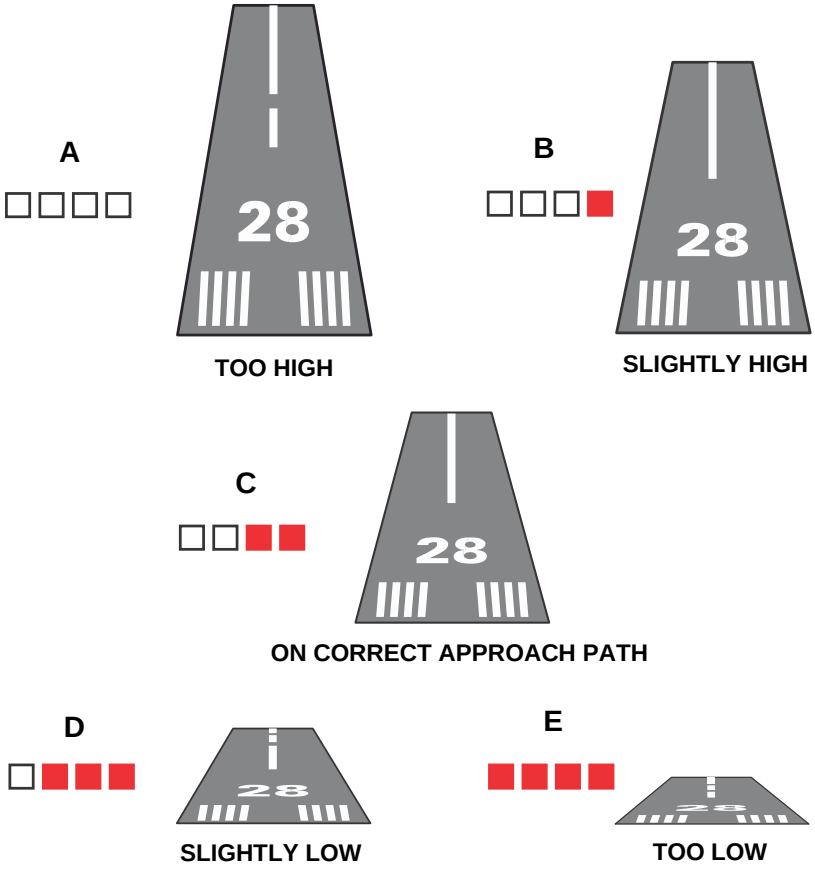
Note – where obstacles located at the extremities of the visual signal preclude the provision of safe clearance, the appropriate aerodrome entry made in the Sierra Leone AIP will be annotated to that effect.

The Minimum Eye Height over Threshold (MEHT), which is notified in the AIP, is a reference value, calculated with respect to the promulgated approach angle for each PAPI. It is the lowest eye height over the runway threshold at which an on-slope indication will be seen.

(c) A typical eye height achieved in practice when crossing the threshold following well established "on slope" approach would in fact be well above the published MEHT value.

(d) Where used together with ILS, PAPI is located so as to ensure, as far as is practicable, correlation between the two approach paths. However, such a siting is made on the assumption that the pilot's eye level is above the ILS glide path receiver aerial, as is the case with most commercial aircraft. Pilots of aircraft in which the ILS aerial is mounted above the level of the pilot's eye may see a PAPI indication 'slightly low' (see Figure 1.4D) when on the ILS glide path.

Figure 1.4 - A Typical PAPI System



3.8 Runway Lighting

All runways intended for night use have Edge, Threshold and End Lighting. Centreline and Touchdown Zone Lighting is provided as additional guidance in support of low visibility operations.

3.8.1 Runway Edge Lighting

Runway Edge Lighting is located along the edges of the area declared for use as the runway delineated by white edge markings, and may be provided either by elevated or by flush fitting lamp fixtures. Where elevated runway edge lights are employed, the light fixtures may be located on the grass shoulder just beyond the declared runway width. Portable battery operated lights may be used in place of fixed lamp fittings at aerodromes where the code number is 1 or 2, with limited night operations. Runway Edge lighting is white.

3.8.1.1 Pre-Threshold Lighting

Where a landing is displaced, but the pre-threshold area is available for the take-off run, the lights between the beginning of the runway pavement and the displaced threshold shows red from the approach, as illustrated at Figure 1.5. Pilots taking off in such a situation would see red edge lights up to green threshold lights and white edge lights beyond.

3.8.1.2 Runway Exit Lighting

One or two omni-directional blue lights may replace or supplement the edge lights in order to indicate an exit taxiway.

3.8.1.3 Stopway Lighting

Where stopway is provided at the end of a runway, the declared stopway is delineated by red edge and end lighting as illustrated in Figure 1.5 showing ONLY in the direction of landing. A stop-way is provided for emergency use only and is not suitable for routine use.

3.8.2 Runway Threshold and Runway End Lighting

Runway threshold lighting is green and indicates the start of the available landing distance. Green threshold wing-bars are provided at certain aerodromes where there is a need to accentuate the threshold. Runway end lighting is red and marks the extremity of the runway that is available for manoeuvring. Pilots should not land before the green threshold lighting nor continue a landing roll or taxi beyond the red runway end lights.

3.8.3 Runway Centreline Lighting

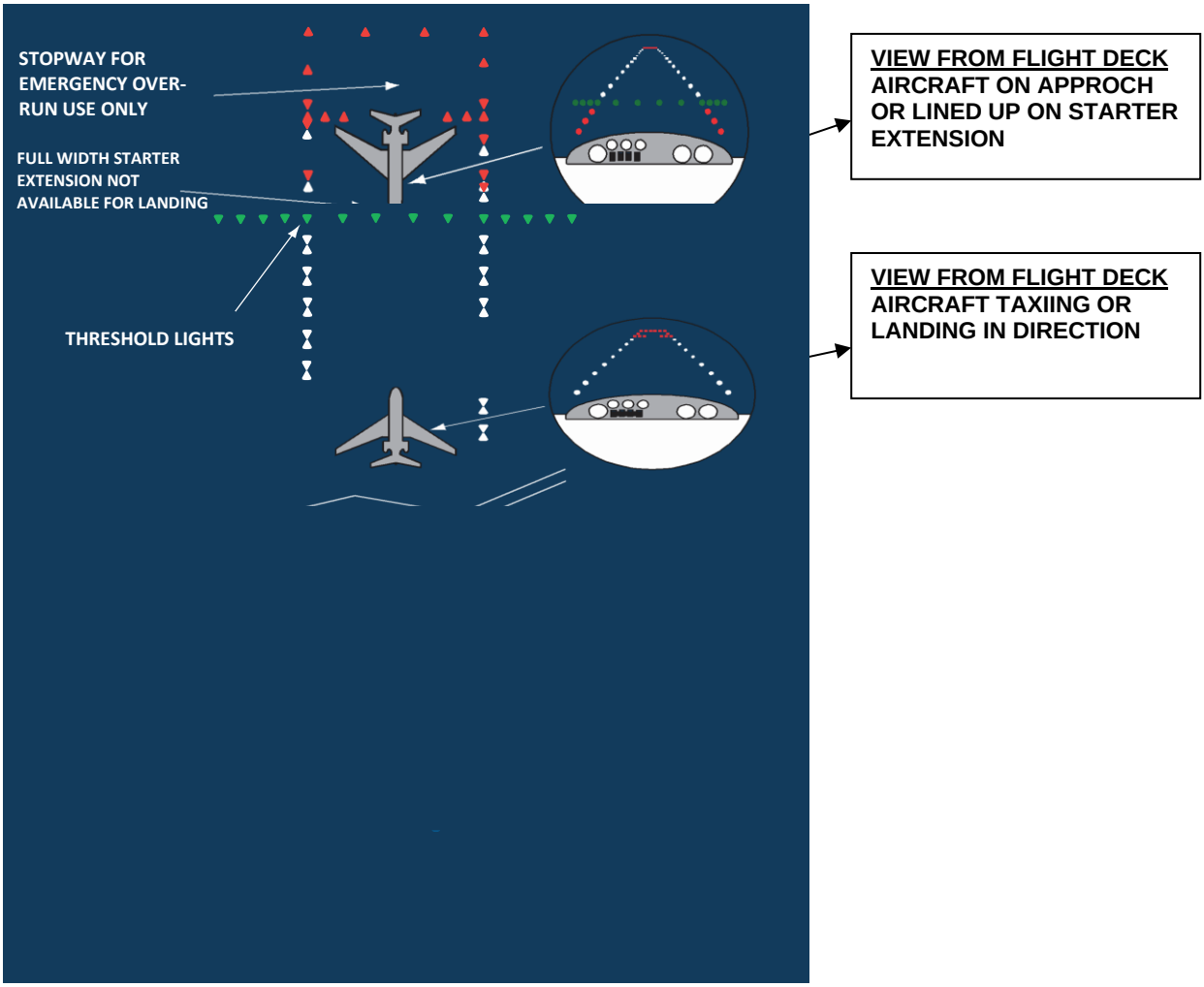
High intensity centreline lighting should be provided in addition to edge lighting on runways equipped for low visibility operations. The centreline lighting is colour coded in order to warn a pilot of the approaching end of the runway. White centreline lighting extends from the threshold to 900m from the runway end, the following 600m is lit with alternate white and red lights, and the final 300m lit by red centreline lighting.

3.8.4 Touchdown Zone (TDZ) Lighting

On runways equipped for Category II and III approaches, additional lighting consisting of two rows of white barrettes, as shown in Figure 1.3, is installed in order to provide textual cues in the touchdown area. The additional lighting extends from the threshold either for 900m or to the midpoint of the runway less than 1800m in length.

Note *- length of the TDZ lighting (normally 900m) determines the length of the Obstacle Free Zone (OFZ) established to protect CAT II and III approaches below decision height (DH) and in the event of a balked landing (or go-around) after DH. A go-around initiated beyond the end of the TDZ lighting is unlikely to be contained within the OFZ*

Figure 1.5 - Runway Edge, Threshold and Edge Lighting

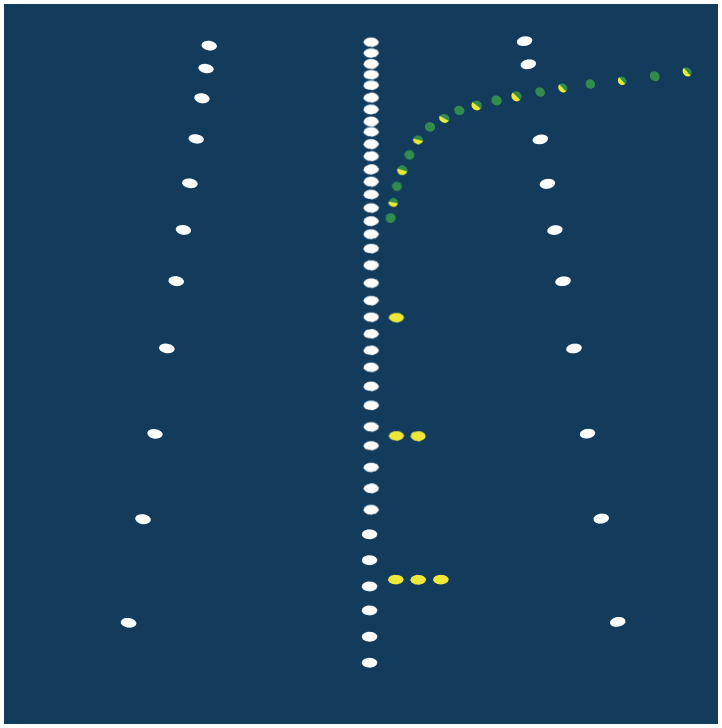


3.8.5 Rapid Exit Taxiway Indicator Lights

Rapid Exit Taxiway Indicator Lights (RETILs) 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.

RETILs consist of six yellow lights adjacent to the runway centerline and configured in a three/two/one pattern spaced 100 m apart; the single light is 100 m from the start of the turn for the rapid exit taxiway, see Figure 1.6.

Figure 1.6 - Rapid Exit Taxiway Indicator Lights



3.9 Taxiway Lighting

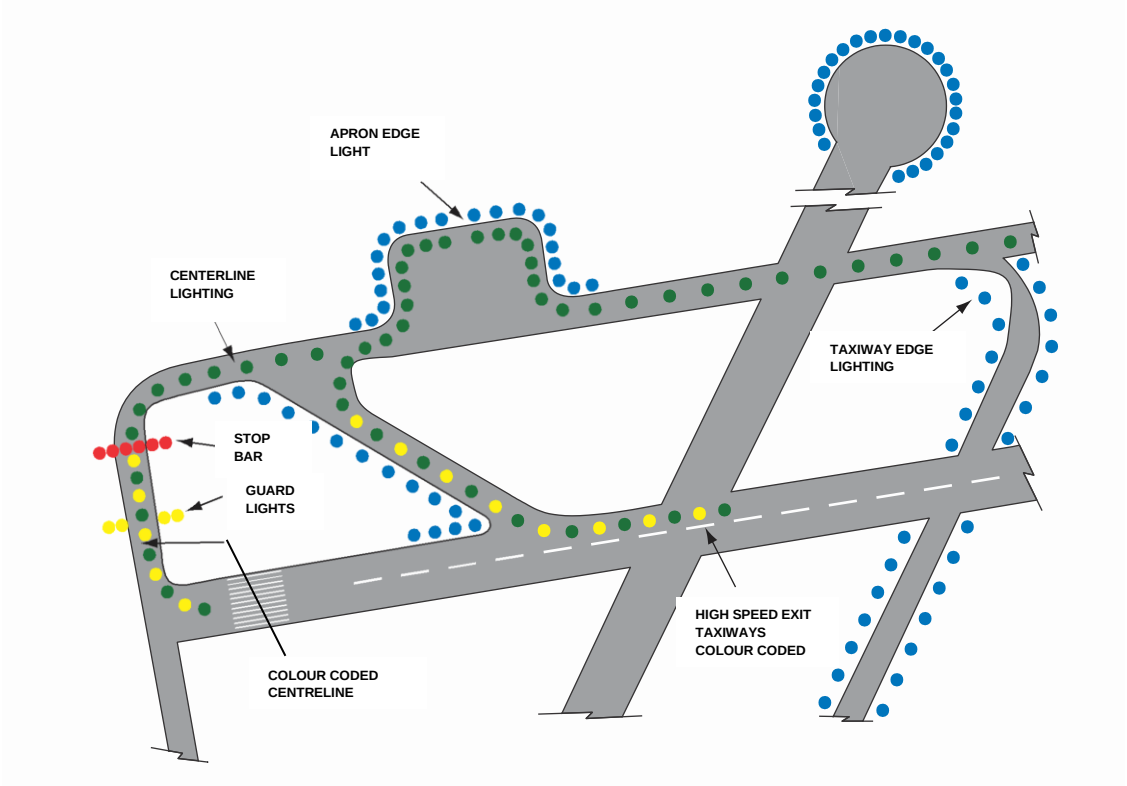
(a) At those aerodromes equipped for low visibility operations, taxiways should be equipped with green centreline lighting, otherwise blue edge lighting is provided, as shown in Figure 1.7. Where green centreline lighting is provided, blue taxiway edge lighting may also be installed as additional guidance on sections of taxiway that are difficult to negotiate. Green taxiway centreline lighting may be provided on the runway prior to an exit taxiway in order to give lead-off guidance. However, the edge of aprons, turning and holding areas are normally marked by blue lighting.

Note 1 - *Where centreline lighting is installed on a taxiway leading onto a runway, the taxiway lighting is curved onto the near side of the runway centreline and pilots should make an appropriate allowance for any loss of Runway Declared Distance incurred in following the 'Taxiway centreline ' lighting whilst lining up for take-off.*

Note 2 - *Taxiway centreline are intended to provide safe clearance between the largest aircraft that the taxiway is designed to accommodate and fixed objects such as buildings, aircraft stands etc., provided that the pilot of the taxiing aircraft keeps the 'Cockpit' of the aircraft on the centreline and that aircraft on stands are properly parked. Taxi Holding Positions are normally located so as to ensure clearance between an aircraft holding and any aircraft passing in front of the holding aircraft, provided that the holding aircraft is properly positioned behind the holding position. Clearance to the rear of any holding aircraft cannot be guaranteed. When following a taxiway route, pilots and persons towing aircraft are expected to keep a good lookout,*

consistent with prevailing visibility and are responsible for taking all possible measures to avoid a collision with another aircraft or a vehicle.

Figure 1.7 - Taxiway Lighting

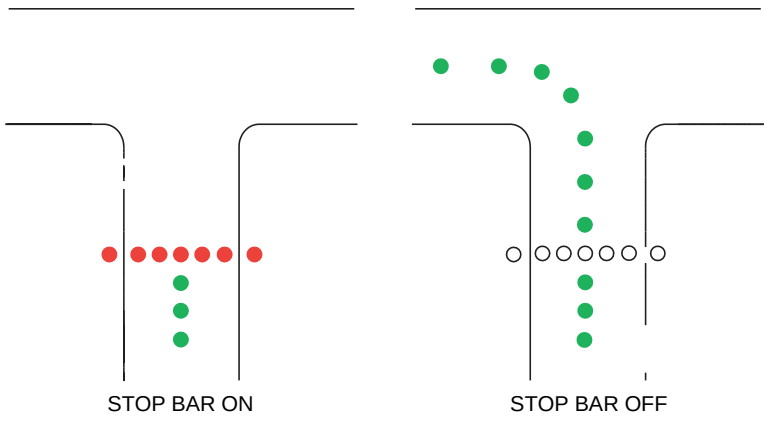


3.9.1 Stop Bars and Taxiway centreline Lights

Lighted Stop Bars and Taxiway centreline Lights are provided at aerodromes authorised for low visibility operations. A Stop bar consists of a row of lights spaced equally across the taxiway normally at right angles to the centreline and showing red towards an approaching aircraft when lit. Stop Bars are normally installed in association with green Taxiway centreline lights which form part of the taxiway centreline lighting beyond the Stop Bar. The Taxiway centreline lights are interlinked with the Stop Bar so that when the Stop Bar is 'on' the green centreline beyond the Stop bar is 'off' and vice versa, as shown in Figure1.8. In this way, the Stop Bar and associated Taxiway centreline lights act in the same sense as traffic lights; therefore pilots must not taxi an aircraft across a Stop Bar that is lit. Stop Bars are provided at entrances to runways, e.g. runway holding positions, and may also be provided at taxiway intersections and at other locations.

Note: *where a Stop Bar is located on or close to a bend in the taxiway route, additional elevated red lights may be installed outboard of each taxiway edge as shown in Figure 1.7, in order to provide maximum advanced warning of the Stop Bar location.*

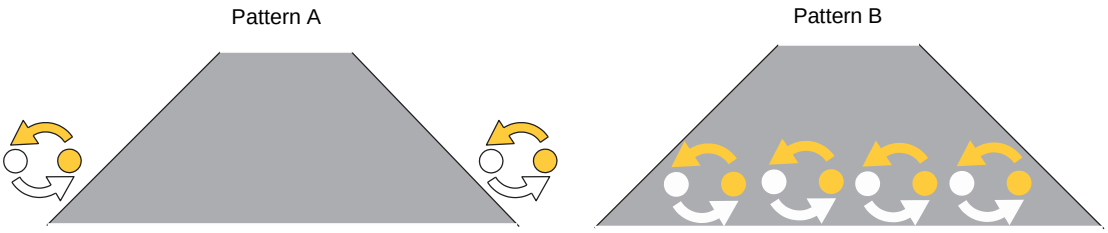
Figure 1.8 - Examples of Stop Bar and Taxiway centreline Lights



3.9.2 Runway Guard Lights

Runway Guard Lights are pairs of alternately flashing yellow lights; one pair located on each side of the taxiway and provides a warning of the close proximity of the runway. Where the taxiway is wider than normal, an alternative form of Runway Guard Light may be provided comprising additional pairs of flashing yellow lights inset into and stretching across the full width of the taxiway. The electrical circuits are so arranged that alternate lights flash in unison. Runway Guard Lights, often referred to as "Wig Wags", are illustrated in Figure 1.9.

Figure 1.9 Runway guard Lights



3.9.3 Taxiway Guidance System

At aerodromes where Category II and III operations take place or where ground movement requirements are complex, a surface movement guidance and control system (SMGCS) may be installed in order to regulate traffic. The system operates by selective switching of the taxiway centreline lighting so that individual sections or routes, each terminating at a lit Stop Bar, are illuminated in order to show the way ahead. The Stop Bar is switched off as the next section of taxiway centreline lighting is selected.

3.9.4 Colour Coded Taxiway Centreline Lighting

Where part of a taxiway equipped with centreline lighting lies within the ILS Sensitive Area or is sufficiently close to a runway that aircraft on that part of the taxiway would present an obstruction to aircraft landing or taking-off, that part of the taxiway will be identified by alternate green and yellow centreline lights, as shown at Figure 1.6 and 1.7. Pilots should avoid stopping with any part of their aircraft in such areas.

3.9.5 Intermediate holding position Lights

At some aerodromes where multiple taxiways are not provided with selective route guidance, Taxiway Intersection Lights may be provided, these consist of a row of at least 3 steady yellow lights disposed symmetrically about the taxiway centreline. Pilots approaching an intersection where these lights are displayed should give way to crossing traffic unless otherwise instructed by air traffic control (ATC).

3.9.6 Taxiway Edge Markers

In taxiways that are used infrequently, reflective edge markers may be used instead of taxiway lighting. Edge markers are blue and green lights.

4 SURFACE MARKING AND MARKERS

4.1 General

Surface Markings are provided at aerodromes in order to assist pilots in identifying certain locations and to provide guidance for ground movement by day. For the purposes of this document, Surface Markings have been divided into two groups, namely;

(i) Paved Surface Markings and

(ii) Unpaved Surface Markings.

4.2 Paved Surface Markings

Paved surface Markings are normally produced by the application of skid resistant paints or retro-reflective materials directly onto the pavement. These markings fall into three categories namely;

(i) Paved Runway Markings,

(ii) Paved Taxiway Markings and

(iii)Paved Apron Markings, all of which are described in the following paragraphs

4.2.1 Paved Runway Markings

Paved Runway Markings shall be white. The various types of markings used on paved runways are explained below. Illustrations of the various markings are given in Figure 3-1.

4.2.1.1 Runway Designation Marking

All paved runways are identified by a Runway Designation Marking. This marking consists of a two digit number indicating the magnetic heading of the runway to the nearest 10 degrees. At those aerodromes with parallel runways where the same magnetic heading applies to more than one runway, the Designation Marking will include a letter, such as 'L' identifying the left runway as seen from the approach or 'R' for the right runway, as appropriate.

4.2.1.2 Threshold, Edge and Centreline Markings

All paved runways have Centreline and Threshold Markings. The Threshold Markings differ according to the classification of the runway. Runway Edge Marking is normally provided on all ILS equipped runways and those other runways where there is insufficient contrast between the runway and its shoulders or where the declared runway width is less than the paved width.

4.2.1.3 Displaced Threshold Markings

While Threshold Markings are normally located at the beginning of the paved runway surface, they may be displaced along the runway where, for example, there are obstructions on the approach or where the first portion of the pavement is unfit for the movement of

aircraft. Where displacement is of a temporary nature, e.g. to accommodate runway maintenance, the normal threshold markings will be obscured and the appropriate Displaced Threshold Marking and threshold marker boards, illustrated at Figure 3-1 (e), put in place in-order to mark the new threshold. Whenever a threshold is displaced, the pre-threshold area will be marked according to its usability at Figure 3-1 (d) and (e).

4.2.1.4 TDZ and Aiming Point Markings

All ILS equipped runways and those other runways where the touchdown zone is insufficiently conspicuous are provided with TDZ and Aiming Point Markings as shown at Figure 3-1(c). These markings are intended to give added visual cues to the runway surface, particularly in conditions of poor visibility; they also indicate the optimum touchdown zone on the runway. The apparent distance between the Aiming Point Marking and the Runway Threshold Marking, as seen from the approach, is intended to aid pilots in judging their angle of approach.

4.2.2 Paved Taxiway Markings

Paved Taxiway Markings are yellow in colour and consist of Centreline, Runway Taxi-Holding Position, Intermediate Taxi-Holding Position, Edge and Information markings all of which are illustrated at Figure 3-2 and described below. The direction in which the holding instruction implicit in the Runway Taxi-Holding position Pattern 'B' and Intermediate Taxi-Holding Position markings applies, is determined by the accompanying sign described in Chapter 4, paragraph 4.3, i.e. the direction from which the sign face is visible indicates the direction in which the holding requirement applies.

4.2.2.1 Centreline Marking

The Taxiway Centreline Marking consists of a single continuous yellow line marking the centre of the taxiway. Where a taxiway crosses a runway, the Taxiway Centreline Marking will indicate the route to be followed but the marking is interrupted as necessary in order to accommodate the runway markings. Taxiway centreline are located to provide safe clearance between the largest aircraft that the taxiway is designed to accommodate and fixed objects such as buildings, aircraft stands etc, provided that the pilot of the taxiing aircraft keeps the *'*Cockpit' of the aircraft on the centreline and that aircraft on a stand are properly parked.

Note 1 - *At runway-taxiway intersections, where the taxiway centreline is curved onto the nearside of the runway centreline, pilots should take account, where appropriate, of any loss of Runway Declared Distances incurred in following the 'Taxiway centreline' while lining up for take-off*

Note 2 - *the taxiway width is determined to ensure a specified minimum clearance between the outer wheels of the largest aircraft that the taxiway is designed to accommodate and the taxiway edge. The minimum wheel to edge clearance is assured in turns provided that the pilot keeps the 'Cockpit' over the taxiway centreline.*

Figure 3.1 - Paved Runway Markings (not to scale)

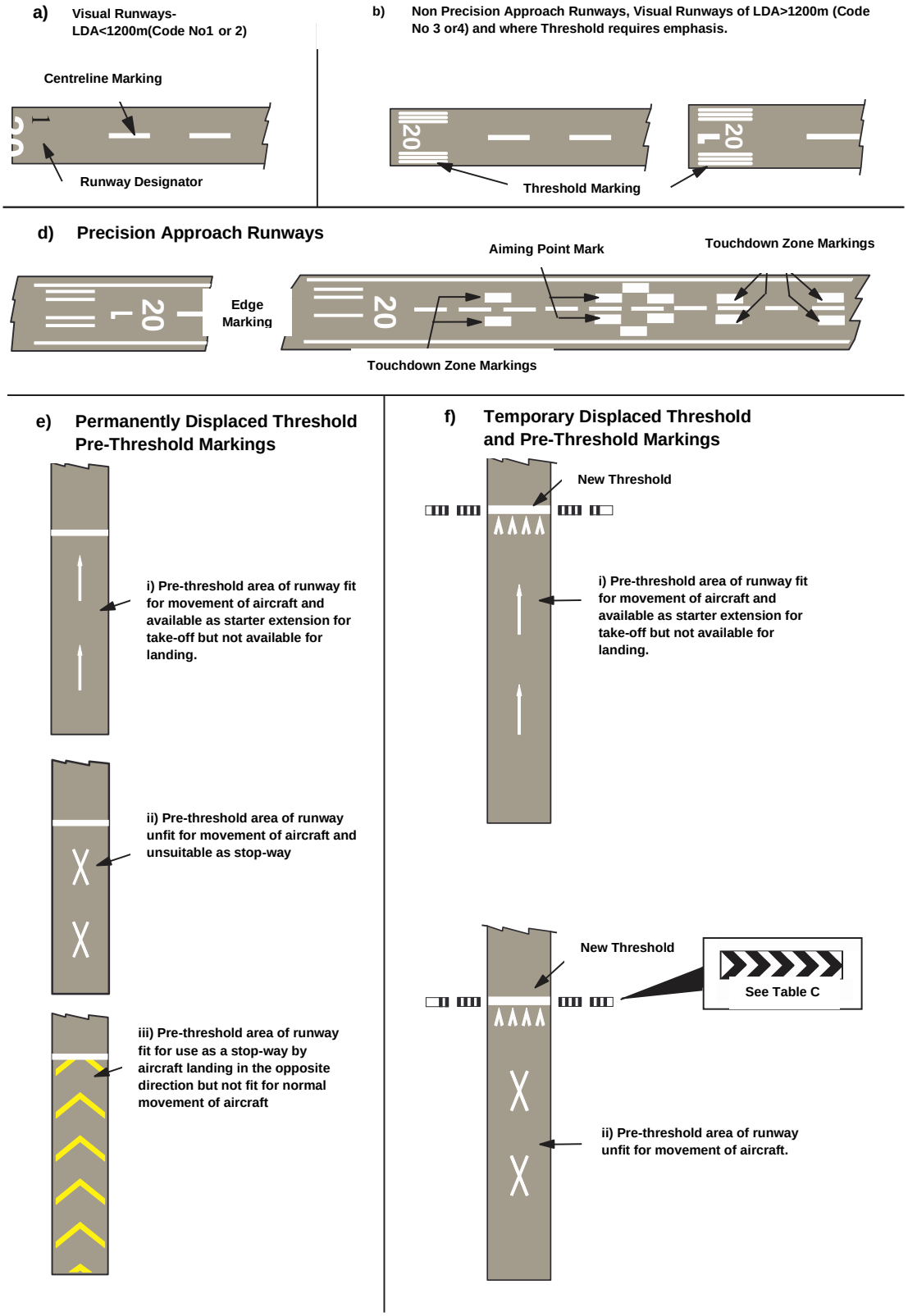
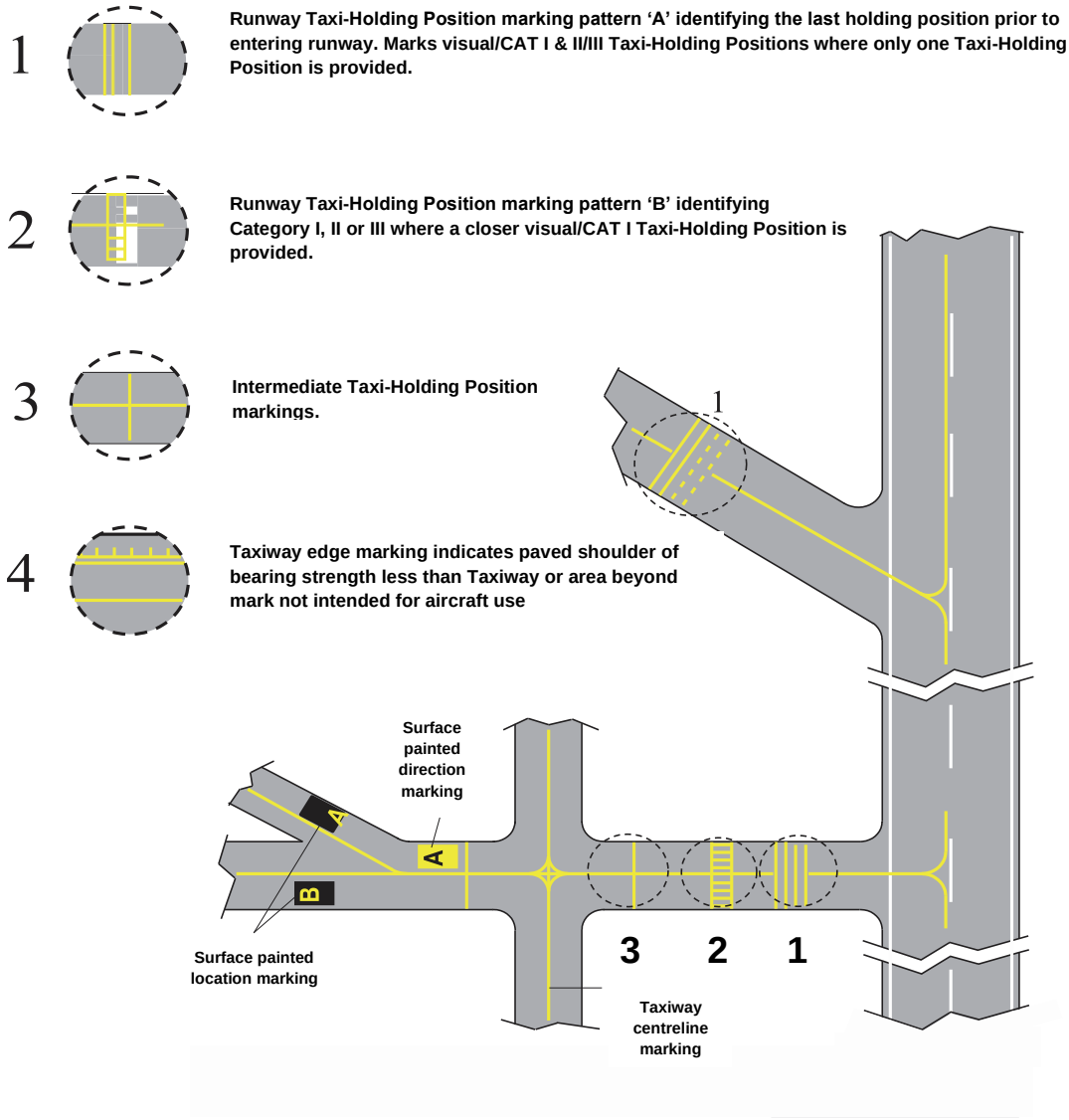


Figure 3.2 Paved Taxiway Markings (not to scale)



4.2.2.2 Runway Holding Position Marking

Runway Holding Positions are established on each taxiway leading to a runway in order to protect aircraft on take-off and landing by ensuring that other taxiing aircraft and vehicles are held well clear of the runway and, where appropriate, outside the ILS Sensitive Area. There are two styles of Runway Holding Position marking, Patterns A and B, both of which are illustrated at Figure 3.2.

(i) A Pattern 'A' style Runway Holding Position marking consists of two solid and two broken lines laid across the entire width of the taxiway and normally at right angles to the taxiway centreline, the broken lines being closer to the runway (see enlargement 1 Figure 3.2).

(ii) A Pattern 'B' style Runway Holding Positions marking, consists of a ladder mark laid across the entire width of the taxiway and normally at right angles to the taxiway centreline (see enlargement 2 Figure 3.2).

The last Runway Holding Position on a taxiway prior to entering the runway is always marked by a Pattern 'A' Runway Holding Position marking; other Runway Holding Positions, where established on the same taxiway, are marked by a Pattern 'B' style marking. Runway Holding Position markings are supported by the appropriate Runway Holding Position sign.

Runway Holding Positions are normally located so as to ensure clearance between an aircraft holding and any aircraft passing in front of the Holding aircraft, provided that the holding aircraft is properly positioned behind the holding position. Clearance to the rear of any holding aircraft cannot be guaranteed.

When following a taxiway route, pilots and persons towing an aircraft are expected to keep a good lookout and are responsible for taking all possible measures to avoid collisions with other aircraft and vehicles.

Note 1 *- Upon reaching a Turn-way Holding position identifying a taxi clearance limit, the pilot should stop the aircraft as close as possible to the Taxi-Hold Position Marking, whilst ensuring that no part of the aircraft protrudes beyond the marking.*

Note 2 - *At those aerodromes where an ATC unit is established, pilots must not taxi beyond a Runway Holding Position marking towards a runway without ATC clearance. Where there is no ATC unit, the Pattern 'A' Runway Holding Position marking is used to indicate the position where aircraft and vehicles are required to hold whilst giving way to aircraft using or on approach to the runway.*

4.2.2.3 Intermediate Holding Position Marking

At those aerodromes where the taxiway layout is complex or involves multiple intersecting taxiways, Intermediate Holding Positions may be established in order to protect a priority taxiway route. These holding positions are marked by a single broken line laid across the entire width of the taxiway and normally at right angles to the taxiway centreline as illustrated in Figure 3.2 enlargement 3. An ITHP marking is supported by a sign as described at Chapter 4 paragraph 4.3.3. These markings are located so as to provide clearance from aircraft passing **in front** of the holding aircraft.

4.2.2.4 Taxiway Edge Marking

Edge markings as illustrated at Figure 3.2 enlargement 4, are used where the area beyond the taxiway edge is paved but not normally available for use by aircraft.

(i) At aerodromes with code number 1 or 2, taxiway edge markers shall be used, in lieu of taxiway edge lights, to delineate the edges of taxiways, particularly at night. The SLCAR Part 14A requires the use of such markers on taxiways where the code number is 1 or 2 and if taxiway centre line or taxiway edge lights are not present.

(ii) On a straight section of a taxiway, taxiway edge markers should be spaced at uniform longitudinal intervals of not more than 60 m. On a curve the markers should be spaced at intervals less than 60 m so that a clear indication of the curve is provided. The

markers should be located as near as practicable to the edges of the taxiway, or outside the edges at a distance of not more than 3 m.

(iii) A taxiway edge marker shall be retro-reflective blue conforming to the specifications in IS 1.2.3 of SLCAR Part 14A. The marked surface as seen by the pilot should be a rectangle and have a minimum viewing area of 150 cm^2.

***Note** - The performance of retro-reflective materials is sensitive to the geometry of the illumination source and the viewpoint of the pilot. The performance is optimized when the taxi-light on an aircraft is located close to the position of the pilot.*

(iv) The markers commonly used are cylindrical in shape. Ideally, the design of the marker should be such that, when installed properly, no portion will exceed 35 cm total height above the mounting surface. However, where significant obstacle heights are possible, markers exceeding 35 cm in height may be used, but their total height should be sufficiently low to preserve clearance for propellers and for the engine pods of jet aircraft.

A taxiway edge marker shall be lightweight and frangible. One type of marker meeting these requirements is detailed in Figure 3-3. The post is made up of flexible PVC and its colour is blue. The sleeve, which is retro-reflective, is also blue. Note that the area of the marked surface is 150 cm^2.

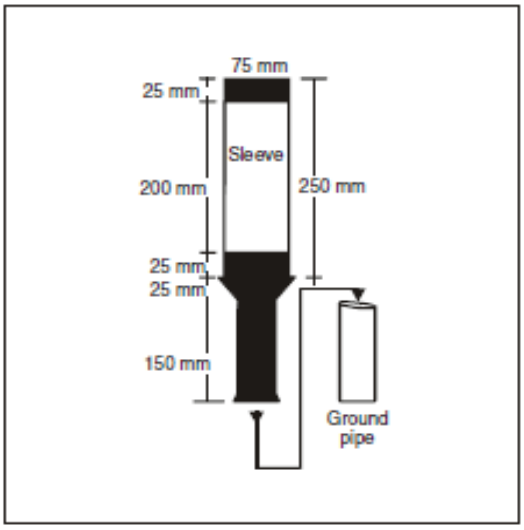


Figure 3-3 Taxiway edge marker

4.2.2.5 Information Marking

Information Marking, in the form of surface painted directions, may be provided where the use of a sign might cause an unacceptable obstruction or to assist in the prevention of runway incursions. Examples of Information Markings are shown at Figure 3-2.

4.2.3 Apron Marking

Apron Markings intended for pilot use are yellow in colour, where a marking is provided for the guidance of pilots parking aircraft on stands. This marking usually comprises of just a stand centreline marking.

4.2.3.1 Objective of guidance on aircraft stands

The main objective of guidance on aircraft stands is to provide:

(i) safe manoeuvring of aircraft on the stand; and

(ii) precise positioning of aircraft.

This objective can often be met by means of apron markings. Several lighting aids are used to supplement the guidance provided by apron markings at night and in poor visibility conditions. Of special interest are the aircraft stand manoeuvring guidance lights and the visual docking guidance systems.

4.2.3.2 Safe manoeuvring of aircraft

Aircraft stands are in general, arranged relatively close to one another so as to minimize as much as possible the paved area as well as the walking distance of passengers. The manoeuvring of aircraft, therefore, needs to be precisely controlled so that at all times they will be kept clear of the adjacent aircraft, buildings and service vehicles on the apron. Consideration should also be given to ensuring that the blast of the manoeuvring aircraft will not interfere with activities at the adjacent stand and that the marking is well within the operational capabilities of all aircraft using the stand. The clearances between manoeuvring aircraft and other aircraft, buildings or other obstacles for various circumstances are given in the SLCARs Part 14A. Control of ground equipment and vehicles should be exercised to ensure that the aircraft manoeuvring area at the stand is clear. Ground equipment and vehicles should be kept outside pre-determined safety lines when aircraft are manoeuvring or when the equipment is left unattended.

4.2.3.3 Manner of following guide lines

There are two recognized ways for aircraft to follow guide lines. In one, the nose of the aircraft (or pilot's seat) is kept over the line; in the other, the nose wheel traces the line. The SLCAR Part 14A, Chapter 3, specifies that the taxiway curves should be designed so as to provide the required clearances when the cockpit of the aeroplane remains over the taxiway centreline markings. This is primarily because of the difficulty the pilot would have in ensuring that the nose wheel follows the guide lines. In some aircraft the nose wheel is displaced as much as 5m behind the cockpit. The requirements for aircraft stand markings however, are not comparable to those for taxiway centre line markings. There are two differences in the manoeuvring of aircraft on aircraft stands:

(i) Because of reduced area for manoeuvring, much smaller radii of turn are needed; and

(ii) Trained marshallers are often used to assist in the manoeuvring of the aircraft.

4.2.3.4 Types of aircraft stand markings

Aircraft stand markings consist of guide lines to denote the path to be followed by aircraft, and reference bars to provide supplementary information. Guide lines may be classified into:

(i) lead-in lines;

(ii) turning lines; and

(iii)lead-out lines.

4.2.3.4.1 Lead-in lines

(a) These lines provide guidance from apron taxiways into specific aircraft stands. They may be required to enable taxiing aircraft to maintain a prescribed clearance from other aircraft on the apron. They may be considered as important as the turning line to align the aircraft axis with the predetermined final position. For nose-in stands, the lead-in lines will mark the stand centre line to the aircraft stopping position. There will be no lead-out lines, and the tractor drivers will use the lead-in lines for guidance during the push-back manoeuvre.

(b) Figure 3-4 shows a simple lead-in line. The advantage of this line is that it presents the most natural method of turning and it is least likely to be misunderstood. Its disadvantages are that it is not suitable for marking a stand where the aircraft is to be located centrally over the lead-in line and that it requires more apron space than the type of marking that can achieve this. The lines are to be followed by the aircraft nose wheel. When these lines are used, it should be noted that the track of the aircraft centre is inside the curve of the guide line. In some instances the apron area available may require the use of a different type of marking. Figure 3-5 shows an offset lead-in line. When the aircraft nose wheel follows these lines, the centre of the aircraft does not cut as far inside the curve but makes a tighter turn. As a consequence, the size of stand positions need not be as great. It should however be noted that while this type of marking positions the aircraft centrally over the lead-in line, a given line can only be fully suitable for one single aircraft type or where the aircraft geometry, in terms of the wheel bases of all the different types using the stand, is virtually identical. Where it is necessary for a stand to be used by a variety of aircraft types and they do not have similar undercarriage geometry, yet the available space requires aircraft to be centrally positioned over the lead-in line, the aims are best achieved by using a short arrow at 90 degrees to the taxiway centre line as in Figure 3-6. One drawback of this arrangement is that the entry point and degree of turn needed to align the aircraft centrally over the lead-in line are left to the pilot's judgement.

4.2.3.4.2 Turning lines

(a) Where the aircraft is required to make a turn on the stand prior to stopping or after "break away", a turning line may be needed for the aircraft to follow. The primary purpose of this line is to limit the turning of aircraft within the designated area so as to keep aircraft clear of obstacles and to aid in accurate positioning of the aircraft.

The former is of special importance where clearances between the stand and near structures or other stands are marginal.

(b) **Straight portion of the turning line**. The turning line should incorporate a straight portion at least 3 m in length at the final aircraft position. This provides a 1.5 m section prior to the final stopping position to relieve pressure on the landing gear and at the same time to correct the aircraft alignment, and a section 1.5 m long after the stopping position to reduce the thrust required and, thereby, blast on "break away". The length of the straight portion referred to above can be reduced to 1.5 m in the case of stands meant for smaller aircraft.

4.2.3.4.3 Lead-out lines

(a) These lines provide guidance from stands to taxiways and ensure that the prescribed clearance from other aircraft and obstacles is maintained. These lines are shown in Figure 3-7. Where aircraft have to make a turn prior to leaving the stand to keep clear of the adjacent obstacles, the lead-out line may be as shown in Figure 3-7 a). Where the clearance from the adjacent stand is less marginal, the lead-out line of Figure 3-7 b) or c) might be practical.

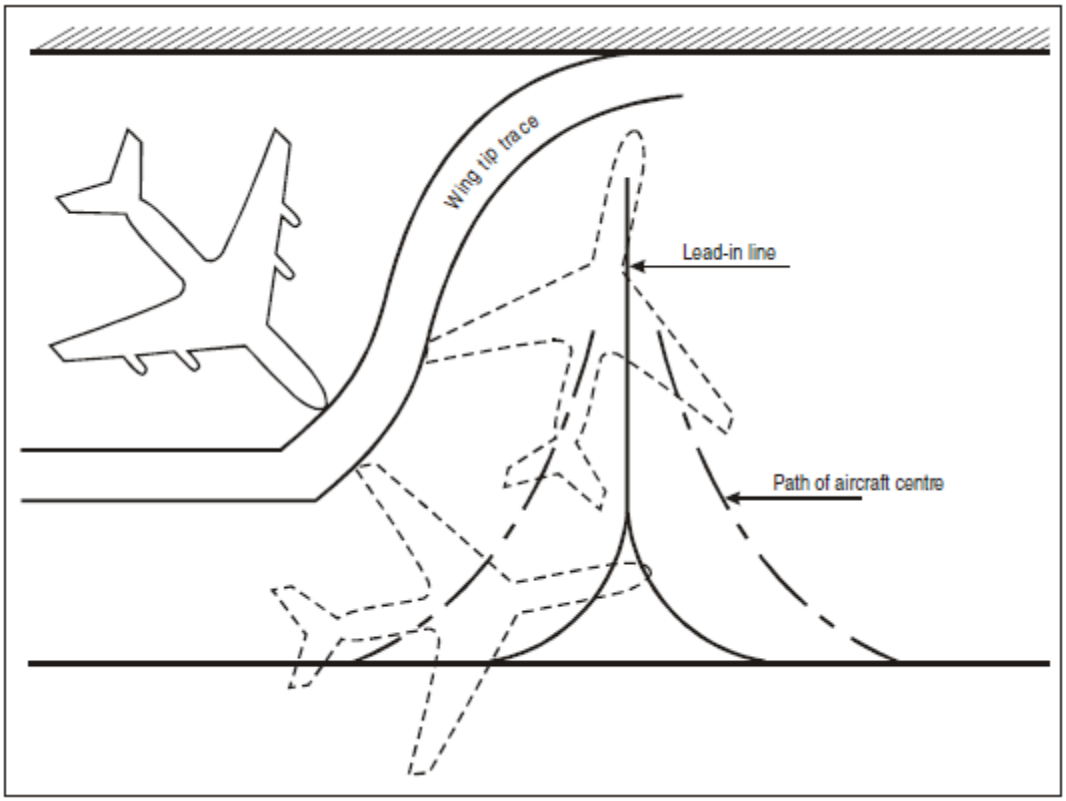


Figure 3-4. Simple nose-wheel lead-in line

Method of computing the radii of curved portions of lead-in, turning and lead-out lines

(a) Whether one uses a nose-wheel line or only a straight lead-in as in Figure 3-6, the assumed or marked radius must be within the turning capability of the aircraft for which the stand is intended. In calculating the radius, one needs to assess the likely effect of blast which can result from using too tight a radius. It is also possible for the minimum acceptable radius of turn to vary with operators even though they are using the same aeroplane. Further, the smaller the turn radius and the larger the nose-wheel angle, the more likelihood there is of tire migration. In other words, while one may have, for example, 65 degrees of nose-wheel angle applied, the effective turn radius is equivalent only to some lesser angle, with possibly as much as a 5-degree loss. To determine the radii, therefore, one needs to consult the manuals issued by the aircraft manufacturers for airport planning purposes; the operators of the individual aeroplane types should also be consulted to find out to what extent they modify the manufacturer's guidance for any reason. The individual apron situation would then need to be studied to see whether further modification would be necessary.

(b) Duplication of guidance

(i) When a stand is used by different types of aircraft and alignment of aircraft is not of great importance, it may be possible to use one set of markings to serve all types.

In such cases the largest turning radius is used. Any type of aircraft of the group can then manoeuvre with sufficient clearance if the nose wheel follows the guide lines. However, where the precise alignment of aircraft on the stand is essential, secondary guide lines may be necessary.

(ii) Secondary guide lines are also necessary when a large aircraft stand must accommodate more than one small aircraft at the same time. Such stands are commonly known as superimposed stands. In all these cases, the primary line should be for the most critical aircraft, i.e. the aircraft requiring the greatest manoeuvring area.

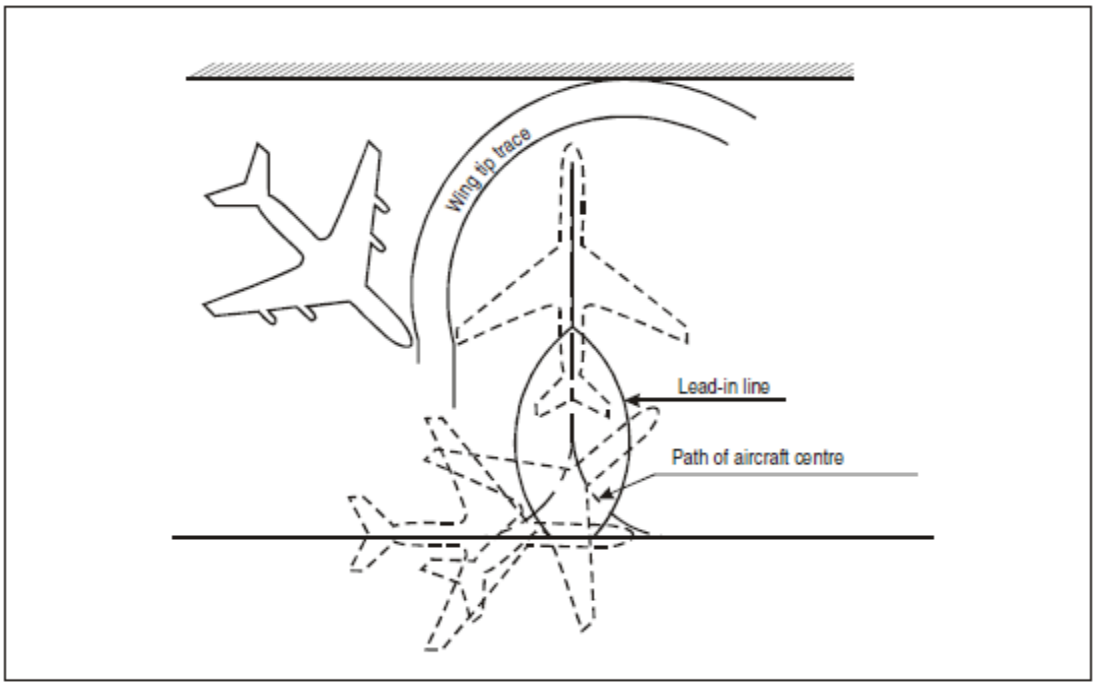


Figure 3-5. Offset nose-wheel lead-in line

(c) Characteristics of guide lines

(i) The guide lines should normally be continuous solid yellow lines at least 15 cm, but preferably 30 cm, in width. However, where a secondary guide line is provided, it should be a broken line to distinguish it from the primary line. Additionally, the type of aircraft that is to follow each line should be clearly indicated.

(ii) Where it is considered necessary to distinguish between lead-in lines and lead-out lines, arrow heads indicating the directions to be followed should be added to the lines. The designation number/letter of the stand should be incorporated in the lead-in line (see Figure 3-8). Additionally, a stand identification sign should be provided at the back of the stand, e.g. on the building or a pole, so as to be clearly visible from the cockpit of an aeroplane.

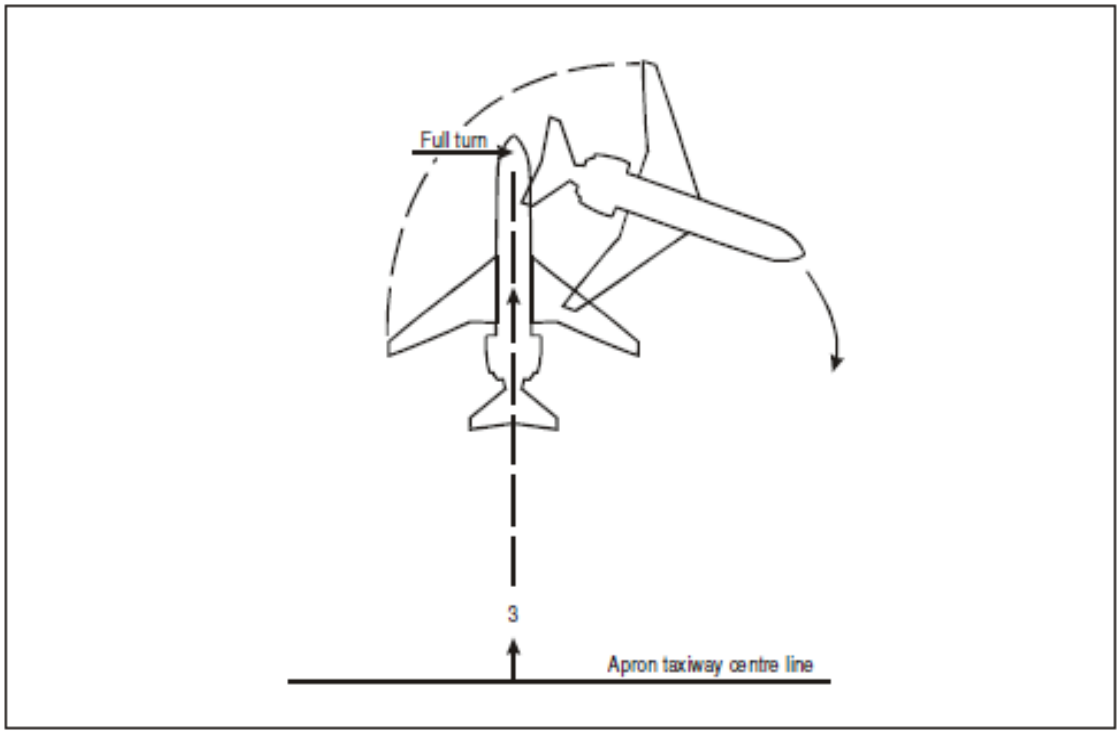


Figure 3-6. Straight lead-in line

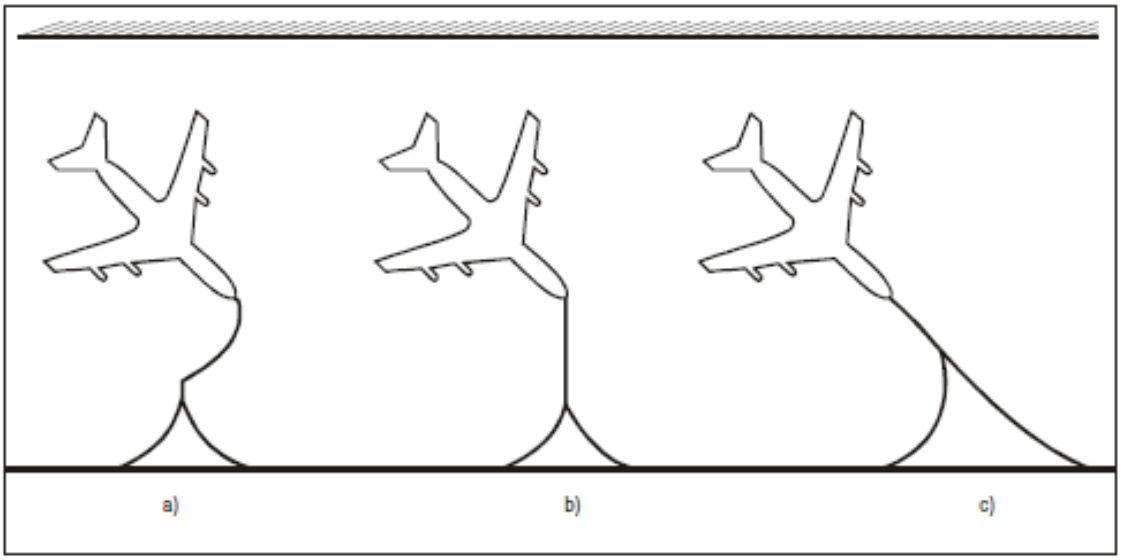


Figure 3-7. Simple nose-wheel lead-out lines

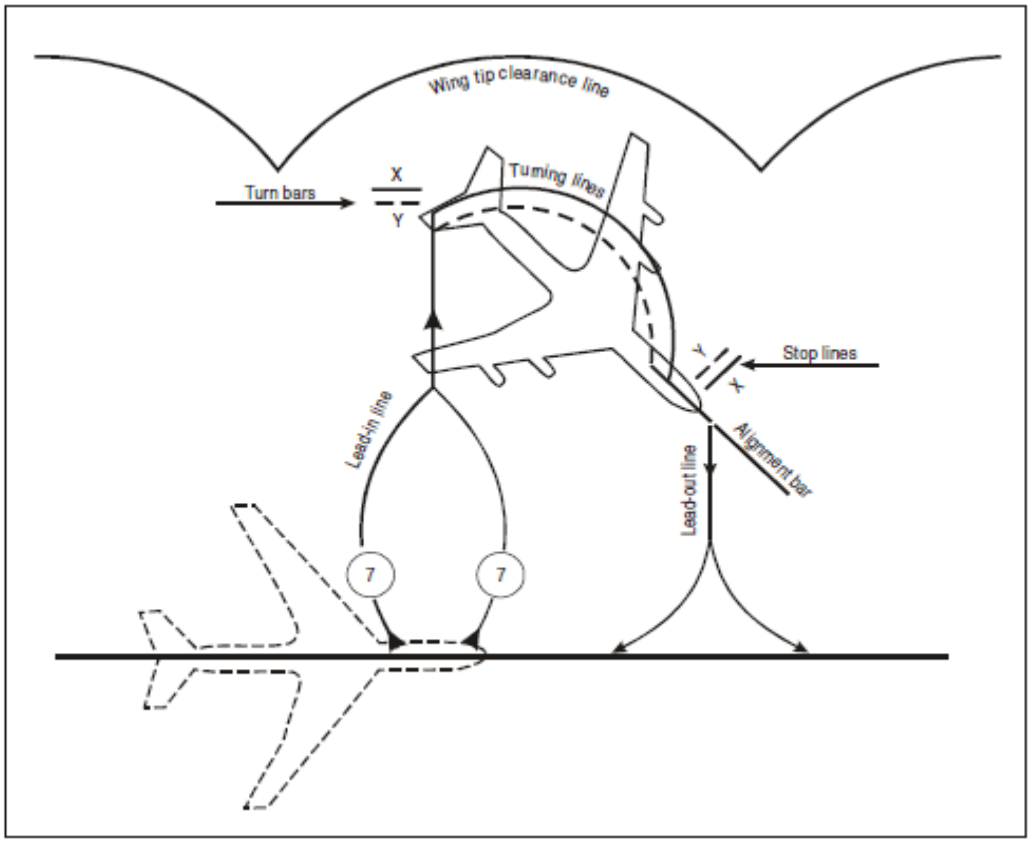


Figure 3-8 Examples of reference bars

4.2.4 Stands provided with Visual Docking Guidance

At airports where visual docking guidance is provided, a variety of different stand layout markings should be used. An example of the layout and markings is illustrated in Figure 3.9. Visual Docking Guidance Systems (VDGS) are further described in Chapter 6.

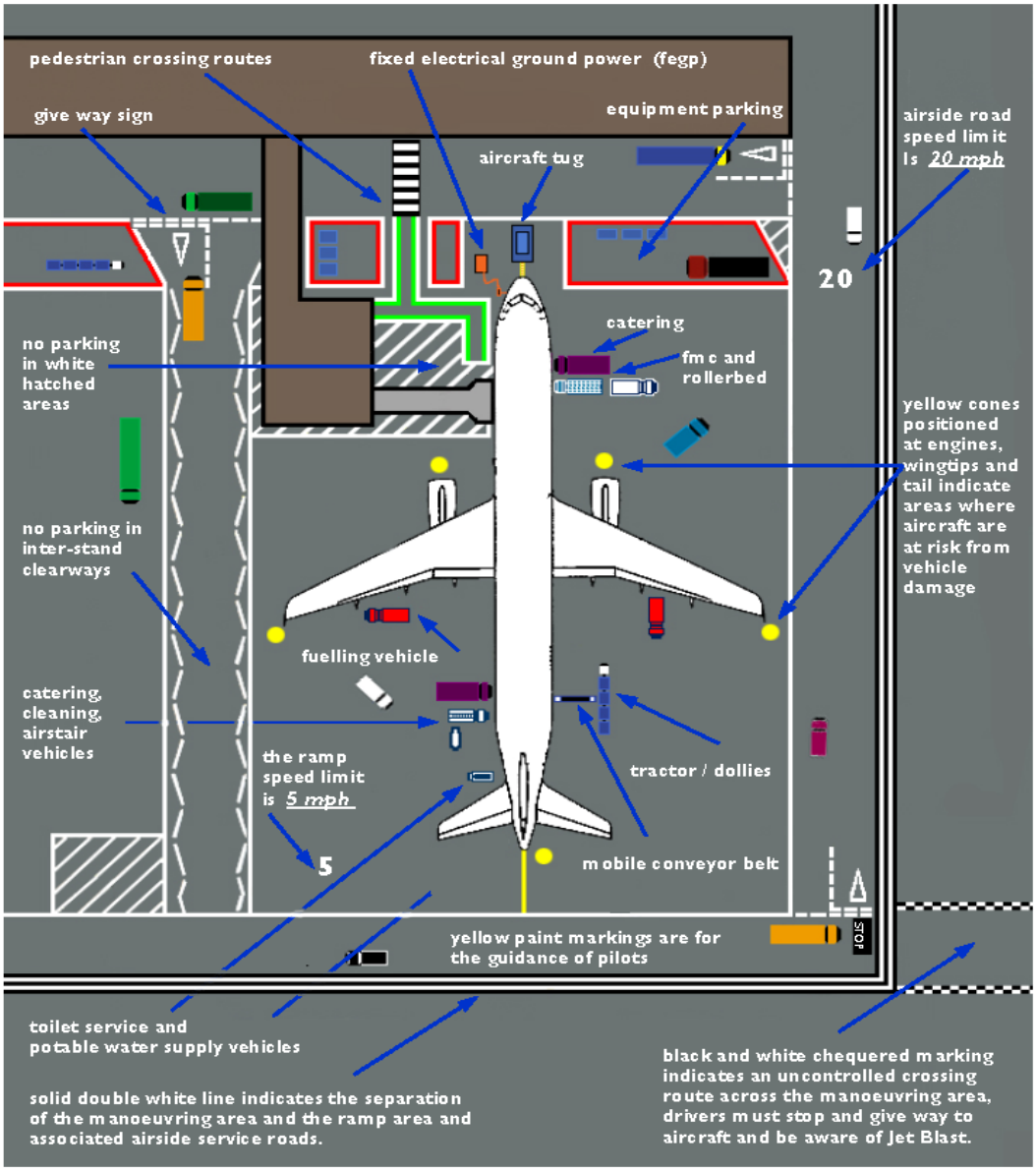


Figure 3.9 - Typical Stand Layout and Markings

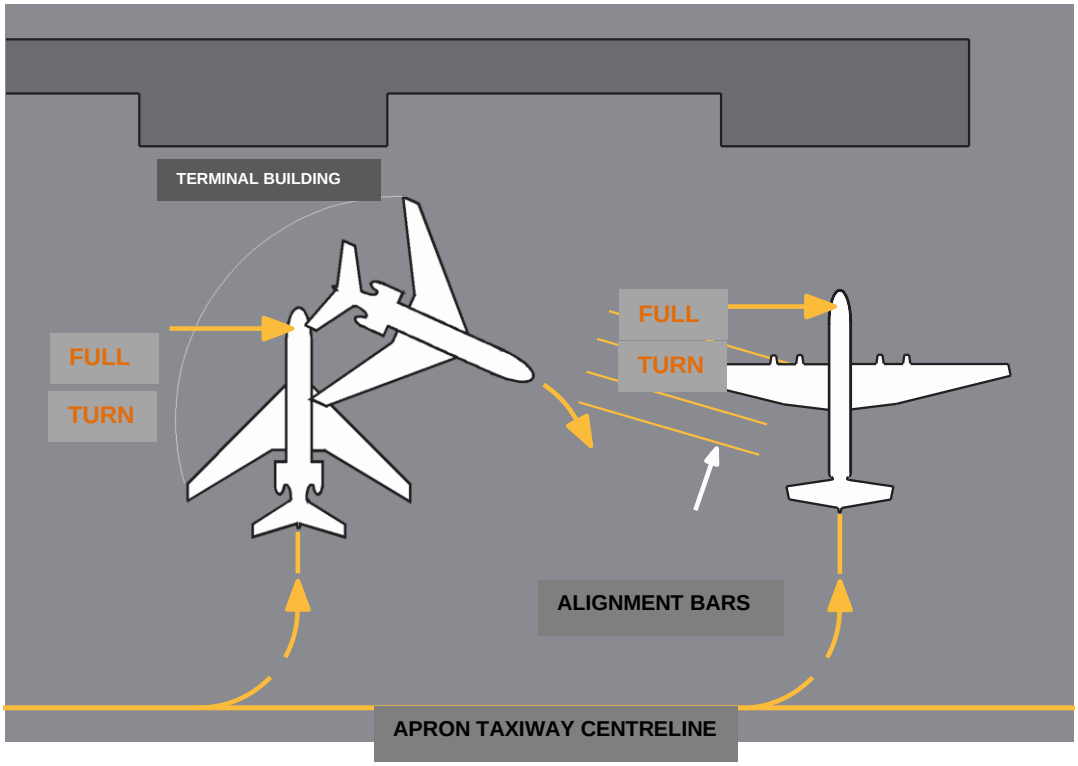


Figure 3.10 - Self Manoeuvring Stand Markings

4.2.5 Self-manoeuvring Stand Markings

Self-manoeuvring stand markings are provided to assist pilots in taxiing their aircraft to correct parking positions without the assistance either of a marshaller or a VDGS. An example of this marking is seen in Figure 3.10 and the method of use is described below:

(a) The pilot turns off the apron taxiway at the arrow which bears the allocated stand number and follows the lead-in line keeping the **nose wheel** on the centreline;

(b) When the FULL TURN arrow is directly abeam the first pilot's position, a turn, using the maximum nose wheel steering angle appropriate to the type of aircraft, is initiated in the direction indicated. This turn is continued until the longitudinal axis of the aircraft is parallel with the alignment bars seen ahead of the aircraft as the designed parking angle is reached;

(c) When the aircraft is parallel to the alignment bars, the turn is discontinued and the aircraft permitted to roll forward in order to straighten the nose wheel. The aircraft is then stopped;

(d) When cleared to taxi by ATC, the pilot taxies out of the stand in the direction indicated by the curved lead-out arrow disregarding the alignment bars.

Note - The provision of safe clearances from other aircraft and fixed obstacles relies heavily on the accuracy with which the pilot follows the surface markings; turning too late, using too great a radius of turn or taxiing the aircraft too far forward, may reduce the clearances below the safe limit, Unlike the principle used on taxiways (cockpit on centreline), when manoeuvring onto stands the pilot must keep the nose wheel on the stand centreline. If in doubt the aircraft commander should seek assistance from a marshaller.

4.2.6 Parking Spots and Parking Circles

At aerodromes with code number 1 or 2 where aircraft parking space is at a premium, a yellow spot, number or circle may be painted on the apron indicating an individual aircraft parking position. Pilots should be aware that parking on the spot or within the circle does not guarantee safe separation either from fixed obstacles or from adjacent aircraft.

4.2.7 Additional Apron Markings NOT for Pilot use

(a) White markings on an apron are intended for the guidance, control and movement of ground service vehicles. White hatched diagonal markings adjacent to an aircraft parking stand delineate an area that ground service vehicles should not park or stop in at any time.

(b) Some aprons may also provide additional markings to highlight safe routes for pedestrian access to an aircraft stand or the terminal building, typically these are green with a white inset border (with a Pedestrian symbol inside the border).

(c) Vehicle and equipment storage bays are typically depicted by a red box inset by a white border.

Note *- Enhanced hatched markings in clearways or other areas are used to denote where vehicles are not permitted to stop.*

4.3 Unpaved Surface Markings

Unpaved surface markings are normally confined to runways and consist of Runway Edge, Centreline, Threshold and End Markings.

4.3.1 Runway Edge and Centreline Marking

The edges of runways are delineated by markers placed at regular intervals along the declared edges of the runway. Where provided, a centreline marking consists of rectangular markers inset flush with the runway surface and spaced at regular intervals along the declared runway centreline. Edge and centreline markers are normally white but may be of any single colour that best contrasts with the background.

4.3.2 Runway Threshold and End Marking

The Threshold and End of a runway are provided with markers of a similar type, size and colour as the edge markers. These markers are placed along the threshold and end of the runway and so positioned in relation to the edge markers as to form an ‘L’ shaped mark at each corner of the runway. In addition, each threshold is marked with a two character designator showing the magnetic heading of the runway to the nearest whole 10 degrees.

5 SIGNS

5.1 General

(a) The signs located at an aerodrome when used in conjunction with an aerodrome chart are intended to simplify surface movement guidance and control procedures, particularly in conditions of low visibility. Signs are divided into two categories, namely Mandatory Signs and Information Signs.

(b) The achievement of safe and efficient aircraft taxiing and ground movement at aerodromes requires the provision of a system of signs for the use of pilots and vehicle drivers on the movement area.

(c) Pilots and vehicle drivers use the signs to identify their position on the movement area. By relating this data to ground map information available in the cockpit or in the vehicle, they can ensure that they are on their assigned route at all times, and can also (as required), report their position to ATC.

(d) At some locations, the signs convey mandatory instructions related to that particular position, thus contributing to the safety of operations.

(e) Signs at intersections expedite movements by indicating the layout of the taxiways at that position. Provided that the sign is seen in sufficient time, pilots and vehicle drivers can then easily identify the exit from the intersection that corresponds to their assigned route.

(f) All signs are classified as either mandatory or information signs.

(g) A mandatory sign shall be provided to identify a location beyond which a vehicle or taxiing aircraft shall not proceed unless authorized by the air traffic management service.

(h) An information sign shall be provided where there is an operational need to indicate, by a sign, a specific location, or routing (direction or destination) information, or to provide other information relevant to the safe and efficient movement of aircraft and vehicles.

5.2 Design

(a) The system of signs specified in the SLCAR Part 14A, Chapter 5, 5.4 and IS 5.4.1.6, meets a number of design criteria.

(b) All signs should conform to a colour code that clearly indicates the functions of each sign. Mandatory signs should be red and white, and information signs yellow and black. The choice of colours was influenced by colour conventions in other modes of transport where colours have specific and well-understood meanings. It was also influenced by the need to use pairs of colours which, in combination, provide signs that are legible in the widest possible range of conditions. Contrast ratios between the elements of the sign are a major factor in determining the legibility of a sign.

(c) There are four basic attributes related to the design of signs:

(i) conspicuity;

(ii) legibility;

(iii)comprehensibility; and

(iv)credibility

(d) Each of these attributes is important. To meet the operational requirements, all signs must be readily seen in the complex aerodrome environment, and the inscription on the sign face must be easy to read. The message being conveyed by the sign must be readily understood by pilots and vehicle drivers, and it must also provide information that is clearly correct.

(e) The overall size, colour and luminance of a sign determines the level of conspicuity. The size, font and layout of the inscriptions together with the luminance contrast between the inscription and the sign face determine the legibility of the signs.

(f) Full compliance with the criteria in SLCAR Part 14A, IS 5.4.1.6, concerning the sign face size is necessary to maximize the conspicuity of the signs and to ensure that the sign characters are legible. The design criteria require a sign face that is always twice the height of the inscription. The width is determined by the overall length of the inscription to which must be added a border of at least 0.5 times the inscription height at either end of the sign. For signs containing only one designator, the lateral border width is required to be equal to the inscription height. This ensures that a sign face of suitable size is provided in all situations. The requirements of SLCAR Part 14A, IS 5.4.1.6, paragraph 11, should be met for mandatory signs.

(g) The font size chosen depends on the maximum range at which the inscription is required to be legible. For an aircraft taxi speed of 30 kt and assuming a reading time of 10 seconds, plus a small allowance for an initial search time to locate the sign, the required font height is at least 30 cm. A font size of 40 cm is applied to enhance the sign performance especially in locations where the level of safety is of particular importance. The font to be used for signs is specified in detail in SLCAR Part 14A, IS 5.4.1.6.

(h) The luminance of the signs is specified to maximize the useful range of the signs in reduced visibility conditions.

(i) The position of signs and the location of the various elements of the sign message strongly influence the comprehensibility of the sign system. The layout of the signs, particularly for applications at complex intersections where several sign elements are collocated, is specifically designed to ensure the speedy and accurate assimilation of the information displayed. The inscriptions specified are chosen to ensure that the information is easily understood by all users. An example of a complex sign layout is given in Figure 4-1.

(j) For operations that take place in low visibility or at night, the illumination of the sign face is an important design parameter. The sign luminance's that are specified in the SLCAR Part 14A, IS 5.4.1.6, have been found to meet the operational criteria in these circumstances. Two sets of luminance's are given. The higher luminance's are only essential during operations in runway visual range conditions less than a value of 800 m. At night in good visibility conditions, the luminance of signs can be reduced as indicated provided that sign conspicuity and legibility criteria are maintained.

(k) To maximize legibility, it is important that the equipment is designed to have a uniform luminance over the complete sign face. Similarly, the specified luminance ratios between the colours of the sign should always be complied with.

5.3 Variable Message Signs

(a) Conventional signs displaying a fixed message shows the same information at all times irrespective of the operational circumstances. This can result in situations that are at least illogical and which could cause operational problems. For example, a pilot taxiing for departure in VMC will be expected to pass a mandatory Category I, II, III or joint II/III holding position sign without obtaining clearance from ATC. This procedure is followed on the basis that the sign is not applicable at the time when the manoeuvre takes place. The potential for any misunderstanding could be removed if the sign information were only visible when the information being displayed is applicable. Selective use of taxiways as part of a full surface movement guidance and control system or as a means of maintaining separations between very large aircraft on close parallel taxiways are other examples of the need for more flexibility in the way in which sign information is displayed. The SLCAR Part 14A, 5.4.1.2 requires that variable message signs be provided to meet the operational needs described above.

(b) Therefore, a variable message sign should be provided when:

(i) the instruction or information displayed on the sign is relevant only during a certain period of time; and/ or

(ii) there is a need for variable pre-determined information to be displayed on the sign to meet the requirements of surface movement guidance and control systems

(c) Variable message signs can be designed to provide high brightness without glare and facilitate the selective display of information. Technologies that could be used include fibre optic or light emitting diodes. The use of such technologies to create the sign message enhances range performance compared with that obtained by using trans-illuminated signs. The luminance of a fibre optic or light emitting diode light point can be approximately 10 000 cd/m2 compared with the value of 300 cd/m2, which is the highest value normally used for trans-illuminated signs.

(d) The following guidelines should be applied to the design of any variable message sign to be used on an aerodrome movement area:

(i) the sign should have a blank face when not in use. A pilot must not see an image or "ghost" of the message;

(ii) the sign should not present a message that could lead to an unsafe action by a pilot in the event of failure of the sign;

(iii) the sign should have a short response time, i.e. the time required for the message to change should be not greater than five seconds;

(iv) different luminance levels will be required for day/night operations and in good/poor visibilities;

(v) care should be taken to ensure that the field of view of the sign is sufficient over the full range of viewing angles that are required for taxiway signs; and

(vi) the sign should only include colour and inscription elements that conform to the basic conventions that are to be followed in the design of mandatory and information signs.

5.4 Mandatory Signs

(a) Mandatory Signs consist of Runway Holding Position signs, Intermediate Holding Position signs and No Entry signs. These are displayed by white characters on a red background as illustrated at Figure 4-3 and 4-4. Runway Holding Position and Intermediate Holding Position signs are located alongside the appropriate surface marking described in Chapter 4 paragraph 4.3.1 and identify the holding position as well as indicate the direction in which the holding instruction applies. Pilots should not proceed beyond a Mandatory Sign unless directed to do so by ATC.

(b) Where there is more than one taxiway serving a runway or more than one Runway Holding Position on a taxiway, a Location Sign is normally attached to the Runway Holding Position sign in order to assist in identifying the position as illustrated at Figure 4-4.

Figure 4-1

(c) Mandatory instruction signs include runway designation signs, Category I, II or III holding position signs, runway-holding position signs, road-holding position signs and NO ENTRY signs. Examples of such signs are shown in Figure 4-2.

(d) A mandatory instruction sign shall always be provided at a taxiway/runway intersection or a runway intersection on each side of the runway-holding position. The SLCAR Part 14A, specifies that:

(i) a pattern "A" runway-holding position marking shall be supplemented at a taxiway/runway inter-section or a runway/runway intersection with a runway designation sign; and

(ii) a pattern "B" runway-holding position marking shall be supplemented with a Category I, II or III holding position sign.

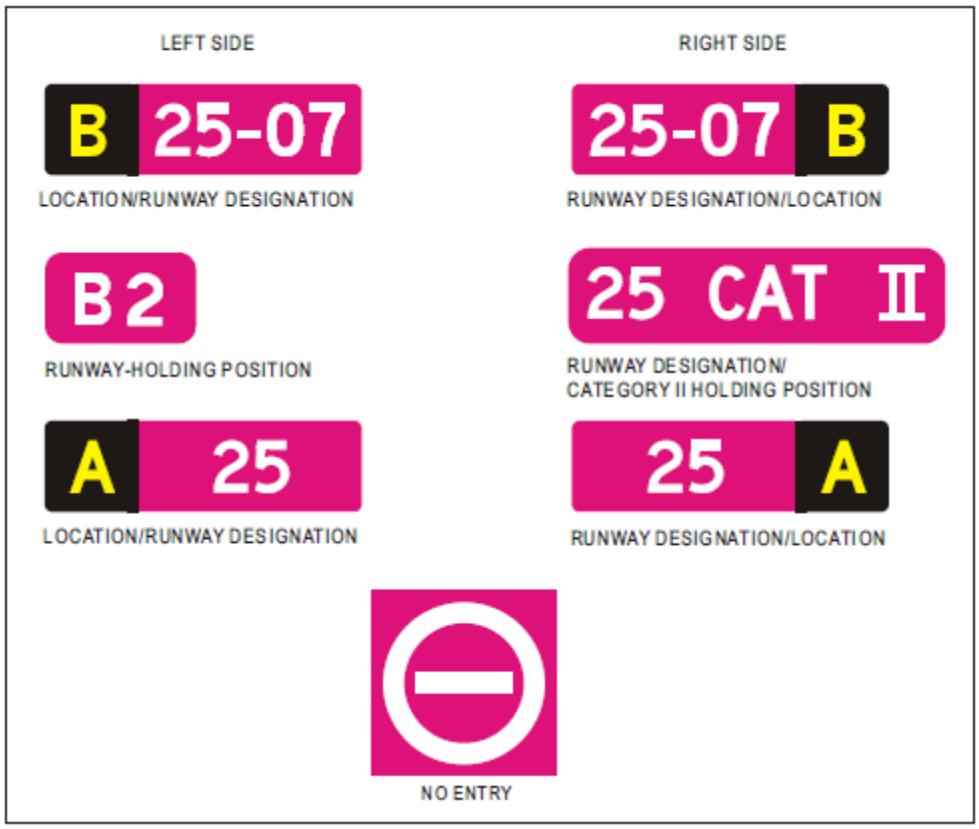


Figure 4-2

(e) As a consequence, 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 always be supplemented with a runway designation sign. Where two or three runway-holding positions are provided at such an intersection, the runway-holding position marking closest to the runway shall be supplemented with a runway designation sign, and the markings farthest from the runway shall be supplemented with a Category I, II or III holding position sign, as appropriate.

(f) Examples of sign positions at taxiway/runway intersections are shown in Figure 4-4.

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

(g) A runway-holding position shall be established on a taxiway if the location or alignment of the taxiway is such that a taxiing aircraft or vehicle can infringe an obstacle limitation surface or interfere with the operations of radio navigation aids at such runway-holding positions. The SLCAR Part 14A, specifies that a pattern "A" runway-holding position marking shall be supplemented with a runway-holding position sign (the "B2" sign in Figure 4-2) on each side of the runway-holding position.

(h) Location signs should be associated with a runway designation sign wherever it is important to ensure that there can be no possible ambiguity in the authorization process. Without exact knowledge of location, it is possible for pilots taxiing at an aerodrome that has multiple runway/ taxiway intersections to misinterpret an authorization issued for another aircraft as being applicable to their movement and mistakenly manoeuvre onto the runway. Thus, the SLCAR Part 14A requires that runway designation signs at taxiway/runway intersection should be supplemented with a location sign in the outboard (farthest from the taxiway) position, as appropriate.

(i) A NO ENTRY sign shall always be provided when entry into an area is prohibited.

(j) For road-holding positions where a road enters a runway, the provisions of the SLCAR Part 14A, 5.4.7, should be applied. An example of a road-holding position sign is shown in Figure 4-8. Since these signs are to be used by aerodrome personnel, it is important that the inscriptions on the sign face are in a language that is comprehensible to all road users at that location.

5.4.1 Runway Holding Position Sign for Visual and Category I Operations

Where an aerodrome is equipped for operations up to and including ILS Category I approaches, a Runway Holding Position sign displaying the runway designator is located on both sides of the taxiway as illustrated at Figure 4-4 (a). Where there is no ATC unit, the Runway Holding Position sign identifies the position where aircraft and vehicles are required to hold whilst conceding right of way to aircraft using or on approach to the runway.

Figure 4.3 - Examples of Mandatory Signs for Aircraft Surface Movements

a) Visual Runway Holding position - denotes the visual Taxi-Holding Position and also the ILS Cat I Holding Position where the Visual and CAT I Holding Positions are co-located.

(i)

(ii)

b) CAT I Runway Holding Position Sign – denotes ILS CAT I Runway Holding Position – a Visual/CAT I Runway Holding Position may be established closer to the runway where it is necessary to expedite traffic flow.

(i)

(ii)

c) CAT II Runway Holding Position Sign – marks the ILS CAT II Runway Holding Position – a Visual/CAT II Runway Holding Position may be established closer to the runway where it is necessary to expedite traffic flow.

(i)

(ii)

d) CAT III Runway Holding Position Sign – marks the ILS CAT III Runway Holding Position – a CAT II Runway Holding Position and a Visual/CAT I Runway Holding Position may be established closer to the runway where it is necessary to expedite traffic flow.

(i)

(ii)

e) Combined Runway Holding Position Sign – marks the Taxi-Holding Position where the ILS – Runway Holding Positions are co-incident. A Visual or CAT I Runway Holding Position Sign may be established or closer to the runway where it is necessary to expedite traffic flow.

(i)

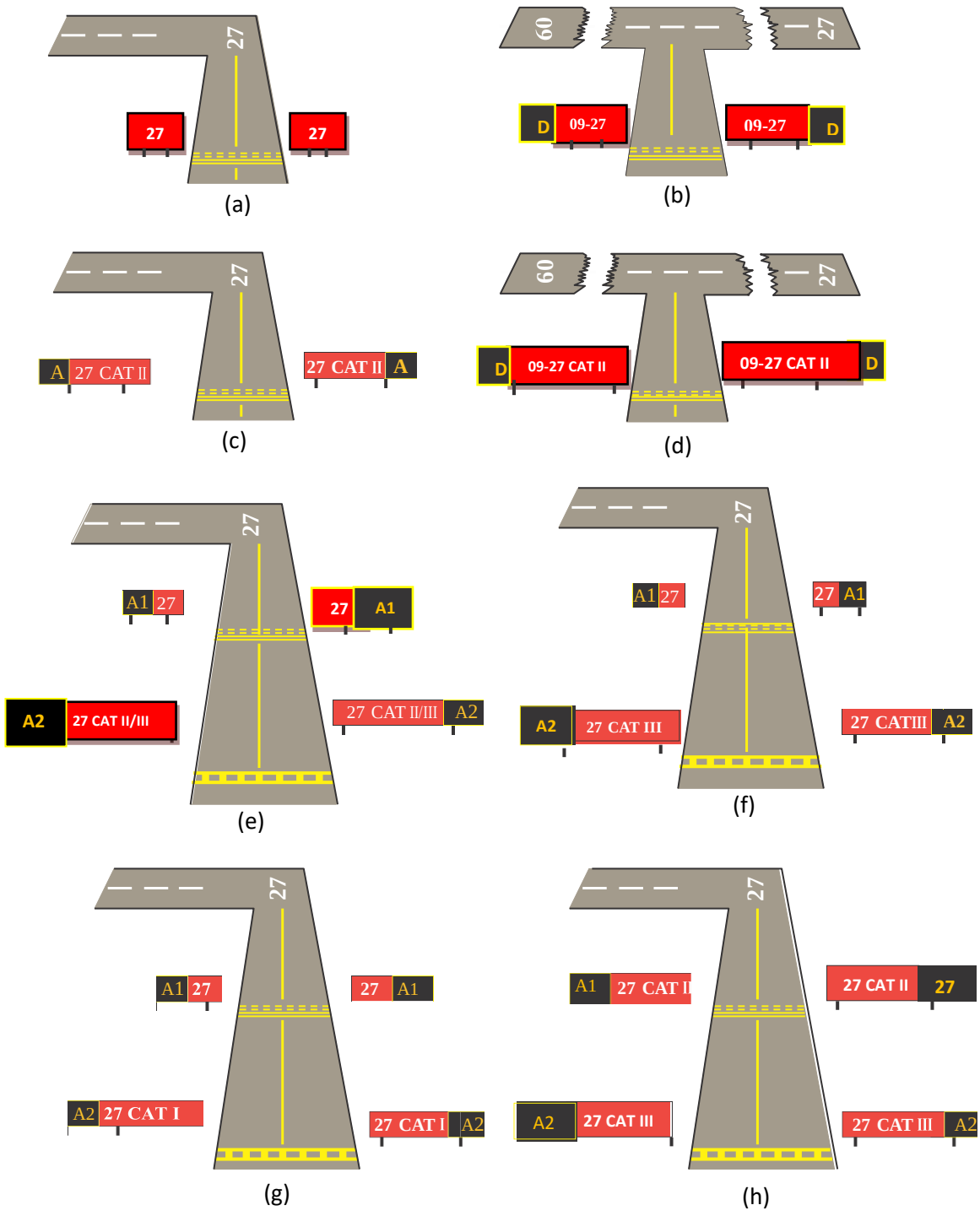
(ii)

f) Runway Holding Position Sign – marks a Holding Position established to protect a priority route.

g) No Entry Sign

Note - The signs at (i) are used where the taxiway normally serves only one runway direction. The signs at (ii) are used where the taxiway normally serves both runway directions. Where a runway holding position serves more than one runway, the sign layout at Fig 3.5 is used.

Figure 4-4: Typical Runway Holding Position Signs and Associated Taxiway Markings.



The diagram in Figure 4-4 illustrates typical signs associated with various Runway holding positions on Taxiway 'A' leading to the threshold of Runway 27 and on Taxiway 'D' leading to an intermediate taxiway entrance to Runway 09-27.

Note *- The signs at intermediate taxiway entrances as shown at Figure 4-4 (b) and (d) show the runway designation in both directions; a left turn is required to reach the threshold of Runway 09 and a right turn to reach the threshold of runway 27.*

5.4.2 Holding Position Sign for Category I, II and III Operations

At aerodromes equipped for Category I, II and III ILS approaches, Runway Holding Position signs are annotated CAT II, CAT III or CAT II/III as appropriate, in the manner illustrated in Figures 4-3 and 4-4. However, because of the need to provide greater protection to Category I, II and III ILS systems, the Runway Holding Positions associated with these procedures are set farther back from the runway than those associated with visual operations as indicated in figure 4-4 (e), (f) and (g).

5.4.3 Runway-Holding Position Sign

The style of sign illustrated at Figure 4-3 (f) is used to identify those locations where runway holding Positions have been established in order to protect a priority route. The signs display the taxiway designator accompanied by a number identifying the individual holding position.

5.4.4 No Entry

Where part of an aerodrome is restricted to one way traffic or it is withdrawn from use, No Entry Signs, as illustrated at Figure 4-3 (g), are located on both sides of the enntrance of the area showing the direction from which entry is prohibited.

5.5 Information Signs

(a) Information Signs consist of Location, Direction and Destination Signs; they are provided only where there is an operational need to provide additional guidance to pilots manoeuvring on the ground, and should be used in conjunction with an aerodrome chart.

(b) Information signs enable pilots and vehicle drivers to continuously monitor their position on the movement area. These signs are intended to be an aid to the safe and efficient navigation of all aircraft and vehicles.

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

(d) Examples of information signs are shown in Figure 4-5. Sign systems displaying a combination of location and direction information are the most commonly used. In Figure 4-5, four examples are given of this type of application. The two simplest examples are alternative ways of indicating prior to a position, where only two taxiways intersect, the designation of the taxiway on which the aircraft or vehicle is currently located and the designation of the crossing taxiway. From this information and reference to an aerodrome map, pilots and vehicle drivers can uniquely identify their

exact location and the direction that they must take at the junction to remain on their assigned route.

(e) It is only for this simplest of taxiway layouts that the option of placing the location information at the end of the sign array is permitted. At all other, more complex intersections the position of the location sign and the associated direction signs must correspond to the convention that the sign layout should directly reflect the intersection geometry. All taxiways requiring a turn to the left must be indicated by a sign inscription placed to the left of the location sign, and all turns to the right must be indicated by a sign inscription placed to the right of the location sign. In addition, the order in which the crossing taxiway information is displaced from the location sign is determined by the magnitude of the turn required to enter that designated taxiway. Thus taxiways that require the smallest change of direction are placed closest to the location sign and those requiring the greatest change of direction are placed furthest from the location sign.

(f) During the development of the signage system, it was demonstrated that by using the sign layout adopted in the standard described above, pilots needed less time to read and interpret the information than with any other layout. Furthermore, they did not make the mistakes in interpreting the taxiway configuration that occurred when testing other sign layouts.

(g) The clear differentiation between location signs and all other information signs that is secured by the reversal of the yellow/black colour combination is also an important element of the system. Location signs are an essential element of the signage at taxiway intersections, but they also have an important function wherever it is necessary to uniquely identify a position on the movement area. For example, a suitably sited location sign can expedite position reporting when an aircraft is manoeuvring off the runway.

(h) When choosing the location of a sign, the provisions of the SLCAR Part 14A, 5.4, shall be followed. The taxiway environment is such that the guidance on siting must be followed if damage due to impact with engine pods or propellers or as a result of jet blast effects is to be avoided.

(i) Where information is displayed to a pilot on the runway, location information is omitted from the sign system. Only direction information is displayed in this situation.

(j) Where it is necessary to provide intermediate holding positions on a taxiway at locations other than a runway/taxiway intersection, the location signs should consist of the taxiway designator supplemented by a number.

(k) An example of the way in which designating letters are assigned to a taxiway system is shown in Figure 4-9. In this figure, taxiways A, C and D are typical taxiways that may require the designation of intermediate holding positions to facilitate ground movement operations.

5.5.1 Location Signs

Location Signs are used to identify taxiways and where necessary, runways, such as at complicated intersections. Taxiways are normally designated by a single letter of the

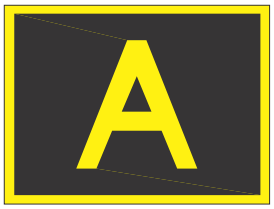
alphabet, e.g. ‘A’ for taxiway Alpha, ‘B’ for Bravo etc. The letters ‘O’, ‘I’ and ‘X’ are not used. On aerodromes with code number 3 or 4, where there are more taxiways than letters of the alphabet, double letter designators may be used in order to identify minor taxiways or taxiway stubs. Runway Location Signs use the first two numbers of the runway magnetic heading.

A Location Sign consists of the characters identifying the runway or taxiway in yellow lettering on a black background surrounded by a yellow border, as illustrated in Figure 4-5 (a) and (b). Where there is a need to identify a specific position on a runway, a Location Sign, displaying the taxiway designator accompanied by an identifying number as illustrated at Figure 4-5 (a) (ii), is used.

5.5.2 Direction and Destination Signs

Direction and Destination Signs consist of a route or destination label accompanied by an arrow point in the appropriate direction, displayed in black characters on a yellow background as illustrated at Figure 4-5. Direction Signs are normally accompanied by a Location Sign and positioned on the left side of a taxiway before an intersection, as shown at Figure 4-6, or adjacent to a runway, as shown at Figure 4-7.

Figure 4-5: Examples of Information Signs (not to scale)



(i)
Designation
(a)Taxiway Location Signs

(ii)
Specific Location

(iii)
Taxiway Ending

(b) Runway Location

(c) Direction Sign

(d) Runway Designation Sign

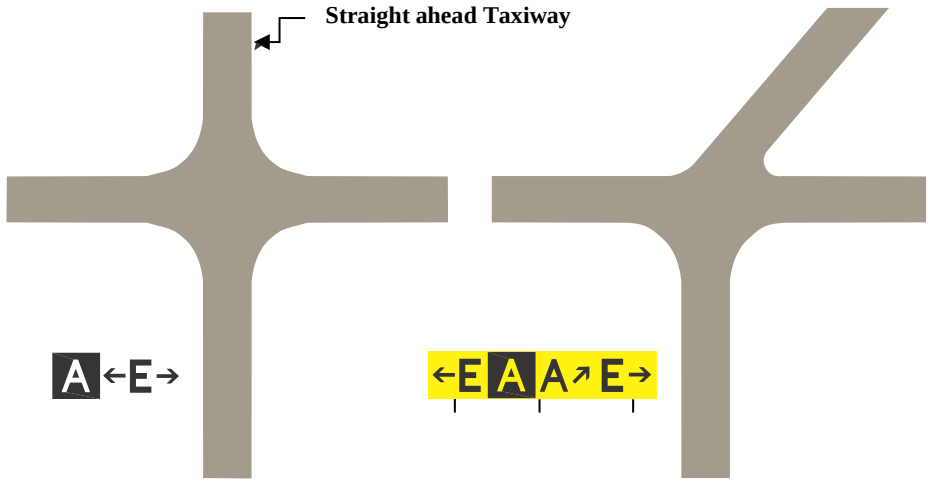
Note the use of a hyphen to separate reciprocal designators and the use of a dot to separate other designators.

(f) Inbound Designation Sign

(e) Designation sign to Different Runways

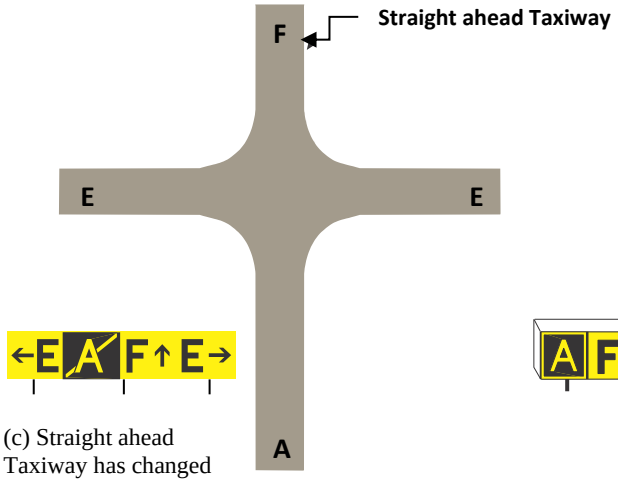
(g) Stand Designation Sign

Figure 4-6 Examples of Taxi Guidance Signs at Taxiway Intersections (not to scale)

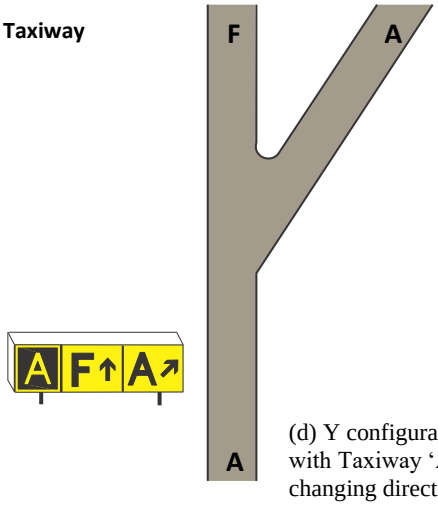


(a) Standard 4 – Way Intersection

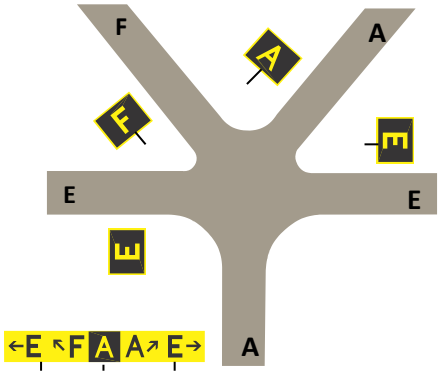
(b) Straight ahead Taxiway has direction change greater than 25 degrees



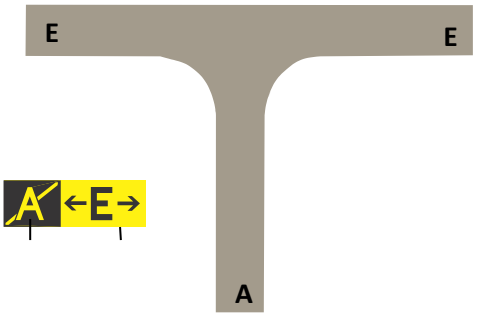
(c) Straight ahead Taxiway has changed designation



(d) Y configuration with Taxiway 'A' changing direction

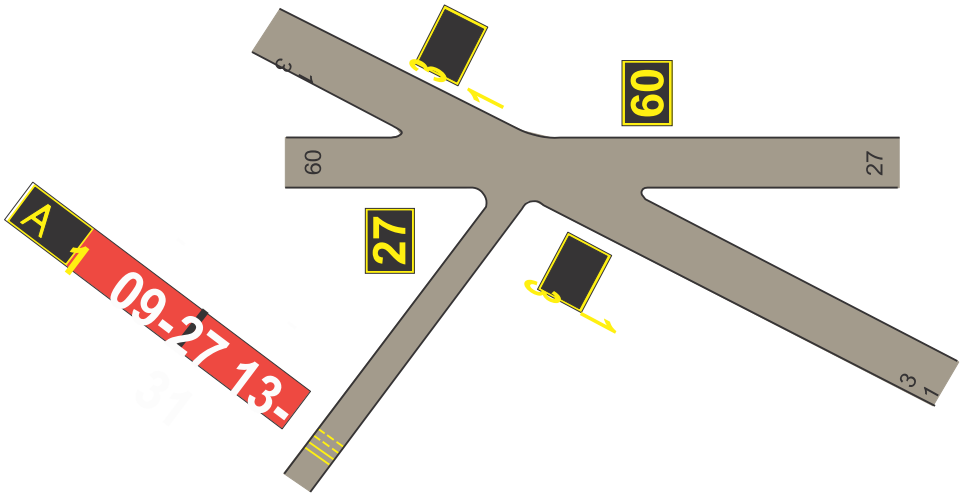


(e) Location signs indicating exit from intersection



(f) Taxiway ending sign

Figure 4-7: Examples of use of Runway Location Signs and Signs at Runway Taxi-Holding Positions serving more than one Runway.



(a) Taxiway entrance at intersection of two runways

(b) Taxiway entrance at intersection of two runway ends

Note:
1. Taxi-holding position signs installed at intersections such as those illustrated here are handled in the manner shown.

2. Runway location signs for runways 31 and 13 are shown in this example on the right side of the runway in order to avoid confusion.

Figure 4-8 Road Holding Position Sign

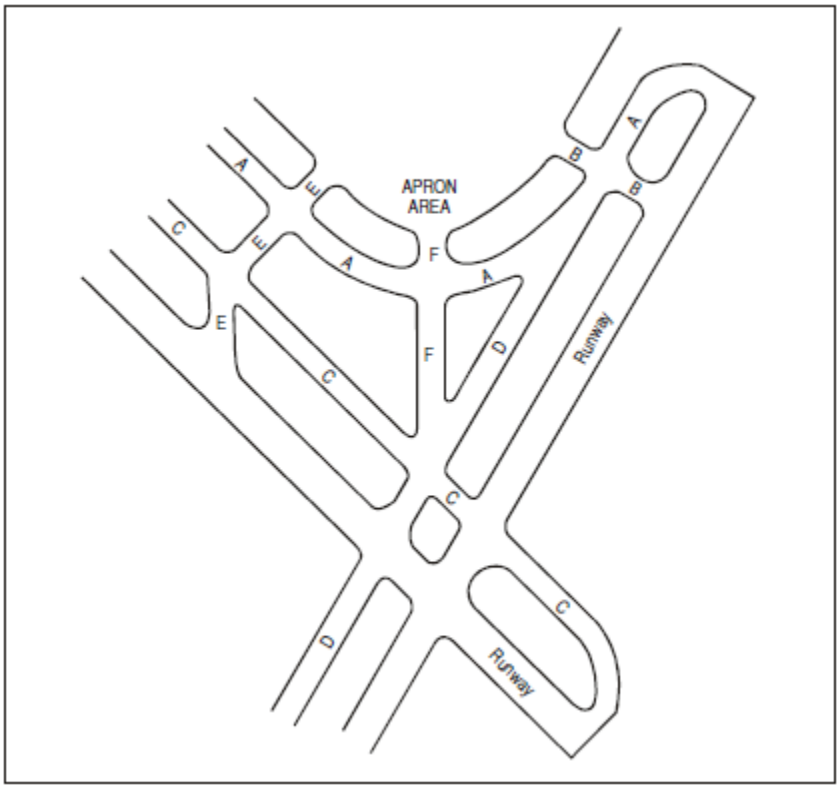


Figure 4-9 Assignment of letters to taxiways

5.6 Sign Evaluation

5.6.1 General

(a) The physical characteristics of taxiway signs are determined by the operational requirements reflected in the provisions of SLCAR Part 14A, IS 5.4.1.6. The colours used in any sign should conform to the specifications given in SLCAR Part 14A, Figures 1.2 to 1.4.

(b) To achieve the specified luminance performance for lighted signs, it is generally found that trans-illuminated signs best meet the requirements. The uniformity of the illumination influences the legibility of a sign. Unevenly lit signs are difficult to read and are therefore not acceptable in a taxiway signage system.

(c) Before a sign is installed, it should be demonstrated that the relevant requirements of the SLCAR Part 14A, are met by the sign design. It is important that both luminance and colour specifications are fully complied with. To demonstrate this compliance, it is necessary to carry out tests on a sign that fully represents the size, colour, inscription layout and lighting system that will be used in service.

(d) The dimensions and location of the reference grid points used for testing sign luminance should always be strictly in accordance with the specifications of SLCAR Part 14A, IS 5.4.1.6, Figure A4-2. Relaxation of the test specifications in terms of grid size or grid point location is not an acceptable means of making a specific sign compliant with the requirements.

(e) When a sign is tested for compliance, all parameters should be evaluated including font size, inscription location, the size of the borders around the inscription and the overall dimensions of the sign face.

(f) Taxi guidance signs shall be frangible but shall also be able to withstand significant wind velocities. For design purposes, a wind speed of at least 60 m/s can be used. In some places, such as any location that is close to the point on a runway where large aircraft are rotated during the take-off run, higher design wind speed values may be appropriate. However, at some locations in the movement area, signs may be exposed to wind velocities of up to 90 m/s caused by jet blast.

(g) Structural members supporting a sign face should not constitute part of the sign face dimensions. When the structure of the design overlaps the sign face, the dimensions of the face should be adjusted accordingly to ensure that the correct area of sign face is provided.

(h) The rear of the sign should be marked in a single conspicuous colour except where signs are mounted back-to-back.

(i) Examples of typical signs that comply with these specifications are shown in Figure 4-4.

5.6.2 Evaluation Procedures

(a) To evaluate the physical characteristics of a sign, the following procedures should be applied:

(i) assess the category of operation for which the sign is to be used;

(ii) measure the height and width of the sign face, excluding the holder frame where applicable;

(iii) measure the height of all characters;

(iv) measure the stroke width of each character and ensure that the stroke width is consistent around the characters, particularly those that contain curved components;

(v) measure the width of each character;

(vi) measure the space around the characters, top, bottom, right and left;

(vii) measure the border width where applicable;

(viii) measure the space between words where applicable;

(ix) where two types of signs are in one unit (e.g. taxiway mandatory and information signs), measure the separation between the signs; and

(x) compare the measured dimensions and spacing's with the recommendations given in SLCAR Part 14A, IS 5.4.1.6.

(b) To evaluate the photometric performance of a sign, the following procedures should be applied:

(i) evaluate the photometric performance of the sign in a darkened environment;

(ii) mark out the grid on the sign face as shown in SLCAR Part 14A, IS 5.4.1.6, Figure A4-2 (exclude any framework). Ensure that the rows/ columns of grid points are correctly aligned parallel to both the top and left edge of the sign face;

(iii) at an appropriate range from the sign, measure the luminance and colour coordinates at each applicable grid point ensuring that the area used for each individual measurement does not exceed that prescribed by a circle of 3 cm in diameter centred on the grid point. For externally lit signs, ensure that the measurement is taken from behind the light source;

(iv) calculate the average luminance level for each colour and compare the values with the minimum values recommended in SLCAR Part 14A, IS 5.4.1.6;

(v) ensure that uniformity of luminance has been achieved by calculating the ratio between the maximum and minimum luminance values for each colour and comparing it with the maximum recommended ratio in SLCAR Part 14A, IS 5.4.1.6;

(vi) for a mandatory (red and white) sign, confirm that the maximum and minimum ratios between the average red luminance and the average white luminance are within the recommended range specified in SLCAR Part 14A, IS 5.4.1.6;

(vii) assess the ratios of adjacent luminance levels in the vertical and horizontal planes and compare them with the recommended maximum ratio given in SLCAR Part 14A, IS 5.4.1.6 (assess the ratio between adjacent points of the same colour only); and

(viii) calculate the average of the colour coordinates for each colour and confirm that the values are within the boundaries recommended in SLCAR Part 14A, IS 1.2.3.

Note - *Signs of different lengths may have different photometric performances.*

5.6.3 Determining the width of a sign face

(a) The examples in Tables 4-1 and 4-2 provide guidance on how to determine the width of a sign face.

Note - *The width of the space between character groups or character groups and symbols should be equal to the average height of the letter used:*

Letter height (mm)	*Average letter width (mm)*
400	280
300	210
200	140

Table 4-1 Inscription: 27 CAT III (letter height 400 mm)

Item	Width (mm)
½ H	200
2	274
character space	76
7	274
character group space	280
C	274
character space	50
A	340
character space	26
T	248
character group space	280
III	440
½ H	200
Total width	**2 962**

Table 4-2 Inscription: APRON → (letter height 300 mm)

Item	Width (mm)
½ H	150
A	255
character space	57
P	205
character space	71
R	205
character space	57
O	214
character space	71
N	205
character group space	210
→	300
½ H	150
Total width	2 150

6 VISUAL DOCKING GUIDANCE SYSTEMS

6.1 General

Visual Docking Guidance Systems (VDGS), sometimes referred to as Nose-in Docking Guidance Systems, provides guidance where accurate aircraft parking is required. This is usually the case where air-bridges are used. Types of VDGS includes Azimuth Guidance for Nose-in Stands (AGNIS), supported by Parallax Aircraft Parking Aid (PAPA). In some cases, mirrors may be provided to permit a pilot to view the position of the nose wheel of the aircraft relative to the stopping position.

Note 1 - *A pilot should not assume that a stand is safe to enter simply because the stand VDGS is active or lit. Where ground handling personnel are not present on the stand or if the pilot has any doubt about the position of any equipment on or NEAR to the stand, the aircraft should be stopped immediately and assistance requested.*

Note 2 - *Except under the guidance of a marshaller, an aircraft should not be taxied onto a VDGS equipment stand when the guidance system is switched off or appears inactive.*

Note 3 - *Ground staff should NOT activate a VDGS until a thorough inspection of the stand and its immediate surroundings has been made in order to ensure that all equipment is correctly parked in allocated areas and that the stand is safe for use by the type of aircraft assigned.*

6.2 The Operational Requirements of Visual Nose-in Docking Guidance Systems

(a) The system must provide positive visual lead-in guidance and when in use must be visible to the pilot throughout the docking manoeuvre.

(b) The guidance provided must be easily recognizable and capable of being interpreted without ambiguity.

(c) There must be continuity between the visual parking guidance and the visual docking guidance systems.

(d) The displays must be readily conspicuous to a pilot approaching the system regardless of other distractions in the area.

(e) Mounting of the unit above apron level should not be critical in relation to the pilot's viewing angle as the air-craft closes in on the stand.

(f) The system should provide left/right guidance utilizing self-evident signals which inform the pilot of the position of the aircraft in relation to the longitudinal guidance line.

(g) The guidance provided by the system should be such that the pilot can acquire and maintain the longitudinal and stopping guidance without over-controlling.

(h) The system should be capable of accommodating variations in pilot eye height including the effects of aircraft loading.

(i) The system for providing left/right guidance should be aligned for use by the pilot occupying the left-hand seat.

(j) The rate of longitudinal closure information should be associated with, or incorporated into, the system.

(k) An unmistakable stop signal for each aeroplane type, preferably deployed permanently without need for selective operation by ground personnel, should be associated with the system. The method used to indicate the stopping point should preferably not require pilots to turn their heads and should be usable by both pilots.

(l) The guidance provided should not be affected by external factors such as pavement condition, weather and lighting conditions.

(m) The accuracy of the system should be adequate for the type of loading bridge with which it is to be used.

6.2.1 Associated requirements for docking

(n) Docking serviceability/unserviceability information should be available and, in the latter case, the point where the pilot should stop the aircraft should be indicated.

(o) The provision of a human safety monitor capable of indicating to the pilot the need for an emergency stop may be necessary.

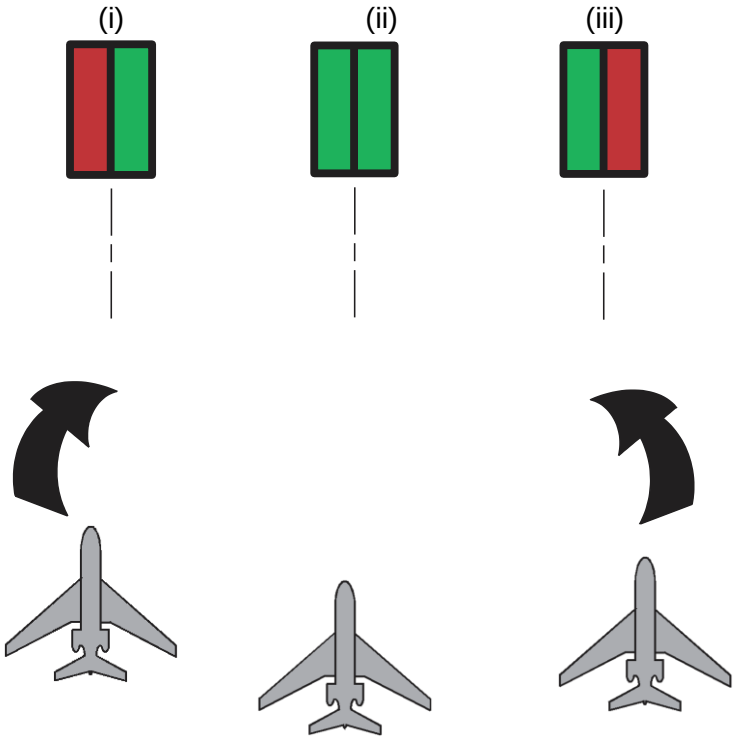
6.3 Azimuth Guidance for Nose-in Stands (AGNIS)

(a) AGNIS provides Stand centreline alignment guidance and is normally used in conjunction with PAPA, marker boards, lines of mirrors, which provide stopping guidance separately. The system is designed for use from the left pilot position only and the unit displays two closely spaced vertical light bars mounted in a box, as illustrated at Figure 5.1, at about flight deck height ahead of the pilot. The light bars display one of the following signals:

(i) one red bar and one green bar as illustrated at Figure 5.1 (i) and (iii), indicating that the pilot should steer away from the red towards the green bar, or

(ii) two green bars, indicating correct alignment, as illustrated at Figure 5.1 (ii)

Figure 5.1 AGNIS

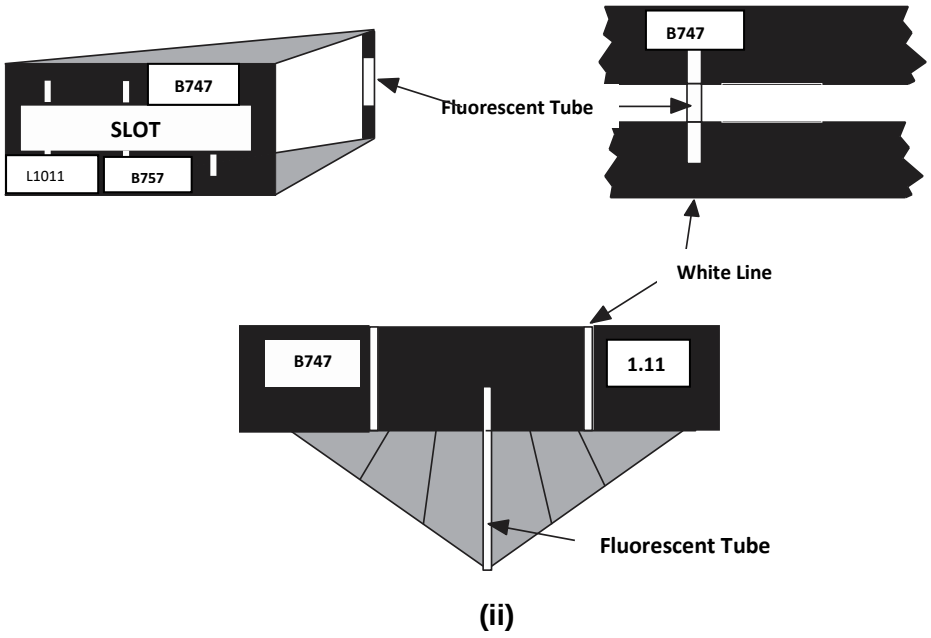


(b) AGNIS may be supported by one of the following aids:

PAPA

This aid is normally positioned to the right side of the Stand centreline and provides stopping guidance by employing a black board marked with white vertical lines bearing aircraft type identification labels and in which a horizontal slot has been cut, as illustrated at Figure 5.2 (i). A short distance behind the slot is a vertically-mounted white fluorescent light tube which, when aligned with the required aircraft type line, indicates the stop-point, as shown at Figure 5.2 (ii). An alternative layout is illustrated at Figure 5.2 (iii) where the board is not provided with a slot and the tube is mounted in front of it; the method of use is identical.

Figure 5.2 PAPA



(ii)

Mirror

The Mirror system consists of a mirror mounted to the left of the stand centreline and facing the approaching aircraft. The mirror is angled so that the pilot in the left hand seat can see the reflection of the aircraft nose wheel during the last few metres of the parking manoeuvre.

The correct stopping position is indicated by aircraft type designators painted in mirror image on the apron surface. As the aircraft approaches, the pilot is able to see in the mirror a reflection of the aircraft nose wheel and an appropriate designator where the aircraft should be stopped. A yellow javelin headed arrow may be used as the designator, with the aircraft type given.

6.4 Aircraft Positioning and Information System (APIS/APIS++)

(a) APIS/APIS++ is designed for use from the left pilot position and combines both alignment and stopping signals in one visual display mounted at flight deck height ahead of the pilot. The elements of the display as illustrated at Figure 5.3 are as follows:

(i) An alphanumeric yellow dot matrix element displayed in the upper portion of the unit indicating as appropriate, any of the signals illustrated.

(ii) A yellow dot matrix progress strip element displayed on the lower left side of the unit indicating progress of the aircraft over the last 16.2 m of the approach to the stop position.

(iii)An azimuth guidance element employing a moiré pattern.

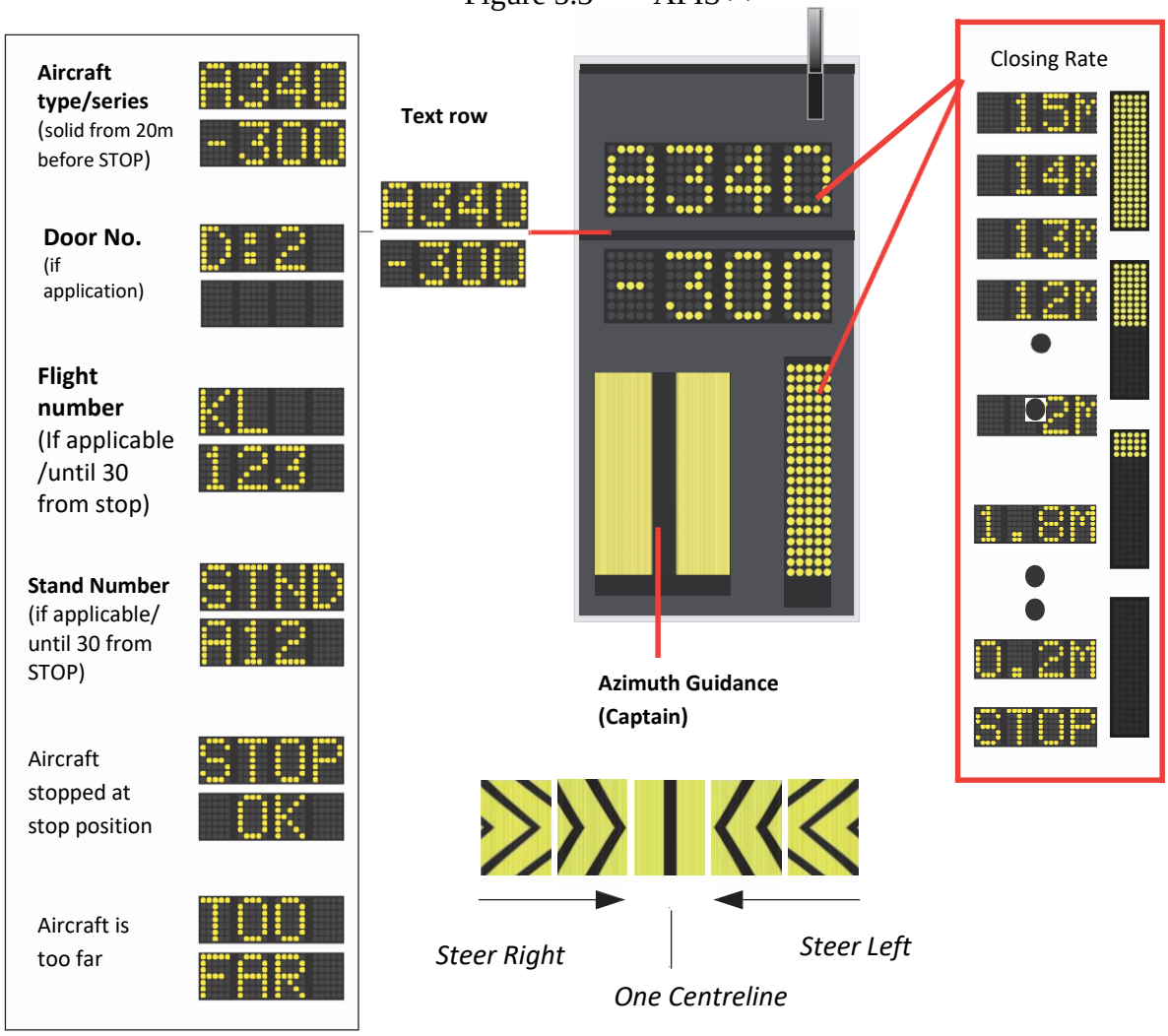
(b) Prior to entering the stand the pilot must ensure that the following signals are displayed:

(i) Correct aircraft type

(ii) Correct stand number

(c) The Azimuth Guidance element consists of a yellow moiré pattern signal providing directional guidance to the pilot in relation to the stand centreline as illustrated in Figure 5.3.

Figure 5.3 APIS++



FMT APIS++ (Aircraft Parking and Information System)

Azimuth and stopping guidance are provided from a display unit mounted at the extension of the stand centreline.

Abort docking if display shows STOP or wrong aircraft type/series, or if the azimuth guidance display is not activated.

6.5 Safe-gate Safe-dock

(a) The Safe-gate Docking Guidance System (known as Safedock) is an AVDGS that provides azimuth guidance, distance to stop information, aircraft type and door in use guidance on a single electronic display, as illustrated at Figure 5.4.

(b) The display unit incorporates three different indicators for alphanumeric, azimuth and distance-to-go information, all of which are clearly visible from both pilot positions in the aircraft. The display comprises an array of LED indicators, yellow and red indicator boards, each housing a processor board connected in series to the control unit via a ribbon cable. A serial communication protocol is used for the communication between the control unit and the LED-modules. The upper two rows are used for alphanumeric information, the third row for azimuth information and the central vertical bar for distance-to-go information.

(c) The alphanumeric display, shown in yellow, will present information such as abbreviations for aircraft type, airport code and flight number. Special text information for guidance is also displayed to the pilot in the docking phase. The azimuth guidance indicator, displayed as a red arrow, gives information to the pilot on how to direct the course of the aircraft. A yellow vertical arrow shows the actual position of the aircraft in relation to the aircraft stand centre line. The system supports multiple convergent centre lines as well as curved centre lines. The distance-to-go indicator, shown in yellow, comprises 32 horizontal elements which will display as a vertical bar that symbolizes the centre line. Each horizontal element represents a distance of 0.5 m.

(d) By using anti-reflective material in the display window and dark colored LED-boards, together with automatic adjustment of the LED light intensity, the displayed information is legible in all light conditions.

(e) The laser scanning unit is housed in the lower part of the display unit cabinet. The unit, based on three-dimensional technology, comprises a laser range finder and scanning mirrors. The unit also incorporates a fixed mirror for use during self-testing of the system.

(f) Three-dimensional profiles for selected aircraft using specific parameters for the geometry of the aircraft are programmed into the visual docking guidance system. During the docking procedure, the laser equipment measures the corresponding parameters of the approaching aircraft.

(g) The docking procedure, as illustrated in Figure 12-1, can be activated by:

(i) the operator of the visual docking guidance system who will select the aircraft type from the operator control panel;

(ii) remote selection of aircraft type by a gate management system, which will have to be confirmed by the operator of the visual docking guidance system at the operator control panel; or

(iii) automatic selection of aircraft type by a gate management system based on information from the flight information display system (FIDS).

(h) Before any docking procedure can be activated, a self-test will be performed by the system. The correct position of a permanent test object located in a known position will be checked. A failed test will result in an error message on the LED display. If the self-test is successful, the aircraft type will be shown on the LED display unit as well as on the operator control panel. Floating arrows on the azimuth and distance-to-go will indicate that the system is ready for operation. The laser scanning unit is now activated, and the operator control panel will indicate the aircraft type and the status of the laser scanning unit as "ACTIVE".

(i) When the aircraft is detected by the laser rangefinder, usually more than 50 m before the stop position, the distance-to-go LED display will be activated. The azimuth display, the yellow arrow, will indicate the lateral position of the aircraft with respect to the aircraft stand centre line, and a red flashing arrow will indicate the direction of any required course adjustment. The operator control panel will show "TRACKING".

(j) During the approach of the aircraft towards the stop position, the aircraft type will be verified by the system by comparing captured data to those programmed for the selected aircraft. If aircraft type verification is not established within 12 m from the stop position, the LED display unit will show "STOP/ID FAIL". If the captured data will verify the aircraft type, the operator control panel will show "IDENTIFIED".

(k) When the aircraft is within a specified distance (12 m or 16 m) from the stop position, the height of the distance-to-go indicator will gradually decrease (the horizontal elements of the yellow bar will be switched off one by one) as the aircraft approaches the stop position. When the aircraft has reached the stop position, the alphanumeric display will indicate "STOP" together with two red stop symbols. When no movement of the aircraft can be detected after a pre-set time period, the alphanumeric display will change from "STOP" to "OK" or "TOO FAR", as the case may be. This will also be indicated on the operator control panel. After an additional pre-set time period, the status on the operator control panel will change to "PARKED".

(l) Another visual docking guidance system that uses a graphical display of the pattern of interference fringes formed by optical gratings (Moiré technique) to provide azimuth guidance and a laser radar to provide distance-to-go and stopping position information is detailed in Figure 12-2. This system consists of a display unit, a control unit and a laser radar unit all housed in an aluminium enclosure. The enclosure is attached to the terminal building or other support close to the extension of the aircraft stand centre line. The system also includes an operator control panel comprising a display terminal and an emergency stop button. The operator control panel is normally located in the passenger boarding bridge or at ground level.

(m) The display unit incorporates three different indicators for alphanumeric, azimuth and distance-to-go information. The alphanumeric and distance-to-go indicator will provide information to both the pilot and the co-pilot. The azimuth indicator will provide guidance only to the pilot. To provide azimuth information to the co-pilot, an additional co-pilot azimuth guidance unit will be required.

(n) The alphanumeric indicator will display horizontal text information, such as aircraft type, "STOP", failure codes, etc. It consists of four alphanumeric display panels each

of which is a 7 by 5 yellow fluorescent dot matrix. Illumination is provided by a fluorescent tube.

(o) The distance-to-go indicator provides information based on a laser range measurement technique. The laser measures the distance to the aircraft, and the display presents the measured distance relative to the parking position in analogue and/or numeric format. Distance measuring is updated 10 times a second. Distance-to-go information is provided over the last 15 m of aircraft approach to the parking position in steps of 0.75 m. The distance-to-go indicator consists of three alphanumeric dis-play panels forming a vertical bar. Each display panel is a 7 by 5 yellow fluorescent dot matrix. Illumination is provided by a fluorescent tube.

(p) When the system is activated for docking, a distance sensor transmits laser pulses in the vertical plane to detect an approaching aircraft. When the laser pulses hit the aircraft, the pulses are reflected to the receiver. Distance measuring is performed 10 times per second. The system is able to detect an aircraft at more than 100 m distance. Data on distance measuring is sent to the control unit, which will process the data relative to the parking position prior to distance-to-go information being presented on the display unit. The whole operation of collecting measuring data, processing the data and showing the information on the display unit takes less than 0.2 seconds.

(q) The azimuth guidance indicator, based on the Moiré technique, provides the pilot with continuous and real-time azimuth guidance information. The azimuth guidance indicator consists of a front grating and a rear grating. Light passes through the superimposed gratings and creates a Moiré arrow pattern. Small relative movements between the gratings result in large changes in the pattern. Illumination is provided by compact fluorescent tubes. Reduced illumination is applied during night to prevent operational problems caused by glare.

(r) When approaching the aircraft stand, the pilot steers the aircraft in the direction indicated by the arrow pattern until the arrow becomes a straight line. When the azimuth guidance display shows a straight vertical black line, the aircraft is established correctly on the centre line.

(s) The control unit is based on an industrial control computer. Aircraft data, such as length, wing span, and distances to nose, pilot’s eyes, nose wheel, main landing gear, and doors 1 and 2, for more than 500 different aircraft types and series are stored in the computer. Event-recording facilities may also be included in the control unit.

(t) The visual guidance docking system can be interfaced with an airport operations database (AODB) or flight information display system (FIDS). It can thus provide the ground crew with flight information, such as the flight number, departure point and destination.

(u) The system can be activated either automatically or from the operator control panel. Manual activation is carried out by selecting the incoming aircraft on the operator control panel. Automatic activation can be provided by connecting the system to the AODB/FIDS at the airport.

(v) The system displays the aircraft type on the alphanumeric indicator. This gives the pilot the opportunity to halt the approach to its parking position if the aircraft type being processed in the system is incorrect.

(w) During aircraft docking the system is being monitored and if a fault or operational error is detected, the alphanumeric indicator will display “STOP” and the error code and the operator control panel will display the error message.

(x) The emergency stop button is used when the operator decides that the approaching aircraft is in jeopardy. When the emergency stop is activated, the visual docking guidance system will display azimuth guidance and distance-to-go information, and the alphanumeric indicator will display “STOP”. After a pre-set time period, the alpha-numeric indicator will display “ESTP” (emergency stop) and “STOP” until the emergency stop button is released. During the time the emergency stop is activated, all inter-locks to other stand equipment are normally released. When the emergency stop button is released, the system will revert to the status it had before the emergency stop was activated

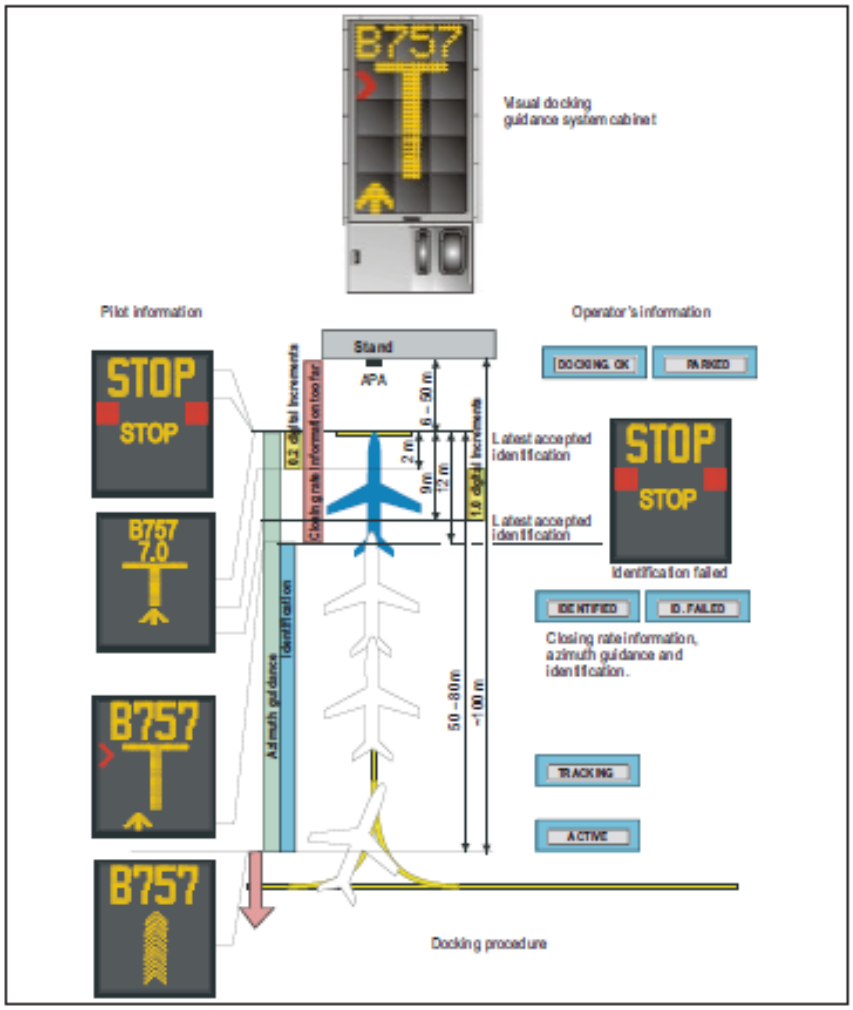


Figure 5-4 A visual docking guidance system using a graphical display and laser-based sensors to provide azimuth guidance, distance-to-go and stopping position information

7 AERODROME SIGNAL AREA

7.1 General

(a) At those aerodromes where General Aviation movements are significant, visual aids displayed in Signals Areas may be employed in order to provide information relating to the conduct of flying operations. Where provided, the Signal Area, measuring approximately 12m square and bounded by a white border is so located on the aerodrome that it is visible from all directions of approach. The meaning of individual signals displayed within the Signal Area is described in Table A.

(b) Light Signals and Pyrotechnic Signals may also be used to convey instructions to pilots and ground staff and have the meanings described at Table B.

(c) The meaning of Aircraft Marshalling Signals prescribed is described in Table C, whilst Table D describes the meaning of signals made by a pilot to a marshaller.

(d) Where signals are applicable only to helicopter operations, they are marked by the symbol.

(e) The signal area should be an even horizontal surface at least 9 m square. It should be constructed of cement concrete reinforced with an adequate quantity of steel to avoid cracks resulting from unequal settlement. The top surface should be finished smooth with a steel trowel and coated with paint of appropriate colour. The colour of the signal area should be chosen to contrast with the colours of the signal panels to be displayed thereon. The signal area should be surrounded by a white border not less than 0.3 m wide.

Signal panels and landing "T"

Dumb-bell

(f) This signal should be constructed of wood or other light material. The dumb-bell should consist of two circles 1.5 m in diameter connected by a crossbar 1.5 m long by 0.4 m wide as shown in Figure 3-1A. It should be painted white.

Landing "T"

(g) The landing "T" should be constructed of wood or other light material and its dimensions should correspond to those shown in Figure 3-1B. It should be painted white or orange. The landing "T" should be mounted on a cement concrete pedestal adequately reinforced with steel bars to avoid cracks resulting from unequal settlement. The surface of the pedestal should be finished smooth with a steel trowel and coated with paint of appropriate colour. The colour of the pedestal should be chosen to contrast with the colour of the landing "T". Before fastening the landing "T" base to the concrete pedestal, the mounting bolts should be checked for correct spacing. The landing "T" should be assembled and mounted in accordance with the manufacturer's installation instructions. It should be free to move about a vertical axis so that it can be set in any direction. The under surface of the landing "T", when mounted on its pedestal, should be not less than 1.25 m above ground level. Where required for use at night, the landing "T" should either be illuminated or outlined by white lights.

Red square with yellow cross

- The dimensions of this signal panel, which relates to prohibition of landing, should correspond to those shown in Figure 3-1C. The signal panel can be constructed using a 3 m × 3 m galvanized iron sheet. The yellow cross should first be painted and then the remaining area should be painted red. The signal panel should be provided with at least two handles to facilitate handling.

Red square with yellow diagonal

(h) This signal panel, which is shown in Figure 3-1D, should be constructed generally following the principles explained in the preceding paragraph. The only difference is that the signal panel will show a yellow diagonal in lieu of the yellow cross.

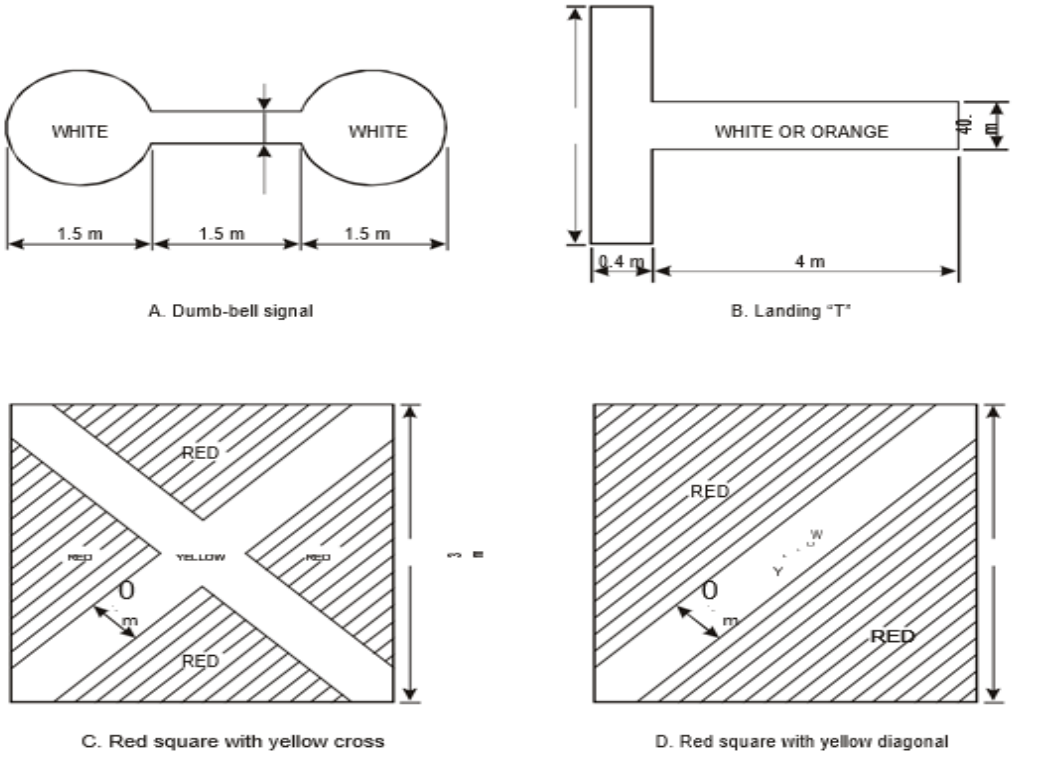
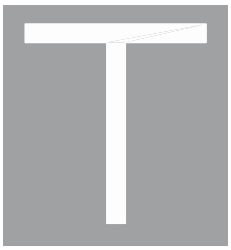
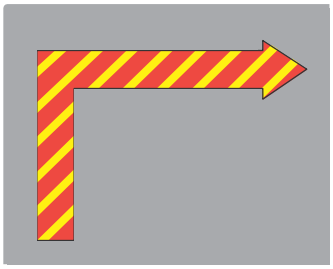


Figure 3-1. Signal panels and landing "T"

Table A - Meaning of Signals Displayed in the Signals Area



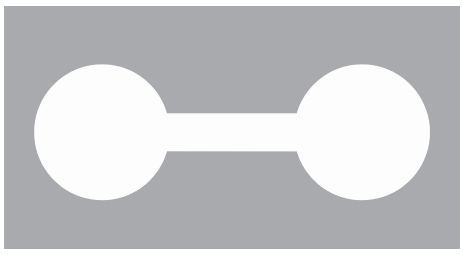
A white landing T signifies that aeroplanes and gliders taking-off or landing shall do so in a direction parallel with the shaft of the T and towards the cross arm, unless otherwise authorised by the appropriate ATC unit.



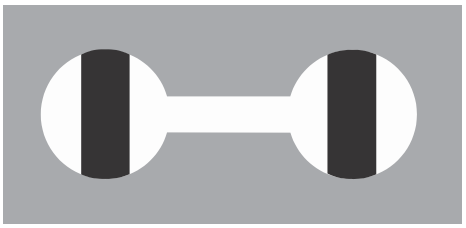
A red and yellow striped arrow placed along the whole of two adjacent sides of the signals area and pointing in a clockwise direction signifies that a right hand circuit is in force.

A red panel square with a yellow diagonal stripe signifies that the state of the manoeuvring area is poor and pilots must exercise special care when landing.

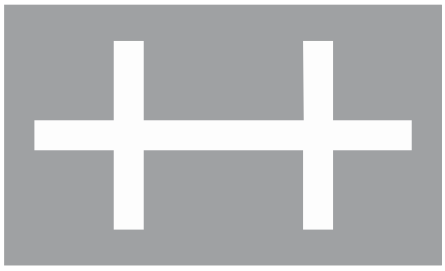
A red panel square with yellow stripes along each diagonal signifies that the aerodrome is unsafe for the movement of aircraft and that landing is prohibited.



A white dumb-bell signifies that movements of aeroplanes and gliders on the ground shall be co confined to paved, metalled or similar hard surface.

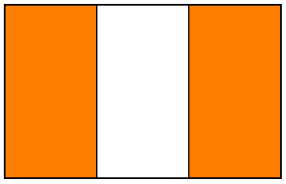


A black strip across each disc of the white dumb-bell at right angles to its shaft signifies that aeroplanes and glider gliders taking –off or landing shall do so on a runway but that movement on the ground is not confined to paved, metalled or similar hard surfaces .



A white double cross signifies that glider flying is in progress.

A white letter H signifies that helicopters shall take-off and within the area designated by a large white letter H.



At intervals along the boundary of an aerodrome

Orange and white striped markers are used to delineate the boundary where it is insufficiently conspicuous

On a portion of a runway

A white mark in the shape of St. Andrew's cross indicates that that portion of the runway up to the next standard marking is unfit for use by aircraft.

On a portion of a taxiway

A yellow cross indicates that that portion of the taxiway up to the next standard marking is unfit for use by aircraft.

Table B

Meaning of Light and Pyrotechnic Signals

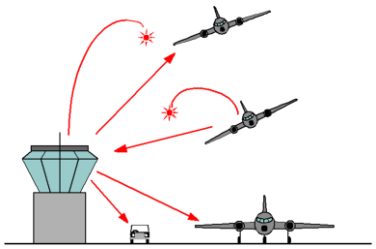
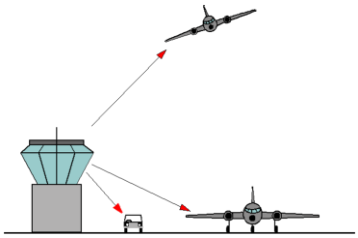
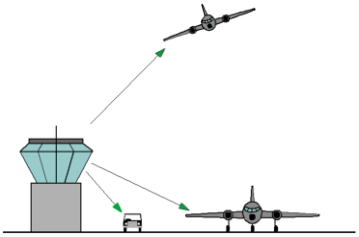
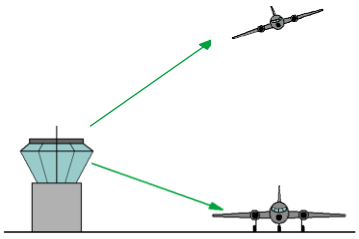
Signal		Meaning
Steady red light to aircraft or vehicle as indicated. Red flare from tower or aircraft		Do not land. Give way continue circling Immediate assistance required Stop
Flashing red light to aircraft or vehicle		Do not land; aerodrome closed Move area clear for landing
Flashing green light to aircraft or vehicle		Return to aerodrome await landing clearance Cleared to taxi/move on the manoeuvring area
Steady green light to aircraft		Cleared to land Cleared to take-off

Table B Meaning of Light and Pyrotechnic Signals

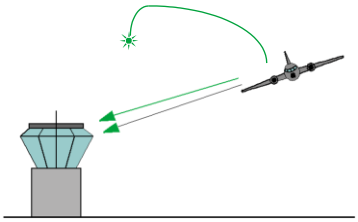
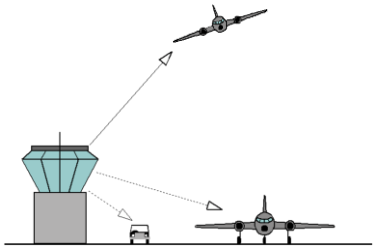
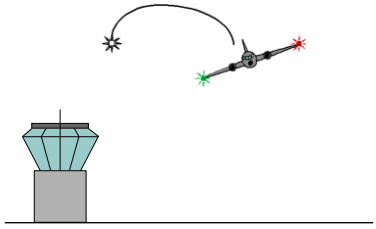
Signal		**Meaning**
Steady or flashing green or green flare from aircraft		By night- may I land? By day- may I land in a direction different from that indicated?
Signal White flashes to aircraft and vehicle		**Meaning** Land here on receipt of steady green and await further instructions. Return to starting point on the aerodrome.
Signal White flare from aircraft or irregular switching of navigation or landing lights		**Meaning** I am compelled to land

Table C Meaning of Marshalling Signals

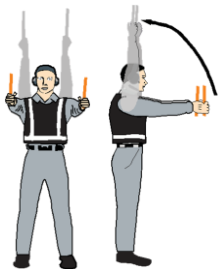
	Description of signal	Meaning of Signal
	**(1)** Raise right hand above head level with wand pointing up; move left-hand wand pointing down toward body	Wing walker/guide-This signal provides an indication by a person positioned at the aircraft wing tip, to the pilot/marshaller/push-back operator, that the aircraft movement on/off a parking position would be unobstructed
	**(2)** Raise fully extended arms straight above head with wands pointing up	Identify gate
	**(3)** Point both arms upwards, move and extend arms outward to sides of body and point with wands to direction of next signalman or taxi area	Proceed to next signalman or as directed by tower/ground control
	**(4)** Bend extended arms at elbows and move wands up and down from chest height to head	Straight ahead

Table C Meaning of Marshalling Signals

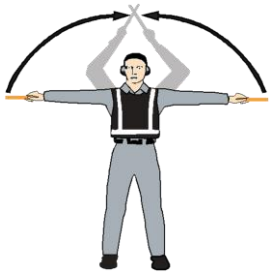
	Description of Signal	Meaning of Signal
	**(5a)** With right arm and wand extended at a 90-degree angle to body, make “come ahead” signal with left hand. The rate of signal motion indicates to pilot the rate of aircraft turn.	Turn left (From pilot’s point of view)
	**(5b)** With left arm and wand extended at a 90-degree angle to body, make “come ahead” signal with right hand. The rate of signal motion indicates to pilot the rate of aircraft turn.	Turn right (From pilot’s point of view)
	**(6a)** Fully extend arms and wands at a 90-degree angle to sides and slowly move to above head until wands cross	Normal stop
	**(6b)** Abruptly extend arms and Wands to top of head, crossing wands	Emergency stop

Table C Meaning of Marshalling Signals

	Description of Signal	Meaning of Signal
	**(7a)** Raise hand just above shoulder height with open palm, Ensuring eye contact with flight crew, close hand into a fist. Do not move until receipt of “thumbs up” acknowledgement from flight crew.	Set brakes
	**(7b)** Raise hand just above shoulder height with hand closed in a fist, Ensuring eye contact with flight crew, open palm. Do not move until receipt of “thumbs up” acknowledgement from flight crew.	Release brakes
	**(8a)** With arms and wands fully extending above head, move wands inwards in a “jabbing” motion until wands touch. Ensure acknowledgement is received from flight crew.	Chocks inserted
	**(8b)** With arms and wands fully extending above head, move wands outwards in “jabbing” motion. Do not remove chocks until authorised by crew	Chocks removed

Table C Meaning of Marshalling Signals

	Description of Signal	Meaning of Signal
	**(9)** Raise right arm to head level with wand pointing up and start a circular motion with hand; at the same time, with left arm raised above head level, point to engine to be started	Start engine(s)
	**(10)** Extend arm with wand forward of body at shoulder level; move hand and wand to top of left shoulder and draw wand to top of right shoulder in a slicing motion across throat	Cut engine(s)
	**(11)** Move extended arms downwards in a “patting” gesture, moving wands up and down from waist to knees	Slow down
	**(12)** With arms down and wands toward ground, wave either right or left wand up and down indicating engine(s) on left or right side respectively should be slowed down	Slow down engine(s) on indicated side

Table C Meaning of Marshalling Signals

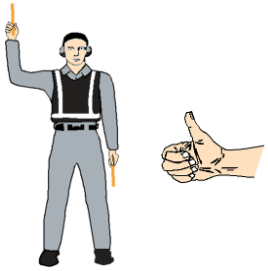
	Description of Signal	Meaning of Signal
	**(13)** With arms in front of body at waist height, rotate arms in a forward motion. To stop rearward movement, use signal 6(a) or 6(b)	Move Back. 
	**(14a)** Point left arm with wand down and bring right arm from overhead vertical position to horizontal forward position, repeating right-arm movement	Turns while backing (for tail to starboard)
	**(14b)** Point right arm with wand down and bring left arm from overhead vertical position to horizontal position, repeating left-arm movement	Turns while backing (for tail to port)
	**(15)** Raise right arm to head level with wand pointing up or display hand with “thumbs up”; left arm remains at side by knee	Affirmative/all clear- This signal is also used as a technical/servicing communication signal

Table C Meaning of Marshalling Signals

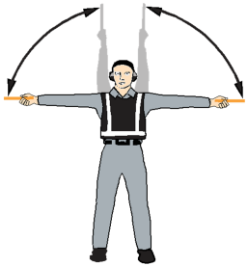
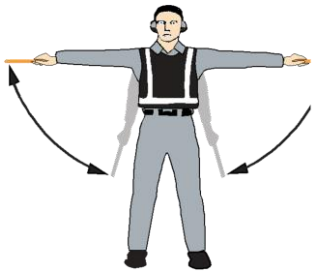
	Definition of Signal	Meaning of Signal
	**(16)** Fully extend arms and wands at a 90-degree angle to sides.	Hover. 
	**(17)** Fully extend arms and wands at a 90-degree angle to sides and, with palms turned up, move hands upwards. Speed of movement indicates rate of ascent.	Move upwards. 
	**(18)** Fully extend arms and wands at a 90-degree angle to sides and, with palms turned down, move hands downwards. Speed of movement indicates rate of decent.	Move downwards. 
	**(19a)** Extend arm horizontally at a 90-degree angle to right side of body. Move other arm in same direction in a sweeping motion.	Move horizontally left (from pilot's point of view). 

Table C Meaning of Marshalling Signals

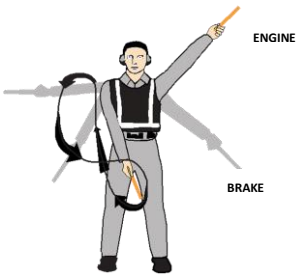
	Description of Signal	Meaning of Signal
	**(19b)** Extend arm horizontally at a 90-degree angle to left side of body. Move other arm in same direction in a sweeping motion.	Move horizontally right (from pilot's point of view). 
	**(20)** Cross arms with wands downwards and in front of body.	Land 
	**(21)** Move right-hand wand in a "fanning" motion from shoulder to knee, while at the same time pointing with left-hand wand to area of fire.	Fire
	**(22)** Fully extend arms and wands downwards at a 45-degree angle to sides. Hold position until aircraft is clear for next manoeuvre.	Hold position/stand by

Table C Meaning of Marshalling Signals

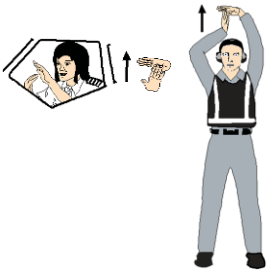
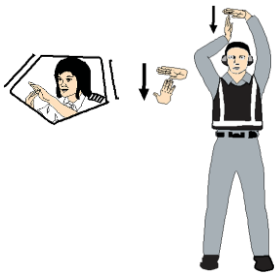
	Description of Signal	Meaning of Signal
	**(23)** Perform a standard salute with right hand and/or wand to dispatch the aircraft. Maintain eye contact with flight crew until aircraft has begun to taxi.	Dispatch aircraft
	**(24)** Extend right arm fully above head and close fist or hold wand in horizontal position; left arm remains at side by knee.	Do not touch controls (technical/servicing communication signal).
	**(25)** Hold arms fully extended above head, open left hand horizontally and move finger tips of right hand into a touch open palm of left hand (forming a “T”). At night, illuminated wands can also be used to form the “T” above head.	Connect ground power (technical/servicing communication signal).
	**(26)** Hold arms fully extended above head with finger tips of right hand touching open horizontal palm of left hand (forming a “T”); then move right hand away from the left. Do not disconnect power until authorised by flight crew. At night, illuminated wands can also be used to form the “T” above head.	Disconnect power (technical/servicing communication signal).

Table C Meaning of Marshalling Signals

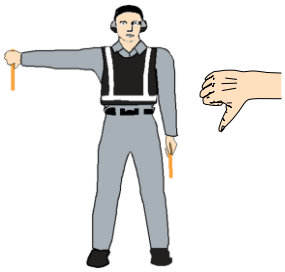
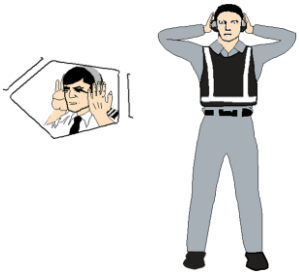
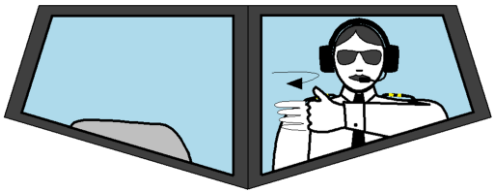
	Description of Signal	Meaning of Signal
	**(27)** Hold right arm straight out at 90 degrees from shoulder and point wand down to ground or display hand with “thumbs down”; left hand remains at side by knee.	Negative (technical/servicing communication signal).
	**(28)** Extend both arms at 90 degrees from body and move hands to cup both ears.	Establish communication via interphone (technical/servicing communication signal).
	**(29)** With right arm at the side and left arm raised above head at 45 degree angle, move right arm in a sweeping motion towards top left shoulder.	Open/close stairs (technical/servicing communication signal). This signal is intended mainly for aircraft with set of integral stairs at the front.

Table D Meaning of Signals made by Pilot to Marshaller

(a)
Raise arm and hand with fingers extended horizontally in front of face, then clench fist.
Meaning
Brakes engaged



(b)
Raise arm with fist clenched horizontally in front of face, the extend fingers.
Meaning
Brakes released

(c)
Arms extended palms facing outwards, move hands inwards to cross in front of face.
Meaning
Insert chocks

(d)
Hands crossed in front of face, palms facing outwards, move arms outwards.
Meaning
Remove chocks

(e)
Raise the number of fingers on one hand indicating the number of the engine to be started. For this purpose the aircraft engines shall be numbered as follows, No. 1 engine shall be the port outer engine, No. 2, the port inner engine, No. 3, the starboard inner engine and No. 4, the starboard outer engine.
Meaning
Ready to start engine indicated.