

RA 3515 - Permanent Fixed Wing Aerodrome - Lighting

Rationale

Most Aerodromes have a requirement to operate in all weather conditions and at all times of the day. At night, or in poor visibility conditions by day, lighting can be more effective than marking to enhance the Safety of ► Aircraft ◀ operations. Aeronautical Ground Lights (AGL) provide clear and consistent information and guidance to the aviation community under all operating conditions.

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**Regulation
3515(1)**
Lighting - Scaling

3515(1) Heads of Establishments (HoEs) and Aviation Duty Holder-Facing Organizations (ADH-Facing Organizations) **shall** ensure that the Aerodrome provides a minimum level of AGL to support ►Aircraft◀ movements during low visibility and night operations.

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3515(1)**
Lighting - Scaling

1. An Aerodrome Operator **should** establish and publish Operating Minima for an Aerodrome's operation. Minimum prescribed scales of AGL **should** be in accordance with (iaw) Table 1.

Table 1. Minimum Prescribed Scale of AGL.

	Operating Category			
	CAT II Precision App	CAT I Precision App ^a	Non-Precision App	Non-Instrument App
Illuminated Wind Direction Indicator	O►b◄	O►b◄	O►b◄	O►b◄
Aerodrome Beacon	R	R	R	R
Simple Approach	-	-	R	O
HI C/L 5 Bar Approach	R	R	-	-
Supplementary Approach	R	-	-	-
Precision Approach Path Indicator (PAPI)	R	R	R	R
Runway Edge	R	R	R	R
Threshold	R	R	R	R
Threshold Wing Bar	O	O	O	O
Runway End	R	R	R	R
Runway Centreline	R	O►c◄	-	-
Touchdown Zone	R	-	-	-
Stopway	R	R	R	R
Taxiway Centreline	R	O►d◄	-	-
Taxiway Edge	-	O►d◄	R	R
Stop Bars	R	-	-	-
Runway Guard Lights	R	-	-	-
Illuminated Runway Signs	R	R	R	O
Obstacle ►Lighting◄	R	R	R	R
Alternate Power Supply	R	R	R	O
KEY R = Required, O = Operationally Desirable, C/L = Centreline, HI = High Intensity, LI = Low Intensity App = Approach, PAR = Precision Approach Radar				

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- a. If a Runway is declared as a Precision Approach Runway, through having a PAR, then it **should** have corresponding levels of lighting relative to the declared operating minima at the Aerodrome.
- b. ► **At least one illuminated wind direction indicator should be provided where there is a requirement for night flying.**
- c. **Runway centreline lighting should be provided on Runways intended to be used for take-off with an operating minimum below a Runway Visual Range (RVR) of 400 m. ◀**
- d. Taxiway edge lighting may be replaced by taxiway centreline lighting.

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Material
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Lighting - Scaling

2. Where the prescribed AGL requirements cannot be provided there may be a consequential penalty on operational minima.
3. It is noted that all Runways at an Aerodrome may not be required to have the same scale of visual aids. ► **This RA** ◀ requires the scale of visual aids be determined according to the Operating Minima, Nature and Types of ► **Aircraft** ◀ operations.
4. Light emitting diode (LED) fittings may be used on Runway, approach, Apron, taxiways, signage, road-holding position lights, Runway guard lights and stop bars, provided that an assessment of the impact on Night Vision Device (NVD) operations is carried out.
5. The energy savings of LED are due in large part to the fact that they do not produce the infra-red heat signature of incandescent lamps. Aerodrome Operators who have come to expect the melting of ice and snow by this heat signature may wish to evaluate whether a modified Maintenance schedule is required during such conditions or evaluate the possible operational value of installing LED fixtures with heating elements.
6. Enhanced vision systems (EVS) technology relies on the infra-red heat signature provided by incandescent lighting. International Civil Aviation Organization (ICAO) Annex 15¹ protocols provide an appropriate means of notifying Aerodrome users of EVS when lighting systems are converted to LED.
7. Centreline lighting may be provided on taxiways with a width greater than 18 m.

**Regulation
3515(2)**

Lighting - Dangerous or Confusing Lights

- 3515(2) HoEs and ADH-Facing Organizations **shall** ensure that, wherever possible, any non-AGL on or near an Aerodrome which might endanger the Safety of ► **Aircraft** ◀ is extinguished, screened or otherwise modified to eliminate the Hazard.

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3515(2)**

Lighting - Dangerous or Confusing Lights

8. Attention **should** be directed to the following areas²:
 - a. Instrument Runway - Code Number 4-6:
 - (1) Within the areas before the threshold and beyond the end of the Runway extending at least 4500 m in length from the threshold and Runway end and 750 m either side of the extended Runway centreline in width.
 - b. Instrument Runway - Code Number 2 or 3:
 - (1) Within the areas before the threshold and beyond the end of the Runway extending at least 3000 m in length from the threshold and

¹ ICAO Annex 15 – Aeronautical Information Services.

² Refer to RA 3510 – Permanent Fixed Wing Aerodrome - Reference Information for information on Aerodrome Reference Codes.

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- Runway end and 750 m either side of the extended Runway centreline in width.
- c. Instrument Runway - Code Number 1 and Non-Instrument Runway:
- (1) Within the approach area.
9. Floodlighting within the areas described in paragraph 8 **should not** allow upward emission of light.
10. Floodlights **should not** be installed where they may obscure the view of the manoeuvring area from the ► Visual Control Room.◀
11. Outside the areas described in paragraph 8, floodlighting **should** be limited as follows:
- 0° elevation above horizontal: maximum intensity 1000 cd.
 - Up to 10° elevation above horizontal: maximum intensity 500 cd.
 - Up to 15° elevation above horizontal: maximum intensity 250 cd.
 - Over 30° elevation above horizontal: maximum intensity 100 cd.
12. Street lighting intensities within the areas described in paragraph 8 **should not** allow upward emission of light.
13. Where the pattern of street lighting may be confused with the AGL, in which case no upward light is permitted, outside the areas described in paragraph 8, street lighting **should** be limited as follows,
- 0° elevation above horizontal: maximum intensity 750 cd.
 - Up to 2° elevation above horizontal: maximum intensity 300 cd.
 - Up to 4° elevation above horizontal: maximum intensity 95 cd.
 - Up to 6° elevation above horizontal: maximum intensity 75 cd.
 - Up to 10° elevation above horizontal: maximum intensity 60 cd.
 - Up to 30° elevation above horizontal: maximum intensity 30 cd.
 - Up to 40° elevation above horizontal: maximum intensity 20 cd.
 - Up to 50° elevation above horizontal: maximum intensity 10 cd.
 - Over 60° elevation above horizontal: maximum intensity 0 cd.

**Guidance
Material
3515(2)**

Lighting - Dangerous or Confusing Lights

14. Nil.

**Regulation
3515(3)**

Approach Lighting - Obstacle Profile

- 3515(3) HoEs and ADH-Facing Organizations **shall** ensure that objects are restricted from protruding into the Approach Light Plane.

**Acceptable
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Compliance
3515(3)**

Approach Lighting - Obstacle Profile

15. The Approach Light Plane **should** extend:
- 60 m beyond the approach end of the light system; and
 - 60 m horizontally either side of the centreline of the system.
16. The Approach Centreline Light profile **should**:
- Have a vertical profile limit no greater than 1 in 66 rise and no less than 1 in 66 fall for the first 300 m, and 1 in 40 fall thereafter;
 - Have a lateral gradient of the centreline lights in each crossbar no greater than 1 in 80 with the mid-point in the plane of the centreline lights; and the

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3515(3)**

gradients of the centreline in any section (including a stopway or clearway) be as small as practicable. The changes in gradients **should** be as few and small as can be arranged and **should not** exceed 1 in 60³.

c. No obstacle **should** penetrate the Approach Light Plane apart from Instrument Landing System (ILS) azimuth antenna. The antenna **should** be treated as an obstacle and lighted accordingly.

d. Within a stopway or clearway, and within 150 m of the end of a Runway, the lights **should** be mounted as near to the ground as local conditions permit in order to minimize Risk of damage to ► **Aircraft** ◀ in the event of an overrun or undershoot. Beyond the stopway and clearway, it is not so necessary for the lights to be mounted close to the ground, and therefore undulations in the ground contours can be compensated for by mounting the lights on poles of appropriate height.

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Approach Lighting - Obstacle Profile

17. An area referred to as the light plane has been established for obstacle clearance purposes, and all lights of the system are in this plane. This plane is rectangular in shape and symmetrically located about the approach lighting system's centreline.

18. No objects are permitted to exist within the boundaries of the light plane which are higher than the light plane except as designated herein. All roads and highways are considered as obstacles extending 4.8 m above the crown of the road, except Aerodrome service roads where all vehicular traffic is under control of the Aerodrome authorities and coordinated with ► **Air Traffic Control (ATC)**. ◀ Railroads, regardless of the amount of traffic, are considered as obstacles extending 5.4 m above the top of the rails.

19. Objects existing within the boundaries of the light plane, requiring the light plane to be raised to meet the criteria contained herein, need to be removed, lowered or relocated where this can be accomplished more economically than raising the light plane.

20. In some instances, objects may exist which cannot be removed, lowered or relocated economically. These objects may be located so close to the threshold that they cannot be cleared by the 2% slope. Where such conditions exist and no alternative is possible, the 2% slope may be exceeded or a "stair step" resorted to in order to keep the approach lights above the objects. Such "step" or increased gradients may be resorted to only when it is impracticable to follow standard slope criteria, and they need to be held to the absolute minimum. Under this criterion no negative slope is permitted in the outermost portion of the system.

21. Where an ILS localiser is installed within the light plane boundaries, it is recognized that the localiser may extend above the light plane.

Civil Equivalence.

22. This Regulation is in line with ICAO Annex 14 Vol I section 5.3.4 and Attachment A sections 12.1 – 12.4.

**Regulation
3515(4)**

Aeronautical Beacons - Identification Beacons

3515(4) HoEs and ADH-Facing Organizations **shall** ensure that an Aeronautical Identification Beacon is provided at an Aerodrome that is intended for use at night.

³ Experience has shown that as one proceeds outwards from the Runway, rising gradients in any section of up to 1 in 66, and falling gradients of down to 1 in 40, are acceptable.

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3515(4)**

Aeronautical Beacons - Identification Beacons

23. An Aeronautical Identification Beacon **should**:
- Be located on or adjacent to the Aerodrome in an area of low ambient background lighting;
 - Be located such that the beacon is not shielded by objects and does not dazzle a pilot ► **conducting an approach to the landing surface**; ◀
 - Flash in red a 2 letter Morse code symbol as promulgated in the Military Aeronautical Information Publications (AIP);
 - Show in all angles of azimuth and the vertical light distribution will extend upwards from an elevation of not more than 1°;
 - Have an intensity not less than 2000 cd in white; and
 - Have a speed of transmission of between 6 to 8 words per minute.

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Material
3515(4)**

Aeronautical Beacons - Identification Beacons

Civil Equivalence.

24. This Regulation is in line with ICAO Annex 14 Vol I para 5.3.3.

**Regulation
3515(5)**

Approach Lighting - Simple Approach Lighting System

- 3515(5) HoEs and ADH-Facing Organizations **shall** ensure that a simple approach lighting system is provided to serve a non-precision approach Runway, except when the Runway is used only in conditions of good visibility or sufficient guidance is provided by other visual aids.

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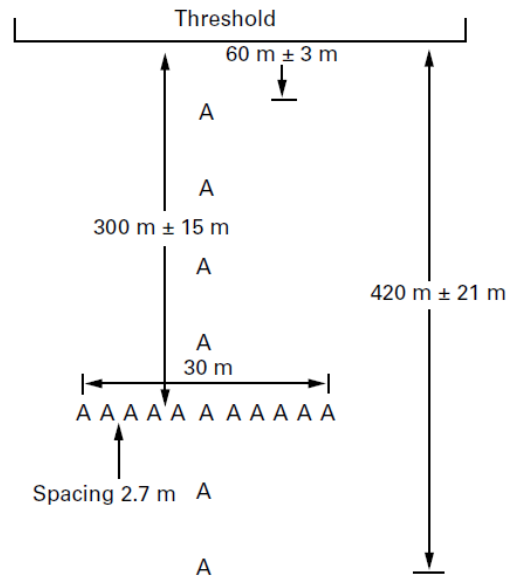
Approach Lighting - Simple Approach Lighting System

25. For a non-instrument Runway intended for use at night, a simple approach lighting system **should** be provided.
26. For a non-precision approach Runway intended for use at night, a simple approach lighting system **should** be provided.
27. A Simple Approach Lighting System **should**:
- Consist of a row of lights on the extended centreline of the Runway extending over a distance of not less than 420 m from the threshold with a row of lights forming a crossbar 30 m in length at a distance of 300 m from the threshold (Figure 1).
 - Have crossbar lights that:
 - Are as close as practicable in a horizontal straight line at right angles to, and bisected by, the line of the centreline lights;
 - Are spaced to produce a linear effect, except that, when a crossbar of 30 m is used, gaps may be left on each side of the centreline. These gaps **should** be kept to a minimum to meet local requirements, and each **should** be no greater than 6 m; and
 - Are spaced laterally 2.7 m apart.
 - Have centreline lights that:
 - Are placed at longitudinal intervals of 60 m;
 - Have the innermost light located 60 m from the threshold; and
 - Are a single source or a barrette with a minimum length of 3 m.
 - Be fixed lights showing variable white;

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- e. Where provided for a non-instrument Runway, show at all angles in azimuth necessary to a pilot on base leg and final approach;
- f. Where provided for a non-precision approach Runway, show at all angles in azimuth necessary to the pilot of an ► Aircraft ◀ which on final approach does not deviate by an abnormal amount from the path defined by the non-visual aid; and
- g. Have a suitable intensity control to allow adjustment to meet the prevailing conditions and to avoid dazzling the pilot during approach and landing.

Figure 1. Simple Approach Lighting System.



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3515(5)**

Approach Lighting - Simple Approach Lighting System

28. When it is desired to improve the guidance, centreline light spacing interval of 30 m may be used.
29. The colour of the lights is to ensure that the system is readily distinguishable from other AGL, and from extraneous lighting if present.
30. If it is not physically possible to provide a centreline extending for 420 m from the threshold, it could be extended to 300 m in order to include the crossbar. If this is not possible, the centreline lights ► will ◀ be extended as far as practicable, and each centreline light will then consist of a barrette at least 3 m in length. Subject to the approach system having a crossbar at 300 m from the threshold, an additional crossbar may be provided at 150 m from the threshold.

Civil Equivalence.

31. This Regulation is in line with ICAO Annex 14 Vol I sections 5.3.4.4 – 5.3.4.7.

**Regulation
3515(6)**

Approach Lighting - High Intensity Centreline and Crossbar Approach System

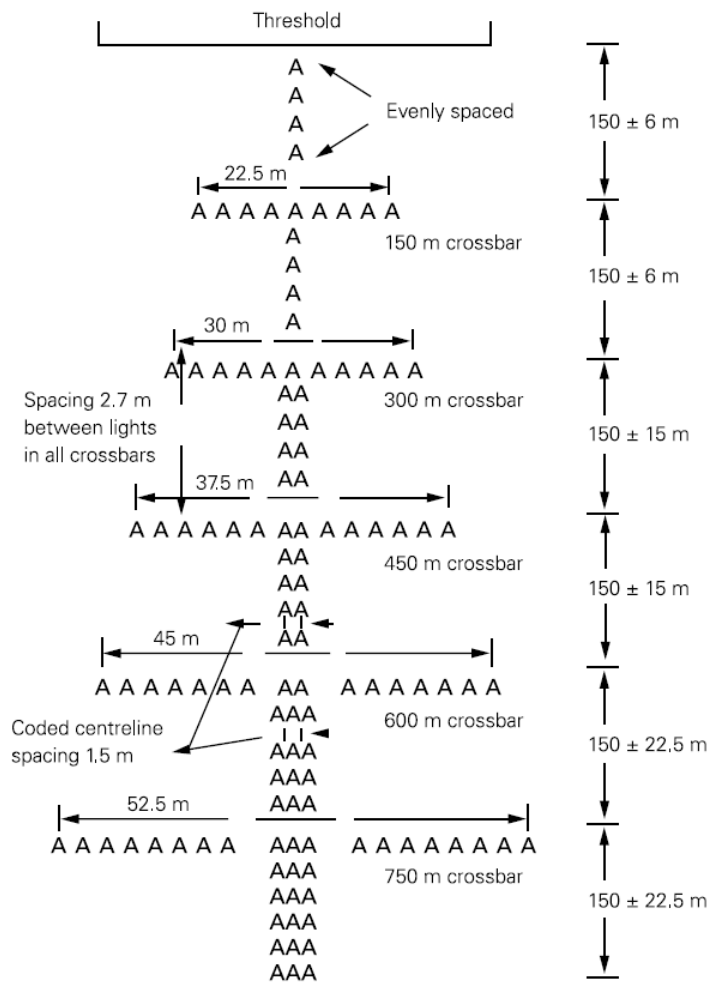
- 3515(6) HoEs and ADH-Facing Organizations **shall** ensure that a High Intensity Centreline and 5 crossbars approach lighting system is provided to serve a precision approach Runway Category I.

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Approach Lighting - High Intensity Centreline and Crossbar Approach System

- 32. For a CAT I precision approach Runway, a High Intensity Centreline and Crossbar Approach Lighting System **should** be provided.
- 33. A High Intensity Centreline and Crossbar Approach System **should**:
 - a. Consist of a 900 m line of white lights, on the extended centreline of the Runway;
 - b. Have five crossbars at 150 m intervals decreasing in width towards the Runway threshold; lines through the outer lights of the bars **should** converge to meet the Runway centreline 300 m upwind from the threshold (Figure 2); and
 - c. Have a suitable intensity control to allow adjustment to meet the prevailing conditions and to avoid dazzling the pilot during approach and landing (minimum of five stages of luminous intensity).
- 34. The approach lights forming the crossbar **should** be placed as **► much ◀** as practicable in a horizontal straight line at right angles to, and bisected by, the line of the centreline lights.

Figure 2. High Intensity Centreline and Crossbar Approach System



**Guidance
Material
3515(6)****Approach Lighting - High Intensity Centreline and Crossbar Approach System**

35. Terrain or other constraints may limit the length or type of approach lighting that can be installed to less than that specified. In such circumstances, a lesser length may be acceptable, subject to Exemption / Waiver from the MAA, but may incur a penalty on Aerodrome operating minima.

Civil Equivalence.

36. This Regulation is in line with ICAO Annex 14 Vol I sections 5.3.4.10 - 5.4.21.

**Regulation
3515(7)****Approach Lighting - Supplementary Approach Lighting**

3515(7) HoEs and ADH-Facing Organizations **shall** ensure that a supplementary approach lighting system and High intensity centreline with 5 crossbar system is provided for precision approach CAT II and CAT III operations.

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3515(7)****Approach Lighting - Supplementary Approach Lighting**

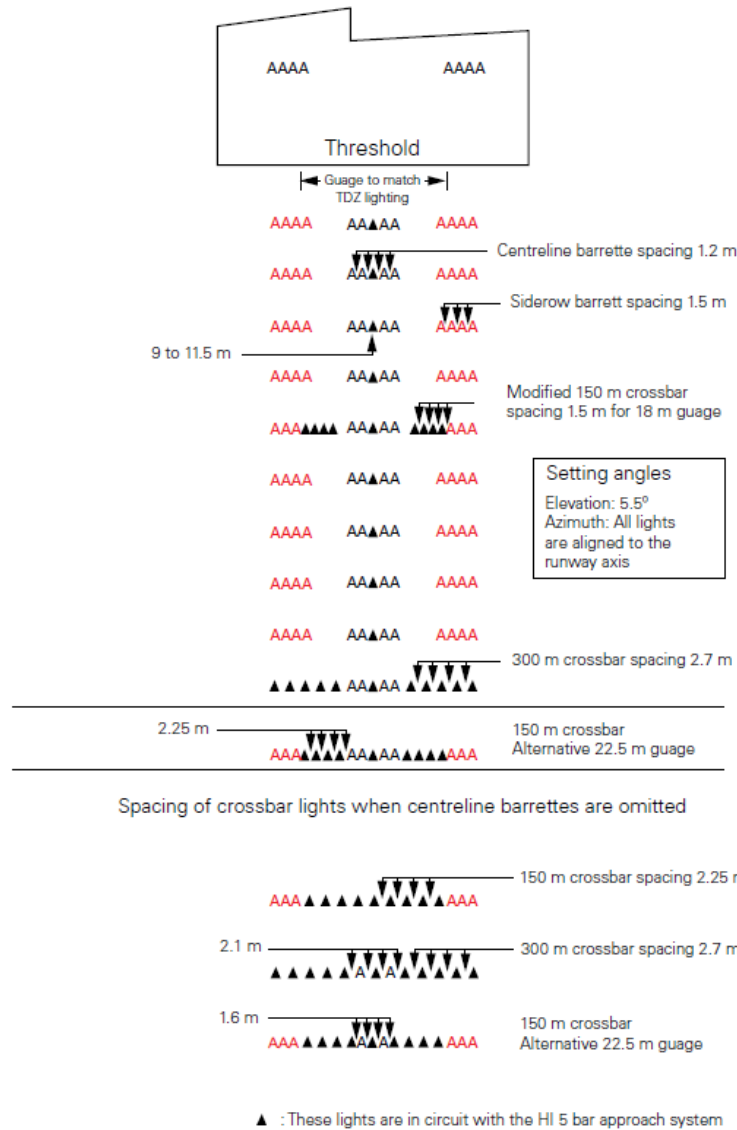
37. For CAT II and III precision approach Runways, a high intensity centreline and crossbar approach system with supplementary approach lighting **should** be provided.

38. Supplementary Approach Lighting **should**:

- a. Consist of two additional white lights on each side of the centreline light forming rows along the inner 300 m of the approach centreline, the lights in each row being spaced 1.2 m apart as shown in Figure 3;
- b. Have red side rows of four lights spaced 1.5 m apart on each side of each centreline row over the inner 270 m of the approach lighting system;
- c. Have the red side row lights set at the same lateral spacing (gauge) as the touchdown zone lights;
- d. At the crossbar 150 m from the threshold, have a lateral spacing of 2.25 m to fill the gap between the centreline and side row lights; and
- e. Have a suitable intensity control to allow adjustment to meet the prevailing conditions and to avoid dazzling the pilot during approach and landing (minimum of 3 stages of luminous intensity).

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Figure 3. Supplementary Approach Lighting



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Approach Lighting - Supplementary Approach Lighting Civil Equivalence.

39. This Regulation is in line with ICAO Annex 14 Vol I para 5.3.4.22 – 5.3.4.39 as applicable.

Regulation 3515(8)

Approach Lighting - Precision Approach Path Indicator

3515(8) HoEs and ADH-Facing Organizations **shall** ensure that a PAPI is installed to provide an accurate depiction of an appropriate approach angle to maintain a safe height over obstacles and the threshold.

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Approach Lighting - Precision Approach Path Indicator

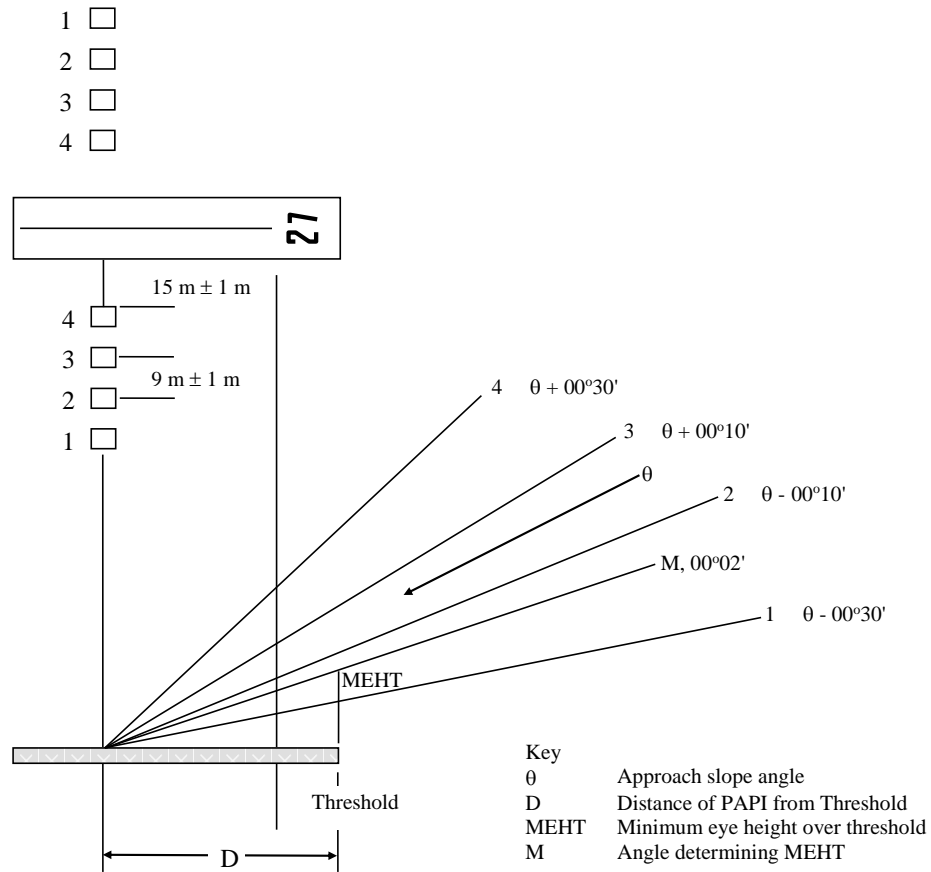
40. The PAPI installation **should**:
- a. Consist of 4 sharp transition multi-lamp units located as a wing bar equally spaced, on each side of the Runway ►so that the wing bars appear opposite each other: ◀
 - (1) The inner light unit **should** be 15 m +/-1 m from the Runway edge. No unit **should** be closer than 14 m to any taxiway, Apron, or another Runway;

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- (2) The spacing between the light units **should** be 9m +/- 1 m;
- b. Be constructed and arranged in such a manner that a pilot making an approach **should**:
- (1) 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;
- (2) When above the approach slope, see the one unit nearest the Runway as red and the three units farthest from the Runway as white; and when further above the approach slope, see all the units as white; and
- (3) 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;
- c. Have the units forming the wing bar mounted to appear to the pilot of an approaching ►Aircraft◀ to be substantially in a horizontal line;
- d. Have the corresponding light units of the wing bars installed either side of the Runway, set at the same angle so that the signals of each wing bar change symmetrically at the same time;
- e. Have an approach slope as defined in Figure 4 appropriate for use by the ►Aircraft◀ using the approach;
- f. Where the Runway is equipped with a precision approach, have the siting and the angle of elevation of the light units such that the visual approach slope conforms as closely as possible with the glide path of the precision approach;
- g. Have the angle of elevation settings of the light units in a PAPI wing bar such that, during an approach, the pilot of an ►Aircraft◀ observing a signal of one white and three reds will clear all objects in the approach area by a safe margin;
- h. Be mounted as low as possible with the following constraints:
- (1) PAPI units **should** be the minimum practical height above ground and not normally above 0.9 m;
- (2) The units of a wing bar **should** all lie in the same horizontal plane, but where cross falls make this impracticable within the 0.9 m constraint, the height difference between adjacent units **should not** exceed 5 cm. Where even this tolerance cannot be achieved, a maximum gradient of 1.25% across the bar may be accepted if it is uniform;
- i. Have concrete bases either depressed below ground level and covered with a suitable infill, or flush fitted;
- j. Be frangible;
- k. Be suitable for day and night operations; and
- l. Have a suitable intensity control to allow adjustment to meet the prevailing conditions and to avoid dazzling the pilot during approach and landing.

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Figure 4. Approach Slope Definition



Example settings for a 3° approach:

Unit number	1 = 2° 30'
	2 = 2° 50'
	3 = 3° 10'
	4 = 3° 30'

If the PAPI is associated with an ILS:

Unit number	1 = 2° 25'
	2 = 2° 45'
	3 = 3° 15'
	4 = 3° 35'

41. The distance of the PAPI from the Runway threshold **should** be based upon the following:

a. The need to provide adequate wheel clearance over the threshold of a non-instrument or non-precision instrument approach Runway for the most demanding of the ► Aircraft ◀ regularly using the Runway, having due regard to the length of Runway available for stopping the ► Aircraft; ◀

(1) Wheel clearance over the threshold **should** take account of the eye-to-wheel height of the most demanding ► Aircraft ◀ when it is at the lowest possible on-slope signal from the PAPI;

(2) The angle which establishes the Minimum Eye Height over Threshold (MEHT) **should** be two minutes of arc less than the setting angle of the unit defining the lower on-slope boundary as per Figure 4. Where a Runway is not equipped with ILS, MEHT **should** provide the wheel clearances specified in Table 2. The MEHT **should** be the combination of the eye-to-wheel height and the desired wheel clearance;

b. The operational requirement that PAPI be compatible with the instrument glide path down to the minimum possible range and height for the types of ► Aircraft ◀ for which the Runway is intended.

(1) PAPI **should** be sited so that its on-slope signal conforms as closely as possible to that of the instrument glide path. Variables that **should** be

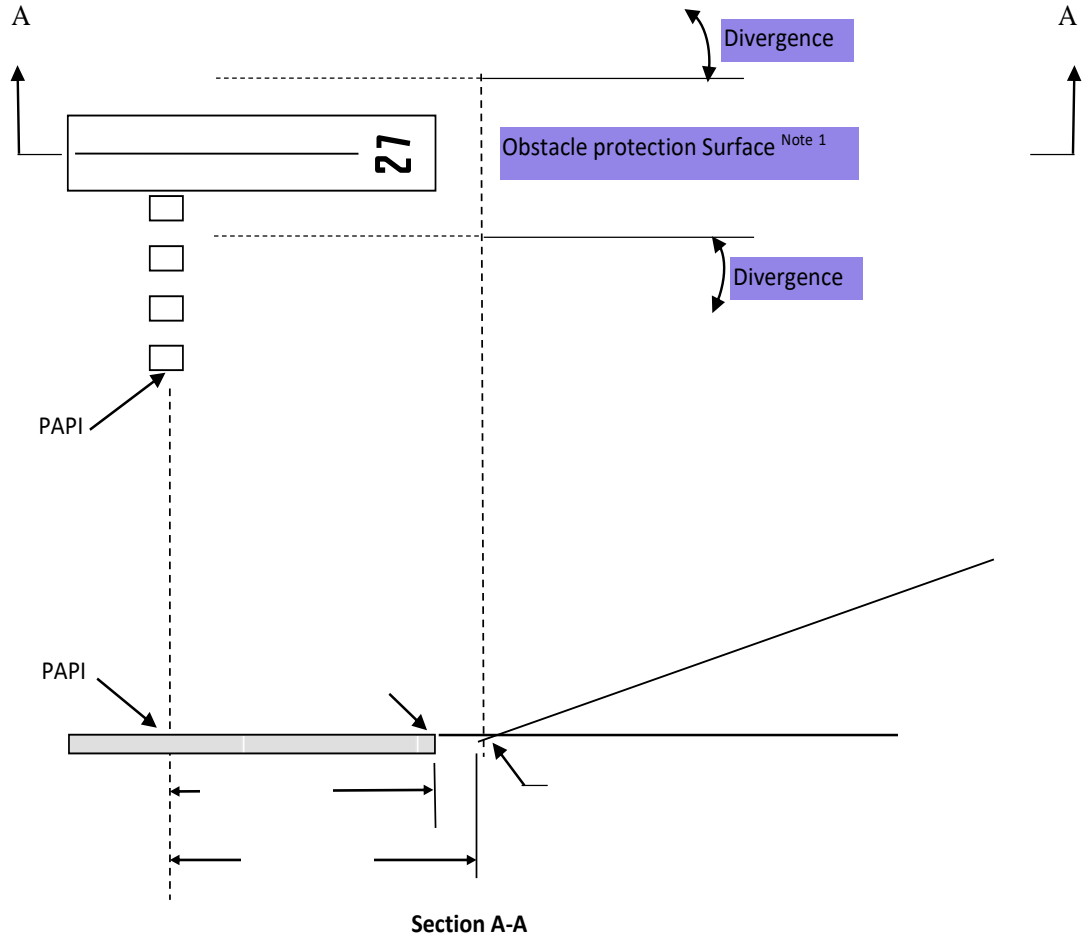
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considered are fluctuations of the instrument glide path and the different eye-to-aerial height of various types of **► Aircraft; ◀**

c. Any difference in elevation between the PAPI units and the Runway threshold. Any height difference between the light unit and the threshold more than 0.3 m **should** be corrected.

42. An Obstacle Protection Surface **should** be established as per Figure 5.

Figure 5 – Obstacle protection Surface for Visual Approach Slope Indicator Systems



Notes:

- 1 Refer to ICAO Annex 14 Vol 1 Table 5.3 & Figure 5.19
- 2 Refer to ICAO Annex 14 Vol 1 Figure 5.19
- 3 Refer to ICAO Annex 14 Vol 1 Table 5.3

Table 2. Wheel clearance over threshold for PAPI and (A)PAPI

Eye-to-wheel height of ► Aircraft ◀ in the approach configuration ►a◀	Desired wheel clearance ►b, c◀ (metres)	Minimum wheel clearance ►d◀ (metres)
(1)	(2)	(3)
up to but not including 3 m	6	3 ►e◀
3 m to but not including 5 m	9	4
5 m to but not including 8 m	9	5
8 m to but not including 14 m	9	6

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- ^a In selecting the eye-to-wheel height group, only Aircraft meant to use the system on a regular basis **should** be considered. The most demanding amongst such Aircraft **should** determine the eye-to-wheel height group.
- ^b Where practicable the desired wheel clearances shown in column (2) **should** be provided.
- ^c The wheel clearances in column (2) may be reduced to no less than those in column (3) where an aeronautical study indicates that such reduced wheel clearances are acceptable.
- ^d When a reduced wheel clearance is provided at a displaced threshold it **should** be ensured that the corresponding desired wheel clearance specified in column (2) will be available when an Aircraft at the top end of the eye-to-wheel height group chosen overflies the extremity of the Runway.
- ^e This wheel clearance may be reduced to 1.5 m on Runways used mainly by lightweight non-turbojet Aircraft. ◀

43. The PAPI light units **should**:
- Have a light intensity distribution iaw RA 3515(29);
 - Have a colour transition from red to white in the vertical plane appear to an observer, at not less than 300 m, to occur within a vertical angle of not more than ►3';◀
 - At full intensity, have a red light Y coordinate not exceeding 0.320;
 - Be capable of adjustment in elevation so that the lower limit of the white part of the beam may be fixed at any desired angle of elevation between 1° 30' and at least 4° 30' above the horizontal;
 - Be so designed that deposits of condensation, snow, ice, dirt, etc., on optically transmitting or reflecting surfaces interfere to the least possible extent with the light signals and **should not** affect the contrast between the red and white signals and the elevation of the transition sector; and
 - Have the azimuth spread of the light beam adjusted where an object located outside the obstacle protection surface of the PAPI system, but within the lateral limits of its light beam, is found to extend above the plane of the obstacle protection surface and an aeronautical study indicates that the object could adversely affect the Safety of operations. The extent of the restriction **should** be such that the object remains outside the confines of the light beam.

Guidance Material 3515(8)

Approach Lighting - Precision Approach Path Indicator

44. A spacing of 6 m (±1 m) between PAPI units may be used on a Runway with code numbers 1 or 2. In such an event, the inner PAPI unit needs to be located not less than 10 m (±1 m) from the Runway edge.
45. An ILS glide path has a tolerance of ±0.075 of the nominal glide path angle for a Category I or II system and of ±0.04 for a Category III. For a nominal 3° glideslope the tolerances are ±13.5 and ±7.2 min of arc respectively. The standard PAPI settings define a glideslope within ±10 min of arc and can therefore show a variation from a nominal ILS glideslope that is operating within its tolerances.
46. Flight crew's pilot's eye-to-aerial height varies considerably with ►Aircraft◀ type and will affect the minimum range to which PAPI and ILS harmonisation is achieved. To allow for the full range of ►Aircraft,◀ harmonisation may be enhanced by widening the on-slope sector from 20 min to 30 min of arc. The ILS glide path angle may vary, so it is desirable to check the calibrated ILS Glide Path angle against the PAPI settings and to change the latter if necessary.
47. When the required approach angle and associated unit setting angles have been determined, the parameters are applied as follows:
- To provide the appropriate wheel clearance over the threshold of a non-instrument or non-precision instrument approach Runway, the distance of PAPI from the threshold is established by adding the approach configuration eye-to-wheel height of ►Aircraft◀ for which the Runway is intended to the required

**Guidance
Material
3515(8)**

threshold wheel clearance and dividing the result by the tangent of angle M in Figure 4.

b. Where ILS is installed the PAPI will need to be sited upwind of the effective ILS glide path origin by a distance that is dependent upon the range of eye-to-aerial heights of the ►Aircraft◀ using the Runway.

c. For further information regarding the Obstacle Protection Surface (OPS) see ICAO Annex 14 Vol 1 Table 5-3.

d. The OPS, its origin and divergence, are determined iaw Figure 5. The OPS is to be examined to confirm the absence of infringements. If the surface is penetrated but the offending object cannot be removed, the vertical extent of the infringement is divided by the tangent of the OPS angle, and the PAPI relocated that much further from the threshold. Alternatively, where a prescribed approach angle is not critical, it may be increased by the angular extent of the infringement. In some circumstances a combined displacement and angular increase may be the best solution.

e. A height difference between threshold and unit lens centres exceeding 0.3 m will require a siting adjustment as follows:

(1) In Figure 6 the uncorrected visual aiming point is shown as the distance D_1 from the threshold. The nominal siting of PAPI would be on a line at right angles to the Runway centreline at this distance, the units being P_1 , P_2 , P_3 and P_4 .

(2) The height difference between the threshold (T_h), and the lens centre of the highest of the units (P_n) at the nominal sites P_1 to P_4 is determined. The following formula will determine the revised distance from threshold D_2 : $D_1 + (T_h - P_n) \cot \emptyset = D_2$, where \emptyset is the setting angle of the unit at site P_2 , less 2 minutes of arc ($\cot \emptyset$ can be taken as 20 for a 3° approach).

(3) The highest unit level at distance D_2 , (P_c) is compared with P_n . If the difference is 0.3 m or more, the final siting, D_3 , is determined as follows: $D_2 + (P_n - P_c) \cot \emptyset = D_3$.

(4) The MEHT resulting from the level of unit P_2 at D_3 is checked to ensure that it achieves the original target.

48. As approach angles steepen, wider differential settings are needed between units to facilitate approach slope capture and flyability. Those differential settings that have been found to be satisfactory are:

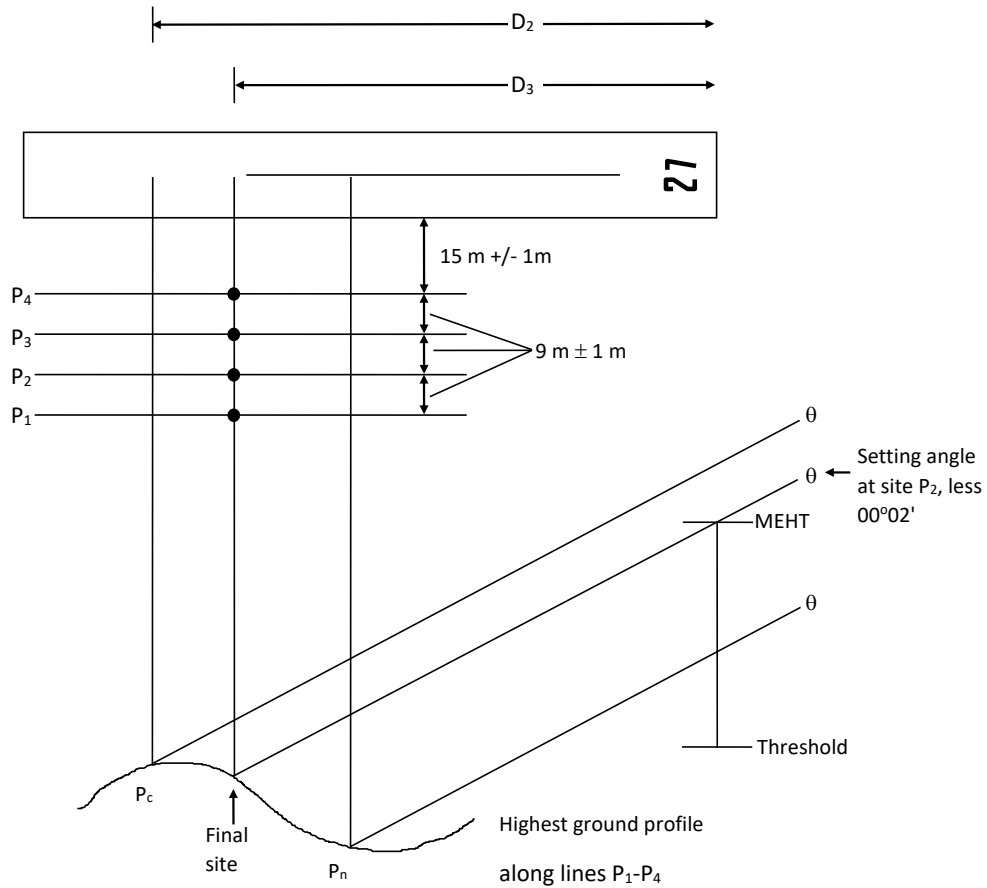
- a. 2-4° approach angle: 20 min differential setting angle (except for ILS);
- b. 4-7° approach angle: 30 min differential setting angle;
- c. Over 7° approach angle: 1° differential setting angle.

Civil Equivalence.

49. This Regulation is in line with ICAO Annex 14 Vol I para 5.3.5.24 – 5.3.5.41.

Guidance Material 3515(8)

Figure 6. PAPI Siting – Principle of Compensation for Different Ground Heights



Regulation 3515(9)

Runway Lights - Runway Edge Lights

3515(9) HoEs and ADH-Facing Organizations **shall** ensure that Runway edge lights are provided for a Runway intended for use at night or for a precision approach Runway intended for use by day or night.

Acceptable Means of Compliance 3515(9)

Runway Lights - Runway Edge Lights

50. Runway edge lights **should**:
 - a. Be placed along the full length of the Runway and **should** be in two parallel rows equidistant from the centreline;
 - b. Be placed along the edges of the area declared for use as the Runway or outside the edges of the area at a distance of not more than 3 m;
 - c. Be uniformly spaced in rows at intervals of not more than 60 m for an instrument Runway, and at intervals of not more than 100 m for a non-instrument Runway;
 - d. For lights on opposite sides of the Runway axis, be on lines at right angles to that axis;
 - e. Where the width of the area which could be declared as Runway exceeds 50 m have a distance between the rows of lights determined considering:
 - (1) The nature of the operations;
 - (2) The light distribution characteristics of the Runway edge lights; and
 - (3) Other visual aids serving the Runway;

**Acceptable
Means of
Compliance
3515(9)**

- f. On a Runway without centreline lighting, a section of the lights 600 m or one-third of the Runway length, whichever is the less, at the remote end of the Runway from the end at which the take-off run is started, **should** show yellow;
- g. Be fixed white lights showing variable white except:
- (1) In the case of a displaced threshold, the lights between the beginning of the Runway and the displaced threshold **should** show red in the approach direction; and
 - (2) A section of the lights 600 m or one-third of the Runway length, whichever is the less, at the remote end of the Runway from the end at which the take-off run is started, may show yellow.
- h. Have intensity and beam spread iaw characteristics specified in RA 3515(29).

51. When the Runway edge lights are intended to provide circling guidance, they **should** show at all angles in azimuth and show at angles up to 15° above the horizontal with an intensity adequate for the conditions of visibility and ambient light in which use of the Runway for take-off or landing is intended. The intensity **should** be at least 50 cd except at an Aerodrome without extraneous lighting, the intensity of the lights may be reduced to not less than 25 cd to avoid dazzling the pilot. Where required, both a high intensity edge light unit and a unit for circling guidance may be collocated or have a combined unit installation.

52. Runway edge lights on a precision approach Runway **should** be iaw the specifications in RA 3515 (29).

**Guidance
Material
3515(9)**

Runway Lights - Runway Edge Lights

53. At intersections of Runways, lights may be spaced irregularly or omitted, provided that adequate guidance remains available to the pilot.

54. To prevent damage occurring to the light units, inset edge lights may be used within the swept area of an ► Aircraft ◀ arresting system.

55. Where required, both a high intensity edge light unit and a unit for circling guidance may be collocated or have a combined unit installation.

56. Where the width of the area which could be declared as Runway exceeds 60 m, the distance between the rows of lights may be determined considering the nature of the operations, the light distribution characteristics of the Runway edge lights, and other visual aids serving the Runway

57. The section of the lights 600 m or one-third of the Runway length, whichever is the less, at the remote end of the Runway from the end at which the take-off run is started, may also show white colour where Runway centreline lights or Illuminated Runway Distance Markers are installed.

58. On a Runway without high intensity lighting system, low intensity omnidirectional Runway edge white lights may have average intensity in a range of 100 cd – 200 cd at angles up to 7° above the horizontal. In addition, the requirements from para 50 are also to be maintained where a circling guidance from these Runway edge light units is required.

Civil Equivalence.

59. This Regulation is in line with ICAO Annex 14 Vol I Section 5.3.9.

**Regulation
3515(10)**

Runway Lights - Runway Threshold Lights

3515(10) HoEs and ADH-Facing Organizations **shall** ensure that Runway threshold lights are provided for a Runway equipped with Runway edge lights, except on a non-instrument or non-precision approach Runway where the threshold is displaced, and wing bar lights are provided.

**Acceptable
Means of
Compliance
3515(10)**

Runway Lights - Runway Threshold Lights

60. Runway threshold lights **should**:
- a. When a threshold is at the extremity of a Runway, be placed in a row at right angles to the Runway axis as near to the extremity of the Runway as possible and, not more than 3 m outside the extremity;
 - b. When a threshold is displaced from the extremity of a Runway, be placed in a row at right angles to the Runway axis at the displaced threshold;
 - c. Be symmetrically disposed about the Runway centreline in two groups, with the lights uniformly spaced in each group and **should** consist of:
 - (1) On a non-instrument or non-precision approach Runway, at least six lights;
 - (2) On a precision approach Runway Category I, at least the number of lights that would be required if the lights were uniformly spaced at intervals of 3 m between the rows of Runway edge lights; and
 - (3) On a precision approach Runway Category II or III, lights uniformly spaced between the rows of Runway edge lights at intervals of not more than 3 m.
 - d. Be fixed unidirectional lights showing green in the direction of approach to the Runway;
 - e. Have intensity and beam spread adequate for the conditions of visibility and ambient light in which use of the Runway is intended; and
 - f. Have luminous intensity compatible with that of the Runway edge lights.
 - g. Have intensity and beam spread law characteristics specified in RA 3515(29).

**Guidance
Material
3515(10)**

Runway Lights - Runway Threshold Lights

61. Where an ► **Aircraft** ◀ arresting system is installed and the threshold lights are located within the hook engagement area (150 m before the barrier) it will be necessary to provide inset light units (fully flush) to avoid hook engagement problems. Where the threshold lights (including Threshold Wing Bars) are installed within the Runway swept area it will be necessary to provide inset light units (semi-flush).

Civil Equivalence.

62. This Regulation is in line with ICAO Annex 14 Vol I Section 5.3.10.

**Regulation
3515(11)**

Runway Lights - Runway Threshold Wing Bar Lights

- 3515(11) HoEs and ADH-Facing Organizations **shall** ensure that Runway threshold wing bar lights are provided on a non-instrument or non-precision approach Runway where the threshold is displaced and Runway threshold lights are required, but are not provided. Runway Threshold Wing bar lights **shall** be provided on a precision approach Runway when additional conspicuity is considered desirable.

**Acceptable
Means of
Compliance
3515(11)**

Runway Lights - Runway Threshold Wing Bar Lights

63. Runway threshold wing bar lights **should**:
- a. Be symmetrically placed about the Runway centreline at the threshold in two groups;
 - b. For each wing bar, be formed by at least five lights extending at least 10 m outward from, and at right angles to, the line of the Runway edge lights, with the innermost light of each wing bar in the line of the Runway edge lights;

**Acceptable
Means of
Compliance
3515(11)**

- c. Be fixed unidirectional lights showing green in the direction of approach to the Runway;
- d. Have intensity and beam spread iaw characteristics specified in RA 3515(29).

**Guidance
Material
3515(11)**

**Runway Lights - Runway Threshold Wing Bar Lights
Civil Equivalence.**

64. This Regulation is in line with ICAO Annex 14 Vol I Section 5.3.10.

**Regulation
3515(12)**

Runway Lights - Runway End Lights

- 3515(12) HoEs and ADH-Facing Organizations **shall** ensure that Runway end lights are provided for a Runway equipped with Runway edge lights.

**Acceptable
Means of
Compliance
3515(12)**

Runway Lights - Runway End Lights

65. Runway End Lights **should**:
- a. Be placed on a line at right angles to the Runway axis as near to the end of the Runway as possible and, in any case, not more than 3 m outside the end;
 - b. Be symmetrically disposed about the Runway centreline in two groups with the lights uniformly spaced in each group and with a gap between the groups of not more than half the distance between the rows of Runway edge lights, and **should** consist of:
 - (1) At least six lights;
 - (2) For a precision approach Runway Category III, have a spacing between Runway end lights, except between the two innermost lights if a gap is used, no greater than 6 m; and
 - (3) Where an arrestor barrier is installed, an additional green light on the Runway centreline with similar characteristics to that of the Runway end lights.
 - c. Be fixed unidirectional lights showing red in the direction of approach to the Runway;
 - d. Have intensity and beam spread iaw characteristics specified in RA 3515(29); and
 - e. Be iaw characteristics specified in RA 3515(29-30).

**Guidance
Material
3515(12)**

**Runway Lights - Runway End Lights
Civil Equivalence.**

66. This Regulation is in line with ICAO Annex 14 Vol I Section 5.3.11.

**Regulation
3515(13)**

Runway Lights - Runway Centreline Lights

- 3515(13) HoEs and ADH-Facing Organizations **shall** ensure that Runway centreline lights are provided on a precision approach Runway Category II or III and on Runways intended to be used for take-off with an operating minimum below a Runway Visual Range (RVR) of ►400◄ m.

**Acceptable
Means of
Compliance
3515(13)**

Runway Lights - Runway Centreline Lights

67. Runway centreline lights **should**:
- Be located along the centreline of the Runway, except that the lights may be uniformly offset to the same side of the Runway centreline by not more than 60 cm where it is not practicable to locate them along the centreline;
 - Be fixed lights showing variable white from the threshold of the Runway to 900 m from the upwind Runway end light position, then the following 600 m **should** be alternate variable white and red lights, and at least the final 300 m to the Runway end light position **should** be all red lights except that for Runways less than 1800 m in length, the alternate red and variable white lights **should** extend from the midpoint of the Runway usable for landing to 300 m from the Runway end light position;
 - Have the electrical circuits for the red and white lights so arranged such that the colour coding is preserved in the event of a circuit failure;
 - Have a spacing between centreline lights of 30 m except that for Category III operations and for take-off in RVR below **▶400◀** m, the spacing **should** be 15 m;
 - Where an **▶Aircraft◀** arresting system is installed be selected to prevent hook engagement problems; and
 - Be in accordance with characteristics specified in RA 3515(29-30).

**Guidance
Material
3515(13)**

Runway Lights - Runway Centreline Lights

68. Centreline guidance for take-off from the beginning of a Runway to a displaced threshold may be provided by:
- An approach lighting system if its characteristics and intensity settings afford the guidance required during take-off, and it does not dazzle the pilot of an **▶Aircraft◀** taking off; or
 - Runway centreline lights; or
 - Barrettes of at least 3 m length, and spaced at uniform intervals of 30 m, designed so that their photometric characteristics and intensity setting afford the guidance required during take-off without dazzling the pilot of an **▶Aircraft◀** taking off.
69. Where necessary, provision needs to be made to extinguish those centreline lights, as prescribed in sub-para b above or reset the intensity of the approach lighting system or barrettes when the Runway is being used for landing. When the Runway is being used for landing centreline lights from the beginning of the Runway to a displaced threshold are not to be lit.
70. Runway centreline lights may be provided on a Runway intended to be used for take-off with an operating minimum of an RVR of **▶400◀** m or higher when used by **▶Aircraft◀** with a very high take-off speed, particularly where the width between the Runway edge lights is greater than 50 m.

Civil Equivalence.

71. This Regulation is in line with ICAO Annex 14 Vol I Section 5.3.12.

**Regulation
3515(14)**

Runway Lights - Runway Touchdown Zone Lights

- 3515(14) HoEs and ADH-Facing Organizations **shall** ensure that touchdown zone lights are provided in the touchdown zone of a precision approach Runway Category II or III.

**Acceptable
Means of
Compliance
3515(14)**

Runway Lights - Runway Touchdown Zone Lights

72. Runway Touchdown Zone lights **should**:
- Consist of barrettes symmetrically disposed either side of the Runway centreline;
 - Extend from the threshold for 900 m or to the midpoint of the Runway, whichever is less;
 - Have barrettes with four white lights spaced not more than 1.5 m apart, the innermost lights being not less than 9 m nor more than 11.5 m either side of the centreline;
 - Have longitudinal spacing between pairs of barrettes of either 30 m or 60 m;
 - Have a lateral gauge of the barrettes equal to that of the Supplementary Approach lighting red side row barrettes; and
 - Be in accordance with characteristics specified in RA 3515(29-30).

**Guidance
Material
3515(14)**

Runway Lights - Runway Touchdown Zone Lights

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

Civil Equivalence.

74. This Regulation is in line with ICAO Annex 14 Vol I para 5.3.13.

**Regulation
3515(15)**

Runway Lights - Stopway Lights

- 3515(15) HoEs and ADH-Facing Organizations **shall** ensure that stopway lights are provided for a stopway intended for use at night.

**Acceptable
Means of
Compliance
3515(15)**

Runway Lights - Stopway Lights

75. Stopway lights **should**:
- Consist of four unidirectional red lights, in the direction of the Runway on a line at right angles to the stopway axis as near to the end of the stopway as possible and, not more than 3 m outside the end;
 - Be equally spaced across the width of the stopway with the outermost light in line with the Runway edge lights;
 - Where marking the edge of the stopway, be placed in pairs of similar red lights at a uniform spacing not exceeding the spacing of Runway edge light and equidistant from the centreline and coincident with the rows of the Runway edge lights;
 - Be in accordance with characteristics specified in RA 3515(29) – (30).

**Guidance
Material
3515(15)**

Runway Lights - Stopway Lights

Civil Equivalence.

76. This Regulation is in line with ICAO Annex 14 Vol I para 5.3.16.

**Regulation
3515(16)**

Taxiway Lights - Taxiway Centreline Lights

- 3515(16) HoEs and ADH-Facing Organizations **shall** ensure that taxiway centreline lights are provided on an exit taxiway, taxiway, de-icing / anti-icing facility, and Apron serving a precision approach Runway Category II or III in such a manner as to provide continuous guidance between the Runway centreline and ► **Aircraft** ◀ stands.

**Acceptable
Means of
Compliance
3515(16)**

Taxiway Lights - Taxiway Centreline Lights

77. Taxiway centreline lights **should** be provided:
- a. On a Runway forming part of a standard taxi-route and intended for taxiing in RVR conditions less than a value of 350 m. On such a taxiway the longitudinal spacing **should not** exceed 15 m. These lights need not be provided where the traffic density is light and taxiway edge lights and centreline marking provide adequate guidance.
 - b. On a taxiway or Runway forming part of a standard taxi-route; the lights **should**:
 - (1) Be fixed lights showing green with beam dimensions such that the light is visible only from ► Aircraft ◀ on, or near the taxiway, except:
 - (a) On Runways equipped with ILS, taxiway centreline lights located within the ILS critical / sensitive area or the lower edge of the obstacle free zone **should** be colour coded to show alternate green / yellow in both directions. The colour coding **should** commence with a green light close to the Runway centreline and end with a yellow light at the perimeter of the ILS critical / sensitive area or the lower edge of the inner transitional surface, whichever is the furthest from the Runway; thereafter the lights are to show green.
 - (2) Be spaced on a particular section of taxiway (straight or curved) such that a clear indication of the taxiway centreline is provided, particularly on a curved section; and
 - (3) On a straight section of a taxiway be spaced at longitudinal intervals of not more than 30 m, except that:
 - (a) Larger intervals not exceeding 60 m may be used where, because of the prevailing meteorological conditions, adequate guidance is provided by such spacing;
 - (b) Intervals less than 30 m **should** be provided on short straight sections; and
 - (4) On a curved section, be spaced at intervals such that a clear indication of the curve is provided.
 - (a) On a taxiway intended for use in RVR conditions of less than a value of 350 m, the lights on a curve **should not** exceed a spacing of 15 m, and on a curve of less than 400 m radius the lights **should** be spaced at intervals of not greater than 7.5 m. This spacing **should** extend for 60 m before and after the curve.
 - c. On an exit taxiway; the lights **should**:
 - (1) Be fixed lights;
 - (2) Have alternate taxiway centreline lights showing green and yellow from their beginning near the Runway centreline to the perimeter of the ILS critical / sensitive area, or the lower edge of the inner transitional surface, whichever is farthest from the Runway; and thereafter all lights **should** show green. The first light in the exit centreline **should** always show green and the light nearest to the perimeter **should** always show yellow;
 - (3) Where ► Aircraft ◀ follow the same centreline in both directions, show green to ► Aircraft ◀ approaching the Runway;
 - (4) Commence at the point where the taxiway centreline marking begins to curve from the Runway centreline and follow the curved taxiway centreline marking at least to the point where the marking leaves the Runway. The first light **should** be at least 60 cm from any row of Runway centreline lights; and

**Acceptable
Means of
Compliance
3515(16)**

- (5) Be spaced at longitudinal intervals of not more than 7.5 m.
- d. On a rapid exit taxiway; the lights **should**:
- (1) Commence at a point at least 60 m before the beginning of the taxiway centreline curve, and continue beyond the end of the curve to a point on the centreline of the taxiway where an ► **Aircraft** ◀ can be expected to reach normal taxiing speed. The lights on that portion parallel to the Runway centreline **should** be at least 60 cm from any row of Runway centreline lights; and
- (2) Be spaced at longitudinal intervals of not more than 15 m. Where Runway centreline lights are not provided, a greater interval not exceeding 30 m may be used.
78. Taxiway centreline lights **should**: ►
- a. **Be located on the taxiway centreline marking, except that they may be offset by not more than 30 cm where it is not practicable to locate them on the marking; and** ◀
- b. Not be extended to the Runway unless they are interlocked with the stop bar lights.
79. Taxiway centreline lights **should** be in accordance with characteristics specified in RA 3515(29) – (30).

**Guidance
Material
3515(16)**

Taxiway Lights - Taxiway Centreline Lights

80. For operations in RVR less than 350 m, the reduced spacing for curved sections need to extend 60 m before the start and 60 m beyond the end of the curves; for operations in RVR of 350 m or greater, this distance is reduced to 30 m.
81. Taxiway centreline lighting may be considered for the following situations to aid pilot situational awareness:
- a. On a taxiway intended for use at night in RVR conditions of 350 m or greater, and particularly on complex taxiway intersections and exit taxiways;
- b. On an exit taxiway, taxiway, de-icing / anti-icing facility, and Apron in all visibility conditions where specified as components of an advanced surface movement guidance and control system in such a manner as to provide continuous guidance between the Runway centreline and ► **Aircraft** ◀ stands; and
- c. On a Runway forming part of a standard taxi-route where specified as components of an advanced surface movement guidance and control system.

Civil Equivalence.

82. This Regulation is in line with ICAO Annex 14 Vol I Section 5.3.17.

**Regulation
3515(17)**

Taxiway Lights - Taxiway Edge Lights

- 3515(17) HoEs and ADH-Facing Organizations **shall** ensure that taxiway edge lights are provided at the edges of a Runway turn pad, holding bay, de-icing / anti-icing facility and Apron, intended for use at night and on a taxiway not provided with taxiway centreline lights which is intended for use at night. Taxiway edge lights **shall** be provided on a Runway forming part of a standard taxi-route which is intended for taxiing at night.

**Acceptable
Means of
Compliance
3515(17)**

Taxiway Lights - Taxiway Edge Lights

83. Taxiway Edge Lights **should**:
- a. Provide adequate guidance on taxiway layouts, curves and corners and where required additional light units **should** be installed to maintain the visual cues or general layout of a taxiway;
 - b. Be spaced at uniform longitudinal intervals of not more than 60 m on a straight section of a taxiway and on a Runway forming part of a standard taxi-route;
 - c. Be spaced on a curve (where 'R' is the radius of the inner curved line joining the inside light positions):
 - (1) Curves with radius between 350 m and 100 m: R/7;
 - (2) Curves with radius between 100 m and 28 m: Close to but not greater than 14.5 m;
 - (3) Curves with radius below 28 m: R/2, minimum of 4 lights incl. tangent positions for 90° curves.
 - d. Be spaced at uniform longitudinal intervals of not more than 60 m on a holding bay, de-icing / anti-icing facility, Apron, etc.
 - e. Be spaced at uniform longitudinal intervals of not more than 30 m on a Runway turn pad;
 - f. Be located on the pavement as near as possible to the edges of the manoeuvring area, or outside the edges at a distance of not more than 3 m;
 - g. Be placed in pairs one on each side of the taxiway on lines at right angles to the centreline except at junctions;
 - h. Be fixed lights showing blue;
 - i. Show up to at least 75° above the horizontal and at all angles in azimuth necessary to provide guidance to a pilot taxiing in either direction. At an intersection, exit, or curve the lights **should** be shielded as far as possible so that they cannot be seen in angles of azimuth in which they may be confused with other lights; and
 - j. Have a minimum intensity of at least 2 cd from 0° to 6° vertical, and 0.2 cd at any vertical angles between 6° and 75°.
84. Where a Runway turn pad is available, turn pad lights **should** be provided if intended for use at night.
85. Runway turn pad lights **should**:
- a. Normally be located on the Runway turn pad marking, except that they may be offset by not more than 30 cm where it is not practicable to locate them on the marking.
 - b. On a straight section of the Runway turn pad marking, be spaced at longitudinal intervals of not more than 15 m.
 - c. On a curved section of the Runway turn pad marking **should not** exceed a spacing of 7.5 m.
 - d. Be unidirectional fixed lights showing green with beam dimensions such that the light is visible only from ► **Aircraft** ◀ on or approaching the Runway turn pad.
 - e. Be in accordance with the specifications of ICAO Annex 14 Vol 1 Appendix 2, Figure A2-13, A2-14 or A2-15, as appropriate.

**Guidance
Material
3515(17)**

Taxiway Lights - Taxiway Edge Lights

86. Where operationally justified, adequate guidance to ► **Aircraft** ◀ may be achieved by surface illumination or other means.

**Guidance
Material
3515(17)**

87. Taxiway edge lighting may be used to augment taxiway centreline lighting where ►Aircraft◀ are required to negotiate difficult curves. In complex taxiway layout or taxiway with small radius curves, taxiway edge lights may be replaced with taxiway centreline lights.

88. The use of elevated taxiway edge lights may be inappropriate if there is the possibility of damage from jet blast or the operation of ►Aircraft◀ arresting systems.

Civil Equivalence.

89. This Regulation is in line with ICAO Annex 14 Vol I Section 5.3.18.

**Regulation
3515(18)**

Taxiway Lights - Stop Bar Lights

3515(18) HoEs and ADH-Facing Organizations **shall** ensure that stop bar lights are provided at every Runway-holding position serving a precision approach Runway Category II or III.

**Acceptable
Means of
Compliance
3515(18)**

Taxiway Lights - Stop Bar Lights

90. Stop Bar lights **should** be provided at all Runway-Holding Positions and Intermediate-Holding Positions intended for use in RVR conditions less than ►550 m,◀ except where:

- a. Appropriate aids and procedures are available to assist in preventing inadvertent incursions of traffic onto the Runway; or
- b. Operational procedures exist to limit the number of:
 - (1) ►Aircraft◀ on the manoeuvring area, or on final approach within 5 nm, to one at a time; and
 - (2) Vehicles on the manoeuvring area to the essential minimum.

91. The Stop Bar installation **should**:

- a. Consist of lights spaced at intervals of 3 m across the taxiway, showing red in the intended direction(s) of approach to the intersection or Runway-holding position;
- b. At a Runway-holding position, be unidirectional, and **should** show red in the direction of approach to the Runway;
- c. At intermediate-holding positions be bi-directional where the holding position is intended for use in each direction;
- d. At Runway-holding positions and intermediate-holding positions be independently switchable. All other stop bars protecting Runway access points **should** be permanently illuminated during Low Visibility Operations;
- e. Be positioned co-incident with any associated Runway-holding position marking so as not to obscure or interfere with the integrity of the marking;
- f. Have the outer lights located on the edges of the taxiway;
- g. Where the flight crew's view of the Stop Bar might be obscured, be extended beyond the edge of the taxiway by the addition of four omni-directional elevated lights, two placed on each side of the taxiway along the stop-bar axis at intervals equal to the spacing of other lights making up the Stop Bar;
- h. Be positioned no closer to a manoeuvring area than the requirements of RA 3511⁴;
- i. Be iaw characteristics specified in RA 3515(29) – (30); and
- j. Where there is more than one stop bar associated with a taxiway / Runway intersection, have only one illuminated at any given time.

92. The lighting circuit for Stop Bars **should** be designed so that:

⁴ Refer to RA 3511 - Permanent Fixed Wing Aerodrome - Physical Characteristics.

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Compliance
3515(18)**

- a. Stop bars located across entrance taxiways are selectively switchable;
- b. Stop bars located across taxiways intended to be used only as exit taxiways are switchable selectively or in groups;
- c. When a stop bar is illuminated, any taxiway centreline lights installed beyond the stop bar **should** be extinguished for a distance of at least 90 m; and
- d. Where a Stop bar is independently switchable, it **should** be interlocked with the taxiway centreline lights so that when the centreline lights beyond the stop bar are illuminated the stop bar is extinguished and vice versa.

**Guidance
Material
3515(18)**

Taxiway Lights - Stop Bar Lights

93. Runway incursions may take place in all visibility or weather conditions. The provision of stop bars at Runway holding positions and their use at night and in visibility conditions greater than ►550 m◀ RVR can form part of effective Runway incursion prevention measures.

Civil Equivalence.

94. This Regulation is in line with ICAO Annex 14 Vol I para 5.3.20.

**Regulation
3515(19)**

Taxiway Lights - Runway Guard Lights

3515(19) HoEs and ADH-Facing Organizations **shall** ensure that Runway Guard Lights are provided at each taxiway / Runway intersection associated with a Runway intended for use in RVR conditions less than a value of 550 m where a stop bar is not installed; and RVR conditions of values between 550 m and 1200 m where the traffic density is heavy.

**Acceptable
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3515(19)**

Taxiway Lights - Runway Guard Lights

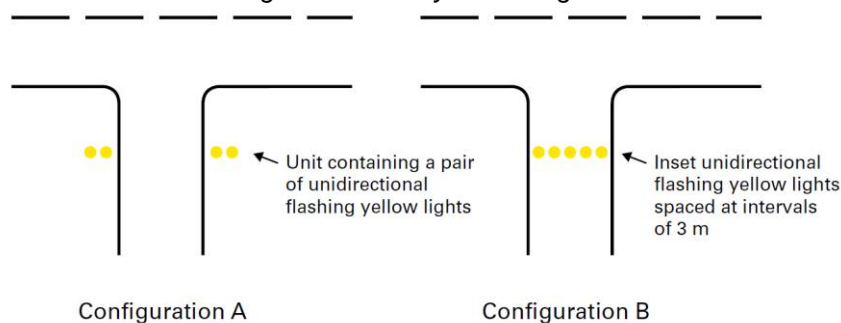
95. Runway Guard Lights **should** (iaw Figure 7, Configuration A):
 - a. Be located at each side of the taxiway and at the same distance as the Runway-holding position marking;
 - b. Consist of two pairs of yellow lights illuminated alternately between 30 and 60 cycles per minute. The light suppression and illumination periods **should** be equal and opposite in each light;
 - c. Not exceed a height above which their presence may endanger ►Aircraft,◀
 - d. Meet the frangibility requirements of RA 3515(29);
 - e. Be unidirectional and aligned to be visible to the pilot of an ►Aircraft◀ taxiing to the holding position;
 - f. Have intensity in yellow light and beam spreads of lights iaw RA 3515(29) and (30);
 - g. Where intended for use during the day, have intensity in yellow light and beam spreads iaw the specifications of RA 3515(29) – (30); and
 - h. Be switched independently of any stop bar lights.
96. Runway Guard Lights **should** (iaw Figure 7 Configuration B):
 - a. Either in conjunction with Configuration A or separately, be provided at each taxiway / Runway intersection where enhanced conspicuity of the taxiway / Runway intersection is needed, such as on a wide-throat taxiway, except that Configuration B **should not** be collocated with a stop bar;
 - b. Be located across the taxiway and at the same distance as the Runway-holding position marking;
 - c. Consist of yellow lights spaced at intervals of 3 m across the taxiway with adjacent lights alternately illuminated and alternative lights illuminated in unison

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Means of
Compliance
3515(19)**

at a rate of 30 to 60 cycles per minute. The light suppression and illumination periods **should** be equal and opposite in each light;

- d. Be unidirectional and aligned to be visible to the pilot of an ► Aircraft ◀ taxiing to the holding position;
- e. Have intensity in yellow light and beam spreads of lights iaw RA 3515(29) and (30);
- f. Where intended for use during the day, have intensity in yellow light and beam spreads iaw the specifications of RA 3515(29) – (30); and
- g. Be switched independently of any stop bar lights.

Figure 7. Runway Guard Lights



**Guidance
Material
3515(19)**

Taxiway Lights - Runway Guard Lights

97. Where there is a need to enhance the contrast between the on and off state of Runway guard lights, Configuration A, intended for use during the day, a visor of sufficient size to prevent sunlight from entering the lens without interfering with the function of the fixture may be located above each lamp.

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

99. Where Runway guard lights are operated in good visibility conditions at night, the luminous intensity may be reduced to 30% but the signal characteristics need to be retained.

Civil Equivalence.

100. This Regulation is in line with ICAO Annex 14 Vol I para 5.3.23.

**Regulation
3515(20)**

Taxiway Lights - Road-Holding Position Lights

3515(20) HoEs and ADH-Facing Organizations **shall** ensure that road-holding position lights are provided at the intersection of all roads with Runways.

**Acceptable
Means of
Compliance
3515(20)**

Taxiway Lights - Road-Holding Position Lights

101. Road-Holding position lights **should**:
- a. Be located 1.5 m from the edge of the left-hand side of the road (or iaw local traffic regulations), at a suitable height, and adjacent to the road-holding position marking as described in RA 3514(5)⁵;
 - b. Comprise a controllable red (stop) / green (go) traffic light or a flashing red light and steady green:
 - (1) The lights **should** be controlled by the ATC controller; and

⁵ Refer to RA 3514(5): ► ◀ Vehicle Roadway Markings.

**Acceptable
Means of
Compliance
3515(20)**

- (2) The system **should** provide an alarm to the ATC controller in the event of a failure of a single red signal.
- c. Be unidirectional and aligned to be visible to the driver of a vehicle approaching the holding position;
- d. Have an intensity of the light beam adequate for the conditions of visibility and ambient light in which the use of the holding position is intended but **should not** dazzle the driver; and
- e. Have a flash frequency of the flashing red light between 30 and 60 flashes per minute;
- f. Be accompanied by a road-holding position sign.

**Guidance
Material
3515(20)**

**Taxiway Lights - Road-Holding Position Lights
Civil Equivalence.**

102. This Regulation is in line with ICAO Annex 14 Vol I Section 5.3.28.

**Regulation
3515(21)**

Apron Lights - Edge Lighting

3515(21) HoEs and ADH-Facing Organizations **shall** ensure that the edges of Aprons including ► **Aircraft** ◀ servicing platforms and operational readiness platforms intended to be used at night are marked with blue edge lights.

**Acceptable
Means of
Compliance
3515(21)**

Apron Lights - Edge Lighting

103. The edges of ► **Aircraft** ◀ Aprons, ► **Aircraft** ◀ servicing platforms and operational readiness platforms **should** be marked with blue edge lights iaw the specifications given for taxiway edge lights given in RA 3515(17).

**Guidance
Material
3515(21)**

Apron Lights - Edge Lighting

104. Nil.

**Regulation
3515(22)**

Apron Lights - Floodlighting

3515(22) HoEs and ADH-Facing Organizations **shall** ensure that floodlighting is provided on an Apron, on a de-icing / anti-icing facility and on a designated ► **Aircraft** ◀ parking position intended to be used at night.

**Acceptable
Means of
Compliance
3515(22)**

Apron Lights - Floodlighting

105. Apron floodlighting **should**:
- a. Be located to provide adequate illumination on all Apron service areas, with a minimum of glare to pilots of ► **Aircraft** ◀ in flight and on the ground, Aerodrome and Apron controllers, and personnel on the Apron;
- b. Be arranged such that an ► **Aircraft** ◀ stand receives light from two or more directions to minimize shadows;
- c. Have a spectral distribution such that the colours used for ► **Aircraft** ◀ marking connected with routine servicing, and for surface and obstacle marking, can be correctly identified;
- d. Have an average illuminance for an ► **Aircraft** ◀ stand of at least:
- (1) Horizontal illuminance — 20 lux with a uniformity ratio (average to minimum) of not more than 4 to 1; and

Acceptable Means of Compliance 3515(22)

(2) Vertical illuminance — 20 lux at a height of 2 m above the Apron in relevant directions; and

e. Have an average illuminance for other Apron areas of at least 50 % horizontal and vertical illuminance of the average illuminance on the ► Aircraft ◀ stands with a uniformity ratio (average to minimum) of not more than 4 to 1.

Guidance Material 3515(22)

Apron Lights - Floodlighting Civil Equivalence.

106. This Regulation is in line with ICAO Annex 14 Vol I Section 5.3.24.

Regulation 3515(23)

Miscellaneous Lights - Undercarriage Inspection Systems

3515(23) HoEs and ADH-Facing Organizations **shall** ensure that an undercarriage inspection system is provided where there may be an operational requirement to view the undercarriage of an ► Aircraft ◀ during periods of darkness.

Acceptable Means of Compliance 3515(23)

Miscellaneous Lights - Undercarriage Inspection Systems

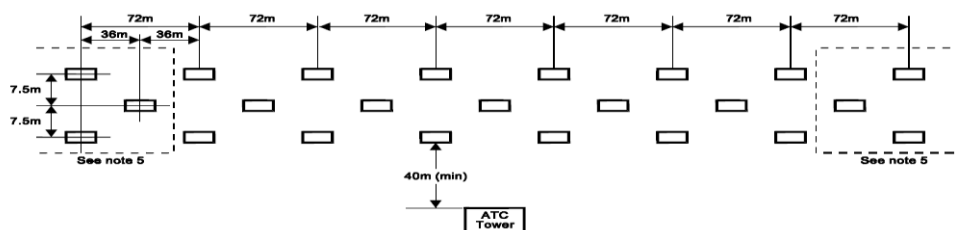
107. An Undercarriage Check Lighting System **should**:

- a. Have a layout as per Figure 8;
- b. Have light units set horizontal longitudinally and aimed vertically upwards with the outer rows toed in by 2°; and

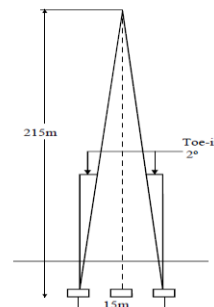
108. An Undercarriage Check Flare-path **should**:

- a. Be installed on Royal Air Force and Royal Navy Aerodromes as depicted in Figure 8;
- b. Consist of 14 flare-path sodiums, eight forming the cluster, with a lead-in and lead-out of three sodiums for accurate line-up;
- c. Be sited on the airfield in a convenient position to enable the ► Aircraft ◀ undercarriage to be checked from the visual control positions without disrupting or hazarding ► Aircraft ◀ in the circuit area.

Figure 8. Undercarriage Inspection System Lights



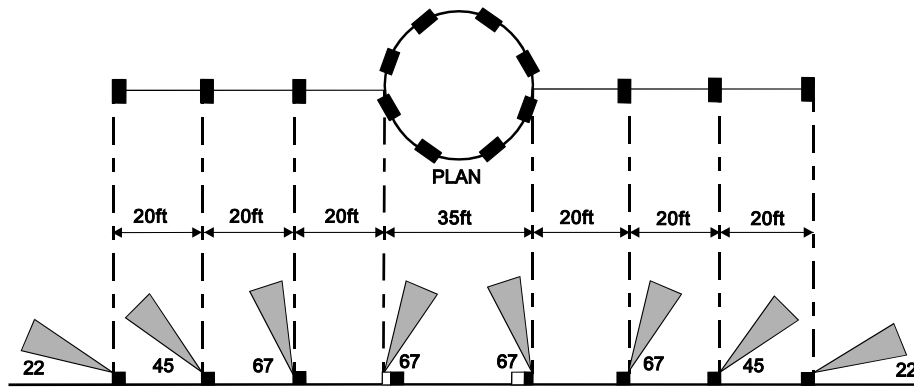
Note: ATC Tower and Centre of System to Coincide.



► Figure 8, Note 5: Refer to paragraph 110. ◀

**Acceptable
Means of
Compliance
3515(23)**

Undercarriage Check Flarepath – Layout and Optical Requirements



**Guidance
Material
3515(23)**

Miscellaneous Lights - Undercarriage Inspection Systems

109. The undercarriage inspection system is designed to allow clear night viewing of the undercarriage of an ► **Aircraft** ◀ flying at 200 kt and 215 m above ground level.

110. Exceptionally, where ► **Aircraft** ◀ speeds through the system will not exceed 120 kt, an abbreviated system may be installed by omitting 3 light units ► **and their associated cabling** ◀ from each end. ► **Other phasing and cabling will remain as shown to allow for possible future extension to the full system.** ◀

**Regulation
3515(24)**

Miscellaneous Lights - Arrestor Cable Systems and Illuminated Runway Distance to go Markers

3515(24) HoEs and ADH-Facing Organizations **shall** ensure that Arrestor Cable System Markers and Runway Distance to go Markers (RDM) installed iaw RA 3517(9) – (10)⁶ are illuminated for use at night or in low visibility operations.

**Acceptable
Means of
Compliance
3515(24)**

Miscellaneous Lights - Arrestor Cable Systems and Illuminated Runway Distance to go Markers

111. Illuminated Arrestor Cable Markers and IRDM **should**:

- For an instrument approach Runway, have an average luminance of at least 150 cd/m² for yellow and 300 cd/m² for white at maximum brilliancy;
- For a non-instrument Runway, have an average luminance of at least 50 cd/m² for yellow and 100 cd/m² for white at maximum brilliancy;
- Have the ratio between the maximum and the minimum luminance value over the whole sign face no greater than 5:1;
- Have marker characteristics iaw RA 3517(9-10).

**Guidance
Material
3515(24)**

Miscellaneous Lights - Arrestor Cable Systems and Illuminated Runway Distance to go Markers

112. Average luminance is obtained as detailed in ICAO Annex 14, Volume 1, Appendix 4.

⁶ Refer to RA 3517 ► (9): **Arrestor System Markers** and RA 3517(10): **Distance To Go Markers.** ◀

**Regulation
3515(25)**

Miscellaneous Lights - Visual Docking Guidance System

3515(25) HoEs and ADH-Facing Organizations **shall** ensure that a Visual Docking Guidance System (VDGS) is provided when it is intended to indicate, the precise positioning of an ►Aircraft◀ on an ►Aircraft◀ stand when other alternative means, such as marshallers, are not practicable.

**Acceptable
Means of
Compliance
3515(25)**

Miscellaneous Lights - Visual Docking Guidance System

113. VDGS facilities **should** be as detailed in ICAO Annex 14, Volume I, Chapter 5, Section 3.25.

**Guidance
Material
3515(25)**

Miscellaneous Lights - Visual Docking Guidance System

114. Nil.

**Regulation
3515(26)**

Miscellaneous Lights - Advanced Visual Docking Guidance System

3515(26) HoEs and ADH-Facing Organizations **shall** ensure that an Advanced VDGS (A-VDGS) is provided where it is operationally desirable to confirm the correct ►Aircraft◀ type for which guidance is being provided and / or to indicate the stand centreline in use, where more than one is provided for.

**Acceptable
Means of
Compliance
3515(26)**

Miscellaneous Lights - Advanced Visual Docking Guidance System

115. A-VDGS facilities **should** be as detailed in ICAO Annex 14, Volume I, Chapter 5, Section 3.26.

**Guidance
Material
3515(26)**

Miscellaneous Lights - Advanced Visual Docking Guidance System

116. Nil.

**Regulation
3515(27)**

Miscellaneous Lights - Emergency Portable Lighting

3515(27) HoEs and ADH-Facing Organizations **shall** ensure that, at an Aerodrome provided with Runway lighting and without a secondary power supply, sufficient emergency lights be conveniently available for installation on at least the primary Runway in the event of failure of the normal lighting system.

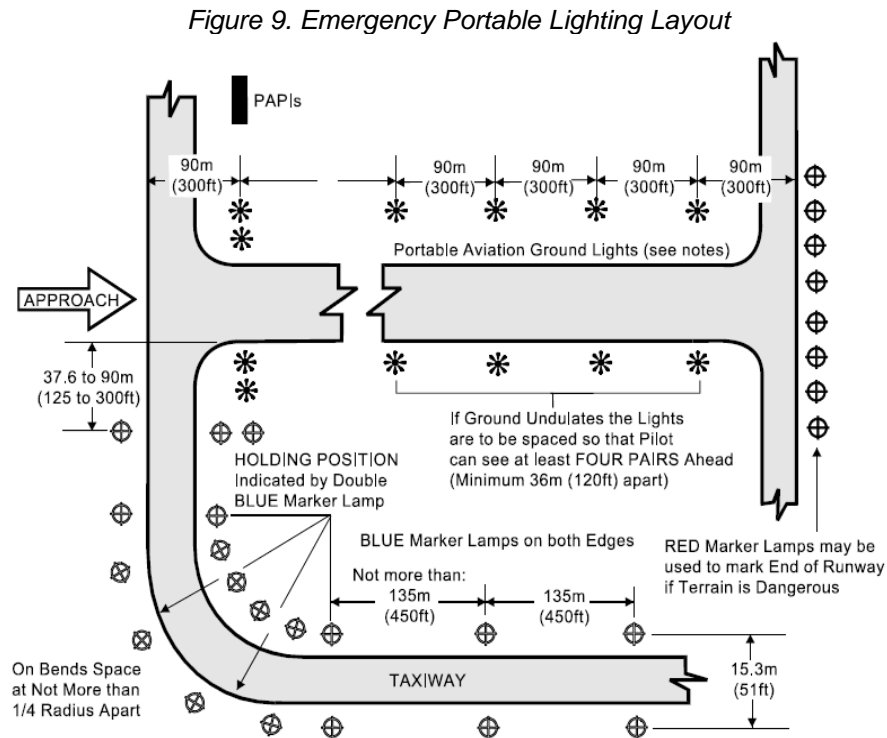
**Acceptable
Means of
Compliance
3515(27)**

Miscellaneous Lights - Emergency Portable Lighting

117. When Emergency Portable Lighting is laid out iaw Figure 9 it **should** provide adequate guidance to ►Aircraft◀ on instrument approaches in visibility down to 800 m.

118. Portable obstacle lights **should** provide adequate visual guidance to ►Aircraft◀ taxiing in normal operating conditions. When ►Aircraft◀ taxi-lights are being used, the taxiway may be delineated with airfield retro-reflective markers or centreline studs.

Acceptable Means of Compliance 3515(27)



Guidance Material 3515(27)

Miscellaneous Lights - Emergency Portable Lighting

119. Emergency Portable Lighting comprises omni-directional Runway edge lights (ORELs); uni-directional approach lights (UAL); tactical PAPIs (TAC PAPI) and NVD compatible PAPIs.

120. Portable Obstacle Lights – Marker Lamps. Portable obstacle lights fitted with blue filters need to be used to augment or provide taxiway lighting on parts of the movement area not equipped with permanent lighting. Portable obstacle lights fitted with red filters need to be used to mark obstacles.

121. Where appropriate, emergency portable Aerodrome lighting equipment may be used as a standby to cover temporary failures in permanent installations or alternatively used to maintain visual cues during construction works. There is no requirement to lay emergency portable lighting at Military airfields on a routine basis.

122. Chance Lights. If available, a chance light or mobile floodlight can be held ready to assist in illuminating the Runway in an emergency.

123. Solar light units.

a. These light units may be used to provide taxiway edge lighting, complying with the characteristics defined for taxiway edge lighting in RA 3515(17). They may be provided adjacent to existing taxiway edge light units.

b. Where appropriate, solar portable Aerodrome lighting equipment may be used after a suitable and sufficient Safety Assessment to cover temporary failures in permanent installations or alternatively used to maintain visual cues during construction works. Solar light units, where used, need to meet the specification of the permanent light units.

Civil Equivalence.

124. This Regulation is in line with ICAO Annex 14 Vol I Section 5.3.2.

Regulation 3515(28)

Aeronautical Ground Lights Characteristics - Construction

3515(28) HoEs and ADH-Facing Organizations **shall** ensure that all AGL fittings are of construction and height that their presence does not endanger ► Aircraft. ◀

**Acceptable
Means of
Compliance
3515(28)****Aeronautical Ground Lights Characteristics - Construction**

125. Elevated Approach Lights and their supporting structure **should**:
- a. Be frangible except that, in that portion of the approach lighting system beyond 300 m from the threshold:
 - (1) Where the height of a supporting structure exceeds 12 m, the frangibility requirement **should** apply to the top 12 m only; and
 - (2) Where a supporting structure is surrounded by non-frangible objects, only that part of the structure that extends above the surrounding objects **should** be frangible;
 - b. When an approach light fixture or supporting structure is not in itself sufficiently conspicuous, be suitably marked; and
 - c. When an approach light fixture or supporting structure is not in itself sufficiently conspicuous, be suitably marked.
126. Elevated Runway, stopway, and taxiway lights **should**:
- a. Be frangible;
 - b. Be sufficiently low to preserve clearance for propellers and for the engine pods of jet ►Aircraft◄;
 - c. Be conspicuous within the manoeuvring area;
 - d. Be no greater in height than 0.36 m above the adjacent pavement level;
 - e. In stopways and clearways used for routine manoeuvring, be flush with the ground;
 - f. In stopways and clearways not used for routine manoeuvring, be no greater than:
 - (1) 0.46 m above ground level in stopways; and
 - (2) 0.9 m above ground level in clearways.
127. Surface Lights inset in the surface of Runways, stopways, taxiways, and Aprons **should**:
- a. Be designed and fitted to withstand being run over by the wheels of an ►Aircraft◄ without damage either to the ►Aircraft◄ or to the lights themselves; and
 - b. **Should not** project above the surrounding surface greater than:
 - (1) 16 mm within 7.5 m either side of the Runway centreline except that inset approach lights in this area and taxiway lights crossing a Runway or leading to a Runway centreline may project 25 mm;
 - (2) 19 mm between 7.5 m from the Runway centreline to 3 m from the Runway edge except that inset approach lights in these areas may project 32 mm and taxiway lights crossing or leading to a Runway centreline may project 25 mm;
 - (3) 38 mm within 6 m of the Runway end or within 3 m of the Runway edge;
 - (4) 32 mm for displaced threshold lights; and
 - (5) 25 mm in taxiway surfaces;
 - c. Be secured in the surface to prevent accidental extraction; and
 - d. Not produce, at the interface between the inset light and an ►Aircraft◄ tyre, by conduction or radiation, a temperature greater than 160° C during a 10 minute period of exposure.

**Guidance
Material
3515(28)**

Aeronautical Ground Lights Characteristics - Construction

128. No deviations present in the main beam pattern when the lighting fixture is properly aimed. The light unit needs to be installed so that the main beam is aligned within 0.5° of the specified requirements.

129. All AGL must conform to Electromagnetic Compatibility Directive 2014/30/EU in that lights must:

- a. Not cause radiated or conducted electromagnetic interference to other electrical systems that may be located on or near the Aerodrome, or that may use the same power supply; and
- b. Have immunity to electromagnetic phenomena and electromagnetic fields, such as from radio transmitters, transients on power lines, atmospheric discharges etc.

130. Have immunity to electromagnetic phenomena and electromagnetic fields, such as from radio transmitters, transients on power lines, atmospheric discharges etc.

Civil Equivalence.

131. This Regulation is in line with ICAO Annex 14 Vol I Sections 5.3.1.4 – 5.3.1.8.

**Regulation
3515(29)**

Aeronautical Ground Lights Characteristics - Intensity and Distribution

3515(29) HoEs and ADH-Facing Organizations **shall** ensure that the intensity and distribution of Runway lighting is adequate for the minimum conditions of visibility and ambient light in which use of the Runway is intended and be compatible with that of the nearest section of the approach lighting system when provided.

**Acceptable
Means of
Compliance
3515(29)**

Aeronautical Ground Lights Characteristics - Intensity and Distribution

132. Intensity and distribution of AGL **should** be as detailed in ICAO Annex 14, Volume I, Appendix 2.

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

- a. Approach Lighting System;
- b. Runway Edge Lights;
- c. Runway Threshold Lights;
- d. Runway End Lights;
- e. Runway Centreline Lights;
- f. Runway Touchdown Zone Lights; and
- g. Taxiway Centreline Lights.

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

135. On the perimeter of and within the rectangle defining the main beam in ICAO Annex 14 Vol 1 Appendix 2, Figures A2-12 to A2-20, the maximum light intensity value **should not** be greater than three times the minimum light intensity value measured iaw Appendix 2, collective notes for Figures A2-12 to A2-21.

**Guidance
Material
3515(29)**

Aeronautical Ground Lights Characteristics - Intensity and Distribution

136. AGL needs to have immunity to electromagnetic phenomena and electromagnetic fields, such as from radio transmitters, transients on power lines, atmospheric discharges etc.

**Regulation
3515(30)**

Aeronautical Ground Lights Characteristics - Colour and Discrimination

3515(30) HoEs and ADH-Facing Organizations **shall** ensure that the colour and discrimination of AGL is such that the possibility of confusion of colours is minimized.

**Acceptable
Means of
Compliance
3515(30)**

Aeronautical Ground Lights Characteristics - Colour and Discrimination

137. Colour and discrimination requirements for all AGL **should** be as detailed in ICAO Annex 14, Volume I, Appendix 1.

**Guidance
Material
3515(30)**

Aeronautical Ground Lights Characteristics - Colour and Discrimination

138. Nil.

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