# CHAPTER TWELVE — AERODROME LIGHTING

<table>
<thead>
<tr>
<th>SECTION</th>
<th>SUBJECT</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Aerodrome Lighting – General</td>
<td>12-1</td>
</tr>
<tr>
<td>1.1</td>
<td>Application and definitions</td>
<td>12-1</td>
</tr>
<tr>
<td>1.2</td>
<td>Lighting in the vicinity of an aerodrome</td>
<td>12-2</td>
</tr>
<tr>
<td>1.3</td>
<td>Minimum lighting system requirements</td>
<td>12-2</td>
</tr>
<tr>
<td>1.4</td>
<td>Primary source of electricity supply</td>
<td>12-3</td>
</tr>
<tr>
<td>1.5</td>
<td>Electrical circuitry</td>
<td>12-3</td>
</tr>
<tr>
<td>1.6</td>
<td>Secondary power supply</td>
<td>12-4</td>
</tr>
<tr>
<td>1.7</td>
<td>Standby power supply</td>
<td>12-5</td>
</tr>
<tr>
<td>1.8</td>
<td>Portable lighting</td>
<td>12-5</td>
</tr>
<tr>
<td>1.9</td>
<td>Light fixtures and supporting structures</td>
<td>12-6</td>
</tr>
<tr>
<td>1.10</td>
<td>Elevated and inset lights</td>
<td>12-6</td>
</tr>
<tr>
<td>1.11</td>
<td>Colour of light shown</td>
<td>12-6</td>
</tr>
<tr>
<td>1.12</td>
<td>Light intensity and control</td>
<td>12-7</td>
</tr>
<tr>
<td>1.13</td>
<td>Commissioning of lighting systems</td>
<td>12-9</td>
</tr>
<tr>
<td>1.14</td>
<td>Pilot activated lighting systems</td>
<td>12-9</td>
</tr>
<tr>
<td>2.</td>
<td>Obstacle lighting</td>
<td>12-13</td>
</tr>
<tr>
<td>2.1</td>
<td>General</td>
<td>12-13</td>
</tr>
<tr>
<td>2.2</td>
<td>Location of obstacle lights</td>
<td>12-13</td>
</tr>
<tr>
<td>2.3</td>
<td>Natural obstacles</td>
<td>12-17</td>
</tr>
<tr>
<td>2.4</td>
<td>Temporary obstacles</td>
<td>12-17</td>
</tr>
<tr>
<td>2.5</td>
<td>Characteristics of low intensity obstacles lights</td>
<td>12-17</td>
</tr>
<tr>
<td>2.6</td>
<td>Characteristics of hazard beacons</td>
<td>12-18</td>
</tr>
<tr>
<td>2.7</td>
<td>Characteristics of high intensity obstacles lights</td>
<td>12-18</td>
</tr>
<tr>
<td>2.8</td>
<td>Monitoring of obstacle lighting</td>
<td>12-20</td>
</tr>
<tr>
<td>2.9</td>
<td>Unserviceability of obstacle lights</td>
<td>12-20</td>
</tr>
<tr>
<td>3.</td>
<td>Aerodrome beacons</td>
<td>12-21</td>
</tr>
<tr>
<td>4.</td>
<td>Illuminated wind direction indicator</td>
<td>12-22</td>
</tr>
<tr>
<td>5.</td>
<td>Approach lighting systems</td>
<td>12-24</td>
</tr>
<tr>
<td>5.1</td>
<td>Simple approach lighting system</td>
<td>12-24</td>
</tr>
<tr>
<td>5.2</td>
<td>Precision approach Category I lighting system</td>
<td>12-24</td>
</tr>
<tr>
<td>5.3</td>
<td>Precision approach Category II and III lighting system</td>
<td>12-26</td>
</tr>
<tr>
<td>6.</td>
<td>Visual approach slope indicator systems</td>
<td>12-28</td>
</tr>
<tr>
<td>7.</td>
<td>T-VASIS and AT-VASIS</td>
<td>12-29</td>
</tr>
<tr>
<td>8.</td>
<td>Precision approach path indicator (PAPI)</td>
<td>12-33</td>
</tr>
<tr>
<td>9.</td>
<td>Runway lighting</td>
<td>12-35</td>
</tr>
<tr>
<td>9.1</td>
<td>Types of runway lighting systems</td>
<td>12-35</td>
</tr>
<tr>
<td>9.2</td>
<td>Runway edge lights</td>
<td>12-35</td>
</tr>
<tr>
<td>9.3</td>
<td>Runway threshold lights</td>
<td>12-38</td>
</tr>
<tr>
<td>9.4</td>
<td>Additional lighting to enhance threshold location</td>
<td>12-39</td>
</tr>
<tr>
<td>9.5</td>
<td>Runway end lights</td>
<td>12-41</td>
</tr>
<tr>
<td>9.6</td>
<td>Runway turning area edge lights</td>
<td>12-42</td>
</tr>
<tr>
<td>9.7</td>
<td>Stopway lights</td>
<td>12-43</td>
</tr>
<tr>
<td>9.8</td>
<td>Hold short lights</td>
<td>12-43</td>
</tr>
<tr>
<td>9.9</td>
<td>Runway centreline lights</td>
<td>12-44</td>
</tr>
<tr>
<td>9.10</td>
<td>Runway touchdown zone lights</td>
<td>12-45</td>
</tr>
</tbody>
</table>
Chapter 12
Aerodrome Lighting

9.11 Photometric characteristics of runway lights 12-45
9.12 Installing and aiming of light fittings 12-46
9.13 Illustrations of runway lighting 12-46

10. Taxiway lighting 12-47
10.1 Provision of type of taxiway lights 12-47
10.2 Control of lights on taxiways 12-47
10.3 Taxiway centreline lights 12-48
10.4 Taxiway edge lights 12-50
10.5 Runway guard lights 12-52
10.6 Taxi-holding position lights 12-54
10.7 Stop bars 12-55
10.8 Taxiway edge markers 12-56
10.9 Taxiway centreline markers 12-56
10.10 Photometric characteristics of taxiway lights 12-56
10.11 Installation and aiming of light fittings 12-56
10.12 Illustrations of taxiway lighting 12-57

11. Apron floodlighting 12-58
11.1 Provision of apron floodlighting 12-58
11.2 Location of apron floodlighting 12-58
11.3 Characteristics of apron floodlighting 12-58

12. Other lights on an aerodrome 12-60
12.1 Vehicle warning lights 12-60
12.2 Works limit lights 12-60
12.3 Road and carpark lighting 12-60

13. Monitoring, maintenance and serviceability of aerodrome lighting 12-61
13.1 General 12-61
13.2 Serviceability of aerodrome lighting 12-61

Appendixes
Sect 1 APP I: Lighting in the vicinity of aerodromes: Advice to lighting designers 12-APP-1-I-1
Sect 1 APP II: Use of unarmoured cables for aerodrome lighting 12-APP-1-II-1
Sect 1 APP III: Colours for aeronautical ground lights 12-APP-1-III-1
Sect 5 APP I: Isocandela diagrams of approach lighting 12-APP-5-I-1
Sect 8 APP I: Technical specification for precision approach path indicator equipment 12-APP-8-I-1
Sect 8 APP II: Specification for the siting of a precision approach path indicator (PAPI) system 12-APP-8-II-1
Sect 9 APP I: Isocandela diagrams of runway lighting 12-APP-9-I-1
Sect 9 APP II: Illustrations of runway lighting 12-APP-9-II-1
Sect 10 APP I: Isocandela diagrams of taxiway lighting 12-APP-10-I-1
CHAPTER 12 — AERODROME LIGHTING

1 AERODROME LIGHTING — GENERAL

1.1 APPLICATION AND DEFINITIONS

1.1.1 – Existing installed lighting systems are to be operated and maintained in accordance with existing procedures. When existing light fittings need to be replaced they may be replaced with either fittings meeting the standards specified in this Chapter or with the type of fittings approved at the time of installation. The standards in this Chapter do not apply to an existing lighting facility until:

(a) the light fittings of a lighting system are being replaced with fittings of a different type. A lighting system in this case has the following meaning: lights on a section of taxiway (not all taxiways), lights on a threshold (not all thresholds) etc.

(b) the facility is upgraded;

(c) there is a change in the category of either:
   (i) aerodrome layout; or
   (ii) aerodrome traffic density; or

(d) in exceptional circumstances, CASA determines that in the interest of safety, a lighting facility has to meet the standards of this chapter.

1.1.2 – For aerodrome lighting purposes, words used in this chapter have the following meaning:

Aerodrome layout. This means the number of runways, taxiways and aprons at an aerodrome provided with lighting, and is divided into the following categories:

- Basic - an aerodrome with one runway, with one taxiway to one apron area;
- Simple - an aerodrome with one runway, having more than one taxiway to one or more apron areas;
- Complex - an aerodrome with more than one runway, having many taxiways to one or more apron areas.

Aerodrome traffic density. This means the number of aircraft movements in the mean busy hour, and is divided into the following categories:

- Light – not greater than 15 movements per runway or typically less than 20 total aerodrome movements;
- Medium – 16 to 25 movements per runway or typically between 20 to 35 total aerodrome movements;
- Heavy – 26 or more movements per runway or typically more than 35 aerodrome movements.

*Note 1: The number of movements in the mean busy hour is the arithmetic mean over the year of the number of movements in the daily busiest hour.*

*Note 2: Either a take-off or a landing constitutes a movement.*
Upgrade of a facility. A facility is deemed to be upgraded if the improvement of the facility allows it to:

(a) accommodate aeroplanes from a higher reference code, such as from code 2 to code 3 or code 3 to code 4;
(b) be used by aeroplanes flying under different approach conditions, such as:
    (i) from non-instrument to non-precision instrument;
    (ii) from non-precision instrument to precision instrument;
    (iii) from precision category I to category II or III.

Practicable. This term is used to allow CASA acceptance of variation to a standard due to insurmountable difficulties in the way of full compliance. If an aerodrome operator feels that compliance with a standard is impracticable, the onus rests with that operator to demonstrate the impracticability to the satisfaction of the relevant CASA office.

1.2 LIGHTING IN THE VICINITY OF AN AERODROME

1.2.1 – An existing or proposed non-aeronautical ground light in the vicinity of an aerodrome which, by reason of its intensity, configuration or colour, might endanger the safety of aircraft is to be notified to the relevant CASA office for a safety assessment. In general, vicinity of the aerodrome can be taken as:

(a) for a code 4 instrument runway – within a rectangular area the length of which extends at least 4500m before each threshold and the width of which is at least 750m either side of the extended runway centreline;
(b) for a code 2 or 3 instrument runway, an area with the same width as (a) with the length extending to at least 3000m from the threshold;
(c) for other cases, within the approach area.

Note 1: Aerodrome operators should liaise with local electricity and planning authorities, so that they can be alerted of lighting proposals in the vicinity of their aerodromes.

Note 2: Section 1, Appendix I provides advice to lighting designers when planning lighting installations in the vicinity of an aerodrome.

1.3 MINIMUM LIGHTING SYSTEM REQUIREMENTS

1.3.1 – At an aerodrome opened for night operations, at least the following facilities are to be provided with appropriate lighting:

(a) runways, taxiways and aprons intended for night use;
(b) at least one wind direction indicator;
(c) if an obstacle within the applicable OLS area of the aerodrome is determined by CASA as requiring obstacle lighting, the obstacle lighting.

Note: In the case of taxiways used only by aeroplanes of code 1 or 2, taxiway reflective markers may be used in lieu of some taxiway lighting.

1.3.2 – Where any approach end of a runway is intended to serve jet aeroplanes engaged in regular public transport operations, that approach end is to be provided with an approved approach slope guidance system. T-VASIS and PAPI are approved approach slope
guidance systems. However, notwithstanding the above, CASA may direct a runway to be provided with an approach slope guidance system if the circumstances surrounding the aerodrome require such an aid for aircraft safety purposes.

1.3.3 – To avoid confusion, the same type of approach slope guidance system is to be used at each end of a runway and, if there is more than one runway, the runways of similar reference code number.

Note: This does not apply to temporary, short term approach slope guidance aids.

1.3.4 – A runway intended to serve Category I, II or III precision approach operations is to be provided with an approach lighting system, where physically practicable, in accordance with the standards set out in this chapter.

1.3.5 – Movement area guidance signs intended for use at night are to be illuminated in accordance with the standards set out in chapter 11.

1.3.6 – In certain circumstances additional lighting systems may be required at some aerodromes. For example, aerodrome beacons, visual docking guidance systems and runway threshold identification lights. Where provided, they are to be in compliance with the standards set out in this chapter.

1.3.7 – Lighting systems not covered by this chapter are not to be introduced without the concurrence of the CASA Aerodrome Standards Section.

1.4 PRIMARY SOURCE OF ELECTRICITY SUPPLY

1.4.1 – Unless it is impracticable to do so, except for paragraph 1.4.3 below, an aerodrome lighting system is to be an electrically connected installation, with the primary source of electric power supplied by the local electricity supply authority.

1.4.2 – Where the power supply of an aerodrome lighting system has to be derived from a source other than the normal reticulated electricity supply, a note to that effect is to be included in ERSA.

1.4.3 – At an aerodrome intended for use by aircraft with less than 10 passenger seats engaged in regular public transport operations, electricity supply may be derived from stand-alone generators or solar charged batteries.

1.5 ELECTRICAL CIRCUITRY

1.5.1 – Where they are electrically connected, aerodrome ground lighting, which includes runway, taxiway, approach and visual approach slope indicator and MAGS lighting circuits, are to be by means of the series current system.

Note: Inter-leaf circuitry is recommended for aerodromes intended for precision approach operations. Guidance on this may be found in ICAO Aerodrome Design Manual Part 5.

1.5.2 – Feeder cables and series isolating transformers are to be installed below ground, being:

(a) directly buried; or

(b) in pits, ducts or similar receptacles.

Note: Section I, Appendix II provides guidelines on the use of unarmoured cables on an aerodrome.
1.5.3 – Other electrical equipment and wiring, except for a light or light fitting, are not to be installed above ground level in the manoeuvring area.

1.6  SECONDARY POWER SUPPLY

1.6.1 – Secondary power supply means electricity power supply which is connected to the load automatically on the failure of the primary power source. This may be derived by either of the following:

(a) independent public power, which is a source of power supplying the aerodrome service from a substation other than the normal substation through a transmission line following a route different from the normal power supply route and such that the possibility of a simultaneous failure of the normal and independent public power supplies is extremely remote; or

(b) generators, batteries etc. from which electric power can be obtained.

1.6.2 – Secondary power is to be provided to at least one runway at an aerodrome intended for Cat I precision approach operations, which would allow the operation of the following lighting systems:

(a) approach lighting;
(b) visual approach slope indicator;
(c) runway edge;
(d) runway threshold;
(e) runway end;
(f) essential taxiway and runway guard lights;
(g) apron; and
(h) obstacles, if any, lighting of which has been determined by CASA as essential for the safety of aircraft operations.

Note: Not applicable in general to off aerodrome obstacle lighting, the status of lighting availability of which is subject to aerodrome operator monitor.

1.6.3 – In addition to 1.6.2 above, for an aerodrome intended for Cat II and III precision approach operations, the secondary power is to be adequate for the lighting of the following:

(a) runway centreline lights;
(b) touchdown zone lights; and
(c) all stop bars.

Switch-over time

1.6.4 – The switch-over time to the secondary power for a precision approach Cat I runway is to be accomplished within 15 seconds, and for Cat II and III, within 1 second.
1.7 STANDBY POWER SUPPLY

Note: Operational credit is given to a runway lighting system notified in ERSA as provided with standby power or portable lighting. This is because when a flight is planned to land at night at an aerodrome with electric runway lighting, provision must be made for flight to an alternate aerodrome unless the destination aerodrome has standby power, or portable runway lights are available and arrangements have been made for a responsible person to be in attendance.

1.7.1 – For lighting to be notified in ERSA as provided with standby power, the standby power supply may be either secondary power or standby generators which are manually activated.

1.7.2 – Where the activation of the standby power is not automatic, procedures are to be established to facilitate the introduction of standby power as soon as possible when the need arises.

Note 1: For non-automatic activation the actual time required for activation of standby power should be noted in ERSA.

Note 2: The procedures should allow standby power to be provided within 15 minutes of demand. Aircraft fuel management is the pilot’s responsibility. CASA guidelines on fuel management are contained in CAAP 234-1(0). For aircraft operating at night with no alternate aerodrome, the recommended fuel reserves are: 45 minutes for propeller driven aeroplanes and 30 minutes for jet aeroplanes.

1.8 PORTABLE LIGHTING

1.8.1 – Portable lights may comprise liquid fuel-burning flares or lamps, or battery powered electric lights.

1.8.2 – When an aerodrome is notified in ERSA as provided with portable lighting, the portable lights are to be kept in a state of readiness and serviceable condition with clean glasses, and appropriate persons are to be trained such that the lights can be deployed and put into operation without delay, when the need arises.

Note: Due to the time required to deploy portable lights, the ERSA entry should include a notation that prior notice is required.

1.8.3 – The portable lights are to be placed at the same spacing as installed lights.

Note: To allow speedy deployment, the locations of the portable lights should be clearly marked, and the surface appropriately treated and maintained.

1.8.4 – When required, they are to be lit or switched on at least 30 minutes before the estimated time of arrival.

Note: The portable lights should be so deployed such that an aircraft can land into the wind.

1.8.5 – For aircraft departing, the portable lights are to be lit or switched on at least 10 minutes before the time of departure and to be retained for at least 30 minutes after take off, or if air-ground communications do not exist, for at least one hour after take-off, in case the aeroplane needs to return to the aerodrome.
1.9 – LIGHT FIXTURES AND SUPPORTING STRUCTURES

1.9.1 – All aerodrome light fixtures and supporting structures are to be of minimum weight while being fit for the function, and frangible.

*Note: ICAO Aerodrome Design Manual Part 4 provides guidelines on frangibility for visual aids.*

1.9.2 – Supporting structures for approach lights also need to be of minimum weight and frangible, except that, in that portion of the approach lighting system beyond 300m from the runway threshold:

(a) where the height of a supporting structure exceeds 12m, the frangibility requirement need apply to the top 12m only; and

(b) where a supporting structure is surrounded by non-frangible objects, only that part of the structure that extends above the surrounding objects need be frangible.

1.9.3 – Where an approach light fixture or supporting structure is not in itself sufficiently conspicuous, it is to be suitably marked.

1.10 ELEVATED AND INSET LIGHTS

1.10.1 – Elevated lights are to be frangible and sufficiently low to preserve clearance for propellers and the engine pods of jet aircraft. In general, they should not be more than 360 mm above the ground.

1.10.2 – Elevated lights should be used wherever practicable as they provide a larger aperture from which light signals can be seen, besides being more economical.

*Note: Elevated lights are not practicable on pavements where aircraft or vehicles travel or in areas subject to significant jet blast.*

1.10.3 – Inset lights are not to:

(a) be constructed with sharp edges;

(b) project more than 25 mm above the surrounding surface at locations where the lights will not normally come into contact with aircraft wheels, such as threshold lights, runway end lights and runway edge lights;

(c) project more than 13 mm above the surrounding surface at locations which will normally come into contact with aircraft wheels, such as runway centreline lights, touch down zone lights and taxiway centreline lights.

1.10.4 – The maximum surface temperature attained by an inset light is not to exceed 160° C over a period of 10 minutes, if operating at maximum intensity while covered by an aircraft wheel.

1.10.5 – The standard colour of the casings of elevated light units is to be yellow.

1.11 COLOUR OF LIGHT SHOWN

1.11.1 – The colour of the light shown is to be in accordance with the applicable standard specified in Section 1, Appendix III.

1.11.2 – To ensure uniformity of visual appearance, light fittings using different filter technology are not to be mixed, e.g. dichroic filters, other absorption filters, light emitting
diode (LED), etc. in such a way as to create inconsistency in either light colour or intensity when viewed by pilots from a moving aircraft on a runway or taxiway.

**1.12 LIGHT INTENSITY AND CONTROL**

- **1.12.1** – At an aerodrome with an air traffic service (ATS), the following lighting systems, if provided, are to be equipped with an intensity control so that the ATS can select light output to suit ambient conditions and avoid dazzling pilots:
  - approach lighting system;
  - approach slope guidance system;
  - runway edge lights;
  - runway threshold lights;
  - runway end lights;
  - runway centreline lights;
  - runway touchdown zone lights;
  - taxiway lights.

- **1.12.2** – Intensity is to be varied in 5 or 6 stages, except that where a runway is equipped with medium intensity lighting, 3 stages will suffice.

- **1.12.3** – Intensity is to be reduced from each successive stage to an order of 25-33%. This is based on the fact that a change of that magnitude is required for the human eye to detect that a change has occurred. For 6 stages of intensities, they should be of the order of: 100%, 30%, 10%, 3%, 1% and 0.3%.

  *Note 1:* Currently, the Airservices Australia air traffic control system uses 6 stage intensity control.

  *Note 2:* Guidance on series line currents for airport lighting systems is set out in the Table below.

- **1.12.4** – If a runway is equipped with both high and medium intensity lighting, the 3 lowest intensity stages are to be provided by the medium intensity system.

- **1.12.5** – For taxiway lights, 3 stages of light intensity control will normally be sufficient.

- **1.12.6** – At an aerodrome where the lighting is provided with intensity settings but the ATS does not provide 24 hours coverage and ATS leaves the lights turned on all night, the appropriate stage of setting which provides adequate illumination but does not dazzle pilots is intensity setting stage 2.
### GUIDANCE ON SERIES LINE CURRENTS FOR AIRPORT LIGHTING SYSTEMS

<table>
<thead>
<tr>
<th>LIGHT FACILITY</th>
<th>LOW INTENSITY</th>
<th>MEDIUM INTENSITY</th>
<th>HIGH INTENSITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Runway Edge Lighting</td>
<td>Intensity 100 cd</td>
<td>Intensity Stage</td>
<td>Intensity Stage</td>
</tr>
<tr>
<td></td>
<td>Current 6.6 amp</td>
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<td>STAGE 2</td>
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<td>0.3%</td>
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<td>Current (amp) (Note 2)</td>
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<td>Precision Approach Lighting (Note 3)</td>
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</tr>
<tr>
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<td>Intensity (cd)</td>
<td>3.0</td>
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</tr>
<tr>
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<td>3.0</td>
<td>3.3</td>
</tr>
<tr>
<td>Touchdown Zone Lighting</td>
<td>Intensity (cd)</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
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<td>Current (amp)</td>
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<td>20</td>
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<td>5.5</td>
</tr>
<tr>
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<td>4.8</td>
<td>5.5</td>
</tr>
<tr>
<td>Threshold (Inset Type) Green</td>
<td>Intensity (cd)</td>
<td>4.5</td>
<td>5.4</td>
</tr>
<tr>
<td></td>
<td>Current (amp)</td>
<td>4.5</td>
<td>5.4</td>
</tr>
<tr>
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<td>Intensity (cd)</td>
<td>4.5</td>
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</tr>
<tr>
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<td>Current (amp)</td>
<td>4.5</td>
<td>5.4</td>
</tr>
</tbody>
</table>

**Note 1.** The intensity value is the average intensity of each light unit in candela and not the peak intensity: applies to all facilities.

**Note 2.** The current value is true root mean square (RMS) in amperes.

**Note 3.** The intensity may vary depending on the light fitting installed.

**Notes 4 & 5** Based on lamp current of 6.6A through 12.5/6.6A and 6.6/6.6A series isolating transformer respectively.
1.13 COMMISSIONING OF LIGHTING SYSTEMS

1.13.1 – Commissioning means the formal process by which the performance of the lighting system is confirmed by CASA, or a qualified person, as meeting the specifications. Qualified person in this case means:

(a) ground check of compliance with electrical specifications and CASA standards — electrical engineer or licensed electrician;

Note: Evidence supplied by others that the light units are in compliance with the standards is acceptable.

(b) flight checking of compliance with operational specifications — pilot approved by CASA as having the competency to conduct flight check.

1.13.2 – All aerodrome lighting systems are to be commissioned by ground check before they are brought into use.

1.13.3 – The ground check of a visual approach slope indicator system is to include verification of vertical and horizontal angles of light signal changes by a person having civil engineering or surveying qualification and experience;

1.13.4 – The commissioning of the following lighting systems are to include flight checks:

(a) approach lighting system;

(b) runway lighting system for instrument runways;

(c) visual approach slope indicator system used by jet aeroplanes engaged in regular public transport operations;

(d) pilot activated lighting system (PAL).

Note: Before a runway is opened for night use, the status of obstacles need to be assessed for obstacle lighting purposes, particularly if the obstacles are within 3 km of the aerodrome.

1.14 PILOT ACTIVATED LIGHTING SYSTEMS

1.14.1 – If a pilot activated lighting (PAL) system is used to activate aerodrome lighting, the PAL is to turn ON all the lighting facilities which are required to be illuminated for night operations, unless the illumination of a required facility is achieved by other means, e.g. obstacle lights activated by photo-electric switches.

1.14.2 – Where PAL is used to activate visual approach slope guidance systems (T-VASIS or PAPI):

(a) activation of the PAL during daytime is to turn the visual approach slope guidance system ON to Day intensity, and leave all other aerodrome lighting extinguished;

(b) activation of the PAL during twilight is to turn the visual approach slope guidance system ON to Twilight intensity, and turn all other aerodrome lighting on to the only intensity available, or to Night intensity if multiple intensities are available;

Note: The night intensity will avoid the effect of glare and is normally adequate for operations during twilight hours. However, if an aerodrome, due to local conditions, requires the aerodrome lights to be set at a higher intensity than night intensity, it is permissible to provide twilight intensity provided it does not produce glare.
(c) activation of the PAL during night-time is to turn the visual approach slope guidance system ON to Night intensity, and turn all other aerodrome lighting on to the only intensity available, or to Night intensity if multiple intensities are available;

(d) once the lighting has been activated by the PAL, appropriate changes from Day to Twilight to Night intensities are to take place automatically;

(e) the appropriate changes from Day to Twilight to Night operation are to take place under the control of a light sensitive switch or similar device.

1.14.3 – The PAL is to activate an aerodrome lighting system on detection of a coded carrier frequency signal from an aircraft air/ground VHF transmitter.

1.14.4 – On receipt of the coded signal the PAL control unit is to go into the operate mode for a pre-set period. The minimum period that the lights remain ON is to be 30 minutes.

Note: The length of the period should be adjustable as local aerodrome operating conditions may require the lights to remain ON for a longer period.

1.14.5 – Ten minutes before the aerodrome lighting system is due to turn OFF, the PAL is to cause the lights of the primary Illuminated Wind Direction Indicator (IWDI) to commence to flash at approximately 50 cycles per minute (approximately 0.6 seconds ON and 0.6 seconds OFF), and continue to flash until either:

(a) the PAL system switches OFF, and all aerodrome lighting, including the IWDI lights, is extinguished; or

(b) the PAL system has been reset for another ON period.

1.14.6 – When in operate mode (including the last 10 minutes) the receipt of another correctly coded signal is to reset the PAL system to the beginning of the pre-set period.

**VHF Carrier Activation Code**

1.14.7 – The code required to activate the PAL system is to be generated when the microphone button of the aircraft radio air/ground VHF transmitter is depressed and a radio frequency carrier signal is produced.

1.14.8 – The correct code is to consist of three bursts of carrier signal each anywhere between 1 and 5 seconds long, with the last two code bursts completed within 24 seconds of the end of the first burst.

1.14.9 – The gap between code bursts that the detector can tolerate is to be 0.1 seconds. (This is less than the time it takes to release and depress the aircraft microphone button.)

Note: Pilots are advised that the code they should send is three bursts of approx. 3 seconds, with at least 1 second between bursts, and the three bursts must be transmitted within 25 seconds.

**VHF Carrier Detector Technical Requirements**

1.14.10 – The VHF carrier detector is to accept a carrier signal over the frequency range of 118 MHz to 136 MHz.

1.14.11 – The receiver is to be crystal controlled at a single frequency within the frequency range, with a channel separation of 25 KHz.

1.14.12 – Only allocated frequencies are to be used, to maintain order in the air/ground VHF band, and prevent interference to other facilities or users in the vicinity.
Note: Frequencies are allocated by the responsible authority. At this time Airservices Australia has the authority to allocate aeronautical frequencies including PAL frequencies.

1.14.13 – The frequency stability is to be within ± 0.0010 % over the temperature range of -10°C to + 70°C.

1.14.14 – The minimum detectable input signal of the VHF carrier detector is to be adjustable over a range to suit the operational requirements.

1.14.15 – Under normal circumstances, to ensure activation of the PAL system by aircraft at approximately 15 NM from the aerodrome, the receiver sensitivity is to be set at not less than 15 µV.

Note 1: The suitability of the receiver sensitivity from different azimuth of the aerodrome will be flight tested.

Note 2: The upper range of the receiver sensitivity may be of the order of 50 to 65 µV, but may be adjusted downward depending on whether nuisance operation is experienced from aircraft using the same PAL frequency at other locations.

1.14.16 – The VHF carrier detector bandwidth is to have the following characteristics:-

\[ \pm 7.5 \text{ KHz} \quad \text{within 3 dB of nominal} \]

\[ \pm 16 \text{ KHz} \quad \text{greater than 60 dB below nominal}; \]

the spurious response is to be no less than 80 dB below nominal.

Inputs to the PAL

1.14.17 – The PAL is to be capable of having the following inputs:

(a) radio frequency activation signal, as described above;

(b) manual activation of the PAL. An ON/OFF switch is to be provided for manual activation. When the switch is selected to ON the lighting system will be activated and remain on. When the switch is selected to OFF the PAL system is to go into operate mode for the full timing cycle, including the ten minute turn-off warning. This is intended for use by authorised ground personnel, departing pilots, and maintenance technicians;

(c) remote control override of the PAL. If a PAL is provided at a controlled aerodrome, the circuitry of the PAL system is to be such that when the controller is on duty, the PAL will be overridden by the controller.

Fail safe arrangements with PAL system

1.14.18 – The circuitry of the PAL system is to be so designed that if the PAL fails for whatever reason, the aerodrome lighting can still be provided. This can be achieved by either:

(a) the lighting facilities being automatically turned ON if the PAL fails; or

(b) the provision of a by-pass switch to allow manual activation of the lights.

1.14.19 – The mains supply to the equipment may be subject to electrical transients, typical of rural electrical distribution systems. The PAL system is to be so designed that the electrical transients have no effect on the PAL system.

August 2002
1.14.20 – Following a PAL failure, on restitution of power the PAL is to automatically commence a complete “Light ON” cycle.

Access to manual switches

1.14.21 – If the manual switches provided for PAL are either key operated switches, or enclosed in an area that requires key access, sufficient numbers of keys are to be provided to persons who may have reason to gain access to the manual switches in the event of the PAL failing to respond to aerial VHF signal from incoming aircraft.

Note: The aerodrome operator is responsible for the allocation of access keys.

1.14.22 – The following persons are likely to be called upon to manually activate the aerodrome lighting:

(a) the agents of the airlines using the aerodrome;
(b) a representative from local operators of flying schools, fuelling agents, or aircraft maintenance organisations;
(c) representatives from the local hospital and/or emergency services;
(d) local police;
(e) where available, responsible person or persons living in houses close to the aerodrome.

Receiving Antenna

1.14.23 – The PAL receiving antenna is to be so located such that it will receive activating signals from aircraft both in the air and on the aerodrome movement area.

1.14.24 – The PAL is to be designed that it will operate satisfactorily when connected to an antenna with the following specifications:

(a) unity gain with respect to a dipole;
(b) vertical polarisation;
(c) omni-directional radiation pattern in the horizontal plane;
(d) voltage standing wave ratio when matched to the PAL antenna input of not greater than 1.5:1, over the frequency range of 118 to 136 MHz;
(e) height of the mounting above local ground level not less than 4.5 m.

PAL with Audio acknowledgment

1.14.25 – The use of a PAL which incorporates a message acknowledgment capability on activating of the lighting system following receipt of a valid code and a 10 minute switch off warning feature is encouraged.

Note: Such a PAL will require a radio transmitter licence.

1.14.26 – Where provided, the broadcast message is to be brief, to minimise congestion on the frequency.

Note: Typical broadcast message should be of the form: “Name of aerodrome” PAL activated
2. OBSTACLE LIGHTING

2.1 General

2.1.1 – Under the Civil Aviation Regulations, CASA may determine that an object or a proposed object which intrudes into navigable airspace requires, or will be required to be provided with, obstacle lighting. Responsibility for the provision and maintenance of obstacle lighting on a building or structure rests with the owner of the building or structure. Within the limits of the obstacle limitation surfaces of an aerodrome, responsibility for the provision and maintenance of obstacle lighting on natural terrain or vegetation, where determined necessary for aircraft operations at the aerodrome, rests with the aerodrome operator.

2.1.2 – In general, an object in the following situations would require to be provided with obstacle lighting unless CASA, in an aeronautical study, assesses it as being shielded by another lit object or that it is of no operational significance:

(a) for a runway intended to be used at night:
   (i) if the object extends above the take-off climb surface within 3000m of the inner edge of the take-off climb surface;
   (ii) if the object extends above the approach or transitional surface within 3000m of the inner edge of the approach surface;
   (iii) if the object extends above the applicable inner, conical or outer horizontal surfaces;
   (iv) if the object extends above the obstacle protection surface of the T-VASIS or PAPI installed at the aerodrome;
   (v) a vehicle or other mobile objects, excluding aircraft, on the movement area, except aircraft service equipment and vehicles used only on aprons;
   (vi) obstacles in the vicinity of taxiways, apron taxiways or taxilanes, except that obstacle lights are not to be installed on elevated ground lights or signs in the movement area.

(b) outside the obstacle limitation surfaces of an aerodrome, if the object is or will be more than 110m above ground level.

2.1.3 – Owners of tall buildings or structures below the obstacle limitation surfaces, or less than 110m above ground level, may, of their own volition, provide obstacle lighting to indicate the presence of such buildings or structures at night. To ensure consistency and avoid any confusion to pilots, the obstacle lighting provided needs to conform with the standards specified in this chapter.

2.1.4 – In circumstances where the provision of obstacle marking is impracticable, obstacle lighting may be used during the day in lieu of obstacle marking.

2.2 Types of obstacle lighting and their use

2.2.1 – Three types of lights are used for lighting obstacles. These are low intensity, medium intensity and high intensity lights, or a combination of such lights.
2.2.2 – Low intensity obstacle lights are steady red lights and are to be used on non-extensive objects whose height above the surrounding ground is less than 45m.

Note: A group of trees or buildings is regarded as an extensive object.

2.2.3 – Medium intensity obstacle lights are to be used either alone or in combination with low intensity lights, where:

(a) the object is an extensive one;
(b) the object is 45m above the surrounding ground; or
(c) CASA determines that early warning to pilots of the presence of the object is desirable.

2.2.4 – Medium intensity obstacle lights can be flashing red lights, steady red lights or flashing white lights. The flashing red light is also known as a hazard beacon. The steady red is an option when there is objection to flashing red lights. Flashing white obstacle lights are obviously most effective, but they may not be compatible with the environment, especially near build up areas. Medium intensity flashing white lights may be used in lieu of obstacle markings during the day to indicate temporary obstacles in the vicinity of an aerodrome.

2.2.5 – High intensity obstacle lights are flashing white lights used on obstacles that are in excess of 150m in height. As high intensity obstacle lights have a significant environmental impact on people and animals, it is necessary to consult with interested parties about their use. High intensity obstacle lights may also be used during the day, in lieu of obstacle markings, on obstacles that are in excess of 150m in height, or are difficult to be seen from the air because of their skeletal nature, such as towers with overhead wires and cables spanning across roads, valleys or waterways.

2.3 Location of obstacle lights

2.3.1 – One or more obstacle lights are to be located as close as practicable to the top of the object. The top lights are to be arranged so as to at least indicate the points or edges of the object highest above the obstacle limitation surface.

2.3.2 – In the case of a chimney or other structure of like function, the top lights are to be placed sufficiently below the top (nominally 1.5m to 3m) so as to minimise contamination by smoke, etc.

2.3.3 – In the case of a tower or antenna structure to be provided with high intensity obstacle lights, and the structure has an appurtenance such as a rod or antenna extending greater than 12m above the structure, and it is not practicable to locate the high intensity obstacle light on top of the appurtenance, the high intensity obstacle light is to be located at the highest practicable point and, if practicable, have a medium intensity obstacle light (flashing white) mounted on the top.

2.3.4 – In the case of an extensive object or a group of closely spaced objects, top lights are to be displayed at least on the points or edges highest in relation to the obstacle limitation surfaces, so as to indicate the general definition and extent of the objects. If two or more edges are at the same height, the edge nearest the runway threshold is to be lit. Where low intensity lights are used, they are to be spaced at longitudinal intervals not exceeding 45m. Where medium intensity lights are used, they are to be spaced at longitudinal intervals not exceeding 900m, and at least three are to be displayed on one side of the extensive obstacle to indicate a line of lights.
2.3.5 – When the obstacle limitation surface concerned is sloping and the highest point above the obstacle limitation surface is not the highest point of the object, additional obstacle lights are to be placed on the highest part of the object.

2.3.6 – When the top of the obstacle is more than 45m above the level of the surrounding ground or the elevation of the tops of nearby buildings (when the obstacle is surrounded by buildings), the top lights are to be medium intensity lights. Additional low intensity lights are to be provided at lower levels to indicate the full height of the structure. These additional lights are to be spaced as equally as possible, between the top lights and ground level or the level of tops of nearby buildings, as appropriate. The spacing between the lights is not to exceed 45m.

2.3.7 – Where high intensity obstacle lights are used on an object other than a tower supporting overhead wires or cables, the spacing between the lights is not to exceed 105m. Where the high intensity obstacle lights are used on a tower supporting wires or cables, they are to be located on three level:

(a) at the top of the tower;

(b) at the lowest level of the catenary of the wires or cables; and

(c) at approximately midway between the two levels.

Note: In some cases this may require the bottom and middle lights to be located off the tower.

2.3.8 – The number and arrangement of lights at each level to be marked is to be such that the obstacle is indicated from every angle of azimuth. Where a light is shielded in any direction by an adjacent object, the light so shielded may be omitted but additional lights may be required in such a way so as to retain the general definition of the obstacle.

2.3.9 – Illustrations of typical lighting of obstacles are shown below.
Chapter 12
Aerodrome Lighting

TYPICAL LIGHTING OF TALL OBSTRUCTIONS

TYPICAL LIGHTING OF A GROUP OF OBSTRUCTIONS
**Chapter 12**  
Aerodrome Lighting

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>90m or less</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Between 25m and 45m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>25m or less</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: If A is more than 90m or B more than 45m intermediate lights shall be provided.

TYPICAL LIGHTING OF HORIZONTALLY EXTENDED OBSTRUCTIONS

TYPICAL LIGHTING OF TOWERS AND LARGE OBSTRUCTIONS

April 2001
Natural obstacles

2.3.10 – Natural obstacles such as terrain and vegetation are normally extensive and the need for obstacle lighting will be assessed by CASA on an individual case basis. Where required, obstacle lights are to be provided as follows:

(a) if the obstacle is located within the approach area, the portion of the obstacle which is within the approach area is to be treated in the same manner as man-made obstacles for the provision of obstacle lights;

(b) if the obstacle is located outside the approach area, it is to be marked by sufficient number of lights on the highest and most prominent features, so placed that the obstacle can be readily identified.

Temporary obstacles

2.3.11 – At night and in poor visibility conditions, temporary obstacles in the approach area or on the movement area are to be marked with permanent or temporary red obstacle lights. The lights are to be so arranged that they clearly mark the height, limits and extent of the obstacle.

2.4 Characteristics of low intensity obstacle lights

2.4.1 – Low intensity obstacle lights are to be fixed lights showing red in all directions in azimuth and from 3° below to 90° above the horizontal.

2.4.2 – Low intensity obstacle lights are to have peak intensity of at least 100 candelas, and not less than 10 candelas between 3° below to 90° above the horizontal, and a vertical distribution as shown in the diagram below.

Note: 1 The intensity level is higher than ICAO standards because in Australia only obstacles assessed as significant to aircraft operations are required to be provided with obstacle lighting.

2 Currently the intensity requirement is normally met by a double-bodied light fitting which also provides a degree of redundancy.

3 For objects that do not infringe the obstacle limitation surfaces, and where CASA has not determined that obstacle lights are required, if the object owner wishes, of their own volition, to provide obstacle lights, it is sufficient for these low intensity obstacle lights to have the following intensity distribution:

peak intensity 32 cd minimum, vertical beam spread of 10°, and 32 cd minimum at +6° and +10° elevation.

2.4.3 – The minimum intensity for low intensity obstacle lights used to illuminate taxiway obstacles and movement area unserviceabilities is to be not less than 10 candelas.

2.5 Characteristics of medium intensity obstacle lights

2.5.1 – Medium intensity obstacle lights are to be flashing or steady red lights or flashing white lights, visible in all directions in azimuth.

2.5.2 – The frequency of flashes is to be between 40-60 flashes per minute with the period of brightness being approximately double the period of darkness.

2.5.3 – The peak effective intensity is to be 2000 ± 25% cd with a vertical distribution as follows:
(a) vertical beam spread is to be 3° minimum;
   (Beam spread is defined as the angle between two directions in a plane for which
   the intensity is equal to 50% of the lower tolerance value of the peak intensity)
(b) at -1° elevation the intensity is to be 50% minimum and 75% maximum of lower
tolerance value of the peak intensity;
(c) at 0° elevation the intensity is to be 100% minimum of the lower tolerance value
of the peak intensity.

2.6 Characteristics of high intensity obstacle lights
2.6.1 – High intensity obstacle lights are flashing white lights.
2.6.2 – The effective intensity of a high intensity obstacle light located on an object other
than a tower supporting overhead wires or cables is to vary depending on background
luminance as follows:
   (a) 200,000 ± 25% cd effective intensity at a background luminance of above 500
       cd/m² (day);
   (b) 20,000 ± 25% cd effective intensity at a background luminance of between 50-
       500 cd/m² (dusk or dawn);
   (c) 2,000 ± 25% cd effective intensity at a background luminance of below 50
       cd/m² (night).
2.6.3 – The effective intensity of a high intensity obstacle light located on a tower supporting
overhead wires or cables is to vary depending on background luminance as follows:
   (a) 100,000 ± 25% cd effective intensity at a background luminance of above 500
       cd/m² (day);
   (b) 20,000 ± 25% cd effective intensity at a background luminance of between 50-
       500 cd/m² (dusk or dawn);
   (c) 2,000 ± 25% cd effective intensity at a background luminance of below 50
       cd/m² (night).
2.6.4 – High intensity obstacle lights located on an object other than a tower supporting
overhead wires or cables are to flash simultaneously at a rate between 40-60 flashes per
minute.
2.6.5 – High intensity obstacle lights located on a tower supporting overhead wires or cables are to flash sequentially; first the middle light, second the top light, and last the bottom light. Cycle frequency is to be 40-60 per minute and the intervals between flashes of lights are to approximate the following ratios:

<table>
<thead>
<tr>
<th>Flash interval between</th>
<th>Ratio of cycle time</th>
</tr>
</thead>
<tbody>
<tr>
<td>middle and top light</td>
<td>1/13</td>
</tr>
<tr>
<td>top and bottom light</td>
<td>2/13</td>
</tr>
<tr>
<td>bottom and middle light</td>
<td>10/13</td>
</tr>
</tbody>
</table>

2.6.6 – To minimise environmental impact, unless otherwise directed by CASA, the installation setting angles for high intensity obstacle lights are to be:

<table>
<thead>
<tr>
<th>Height of light unit above terrain</th>
<th>Angle of the peak of the beam above the horizontal</th>
</tr>
</thead>
<tbody>
<tr>
<td>greater than 151m AGL</td>
<td>0°</td>
</tr>
<tr>
<td>122m to 151m AGL</td>
<td>1°</td>
</tr>
<tr>
<td>92m to 122m AGL</td>
<td>2°</td>
</tr>
<tr>
<td>less than 92m AGL</td>
<td>3°</td>
</tr>
</tbody>
</table>

2.7  **Floodlighting of obstacles**

2.7.1 – Where the installation of normal obstacle lights is deemed impracticable or undesirable for aesthetic or other reasons, floodlighting of obstacles may be an acceptable alternative. However, floodlighting is not to be used unless with the concurrence of the relevant CASA office.

2.7.2 – In general, floodlighting is not suitable if:

   (a) the structure is skeletal as a substantially solid surface or cladding with satisfactory reflectance properties are required; or

   (b) there is high background lighting level.

2.7.3 – The floodlighting colour is to be white. Illumination of the obstacle is to cover all directions of azimuth over the full height portion of the obstacle which needs to be illuminated and is to be uniform around the circumferences of the obstacle.

2.7.4 – The minimum level of luminance is to be 5 cd/m² at all points.

   *Note: Based on a reflectance factor of 50% for white paint, this would require illuminance of at least 10 lux. For concrete with typical reflectance factor of 40%, the required illuminance would be at least 12.5 lux. Materials with reflectance factors less than 30% are unlikely to be suitable for floodlighting.*

2.7.5 – The light fittings are to be spaced evenly around the structure, at not more than 120° with at least two fittings at each location. At each location the fittings are to be on separate circuits and separately fused.

2.8  **Ongoing availability of obstacle lights**
2.8.1 – It is important that obstacle lights provided are in working condition when they are required to be on. The owners of obstacle lights needs to establish a pro-active maintenance program to minimise light outage.

2.8.2 – For obstacle lights located within the obstacle limitation surface area of the aerodrome, the aerodrome operator is to establish a monitoring program, which is to include:

(a) visual observation of the obstacles lights at least once every 24 hours (see note); and

(b) where a medium or high intensity obstacle light is located such that it is not readily observable visually:

(i) establish a procedure whereby such a light would be visually monitored within every 24 hour period; or

(ii) install an automatic visual or audio alarm indicator at an aerodrome location generally occupied by aerodrome personnel.

Note: at smaller aerodromes with a low level of night aircraft operations, this period may be extended with the agreement of the relevant CASA office.

2.8.3 – For obstacles located within the obstacle limitation surface area of the aerodrome, in the event of an obstacle light outage, the aerodrome operator is to:

(a) notify the relevant CASA office immediately if the obstacle light has been determined by CASA as being a requirement for aircraft operations;

(b) in any case, initiate NOTAM action to advise pilots of such light outage;

(c) liaise with the owner of the obstacle light to effect a speedy repair.

2.8.4 – For obstacles located outside the obstacle limitation surface area of an aerodrome, the owners of the lights need to establish a program to monitor the lights and report light failures. The reporting point for obstacle light failure is normally the nearest CASA office. When an obstacle light is unserviceable, the matter needs to be reported immediately to the relevant CASA office so that a NOTAM warning pilots of the light outage can be initiated.

3 AERODROME BEACONS

3.1 – An aerodrome beacon is to be provided if it is determined by CASA that such a visual cue is operationally necessary.

3.2 – The following factors will be used in determining operational necessity:

(a) whether the aerodrome is intended to be used at night by aircraft navigating predominantly by visual means;

(b) the type and quantity of air traffic;

(c) the presence of other visual or radio aids;

(d) whether the location is subject to frequent periods of reduced visibility;

(e) whether it is difficult to locate the aerodrome from the air due to surrounding lights or terrain.

3.3 – Where provided, the aerodrome beacon is to be located on or adjacent to the aerodrome in an area of low ambient background lighting. In addition, the aerodrome beacon is to be
sited so that it is neither shielded by obstacles nor dazzling to a pilot making an approach to land.

3.4 – At international aerodromes or aerodromes in built-up areas, the aerodrome beacon is to show two flashes, one white and the other coloured, so that they produce alternate white and colour flashes. For land aerodromes, the colour is to be green, for water aerodromes, the colour is to be yellow.

3.5 – At other locations, white flashes only is satisfactory.

3.6 – The aerodrome beacon is to flash at a rate of 12-30 flashes per minute, preferably not less than 20 per minute.

3.7 – The light from the beacon is to be visible from all angles of azimuth.

3.8 – The light intensity distribution of the aerodrome beacon is to be as follows:

<table>
<thead>
<tr>
<th>Elevation angle (in degrees)</th>
<th>Minimum effective intensity of white flashes (in candelas)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 2</td>
<td>25 000</td>
</tr>
<tr>
<td>2 to 8</td>
<td>50 000</td>
</tr>
<tr>
<td>8 to 10</td>
<td>25 000</td>
</tr>
<tr>
<td>10 to 15</td>
<td>5 000</td>
</tr>
<tr>
<td>15 to 20</td>
<td>1 000</td>
</tr>
</tbody>
</table>

The effective intensity of colour flashes is to be not less than 0.15 times the intensity of the white flashes at the corresponding angle of elevation.

3.9 – Where provided, information on the colour coding, flash rate and location (if not in the immediate vicinity of the aerodrome) of the aerodrome beacon is to be published in the aerodrome ERSA entry.

4 ILLUMINATED WIND DIRECTION INDICATOR

Note: See also CAO 92.2.

4.1 – At an aerodrome intended for night use, at least one wind direction indicator is to be lit.

4.2 – If a WDI is provided in the vicinity of a runway threshold to provide surface wind information for pilots engaged in instrument straight-in approach and landing operations, and such operations are to be conducted at night, then the wind direction indicator is to be lit.

4.3 – The illumination of a wind direction indicator is to be achieved by providing floodlighting from above by means of:

(a) four 200W 240V tungsten filament general purpose lamps in either vertical elliptical industry reflectors, or round deep bowl reflectors, between 1.8m and 2.2m above the midheight of the sleeve mounting, and between 1.7m and 1.9m radial distance from the axis of rotation of the wind sleeve; or
(b) eight 120W 240V PAR 38 flood lamps in reflectorless fittings, between 1.8m and 2.2m above the mid height of the wind sleeve mounting, and between 1.7m and 1.9m radial distance from the axis of the rotation of the wind sleeve; or

(c) some other method of floodlighting which produces lighting equivalent to what would be provided under paragraph (a) or (b), with accurate colour rendering and no perceptible warm-up or restrike delay.

**Note:** The standards prescribed above are equipment based. These may be replaced by photometric performance based standards later.

### 4.4

- The floodlighting is to be aimed and shielded so as to:
  - (a) not cause any glare or distraction to pilots; and
  - (b) uniformly illuminate the maximum swept area of the wind sleeve.

**Note:** A uniformity ratio in the horizontal plane through the mid height of the wind cone of not more than 4:1 (average to minimum) will be satisfactory.

### 4.5

- If only one wind direction indicator is lit at an aerodrome and there are two or more lit runways, control of the lighting of the wind direction indicator is to be incorporated in the runway lighting control for each runway, so that energising any runway lighting system will automatically energise the lighting of the wind direction indicator.

### 4.6

- Where more than one wind direction indicator can be lit, control of the lighting of each wind direction indicator is to be incorporated in the runway lighting control for the operationally related runway.

### 4.7

- If the electricity supply to a wind direction indicator is provided from a runway lighting circuit for which intensity control is provided, a uniform intensity is required for the wind direction indicator irrespective of the intensity setting of the runway lighting.

### 4.8

- Where a PAL is installed the wind direction indicator lighting is to be programmed in such a way that 10 minutes before the end of the aerodrome lighting ‘ON’ period, the lights of the wind direction indicator will commence to flash, at approximately 50 cycles per minute, and continue to flash until either:
  - (a) the PAL system switches off, and all aerodrome lighting, including the wind direction indicators, is extinguished; or
  - (b) the PAL system has been reset for another ‘ON’ period.

### 4.9

- If the PAL system is reset for another ‘ON’ period, the lights of the wind direction indicator are to return to steady lighting.

### 4.10

- At aerodromes with more than one lit wind direction indicator, it is sufficient for only the primary wind direction indicator to flash as part of the PAL system, provided that the flashing is clearly visible to pilots on all approaches to lit runways.
5 APPROACH LIGHTING SYSTEMS

5.1 SIMPLE APPROACH LIGHTING SYSTEM

5.1.1 – A simple approach lighting system is a lighting system intended for a non-instrument or a non-precision approach runway. Standards for this system are not included in this chapter as there is no operational credit for such systems.

*Note:* Standard runway edge and threshold lights, supplemented by a visual approach slope indicator system have been found adequate for non-instrument and non-precision approach runways.

5.2 PRECISION APPROACH CATEGORY I LIGHTING SYSTEM

5.2.1 – A precision approach Category I lighting system is to be provided to serve a Cat I precision approach runway.

**Location**

5.2.2 – A precision approach Category I lighting system is to consist of a row of lights on the extended centreline of the runway extending, wherever practicable, over a distance of 900m prior to the threshold, with rows of lights forming 5 crossbars, as shown below.

*Note 1:* The installation of an approach lighting system of less than 900m in length may result in operational limitations on the use of the runway.

*Note 2:* Existing lights spaced in accordance with imperial measurements are deemed to comply with comparable metric measurements.

5.2.3 – The lights forming the centreline are to be placed at longitudinal intervals of 30m with the innermost light located 30m from the threshold. Each centreline light position is to consist of a single light source in the innermost 300m of the centreline, two light sources in the central 300m of the centreline, and three light sources in the outer 300m of the centreline, to provide distance information.

5.2.4 – The lights forming the centreline light positions in the central 300m and the outer 300m of the centreline are to be spaced at 1.5m apart.

5.2.5 – The lights forming the 5 crossbars are to be placed at 150m, 300m, 450m 600m and 750m from the threshold. The lights forming each crossbar are to be as nearly as practicable in a horizontal straight line at right angles to, and bisected by, the line of the centreline lights. The lights of the crossbar are to be spaced so as to produce a linear effect, except that gaps may be left on each side of the centreline. The lights within each bar on either side of the centreline are to be spaced at 2.7m apart. The outer ends of the crossbars are to lie on two straight lines that converge to meet the runway centreline 300m from the threshold.

5.2.6 – The system is to lie as nearly as practicable in the horizontal plane passing through the threshold, provided that:

(a) no object other than an ILS antenna is to protrude through the plane of the approach lights within a distance of 60m form the centreline of the system; and

(b) no light other than a light located within the central part of a crossbar, or a centreline light position, may be screened from an approaching aircraft.

5.2.7 – Any ILS antenna protruding through the plane of the lights is to be treated as an obstacle and marked and lighted accordingly.
Characteristics

5.2.8 – The centreline and crossbar lights of a precision approach Category I lighting system are to be fixed lights showing variable white.

5.2.9 – The lights are to be in accordance with the specifications of Section 5 Appendix I, Figures 1 and 2.

Illustration of a Category I approach lighting system
5.3 PRECISION APPROACH CATEGORY II AND III LIGHTING SYSTEM

5.3.1 – A precision approach Category II and III lighting system is to be provided to serve a Cat II or III precision approach runway.

Location

5.3.2 – A precision approach Category II and III lighting system is to consist of a row of lights on the extended centreline of the runway extending, where possible, over a distance of 900m from the runway threshold. In addition, the system is to have two side rows of lights, extending 240m from the threshold, and 5 crossbars, at 150m, 300m, 450m, 600m and 750m from the threshold, as shown below.

Note: The length of 900m is based on providing guidance for operations under Cat I, II and III conditions. Reduced lengths may support Cat II and III operations but may impose limitations on Cat I operations.

5.3.3 – The lights forming the centreline lights are to be placed at longitudinal intervals of 30m with the innermost light located 30m from the threshold.

5.3.4 – The centreline for the first 300m from the threshold is to consist of either:
   (a) barrettes; or
   (b) single light sources where the threshold is displaced 300m or more.

5.3.5 – Beyond 300m from the threshold each centreline light position is to consist of either:
   (a) a barrette as used on the inner 300m; or
   (b) two light sources in the central 300m of the centreline and three light sources in the outer 300m of the centreline.

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

5.3.7 – Where the centreline light position is either two or three light sources, the lights are to be spaced at 1.5m apart.

5.3.8 – The lights forming the side rows are to be placed on each side of the centreline. The rows are to be spaced at 30m intervals, with the first row located 30m from the threshold. The lateral spacing (or gauge) between the innermost lights of the side row is to be not less than 18m nor more than 22.5m, and preferably 18m, but in any event is to be equal to that of the touchdown zone light barrettes.

5.3.9 – The length of a side row barrette and the uniform spacing between its lights are to be equal to those of the touchdown zone light barrettes.

5.3.10 – The crossbar provided at 150m from the threshold is to fill in the gaps between the centreline and side row lights.

5.3.11 – The crossbar provided at 300m from the threshold is to extend on both sides of the centreline lights to a distance of 15m from the centreline.

5.3.12 – The crossbars provided at 450m, 600m, and 750m from the threshold are to have the outer ends of the crossbars lie on two straight lines that converge to meet the runway.
centreline 300m from the threshold. The lights are to be spaced so as to produce a linear effect, except that gaps may be left on each side of the centreline.

5.3.13 – The lights forming the crossbars are to be uniformly spaced at intervals of not more than 2.7m.

5.3.14 – The system is to lie as nearly as practicable in the horizontal plane passing through the threshold, provided that:

(a) no object other than an ILS antenna is to protrude through the plane of the approach lights within a distance of 60m from the centreline of the system; and

(b) no light other than a light located within the central part of a crossbar, or a centreline light position, may be screened from an approaching aircraft.

5.3.15 – Any ILS antenna protruding through the plane of the lights is to be treated as obstacle and marked and lighted accordingly.

Characteristics

5.3.16 – The centreline and crossbar lights of a precision approach Category II and III lighting system are to be fixed lights showing variable white.

5.3.17 – The side row barrettes are to be fixed lights showing red. The intensity of the red light is to be compatible with the intensity of the white light.

5.3.18 – The lights are to be in accordance with the specifications of Section 5, Appendix I, Figures 1 and 2.

Illustration of the inner 300m of category II and III approach lighting system
6. VISUAL APPROACH SLOPE INDICATOR SYSTEMS

6.1 General

6.1.1 – A visual approach slope indicator system shall be provided to serve the approach to a runway, whether or not the runway is served by electronic approach slope guidance, where one of the following applies:

(a) the runway is regularly used by jet-propelled aeroplanes engaged in air transport operations; or

(b) CASA directs that visual approach slope guidance be provided, because it has determined that such a visual aid is required for the safe operation of aircraft.

6.1.2 – In making a determination that visual approach slope guidance is required, CASA will take into account the following:

(a) the runway is frequently used by other jet-propelled aeroplanes, or other aeroplanes with similar approach guidance requirements;

(b) The pilot of any type of aeroplane may have difficulty in judging the approach due to:

   (i) inadequate visual guidance such as is experienced during an approach over water or featureless terrain by day or in the absence of sufficient extraneous lights in the approach area by night;

   (ii) misleading approach information such as that produced by deceptive surrounding terrain, runway slope, or unusual combinations of runway width, length and light spacing;

   (iii) a displaced threshold;

(c) the presence of objects in the approach area may involve serious hazard if an aeroplane descends below the normal approach path, particularly if there are no non-visual or other visual aids to give warning of such objects;

(d) physical conditions at either end of the runway present a serious hazard in the event of an aeroplane undershooting or overrunning the runway; and

(e) terrain or prevalent meteorological conditions are such that the aeroplane may be subjected to unusual turbulence during approach.

6.1.3 – CASA may direct that a visual approach slope indicator system be provided for temporary use only, for example due to a temporary displaced threshold, or during works in progress.

6.1.4 – The following visual approach slope indicator systems are approved for use in Australian civil aerodromes:

(a) T-VASIS;
(b) AT-VASIS;
(c) double sided PAPI; and
(d) PAPI.

6.1.5 – The standard installations must be:
(a) at international aerodromes, T-VASIS, or double sided PAPI. Where this is impracticable, an AT-VASIS or PAPI is acceptable;
(b) at aerodromes other than international aerodromes, AT-VASIS or PAPI, except where (c) below applies;
(c) at aerodromes where CASA has determined that additional roll guidance is required, and/or high system integrity is necessary, T-VASIS or double sided PAPI; and
(d) AT-VASIS and PAPI must be installed on the left side of the runway, unless this is impracticable.

6.1.6 – Where a T-VASIS is to be replaced by a PAPI, a double-sided PAPI must be provided.

6.1.7 – Where more than one visual approach slope indicator system is provided at an aerodrome, to avoid confusion, the same type of approach slope indicator system must be used at each end of a runway. If there is more than one runway, the same type of approach slope indicator system must be used on all runways of similar reference code number.

6.1.8 – Where a visual approach slope indicator system is provided for temporary use only, in accordance with paragraph 6.1.3, then paragraph 6.1.7 need not apply.

6.1.9 – The choice of T-VASIS or PAPI is a matter between the aerodrome operator and airline operators using the runway. For capital city runways used by a range of medium and large jet aeroplanes, T-VASIS would be a better visual aid.

6.1.10 – A visual approach slope indicator system must not be brought into service until it is appropriately commissioned and approved by CASA.

6.2 Obstacle assessment surface

6.2.1 – An obstacle assessment surface (OAS) must be surveyed and assessed for obstacles for each end of the runway where a T-VASIS, AT-VASIS or PAPI is to be provided. Standards of OAS are as follows and an OAS is illustrated below:
(a) Baseline: Width 150m, coincident with the existing baseline for the approach surface;
(b) Slope: 1.9°;
(c) Splay: 7.5° outwards, commencing from the ends of the baseline;
(d) Length: 9 km from the baseline.
6.2.2 – The aerodrome operator must check any penetration by, or proximity to, objects such as radio masts, buildings etc., and terrain, of the Obstacle Assessment Surface as specified in paragraph 6.2.1. Where one or more obstacles are found, or where high ground lies close to the approach path, the relevant CASA Office must be requested to conduct an aeronautical study to determine whether the obstacle(s) or terrain could adversely affect the safety of aircraft operations.

6.2.3 – Where practicable, objects above the assessment surface must be removed, except where CASA determines that the object would not adversely affect the safety of operations.

6.2.4 – If the study determines that safety could be adversely affected, and it is not practicable to remove the object, then one or more of the following measures should be undertaken:

(a) suitably raise the approach slope of the system – to a maximum of 3.3° where the runway is used by jet propelled aeroplanes, or 4° for other aeroplanes: the OAS slope can then be raised by the same amount (eg. for a 3.3° slope the OAS can become 2.2° instead of 1.9°);

(b) reduce the azimuth spread so that the obstacle is outside the confines of the beam;

(c) displace the axis of the system and its associated OAS by up to 5°;

(d) suitably displace the threshold; and

(e) if (d) is impracticable, suitably displace the system upwind of the threshold to provide an increase in threshold crossing height equal to the height of the obstacle penetration.
7. **T-VASIS AND AT-VASIS**

7.1 – T-Visual Approach Slope Indicator System (T-VASIS) is a set of lights so arranged that the pattern seen by the pilot varies according to his position (up or down, left or right) relative to the desired approach path. Where installed in the runway strip, it provides the pilot with visual cues about his actual descent path relative to the desired descent path.
7.2 – Deleted

7.3 – A T-VASIS is to consist of twenty light units symmetrically disposed about the runway centreline in the form of two wing bars of four light units each, with bisecting longitudinal lines of six lights, and laid out as shown below.

7.4 – An AT-VASIS is to consist of ten light units arranged on one side of the runway in the form of a single wing bar of four light units with a bisecting longitudinal line of six lights.

7.5 – The light units are to be constructed and arranged in such a manner that the pilot of an aircraft during an approach will:

(a) when above the correct approach slope, see an inverted white “T” pattern comprising the white wing bar(s) lights, and one, two or three white “fly-down lights, the more “fly-down” lights being visible the higher the pilot is above the correct approach slope;

(b) when on the correct approach slope, see a line of white wing bar(s) lights;

(c) when below the correct approach slope, see a white “T” pattern comprising the white wing bar(s) lights and one, two or three white “fly-up” lights, the more “fly-up” lights being visible the lower the pilot is below the correct approach slope; and when well below the correct approach slope, see a red “T” pattern with the wing bar(s) and the three “fly-up’ lights showing red.

Characteristics of the light units

7.6 – The beam of light produced by the units is to be such that in clear weather the effective visual range of the indicator is to be at least 4 nautical miles over the angle of 1½ degrees above and 1 degree below the correct approach slope, both by day and by night, and in azimuth over 10 degrees by day and 30 degrees by night. The light units are to have as great an intensity as possible from ground level to 6 degrees in elevation.
7.7 – The colour transition from white to red is to be such as to appear to an observer at a distance to occur over a vertical angle of not more than 1/4 degree. Immediately below this transition sector the intensity of the completely red beam is not to be less than 15 percent of the intensity of the completely white beam immediately above the transition sector.

7.8 – The light units forming the wing bars are to be mounted so as to appear to the pilot of an approaching aircraft to be substantially in a horizontal line. The light units are to be mounted as low as possible and are to be sufficiently light and frangible as not to constitute a hazard to aircraft.

7.9 – The light units are to be so designed that deposits of condensation, dirt, etc, on optically transmitting or reflecting surfaces, interfere to the least possible extent with light signals and are to in no way affect the cut-off angles, the contrast between the red and white signals, and the elevation of the transition sector. The construction of the light units are to be such, as to minimise the possibility of light aperture being wholly or partially blocked by snow or ice at locations where these conditions are likely to be encountered.

7.10 – A suitable intensity control is to be provided so as to allow adjustment to meet the prevailing light conditions and avoid dazzling the pilot during the approach and landing.

Elevation of the light beams

7.11 – The light beams from the corresponding light units on opposite sides of the runway are to have the same recognition angle. The upwind and downwind legs of the ‘T’ are to appear with uniform steps as the approach slopes changes. Steps of 7 plus or minus ½ minutes in the upwind leg and of 5 plus or minus ½ in the downwind leg are recommended, with leg boxes nearest the bar set for the correct approach slope angle.

7.12 – The recognition angle at which each light of the “fly-up” “T” changes colour to red is not to be less than 1 degree and 54 minutes when measured from the light source, and in any case is not to be less than the obstacle clearance plane. The recognition angle at which each light of the “fly-up” “T” changes to white is not to be greater than 2 degrees and 20 minutes when measured from the light source.

7.13 – An approach slope that is operationally satisfactory is to be selected for each runway. The standard approach slope is 3° (1:19 nominal), and with an eye height over threshold of 15m.

Clearance from movement areas

7.14 – No light unit is to be sighted closer than 15m from the edge of any runway. Light units should be sited at least 15m from the edge of a taxiway but should circumstances require units to be closer than this distance the particular case should be referred to CASA.

System dimensions

7.15 – The standard layout on level ground is illustrated above. However, in practice this seldom occurs. Variations in layout to suit the terrain is permitted and also some tolerance is allowed on actual adjustments made in the field.

7.16 – Tabulated below are system dimensions, with allowable tolerances. These values apply to design, installation and subsequent maintenance.
### Chapter 12
### Aerodrome Lighting

<table>
<thead>
<tr>
<th>Item</th>
<th>Standard</th>
<th>Allowable Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye height over threshold</td>
<td>15 m (^1)(^2)</td>
<td>±1 m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-3 m</td>
</tr>
<tr>
<td>Approach slope (^3)</td>
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<td>(1: 19 nominal)</td>
</tr>
<tr>
<td>Distance of longitudinal line of light units from runway edge (^4)</td>
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<td>±3 m</td>
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<tr>
<td>Leg light unit spacing</td>
<td>45 m</td>
<td>±4.5 m</td>
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<tr>
<td></td>
<td>90 m</td>
<td>±9 m</td>
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<td>Clearance from pavements</td>
<td>15 m (^5)</td>
<td></td>
</tr>
<tr>
<td>Alignment of each light unit</td>
<td>Parallel to runway centreline</td>
<td>±1°</td>
</tr>
<tr>
<td>Light units in a wing bar</td>
<td>Aligned</td>
<td>±25 mm</td>
</tr>
<tr>
<td>Fronts of light units</td>
<td>Aligned</td>
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<tr>
<td>Height of light units</td>
<td></td>
<td>±25 mm</td>
</tr>
<tr>
<td>Levelling of light units</td>
<td>Level</td>
<td>To the accuracy of the precision engineers level (^6)</td>
</tr>
</tbody>
</table>

\(^1\) When the runway on which a T-VASIS is provided is equipped with an ILS, the siting and elevations of the T-VASIS shall be such that the visual approach slope conforms as closely as possible to the Glide Path of the ILS.

\(^2\) A T-VASIS eye height over threshold 1 m higher than the ILS Glide Path satisfies most aircraft.

\(^3\) The use of a different approach slope requires prior approval from CASA.

\(^4\) The edge of the runway is defined as the distance from the runway centreline, which is half the nominal width of the runway and ignores sealed shoulders.

\(^5\) A minimum clearance between any part of a T-VASIS light unit (but not the foundation slab) and an adjacent runway or taxiway pavement.

\(^6\) This includes end-for-ending the level to ensure no inaccuracy of the instrument.

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7.17 – The aerodrome operator is to ensure that the immediate surround of each unit is kept free of grass. Tall grass immediately in front of the light unit could provide conflicting light signals. Grass growing near to the box on any side could result in the fine settings being disturbed during power mowing operations.
8. **PRECISION APPROACH PATH INDICATOR (PAPI)**

**General**

8.1 – The Precision Approach Path Indicator (PAPI) system is a visual approach slope indicator system.

8.2 – Paragraphs 8.3 to 8.15 (inclusive) and Appendices I and II to this Chapter set out CASA’s requirements in respect of PAPI.

**PAPI Equipment**

8.3 – PAPI light units, and their associated ancillary equipment, are to meet the technical specification specified in Appendix I.

8.4 – Deleted

8.5 – Deleted.

**PAPI Siting**

8.6 – Where PAPI is to be installed on one side of a runway it must be installed on the left side; only where this is not possible may it be installed on the right side; in this instance the order of lights is reversed, the two-red on-slope indication being provided by the two light boxes closest to the runway in all cases.

8.7 – Whenever PAPI systems are installed on both sides of a runway indications seen by the pilot must be symmetrical.

8.8 – The specifications for the siting of PAPI are prescribed in Appendix II.

8.9 – PAPI units are to be mounted as low as possible and are to be sufficiently light and frangible so that they do not constitute a hazard to aircraft.

**PAPI Performance**

8.10 – The PAPI system is to be sited and adjusted as specified in Appendix II so that a pilot making an approach will:

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

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

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

8.11 – The PAPI system is to be suitable for both day and night operations.

**Commissioning**

8.12 – Where the PAPI system is available for other than private use, it is to be commissioned by CASA or a person authorised by CASA, before being put into service.

8.12A – The commissioning of a visual approach slope indicator system requires:
(a) a ground check which must include verification of vertical and horizontal angles of light signal changes by a person having civil engineering or surveying qualifications and experience;

(b) in addition to the ground check, a flight check must be performed on visual slope indicator systems:
   (i) used by jet propelled aeroplanes engaged in air transport operations; or
   (ii) installed on CASA direction.

**8.12B** – For a visual approach slope indicator system that is provided for temporary use only, for example due to a temporary displaced threshold, or during works in progress, the requirement for a flight check is waived.

**8.13** – Following successful commissioning a NOTAM can be issued declaring the aid available for general use. The minimum eye-height over the threshold of the lowest on-slope signal, and the nominal on-slope angle are to be included in the NOTAM.

**8.14** – Flight checking by CASA at regular intervals, following commissioning, can be expected.

**Maintenance**

**8.15** – Manufacturer’s instructions are to be followed.
9. RUNWAY LIGHTING

9.1 TYPES OF RUNWAY LIGHTING SYSTEMS

9.1.1 – A runway lighting system may be of the following type:

(a) low intensity – a single intensity lighting system suitable for a non-instrument runway or a non-precision approach runway. This is provided at an aerodrome where there is no appropriate person, such as an air traffic controller, to adjust the intensity settings of the lights;

(b) medium intensity – a 3-stage intensity lighting system suitable for a non-instrument runway or a non-precision approach runway. This is provided to enhance the lighting system particularly in marginal weather conditions. This system cannot be used at an aerodrome that does not have air traffic services or similar personnel.

   Note: This system is for controlling light intensity during the landing phase. This system is not to be confused with lighting systems controlled by a photo-electric cell which can provide day, twilight and night intensities based on ambient conditions.

(c) high intensity – a 5 or 6 stage intensity lighting system which is suitable for precision approach runways. This system cannot be used at an aerodrome that does not have air traffic services or similar personnel.

9.2 RUNWAY EDGE LIGHTS

9.2.1 – Runway edge lights are to be provided for a runway intended for use at night or for a precision approach runway intended for use by day or night.

9.2.2 – Runway lighting is to meet the following operational requirements:

(a) for a non-instrument and a non-precision approach runway, lights meeting the omnidirectional characteristics requirements of paragraphs 9.2.13 to 9.2.15 are to be provided to cater for both visual circling after an instrument approach to circling minima and circuits in VMC;

(b) for a precision approach runway, lights are to meet both the omnidirectional characteristics of paragraphs 9.2.13 to 9.2.15 and unidirectional characteristics of paragraphs 9.2.16 to 9.2.21. The omnidirectional characteristics are required to cater for the operational requirements set out in (a) and the unidirectional characteristics are to cater for precision approaches.

   Note 1: The dual requirement is normally met by selecting lighting units or combination of lighting units which can provide lighting to meet both the omnidirectional and unidirectional characteristics standards.

9.2.3 – Unless it is impracticable to do so, runway edge lights are to be elevated lights.

Location of runway edge lights

9.2.4 – Runway edge lights are to be placed along both sides of the runway, in two parallel straight rows equidistant from the centreline of the runway, commencing one light spacing from the threshold and continuing to one light spacing from the runway end.
**Longitudinal spacing of runway edge lights**

**9.2.5** – The longitudinal spacing of runway edge lights is to be uniform and be:

(a) 60 ± 0/−5m for an instrument runway, except that existing edge lights spaced at 90 ± 10m apart are acceptable for non-precision instrument runways intended to be used in visibility condition of 1.5 km or better.

(b) 90 ±10m for a non-instrument runway.

*Note 1:* With GPS technology, virtually any runway can become an instrument runway. Accordingly, any new runway edge lights should be spaced in accordance with subparagraph (a).

*Note 2:* Existing lights spaced in accordance with previous standards of 200 ft or 300 ft imperial measurements may exceed 60m or 100m respectively. They are deemed to comply with the standards of this paragraph.

**9.2.6** – At intersections of runways or taxiways more than 600m from the threshold, a runway edge light for a non-instrument or a non-precision instrument runway may be spaced irregularly or omitted, provided that such irregular spacing or omission does not significantly alter the visual guidance available to a pilot using the runway. However, no two consecutive lights may be omitted.

**9.2.7** – Where a runway edge light cannot be omitted, inset runway edge lights are to be provided in place of elevated lights.

**9.2.8** – Unless a light is omitted or displaced in accordance with paragraph 9.2.6, a runway edge light is to be aligned with a light on the opposite side of the runway.

**9.2.9** – Runway edge lights are not to be omitted on a precision approach runway.

**Lateral spacing of runway edge lights**

**9.2.10** – Subject to paragraph 9.2.11, runway edge lights are to be placed along the edges of the area declared for use as the runway or outside the edges of the area at a distance of not more than 3m.

*Note:* Existing edge lights located beyond 3m from the edge of runway as a result of a reduction in the declared runway width do not need to be relocated until they are being replaced.

**9.2.11** – If the width of a runway is less than 30m in width, the runway edge lights are to be placed as if the runway is 30m in width, and in accordance with paragraph 9.2.10.

**9.2.12** – If a runway is provided with both low or medium intensity and high intensity runway light units, the row of high intensity light units is to be placed closer to the runway centreline. The two rows of light units are to be parallel, separated by a distance of at least 0.5m.

**Characteristics of low and medium intensity runway edge lights**

**9.2.13** – Low intensity and medium intensity runway edge lights are to be fixed omni-directional lights that show variable white. Omnidirectional lights are to have light distribution that is uniform for the full 360° horizontal coverage. Inset lights are allowed 25% reduction of intensity at structural ribs.
Chapter 12
Aerodrome Lighting

Photometrics of low intensity runway edge lights

9.2.14 – In accordance with Section 9, Appendix I, Figure 1, low intensity runway edge lights are to have the following characteristics:

(a) a main beam with a vertical coverage of at least 7° above the horizontal;
(b) a minimum average intensity within the main beam of not less than 100 candela;
(c) an average intensity within the main beam of not more than 200 candela;
(d) at angles up to 15° above the horizontal, an intensity of at least 25 candela;
(e) a single intensity for all lights in the same runway lighting system.

Photometrics of medium intensity runway edge lights

9.2.15 – In accordance with Section 9, Appendix I, Figure 2, medium intensity runway edge lights are to have the following characteristics:

(a) a main beam with a vertical coverage of at least 7° above the horizontal;
(b) a minimum average intensity within the main beam of not less than 200 candela;
(c) an average intensity within the main beam of not more than 600 candela;
(d) at angles up to 15° above the horizontal, an intensity of at least 50 candela.

Characteristics of high intensity runway edge lights

9.2.16 – High intensity runway edge lights are to be fixed unidirectional lights with the main beam directed towards the threshold.

9.2.17 – High intensity runway edge light beam coverage are to be toed in towards the runway as follows:

(a) 3.5° in the case of a 30-45m wide runway;
(b) 4.5° in the case of a 60m wide runway.

9.2.18 – High intensity runway edge lights are to show variable white except for those located within 600m from the runway end which are to show yellow.

Use of bidirectional or back to back light fittings

9.2.19 – On precision runways intended to be used for landings in either directions, separate runway edge light fittings may be provided back to back or bi-directional light fittings may be used.

Photometrics of high intensity runway edge lights

9.2.20 – The minimum light intensity for high intensity runway edge lights that show variable white is to be in accordance with Section 9, Appendix I:

(a) Figure 3 for 30-45m wide runways;
(b) Figure 4 for 60m wide runways.

9.2.21 – The minimum light intensity for high intensity runway edge lights that show yellow is the standard set out in Figure 3 or 4, whichever is applicable, multiplied by 0.4.
9.3 RUNWAY THRESHOLD LIGHTS

9.3.1 – Runway threshold lights are to be provided on a runway that is equipped with runway edge lights.

Location of runway threshold lights

9.3.2 – Runway threshold lights are to be located in a straight line at right angles to the centreline of the runway and:

(a) when the threshold is at the extremity of a runway – as near to the extremity as possible and not more than 3m outside, or 1m inside of the extremity; or

(b) when the threshold is a displaced threshold – at the displaced threshold with a tolerance of ± 1m.

Pattern of low intensity and medium intensity runway threshold lights

9.3.3 – Low and medium intensity runway threshold lights are to consist of:

(a) 2 omnidirectional elevated lights, 1 at each end of the threshold and in line with the runway edge lights; and

(b) 6 unidirectional elevated lights at equal intervals between the 2 omnidirectional lights.

9.3.4 – The 6 unidirectional lights are to be inset lights if:

(a) it is impractical for elevated lights to be installed;

(b) the threshold is a permanently displaced threshold; or

(c) the threshold is also equipped with high intensity threshold lights.

Alternate pattern of low intensity and medium intensity runway threshold lights

9.3.5 – If a runway is used mainly by aeroplanes with a maximum take-off weight of less than 5700 kg, the threshold lights may consist of 6 elevated lights arranged in 2 groups of 3 equally spaced lights, with the distance between the groups equal to half the lateral distance between the two rows of runway edge lights. The outer lights on either side are to be omni directional green lights and the inner lights are to be bidirectional green/red lights.

Pattern of high intensity runway threshold lights

9.3.6 – High intensity runway threshold lights are to consist of:

(a) 2 unidirectional elevated lights, one at each end of the threshold and in line with the row of runway edge lights; and

(b) inset unidirectional lights uniformly spaced between the 2 elevated lights at intervals of not more than 3m.

Characteristics of low intensity and medium intensity runway threshold lights

9.3.7 – Low intensity and medium intensity runway threshold lights are to have the following characteristics:

(a) the outermost light on each side are to be a fixed omnidirectional light showing green;
(b) the inner lights are to be fixed unidirectional lights showing green in the direction of approach over not less than 38° or more than 180° of azimuth;
(c) the light distribution in the direction of approach is to be as close as practicable to that of the runway edge lights;
(d) the intensity of the green lights is not to be less than half, and not more than 1.5 times, and preferably in the range of 1 to 1.5 times of the intensity of the runway edge lights.

Characteristics of high intensity runway threshold lights

9.3.8 – High intensity runway threshold lights are to be fixed lights showing green in the direction of approach with a minimum light intensity in accordance with Section 9, Appendix I, Figure 5.

9.4 ADDITIONAL LIGHTING TO ENHANCE THRESHOLD LOCATION

9.4.1 Threshold wing bars

9.4.1.1 – On a precision approach runway, if it is operationally required that an increase in the conspicuity of the threshold at night be provided, the threshold is to be provided with threshold wing bars.

9.4.1.2 – Where provided, threshold wing bars are to be symmetrically disposed on either side of the threshold:
(a) each wing bar is to consist of 5 lights at 2.5m apart;
(b) at right angles to the runway centreline; and
(c) with the inner most light of each wing bar aligned with the row of runway edge lights on that side of the threshold.

Characteristics of threshold wing bars

9.4.1.3 – Threshold wing bars are to have the following characteristics:
(a) as far as practicable, be elevated lights;
(b) be fixed unidirectional lights showing green in the direction of approach;
(c) the minimum light intensity is to be in accordance with Section 9, Appendix I, Figure 6.

9.4.1.4 – If it is impracticable to use elevated lights, inset lights may be used instead. However, inset and elevated lights are not to be used in the same threshold wing bar.

9.4.2 Runway threshold identification lights

9.4.2.1 – At an aerodrome where it is difficult to locate a runway threshold from the air during the day such as one having a complex runway/taxiway layout in the vicinity of the threshold, runway threshold identification lights may be required.

Note: Runway threshold identification lights may also assist pilot acquisition of a threshold during twilight hours and at night. During these periods the lights need to be controlled such that an approaching pilot will not be dazzled by the flashing lights.
9.4.2.2 – Runway threshold identification lights are to be provided, during the day, to mark a temporarily displaced threshold of a runway serving international jet aircraft conducting regular public transport operations.

Note: Runway threshold identification lights may also be used to mark the temporarily displaced thresholds of other runways. When used, the need for temporarily displaced threshold V-bar markings is normally waived.

Location of runway threshold identification lights

9.4.2.3 – Where provided, one unit of runway threshold identification light is to be placed on each side of the runway in line with the new threshold and approximately 12-15m outside each line of runway edge lights.

Characteristics of runway threshold identification lights

9.4.2.4 – Runway threshold identification lights are to have the following characteristics:

(a) be flashing lights;
(b) the light flashes are synchronised with a normal flash rate of 100-120 per minute;
(c) the colour of the lights is white;
(d) a minimum range in bright sunlight of approximately 7 km;
(e) the aiming angle of the light units is up to 4°.

Note: L-849 A and E light units specified in FAA AC 150/5345-51 “Specification for Discharged -Type of Flashing Light Equipment” are xenon strobe type of lights suitable for use as displaced threshold identification lights.

9.4.3 Temporarily displaced threshold lights for use at night

9.4.3.1 – Temporarily displaced threshold lights are to be provided at night to identify the new threshold location when the threshold of a runway is temporarily displaced.

Location of temporarily displaced threshold lights

9.4.3.2 – Temporarily displaced threshold lights are to be provided on each side of the runway:

(a) in line with the displaced threshold;
(b) at right angles to the runway centreline; and
(c) with the innermost light on each side aligned with the row of runway edge lights on that side of the threshold.

Characteristics of temporarily displaced threshold lights

9.4.3.3 – Temporarily displaced threshold lights are to have the following characteristics:

(a) each side is to consist of 5 lights if the runway width is 45m or greater, or 3 lights if the runway width is 30m or less;
(b) the lights are to be spaced at 2.5m apart;
(c) the lights are as far as practicable to be elevated lights;
(d) the innermost light of each side is to be a fixed omnidirectional light showing green in all angles of azimuth;
(e) the outer 4 or 2 lights, as appropriate, of each side are to be fixed unidirectional lights showing green in the direction of approach, over not less than 38° or more than 180° of azimuth;
(f) the light distribution in the direction of approach is to be as close as practicable to that of the runway edge lights;
(g) the light intensity is to be as close as practicable to 1.5 times, and not less than, that of the runway edge lights.

9.4.4 – Runway lighting before a displaced threshold

9.4.4.1 – If the part of runway located before a displaced threshold is available for aircraft use, i.e. for take-offs, and landings from the opposite direction, runway edge lights in this part of runway are to:
   (a) show red in the direction of approach to the displaced threshold; and
   (b) white in the opposite direction, or yellow as appropriate for a precision approach runway.

9.4.4.2 – The intensity of the red runway edge lights required under paragraph 9.4.4.1 is not to be less than one-quarter, and not more than one-half, that of the white runway edge lights.

9.4.4.3 – Runway edge lights may be bi-directional light fittings or separate light fittings installed back to back.

9.4.4.4 – If the portion of runway before a displaced threshold is closed to aircraft operations, all the runway lights thereon are to be extinguished.

9.5 RUNWAY END LIGHTS

9.5.1 – Runway end lights are to be provided on a runway equipped with runway edge lights.

Location of runway end lights

9.5.2 – Runway end lights are to be located in a straight line at right angles to the runway centreline, and:
   (a) when the runway end is at the extremity of the runway – as near to the extremity as possible and not more than 3m outside, or 1m inside the extremity;
   (b) when the runway end is not at the extremity of the runway – at the runway end, with a tolerance of ± 1m.

Pattern of runway end lights

9.5.3 – The pattern of runway end lights is to consist of:
   (a) 6 lights spaced at equal intervals between the rows of runway edge lights; or
   (b) if the runway is provided with the alternative threshold light pattern, the threshold pattern.
Characteristics of low and medium intensity runway end lights

9.5.4 – Low intensity and medium intensity runway end lights are to have the following characteristics:

(a) the lights are to be fixed unidirectional showing red in the direction of the runway over not less than 38° or more than 180° of azimuth;

(b) the intensity of the red light is not to be less than one-quarter, and not more than one-half, that of the runway edge lights;

(c) the light distribution in the direction of the runway is to be as close as practicable to that of the runway edge lights;

(d) unless it is impractical, the lights are to be elevated lights.

9.5.5 – Low intensity and medium intensity runway end lights are to be inset lights if:

(a) it is impracticable for elevated lights to be installed at the location; or

(b) the runway is also equipped with high intensity runway end lights.

9.5.6 – If the runway end coincides with the runway threshold, bi-directional light fittings may be used or separate light fittings installed back to back.

Characteristics of high intensity runway end lights

9.5.7 – High intensity runway end lights are to have the following characteristics:

(a) the lights are to be fixed, unidirectional showing red in the direction of the runway; and

(b) the minimum light intensity is to be in accordance with Section 9, Appendix I, Figure 7.

9.6 RUNWAY TURNING AREA EDGE LIGHTS

9.6.1 – Where an aircraft turning area is provided on a runway, the edge of the turning area is to be provided with blue edge lights if the runway is provided with edge lights.

Location of runway turning area edge lights

9.6.2 – Runway turning area edge lights are to be located not less than 0.6m, and not more than 1.8m, outside the edge of the turning area.

9.6.3 – If the beginning of the splay into a runway turning area is more than 10m from the previous runway edge light, a blue edge light is to be located where the turning area commences.

9.6.4 – Turning area edge lights are to be provided to mark any change of direction along the side of the turning area.

9.6.5 – Where a side of the turning area is longer than 30m, equally spaced blue edge lights are to be provided along that side, with spacing not exceeding 30m.

Characteristics of the runway turning area edge lights

9.6.6 – Runway turning area edge lights are to have the following characteristics:

(a) the lights are to be fixed omnidirectional lights that show blue;
(b) the minimum light intensity up to 30° above the horizontal are to have a minimum peak of 5 candela; and
(c) the lights are to be elevated unless impractical, in which case inset lights are to be used.

9.7 STOPWAY LIGHTS

9.7.1 – Stopway lights are to be provided on a stopway which is longer than 180m and is intended for night use.

Location of stopway lights

9.7.2 – Stopway lights are to be located along both sides of the stopway in line with the runway edge lights and up to the stopway end.
9.7.3 – The spacing of stopway lights are to be uniform and not more than that of the runway edge lights, with the last pair of lights located at the stopway end.
9.7.4 – The stopway end is to be further indicated by at least 2 stopway lights at equal intervals across the stopway end between the last pair of stopway lights.

Characteristics of stopway lights

9.7.5 – Stopway lights are to have the following characteristics:
(a) the lights are to be fixed and unidirectional showing red in the direction of the runway, and not visible to a pilot approaching to land over the stopway;
(b) the light distribution in the direction of the runway is to be as close as possible to that of the runway edge lights;
(c) the intensity of the red light is not to be less than one quarter, and not more than one half, that of the white runway edge lights;
(d) the lights are to be elevated lights.

9.8 HOLD SHORT LIGHTS

9.8.1 – Hold short lights are to be provided on a runway which is intended to accommodate land and hold short operations (LAHSO).

Location of hold short lights

9.8.2 – Hold short lights are to be at least 6 inset lights located across the runway as near to the hold short line as possible, and in any case not beyond, and not more than 3m before the hold short line, which is at least 75m from the centreline of the intersecting runway.
9.8.3 – The hold short lights are to be at right angles to the runway, and located symmetrically about the runway centreline, with the closest lights at 1.5m from the centreline, and subsequent lights 3m apart.

Characteristics of hold short lights

9.8.4 – The hold short lights are to be unidirectional, showing white in the direction of approach to the hold short position, and have photometric characteristics in accordance with Section 9, Appendix I, Figure 8.
9.8.5 – The lights are to occult, in unison, at between 25 and 35 cycles per minute. The illumination period shall be approximately 2/3, and the light suppression period shall be approximately 1/3, of the total period of each cycle.

*Note:* The illumination and suppression period will be affected by varying the light intensity. The FAA AC 150/5345-54 specified L-884 Power and Control Unit (PCU) is typically used to power LAHSO systems. The PCU pulses the lights by varying the voltage on the primary side of the series circuit. The light fixtures need to be isolated from the series circuit via 6.6/6.6 ampere isolating transformers. Typically, the PCU continuously switch the output current with an “on” cycle duration of 1.35 ± 0.1 seconds, and an “off” cycle duration of 0.8 ± 0.1 seconds.

9.8.6 – Each bar or opposite pair, as appropriate, of hold short lights are to be individually controlled, provided with variable intensity setting, and technically monitored for serviceability.

9.8.7 – Where standby power is available, hold short lights are to be connected to the standby power system, with changeover times not greater than for the runway lighting on the same runway.

9.9 **RUNWAY CENTRELINE LIGHTS**

9.9.1 – Runway centreline lights are to be provided on a precision approach runway Category II or III.

*Note:* Provision of runway centreline lights on a precision approach runway Category I where the width between the runway edge lights is greater than 50m is recommended.

**Location of runway centreline lights**

9.9.2 – Runway centreline lights are to be located from the threshold to the end at longitudinal spacing of approximately:

(a) 15m on a runway intended for use in runway visual range conditions less than a value of 300m; and

(b) 30m on a runway intended for use in runway visual range conditions of 300m or greater.

9.9.3 – The runway centreline lights may be offset by not more than 0.6m from the true runway centreline, for maintenance of runway marking purposes.

9.9.4 – The offset is to be on the left hand side of the landing aircraft, where practicable. Where the runway is used in both directions, the direction from which the majority of landings will take place is to prevail.

**Characteristics of runway centreline lights**

9.9.5 – Runway centreline lights are to be inset, fixed lights showing white from the threshold to a point 900m from the runway end. From 900m to 300m from the runway end, the light pattern is to be two red lights followed by two white lights. For the last 300m before the runway end, the lights are to show red.
Note: The double red and white alternating light arrangement is for interleaving circuitry, to ensure that failure of part of the electrical system does not result in a false indication of the runway distance remaining.

9.9.6 – The light intensity and distribution of runway centreline lights are to be in accordance with:

(a) Section 9, Appendix I, Figure 8 – for 30m spacing;
(b) Section 9, Appendix I, Figure 9 – for 15m spacing.

9.10 RUNWAY TOUCHDOWN ZONE LIGHTS

9.10.1 – Runway touchdown zone lights are to be provided for a runway intended for precision approach Cat II or III operations.

Location of runway touchdown zone lights

9.10.2 – Runway touchdown zone lights are to extend from the threshold for a distance of 900m. The lighting is to consist of a series of transverse rows of lights, or barrettes, symmetrically located on each side of the runway centreline.

9.10.3 – Each barrette is to consist of three light units at 1.5m apart. The innermost light of each barrette is to be at 9m from the true runway centreline.

9.10.4 – The first pair of barrettes is to be located at 60m from the threshold. Subsequent barrettes are to be spaced longitudinally at 60m apart.

Characteristics of runway touchdown zone lights

9.10.5 – Runway touchdown zone lights are to be fixed unidirectional lights showing variable white.

9.10.6 – Runway touchdown zone lights are to be in accordance with Section 9, Appendix I, Figure 10.

9.11 PHOTOMETRIC CHARACTERISTICS OF RUNWAY LIGHTS

Calculating average light intensity

9.11.1 – Section 9, Appendix I, Figure 11 shows the method of establishing the grid points for calculating the average intensity of low and medium intensity runway lights for non-instrument and instrument non-precision approach runways.

9.11.2 – Section 9, Appendix I, Figure 12 shows the method of establishing grid points for calculating the average intensity of high intensity approach and runway lights for precision approach runways.

9.11.3 – The average light intensity of the main beam of a light is calculated by:

(a) establishing grid points in accordance with the method shown in Section 9, Appendix I, Figures 12 or 13, whichever is applicable.
(b) measuring the light intensity values at all grid points within and on the perimeter of the rectangle or ellipse representing the main beam;
(c) calculating the arithmetic average of the light intensity values as measured at those grid points.
9.11.4 – The maximum light intensity value measured on or within the perimeter of the main beam is not to be more than three times the minimum light intensity value so measured.

9.12 INSTALLATION AND AIMING OF LIGHT FITTINGS

9.12.1 – The following points are to be followed in the installation and aiming of light fittings:

(a) the lights are aimed so that there are no deviations in the main beam pattern, to within 1/2° from the applicable standard specified in this chapter;

(b) horizontal angles are measured with respect to the vertical plane through the runway centreline;

(c) when measuring horizontal angles for lights other than runway centreline lights, the direction towards the runway centreline is to be taken to be positive;

(d) vertical angles specified are to be measured with respect to the horizontal plane.

9.13 ILLUSTRATIONS OF RUNWAY LIGHTING

9.13.1 – Section 9, Appendix II contains illustrations of runway lighting.
10. TAXIWAY LIGHTING

10.1 PROVISION OF TYPE OF TAXIWAY LIGHTS

Taxiway centreline lights

10.1.1 – Taxiway centreline lights are to be provided on a taxiway intended for use in conjunction with an associated runway when the runway is used in precision approach Category II or III conditions, unless the aerodrome traffic density is light.

10.1.2 – Taxiway centreline lights are to be provided on a taxiway intended for use in conjunction with an associated runway when the runway is used in precision approach Category I conditions, unless the aerodrome layout is simple or the aerodrome traffic density is light.

10.1.3 – Taxiway centreline lights are to be used on a rapid exit taxiway.

Taxiway edge lights

10.1.4 – Except for paragraphs 10.1.5 and 10.1.6, taxiway edge lights are to be provided at the edges of a taxiway and holding bays, intended for use at night and not provided with centreline lights.

Taxiway markers

10.1.5 – For code letter A or B taxiways, reflective taxiway edge markers may be used instead of taxiway centreline or edge lights, or to supplement taxiway lights. However, at least one taxiway from the runway to the apron is to be provided with taxiway lighting.

Apron taxiway lighting

10.1.6 – Taxiway lights are not required for an apron taxiway if the apron taxiway is illuminated by apron floodlighting meeting the standards specified in section 11.

Use of different types of taxiway lights

10.1.7 – As far as practicable, the provision of taxiway lights is to be such that taxying aircraft do not need to alternate between taxiway centreline and edge lights.

10.1.8 – Where additional guidance is required to delineate taxiway edges, taxiway edge lights may be used to supplement taxiway centreline lights. When provided, taxiway edge lights are to comply with paragraph 10.4. This may occur at:

(a) rapid exit taxiways;
(b) taxiway curves;
(c) intersections;
(d) a narrower section of taxiway.
10.2 CONTROL OF LIGHTS ON TAXIWAYS

10.2.1 – At an aerodrome with Air Traffic Service, taxiway lights with an average intensity within the main beam of more than 20 candela are to be provided with 3-stage intensity control to allow adjustment of the lighting to suit ambient conditions.

10.2.2 – If it is desired to illuminate only standard taxi routes during certain period of operations, for example during low visibility operations, the taxiway lighting may be designed to allow taxiways in use to be lit and those not in use to be unlit.

10.3 TAXIWAY CENTRELINE LIGHTS

Introductory Note: The longitudinal spacing of centreline lights that will provide satisfactory guidance to pilots on curved sections of taxiway, including exit taxiways and fillets at intersections, is influenced by the width of the light beam from the centreline light fittings.

Australia introduced taxiway centreline lights before international standards had been established, and chose to use the same spacing standards applicable to the omnidirectional edge lights.

Since then, international standards have been established, with lights having narrower beam spreads, and higher light intensity. Australia has now adopted the internationally accepted ICAO standards on taxiway centreline lights, recognising that international light manufacturers will be producing lights in compliance with these standards. To provide satisfactory guidance with these light fittings it is necessary to use longitudinal spacing that is less than previously used in Australia, particularly on curved sections.

There is no need to replace existing lights, or change the spacing of existing lights. The longitudinal spacing and photometric specifications herein are meant for all new taxiway centreline lights, and for replacement of existing light fittings with light fittings in compliance with ICAO standards.

Location of taxiway centreline lights

10.3.1 – Taxiway centreline lights are to be located on the centreline of the taxiway or uniformly offset from the taxiway centreline by not more than 0.3m.

Spacing of taxiway centreline lights

10.3.2 – Except for paragraphs 10.3.3 and 10.3.8, the longitudinal spacing of taxiway centreline lights on a straight section of taxiway is to be uniform and be not more than the values specified below:

<table>
<thead>
<tr>
<th>Description</th>
<th>General</th>
<th>Last 60m before a runway or apron</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) taxiways used in conjunction with a non-precision approach or a precision approach Category I runway</td>
<td>60m</td>
<td>15m</td>
</tr>
<tr>
<td>(b) taxiways used in conjunction with a precision approach Category II runway</td>
<td>30m</td>
<td>15m</td>
</tr>
<tr>
<td>(c) taxiways used in conjunction with a precision approach Category III runway</td>
<td>15m</td>
<td>7.5m</td>
</tr>
</tbody>
</table>
10.3.3 – For the purpose of taxiway centreline lighting, a straight section of taxiway that is less than 181 metres in length is considered a short straight taxiway. Taxiway centreline lights on a short straight section of taxiway are to be spaced at uniform intervals of not more than 30 m.

10.3.4 – In the case of an entry taxiway, the last light is not to be more than 1m outside the line of runway edge lights.

10.3.5 – When a taxiway changes from a straight to a curved section, the taxiway centreline lights are to continue on from the preceding straight section at a uniform distance from the outside edge of the taxiway.

10.3.6 – Longitudinal spacing of taxiway centreline lights on a curved section of taxiway used in conjunction with a non-precision or a precision category I or II runway is to be not more than 15m.

   Note 1: At a busy or complex taxiway intersection where additional taxying guidance is desirable, closer light spacing down to 7.5m should be used.

   Note 2: If the radius of the curve is in excess of 400 m, light spacing of not more than 30m may be used.

10.3.7 – Longitudinal spacing of taxiway lights on a curved section of taxiway used in conjunction with a category III runway is to be not more than 7.5m, except that if the radius of curve is more than 400m, the spacing is to be not more than 15m. The same spacing is to be used on the straight section of taxiway for a distance of 60m before and after the curve.

**Location of taxiway centreline lights on exit taxiways**

10.3.8 – Taxiway centreline lights on exit taxiways, other than rapid exit taxiways, are to:

   (a) start at the tangent point on the runway;

   (b) have the first light offset 1.2m from the runway centreline on the taxiway side; and

   (c) be spaced at uniform longitudinal intervals of not more than 7.5m.

**Location of taxiway centreline lights on rapid exit taxiways**

10.3.9 – Taxiway centreline lights on a rapid exit taxiway are to:

   (a) start at least 60m before the tangent point;

   (b) on that part of taxiway parallel to the runway centreline, be offset 1.2 m from the runway centreline on the taxiway side; and

   (c) continue at the same spacing to a point on the centreline of the taxiway at which an aeroplane can be expected to have decelerated to normal taxying speed.

10.3.10 – Taxiway centreline lights on a rapid exit taxiway is to be spaced at uniform longitudinal intervals of not more than 15m.
Chapter 12
Aerodrome Lighting

Characteristics of taxiway centreline lights

10.3.11 – Taxiway centreline lights on a taxiway other than an exit taxiway and on a runway forming part of a standard taxi-route are to be fixed lights showing green.

10.3.12 – Taxiway centreline lights on exit taxiways, including rapid exit taxiways, are to be fixed lights:

(a) showing green and yellow alternately, from the point where they begin to the perimeter of the ILS or MLS critical area or the lower edge of the inner transitional surface, whichever is further from the runway; and

(b) showing green from that point onwards.

10.3.13 – When viewed from the runway, the light on an exit taxiway nearest the perimeter or the lower edge of the inner transitional surface, whichever is further, is to show yellow.

10.3.14 – Where the taxiway centreline lights are used for both runway exit and entry purposes, the colour of the lights viewed by a pilot of an aircraft entering the runway is to be green.

Beam dimensions and light distribution

10.3.15 – The beam dimensions and light distribution of taxiway centreline lights are to be such that the lights are visible only to pilots of aircraft on, or in the vicinity of, the taxiway.

10.3.16 – The light distribution of the green taxiway centreline lights in the vicinity of a threshold is to be such as not to cause confusion with the runway threshold lights.

10.3.17 – On a taxiway intended for use in conjunction with a non-precision or a precision approach Category I or II runway, taxiway centreline lights are to comply with the specifications set out in Section 10, Appendix I, Figure 1 or 2, whichever is applicable.

10.3.18 – On a taxiway that is intended for use in conjunction with a precision approach Category III runway, the taxiway centreline lights are to comply with the specifications set out in Section 10, Appendix I, Figure 3, 4 or 5, whichever is applicable.

10.4 TAXIWAY EDGE LIGHTS

Location of taxiway edge lights

10.4.1 – Taxiway edge lights are to be located along both sides of the taxiway, with edge lights along each edge located opposite the corresponding lights along the other edge, except as allowed for in paragraph 10.4.2.

10.4.2 – A taxiway light may be omitted if it would otherwise have to be located on an intersection with another taxiway or runway.

10.4.3 – Taxiway edge lights are to be located outside the edge of the taxiway, being:

(a) equidistance from the centreline except where asymmetric fillets are provided; and

(b) as close as practicable to 1.2m from the taxiway edge, but no further than 1.8m, or nearer than 0.6m.
Spacing of taxiway edge lights

10.4.4 – Spacing of taxiway edge lights is to be in accordance with the Figure below:

10.4.5 – On a curved section of taxiway, the edge lights are to be spaced at uniform longitudinal intervals in accordance with Curve A in the Figure above.

10.4.6 – On a straight section of taxiway, the edge lights are to be spaced at uniform longitudinal intervals, not exceeding 60m, in accordance with Curve B in the Figure above.
10.4.7 – Where a straight section joins a curved section, the longitudinal spacing between taxiway edge lights is to be progressively reduced, in accordance with paragraphs 10.4.8 and 10.4.9, over not less than 3 spacings before the tangent point.

10.4.8 – The last spacing between lights on a straight section is to be the same as the spacing on the curved section.

10.4.9 – If the last spacing on the straight section is less than 25m, the second last spacing on the straight section is to be no greater than 25m.

10.4.10 – If a straight section of taxiway enters an intersection with another taxiway, a runway or an apron, the longitudinal spacing of the taxiway edge lights is to be progressively reduced over not less than 3 spacings, before the tangent point, so that the last and the second last spacings before the tangent point are not more than 15m and 25m respectively.

10.4.11 – The taxiway edge lights are to continue around the edge of the curve to the tangent point on the other taxiway, the runway or apron edge.

10.4.12 – Taxiway edge lights on a holding bay or apron are to be spaced at uniform longitudinal intervals not exceeding 60m, and in accordance with Curve B in the Figure above.

Characteristics of taxiway edge lights

10.4.13 – Taxiway edge lights are to be fixed omnidirectional lights showing blue. The lights are to be visible:

(a) up to at least 30° above the horizontal; and
(b) at all angles in azimuth necessary to provide guidance to the pilot of an aircraft on the taxiway.

10.4.14 – At an intersection, exit or curve, the lights are to be shielded to reduce, as far as is practicable, the possibility of confusion with other lights.

10.4.15 – The peak intensity of the blue edge lights is not to be less than 5 candela.

10.5 RUNWAY GUARD LIGHTS

Introductory Note: Runway guard lights are sometimes colloquially referred to as “wig wags”. The effectiveness of this lighting system has been successfully proven in a number of countries and this lighting system has been adopted by ICAO as a standard. Provision of runway guard lights will bring Australian aerodrome lighting in line with international practices. To allow relevant aerodrome operators sufficient time to introduce this lighting system, a deferred effective date for this standard is prescribed. However, provision of runway guard lights at an earlier date is permissible, and indeed, encouraged.

10.5.1 – Runway guard light standards are to be applicable from 1 August 2004.

10.5.2 – Runway guard lights are to be provided at the intersection of a taxiway with a precision approach runway if stop bars are not provided at the intersection, and the runway is:

(a) a precision approach Category I runway where the traffic density is heavy; or
(b) a precision approach Category II or III runway.

Note: For (a), consideration for deferment beyond 1 August 2004 may be given to an aerodrome which has a low incidence of Category I visibility conditions, and here the traffic density, though marginally heavy, consists of a large percentage
of light aircraft movements. Aerodrome operators seeking such a deferment should submit an application which must be supported by a safety case study.

10.5.3 – When introduced, runway guard lights are to be used at all taxiways which allow access onto the runway. They are to be brought into operation at the same time.

Note: Where a taxiway is used for exit only and cannot be used for entry to the runway, runway guard lights are not required.

Pattern and location of runway guard lights

Note: There are two standard configurations of runway guard lights: Configuration A (or Elevated Runway Guard Lights) has lights on each side of the taxiway, and Configuration B (or In-pavement Runway Guard lights) has lights across the taxiway. Configuration B runway guard lights are intended for wide throat taxiways.

10.5.4 – Configuration A runway guard lights are to be located on both sides of the taxiway, at the taxy-holding position closest to the runway, with the lighting on both sides:

(a) equidistant from the taxiway centreline; and
(b) not less than 3m, and not more than 5m, outside the edge of the taxiway.

10.5.5 – Configuration B runway guard lights are to be located across the taxiway, at the taxy-holding position closest to the runway, with the lights spaced at uniform interval of 3m.

Characteristics of runway guard lights

10.5.6 – Configuration A runway guard lights are to consist of two pairs of elevated lights showing yellow, one pair on each side of the taxiway.

Note: To enhance visual acquisition:

(a) the centreline of lights in each pair should be separated by a horizontal distance that is not less than 2.5 times, and not more than 3 times, the radius of the individual lantern lens;

(b) each light should be provided with a visor to minimise extraneous reflection from the optical surfaces of the lanterns;

(c) the visors and the face of the light fitting surrounding the lantern lens should be black to minimise reflection and provide enhanced contrast;

(d) where additional isolation of the signal is required from the background, a black target board may be provided around the sides and top of the face of the light fitting.

10.5.7 – Configuration B runway guard lights are to consist of inset lights showing yellow.

10.5.8 – The performance of Configuration A runway guard lights is to comply with the following:

(a) the lights in each pair are to be illuminated alternately at between 30 and 60 cycles per minute;

(b) the light suppression and illumination periods of each light in a pair are to be of equal and opposite duration;
(c) the light beams are to be unidirectional and aimed so that the beam centres cross the taxiway centreline at a point 60m prior to the taxy-holding position;
(d) the effective intensity of the yellow light and beam spread are to be in accordance with the specifications in Section 10, Appendix I, Figure 6.

10.5.9 – The performance of Configuration B runway guard lights is to comply with the following:

(a) adjacent lights are to be alternately illuminated and alternate lights are to illuminate in unison;
(b) the lights are to be illuminated between 30 and 60 cycles per minute and the light suppression and illumination periods are to be equal and opposite in each light;
(c) the light beam is to be unidirectional and aligned so as to be visible to the pilot of an aeroplane taxying to the holding position.
(d) the effective intensity of the yellow beam and beam spread are to be in accordance with the specifications in Section 10, Appendix I, Figure 3.

Control of runway guard lights

10.5.10 – Runway guard lights are to be electrically connected such that all runway guard lights protecting a runway can be turned on when the runway is active, day or night.

10.6 TAXY-HOLDING POSITION LIGHTS

10.6.1 – Except where a stop bar or runway guard lights have been installed, taxy-holding position lights are to be provided at the following locations:

(a) the holding position of an entry taxiway to a runway equipped for night use;
(b) the holding position of a holding bay, where the holding bay is intended to be used at night;
(c) at taxiway intersections where it is necessary to identify the aircraft holding position; and
(d) a designated holding position on a taxiway intended to be used at night.

Note: Provision of taxy-holding position lights for (c) and (d) is based on local air traffic control procedures requirements.

Location of taxy-holding position lights

10.6.2 – On a taxiway equipped with centreline lights, the taxy-holding position lights are to consist of at least 3 inset lights, spaced 1.5m apart, disposed symmetrically about, and at right angles to, the taxiway centreline, located not more than 0.3m before the taxy-holding position marking or the taxiway intersection marking, as appropriate.

10.6.3 – On a taxiway equipped with edge lights, the taxy-holding position lights are to consist of 1 elevated light on each side of the taxiway, located in line with the taxiway edge lights and the taxy-holding position marking or taxiway intersection marking, as appropriate.

Characteristics of taxy-holding position lights

10.6.4 – Inset taxy-holding position lights are to:
(a) be fixed, unidirectional lights showing yellow;
(b) be aligned so as to be visible to the pilot of an aircraft approaching the holding position;
(c) have light distribution as close as practicable to that of the taxiway centreline lights.

10.6.5 – Elevated taxi-holding position lights are to:
(a) be fixed, omnidirectional lights showing yellow;
(b) have light distribution as close as practicable to that of the taxiway edge lights.

10.7 STOP BARS

10.7.1 – A stop bar is to be provided at every taxi-holding position serving a runway when it is intended that the runway will be used in Cat II or III conditions, if operational procedures at the aerodrome do not restrict the number of aircraft on the manoeuvring area to one at a time during Cat II or III conditions.

10.7.2 – Where provided, the control mechanism for stop bars are to meet the operational requirements of the Air Traffic Service at that aerodrome.

Location of stop bars

10.7.3 – A stop bar is to:
(a) be located across the taxiway on, or not more than 0.3m before, the point at which it is intended that traffic approaching the runway stop;
(b) consist of inset lights spaced 3m apart across the taxiway;
(c) be disposed symmetrically about, and at right angles to, the taxiway centreline.

10.7.4 – Where a pilot may be required to stop the aircraft in a position so close to the lights that they are blocked from view by the structure of the aircraft, a pair of elevated lights, with the same characteristics as the stop bar lights, are to be provided abeam the stop bar, located at a distance of at least 3m from the taxiway edge sufficient to overcome the visibility problem.

Characteristics of stop bars

10.7.5 – A stop bar is to be unidirectional and show red in the direction of approach to the stop bar.

10.7.6 – The intensity and beam spread of the stop bar lights are to be in accordance with the applicable specifications in Section 10, Appendix I, Figures 1 to 5.

10.7.7 – Selectively switchable stop bars are to be installed in conjunction with at least three taxiway centreline lights (extending for a distance of at least 90m from the stop bar) in the direction that it is intended for an aircraft to proceed from the stop bar.

10.7.8 – The lighting circuit is to be designed so that:
(a) stop bars located across entrance taxiways are selectively switchable;
(b) stop bars located across taxiways used as exit taxiways only are switchable selectively or in groups;
(c) when a stop bar is illuminated, any taxiway centreline lights immediately beyond the stop bar are to be extinguished for a distance of at least 90m; and
(d) with control interlock and not manual control, when the centreline lights beyond the stop bar are illuminated the stop bar is extinguished and vice versa.

10.8 TAXIWAY EDGE MARKERS
10.8.1 – Where used in lieu of taxiway edge lights on a taxiway with code letter A or B, taxiway edge markers are to be provided at least at the locations where taxiway edge lights would otherwise have been provided.

Characteristics of taxiway edge markers
10.8.2 – Taxiway edge markers are to be retro-reflective blue.
10.8.3 – The surface of a taxiway edge marker as viewed by the pilot is to be a rectangle with a height to width ratio of approximately 3:1 and a minimum viewing area of 150 cm².
10.8.4 – Taxiway edge markers are to be lightweight, frangible and low enough to preserve adequate clearance for propellers and for the engine pods of jet aircraft.

10.9 TAXIWAY CENTRELINE MARKERS
10.9.1 – Taxiway centreline markers may be used on sections of the taxiway as a supplement to taxiway edge markers or taxiway edge lights, e.g. on curves or intersections. When used, taxiway centreline markers are not to be spaced greater than the spacing for centreline lights.

Characteristics of taxiway centreline markers
10.9.2 – Taxiway centreline markers are to be retro-reflective green.
10.9.3 – The marker surface as viewed by the pilot is to be a rectangle and is to have a minimum viewing surface of 20 cm².
10.9.4 – Taxiway centreline markers are to be able to withstand being run over by the wheels of an aircraft without damage either to the aircraft or to the markers themselves.

10.10 PHOTOMETRIC CHARACTERISTICS OF TAXIWAY LIGHTS

Calculating average light intensity
10.10.1 – The average intensity of the main beam of a taxiway light is calculated by:
   (a) establishing the grid points in accordance with the method shown in Section 10, Appendix I, Figure 7;
   (b) measuring the light intensity values at all grid points located within and on the perimeter of the rectangle representing the main beam;
   (c) calculating the arithmetic average of the light intensity values as measured at those grid points.
10.10.2 – The maximum light intensity value measured on or within the perimeter of the main beam is not to be more than three times the minimum light intensity values so measured.
10.11 INSTALLATION AND AIMING OF LIGHT FITTINGS

10.11.1 – The following points are to be followed in the installation and aiming of light fittings:

(a) the lights are aimed so that there are no deviations in the main beam pattern, to within $\frac{1}{2}^\circ$ from the applicable standard specified in this chapter;

(b) horizontal angles are measured with respect to the vertical plane through the taxiway centreline;

(c) when measuring horizontal angles for lights other than taxiway centreline lights, the direction towards the taxiway centreline is to be taken to be positive;

(d) vertical angles specified are to be measured with respect to the horizontal plane.

10.12 ILLUSTRATIONS OF TAXIWAY LIGHTING

10.12.1 – Section 10, Appendix II contains illustrations of taxiway lighting.
11 APRON FLOODLIGHTING

Introductory Note: Previous apron floodlighting standards called for different illuminance specifications for international and domestic aprons, with higher illuminance specifications for the international aprons. With airlines now conducting both domestic and international operations, setting apron floodlighting requirements based on the international or domestic usage is no longer appropriate and can inhibit flexibility of apron usage. This section will use aeroplane size as the criterion for illuminance specification.

ICAO establishes only one apron floodlighting standard. However, Australia will retain the two tier system, viz. a higher illuminance standard for aprons intended to serve larger aeroplanes, and a lower illuminance standard for aprons intended to serve only smaller aeroplanes. For the purpose of this section, aeroplanes bigger than code 3C are treated as larger aeroplanes. Code 3C aeroplanes and aeroplanes smaller than code 3C are treated as smaller aeroplanes.

An existing floodlighting system on an apron currently used by larger aeroplanes which does not meet the specifications of this section does not need to be replaced until the system is due for replacement, or there is a significant change in the usage of the apron by larger aeroplanes.

11.1 PROVISION OF APRON FLOODLIGHTING

11.1.1 Apron floodlighting, in accordance with this section, is to be provided on an apron, or the part of an apron, and on a designated isolated aircraft parking position, intended to be brought into use at night.

11.2 LOCATION OF APRON FLOODLIGHTING

11.2.1 Apron floodlighting is to be located so as to provide adequate illumination on all the apron service areas that are intended for use at night.

11.2.2 If an apron taxiway is not provided with taxiway lighting, then it is to be illuminated by the apron floodlighting in accordance with either 11.3.2(b) or 11.3.3(b).

11.2.3 Apron floodlights are to be so located and shielded so that there is a minimum of direct or reflected glare to pilots of aircraft in flight and on the ground, air traffic controllers, and personnel on the apron.

  Note: See also Section 1 Appendix I in regard to upward component of light.

11.2.4 An aircraft parking position is to receive, as far as practicable, apron floodlighting from two or more directions to minimise shadows.

  Note: For apron floodlighting purpose, an aircraft parking position means a rectangular area subtended by the wing span and overall length of the largest aircraft that is intended to occupy that position.

11.2.5 Apron floodlighting poles or pylons are not to penetrate the obstacle limitation surfaces.
11.3 CHARACTERISTICS OF APRON FLOODLIGHTING

11.3.1 – To minimise the chance of an illuminated rotary propeller appearing stationary at major aerodromes, three-phase power is to be used to avoid a stroboscopic effect for the apron floodlighting.

11.3.2 – The spectral distribution of apron floodlights is to be such that the colours used for aircraft marking connected with routine servicing, and for surface and obstacle marking, can be correctly identified. Monochromatic lights are not to be used.

11.3.3 – The average illuminance of an apron intended for larger aeroplanes is to be at least as follows:

(a) at an aircraft parking position:
   (i) for horizontal illuminance – 20 lux with a uniformity ratio (average to minimum) of not more than 4 to 1; and
   (ii) for vertical illuminance – 20 lux at a height of 2m above the apron in the relevant parking direction, parallel to the aeroplane centreline;

(b) at other apron areas, horizontal illuminance at 50 per cent of the average illuminance on the aircraft parking position with a uniformity ratio (average to minimum) of not more than 4 to 1.

Note: The uniformity ratio between the average of all values of illuminance, measured over a grid covering the relevant area, and the minimum illuminance within the area. A 4:1 ratio does not necessarily mean a minimum of 5 lux. If an average illuminance of say 24 lux is achieved, then the minimum should be not less than 24/4=6 lux.

11.3.4 – The average illuminance of an apron intended to be used only by smaller aeroplanes is to be at least as follows:

(a) at an aircraft parking position:
   (i) for horizontal illuminance – 5 lux with a uniformity ratio (average to minimum) of not more than 4 to 1; and
   (ii) for vertical illuminance – 5 lux at a height of 2m above the apron in the relevant parking direction, parallel to the aeroplane centreline;

(b) at other apron areas, horizontal illuminance graded to a minimum of 1 lux at the apron extremities or 2 lux for apron edge taxiways which do not have taxiway lights.

11.3.5 – A dimming control may be provided to allow the illuminance of an aircraft parking position on an active apron that is not required for aircraft use to be reduced to not less than 50 per cent of its normal values.

11.3.6 – At an aerodrome where the apron floodlighting is activated by PAL, the apron floodlighting is to achieve normal illuminance within 2 minutes of activation.

11.3.7 – For aprons used by larger aeroplanes, the apron floodlighting is to:
   (a) be included in the aerodrome standby power supply system; and
   (b) be capable, following a power interruption of up to 30 seconds, of being re-lit and achieving not less than 50 per cent of normal illuminance within 60 seconds.
11.3.8 – If existing floodlights cannot meet the requirement of paragraph 11.3.7, auxiliary floodlighting is to be provided that can immediately provide at least 2 lux of horizontal illuminance of aircraft parking positions. This auxiliary floodlighting is to remain on until the main lighting has achieved 80 per cent of normal illuminance.

12. OTHER LIGHTS ON AN AERODROME

12.1 VEHICLE WARNING LIGHTS

12.1.1 – Vehicle warning lights are provided to indicate to pilots and others the presence of moving vehicles or plant within the movement area.

12.1.2 – Vehicle warning lights are to be amber/yellow/orange, flashing or rotating dome lights of a standard type commercially available as an automobile accessory. They are to be placed on the roofs of vehicles or in a conspicuous position (preferably the highest point) on items of plant.

12.2 WORKS LIMIT LIGHTS

12.2.1 – Works limit lights are provided to indicate persons associated with the works organisation the limit of the works area.

12.2.2 – Works limit lights are to be portable, orange, bidirectional, battery operated lights of a standard type commercially available as works warning lights. Alternatively they may be liquid fuel lanterns with orange lenses.

12.3 ROAD AND CARPARK LIGHTING

12.3.1 – The aerodrome operator should provide road and carpark lighting in conformity with Australian Standards AS 1158 – code of Practice for Public Lighting.
13. MONITORING, MAINTENANCE AND SERVICEABILITY OF AERODROME LIGHTING

13.1 General

13.1.1 – The aerodrome operator is to monitor and maintain all lights and lighting systems associated with visual ground aids, both day and night, on a continuing basis for correctness and so that they are easily seen. Monitoring of lighting systems such as T-VASIS, PAPI and approach lighting are to be carried out in accordance with the frequencies and procedures set out in the Aerodrome Manual. Other aerodrome lights are to be monitored during the daily serviceability inspections and they are to be switched on for this purpose.

13.1.2 – Grass areas around lights are to be maintained such that the lights are not in any way obscured. Lights are to be kept free from dirt so as not to degrade their colour and conspicuousness. Damage to lights, including loss or degradation of light is to be made good.

13.2 SERVICEABILITY OF AERODROME LIGHTING

13.2.1 – Any aerodrome light outage detected should be fixed as soon as is practicable. The specifications below are not meant to condone unserviceability but are intended to indicate the minimum level of lighting needed to support safe aircraft operations. The specifications should be used as triggers for NOTAM action unless the unserviceability can be rectified before the next period of use.

13.2.2 – A light is deemed unserviceable when the main beam is out of its specified alignment or where its average intensity is less than 50 per cent of the specified value.

13.2.3 – A flashing or occulting light is deemed unserviceable when:

(a) the light ceases to flash or occult; or

(b) the frequency and/or duration of flash is outside the specified range by a factor of 2 to 1 or greater; or

(c) within a 10 minute period, more than 20% of flashes fail to occur.

13.2.4 – A lighting system is deemed to be unserviceable when-

(a) in the case of a lighting system comprising less than 4 lights (eg. taxiway holding position lights or runway threshold identification lights), any of the lights become unserviceable;

(b) in the case of a lighting system comprising 4 or 5 lights (eg. wind direction indicator lights or runway guard lights), more than 1 light become unserviceable;

(c) in the case of a lighting system comprising 6 to 13 lights (eg. threshold lights or LAHSO lights), more than 2 lights become unserviceable, or 2 adjacent lights become unserviceable;

(d) in the case of a lighting system comprising more than 13 lights, more than 15% of the lights become unserviceable, or two adjacent lights become unserviceable.

13.2.5 – For a T-VASIS, the serviceability standards take into account both the number of unserviceable lamps within a light unit, and also the number of light units within the T-VASIS system. The standards are:
(a) a T-VASIS light unit is deemed unserviceable when 3 or more lamps in the electrical (day) circuit are unserviceable, or when any of the lamps in the electrical (night) circuit is unserviceable.

(b) a T-VASIS system is deemed unserviceable when:
   - Bar units: more than 2 light units or two adjacent light units are unserviceable;
   - Fly up units: more than 1 light unit are unserviceable;
   - Fly down units: more than 1 light unit are unserviceable;

(c) an AT-VASIS system is deemed unserviceable when:
   - Bar units: more than 1 light unit is unserviceable; or
   - Fly up units: any light unit is unserviceable; or
   - Fly down units: any light unit is unserviceable;

(d) Whenever a red filter is unserviceable, missing or damaged, all the lamps within the affected light unit are to be extinguished until the red filter is rectified. The affected light unit is included as an unserviceable light unit when applying (b) or (c) above.

13.2.6 – For a PAPI, the serviceability standards take into account both the number of unserviceable lamps within a light unit, and also the number of light units within the PAPI system. The standards are:

(a) a PAPI light unit is deemed unserviceable when more than 1 lamp in a 3-or-more lamp light unit is unserviceable, or any lamp in a less-than-3-lamp light unit is unserviceable;

(b) a double-sided PAPI system (ie. 8 light units) is deemed unserviceable when more than 1 light unit is unserviceable;

(c) a single-sided PAPI system (ie. 4 light units) is deemed unserviceable when any light unit is unserviceable.

(d) whenever a red filter is unserviceable, missing, or damaged, all the lights within the affected light unit are to be extinguished until the red filter is rectified. The affected light unit is included as an unserviceable light unit when applying (b) or (c) above.

Note: A lighting system here means lights used to illuminate a particular facility, eg. all the lights used to mark a threshold or runway end, runway edge lights on a runway, taxiway lights on a length of taxiway between intersections, a T-VASIS or a PAPI system.
SECTION 1: APPENDIX I

LIGHTING IN THE VICINITY OF AERODROMES

ADVICE TO LIGHTING DESIGNERS

(This paper supersedes a paper of the same name dated July 1988 and issued by the Civil Aviation Authority)

1. INTRODUCTION

1.1 – The Civil Aviation Safety Authority (CASA) has the power through regulation 94 of the Civil Aviation Regulations 1988 (CAR 1988), to require lights which may cause confusion, distraction or glare to pilots in the air, to be extinguished or modified. Ground lights may cause confusion or distraction by reason of their colour, position, pattern or intensity of light emission above the horizontal plane. The text of regulation 94 is reproduced below for reference:

“Dangerous Lights

94. (1) Whenever any light is exhibited at or in the neighbourhood of an aerodrome, or in the neighbourhood of an air route or airway facility on an air route or airway, and the light is likely to endanger the safety of aircraft, whether by reason of glare, or by causing confusion with, or preventing clear reception of, the lights or signals prescribed in Part XII or of air route or airway facilities provided under the Air Services Act 1995, CASA may authorise a notice to be served upon the owner of the place where the light is exhibited or upon the person having charge of the light directing that owner or person, within a reasonable time to be specified in the notice, to extinguish or to screen effectually the light and to refrain from exhibiting any similar light in the future.

“(2) If any owner or person on whom a notice is served under this regulation fails, without reasonable cause, to comply with the directions contained in the notice, the owner or person shall be guilty of an offence punishable, on conviction, by a fine not exceeding 25 penalty units.

“(3) If any owner or person on whom a notice under this regulation is served fails, within the time specified in the notice, to extinguish or to screen effectually the light mentioned in the notice, CASA may authorise an officer, with such assistance as is necessary and reasonable, to enter the place where the light is and extinguish or screen the light, and may recover the expenses incurred by CASA in so doing from the owner or person on whom the notice has been served.”

2. GENERAL REQUIREMENT

2.1 – Advice for the guidance of designers and installation contractors is provided for situations where lights are to be installed within a 6km radius of a known aerodrome. Lights within this area fall into a category most likely to be subjected to the provisions of the regulation 94 of CAR 1988. Within this large area there exists a primary area which is divided
into four light control zones: A, B, C and D. These zones reflect the degree of interference ground lights can cause as a pilot approaches to land.

2.2 – The primary area is shown in Fig. 1. This drawing also nominates the intensity of light emission above which interference is likely. Lighting projects within this area should be closely examined to see they do not infringe the provision of regulation 94 of CAR 1988.

2.3 – The fact that a certain type of light fitting already exist in an area is not necessarily an indication that more lights of the same type can be added to the same area.

2.4 – Even though a proposed installation is designed to comply with the zone intensities shown in Fig. 1, designers are advised to consult with CASA as there may be overriding factors which require more restrictive controls to avoid conflict.

3.  LIGHT FITTINGS

3.1 – Light fittings chosen for an installation should have their iso-candela diagram examined to ensure the fitting will satisfy the zone requirements. In many cases the polar diagrams published by manufacturers do not show sufficient detail in the sector near the horizontal, and therefore careful reference should be made to the iso-candela diagram.

3.2 – For installations where the light fittings are selected because their graded light emission above horizontal conform with the zone requirement, no further modification is required.

3.3 – For installations where the light fitting does not meet the zone requirements, then a screen should be fitted to limit the light emission to zero above the horizontal. The use of a screen to limit the light to zero above the horizontal is necessary to overcome problems associated with movement of the fitting in the wind or misalignment during maintenance.

4.  COLOURED LIGHTS

4.1 – Coloured lights are likely to cause conflict irrespective of their intensity as coloured lights are used to identify different aerodrome facilities. Proposals for coloured lights should be referred to the Authority for detailed guidance.

5.  INFORMATION AND CORRESPONDENCE

5.1 – Check with the nearest CASA office for likely effect on aircraft operations of proposed lighting in the vicinity of an aerodrome.
Chapter 12
Aerodrome Lighting

MAXIMUM INTENSITY OF LIGHT SOURCES MEASURED AT 3° ABOVE THE HORIZONTAL

ZONE A  0 cd
ZONE B  50 cd
ZONE C  150 cd
ZONE D  450 cd

Figure 1
SECTION 1: APPENDIX II

USE OF UNARMOURED CABLES FOR AERODROME LIGHTING

1. INTRODUCTION

1.1 – The type of cable usually used in Australia for the series current electrical supply to aerodrome lighting fittings is a single core 6 sq. mm (7/1.04 mm) plain annealed copper conductor covered with a polyethylene insulation and an overall nylon sheath. It may be safely operated at 3000 volt. The nylon sheath provides additional protection against rough handling during installation, and also prevents damage by termites. The cable is suitable for direct burial in the ground.

1.2 – As the series current system, and the cable used, was significantly different from normal electrical practice, the Department of Civil Aviation (DCA) referred the matter to the Standards Association of Australia in 1958.

1.3 – Committee EL/1, the committee responsible for the SAA Wiring Rules, advised DCA in 1959 that it recommended to all Statutory Authorities that such installations be treated as “unusual installations” that did not have to strictly comply with certain parts of the Wiring Rules, provided certain precautions were observed.

2. SIGNIFICANT AREAS OF THE DISPENSATION

2.1 – Firstly it allowed unarmoured cable to be used for high voltage, and that the cable could be installed at a depth of 450mm instead of the 750mm required for high voltage in the Wiring Rules.

2.2 – Secondly, it allowed the cable to be buried directly in the ground without mechanical protection against digging.

2.3 – The dispensation was reaffirmed to the Department of Aviation in 1983, and again to the Civil Aviation Authority in 1993.

3. CONDITIONS GOVERNING THE DISPENSATION

3.1 – The conditions under which the dispensation was sanctioned by the SAA are:

(a) the series lighting circuit which they serve are normally isolated from the supply mains;
(b) the location of the cables is carefully and permanently marked;
(c) earthworks and excavations on an aerodrome are very strictly controlled; and
(d) the lighting circuits are not normally energised during daylight hours when earthworks could be in progress.

4. ASPECTS TO NOTE

4.1 – The dispensation only applies to the Movement Area. In other areas of the aerodrome, such as within the building area, the dispensation does not apply.

4.2 – To satisfy condition (b), cables should as far as practicable, be laid in straight lines. Suitably engraved permanent cable markers should be installed above all buried cable. The markers should be flush with the finished ground surface and should be located at changes of

November 2000

12 – APP – I – II – 1
direction, duct ends, at no more than 100 metre intervals on long straight runs, and at points of entry into buildings.

4.3 – Accurate and up to date plans of the aerodrome should be maintained which record actual locations of all cables installed on the aerodrome.

4.4 – To satisfy condition (d), at aerodromes where lighting systems may be used by day, including visual approach slope guidance systems, or where pilot activation of aerodrome lighting is possible, local procedures should be established that ensure that aerodrome lighting systems are electrically isolated when any works are in progress that could endanger such cable on an aerodrome.

4.5 – A copy of the most recent Standards Australia letter dated 7 September 1993, is attached for reference.

5. ACCEPTABILITY OF AN INSTALLATION TO THE SUPPLY AUTHORITY

5.1 – Not withstanding anything in this Appendix, it is the aerodrome operators’ responsibility to ensure that any proposed installation on their aerodrome meets the requirements of the relevant Supply Authority.
7 September 1999

Civil Aviation Authority
Technical Services Division
GPO Box 387
CANBERRA ACT 2601

Attention: Mr B Sullivan

Dear Mr Sullivan,

AS 2009 - 1991: SAA WIRING RULES
USE OF UNARMOURED CABLES FOR AIRFIELD LIGHTING

I would advise you that the use of unarmoured cables for airfield lighting was discussed at the 44th meeting of Committee EL/1, the committee responsible for the SAA Wiring Rules.

The committee noted that, in respect of airfield lighting, an exemption was granted in 1982 and reaffirmed in 1983 which allowed unarmoured cables to be used for airfield lighting in aerodrome movement areas under certain conditions.

The committee agreed that the exemption be reaffirmed again. This allows single core polythene insulated cables operating at 3.3kV and used for lighting series circuits to be installed buried direct at a depth of 450 mm within the aerodrome movement area only if the following four conditions are met:

(i) The series lighting circuits which they serve are normally isolated from the supply mains;

(ii) The location of the cables is carefully and permanently marked;

(iii) Earthworks and excavations on an aerodrome are very strictly controlled; and

(iv) The lighting circuits are not normally energised during daylight hours when earth works could be in progress.

This exemption may be applied to both Licensed Aerodromes and Authorised Landing Areas.

August 1999
The committee further noted that CAA information publications titled “Airport Lighting for Licensed Aerodromes - Specification of Requirements” and “Airfield Lighting Dr. Authorized Landing Areas - Advice to Owners” include details of this practice. The committee has asked that if these publications do not already contain details of the conditions under which the exemption is valid that they be amended to state these conditions.

If you require any further information please contact me.

Yours faithfully

Gerry Boardman
Projects Manager
Committee EL/A
SECTION 1: APPENDIX III

COLOURS FOR AERONAUTICAL GROUND LIGHTS

1 GENERAL
1.1 – The following specifications define the chromaticity limits of colours to be used for aerodrome lighting.
1.2 – The chromaticities are expressed in terms of the standard observer and co-ordination system adopted by the International Commission on Illumination (CIE).

2 CHROMATICITIES
2.1 – The chromaticities of aerodrome lights must be within the following boundaries:
CIE Equation (see Figure 1)

(a) Red
   Purple boundary y=0.980 - x
   Yellow boundary y=0.335

(b) Yellow
   Red boundary y=0.382
   White boundary y=0.790 - 0.667x
   Green boundary y=x - 0.120
   (except for visual docking guidance systems)
   White boundary x=0.650y - 0.041
   (for visual docking guidance systems)
   Blue boundary y=0.390 - 0.171x

(c) Green
   Yellow boundary y=0.726 - 0.726x
   White boundary x=0.650y
   Green boundary y=0.440  and  y=0.150 + 0.640x
   Purple boundary y=0.050 + 0.750x  and  y=0.382

(d) Blue
   Green boundary y=0.805x + 0.065
   White boundary y=0.400 - x
   Purple boundary x=0.600y + 0.133

(e) White
   Yellow boundary x=0.500
   Blue boundary x=0.285
   Green boundary y=0.440  and  y=0.150 + 0.640x
   Purple boundary y=0.050 + 0.750x  and  y=0.382
(f) Variable White

- Yellow boundary: \[ x = 0.255 + 0.750y \] and \[ x = 1.185 - 1.500y \]
- Blue boundary: \[ x = 0.285 \]
- Green boundary: \[ y = 0.440 \] and \[ y = 0.150 + 0.640x \]
- Purple boundary: \[ y = 0.050 + 0.750x \] and \[ y = 0.382 \]

3. **DISCRIMINATION BETWEEN COLOURED LIGHTS**

3.1 – If there is a requirement to discriminate yellow and white from each other, they must be displayed in close proximity of time or space as, for example, by being flashed successively from the same beacon.

3.2 – If there is a requirement to discriminate yellow from green or white, as for example with exit taxiway centreline lights, the “y” co-ordinate of the yellow light must not exceed a value of 0.40.

*Note: The limits of white have been based on the assumption that they will be used in situations in which the characteristics (colour, temperature) of the light source will be substantially constant.*

3.3 – The colour variable white is intended to be used only for lights that are to be varied in intensity, e.g. to avoid dazzling. If these lights are to be discriminated from yellow lights, the lights must be designed and operated so that:

- (a) the “x” co-ordinate of the yellow is at least 0.050 greater than the “x” co-ordinate of the white; and
- (b) the disposition of the lights is such that the yellow lights are displayed simultaneously and in close proximity to the white lights.
Figure 1 — Colours for aeronautical ground lights
SECTION 5: APPENDIX I

ISOCANDELA DIAGRAMS OF APPROACH LIGHTING

Collective notes to Figures 1 to 2

1. Except for paragraph 4, the collective notes for Section 9, Appendix I apply to this Appendix.

2. Average intensity ratio. The ratio between the average intensity within the ellipse defining the main beam of a typical new light and the average intensity of the main beam of a new runway edge light is to be as follows:

   Figure 1  Approach centreline and crossbars  1.5 to 2.0 (white light)

   Figure 2  Approach side row  0.5 to 1.0 (red light)
Notes: 1. Curves calculated on formula \[ x^2 + y^2 = 1 \]

2. Vertical setting angles of the lights shall be such that the following
vertical coverage of the main beam will be met:

<table>
<thead>
<tr>
<th>Distance from threshold</th>
<th>Vertical main beam coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threshold to 315m</td>
<td>0° - 11°</td>
</tr>
<tr>
<td>318m to 475m</td>
<td>0.5° - 11.5°</td>
</tr>
<tr>
<td>478m to 640m</td>
<td>1.5° - 12.5°</td>
</tr>
<tr>
<td>641m and beyond</td>
<td>2.5° - 13.5° (as illustrated above)</td>
</tr>
</tbody>
</table>

3. Lights in crossbars beyond 22.5m from the centreline shall be fixed-in 2 degrees. All other lights shall be aligned parallel to the centre of the runway.

4. See collective notes for Figures 1 to 2

**Figure 1: Isocandela Diagram for approach centreline light and cross bars (white light)**
Notes:
1. Curves calculated on formula \( \frac{x}{a} \frac{y}{b} = 1 \)
2. Toe-in 2.0 degrees
3. Vertical setting angles of the lights shall be such that the following vertical coverage of the main beam will be achieved:
   - Distance from threshold
     - Threshold to 115m: 0.9° to 10.5°
     - 116m to 215m: 1° to 11°
     - 216m and beyond: 1.5° to 11.5° (as illustrated above)
4. See collective notes for Figures 1-2

Figure 2: Isocandela Diagram for approach side row light (red light)
SECTION 8: APPENDIX I

TECHNICAL SPECIFICATION FOR PRECISION APPROACH PATH INDICATOR EQUIPMENT

1. GENERAL

1.1 – Deleted.

2. SYSTEM REQUIREMENTS

2.1 – The PAPI system is to consist of the following:
   (a) four identical light units;
   (b) mounting equipment for the light units; and
   (c) aiming, aligning, and calibrating equipment.

2.2 – The system is to be suitable for both day and night operations.

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

2.4 – The system is to be a current powered (series circuit) system.

2.5 – Deleted

2.6 – The light units are to be so designed that dynamic loading due to wind will not cause the light patter to be displaced.

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

2.8 – Each light unit is to be capable of adjustment in elevation so that the lower limit of the whole part of the beam may be fixed at any desired angle of elevation between 1° 30', and at least 4° 30' above the horizontal. Where an aligning device is used, each light unit is to be have precision mounting surfaces to accommodate it.

2.9 – The aligning device is to indicate vertical angles with a precision of at least one minute of arc. Each aligning device is to come with a certificate of accuracy from a NATA, or overseas equivalent, registered weights and measures laboratory.

2.10 – Light units are to be lightweight and frangible. They are to have at least three mounting legs which are to be adjustable to permit levelling where one side of the unit is installed up to 25mm higher or lower than the opposite side. The frangible points are to be as close to ground level as possible. Manufacturers are to state the static and dynamic withstand and fail loads for frangible mountings. The maximum height of the units is not to exceed 1 m when installed at the minimum mounting height.

2.11 – The exteriors of all units are to have a non-reflective surface treatment. Preferred colours are bright orange or yellow.

2.12 – All wiring is to be introduced into the light units through leads fitted with factory moulded plugs. The mating socket/s are to be fixed just below the frangible points. Strain relief is to be provided to constrain cable separation to the plug/socket interface.
3 PHOTOMETRIC REQUIREMENTS

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

3.2 – At full intensity, the red light is to have colour co-ordinates within the following boundaries:

CIE Equations \[ y = 0.980 - x \]
\[ y = 0.320 \]

3.3 – The light intensity distribution of the light units is to be as shown in Figure 1.

3.4 – The intensity value in the white sector of the beam is to be no less than 2 and may be as high as 6.5 times the corresponding intensity in the red sector.

3.5 – Deleted

3.6 – Deleted

4. HANDBOOK

4.1 – Deleted
Note 1.— These curves are for minimum intensities in red light.

Note 2.— The intensity value in the white sector of the beam is no less than 2 and may be as high as 6.5 times the corresponding intensity in the red sector.

Figure 1—Light Intensity Distribution of PAPI Light Units
SECTION 8: APPENDIX II
SPECIFICATION FOR THE SITING OF A PRECISION APPROACH PATH INDICATOR (PAPI) SYSTEM

1. GENERAL
1.1 – The PAPI system is to consist of a row, also termed “wing bar”, of 4 equally spaced sharp transition multi-lamp (or paired single lamp) units. The system is to be located on the left side of the runway, as viewed by an aircraft approaching to land, unless it is impracticable to do so.

2. SITING OF PAPI LIGHT UNIT
2.1 – PAPI light units are to be located in the manner shown in Figure 1.

3. APPROACH SLOPE AND ELEVATION SETTING OF LIGHT UNITS
3.1 — The requirements for the approach slope and elevation setting of light units are:

(a) The approach slope, as defined in Figure 2, must be appropriate for use by the aeroplanes using the approach. The standard approach slope is 3°.

(b) When the runway on which a PAPI is provided is equipped with an ILS, the sitting and elevation of the light units must be such that the PAPI approach slope conforms as closely as possible with the ILS glide path.

(c) The angle of elevation settings of the light units in a PAPI wing bar must be such that, during an approach, the pilot of an aeroplane observing a signal of one white and three reds will clear all objects in the approach area by a safe margin. See Section 6, paragraph 6.2.4(a) concerning the raising of the approach slope.

(d) The azimuth spread of the light beam must be suitably restricted where an object located outside the obstacle assessment surface of the PAPI system, but within the lateral limits of its light beam, is found to extend above the plane of the obstacle assessment surface and an aeronautical study indicates that the object could adversely affect the safety of operations. The extent of the restriction must be such that the object remains outside the confines of the light beam.
(e) Where a double sided PAPI is provided, corresponding units must be seen at the same angle so that the signals of each wing bar change symmetrically at the same time.

![Diagram of PAPI wing bar and threshold with light beams](image)

**Figure 2**: Light beams and angle of elevation setting for PAPI. $3^\circ$ approach slope

3.2 – The distance $D$ that the PAPI wing bar is located away from the threshold is based on the following:

(a) The optimum distance of PAPI wing bar from the runway threshold is determined by:

(i) the requirement to provide adequate wheel clearance over the threshold for all types of aircraft landing on the runway;

(ii) the operational desirability that PAPI is compatible with any non-visual glide path down to the minimum possible range and height; and

(iii) any difference in elevation between the PAPI units and the runway threshold.

(b) The distance of the PAPI units from the threshold may have to be modified from the optimum after consideration of:

(i) the remaining length of runway available for stopping the aircraft; and

(ii) obstacle clearance.

(c) Table 1 specifies the standard wheel clearance over the threshold for the most demanding amongst the aircraft regularly using the runway, for four aircraft eye-to-wheel height groups. Where practicable, the standard wheel clearance shown in column (2) must be provided.
(d) Where the landing run may be limited, especially at smaller aerodromes, a reduction in wheel clearance over the threshold may be more acceptable than a loss of landing distance. The special minimum wheel clearance shown in column (3) may be used in such a situation, if an aeronautical study indicates such reduced clearances to be acceptable. As guidance, these wheel clearances are unlikely to be acceptable where there are objects under the approach near the threshold, such as approach light supporting structures, boundary fences, roads, etc.

(e) The final location of the units is determined by the relationship between the approach angle, the difference in levels between threshold and the units, and the minimum eye height over the threshold (MEHT). The angle M used to establish the MEHT is 2° of arc less than the setting angle of the unit which defines the lower boundary of the on-slope indication, i.e. unit B, the third unit from the runway. See Figure 3.

(f) Where a PAPI is installed on a runway not equipped with an ILS, the distance $D_1$ shall be calculated to ensure that the lowest height at which a pilot will see a correct approach path indication provides the wheel clearance over the threshold specified in Table 1 for the most demanding amongst aeroplanes regularly using the runway.

(g) Where a PAPI is installed on a runway equipped with an ILS, the distance $D_1$ shall be calculated to provide the optimum compatibility between the visual and non-visual aids for the range of eye-to-antenna heights of the aeroplanes regularly using the runway.

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

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

(j) PAPI units must be the minimum practicable height above ground, and not normally more than 0.9m. All units of a wing bar should ideally lie in the same horizontal plane; however, to allow for any transverse slope, small height differences of no more than 50mm between light units are acceptable. A lateral gradient not greater than 1.25% can be accepted provided it is uniformly applied across the units.
Chapter 12
Aerodrome Lighting

Table 1: Wheel clearance over threshold for PAPI

<table>
<thead>
<tr>
<th>Eye-to-wheel height of aeroplane in the approach configuration</th>
<th>Standard wheel clearance (metres)</th>
<th>Special minimum wheel clearance (metres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>Up to but not including 3 m</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>3 m up to but not including 5 m</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>5 m up to but not including 8 m</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>8 m up to but not including 14 m</td>
<td>9</td>
<td>6</td>
</tr>
</tbody>
</table>

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

b Where practicable, the standard wheel clearance shown in column (2) shall be provided.

c The wheel clearance may be reduced to not less than those in column (3) with specific agreement of CASA, where an aeronautical study indicates that such reduced wheel clearances are acceptable.

d Where the Special Minimum wheel clearance is provided at a displaced threshold it shall be ensured that the corresponding Standard wheel clearance specified in column (2) will be available when an aeroplane at the top end of the eye-to-wheel height group chosen overflies the extremity of the runway.

4. ESTABLISHING THE DISTANCE OF THE PAPI WING BAR FROM THE RUNWAY THRESHOLD

4.1 – The following procedure may be used for establishing the distance of the PAPI wing bar from the runway threshold:

(a) Decide on the required approach slope. The standard approach slope is 3°.

(b) On runways where no ILS is installed, refer to Table 1 to determine the aeroplane eye-to-wheel group and the wheel clearance to be provided at the threshold. The MEHT, which provides the appropriate wheel clearance over the threshold, is established by adding the approach configuration eye-to-wheel height of the most demanding amongst the aircraft regularly using the runway to the required threshold wheel clearance.
(c) The calculation of the nominal position of the PAPI is made on the assumption that the PAPI units are at the same level as the runway centreline adjacent to them, and this level, in turn, is the same as that of the runway threshold. The nominal distance of the PAPI is derived by multiplying the required MEHT by the cotangent of the angle M in Figure 3.

(d) Where there is a difference in excess of 0.3m between the elevation of the runway threshold and the elevation of the B unit at the nominal distance from the threshold, it will be necessary to displace the PAPI from its nominal position. The distance will be increased if the proposed site is lower than the threshold and will be decreased if it is higher. The required displacement is determined by multiplying the difference in level by the cotangent of the angle M.

(e) Where a PAPI is installed on a runway equipped with an ILS, the distance $D_1$ must be equal to that between the threshold and the effective origin of the ILS glide path, plus a correction factor for the variation of eye-to-antenna heights of the aeroplanes concerned. The correction factor is obtained by multiplying the average eye-to-antenna height of those aeroplanes by the cotangent of the approach angle. The PAPI is then aimed at the same angle as the ILS glide slope. Harmonization of the PAPI signal and the ILS glide path to a point closer to the threshold may be achieved by increasing the width of the PAPI on-course sector from 20° to 30°. However, the distance $D_1$ must be such that in no case will the wheel clearance over the threshold be lower than specified in column (3) of Table 1.
Chapter 12
Aerodrome Lighting

Figure 3 The arrangement of a PAPI system and the resulting display

Key
- RED
- WHITE

0 – approach slope angle
D1 – distance of PAPI from threshold
METH – minimum eye height over threshold
M – angle determining METH

Obstacle assessment surface (OAS)

MEHT (D1 tan θ - 0°12´)
SECTION 9: APPENDIX I
ISOCANDELA DIAGRAMS OF RUNWAY LIGHTING

COLLECTIVE NOTES TO FIGURES 1 TO 10

(1) The ellipses in each figure are symmetrical about the common vertical and horizontal axes.

(2) Figures 1 to 10 show the minimum allowable light intensities. The average intensity of the main beam is calculated by establishing the grid points as shown in Figure 11 or Figure 12, as appropriate, and using the intensity values measured at all grid points located within and on the perimeter of the ellipse representing the main beam. The average value is the arithmetic average of light intensities measured at all considered grid points.

(3) No deviations are acceptable in the main beam pattern when the lighting fixture is properly aimed.

(4) Average intensity ratio. The ratio between the average intensity within the ellipse defining the main beam of a typical new light and average light intensity of the main beam of a new runway edge light is to be as follows:

<table>
<thead>
<tr>
<th>Figure</th>
<th>Light Description</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1</td>
<td>Low intensity runway edge lights</td>
<td>1.0 (white light)</td>
</tr>
<tr>
<td>Figure 2</td>
<td>Medium intensity runway edge lights</td>
<td>1.0 (white light)</td>
</tr>
<tr>
<td>Figure 3</td>
<td>High intensity runway edge lights</td>
<td>1.0 (white light)</td>
</tr>
<tr>
<td></td>
<td>(where the width of runway is 30-45m)</td>
<td></td>
</tr>
<tr>
<td>Figure 4</td>
<td>High intensity runway edge lights</td>
<td>1.0 (white light)</td>
</tr>
<tr>
<td></td>
<td>(where the width of runway is 60m)</td>
<td></td>
</tr>
<tr>
<td>Figure 5</td>
<td>High intensity threshold lights</td>
<td>1.0 to 1.5 (green light)</td>
</tr>
<tr>
<td>Figure 6</td>
<td>High intensity threshold wing bar lights</td>
<td>1.0 to 1.5 (green light)</td>
</tr>
<tr>
<td>Figure 7</td>
<td>High intensity runway end lights</td>
<td>0.25 to 0.5 (red light)</td>
</tr>
<tr>
<td>Figure 8</td>
<td>High intensity runway centreline lights</td>
<td>0.5 to 1.0 (white light)</td>
</tr>
<tr>
<td></td>
<td>(longitudinal spacing 30m)</td>
<td></td>
</tr>
<tr>
<td>Figure 9</td>
<td>High intensity runway centreline lights</td>
<td>0.5 to 1.0 for CAT III (white light)</td>
</tr>
<tr>
<td></td>
<td>(longitudinal spacing 15m)</td>
<td>to 0.5 for CAT I, II (white light)</td>
</tr>
<tr>
<td>Figure 10</td>
<td>Runway touchdown zone lights</td>
<td>0.5 to 1.0 (white light)</td>
</tr>
</tbody>
</table>

(5) The beam coverages in the figures provide the necessary guidance for approaches down to an RVR of the order of 150m and take-off to an RVR of the order of 100m.

(6) Horizontal angles are measured with respect to the vertical plane through the runway centreline. For lights other than centreline lights, the direction towards the runway centreline is considered positive. Vertical angles are measured with respect to the horizontal plane.
(7) The light units are to be installed so that the main beam is aligned within one-half degree of the specified requirement.

(8) On the perimeter of and within the ellipse defining the main beam, the maximum light intensity is not to be greater than three times the minimum light intensity value measured.

---

**Figure 1:** Isocandela Diagram for Omnidirectional Runway Edge Light - Low Intensity Runway Lighting System
Figure 2:  Isocandela Diagram for Omnidirectional Runway Edge Light - Medium Intensity Runway Lighting System
Chapter 12
Aerodrome Lighting

Figure 3: Isocandela Diagram for High Intensity Runway Edge Lights where the Width of the Runway is 30-45 metres (White Light)
Figure 4: Isocandela Diagram for High Intensity Runway Edge Lights where the Width of the Runway is 60m (White Light)

Notes: 1 Curves calculated on formula \( \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \)
2 Toe-in 4.5 degrees
3 For yellow light multiply values by 0.4
4 See collective notes for Figures 1-10

<table>
<thead>
<tr>
<th></th>
<th>6.5</th>
<th>8.5</th>
<th>10.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>3.5</td>
<td>6.0</td>
<td>8.5</td>
</tr>
</tbody>
</table>
Chapter 12
Aerodrome Lighting

Figure 5: Isocandela Diagram for High Intensity Threshold Lights (Green Light)

Figure 6: Isocandela Diagram for High Intensity Threshold Wing Bar Lights (Green Light)
Chapter 12
Aerodrome Lighting

Notes: 1 Curves calculated on formula \( \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \)
2 See collective notes for Figures 1-10

Figure 7: Isocandela Diagram for High Intensity Runway End Lights (Red Light)
Chapter 12
Aerodrome Lighting

Notes:
1. Curves calculated on formula \( \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \)
2. For red light multiply values by 0.15
3. See collective notes for Figures 1-10

Figure 8: Isocandela Diagram for High Intensity Runway Centreline Lights with 30m LongitudinalSpacing (White Light)
Figure 9: Isocandela Diagram for High Intensity Runway Centreline Lights with 15m Longitudinal Spacing (White Light)
Chapter 12
Aerodrome Lighting

Figure 10: Isocandela Diagram for Runway Touchdown Zone Lights (White Light)

Notes: 1 Curves calculated on formula \( \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \)
2 Toe-in 4.0 degrees
3 See collective notes for Figures 1-10

Figure 11: Method of Establishing Grid Points to be used for the Calculation of Average Intensity of Runway Lights specified by Figures 1 & 2
Figure 12: Method of Establishing Grid Points to be used for the Calculation of Average Intensity of Runway Lights specified by Figures 3, 4, 5, 6, 7, 8, 9 and 10
SECTION 9: APPENDIX II
ILLUSTRATIONS OF RUNWAY LIGHTING

Figure 1: Runway Edge Lights, Threshold Lights and Runway End Lights Low and Medium Intensity for Non-Instrument and Non-Precision Approach Runways
See Figure 3 for detail of runway end lighting.

Elevated unidirectional runway edge light - yellow within last 600m

Inset unidirectional runway edge light - yellow within last 600m

Uniform longitudinal spacing: 60 ± 5m

Elevated unidirectional runway edge light - white

See Figure 3 for detail of runway threshold lighting.

Figure 2: Runway Edge Lights High Intensity for Precision Approach Runways
Chapter 12
Aerodrome Lighting

6 Unidirectional inset lights at equal intervals - red

TYPICAL RUNWAY END LIGHTS
HIGH INTENSITY
FOR PRECISION APPROACH RUNWAYS

Threshold wing bar.
Unidirectional elevated lights - green

TYPICAL RUNWAY THRESHOLD LIGHTS WITH THRESHOLD WING BARS
HIGH INTENSITY
FOR PRECISION APPROACH RUNWAYS

Unidirectional inset lights at equal intervals of not more than 3m - green

Unidirectional elevated lights - green

TYPICAL RUNWAY THRESHOLD LIGHTS
HIGH INTENSITY
FOR PRECISION APPROACH RUNWAYS

Figure 3 : Typical Runway Threshold and Runway End Lights High Intensity for Precision Approach Runways
Equal intervals

This part of the runway located before the displaced threshold is available for aircraft use, i.e. for take-off, and landings from the opposite direction.

Figure 4: Typical Temporarily Displaced Threshold
Runway end (and threshold) lights. Inner lights must be inset.

Figure 5: Typical Stopway Lights
Where distance 'A' is longer than 30m, equally spaced lights not exceeding 30m spacing to be included.

* Blue edge lights at the start of the splay to be omitted where runway edge lights are located within 10m of start of splay.

**Figure 6: Typical Turning Area Edge Lights**
Figure 7: Typical Light Layout Where Runway Pavement is 23m or 18m wide
SECTION 10: APPENDIX I

ISOCANDELA DIAGRAMS FOR TAXIWAY LIGHTS

Collective notes to Figures

1. Figures 1 to 5 show candela values in green and yellow for taxiway centreline lights and red for stop bar lights.

2. Figures 1 to 5 show the minimum allowable light intensities. The average intensity of the main beam is calculated by establishing grid points as shown in Figure 7 and using the intensity values measured at all grid points located within and on the perimeter of the rectangle representing the main beam. The average value is the arithmetic average of the light intensities measured at all considered grid points.

3. No deviations are acceptable in the main beam when the lighting fixture is properly aimed.

4. Horizontal angles are measured with respect to the vertical plane through the taxiway centreline except on curves where they are measured with respect to the tangent to the curve.

5. Vertical angles are measured from the longitudinal slope of the taxiway surface.

6. The light unit is to be installed so that the main beam is aligned within one-half degree of the specified requirement.

7. On the perimeter of and within the rectangle defining the main beam, the maximum light intensity value is not to be greater than three times the minimum light intensity measured.
Chapter 12
Aerodrome Lighting

Notes: 1 The intensities values have taken into account high background luminance, and possibility of deterioration of light output resulting from dust and local contamination.
2 Where omnidirectional lights are used they must comply with the vertical beam spread requirements in this figure.
3 These beam coverages allow for displacement of the cockpit from the centre line up to distance of the order of 12m as could occur at the end of curves.
4 See collective notes for these isocandela diagrams.

Figure 1: Isocandela Diagram for Taxiway Centreline Lights, and Stop Bar Lights, on Straight Sections of Taxiways intended for use in conjunction with a Non-Precision or Precision Approach Category I or II Runway

Notes: 1 The intensities values have taken into account high background luminance, and possibility of deterioration of light output resulting from dust and local contamination.
2 Lights on curves to have light beam toeled-in 15.75 degrees with respect to the tangent of the curve.
3 These beam coverages allow for displacement of the cockpit from the centre line up to distance of the order of 12m as could occur at the end of curves.
4 See collective notes for these isocandela diagrams.

Figure 2: Isocandela Diagram for Taxiway Centreline Lights, and Stop Bar Lights, on Curved Sections of Taxiways intended for use in conjunction with a Non-Precision or Precision Approach Category I or II Runway
Chapter 12
Aerodrome Lighting

Figure 3: Isocandela Diagram for Taxiway Centreline Lights, and Stop Bar Lights, on Taxiway intended for use in conjunction with a Precision Approach Category III Runway — for use on straight sections of taxiway where large offsets can occur.

Notes: 1 These beam coverages are suitable for a normal displacement of the cockpit from the centre line of up to 3m.
2 See the collective notes for these isocandela diagrams.

Figure 4: Isocandela Diagram for Taxiway Centreline Lights, and Stop Bar Lights, for Taxiways intended for use in conjunction with a Precision Approach Category III Runway — for use on straight sections of taxiway where large offsets do not occur.

Notes: 1 These beam coverages are suitable for a normal displacement of the cockpit from the centre line of up to 3m.
2 See the collective notes for these isocandela diagrams.
Figure 5: Isocandela Diagram for Taxiway Centreline Lights, and Stop Bar Lights, for Taxiways intended for use in conjunction with a Precision Approach Category III Runway — for use on curved sections of taxiway.

Figure 6: Isocandela Diagram for Runway Guard Lights
Figure 7: Method of Establishing Grid Points to be used for Calculation of Average Intensity of Taxiway Centreline Lights and Stop Bar Lights
SECTION 10: APPENDIX II

ILLUSTRATIONS OF TAXIWAY LIGHTING

Figure 1: Typical Taxiway Centreline Lights Layout
Transition from curved to straight taxiway

Transition entering an intersection

Transition entering an intersection

Figure 2: Typical Taxiway Edge Lights Layout