MORDEA AIRPORT RUNWAY LIGHTS REPLACEMENT
REQUEST FOR QUOTATIONS

| PROJECT DESCRIPTION | This RFQ is for supply and install of runway lights in Morden Airport. This includes all wires, lights and other components required to complete the system. The lights to be installed in accordance with TP312 5th Edition (medium intensity lighting system).
| Specification: |
| 1. Power is coming from Club House building (See the plan) |
| 2. Lights by colour: white – 41 pieces; red/green – 12 pieces; blue – 16 pieces. |
| 3. New lights to be installed 2m from the edge of runway. |
| 4. The height and style of elevated lights in accordance with Figure 5-21 (TP312 5th Edition). |
| 5. The spacing of white lights to be approx. 60m |
| 6. Existing lights must be in working condition till the new system is ready to be turned on. |
| 7. Temporary wire (installed on the ground in 2018 to replace failed connections to some lights) to be reused. |
| 8. 4 pushes will be required to run wires across existing runways and taxiway (see the plan) |

| COMPLETION DATE | October 31, 2019. Please familiarize yourself with the existing and new systems before submitting your bid. |

| FORM OF SUBMISSION | Submissions are welcomed at the City of Morden’s main office by mail, delivered in person, or emailed as follows below. Address all correspondence to Tatiana Sinchenko. |
| Mailing Address: |
| City of Morden Civic Center |
| c/o Tatiana Sinchenko |
| 100-195 Stephen Street |
| Morden, MB, R6M 1V3 |
| Hand Delivery: |
| Civic Center or City of Morden PDO Building |
| 133 7th Street, Morden |
| Email: |
| tsinchenko@mordenmb.com |
| Please fill in and submit the attached form by 3pm on August 21, 2019. |
NEGOTIATED CONTRACT

The City may, at its discretion, enter into contract with one, multiple, or none of the parties who submit a quotation. The City is not under obligation to any party on the basis of their submission.

MORDEN AIRPORT RUNWAY LIGHTS REPLACEMENT

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Payment Terms</th>
<th>Qty.</th>
<th>Unit</th>
<th>Unit Price ($)</th>
<th>Total Price ($)</th>
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<td>1. Supply and install runway lights</td>
<td>NA</td>
<td>1</td>
<td>LS</td>
<td>$</td>
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| TOTAL FOR SECTION | $ |
| GST (5%)          | $ |
| TOTAL             | $ |

Bidder Signature

________________________________________
MORDEN AIRPORT RUNWAY LIGHTS REPLACEMENT

6 RED/GREEN LIGHTS

PUSH UNDER GRASS RUNWAY
~32LM

BACKFILL TRENCH WITH SAND

16 BLUE LIGHTS

PUSH UNDER TAXIWAY
~10LM

41 WHITE LIGHTS

PUSH UNDER RUNWAY
~24LM

PUSH UNDER TAXIWAY
~4LM

6 RED/GREEN LIGHTS

Date: AUGUST 2019
Drawing Scale: NTS
Project Code: X-01
Sheet Reference: X-01 R-A
5.3 LIGHTING

5.3.1 General

5.3.1.1 When a runway, taxiway, apron or portion thereof is permanently closed, all lighting is removed.

5.3.1.2 When a runway, taxiway, apron or portion thereof is closed for a short duration, all associated lighting, such as threshold, edge, end, centreline, and approach lighting is turned off, blacked out or occluded except where the lighting is required to be on for maintenance purposes.

5.3.1.3 Edge lights, including threshold and runway end lights, are placed outside the edges of the area declared for use as a movement area at a constant distance (±0.3 m), of up to 3 m from the declared operational edge.

Note: Edge light fixtures may be of the elevated or inset type.

Elevated lights

5.3.1.4 Elevated light fixtures and their supporting structures on the runway strip, taxiway strip, RESA, and apron areas:

(a) are frangible, and

(b) have the frangible break point located 0 to 5 cm above grade.

5.3.1.5 Elevated edge light fixtures are mounted to a maximum height of 35 cm above the edge of the operational surface (runway, taxiway, apron, etc…), subject to the following;

(a) the top of the light fixture may be raised to a maximum height of 75 cm when located 3 m from the edge of the operational surface using a ratio of 1 cm per 3.75 cm as the light fixture is moved out from the 1.5 m to the 3 m position; and

(b) when the light is raised above the 35 cm height, a minimum clearance of 15 cm is provided between the top of the light fixture and any overhanging part of the aircraft expected to operate on the surface when its main gear is coincident with the edge of the operational surface.

Note 1: See Figure 5-21 for depiction of edge light fixture mounting height.

Note 2: Elevated edge light fixtures include runway end and threshold lights.

Inset lights

5.3.1.6 Inset light fixtures located in the surface of runways, stopways, taxiways and aprons are so designed and fitted as to withstand being run over by the wheels of an aircraft without damage either to the aircraft or to the lights themselves.
In this area the maximum fixture height is 35 cm above the grade.

In this area the fixture height may be increased incrementally to a maximum of 75 cm at 3 m from the pavement edge. (refer to standard 5.3.1.5)

When lights are raised above 35 cm, a minimum clearance of 15 cm shall be maintained between the fixture and any overhanging part of an aircraft.

Figure 5-21: Elevated light mounting height
Light Intensity and Control

5.3.1.7  Medium and high intensity aerodrome lighting systems are provided with brightness steps as shown in Table 5.3.1.7.

<table>
<thead>
<tr>
<th>Lighting System</th>
<th>Number of Intensity Steps</th>
<th>Intensity Steps – Used and Not Used</th>
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<tbody>
<tr>
<td>ALSF-2</td>
<td>5</td>
<td>5 5 4 3 2 1</td>
</tr>
<tr>
<td>SSALS and SSALR</td>
<td>S</td>
<td>5 5 4 3 2 1</td>
</tr>
<tr>
<td>RAIL (3)</td>
<td>5</td>
<td>5 high 4 3 2 1</td>
</tr>
<tr>
<td>Runway centreline</td>
<td></td>
<td>5 5 4 3 2 1</td>
</tr>
<tr>
<td>Taxiway centreline</td>
<td></td>
<td>5 5 4 3 2 1</td>
</tr>
<tr>
<td>Touchdown zone</td>
<td></td>
<td>5 5 4 3 2 1</td>
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<tr>
<td>Land and hold short lights</td>
<td></td>
<td>5 5 4 3 2 1</td>
</tr>
<tr>
<td>Stop bar</td>
<td></td>
<td>5 5 4 3 2 1</td>
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<tr>
<td>High intensity runway edge (1)</td>
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<td>5 5 4 3 2 1</td>
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<tr>
<td>Exit taxiway centreline (4)</td>
<td></td>
<td>5 5 4 3 2 1</td>
</tr>
<tr>
<td>PAPI/APAPI</td>
<td></td>
<td>5 5 4 3 2 1</td>
</tr>
<tr>
<td>RETIL (4)(5)</td>
<td></td>
<td>5 5 4 3 2 1</td>
</tr>
<tr>
<td>RGL</td>
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<td>5 5 4 3 2 1</td>
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<td>MALSR and MALSF (2)</td>
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<td>MALS (2)</td>
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<td>RAIL (3)</td>
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<tr>
<td>ODALS</td>
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<td>3 3 2 1</td>
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<tr>
<td>Medium intensity runway edge (1)</td>
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<td>3 3 2 1</td>
</tr>
<tr>
<td>Taxiway edge lighting (6)</td>
<td></td>
<td>3 3 2 1</td>
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<tr>
<td>RTIL</td>
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<td>3 3 2 1</td>
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<td>RGL</td>
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<td>VAGS</td>
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<td>PAPI/APAPI</td>
<td></td>
<td>3 3 2 1</td>
</tr>
<tr>
<td>RTIL</td>
<td></td>
<td>1 1</td>
</tr>
<tr>
<td>Guidance signs (6)</td>
<td></td>
<td>1 1</td>
</tr>
<tr>
<td>Wind direction indicator(6)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

S = Steady burning portion of the approach lighting system
(1) Includes runway threshold, end and wing bar lights.
(2) MALS and MALSF may be operated with two intensity settings.
(3) RAIL as used for ALSF-2, SSALR, MALSR and MALSF.
(4) RETIL and exit taxiway centreline lighting are operated at the same intensity step as the runway centreline lighting.
(5) An interlock is provided to prevent the RETIL being turned ON without the runway lighting being ON.
(6) Where guidance signs or wind direction indicators are connected to an adjacent runway or taxiway circuit, they are designed to provide the required luminance values regardless of the current selection.
Photometrics

5.3.1.8 On the perimeter of and within the ellipse defining the main beam [inner ellipse] in Appendix 5B, Figures B-1 to B-10 and (a) in Figure B-24, the maximum light intensity value is not greater than three times the minimum light intensity value measured in accordance with Appendix 5B, Figure B-11.

5.3.1.9 On the perimeter of and within the rectangle defining the main beam [inner rectangle] in Appendix 5B, Figures B-12 to B-17 and (b) in Figure B-24, the maximum light intensity value is not greater than 3 times the minimum light intensity value measured in accordance with Appendix 5B, Figure B-18.

Note: The minimum light intensity is 0.5 times the minimum average intensity specified for the main beam.

5.3.1.10 Subject to 5.3.1.11, colours of lights are in accordance with Appendix 5A.

5.3.1.11 Where the standard requires the colour of light to be “variable white” and the lighting system installed uses solid state lighting, the “variable white” is to be interpreted as “white” with the chromaticity boundary equations as specified for Figure A-1(b) of Appendix 5A.

5.3.2 Not Allocated
5.3.3 Aerodrome Beacon

Application

5.3.3.1 An aerodrome beacon is provided where the aerodrome is difficult to identify from the air at night.

Location

5.3.3.2 The aerodrome beacon is located on, or adjacent to, the aerodrome in an area of low ambient background lighting.

5.3.3.3 The location of the beacon is such that it:
   (a) is not shielded by objects in significant directions of approach, or
   (b) does not cause conflicting visual indications to the pilot approaching to land.

Characteristics

General

5.3.3.4 The aerodrome beacon shows white flashes.

Rotating Type

5.3.3.5 The frequency of total flashes is from 24 flashes per minute (fpm), ±2 fpm.

5.3.3.6 The light from the beacon shows at all angles of azimuth.

5.3.3.7 The vertical light distribution extends upwards from an elevation of not more than 1°.

5.3.3.8 Subject to 5.3.3.9, the aerodrome beacon provides an effective intensity distribution of the flash, in accordance with Table 5.3.3.8.

<table>
<thead>
<tr>
<th>Table 5.3.3.8—Intensity Distribution of Rotating Beacons</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Medium Intensity</strong></td>
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<tr>
<td>Elevation angle (degrees)</td>
</tr>
<tr>
<td>1 to 2</td>
</tr>
<tr>
<td>3 to 7</td>
</tr>
<tr>
<td>8 to 10</td>
</tr>
</tbody>
</table>

5.3.3.9 For aerodromes with high ambient background lighting, the light unit provides an effective intensity distribution of the flash in accordance with Table 5.3.3.9.

<table>
<thead>
<tr>
<th>Table 5.3.3.9—Intensity Distribution of Rotating Beacons</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High Intensity</strong></td>
</tr>
<tr>
<td>Elevation angle (degrees)</td>
</tr>
<tr>
<td>1 to 2</td>
</tr>
<tr>
<td>3 to 7</td>
</tr>
<tr>
<td>8 to 10</td>
</tr>
</tbody>
</table>

Note: The light beam centre is set at 5° above the horizontal plane (0°) for the parameters of Tables 5.3.3.8 and 5.3.3.9.

5.3.3.10 The effective duration of individual flashes is 75 to 300 ms.


Flashing Type

Intensities

5.3.3.11 The beacon is provided with three site selectable intensities (not available for selection by air traffic services) of 3 000, 6 000 and 12 000 nominal peak effective candelas.

Note 1: The intensity setting is normally selected at the time of installation in consideration of the ambient lighting conditions and possible glare to the pilot or air traffic services personnel.

Note 2: Normally the beacon is set for 6 000 effective candelas and may be later adjusted should this be found to be insufficient or excessive, depending upon the site conditions.

Flash Rate

5.3.3.12 The unit has a flash rate of between 20 to 30 flashes per minute.

Note: The lower flash rate may be required for aerodromes with nearby white flashing medium intensity obstruction lights.

Flash Duration

5.3.3.13 The flash duration is 100–250 ms.

Note: This flash duration may consist of a rapid sequence of flashes, giving the appearance of a continuous single flash.

Distribution

5.3.3.14 The distribution of the light signal is as follows:

(a) Horizontal—The flash head provides an omnidirectional output of 360° horizontal.

(b) Minimum Peak Intensity—The minimum peak intensity is as specified in 5.3.3.11 minus 25%.

(c) Beam Spread—The beam spread, defined as the angular distance between the points of intensity, which is half of the actual peak intensity, is a minimum of 3° vertical.

(d) When the light unit is installed as per the manufacturer’s instructions, the intensity at 0° elevation angle (horizontal) is at least as great as the minimum specified beam peak intensity.

(e) Stray Light—To reduce stray light, the intensity at 10° below horizontal, at any radial, is not greater than 3% of the peak intensity at the same radial.
5.3.4 Aerodrome Flight Manoeuvring Area Hazard Lights

Note: Aerodrome flight manoeuvring area hazard lights delineate a safe flight manoeuvring area for night operations at aerodromes that have hazardous high terrain features in the vicinity of the flight circuit pattern.

Application

5.3.4.1 Aerodrome flight manoeuvring area hazard lights are provided where a risk assessment indicates that flight safety at night would be enhanced by lighting the hazardous terrain with a visual indication of the boundaries of the safe flight manoeuvring area.

General

5.3.4.2 The dimension of the flight manoeuvring area to be free of obstacles:

(a) is determined by drawing arcs with a minimum radius of 2.3 NM centred on each runway threshold and joining those arcs with tangent lines; and

(b) provides a minimum of 100 m vertical obstacle clearance with respect to the aircraft operating altitude referenced in 5.3.4.3.

Note: See Figure 5-22 for depiction of the flight manoeuvring area and placement of lights.

Location

5.3.4.3 The lights are located so as to be visible to pilot(s) operating at the highest authorized circling IMC minimum descent altitude and to pilot(s) operating in VMC from any position within the traffic pattern.

5.3.4.4 The lights are located at approximately the same elevation.

5.3.4.5 Each aerodrome flight manoeuvring area hazard light system consists of a group of lights positioned so as to define the extent of the safe manoeuvring area and so that each light in the system can be seen from the preceding one. Where appropriate, the lights of cities and towns may be included to aid in the determination of the safe flight manoeuvring area.

Characteristics

5.3.4.6 The aerodrome flight manoeuvring area hazard light is an omnidirectional, red or white flashing with an effective intensity of 2 000 candelas during night operations.

Note 1: Where there are multiple units, consideration to have these lights operate in unison.

Note 2: Refer to CARs Standard 621 for type CL-864 and CL-865 light units.

5.3.4.7 Monitoring of the aerodrome flight manoeuvring area hazard lights is provided to ensure that the appropriate authorities are aware of an outage and a voice advisory and/or NOTAM action is promulgated.
Note: The traffic pattern depicted above has been restricted to one side of the runway due to the proximity of high obstacles, therefore limiting the installation of the hazard lights to outline the operational side.

Figure 5-22: Aerodrome flight manoeuvring area hazards lights
5.3.5 APPROACH LIGHTING SYSTEMS

Acronyms

MALS Medium intensity approach lighting system
MALSF Medium intensity approach lighting system with sequenced flashing lights
MALSRS Medium intensity approach lighting system with runway alignment indicator lights
ODALS Omnidirectional approach lighting system
SSALSR Simplified short approach lighting system with runway alignment indicator lights
ALSFR Approach lighting system with flashing lights for category II or III operations

Note: See Figure 5-23 for depiction of approach lighting systems.

Application

5.3.5.1 A SSALR approach lighting system is provided for a precision runway supporting a category I approach.

5.3.5.2 An ALSF-2 approach lighting system is provided for a precision runway supporting a category II or III approach.

5.3.5.3 All approach lighting systems provided at an aerodrome are in accordance with the specifications provided in this document.

General

5.3.5.4 No object protrudes through the plane of lights within a distance of 60 m from the centreline of the approach lighting system or runway strip width, whichever is lesser unless it:

(a) is lightweight, frangible;
(b) is required to be there by function; and
(c) does not shield any light from the pilots view in those directions intended for operational use.

5.3.5.5 The overall height of elevated approach light fixtures located within 90 m of the runway threshold is:

(a) in accordance with Figure 5-21 within the first 3 m from runway threshold, and
(b) no greater than 75 cm above threshold elevation.

5.3.5.6 Any transportation corridor passing through the approach light area is considered as an object with a minimum height of:

(a) for a multi-lane highway, 5.2 m above the crown of the highway;
(b) for other roads, 4.3 m above the crown of a road;
(c) for a railway, 7 m above the top of the rails; and
(d) for a specific waterway, the height of the critical object is determined by an aeronautical evaluation and recorded in the aerodrome operations manual.
Figure 5-23: Approach lighting systems configurations
Omnidirectional Approach Lighting System (ODALS)

Location

5.3.5.7 An ODALS consists of five (5) lights installed on the extended centreline of the runway extending over a total distance of 450 m (+30, -0 m), and two (2) light units, one each abeam the runway threshold.

Note: See Figure 5–24 for depiction of an ODALS.

5.3.5.8 The lights forming the centreline of the ODALS are as follows:
   (a) light unit at station 90 is installed at 90 m (+7.5, -0 m) from the threshold;
   (b) the remaining lights are spaced at intervals of 90 m (+7.5 m); and
   (c) the lateral installation tolerance is +/- 1 m from the extended runway centreline.

5.3.5.9 The two lights installed at the threshold are located:
   (a) symmetrically about the runway centreline or extended centreline, such that the difference in the distance of the two lights to the runway centreline does not exceed 2 m;
   (b) at a lateral distance of 12 m (+10.5 m, -0.0 m) from the runway edge or extended runway edge; and
   (c) in a line perpendicular to the extended runway centreline at equidistant positions longitudinally from the threshold (+30 m, -0.0 m).

5.3.5.10 Subject to 5.3.5.11, the light centres of the elevated ODALS fixtures including and beyond light station 180 lie within ±3 cm of the horizontal datum, which is 35 cm above the threshold crown elevation.

5.3.5.11 Where it is necessary for the elevated centreline fixtures of the ODALS to deviate from the horizontal plane due to terrain features, to minimize the height of supporting structures, or to achieve clearance over an object, sloping segments are permitted as follows:
   (a) only one (1) slope change after 90 m is permitted;
   (b) where a slope change is established, the preceding segment is horizontal;
   (c) the slope is a maximum of ±2.0%; and
   (d) the light centres are installed with a vertical tolerance of ±3 cm.

Note 1: See Figure 5-25 for depiction of the ODALS profile and limit of light centres.

Note 2: The slope referenced in (a) is measured through the centre of each lamp.

Note 3: The light unit at station 90 may be installed with overall height of 75 cm above threshold elevation without being counted as a slope change. See 5.3.5.5.

5.3.5.12 The tops of the two (2) threshold light units are installed within a vertical tolerance of +1.0 m/-0.5 m of the runway threshold elevation.
Characteristics

5.3.5.13 The individual lights of an ODALS consist of single omnidirectional variable white flashing light units.

5.3.5.14 Each light is flashed in sequence, beginning with the outermost light and progressing toward the threshold to the innermost light of the system. The centreline lights are sequenced with 1/15 second interval between flashes. The two (2) runway threshold units flash simultaneously 4/15 seconds after the innermost centreline light. The cycle begins again 7/15 seconds after the flash of the two (2) runway threshold lights giving an overall rate of 60 cycles per minute (±10%).

5.3.5.15 The ODALS has a variable intensity control with three (3) intensity settings in accordance with 5.3.1.7.

5.3.5.16 Subject to 5.3.5.17, the lights:

(a) show at all angles of azimuth above 2° and are visible from any direction; and
(b) are in accordance with the specifications of Appendix 5B, Figure B-23.

5.3.5.17 Where shielding is applied to reduce a dazzling effect, the shielding is as follows:

(a) limited to light at station 90, 0a and 0b;
(b) only on the non-approach side;
(c) centred parallel to the runway centreline; and
(d) with a maximum azimuth spread of 180°.
Figure 5-24: ODALS configuration

Note: For information on installation tolerances, refer to the standards.
Figure 5-25: ODALS profile and limit of light centres
Medium Intensity Approach Lighting System (MALS)

Note: The MALS consists of the steady burning lights of a MALSR.

Location

5.3.5.18 The MALS is installed on the extended centreline of the runway extending over a distance of 420 m (+15 m, -0 m) and consists of:

(a) seven (7) centreline barrettes, placed at longitudinal intervals of 60 m (+7 m) with the innermost barrette located 60 m (+7 m, -0 m) from the threshold;

(b) a crossbar located at 300 m (+15 m) from the runway threshold, in line with the centreline barrette. The crossbar contains two side barrettes centred 7.5 m from the extended runway centreline; and

(c) approach threshold lights specified in section 5.3.6.

Note: See Figure 5-26 for depiction of MALS configuration.

5.3.5.19 Subject to 5.3.5.20, the light centres of the elevated MALS fixtures beyond the strip end lie within ±3 cm of the horizontal plane which is 35 cm above the threshold.

5.3.5.20 Where it is necessary for the elevated MALS fixtures of the system to deviate from the horizontal plane due to terrain features, to minimize the height of supporting structures, or to achieve clearance over an object, sloping segments are permitted as follows:

(a) the slope starts not less than 90 m outwards from the runway threshold;

(b) only one rising gradient segment is permitted;

(c) only three changes in profile gradient are permitted;

(d) the slope gradient is kept to a minimum and does not exceed a rising gradient of 2.0%, nor a falling gradient of 1.0% to a point 420 m from the threshold, and from this point, the falling gradient does not exceed 2.5%;

(e) the slope segment extends over a minimum of three (3) light units and starts and ends at a light unit; and

(f) the sloping segment continues to the end of the approach light system, reverts to the horizontal, or begins a falling gradient provided that the final segment extends over a distance of three (3) light units.

Note: See Figure 5-27 for depiction of MALS profile and limit of light centres.

5.3.5.21 The transverse tolerance for the installed position of an individual MALS barrette centre is ±15 cm.

5.3.5.22 The centreline barrettes and crossbar lights of a MALS are fixed lights showing variable white.

5.3.5.23 The centreline barrettes of the MALS each contain five (5) lights with centres 1.0 m (±3 cm) apart, having an overall width of 4 m (±3 cm).

5.3.5.24 The crossbar side barrettes of the MALS each contain five (5) lights with centres 1.5 m (±3 cm) apart, having an overall width of 6 m (±3 cm).
5.3.5.25 The vertical tolerance with respect to an individual MALS light centre within a barrette is ±3 cm.

**Characteristics**

5.3.5.26 The steady burning lights of the MALS are in accordance with the specifications of Appendix 5B, Figure B-22.

5.3.5.27 The MALS lights are aligned laterally with their beam axis parallel to the extended runway centreline (±1.0°). The vertical alignment of lights is in accordance with Table 5.3.5.27 (±1.0°) and Figure 5-28.

<table>
<thead>
<tr>
<th>Table 5.3.5.27</th>
<th>Angle of Elevation Settings for Approach Lighting Systems other than ALSF-2</th>
</tr>
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<tbody>
<tr>
<td>station</td>
<td>MALS</td>
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<tr>
<td>0</td>
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<tr>
<td>60</td>
<td>3.2</td>
</tr>
<tr>
<td>120</td>
<td>3.3</td>
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<td>180</td>
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<tr>
<td>660</td>
<td></td>
</tr>
<tr>
<td>720</td>
<td></td>
</tr>
</tbody>
</table>

Note 1: These angle settings are for elevated lights installed at the elevation of the horizontal. Figure 5-28 provides guidance on adjustments to the vertical aiming for lights that are not installed at the elevation of the horizontal datum. Inset approach lights are designed to incorporate the required viewing angles.

Note 2: Elevation settings for flashing lights are in brackets.

5.3.5.28 The MALS has a variable intensity control with three (3) intensity settings in accordance with 5.3.1.7.
Figure 5-26: MALS / SSALS configuration

Note: For information on installation tolerances, refer to standard.
Figure 5-27: SSALR / SSALS / MALSR / MALSF / MALS profile and limit of light centres
Figure 5-28: Correction of elevated setting angle

Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR)

Note: A MALSR has a similar presentation as a SSALR with medium intensity fixtures.

Location

5.3.5.29 The MALSR is installed on the extended centreline of the runway over a distance of 720 m (+15 m, -0 m) and consists of:

(a) seven (7) centreline barrettes over a length of 420 m (+15 m), placed at longitudinal intervals of 60 m (+7 m) with the innermost barrette located 60 m (+7 m, -0 m) from the threshold;

(b) a crossbar located at 300 m (+15 m) from the runway threshold, in line with the centreline barrette. The crossbar contains two (2) side barrettes centred 7.5 m from the extended runway centreline;

(c) five (5) sequenced flashing RAIL placed at longitudinal intervals of 60 m (+7 m) with the innermost light located 60 m (+7 m) beyond the outermost centreline barrette; and

(d) approach threshold lights specified in section 5.3.6.

Note: See Figure 5-29 for depiction of MALSR configuration.
5.3.5.30 Subject to 5.3.5.31, the light centres of the elevated MALSR fixtures beyond the strip end lie within ±3 cm of the horizontal plane, which is 35 cm above the threshold.

5.3.5.31 Where it is necessary for the elevated fixtures of the MALSR to deviate from the horizontal plane due to terrain features, to minimize the height of supporting structures, or to achieve clearance over an object, sloping segments are permitted as follows:

(a) the slope starts not less than 90 m outwards from the runway threshold;
(b) only one (1) rising gradient segment is permitted;
(c) only three (3) changes in profile gradient are permitted;
(d) the slope gradient is kept to a minimum and does not exceed a rising gradient of 2.0%, nor a falling gradient of 1.0% to a point 420 m from the threshold, and from this point, the falling gradient does not exceed 2.5%;
(e) the slope segment extends over a minimum of three (3) light units and starts and ends at a light unit; and
(f) the sloping segment continues to the end of the approach light system, reverts to the horizontal, or begins a falling gradient provided that the final segment extends over a distance of three (3) light units.

Note: See Figure 5-27 for depiction of approach lighting profile and limit of light centres.

5.3.5.32 The transverse tolerance for the installed position of an individual MALSR barrette centre is ±15 cm.

5.3.5.33 The centreline barrettes and crossbar lights of the MALSR are fixed lights showing variable white.

5.3.5.34 The centreline barrettes of the MALSR each contain five (5) lights with centres 1.0 m (±3.0 cm) apart, having an overall width of 4 m (±3 cm).

5.3.5.35 The crossbar barrettes of the MALSR each contain five (5) lights with centres 1.5 m (±3.0 cm) apart, having an overall width of 6 m (±3 cm).

5.3.5.36 The vertical tolerance with respect to an individual MALSR light centre within a barrette is ±3.0 cm.

Characteristics

5.3.5.37 Each light of the RAIL portion of the MALSR flashes twice a second (±25 ms) with a time interval between flashes of adjacent units of 35 ms (±5 ms) beginning with the outermost light and progressing toward the threshold to the innermost light of the system. Any remaining time in each sequence occurs between the flash of the last unit and the flash of the first unit.

The design of the triggering circuit is such that failure of one or more of the flash units does not affect operation of the remaining units.

The design of the electrical circuit is such that the RAIL can only be operated when the other lights of the approach lighting system are on. The RAIL can be turned off leaving the steady burning lights in operation. The steady burning lights cannot be turned off leaving the RAIL in operation. The RAIL can only be energized when the steady burning lights are operational.
5.3.5.38 The lights of the MALSR are in accordance with the specifications of Appendix 5B, Figure B-22 for the steady burning lights, and Figure B-23 for the sequenced RAIL.

5.3.5.39 The MALSR lights are aligned laterally with their beam axis parallel to the extended runway centreline (±1.0°). The vertical alignment of lights is in accordance with Table 5.3.5.27 (±1.0°) and Figure 5-28.

5.3.5.40 The MALSR has a variable intensity control with three (3) intensity settings in accordance with 5.3.1.7.

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

Figure 5-29: MALSR / SSALR configuration
Medium Intensity Approach Lighting System with Sequenced Flashing Lights (MALSF)

Note: The MALSF consists of a MALS with three (3) sequenced flashing lights located at the last three light bar stations. These flashing lights are added to the MALS at locations where high ambient background lighting, or other reasons, requires these lights to assist pilots in making an earlier identification of the system.

Location

5.3.5.41 A MALSF is installed on the extended centreline of the runway over a distance of 420 m (+15 m, –0 m) and consists of:

(a) seven (7) centreline barrettes, placed at longitudinal intervals of 60 m (±7 m) with the innermost barrette located 60 m (+7 m, –0 m) from the threshold;

(b) a crossbar located at 300 m (±15 m) from the runway threshold, in line with the centreline barrette. The crossbar contains two (2) side barrettes centred 7.5 m from the extended runway centreline;

(c) three (3) sequenced flashing RAIL placed at longitudinal intervals of 60 m (±7 m) with the outermost light located at the outermost centreline barrette; and

(i) when installed on the barrette, no higher than the beam centres of the steady burning lights of the associated centreline barrette, and at the mid-point between the centre steady burning light and the next outward; within a tolerance of ±3 cm.

(ii) when installed in front of the associated barrette, not more than 1.5 m in front of the barrette, not lower than 1.0 m below the plane established by the beam centres of the steady burning lights, and of a height so as to not obscure the output of the adjacent steady burning light.

(d) approach threshold lights specified in section 5.3.6.

Note: See Figure 5-30 for depiction of a MALSF configuration.

5.3.5.42 Subject to 5.3.5.43, the light centres of the elevated MALSF fixtures beyond the strip end lie within ±3 cm of the horizontal plane, which is 35 cm above the threshold.

5.3.5.43 Where it is necessary for the elevated fixtures of the MALSF to deviate from the horizontal plane due to terrain features, to minimize the height of supporting structures, or to achieve clearance over an object, sloping segments are permitted as follows:

(a) the slope starts not less than 90 m outwards from the runway threshold;

(b) only one (1) rising gradient segment is permitted;

(c) only three (3) changes in profile gradient are permitted;

(d) the slope gradient is kept to a minimum and does not exceed a rising gradient of 2.0%, nor a falling gradient of 1.0% to a point 420 m from the threshold, and from this point, the falling gradient does not exceed 2.5%;

(e) the slope segment extends over a minimum of three (3) light units and starts and ends at a light unit; and

(f) the sloping segment continues to the end of the approach light system, reverts to the horizontal, or begins a falling gradient provided that the final segment extends over a distance of three (3) light units.

Note: See Figure 5-27 for depiction of the approach lighting profile and limit of light centres.
5.3.5.44 The transverse tolerance for the installed position of an individual MALSF barrette centre is ±15 cm.

5.3.5.45 The centreline barrettes and crossbar lights of the MALSF are fixed lights showing variable white.

5.3.5.46 The centreline barrettes of the MALSF each contain five (5) lights with centres 1.0 m (±3.0 cm) apart, having an overall width of 4 m (±3 cm).

5.3.5.47 The crossbar barrettes of the MALSF each contain five (5) lights with centres 1.5 m (±3.0 cm) apart, having an overall width of 6 m (±3 cm).

5.3.5.48 The vertical tolerance with respect to an individual MALSF light centre within a barrette is ±3.0 cm.

**Characteristics**

5.3.5.49 Each light of the RAIL portion of the MALSF flashes twice a second (±25 ms) with a time interval between flashes of adjacent units of 35 ms (±5 ms) beginning with the outermost light and progressing toward the threshold to the innermost light of the system. Any remaining time in each sequence occurs between the flash of the last unit and the flash of the first unit.

The design of the triggering circuit is such that failure of one or more of the RAIL units does not affect operation of the remaining units.

The design of the electrical circuit is such that the RAIL can be operated independently of the other lights of the approach lighting system. The RAIL can be turned off leaving the steady burning lights in operation. The steady burning lights cannot be turned off leaving the RAIL in operation. The RAIL can only be energized when the steady burning lights are operational.

*Note: The means of control enables the RAIL to be turned on and off, but only with the steady burning lights on.*

5.3.5.50 The lights of the MALSF are in accordance with the specifications of Appendix 5B, Figure B-22 for the steady burning lights and Figure B-23 for the sequenced flasher lights.

5.3.5.51 The MALSF lights are aligned laterally with their beam axis parallel to the extended runway centreline (±1.0°). The vertical alignment of MALSF lights is in accordance with Table 5.3.5.27 (±1.0°) and Figure 5-28.

5.3.5.52 The MALSF has a variable intensity control with three (3) intensity settings in accordance with 5.3.1.7.
light beam output is from the curved side of symbol... a means \( \triangleright \)

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**5-30: MALSF configuration**

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Note: For information on installation tolerances, refer to standard.
Simplified Short Approach Lighting System (SSALS)

Note: The SSALS consists of the steady burning lights of a SSALR.

Location

5.3.5.53 The SSALS is installed on the extended centreline of the runway over a distance of 420 m (+15 m, -0 m) and consists of:

(a) seven (7) centreline barrettes, placed at longitudinal intervals of 60 m (±7 m) with the innermost barrette located 60 m (+7 m, -0 m) from the threshold;

(b) a crossbar located at 300 m (±15 m) from the runway threshold, in line with the centreline barrette. The crossbar contains two (2) side barrettes centred 7.5 m from the extended runway centreline; and

(c) approach threshold lights specified in section 5.3.6.

Note: See Figure 5-26 for depiction of SSALS configuration.

5.3.5.54 Subject to 5.3.5.55, the light centres of the elevated SSALS fixtures beyond the strip end lie within ±3 cm of the horizontal plane, which is 35 cm above the threshold.

5.3.5.55 Where it is necessary for the elevated fixtures of the SSALS to deviate from the horizontal plane due to terrain features, to minimize the height of supporting structures, or to achieve clearance over an object, sloping segments are permitted as follows:

(a) the slope starts not less than 90 m outwards from the runway threshold;

(b) only one (1) rising gradient segment is permitted;

(c) only three (3) changes in profile gradient are permitted;

(d) the slope gradient is kept to a minimum and does not exceed a rising gradient of 2%, nor a falling gradient of 1.0% to a point 420 m from the threshold;

(e) the slope segment extends over a minimum of three (3) light units and starts and ends at a light unit; and

(f) the sloping segment continues to the end of the approach light system, reverts to the horizontal, or begins a falling gradient provided that the final segment extends over a distance of three (3) light units.

Note: See Figure 5-27 for depiction of SSALS profile and limit of light centres.

5.3.5.56 The transverse tolerance for the installed position of an individual SSALS barrette centre is ±15 cm.

5.3.5.57 The centreline barrettes and crossbar lights of the SSALS are fixed lights showing variable white.

5.3.5.58 The centreline barrettes of the SSALS each contain five (5) lights with centres 1.0 m (±3.0 cm) apart, having an overall width of 4 m (±3 cm).

5.3.5.59 The crossbar barrettes of the SSALS each contain five (5) lights with centres 1.5 m (±3.0 cm) apart, having an overall width of 6 m (±3 cm).

5.3.5.60 The vertical tolerance with respect to an individual SSALS light centre within a barrette is ±3.0 cm.
Characteristics

5.3.5.61 The steady burning SSALS lights are in accordance with the specifications of Appendix 5B, Figure B-1.

5.3.5.62 The SSALS lights are aligned laterally with their beam axis parallel to the extended runway centreline (±1.0°). The vertical alignment of SSALS lights is in accordance with Table 5.3.5.27 (±1.0°) and Figure 5-28.

5.3.5.63 The SSALS has a variable intensity control with five (5) intensity settings in accordance with 5.3.1.7.

Simplified Short Approach Lighting with Runway Alignment Indicator Lights (SSALR)

Location

5.3.5.64 The SSALR is installed on the extended centreline of the runway over a distance of 720 m (+ 15 m, – 0 m) and consists of:
   (a) seven (7) centreline barrettes, placed at longitudinal intervals of 60 m (±7 m) with the innermost barrette located 60 m (+7 m, -0 m) from the threshold;
   (b) a crossbar located at 300 m (±15 m) from the runway threshold, in line with the centreline barrette. The crossbar contains two (2) side barrettes centred 7.5 m from the extended runway centreline;
   (c) five (5) sequenced flashing RAIL placed at longitudinal intervals of 60 m (±7 m) with the innermost light located 60 m (±7 m) beyond the outermost centreline barrette; and.
   (c) approach threshold lights specified in section 5.3.6.

Note: See Figure 5-29 for depiction of a SSALR

5.3.5.65 Subject to 5.3.5.66, the light centres of the elevated SSALR fixtures beyond the strip end lie within ±3 cm of the horizontal plane which is 35 cm above the threshold,

5.3.5.66 Where it is necessary for the elevated fixtures of the SSALR to deviate from the horizontal plane due to terrain features, to minimize the height of supporting structures, or to achieve clearance over an object, sloping segments are permitted as follows:
   (a) the slope starts not less than 90 m outwards from the runway threshold;
   (b) only one (1) rising gradient segment is permitted;
   (c) only three (3) changes in profile gradient are permitted;
   (d) the slope gradient is kept to a minimum and does not exceed a rising gradient of 2%, nor a falling gradient of 1.0% to a point 420 m from the threshold, and from this point, the falling gradient does not exceed 2.5%;
   (e) the slope segment extends over a minimum of three (3) light units and starts and ends at a light unit; and
   (f) the sloping segment continues to the end of the approach light system, reverts to the horizontal, or begins a falling gradient provided that the final segment extends over a distance of three (3) light units.

Note: See Figure 5-27 for depiction of approach lighting profile and limit of light centres.
5.3.5.67 The transverse tolerance for the installed position of an individual SSALR barrette centre is ±15 cm.

5.3.5.68 The centreline barrettes and crossbar lights of the SSALR are fixed lights showing variable white.

5.3.5.69 The centreline barrettes of the SSALR each contain five (5) lights with centres 1.0 m (±3.0 cm) apart, having an overall width of 4 m (±3 cm).

5.3.5.70 The crossbar barrettes of the SSALR each contain five (5) lights with centres 1.5 m (±3.0 cm) apart, having an overall width of 6 m (±3 cm).

5.3.5.71 The vertical tolerance with respect to an individual SSALR light centre within a barrette is ±3.0 cm.

Characteristics

5.3.5.72 Each light of the RAIL portion of the SSALR flashes twice a second (±25 ms) with a time interval between flashes of adjacent units of 35 ms (±5 ms) beginning with the outermost light and progressing toward the threshold to the innermost light of the system. Any remaining time in each sequence occurs between the flash of the last unit and the flash of the first unit.

The design of the triggering circuit is such that failure of one or more of the flash units does not affect operation of the remaining units.

The design of the electrical circuit is such that the RAIL can be operated independently of the other lights of the approach lighting system. The RAIL can be turned off leaving the steady burning lights in operation. The steady burning lights cannot be turned off leaving the RAIL in operation. The RAIL can only be energized when the steady burning lights are operational.

Note: The means of control enables the RAIL to be turned on and off, but only with the steady burning lights on.

5.3.5.73 The lights of the SSALR are in accordance with the specifications of Appendix 5B, Figure B-1 for the steady burning lights and Figure B-23 for the sequenced flasher lights.

5.3.5.74 The SSALR lights are aligned laterally with their beam axis parallel to the extended runway centreline (±1.0°). The vertical alignment of lights is in accordance with Table 5.3.5.27 (±1.0°) and Figure 5-28.

5.3.5.75 The SSALR has a variable intensity control with five (5) intensity settings in accordance with 5.3.1.7.
Approach Lighting System with Flashing Lights for Category II or III Operations (ALSF-2)

Location

5.3.5.76 The ALSF-2 is installed on the extended centreline of the runway over a distance of 720 m (+15 m, -0 m) and consists of:

(a) twenty-four (24) centreline barrettes placed at longitudinal intervals of 30 m (±3 m) with the innermost barrette located 30 m (+3 m, -0 m) from the threshold;

(b) nine (9) side row light barrettes placed on each side of and aligned with the first nine (9) centreline barrettes described in (a). The lateral spacing between the innermost lights of the side row is equal to that of the touchdown zone lighting. The width of the side row barrette matches the width of the touchdown zone lighting;

(c) crossbars located 150 m (±7.5 m) and 300 m (±15 m) from the runway threshold;

(d) fifteen (15) sequenced flashing RAIL located on the extended runway centreline with each one mounted no greater than 1.5 m in front of a centreline barrette as described in (a), and with the innermost located with the barrette 300 m (±15 m) from the threshold; and

(i) when installed on the barrette, no higher than the beam centres of the steady burning lights of the associated centreline barrette, and at the mid-point between the centre steady burning light and the next outward; within a tolerance of ±3 cm.

(ii) when installed in front of the associated barrette, not lower than 1.0 m below the plane established by the beam centres of the steady burning lights, and of a height so as to not obscure the output of the adjacent steady burning light.

(e) approach threshold lights specified in section 5.3.6.

Note: See Figure 5-31 for depiction of ALSF-2 configuration.

5.3.5.77 The ALSF-2 crossbar barrettes provided at 150 m from the threshold are located equidistant between and coincident with the centreline barrettes and side row barrettes.

5.3.5.78 The ALSF-2 crossbar barrettes provided at 300 m extend on both sides of and are coincident with the centreline barrette. They are positioned with their innermost lights centred 4.5 m (±3 cm) from the extended runway centreline.

5.3.5.79 Subject to 5.3.5.80, the light centres of the elevated ALSF-2 fixtures beyond the strip end lie within ±3 cm of the horizontal plane, which is 35 cm above the threshold.

5.3.5.80 Where it is necessary for the elevated fixtures of the ALSF-2 system to deviate from the horizontal plane due to terrain features, to minimize the height of supporting structures, or to achieve clearance over an object, a sloping segment is permitted as follows:

(a) the slope starts not less than 90 m outwards from the runway threshold;

(b) only one (1) sloping segment is permitted;

(c) the slope gradient is kept to a minimum and does not exceed a rising gradient of 2%, nor a falling gradient of 1% except that a falling gradient is not permitted in the inner 450 m;

(d) the slope segment extends over a minimum of four (4) light units and starts and ends at a light unit; and

(e) the sloping segment may continue to the end of the approach light system or may revert to the horizontal provided that the horizontal segment extends over a distance of three (3) light units.

Note: See Figure 5-32 for depiction of the ALSF-2 profile and limit of light centres.
5.3.5.81 The transverse tolerance for the installed position of an individual barrette centre is ±15 cm.

5.3.5.82 Each centreline barrette within an ALSF-2 contains five (5) lights with centres 1.0 m (±3 cm) apart, having an overall width of 4 m (±3 cm).

5.3.5.83 Each side row barrette within an ALSF-2 contains three (3) lights with centres 1.5 m (±3 cm) apart, having an overall width of 3 m (±3 cm).

5.3.5.84 The crossbar barrettes located 150 m from the runway threshold each contain four (4) lights with centres 1.5 m apart, having an overall width of 4.5 m (±3 cm).

5.3.5.85 The crossbar located 300 m from the runway threshold consists of the centreline barrette and two (2) side barrettes. Each side barrette contains eight (8) lights with centres 1.5 m (±3 cm) apart, having an overall width of 12 m (±3 cm).

5.3.5.86 The vertical tolerance with respect to an individual ALSF-2 light centre within a barrette is ±3.0 cm.

Characteristics

5.3.5.87 The centreline barrettes and crossbar lights of an ALSF-2 are fixed white lights showing variable white. The side row lights as described in 5.3.5.84 are fixed lights showing red.

5.3.5.88 Each light of the RAIL portion of the ALSF-2 flashes twice a second in sequence (±2.5%) with a time interval between flashes of adjacent units of 16.67 ms (±2.5%), beginning with the outermost light in the system progressing toward the threshold to the innermost light of the system. Any remaining time in each sequence occurs between the flash of the last unit and the flash of the first unit.

Flash duration for xenon-based flash lamps is not less than 0.25 ms nor more than 5.5 ms at 50% of the peak instantaneous candlepower.

The design of the triggering circuit is such that failure of one or more of the flash units does not affect operation of the remaining units.

The design of the electrical circuit is such that the RAIL can be operated independently of the other lights of the approach lighting system. The RAIL can be turned off leaving the steady burning lights in operation. The steady burning lights cannot be turned off leaving the RAIL in operation. The RAIL can only be energized when the steady burning lights are operational.

5.3.5.89 The lights of the ALSF-2 are in accordance with the specifications of Appendix 5B, Figure B-1 or Figure B2, as appropriate for the steady burning lights, and Figure B-23 for the sequenced flashing lights.
5.3.5.90 The ALSF-2 lights are aligned laterally with their beam axis parallel to the extended runway centreline (±1.0°). The vertical alignment of lights is in accordance with Table 5.3.5.90 (±1.0°) and Figure 5-28.

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<th>Red Side Row Barrettes</th>
<th>Flashing Lamps</th>
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Note: These angle settings are for elevated lights installed at the elevation of the horizontal datum as shown in Figure 5-32. Figure 5-28 provides guidance on adjustments to the vertical aiming for lights that are not installed at the elevation of the horizontal datum. Inset approach lights are designed to incorporate the required viewing angles.

5.3.5.91 The ALSF-2 has a variable intensity control with five (5) brightness settings in accordance with 5.3.1.7.
Figure 5-31: ALSF-2 configuration
Figure 5-32: ALSF-2, limits of light centres
5.3.6 Approach Threshold Lights

Note: Approach lighting systems, other than ODALS, include a threshold bar. The approach lighting threshold bar is composed of the green lights displaying towards the approach side, which supplements the runway threshold lights. Circuit design should be such that the approach threshold lights operate with the approach light system.

Application

5.3.6.1 Approach threshold lights are provided as part of the installation of MALS, MALSR, MALSF, SSALS, SSALR, or ALSF-2.

Location

5.3.6.2 The approach threshold lights associated with a MALS, MALSR, MALSF, SSALS or SSALR are installed as follows:
   (a) the lights are installed with a maximum spacing of 3 m between individual lights, and;
   (b) the lights are placed on the same axial orientation as the runway threshold lights.

5.3.6.3 The approach threshold lights associated with an ALSF-2 are installed as follows:
   (a) the lights are installed with a maximum spacing of 1.5 m between individual lights;
   (b) the lights extend 13.5 m from the runway edge; and
   (c) the lights are placed on the same axis as the runway threshold lights.

Note: See Figures 5-33 and 5-34 for depiction of threshold lighting configurations

Characteristics

5.3.6.4 The approach threshold lighting is composed of fixed unidirectional lights showing green in the direction of approach to the runway. The intensity and beam spread of the lights conform to the minimum requirements in Appendix 5-B as follows:
   (a) Figure B-3 for high intensity systems;
   (b) Figure B-4 for the ALSF-2 lights extending from the runway edge as referenced in 5.3.6.3(b);
   (c) Figure B-22 for medium intensity systems.

5.3.6.5 The approach threshold lighting [unidirectional green] is aimed vertically in accordance with the angle prescribed in Table 5.3.5.27 or 5.3.5.90 as appropriate for station 0.
5.3.7 Runway Threshold and Wing Bar Lights

Note: This section applies to threshold lights on a runway without consideration of any associated approach lighting system. Refer to 5.3.6 Approach Threshold Lights for additional threshold lighting requirements associated with approach lighting systems other than ODALS. Where approach threshold lights are installed, circuit design should be such that the threshold lights referred to in this section are operated with the runway edge lights.

Application

5.3.7.1 Subject to 5.3.7.2, runway threshold lights are provided for a runway equipped with runway edge lights.

5.3.7.2 Where the threshold of a non-instrument or non-precision runway is not located at the runway end and inset threshold lights are not provided, wing bar lights are provided to indicate the location of the threshold.

Location

Threshold Lights

5.3.7.3 Runway threshold lights consist of two (2) groups of lights, each group consisting of:

(a) on a runway less than 45 m in width, three (3) lights, and;
(b) on a runway 45 m and greater in width, four (4) lights.

5.3.7.4 The groups of runway threshold lights are placed in a row at right angles to the runway axis as near to the extremity of the runway as possible and, in any case, not more than 3 m outside the extremity.

Note: See 5.3.1.5 and Figure 5-21 for height limitation of elevated lights.

5.3.7.6 Each group of runway threshold lights is installed as follows:

(a) the outermost runway threshold light is aligned with the runway edge lights; and
(b) the individual lights are spaced at intervals of 3 m (±0.1 m).

Wing Bar Lights

5.3.7.7 Wing bar lights consist of two (2) groups of lights (i.e. wing bars) each consisting of a minimum of:

(a) three (3) lights when used to mark the location of a threshold for a runway 30 m or less in width;
(b) four (4) lights when used to mark the location of a threshold for a runway greater than 30 m but less than 45 m in width; or
(c) five (5) lights when used to mark the location of a threshold for a runway greater than 45 m.

5.3.7.8 Wing bar lights are installed as follows:

(a) the lights are symmetrically disposed on each side of the runway prior to the imaginary line of the threshold (+3.0 m, -0.0 m);
(b) each wing bar is at a right angle to the line of runway edge lights with the innermost light in line with the runway edge lights; and
(c) the lights are spaced at intervals of 3 m (±0.1 m).
Characteristics

5.3.7.9 Runway threshold and wing bar lights are fixed unidirectional lights showing green in the direction of approach to the runway.

Where the position of the innermost wing bar light coincides with the position of a runway edge light, the runway edge light is bi-directional green/white or green/yellow, as appropriate.

The intensity and beam spread of the runway threshold and wing bar lights conform to the following in Appendix 5B:

(a) Figure B-25 when associated with a medium intensity runway edge light system not requiring approach threshold lights as specified in 5.3.6.1;

(b) Figure B-3 and Figure B-4 where appropriate, when associated with high intensity runway edge light systems.

Note 1: See Figures 5-33 and 5-34 for depiction of threshold lighting configurations.

Note 2: Where wing bar lights are installed to identify a threshold not coincident with the runway end, see section 5.3.8 Runway End Lights for illumination of the runway end. See Figure 5-34 for depiction.

5.3.7.10 Runway threshold and wing bar lights are configured to be illuminated at the same brightness level as the associated runway edge lighting.

5.3.7.11 Runway threshold and wing bar lights (projector style) are aimed vertically as follows:

(a) 3.1° for medium intensity

(b) 5.5° for high intensity
Figure 5-33: Approach threshold, threshold and end light configurations
Figure 5-34: Threshold and end lighting (with displacement)
5.3.8 Runway End Lights

Application

5.3.8.1 Runway end lights are provided for a runway equipped with runway edge lights.

Location

5.3.8.2 Runway end lights consist of two groups of lights, each group consisting of:
   (a) on a runway less than 45 m in width, three (3) lights, and;
   (b) on a runway 45 m and greater in width, four (4) lights.

5.3.8.3 Runway end lights are placed on a line at right angles to the runway axis as near to the end of the runway as possible and, in any case, not more than 3 m beyond the end.

5.3.8.4 The groups of runway end lighting are symmetrically disposed about the runway centreline with the outermost runway end lights positioned to align with the runway edge lights and the remainder spaced at intervals of 3 m (±0.1 m).

Characteristics

5.3.8.5 Runway end lights are fixed unidirectional lights showing red in the direction of the runway.

5.3.8.6 Runway end lights on a runway with high intensity edge lights conform to the specifications of Appendix 5B, Figure B-8.

5.3.8.7 Runway end lights on a runway with medium intensity edge lights conform to the specifications of Appendix 5B, Figure B-25.

Note: See Figure 5-33 and Figure 5-34 for depiction of runway end light configurations

5.3.8.8 Runway end lights are configured to be illuminated at the same brightness level as the associated runway edge lighting.

5.3.9 Stopway Lights

Note: See Figure 5-35 for depiction of stopway lighting configuration.

Application

5.3.9.1 Stopway lights are provided for a stopway used at night.

Location

5.3.9.2 Stopway lights are placed along the full length of the stopway as follows:
   (a) in two parallel rows that are equidistant from the centreline and coincident with the rows of the runway edge lights; and
   (b) the longitudinal spacing of the lights does not exceed the spacing of the associated runway edge lights.
5.3.9.3 Stopway lights across the end of the stopway are on a line at right angle to the stopway axis as near to the end of the stopway as possible and, in any case, not more than 3 m beyond the end.

5.3.9.4 The number and configuration of the stopway lights across the end of a stopway are the same as for runway end lights specified in 5.3.8.2.

Note: See 5.3.1.5 and Figure 5-21 for height limitation of elevated lights.

Characteristics

5.3.9.5 Stopway lights are fixed unidirectional lights showing red in the direction of the runway.

5.3.9.6 Stopway lights are in accordance with the runway end lights characteristics of the associated runway.

Note: See section 5.3.8 for runway end light characteristics.

Figure 5-35: Stopway lighting (with displacement)
5.3.10 Runway Threshold Identification Lights (RTIL)

Note: See Figure 5-36(b) for depiction of runway threshold light configuration.

Application

5.3.10.1 Where provided, the runway threshold identification light (RTIL) is as specified in this section.

Location

5.3.10.2 The RTIL are located:

(a) symmetrically about the runway centreline or extended centreline, such that the difference
in the distance of the two lights to the runway centreline does not exceed 2 m;

(b) at a lateral distance of 12 m (+10.5 m, -0.0 m) from the runway edge or extended runway
edge; and

(c) in a line perpendicular to the extended runway centreline at equidistant positions
longitudinally from the threshold (+ 30 m, - 0.0 m).

5.3.10.3 The tops of the light units are installed within a vertical tolerance of +1.0 m/-0.5 m of the runway
threshold elevation.

5.3.10.4 The unidirectional type of RTIL are aimed as follows:

(a) 15° outward from a line parallel to the approach centreline, and

(b) inclined at an angle 10° above the horizontal.

Characteristics

5.3.10.5 The RTIL is one of the following styles:

A - Unidirectional, high intensity, one brightness step.
B - Omnidirectional, high intensity, one brightness step.
C - Unidirectional, low intensity, one brightness step.
D - Omnidirectional, low intensity, one brightness step.
E - Unidirectional, three brightness steps.
F - Omnidirectional, three brightness steps.

5.3.10.6 Each light of the RTIL is in accordance with the specifications of Appendix 5B, Figures B-23.

Note: Light output below the vertical cut-off points should be minimized for environmental purposes.

5.3.10.7 Both light units of the RTIL flash simultaneously (no more than a 20 ms separation) at a rate of
90 (±30) flashes per minute.
5.3.11 Visual Alignment Guidance System (VAGS)

Note: A visual alignment guidance system (VAGS) could be provided to serve the visual approach to a runway where concerns exist, such as obstacle clearance, noise abatement or traffic control procedures requiring a particular direction to be flown, or the environment provides few visual surface cues, especially for night operations.

Application

5.3.11.1 Where provided, a visual alignment guidance system (VAGS) is as specified in this section.

Location

5.3.11.2 The VAGS lights are located:

(a) symmetrically about the runway centreline or extended centreline, such that the difference in the distance of the two lights to the runway centreline does not exceed 2m;

(b) at a lateral distance of 10 m (±1.0 m) from the runway edge; and

(c) in a line perpendicular to the extended runway centreline at equidistant positions longitudinally from the threshold (+30 m, -0.0 m).

Note: The optimum location for installation is abeam the threshold.

5.3.11.3 The top of the light units is a maximum of 1 m above the runway threshold elevation at centreline.

5.3.11.4 The VAGS lights are aligned parallel with the approach centreline.

Characteristics

Signal Format

5.3.11.5 The VAGS signal format includes two light units placed symmetrically to the sides of the runway threshold, as shown below in Figure 5-36. The signal format produces unidirectional beams that flash in such a manner that a pilot making an approach will see one of a minimum of three discrete signal sectors providing “offset to the right”, “on track” and “offset to the left” signals:

(a) When inside a ±0.5° width angular sector, centred on the approach axis, the pilot sees the two lights flashing simultaneously.

(b) When the aircraft flies inside a ±15° width angular sector, centred on the approach axis but outside the inner ±0.5° sector, the pilot sees the two lights flashing with a variable delay (60 to 330 ms) according to the position of the aircraft in the sector. The further the aircraft is from the approach axis, the greater the delay. The delay between the two flashes produces a sequence effect, which shows the direction to the axis.

(c) When outside the ±15° angular sector, the pilot will not see any signal.

5.3.11.6 The signal format is such that there is no possibility of confusion between the system and any associated visual approach slope indicator or other visual aids.
The light beam of each VAGS unit rotates at a speed of one rotation a second and has the following characteristics:

<table>
<thead>
<tr>
<th>Colour</th>
<th>Main beam (degrees)</th>
<th>Minimum intensity at a 50 % curve</th>
</tr>
</thead>
<tbody>
<tr>
<td>white</td>
<td>horizontal</td>
<td>vertical</td>
</tr>
<tr>
<td></td>
<td>-0.5 to +0.5</td>
<td>-1.5 to +7.0</td>
</tr>
</tbody>
</table>

Angular setting (degrees)

<table>
<thead>
<tr>
<th></th>
<th>elevation</th>
<th>toe-in</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.7</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
5.3.11.8 Suitable intensity control is provided so as to allow adjustment to meet the prevailing conditions and to avoid dazzling the pilot during approach and landing.

Approach track and azimuth setting

5.3.11.9 The visual alignment guidance system is capable of adjustment in azimuth to within ±5 minutes of arc of the desired approach path.

5.3.11.10 The angle of azimuth guidance system is such that during an approach, the pilot of an aircraft at the boundary of the "on track" signal will clear all objects in the approach area by a safe margin.

5.3.11.11 In the event of the failure of any component affecting the signal format the system is automatically switched off.

5.3.11.12 The light units are so designed that deposits of condensation, ice, dirt, etc., on optically transmitting or reflecting surfaces will interfere to the least possible extent with the light signal and will not cause spurious or false signals to be generated.

5.3.12 Runway Edge Lights

Note: See Figure 5-37 for depiction of runway edge light configuration.

Application

5.3.12.1 Runway edge lights are provided as follows:

(a) Medium intensity runway edge lights for:

(i) a non-instrument runway; or

(ii) non-precision runway used at night.

(b) High intensity runway edge lights for:

(i) a precision runway; or

(ii) a runway used for aircraft take-off in visibility conditions below RVR1200 (¼ SM).

Location

5.3.12.2 Runway edge lights are placed along the full length of the runway, in two (2) parallel rows equidistant from the centreline.

5.3.12.3 Runway edge lights are installed as follows:

(a) With a uniform longitudinal spacing between lights of not more than 60 m [±1 m], except for spacing from the threshold/end light to first/last edge light which may be of a lesser dimension to accommodate for runway length.

(b) The lights are installed within the lateral tolerance stated in 5.3.1.3.

(c) The lights on opposite sides of the runway axis are on lines at right angles to that axis.

(d) Subject to 5.3.12.4, where the spacing of the lights would result in a light being within a runway/runway intersection, the light within the intersection is omitted, irregularly spaced, or inset;
(e) Subject to 5.3.12.4, where the spacing of the lights would result in a light being within a runway/taxiway intersection, the light within the intersection is omitted or replaced with an inset light.

(f) Where a light is omitted, the spacing between:
   (i) the adjacent lights on that side does not exceed 122 m, and
   (ii) the lights on the opposite side of the intersection maintain the designed spacing.

5.3.12.4 Where the runway is used for operations in visibility conditions below RVR1200 (¼ SM), the runway edge lights within taxiway/runway and runway/runway intersections are inset.

Characteristics

5.3.12.5 Runway edge lights are fixed lights showing variable white, except:
   (a) in the case of a threshold not located at the runway end, the lights between the beginning of the runway and the threshold show red towards an aircraft on approach;
   (b) on runways 1 200 m or greater in length, a section of the lights 600 m or one-third of the runway length from the runway end whichever is the less, shows yellow towards an aircraft on take-off.

5.3.12.6 High intensity runway edge lights are in accordance with the specifications of Appendix 5B, Figure B-9 or Figure B-10, as appropriate.

5.3.12.7 Medium intensity runway edge lights are in accordance with the specifications of Appendix 5B, Table 5B-1.

5.3.13 Runway Centreline Lights

Note: See Figure 5-37 for depiction of runway centreline light configuration.

Application

5.3.13.1 Runway centreline lights are provided on:
   (a) a precision runway category II or III; or
   (b) a runway used for take-off in visibility conditions below RVR1200 (¼ SM).

Location

5.3.13.2 Where the threshold of the opposite runway is not co-located with the runway end, the runway centreline lights are extended into the displaced area to indicate the TORA.

Note: Runway centreline lights in the displaced portion of the runway are not displayed to aircraft on approach.
5.3.13.3 Runway centreline lights are located along the centreline of the declared TORA for the runway, except that the lights may be uniformly offset to the same side of the runway centreline by not more than 60 cm where it is not practicable due to pavement joints to locate them along the centreline. The lights are located from the threshold to the end at a longitudinal spacing (±0.6 m) of:

(a) 15 m on a precision approach runway category II or III;
(b) 15 m on runways used for take-off in visibility conditions below RVR 1200 (¼ SM); and
(c) the first or last light is located at 22.5 m (+3.75 m, -7.5 m) from the threshold/runway end.

Characteristics

5.3.13.4 Runway centreline lights are fixed lights showing variable white from the threshold to 900 m from the runway end; alternate red and variable white from 900 m to 300 m from the runway end; and red from 300 m to the runway end. Exception: For runways less than 1800 m in length, the alternate red and variable white lights extend from the midpoint of the LDA to 300 m from the runway end.

Note: Bidirectional fixtures may be used with the appropriate filter in each direction to facilitate the provision of runway centreline lighting on the opposite direction runway.

5.3.13.5 Runway centreline lights are in accordance with the specifications of Appendix 5B, Figure B-7.

Figure 5-37: Runway edge, centreline and touchdown zone lighting
5.3.14 Runway Touchdown Zone Lights

Note: See Figure 5-37 for depiction of touchdown zone light configuration.

Application

5.3.14.1 Touchdown zone lights are provided on a precision runway category II or III.

Location

5.3.14.2 Touchdown zone lights extend from the threshold for a longitudinal distance of 900 m. On runways less than 1800 m in length, the system is shortened so that it does not extend beyond the midpoint of the runway. Pairs of barrettes symmetrically located about the runway centreline form the pattern.

5.3.14.3 The lateral spacing between the innermost lights of a pair of barrettes is equal to the lateral spacing selected for the aiming point marking.

Note: See 5.2.9 Aiming Point Marking

5.3.14.4 The longitudinal spacing between pairs of barrettes is 30 m (±0.6 m).

5.3.14.5 The barrette is composed of three (3) lights with spacing between the lights of 1.5 m (±3 cm). The overall width of the barrette is 3.0 m (±3 cm). The lateral spacing tolerance from centreline is ±0.15 m.

Characteristics

5.3.14.6 Touchdown zone lights are fixed unidirectional lights showing variable white.

5.3.14.7 Touchdown zone lights conform to the specifications in Appendix 5B, Figure B-5.

5.3.15 Simple Touchdown Zone Lights

Note 1: The purpose of simple touchdown zone lights is to provide pilots with enhanced situational awareness to assist their decision on whether to commence a go-around if the aeroplane has not landed by a certain point on the runway. Simple touchdown zone lights are typically provided at an aerodrome where the approach angle is greater than 3° and/or the landing distance available combined with other factors increases the risk of an overrun. It is essential that pilots operating at aerodromes with simple touchdown zone lights be familiar with the purpose of these lights.

Note 2: See Figure 5-38 for depiction of simple touchdown zone light configuration.

Application

5.3.15.1 Where provided, simple touchdown zone lights conform to the specifications of this section.
Location

5.3.15.2 Simple touchdown zone lights are located on both sides of the runway centreline at the upwind edge of the final touchdown zone marking. The lateral spacing between the pair of lights is equal to the lateral spacing selected for the touchdown zone marking.

5.3.15.2 The lights within each pair are spaced at 1.5 m or one half (½) of the touchdown zone marking width (±0.15 m), whichever is greater.

5.3.15.4 Where provided, on a runway without touchdown zone markings, simple touchdown zone lights are installed in such a position that provides the equivalent touchdown zone information.

Characteristics

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

5.3.15.6 Simple touchdown zone lights conform to the specifications in Appendix 5B, Figure B-5.

Figure 5-38: Simple touchdown zone lights
5.3.16  PAPI and APAPI Systems

Application

5.3.16.1  PAPI or APAPI is provided on runways where:

(a) the approach slope (OLS) for the runway is steeper than the minimum in Table 4-1(a);

(b) the threshold of a runway without vertical guidance used by CAR 704 or 705 scheduled commercial passenger operations is:

   (i) permanently positioned at a point where the start of the LDA is not coincident with the beginning of the runway, or

   (ii) temporarily repositioned to a point where the start of the LDA is not coincident with the beginning of the runway for a planned period exceeding 48 hours.

(c) LAHSO operations are conducted;

(d) a risk assessment indicates the need to provide a PAPI or APAPI for reason of one of the following conditions:

   (i) the approach is over water or other featureless terrain,

   (ii) there is deceptive surrounding terrain or runway slopes,

   (iii) there are unlighted obstacles (such as trees) where the danger of descending below a normal flight path cannot be readily ascertained,

   (iv) the aircraft is likely to experience significant turbulence due to terrain and prevailing winds, or

   (v) where an aircraft undershooting the runway in the immediate vicinity of the aerodrome is likely to cause a hazard to public safety.

Location

5.3.16.2  When one or more of the conditions of 5.3.16.1 are met; a PAPI or APAPI is installed in accordance with the eye to wheel height (EWH) of the critical aircraft, in the normal approach configuration, as in Table 5.3.16.4.

5.3.16.3  The PAPI or APAPI system is located on the left side of the runway unless it is physically impracticable to do so.

5.3.16.4  The light units are located at a distance "D" from the threshold so that:

   (a) subject to 8.4.1.4, where the runway is equipped with an ILS, the on course sector is harmonized with the glide slope of the ILS, and

   (b) the minimum wheel to threshold height (WTH) specified in Table 5.3.16.4 is provided for all aircraft EWH within the selected system.

Note: Guidance for barometric vertical navigation (BARO-VNAV) approach criteria in Criteria for the Development of Instrument Procedures (TP 308) should be consulted when installing a PAPI/APAPI system.
Table 5.3.16.4—Minimum Wheel Clearance over Threshold for PAPI (P) and APAPI (AP)

<table>
<thead>
<tr>
<th>System to Be Provided</th>
<th>Eye to Wheel Height (EWH)</th>
<th>Wheel to Threshold Height (WTH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>AP or P1</td>
<td>x &lt; 3 m</td>
<td>3 m (2)</td>
</tr>
<tr>
<td>P2</td>
<td>3 m ≤ x &lt; 7.5 m</td>
<td>4.5 m</td>
</tr>
<tr>
<td>P3</td>
<td>7.5 m ≤ x &lt; 14 m</td>
<td>6 m</td>
</tr>
</tbody>
</table>

(1) The above values of EWH and WTH are entered into the formula of standard 5.3.16.5 to determine the location of the PAPI and APAPI units.

(2) This wheel clearance may be reduced to 1.5m on runways Aircraft Group I and II where the stopping distance beyond the touchdown point is an operational concern.

5.3.16.5 The horizontal location of PAPI and APAPI light units from threshold are determined through a two step process, using the values of Table 5.3.16.4, to provide a minimum eye height over threshold, as follows;

(a) The nominal location "D" is found through means of the formula:

\[ D = \frac{(EWH + WTH)}{\tan M} = \frac{MEHT}{\tan M} \]

Where:

MEHT is minimum eye height over threshold.
For PAPI: M is the angle B minus 2 minutes of arc.
For APAPI: M is the angle A minus 2 minutes of arc.

b) The nominal location of the light units is corrected for difference between the elevation of the runway threshold crown and that of the unit light centres. This second step is an iterative process, since movement of the light units may be into an area of different ground elevation.

The difference in elevation between the lens centre of the installed PAPI light units and the runway threshold crown may be compensated for by moving the PAPI light units towards the threshold by the formula:

\[ \Delta d = \frac{\Delta h}{\tan M} \]

where

\( \Delta d \) is distance of movement towards the threshold.
\( \Delta h \) is the difference in elevation between the PAPI lens centre and the runway threshold crown.

Note 1: The movement of the PAPI is away from the threshold if the elevation difference \( \Delta h \) is a negative value.

5.3.16.6 The lateral location is as follows, where:

(a) a PAPI is installed:

(i) subject to (ii), the innermost light unit is 15 m (±1 m) from the runway edge and a spacing of 9 m (±1 m) between units.

(ii) a spacing of 6 m (±1 m) may be used on runway serving AGNs I - IIIA. In this case, the inner light unit is located not less than 10 m (±1 m) from the runway edge.
(b) an APAPI is installed:

(i) subject to (ii), the innermost light unit is 10 m (±1 m) from the runway edge and a spacing of 6 m (±1 m) between the units.

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

5.3.16.7 The height of the units is as follows:

(a) The height of the light units [lens centre] is 0.6 m – 1.2 m above grade.

(b) Mounting height tolerances. The beam centers of all light units are within ±3 cm of a horizontal plane. The horizontal plane is defined by the height of the beam centre of light unit B for PAPI and light unit A for APAPI.

Azimuth Aiming

5.3.16.8 Each light unit is aimed outward into the approach zone on a line parallel to the runway centerline within a tolerance of ±1/2°.

Tolerance

5.3.16.9 Installation along a line perpendicular to the runway axis. The front face of each light unit in a bar is located on a line perpendicular to the runway centerline within ±15 cm.

Characteristics

5.3.16.10 The PAPI system consists of four (4) equally spaced light units constructed and arranged in such a manner that a pilot making an approach will:

(a) when on or close to the approach slope, see the two (2) light units nearest the runway edge as red and the two (2) light units farthest from the runway edge as white;

(b) when above the approach slope, see the one (1) light unit nearest the runway edge as red and the three (3) light units farthest from the runway edge as white; and when further above the approach slope, see all light units, as white; and

(c) when below the approach slope, see the three (3) light units nearest the runway edge as red and the unit farthest from the runway edge as white; and when further below the approach slope, see all light units as red.

Figure 5-39: PAPI approach slope presentation
5.3.16.11 The APAPI system consists of two (2) light units constructed and arranged in such a manner that a pilot making an approach will:

(a) when on or close to the approach slope, see the light unit nearer the runway edge as red and the light unit farther from the runway edge as white;

(b) when above the approach slope, see both light units as white; and

(c) when below the approach slope, see both light units as red.

Figure 5-40: APAPI approach slope presentation

5.3.16.12 The light intensity distribution of the light units is as shown in Appendix 5B, Figure B-19.

5.3.16.13 The colour transition from red to white in the vertical plane appears to an observer, at a distance of not less than 300m, to occur within a vertical angle of not more than 3 minutes of arc at the beam centre, increasing to not more than 5 minutes of arc at the beam edges of plus and minus 15° horizontal.

5.3.16.14 The intensity steps of the PAPI/APAPI system is as stated in 5.3.1.7.

5.3.16.15 The light units are designed, operated and maintained such that deposits of condensation, snow, ice, dirt, etc., on optically transmitting or reflecting surfaces do not:

(a) interfere with the light signals; and

(b) adversely affect the required photometric display.

5.3.16.16 The APAPI system is fitted with an automatic shut-off switch, which will extinguish both light units in the event of a misalignment on one or both units.

Note: This is to preclude a misalignment of one or both APAPI units caused by a natural factor (e.g. frost heaves) or by physical interference which could result in a dangerously low on slope indication.
Approach Slope and Elevation Setting of Light Units

5.3.16.17 The standard approach slope is 3.0°, although it can be raised to a maximum of:

- (a) 3.1° for runway serving AGNs V and VI;
- (b) 3.6° for runways serving AGNs IIIB & IV;
- (c) 4.2° for runway serving AGN IIIA;
- (d) 5.7° for runway serving AGNs I and II.

5.3.16.18 Subject to 5.3.16.19 and 5.3.16.20, the angle settings of the system for a standard 3° approach are in accordance with Table 5.3.16.18.

### Table 5.3.16.18—Setting Angles for 3.0° Approach

<table>
<thead>
<tr>
<th>Settings – Degrees</th>
<th>APAPI</th>
<th>PAPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit A</td>
<td>2° 45’</td>
<td>2° 30’</td>
</tr>
<tr>
<td>Unit B</td>
<td>3° 15’</td>
<td>2° 50’</td>
</tr>
<tr>
<td>Unit C</td>
<td>N/A</td>
<td>3° 10’</td>
</tr>
<tr>
<td>Unit D</td>
<td>N/A</td>
<td>3° 30’</td>
</tr>
</tbody>
</table>

(1) The differential setting for the on-course sector may be increased to 30 minutes where harmonization with electronic glide path is desired.

**Note:** See Figure 5-41 and Figure 5-42 for the depiction of PAPI/APAPI setting angles.

5.3.16.19 Where it is necessary to harmonize with an ILS or to raise the approach slope of the PAPI or APAPI units above the standard 3°:

- (a) the differential settings of the light units are in accordance with Table 5.3.16.19, and
- (b) the approach angle is published in the aeronautical publications.

### Table 5.3.16.19—Differential settings for PAPI/APAPI

<table>
<thead>
<tr>
<th></th>
<th>APAPI</th>
<th>PAPI (1)</th>
<th>PAPI with ILS (2)</th>
<th>PAPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approach slope</td>
<td>3°</td>
<td>3°–4°</td>
<td>3°–4°</td>
<td>4°–5° 42’</td>
</tr>
<tr>
<td>OPS slope</td>
<td>1° 51’</td>
<td>1° 56’–2° 56’</td>
<td>1° 51’–2° 51’</td>
<td>2° 41’–4° 23’</td>
</tr>
<tr>
<td>Unit A to OPS</td>
<td>54’</td>
<td>34’</td>
<td>29’</td>
<td>24’</td>
</tr>
<tr>
<td>Unit B to A</td>
<td>30’</td>
<td>20’</td>
<td>20’</td>
<td>30’</td>
</tr>
<tr>
<td>Unit C to B</td>
<td>N/A</td>
<td>20’</td>
<td>30’</td>
<td>30’</td>
</tr>
<tr>
<td>Unit D to C</td>
<td>N/A</td>
<td>20’</td>
<td>20’</td>
<td>30’</td>
</tr>
</tbody>
</table>

(1) Where the angles are raised to address obstacle(s) within the OPS, the specified setting for Unit A is referenced to the highest obstacle height in the PAPI / APAPI OPS. This serves to maintain a 34’ clearance between Unit A of a PAPI and the slope of OPS and a 54’ clearance between Unit A of an APAPI and the slope of the OPS.

(2) The differential setting for the on-course sector may be increased to 30’ where harmonization with electronic glide path is required.
5.3.16.20 The system is installed with the longitudinal axis of the approach slope parallel with the runway centreline and extended centreline, except that the axis may be displaced to a maximum of 5° to match with an offset approach surface where provided.

System Failure

5.3.16.21 The following measures are undertaken when the PAPI or APAPI is unavailable:

(a) Where the approach OLS slope is established in accordance with 5.3.16.1(a), the following operational restrictions apply:
   (i) The runway threshold is displaced using the minimum approach OLS in Table 4-1(a) and marked and lighted in accordance with the standards.
   (ii) Where the runway threshold cannot be positioned or lighted in accordance to the standards, the runway is closed for arrivals at night in the appropriate direction.

(b) Where the system is provided in accordance with 5.3.16.1(b) and the system failure is greater than 48 hr, the affected runway is not available for scheduled 704/705 commercial passenger operations;

(c) Where the system is provided in support of LAHSO operations in accordance with 5.3.16.1(c), LAHSO operations cease;

(d) Where a PAPI/APAPI is installed as a result of a risk assessment in accordance with 5.3.16.1(d), the assessment includes measures to be taken in event of a PAPI/APAPI failure.

Obstacle Protection Surface (OPS)

Application

5.3.16.22 An obstacle protection surface (OPS) is established where a PAPI or APAPI system is provided.

Characteristics

5.3.16.23 The limits of the OPS comprises:

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

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

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

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

5.3.16.25 The slope of the OPS is measured in the vertical plane containing the extended centreline of the runway.

5.3.16.26 The width and length of the OPS is measured in the horizontal plane.
5.3.16.27 The characteristics of the OPS, i.e. origin, divergence, length and slope are as specified in the relevant column of Table 5.3.16.27.

<table>
<thead>
<tr>
<th>Aircraft Group Number</th>
<th>I</th>
<th>II</th>
<th>IIIA</th>
<th>IIIB</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of inner edge each side of centreline</td>
<td>See Table 4-1(a), Approach: Length of inner edge each side of centreline</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance from threshold</td>
<td>See Table 4-1(a), Approach: Distance from threshold</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Divergence (%)</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Length (m)</td>
<td>7 500</td>
<td>7 500</td>
<td>7 500</td>
<td>7 500</td>
<td>7 500</td>
<td>7 500</td>
<td>7 500</td>
</tr>
<tr>
<td>Slope PAPI (3° approach path)</td>
<td>1° 56'</td>
<td>1° 56'</td>
<td>1° 56'</td>
<td>1° 56'</td>
<td>1° 56'</td>
<td>1° 56'</td>
<td>1° 56'</td>
</tr>
<tr>
<td>Slope APAPI (3° approach path)</td>
<td>1° 51'</td>
<td>1° 51'</td>
<td>1° 51'</td>
<td>1° 51'</td>
<td>1° 51'</td>
<td>1° 51'</td>
<td>1° 51'</td>
</tr>
</tbody>
</table>

5.3.16.28 Except as stated in 5.3.16.29, objects, including terrain, do not protrude above the OPS.

5.3.16.29 Terrain in the strip end area may be above the point of origin of the adjoining OPS, provided that:

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

(b) thereafter is no higher than the OPS.

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

5.3.16.30 Where an object or terrain protrudes above the OPS, beyond the length of the approach OLS, one or more of the following measures are taken:

(a) remove the obstacle;

(b) raise the approach slope as permissible in 5.3.16.17 and the OPS of the system;

(c) displace the axis of the system and its associated OPS by no more than 5° and establish the appropriate criteria for an offset approach surface;

(d) displace the system upwind of the threshold to provide an increase in the threshold crossing height equal to the height of the object penetration;

(e) light and mark the obstacle, and publish the reduced operational length; or

(f) displace the threshold;

Note: See Chapter 4—Obstacle Management for standards relating to the establishment of an offset approach surface.
Figure 5-41: PAPI general arrangement

Example: Settings for a 3 degree approach slope:
Unit D = 3° 30'
Unit C = 3° 10'
Unit B = 2° 50'
Unit A = 2° 30'
angle M = 2° 48' = 2.8°
angle 2' = 0.03°

LEGEND
θ = approach slope angle
D = distance of PAPI from threshold
MEHT = minimum eye height over threshold
M = angle determining MEHT
OPS = obstacle protection surface
Figure 5-42: APAPI general arrangement

Example: Settings for a 3 degree approach slope:
- Unit B = 3° 15'
- Unit A = 2° 45'
- angle M = 2° 43’ ± 2.72°
- angle Z = 0.03°

LEGEND
- ω = approach slope angle
- D = distance of PAPI from threshold
- MEHT = minimum eye height over threshold
- M = angle determining MEHT
- OPS = obstacle protection surface

Note: For information on installation tolerances, please refer to standard.
5.3.17 Land and Hold Short Lights

Note: The intent of land and hold short lights is to enhance the holding position on a runway where land and hold short operations are conducted.

Application

5.3.17.1 Where provided, the land and hold short lights are in accordance with the specifications of this section.

Location

5.3.17.2 Land and hold short lights consist of a single row of six (6) fixtures:
   (a) located on the holding side of the runway-holding position, at a distance of 0.6 m (+0.9 m, -0.0 m) from the runway-holding position marking.
   (b) positioned so that the total width of the row of lights, measured between the centres of the outboard fixtures, is:
      (i) 50% (±10%) of the defined runway width; and
      (ii) symmetrically disposed about the runway centreline, with an equal distance (±0.05 m) between each light

Note: See Figure 5-43 for depiction of LAHSO visual aids configuration.

Characteristics

5.3.17.3 Land and hold short lights are:
   (a) inset fixtures;
   (b) unidirectional;
   (c) emit a white colour; and
   (d) flash simultaneously between “ON” and “OFF” as follows:
      (i) 1.35 seconds (±0.1 second) on; and
      (ii) 0.8 seconds (±0.1 second) off.

5.3.17.4 The intensity and distribution of the land and hold short lights is in accordance with Appendix 5B, Figure B-7
Figure 5-43: LAHSO visual aids configuration

Notes:
1. The 6 lights of the system are symmetrically disposed about the runway centreline.
2. Light fixtures are uniformly spaced between the outboard light fixtures.
3. Refer 5.3.17 for tolerances and fixture alignment.
5.3.18 Runway Status Lights (RWSL)

Note 1: Runway status light (RWSL) is an automated system that may be installed in conjunction with enhanced taxiway markings, stop bars or runway guard lights. It functions independently of any other visual system to provide direct warning to a pilot of an incursion danger on the runway ahead. The system comes in three basic forms: runway entrance lights (REL), take-off hold lights (THL) and runway intersection lights (RIL). Either system may be installed by itself, but it is preferred that the systems are installed so as to complement each other.

Note 2: The RWSL processor receives surveillance data of aircraft and vehicles on or near the aerodrome surface from the ground surface surveillance system to determine activation and deactivation of the REL, THL and RIL. The system will automatically adjust light intensity according to the ambient conditions for the time of day.

Note 3: The status of the RWSL lighting is indicated in the ATS control panel. ATS can override automated brightness settings and can disable the system when necessary.

Application

5.3.18.1 Where provided, Runway Status Lights are in accordance with the specifications of this section.

Runway Entrance Light (REL)

Location

5.3.18.2 RELs are offset a maximum of 0.6 m from the taxiway centreline on the opposite side to the taxiway centreline lights, where provided, and begin a maximum of 0.6 m before the runway-holding position marking. An additional single light is placed on the runway 0.6 m (+1.0 m, -0.0 m) from the runway centreline and aligned with the last and next to last light on the taxiway.

Note: See Figure 5-44 for depiction of runway entrance light installation.

5.3.18.3 Subject to 5.3.18.4, the REL consists of at least six (6) light units, with the lights on the taxiway spaced at a minimum of 3.8 m and a maximum of 15.2 m longitudinally, depending upon the taxiway length involved.

5.3.18.4 When the taxiway centreline marking between the holding position marking and the runway is curved, the maximum REL longitudinal spacing conforms to Table 5.3.18.4.

<table>
<thead>
<tr>
<th>Radius of Curved Centrelines</th>
<th>≥ RVR1200 (¼ SM)</th>
<th>&lt; RVR1200 (¼ SM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 120 m</td>
<td>7.5 m</td>
<td>7.5 m</td>
</tr>
<tr>
<td>121 m to 364 m</td>
<td>15 m</td>
<td>7.5 m</td>
</tr>
<tr>
<td>≥ 365 m</td>
<td>30 m</td>
<td>15 m</td>
</tr>
</tbody>
</table>

5.3.18.5 For angled and highly angled taxiways (e.g. less than 60° from the runway centreline heading), the fixtures used and aiming is determined on a case by case basis to ensure that the RELs are not seen by traffic on the runway.

Characteristics

5.3.18.6 The RELs consist of a single row of fixed in-pavement lights showing red in the direction of aircraft approaching the runway.
5.3.18.7 Intensity and beam spread of REL are in accordance with the specifications of Appendix 5B, Figure B-24.

5.3.18.8 The REL are automated to the extent that the only control over each system will be to disable one or both systems.

*Note: ATS personnel do not have operational control over the light array.*

![Figure 5-44: Runway status lights—runway entrance lights (REL)](image-url)
Take-off Hold Light (THL)

Location

5.3.18.9 THLs are offset 1.8 m on each side of the runway centreline lights, where provided, and extend, in pairs, starting at a point 112.5 m (±7.5 m) from the beginning of the runway and thereafter every 30 m (±0.6 m) for at least 450 m.

Note: See Figure 5-45 for depiction of take-off and hold light installation.

Characteristics

5.3.18.10 The take-off hold light (THL) array consists of two rows of fixed in-pavement lights showing red in the direction of aircraft taking off on the runway.

5.3.18.11 The intensity and beam spread of the THL conforms to the specifications of Appendix 5B, Figure B-24.

![Diagram of runway status lights—take-off hold lights (THL)](image)

Notes:

(1) 7 ½ m centreline light spacings.

(2) Preferably the THL is positioned such that a line formed by two THL lights will be near the mid-point between two centreline lights.

(3) If the runway centreline lights are offset from the physical centreline, the THL lights are similarly offset to maintain the 1.8 m dimension.

Figure 5-45: Runway status lights—take-off hold lights (THL)
Runway Intersection Light (RIL)

Note: See Figure 5-46 for depiction of runway intersection light installation.

Location

5.3.18.12 RILs are a double row (31 pairs) of inset red lights that are aligned with the runway centreline lights and aimed toward an aircraft or vehicle that is approaching an intersecting runway. They begin at the land and hold short inset lights or the runway-holding position marking and extend toward the approach end of the runway for 900 m.

5.3.18.13 The first pair of RIL fixtures is located 1.8 m (+7.5 m, -0.0 m) longitudinally (measured to the centreline of a RIL fixture) from the outer edge of the first solid line of the runway-holding position marking toward the approach end of the runway. If land and hold short in-pavement lights are installed, the first pair of RIL fixtures is located 1.8 m (+7.5 m, -0.0 m) longitudinally, measured to the centre of the RIL fixture, from the centre of a LAHSO light fixture. RILs are installed every 30 m (±0.6 m) and displaced 1.8 m either side of the runway centreline lights in the same manner as THLs.

5.3.18.14 Where RILs are to be installed on a runway that does not have runway centreline lights, the RIL array is installed with respect to an imaginary line that represents the location of the runway centreline lights.

Note: In some situations, due to available pavement length, RIL and THL fixtures may overlap.

Characteristics

5.3.18.15 The RIL array consists of two (2) rows of fixed in-pavement lights showing red in the direction of aircraft approaching the intersection.

5.3.18.16 Intensity and beam spread of RILs are in accordance with the specifications of Appendix 5B, Figure B-24.
Notes:
(1) If the centreline lights are offset from the centreline, the RIL lights are similarly offset to maintain the 1.8 m dimension.

(2) If LAHSO lights are installed, the first pair of RIL lights is located at least 0.6 m from the centreline of the LAHSO light bar.

(3) For some installations the RIL may overlap the THL.

Figure 5-46: Runway status lights—runway intersection lights (RIL)
5.3.19  Runway Lead-In Lighting System (LDIN)

Note: A runway lead-in lighting system is provided where it is desirable to provide visual guidance along a specific approach path for reasons such as avoiding hazardous terrain or for the purposes of noise abatement. The system terminates at an approved approach lighting system or at a distance from the threshold, permitting visual reference to the runway environment where no approach lighting system is required under this Chapter. This system is not for use in support of an instrument approach.

Application

5.3.19.1  Where provided, the runway lead-in lighting system (LDIN) is as specified in this section.

Note: See Figure 5-47 for depiction of a runway lead-in light system.

Location

5.3.19.2  The LDIN consists of groups of lights positioned so as to define the desired approach path and so that one group may be sighted from the preceding group. The interval between adjacent groups does not exceed 1 600 m.

Note: A LDIN may be curved, straight or a combination thereof.

5.3.19.3  The LDIN extends from a point as determined by an aeronautical evaluation, up to a point where the approach lighting system (if provided), the runway or the runway lighting system is in view.

Characteristics

5.3.19.4  Each LDIN group of lights consists of at least three (3) flashing lights in a linear configuration. The lights within each group are designed to flash in sequence towards the aerodrome. The flash sequencing in a group can be independent of the flash sequencing in a following group.

Note 1: Steady burning lights may augment the system where such lights would assist in identifying the system.

Note 2: The actual number of lights within each group is site dependent.

5.3.19.5  The flashing lights are white in colour.

5.3.19.6  The flashing lights of the LDIN are in accordance with the specifications of Appendix 5B, Figure B-23.
Figure 5-47: Runway lead-in lighting system

Groups of lead-in lights (flashing). As near to the desired approach track as practicable.

Desired approach path [centre of river]

1600 m
5.3.20 Rapid Exit Taxiway Indicator Lights (RETI)

Note: The purpose of rapid exit taxiway indicator lights (RETI) is to provide pilots with distance-to-go information to the nearest rapid exit taxiway on the runway, enhance situational awareness in low visibility conditions and enable pilots to apply braking action for more efficient roll-out and runway exit speeds.

Application

5.3.20.1 Where provided, the rapid exit taxiway indicator lights are as specified in this section.

5.3.20.2 Rapid exit taxiway indicator lights are not displayed in the event of any lamp failure or other failure that prevents the display of the full light pattern depicted in Figure 5-48.

Location

5.3.20.3 A set of rapid exit taxiway indicator lights are located on the runway on the same side of the runway centreline as the associated rapid exit taxiway, in the configuration shown in Figure 5-48. In each set, the lights are located 2 m (±0.006 m) apart and the light nearest to the runway centreline is displaced 2 m (±0.012 m) from the runway centreline.

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

Characteristics

5.3.20.5 Rapid exit taxiway indicator lights are fixed unidirectional yellow lights, aligned so as to be visible to the pilot of a landing aeroplane in the direction of approach to the runway.

5.3.20.6 Rapid exit taxiway indicator lights are in accordance with the specifications in Appendix 5B, B-7.

5.3.20.7 Rapid exit taxiway indicator lights are displayed only when the associated runway edge and centreline lights are displayed.

5-48: Rapid exit taxiway indicator lights (RETI)
5.3.21 Taxiway Centreline Lights

Note: See Figure 5-49 for an overview of taxiway lighting system configurations.

Application

5.3.21.1 Taxiway centreline lights are provided on:

(a) an exit taxiway, taxiway, runway turn pad, and aircraft stand taxilane used in visibility conditions below RVR1200 (¼ SM) in such a way as to provide continuous guidance between the runway centreline and the point on the apron where aircraft commence manoeuvring for parking, except for take-off operations in RVR600 (¼ SM) and above, where procedures exist to limit aircraft on the manoeuvring area to one at a time and vehicles on the manoeuvring area to essential minimum; or

(b) a runway forming part of a normal taxi route used in visibility conditions below RVR1200 (¼ SM), except for take-off operations in RVR600 (¼ SM) and above, where procedures exist to limit aircraft on the manoeuvring area to one at a time and vehicles on the manoeuvring area to essential minimum.

Note 1: See sections 5.3.28 to 5.3.30 concerning standards for the provision of aircraft stand manoeuvring guidance lights.

Note 2: See section 8.2 for provisions concerning the interlocking of taxiway lighting systems with other systems.

Location

5.3.21.2 The taxiway centreline lights are located along the centreline of the taxiway or uniformly offset to the same side of the taxiway centreline by no more than 30 cm except for taxiway centreline lights on a runway, which are at least 60 cm from any row of runway centreline lights.

Note: See Figure 5-50 for depiction of taxiway centreline offset.

Taxiway Centreline Lights Spacing

General

5.3.21.3 Taxiway centreline lights on a straight section of a taxiway are spaced at longitudinal intervals of not more than 30 m; on a taxiway intended for use in visibility conditions below RVR1200 (¼ SM), the longitudinal spacing does not exceed 15 m.

5.3.21.4 Taxiway centreline lights on a taxiway curve continue from the straight portion of the taxiway at a constant distance from the outside edge of the taxiway curve. The lights are spaced at intervals such that a clear indication of the curve is provided.

5.3.21.5 The taxiway centreline lights on a curve do not exceed a spacing of:

<table>
<thead>
<tr>
<th>Curve Radius</th>
<th>Light Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 400 m</td>
<td>7.5 m</td>
</tr>
<tr>
<td>greater than 400 m</td>
<td>15 m</td>
</tr>
</tbody>
</table>

5.3.21.6 On a taxiway where both taxiway centreline lights and edge lights are installed, the lights of these systems are overlapped for a minimum distance of 90 m to provide transition from one system to another.
Figure 5-49: Taxiway lighting
Figure 5-50: Offset runway and taxiway centreline lights

Where exit taxiways are located on one side of a runway and it is practicable to locate the runway centreline lights along the runway centreline.

**Condition (a)**

Where exit taxiways are located on one side of a runway and it is not practicable to locate the runway centreline lights along the runway centreline.

**Condition (b)**

Where exit taxiways are located on both sides of a runway and it is practicable to locate the runway centreline lights along the runway centreline.

**Condition (c)**

Where exit taxiways are located on both sides of a runway and it is not practicable to locate the runway centreline lights along the runway centreline.

**Condition (d)**

Notes:
1. Offset is applied uniformly through the system.
2. Example light fixtures are 0.3 m diameter.
Taxiway Centreline Lights on Rapid Exit Taxiways and Other Exit Taxiways

Note: See Figure 5-51 for depiction of taxiway centreline lighting on exit taxiways.

5.3.21.7 Taxiway centreline lights on a rapid exit taxiway:
(a) commence at a point at least 60 m before the beginning of the taxiway curve or at the start of the taxiway centreline on the runway, whichever is greater;
(b) continue beyond the end of the curve to a point on the centreline of the taxiway where an aircraft can be expected to reach normal taxiing speed or three (3) lights beyond the runway-holding position, whichever is greater; and
(c) are at least 60 cm from any row of runway centreline lights for that portion parallel to the runway centreline.

5.3.21.8 Taxiway centreline lights on exit taxiways other than rapid exit taxiways:
(a) commence at a point of tangency where the taxiway centreline begins to curve from the runway centreline, and
(b) follow the curved taxiway centreline marking to at least the point where the holding position is located.

Figure 5-51: Taxiway centreline lighting

Taxiway Centreline Lights on Runway Turn Pads

Note: See Figure 5-52 for depiction of taxiway centreline lights on a runway turn pad.

5.3.21.9 Taxiway centreline lights are provided up to a point where a 180° turn goes at least three lights beyond the runway centreline, as shown in Figure 5-52.
Characteristics

5.3.21.10 Subject to 5.3.21.11, with the exception of an exit taxiway, taxiway centreline lights, on a taxiway and on a runway forming part of a recognized taxi-route, are fixed lights showing green with beam dimensions such that the light is visible only from aircraft on or in the vicinity of the taxiway.

5.3.21.11 The taxiway centreline lights, from a runway-holding position up to the termination point on the runway or between runway-holding positions when crossing a runway, may show alternating green and yellow.

Note: The intent is to increase awareness of the proximity of a runway to reduce runway incursions.

5.3.21.12 Where aircraft follow the same centreline in both directions, the centreline lights are bidirectional.

5.3.21.13 Taxiway centreline lights on an exit taxiway are fixed lights. Alternate taxiway centreline lights show green and yellow from their beginning near the runway centreline to the outer perimeter of the ILS/MLS critical/sensitive area or the taxi-holding position, whichever is farthest from the runway; thereafter, all lights show green. The first light in the exit centreline shows green and the light nearest to the perimeter shows yellow.

Note: The size of the ILS/MLS critical/sensitive area depends on the characteristics of the associated ILS or MLS. Contact the ILS service provider for the specific dimensions of the critical and sensitive areas.
5.3.21.14 Taxiway centreline lights are in accordance with the specifications of:

(a) Appendix 5B, Figures B-12, B-13 or B-14, as appropriate for taxiways used in visibility conditions below RVR1200 (¼ SM); and

(b) Appendix 5B, Figures B-15 or B-16 as appropriate for other taxiways.

5.3.22 Taxiway Edge Lights

Note: See Figure 5-54 for an overview of taxiway edge lighting systems.

Application

5.3.22.1 Taxiway edge lights are provided on:

(a) a holding bay, apron, runway turn pad used at night and on a taxiway not provided with taxiway centreline lights and intended for use at night;

(b) curved portions of taxiways where aircraft operations are being conducted in visibility conditions below RVR600 (¼ SM); or

(c) a daytime only runway used for aircraft taxiing at night.

Exceptions:

(i) Retro-reflective markers may be provided in lieu of taxiway edge lighting for aircraft operations in visibility conditions of RVR1200 (¼ SM) and above on private taxiways, and on aprons where, considering the nature of the operations, adequate guidance can be achieved by surface illumination or other means.

(ii) For taxiways on an apron, edge lighting need not be provided on the side adjacent to the apron, provided a taxiway side stripe marking is installed.

Note: See section 5.5.4 for taxiway edge markers.

Location

5.3.22.2 Taxiway edge lights have a uniform designed spacing not exceeding 60 m on straight segments. The installation tolerance is ±1 m of the design spacing.

5.3.22.3 Taxiway light spacing on a curved or fillet section of a taxiway is spaced in accordance with the requirements of Figure 5-53 so that a clear indication of the curve is provided. The installation tolerance is generally ±1 m of the required chord length except chords next to the points of tangency (PT) have a tolerance of (+1m, 0m) to maintain the required spacing of 5.3.22.2.

5.3.22.4 Curved or filleted sections of more than 30° of arc have a minimum of three (3) edge lights.

5.3.22.5 The lights on opposite sides of straight portions of the taxiway axis are aligned, at right angles to that axis. Where the spacing of the lights would result in a light being within an intersection, the light(s) is omitted.
5.3.22.6 A taxiway/taxiway or taxiway/runway intersection, where no fillet or curve is provided, is indicated by placing two (2) blue edge lights (double blues) on each side of the intersection. Where the taxiway is situated at the end of the runway, the set of double blues in line with the runway end lights may be omitted.

5.3.22.7 The intersection of a taxiway with an apron is indicated by placing two (2) yellow edge lights (double yellows) on each side of apron exit, adjacent to the taxiway/apron intersection, except where taxiway centreline lights are provided to lead aircraft from the apron to the taxiway these lights may be omitted.

Note: The purpose of the double yellow edge lights is to provide exit guidance from the apron.

5.3.22.8 The two (2) lights provided in accordance with 5.3.22.6 and 5.3.22.7 are located so that one light is positioned in line with the other edge lights. The second is positioned 0.6 m \([±0.05\text{m}]\) from the first and aligned to be equidistant from the edges of the pavement on each side of the first light.

Characteristics

5.3.22.9 Taxiway edge lights are fixed lights showing blue. The lights are visible up to at least 30° above the horizontal and at all angles in azimuth necessary to provide guidance to a pilot taxiing in either direction.

Note: See section 5.5.4 for characteristics of retroreflective taxiway edge markers.

5.3.22.10 The intensity and distribution of taxiway edge lights conform to Appendix 5B, Table 5B-1.
Table: Chord length versus radius

<table>
<thead>
<tr>
<th>Radius &quot;R&quot; of curve (metres)</th>
<th>Chord &quot;Z&quot; (metres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0</td>
<td>6.0</td>
</tr>
<tr>
<td>7.5</td>
<td>7.4</td>
</tr>
<tr>
<td>15</td>
<td>10.5</td>
</tr>
<tr>
<td>23</td>
<td>12.9</td>
</tr>
<tr>
<td>30</td>
<td>14.1</td>
</tr>
<tr>
<td>45</td>
<td>16.7</td>
</tr>
<tr>
<td>60</td>
<td>19.2</td>
</tr>
<tr>
<td>75</td>
<td>21.8</td>
</tr>
<tr>
<td>90</td>
<td>24.3</td>
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<tr>
<td>150</td>
<td>34.5</td>
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<tr>
<td>200</td>
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<tr>
<td>250</td>
<td>51.5</td>
</tr>
<tr>
<td>300</td>
<td>60.0</td>
</tr>
</tbody>
</table>

- For radii not listed, determine "Z" spacing by linear interpolation.
- "Z" is the chord length. "Z" is not a segment of the circumference.
- Uniformly space lights on curved edges.
- Do not exceed the values listed in the above table.
- For runway/taxiway intersections the light at the PT may be a runway edge light.
- On curved edges in excess of 30 degrees of arc, do not install less than 3 lights including those at the PTs.

Figure 5-53: Spacing of lights on curved taxiway edges
Figure 5-54: Taxiway edge lighting configuration

Notes:
1. On straight sections of taxiways, the longitudinal spacing of lights is 60 m or less.
2. Spacing of lights on taxiway curved edges is as shown in Figure 5-53.
3. Maintain cross-taxiway alignment on straight sections.
4. Runway light at PT.
5. One inset edge light may be omitted; refer runway edge light section.

LEGEND
- Runway edge light - inset
- Runway edge light
- Taxiway edge light
- PT point of tangency
5.3.23 Stop Bars

Note 1: The provision of dynamic stop bars requires their control by air traffic services. Stop bars may be static or dynamic in operational nature depending on the control requirements of air traffic services under the low visibility operations plan. Dynamic stop bars are commonly located at holding positions used in low visibility operations, while static stop bars are typically used on taxiways not part of the low visibility routing.

See also 5.3.31—Road-Holding Position Light

Note 2: Stop bars are comprised of inset lights across the holding position and supplemental lights (elevated or inset) at the outer edges of the holding position.

Application

5.3.23.1 A stop bar is provided at every runway-holding position serving a runway operating in visibility conditions below RVR1200 (¼ SM), except where operational procedures exist in the reduced or low visibility plan to limit the number of aircraft on the manoeuvring area to one at a time and vehicles on the manoeuvring area to the essential minimum.

Note: An aircraft under tow or escorted by a follow me vehicle constitutes a single movement

Location

5.3.23.2 The stop bar is installed perpendicular to the taxiway centreline on the holding side of the runway-holding position marking, not more than 0.9 m from the marking.

5.3.23.3 For dynamic stop bars, a pair of supplemental stop bar lights is provided on each side of the runway-holding position, in line with the inset stop bar lights and located at a distance of 1.5 to 3 m from the edge of the runway or taxiway.

5.3.23.4 Inset stop bar lights within a runway or taxiway are normally aimed parallel with the taxi centreline. However, for certain applications angular aiming may be necessary depending upon site requirements to facilitate viewing from the aircraft, such as in a curve.

5.3.23.5 Where elevated runway guard lights are installed, the supplemental stop bar lights are installed a minimum of 1 m inboard of the elevated runway guard lights.

Note: See Figure 5-55 for depiction of a stop bar and runway guard light installations.

5.3.23.6 The two supplemental stop bar lights are spaced 40 cm (+5 cm) apart.

5.3.23.7 Supplemental stop bar lights are aimed toward the taxi centreline at a distance of between 37 m and 52 m from the runway-holding position.

5.3.23.8 The vertical aiming angle of the supplemental stop bar lights is set between 5° and 10° above the horizontal.

5.3.23.9 Stop bars consist of lights spaced at uniform intervals not exceeding 3 m across the runway-holding position.
Characteristics

5.3.23.10 Stop bars installed at a runway-holding position are unidirectional and show red in the direction of approach to the intersection or the runway-holding position.

5.3.23.11 Selectively switchable (dynamic) stop bars at a runway-holding position are installed in conjunction with at least 90 m of taxiway centreline lights extending from the stop bar to the runway centreline.

Note: See section 5.3.21 for standards concerning the spacing of taxiway centreline lights.

5.3.23.12 Where the supplemental stop bar lights are inset fixtures, they are in accordance with Appendix 5B, Figures B-12 to B-16, as appropriate.

5.3.23.13 The intensity in red light and beam spreads of inset stop bar lights conforms to specifications in Appendix 5B, Figures B-12 to B-16, as appropriate.

5.3.23.14 The intensity in red light and beam spreads of elevated stop bar lights conforms to the specifications in Appendix 5B, Figure B-26.

5.3.23.15 The lighting circuit is designed so that:

(a) stop bars located across entrance taxiways are selectively switchable;
(b) stop bars located across taxiways intended to be used only as exit taxiways are switchable selectively or in groups;
(c) when a stop bar is illuminated, taxiway centreline lights installed beyond the stop bar are extinguished for a distance of at least 90 m;
(d) stop bars are interlocked with the taxiway centreline lights so that when the centreline lights beyond the stop bar are illuminated the stop bar is extinguished and vice versa;
(e) when inset runway guard lights are co-located with stop bars, they are interlocked so that when the stop bars are ON, the runway guard lights are OFF and vice-versa; and
(f) when more than one stop bar is associated with a taxiway/runway intersection, only one is illuminated at a time.

5.3.23.16 Where a change in the operational status of a stop bar has occurred, the control system response time is as follows: within two seconds from the time the stop bar button on the ATC airfield lighting control panel is activated, the stop bar lights switch off and the lead-on taxiway centreline lights switch on.

Note: See sections 8.1 and 8.4 for provisions on selective switching of stop bars and taxiway centreline lights.
Figure 5-55: Stop bar lighting

Notes:
1. Supplemental light units are aimed horizontally toward aircraft cockpit at 37 to 52 m from the holding position and vertically aimed at 5 to 10 degrees above the horizontal.
2. Taxiway centreline lights provided for operations below RVR1200 (1/4 statute mile).
3. For aiming of pavement lights, refer Figure 5-57.
5.3.24  No-Entry Bars

Note: No-entry bars are typically used where the entry to a taxiway prohibited. The provision of no-entry requires their control by air traffic services where the exit is intended for aircraft movement in one direction on a temporary basis.

Application

5.3.24.1 Where a no-entry bar is provided, it is as specified in this section.

Location

5.3.24.2 A no-entry bar is located at the entrance of a taxiway to protect the no-entry side.

Note: See Figure 5-49 for depiction of a no-entry bar located on an exit-only taxiway.

5.3.24.3 A no-entry bar is composed of lights which are normally aimed parallel with the taxiway centreline. However, for certain applications, angular aiming may be necessary depending upon site requirements to facilitate viewing from the aircraft, such as just prior to a curve.

5.3.24.4 No-entry bars consist of lights spaced at uniform intervals not exceeding 3 m across the width of the taxiway.

Characteristics

5.3.24.5 No-entry bar lights are inset unidirectional lights showing red in the direction of approach to the intersection.

5.3.24.6 The intensity in red light and beam spreads of no-entry bar lights conforms to the specifications in Appendix 5B, Figures B-12 to B-16, as appropriate.

5.3.24.7 The lighting circuit is designed so that:

(a) no-entry bars located across entrance taxiways are selectively switchable;

(b) no-entry bars are interlocked with the taxiway centreline lights, where provided, so that when the no-entry lights are selected, the centreline lights beyond the no-entry bar are turned off for a minimum distance of 90 m and vice versa; and

(c) when there is a (visible) stop bar beyond the no-entry bar, only one (stop bar or no-entry bar) is illuminated at a time.

5.3.24.8 Where a change in the operational status of a no-entry bar has occurred, an indication is automatically provided to the air traffic control service within 2 seconds of the change.
5.3.25 **Intermediate Holding Position Lights**

*Note: See 5.2.17 for standards on intermediate holding position marking.*

**Application**

5.3.25.1 Intermediate holding position lights are provided where an intermediate holding position marking is established for operations in visibility conditions below RVR1200 (1/4 SM).

**Location**

5.3.25.2 The lights are located no more than 1 m from the intermediate holding position marking on the holding side. The lights are disposed symmetrically and at 90° to the taxiway centreline, with individual lights spaced 1.5 m (±0.3m) apart.

5.3.25.3 In order to avoid pavement joints, the intermediate holding position lights may be offset by a maximum of 0.3 m, in the same direction as the taxiway centreline lights, if provided.

5.3.25.4 Where there would be co-location of an intermediate holding position light and a taxiway centreline light, an intermediate holding position light is installed.

*Note: See Figure 5-49 for depiction of intermediate holding position lights.*

**Characteristics**

5.3.25.5 Intermediate holding position lights consist of three (3) fixed inset unidirectional lights showing yellow in the direction of approach to the intermediate holding position with a light distribution in accordance with Appendix 5B, Figure B-17.
5.3.26 Runway Guard Lights

Application

5.3.26.1 Runway guard lights, configuration A or configuration B (refer to Figure 5-56), are provided at each taxiway/runway-holding position associated with a runway operating in visibility conditions below RVR2600 (½ SM), except:

(a) where a stop bar is installed and operated below RVR2600 (½ SM); or
(b) where there are procedures in place to manage the vehicular traffic to essential minimum, and limit aircraft movement to one at any time on the manoeuvring area.

Location

5.3.26.2 Elevated runway guard lights, configuration A, are located at each side of the taxiway as follows:

(a) on the holding side of the runway-holding position marking, no more than 1 m from the extended edge of the marking,
(b) between 3–5 m from the defined edge of the taxiway; and
(c) a minimum separation of 1 m outboard of the supplementary stop bar, if provided.

5.3.26.3 Elevated runway guard lights are no higher than 75 cm above the edge of the taxiway.

5.3.26.4 Inset runway guard lights, configuration B, are located across the holding side of the runway-holding position marking as follows:

(a) located at a uniform distance from the edge of the runway-holding position marking no more than 1 m from the edge of the marking; and
(b) the lights are uniformly spaced across the full width of the taxiway at intervals of no more than 3 m.

Note: See Figure 5-12 for runway-holding position markings.

Characteristics

5.3.26.5 Elevated runway guard lights, configuration A, consist of two pairs of yellow lights.

5.3.26.6 Inset runway guard lights, configuration B, consist of yellow lights.

5.3.26.7 The light beam is unidirectional and aimed so as to be visible to the pilot of an aircraft taxiing (approaching) to the holding position.

Note: See Figure 5-57 for aiming of inset runway guard lights.

5.3.26.8 Where elevated runway guard lights are provided they are oriented toward the taxiway centreline at a distance of between 45–60 m from the runway-holding position.

Note: The complexity of the taxiway intersection may require the installation of multiple lights to adequately cover the different taxi paths.

5.3.26.9 The vertical aiming angle of configuration A lights is set between 5°–10° above the horizontal plane.

Note: Configuration A runway ground lights are oriented to maximize the visibility of the lights to pilots of aircraft approaching the runway-holding position. The orientation aims the centre of the light beam toward the aircraft cockpit at a specified distance along the predominant taxi path to the holding position. If these criteria cannot be met for all taxi paths to the holding position, consider using multiple fixtures aimed to adequately cover the different taxi paths. Alternatively use in-pavement fixtures, configuration B.
Figure 5-56: Runway guard light configuration

Figure 5-57: Inset runway guard light orientation
5.3.26.10 The intensity in yellow light and beam spreads of elevated runway guard lights conforms to the specifications set out in Appendix 5B, Figure B-20.

5.3.26.11 The intensity in yellow light and beam spreads of inset runway guard lights conforms to the specifications set out in Appendix 5B, Figure B-17.

5.3.26.12 The lights in each elevated runway guard light unit are illuminated alternately.

5.3.26.13 For inset runway guard lights, adjacent lights are alternately illuminated and alternate lights are illuminated in unison.

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

5.3.26.15 Runway guard lights are provided with variable intensity as per 5.3.1.7.

5.3.26.16 Where runway guard lights, configuration B, are co-located with a stop bar at a holding position, an interlock is provided such that both systems are not operated simultaneously.

5.3.26.17 Where runway guard lights, configuration A or B, are installed at a primary holding position and stop bar lights are installed at another holding position further from the runway, an interlock is provided such that the runway guard lights are not operated simultaneously with the stop bar lights.

5.3.27 Apron Floodlighting

Note: Additional information on illumination levels for working areas such as apron areas can be found in external documents, such as the Canada Labour Code.

Application

5.3.27.1 Where provided, apron floodlighting is in accordance with the specifications of this section.

Location

5.3.27.2 Apron floodlights are configured so as to provide minimum glare to pilots of aircraft in flight and on the ground, and to aerodrome and apron controllers.

Characteristics

5.3.27.3 The colour rendition of light emitted from apron floodlights is such that the colours used for surface and/or obstacle marking can be correctly identified.
5.3.28 Visual Docking Guidance System (VDGS)

Application

5.3.28.1 A visual docking guidance system is provided when precise positioning of an aircraft is required and other means, such as marshallers, are not practical.

Characteristics

5.3.28.2 The visual docking guidance system provides both azimuth and stopping guidance.

5.3.28.3 The azimuth guidance unit and the stopping position indicator are adequate for use in all weather, visibility, background lighting and pavement conditions for which the system is intended, both by day and night, but do not dazzle the pilot.

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

5.3.28.4 The azimuth guidance unit and the stopping position indicator (where installed) are of a design such that:
   (a) a clear indication of malfunction of either or both is available to the pilot; and
   (b) they can be turned off.

5.3.28.5 The azimuth guidance unit and the stopping position indicator are located in such a way that there is continuity of guidance between the aircraft stand markings, the aircraft stand manoeuvring guidance lights, if present, and the visual docking guidance system.

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

5.3.28.7 If selective operation is required to prepare the system for use by a particular type of aircraft, then the system provides an identification of the selected aircraft type to both the pilot and the system operator as a means of ensuring that the system has been set properly.

Azimuth Guidance Unit

Location

5.3.28.8 The azimuth guidance unit is located on or close to the extension of the stand centreline ahead of the aircraft so that its signals are visible from the cockpit of an aircraft throughout the docking manoeuvre and aligned for use by at least the pilot occupying the left seat.

Characteristics

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

5.3.28.10 When azimuth guidance is indicated by colour change, green is used to identify the centreline and red for deviations from the centreline.
Stopping Position Indicator

Location

5.3.28.11 The stopping position indicator is located in conjunction with, or sufficiently close to the azimuth guidance unit so that a pilot can observe both the azimuth and stop signals without turning his/her head.

5.3.28.12 The stopping position indicator is usable at least by the pilot occupying the left seat.

Characteristics

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

5.3.28.14 The stopping position indicator shows the stopping position for the aircraft for which guidance is being provided and, in the case of an electronic system, provides closing rate information to enable the pilot to gradually decelerate the aircraft to a full stop at the intended stopping position.

5.3.28.15 When stopping guidance is indicated by colour change, green is used to show that the aircraft can proceed and red to show that the stop point has been reached. For a short distance prior to the stop point, a third colour may be used to warn that the stopping point is close.
5.3.29 Advanced Visual Docking Guidance System (A-VDGS)

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

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

Application

5.3.29.1 Where provided the A-VDGS is as specified in this section.

Location

5.3.29.2 The A-VDGS location is such that unobstructed and unambiguous guidance is provided to the person responsible for, and persons assisting, the docking of the aircraft throughout the docking manoeuvre.

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

Characteristics

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

5.3.29.4 The A-VDGS is used only in conditions in which its operational performance is specified.

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

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

5.3.29.5 The docking guidance information provided by an A-VDGS does not conflict with that provided by a conventional visual docking guidance system on an aircraft stand if both types are provided and are in operational use. A method of indicating that the A-VDGS is not in operational use or is unserviceable is provided.

5.3.29.6 The A-VDGS provides, at minimum, the following guidance information at the appropriate stage of the docking manoeuvre:

(a) an emergency stop indication;
(b) the aircraft type and model for which the guidance is provided;
(c) an indication of the lateral displacement of the aircraft relative to the stand centreline;
(d) the direction of azimuth correction needed to correct a displacement from the stand centreline;
(e) an indication of the distance to the stop position;
(f) an indication when the aircraft has reached the correct stopping position; and
(g) a warning indication if the aircraft goes beyond the appropriate stop position.
5.3.29.7 The A-VDGS is capable of providing docking guidance information for all aircraft taxi speeds encountered during the docking manoeuvre.

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

5.3.29.8 Symbols and graphics used to depict guidance information are intuitively representative of the type of information provided.

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

5.3.29.9 Information on the lateral displacement of the aircraft relative to the stand centreline is provided at least 25 m prior to the stop position.

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

5.3.29.10 Continuous closure distance and rate is provided at least 15 m prior to the stop position.

5.3.29.11 Throughout the docking manoeuvre, an appropriate means is provided on the A-VDGS to indicate the need to bring the aircraft to an immediate halt. In such an event, which includes a failure of the A-VDGS, no other information is displayed.

5.3.29.12 Provision to initiate an immediate halt to the docking procedure is made available to personnel responsible for the operational safety of the stand.

5.3.30 Aircraft Stand Manoeuvring Guidance Lights

**Application**

5.3.30.1 Where provided, aircraft stand manoeuvring guidance lights conform to the specifications of this section.

**Location**

5.3.30.2 Aircraft stand manoeuvring guidance lights are co-located with the aircraft stand markings; lights may be uniformly offset by not more than 30 cm where it is not practical to locate them along the centreline.

**Characteristics**

5.3.30.3 Aircraft stand manoeuvring guidance lights are yellow lights and are visible throughout the segments within which they are intended to provide guidance.
5.3.31 Road-Holding Position Lights

Application

5.3.31.1 A road-holding position light is provided at each road-holding position serving a runway when it is intended that the runway will be used in conditions below RVR1200 (1/4 SM).

Note: See Chapter 8 for low and reduced visibility operations plans.

Location

5.3.31.2 A road-holding position light is located adjacent to the holding position marking 1.5 m (±15 cm) from the right hand edge of the road (when facing the holding position marking), or on the left hand edge of the road should the former be impractical.

Characteristics

5.3.31.3 The road-holding position light is comprised of:
   (a) a controllable red (stop)/green (go) traffic light; or
   (b) a flashing red light.

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

5.3.31.5 The intensity of the light beam is adequate for the conditions of visibility and ambient light in which the use of the holding position is intended.

5.3.31.6 The flash frequency of the flashing red light is between 30 and 60 flashes per minute with the light illuminated approximately 50% of the time.

5.3.32 Unserviceability/Closed Lights

Application

5.3.32.1 Unserviceability lights are provided on a taxiway bridge or runway bridge.

5.3.32.2 In addition to closed markers, unserviceability lights are provided for a temporary closure at night where:
   (a) a closed taxiway is intercepted by a usable runway or taxiway,
   (b) a portion of a taxiway, taxiway safety area or apron used at night is unusable but it is still possible for aircraft to bypass the area safely, or
   (c) any portion of an apron is unusable and there is insufficient ambient lighting to delineate the area with the use of retroreflective markers alone.

Note 1: Where unserviceable lights are used to delineate a portion of the taxiway or taxiway safety area that has become temporarily unserviceable, movements may need to be restricted to aircraft of lesser AGN to maintain the taxiway width standards.

Note 2: See unserviceability markers in section 5.5.6.
Location

5.3.32.3 Unserviceability lights are spaced at maximum intervals of 3 m except on taxiway or runway bridges per 5.3.32.5.

5.3.32.4 When a runway, taxiway or portion thereof is closed and is intersected by a usable runway or taxiway which is used at night, unserviceability lights are placed across the entrances to the closed area at intervals not exceeding 3 m in addition to closed markings, as per 5.3.24.

5.3.32.5 Subject to 5.3.32.6, on a taxiway bridge or runway bridge, three (3) uniformly spaced unserviceability lights are located on each outer edge, across the full length of the bridge.

Note: See Figure 5-11 Taxiway safety area marking for depiction of unserviceability lights on a bridge.

5.3.32.6 On a taxiway bridge with a positive aircraft restraint system installed as per 3.5.3.2, unserviceability lights are positioned as follows:

(a) a maximum of 15 m intervals; and

(b) extending four (4) lights before and after the bridge surface.

Characteristics

5.3.32.7 An unserviceability light:

(a) is fixed red; and

(b) has an intensity not less than 10 cd.
5.3.33  Lighted “X” Closed Area Marker

Application

5.3.33.1  A lighted “X” closed area marker can be used as an alternate to painted Xs on a runway or painted Xs and unserviceable lights on a taxiway if the closure is for a specified period, normally associated with maintenance or construction except for:

(a) permanent closures of a runway, taxiway or portion thereof, or

(b) temporary closure of the displaced portion of a runway.

Location

5.3.33.2  The lighted “X” closed area marker on a runway is positioned on the runway centreline or extended centreline within 75 m of the runway threshold.

5.3.33.3  The lighted “X” closed area marker at a taxiway/taxiway intersection is positioned on the centreline of the closed taxiway at the taxiway to object distance in Table 3.5.1.4.

5.3.33.4  A lighted “X” closed area marker is not used to indicate a taxiway closure as viewed from the runway.

Note: Lighted “X” closed area markers are not considered frangible and are positioned in a manner to ensure the required clearances from operational areas are maintained as stated in Chapters 3 and 4.

Characteristics

5.3.33.5  A lighted “X” closed area marker used for runway closure:

(a) is of a form and proportion displayed in Figure 5-58;

(b) contains a minimum of 9 evenly spaced white lights with maximum intervals of 1 m between centres having the minimum intensity specified in Figure 5-58;

(c) has adjustable aiming and levelling to allow tilting to an optimum angle of 3° from vertical; and

(d) provides the following daytime visual reference during clear conditions when placed on centreline and within 75 m of the runway threshold:

(i) visible to the pilot at a range of at least 5 NM [9.25 km];

(ii) recognizable as a letter “X” from a range of at least 1.5 NM [2.78 km].

Note 1: A runway lighted “X” closed area marker with suitable dimming capability would be usable for both runway and taxiway closures.

Note 2: See Figure 5-58 for depiction of a lighted “X” closed area marker.
Notes:
(1) Lamps to flash simultaneously with a cycle of 2.5 seconds on and 2.5 seconds off (± 20%).
(2) Provide means for photocell selection of day and night intensity.
(3) Provide lamps with photometric distribution as indicated in (A).
(4) The light sources are arranged and arms crossed at an appropriate angle to make the "X" readily discernible.
(5) The minimum intensity for each light source is determined by dividing the specified minimum intensity by the number of light sources.

Figure 5-58: Lighted “X” closed area marker