

**An American National Standard
ANSI/IES RP-8-14 ADDENDUM #1**

If you, as a user of ANSI/IES RP-8-14, *Roadway Lighting*, believe you have located an error not covered by the following revisions, please mail or send a letter with your information to Pat McGillicuddy, IES Manager of Standards Development, at pmcgillicuddy@ies.org, IES, 120 Wall St., 17th Floor, New York, NY 10005. Additions will be posted to this list online as they become available.

Please confine your comments to specific typographical errors or misstatements of fact in the document's text and/or graphics. Do not attempt a general revision of ANSI/IES RP-8-14.

New text is in italic bold font. Deleted text has a strikethrough.

Approved by the IES Standards Committee on Feb. 23, 2018.

Approved as an American National Standard on May 11, 2018.

1.1 Purpose of this Standard Practice

In Canada, The TAC Guide for the Design of Roadway Lighting includes guidance for warranting.

1.3 ~~Roadway~~ **Highway** Lighting and Street Lighting

Note: All instances of "roadway lighting" are changed to "highway lighting".

1.4 Related Documents

Note: Add or update the following references:

- IES DG-21-15 *Design Guide for Residential Street Lighting*
- IES G-1-~~03~~ **16** *Security Lighting Guidelines for People, Property, and Critical Infrastructure*
- IES RP-20-~~98~~ **14** *Lighting for Parking Facilities*
- IES RP-33-~~99~~ **14** *Lighting for Exterior Environments*

2.4 Luminaire Classification System (LCS)

Note: Edits to 3rd paragraph:

An LCS luminaire report for a typical **flat-lens** cobrahead style luminaire is shown in **Figure 3**. The ~~percent~~ **number** of luminaire lumens is noted in each of the zones, allowing the designer to understand more fully the impact and performance of the luminaire.

Note: Edits to 4th paragraph:

Since the LCS system is based on the ~~percent~~ of luminaire lumens within the zones of solid angles of a sphere and the previous system was based on light intensities on a lateral and transverse grid on a target area **luminous intensity as a percentage of lamp lumens**, there is no direct correlation between the two systems. The former system was defined in IES TM-3 (withdrawn) ~~and is now given for reference in Annex E of this practice.~~

3.6 Glare and Sky-Glow Issues

Note: Edits to 3rd Paragraph:

~~IES TM 11-00/R11, *Light Trespass: Research, Results, and Recommendations*, provides guidelines on limitations for light trespass.~~

Note: Edits to 5th Paragraph:

The appropriate lighting level restrictions at each of the above Lighting Zones is currently under review by the IES Roadway Lighting Committee ~~but were not validated and available at the time of this revision.~~

3.9 Spectral Considerations

~~IES TM 12-12, *Spectral Effects of Lighting on Visual Performance at Mesopic Light Levels*, discusses the special issues that have to be considered when evaluating the impact of spectral characteristics of light sources for night time viewing.~~

~~Essentially the rated lumens of sources are based on the photopic luminous efficiency function, which measures the effectiveness of light to produce a visual sensation in the fovea as a function of wavelength (Figure 9). This curve peaks at a wavelength of 555 nm, which is a greenish-yellow color (now used for some roadway signs and emergency vehicles). At very low light levels vision is primarily mediated by the rod system of photoreceptors, which have a different response curve, and are only present outside of the foveal (central vision) region of the retina. The scotopic luminous efficiency function peaks at 505 nm, which, when viewed by cone vision, is a green color.~~

For street and roadway lighting, average light levels are usually in the mesopic range—between the photopic and scotopic ranges. There have been numerous studies, most notably by the LRC (Lighting Research Center, Rensselaer Polytechnic Institute), and more recently by the MOVE consortium (Mesopic Optimization of Visual Efficiency Developed by a European research consortium project), that have shown improved visual performance in the periphery, with light sources that have enhanced scotopic content, when light levels are in the mesopic range.

The results of these studies are summarized in CIE Technical Report 191:2010, “Recommended System for Mesopic Photometry Based on Visual Performance”, and have been expressed in terms of adjustment factors that scale the adaptation luminance level to the level that would give the same visual performance for a light source with a scotopic to photopic (S/P) ratio of one. This CIE document provides a means for calculating mesopic multipliers to account for improved visual performance when using broad spectrum light sources at low lighting levels with higher S/P ratios. Figure 9 illustrates this by showing curves at various light levels in the mesopic range and giving effective mesopic adjustment factors as a function of source S/P ratios. However, each IES committee is responsible for the proper application of these in their respective practices. The luminance levels in Tables 2 and 3 were developed for roadway locations in the direct line of sight of the observer, and thus are to be interpreted as photopic levels only. However, the lighting of off roadway areas is often important in determining the overall quality of the lighting system. This is particularly true for urban areas and lower vehicular speeds, where it is important to be able to evaluate possible road conflicts from pedestrians, bicyclists, and animals. These hazards are likely to be seen in peripheral view, and their visibility will be affected by the mesopic shift.

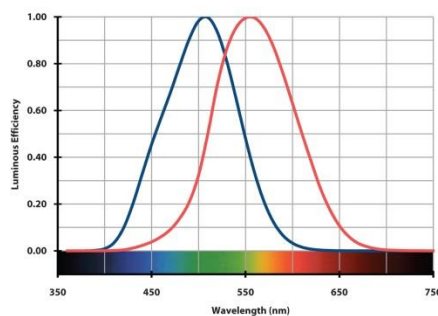


FIGURE 8
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Figure 8: Luminous Efficiency Functions (red line = photopic, blue line = scotopic). (Image © Illuminating Engineering Society of North America.)

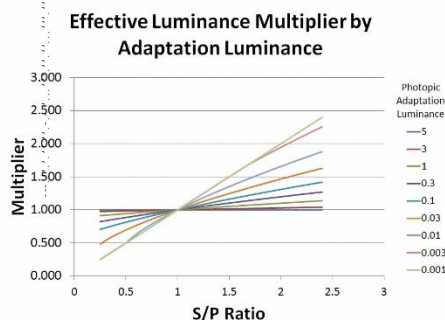


FIGURE 9
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Figure 9: Example effective luminance factors (from CIE 191) for a variety of adaptation luminances and S/P ratios. The right vertical axis shows Luminance (cd/m^2). (© Illuminating Engineering Society of North America.)

The Roadway Lighting Committee is recommending that these mesopic multipliers only be used in applications for street lighting where the posted speed limit is 25 mph (40 km/h) or less. The application of these factors may be appropriate in situations where the fixed roadway lighting system is the dominant or only light source in the driver's field of view. In cases where bright sources or surroundings increase adaptation levels significantly, these factors are not appropriate. A study sponsored by the Federal Highway Administration (FHWA) is underway to evaluate spectral power distribution effects on the nighttime driving task under dynamic conditions. Based on results of this and other research this document will be updated as appropriate.

The spectral content of street and roadway lighting products is varied and, to a limited extent, controllable. Luminaires are available with many different blends of spectra; from nearly monochromatic yellows and reds to combinations of red, blue and green that appear as white light to many observers. Designers may select the spectral content of luminaires to achieve effects of color in the environment of their projects.

As anticipated in RP-8-14, the US Federal Highway Administration (FHWA) sponsored research by the Transportation Institute at Virginia Polytechnic Institute and State University (VTI)⁵⁴ to evaluate the effects of changing spectral content in overhead street and roadway luminaires on driver performance. The Roadway Lighting Committee after review of this research

concluded that varying spectral content of overhead luminaires does not affect driver performance, as represented by detection of potential hazards.

IES TM-12-12 and The Lighting Handbook, 10th ed. (IES 2011) introduced mesopic adjustment factors as potentially relevant to street and highway lighting calculations. The Roadway Lighting Committee considered the possibility that driver performance may vary with changes in spectral content of overhead lighting. After considering the results of the VTTI research, the Roadway Lighting Committee determined that the under realistic driving conditions, the driver is primarily photopically adapted, and therefore mesopic adjustment factors are not appropriate for street and roadway lighting calculations at posted speeds of 40 km/h (25 mi/h) and higher. Therefore, calculations for street and roadway luminance and illuminance are to remain based on the photopic luminous efficiency function without adjustment for

The luminance levels in Tables 2 and 3 (in Sections 4.1 and 4.2, respectively) were developed for roadway locations in the direct line of sight of the observer, and thus are to be interpreted as photopic levels only.

The Roadway Lighting Committee is continuing to investigate mesopic impacts for roads with posted speeds of lower than 40 km/h (25 mi/h) and pedestrian-to-pedestrian visual tasks.

4.0 Roadway Lighting Recommendations

Note: Edits to 8th paragraph:

For determining what horizontal illuminance level should be used instead of the recommended luminance level, a ratio of $1 \text{ cd/m}^2 \cong 15 \text{ lux}$ for an R3 pavement and $1 \text{ cd/m}^2 \cong 10 \text{ lux}$ for an R1 pavement can be used. ~~the following an equivalencies may be used:~~ **1 cd/m^2 for 10 lux on R1 pavement; 1 cd/m^2 for 15 lux on R2 or R3 pavement; and 1 cd/m^2 for 13.3 lux on R4 pavement.** Field validation of a lighting system's performance may be done by luminance or illuminance.

New 9th paragraph:

In street and highway lighting, veiling luminance, L_v , is the metric used to evaluate disability glare as experienced by the driver. Stray light within the eye, produced by light sources in the field of view, effectively superimposes a "veil" of luminance on the retina. This decreases the apparent contrast of objects against their background and can sometimes cause visual discomfort. In Table 2 and Table 3 (in Sections 4.1 and 4.2, respectively), the criterion for limiting glare is expressed as the Veiling Luminance Ratio, which is the veiling luminance maximum divided by the average luminance of the road surface. In this way, luminaire "brightness" is considered in the context of the "brightness" of the road surface as seen by the driver.

Note: Add after the 10th paragraph:

Other considerations when applying these recommendations include:

- All Highways and Streets shall be lighted as per their classification as determined by the proper warrants.
- When a specifying authority selects a Luminaire Classification System with a specific B-U-G rating for a particular highway or street's luminaires, this shall not serve to compromise the design criteria as determined by the highway or street Design Classification and Pedestrian Classification
- Environmental Lighting Zones shall have no influence in the selection of the proper Highway or Street Classification.
- No off-road lighting shall be considered in determining either a Highway or Street Classification nor shall any off-road lighting contribution be used to achieve the minimum lighting requirements of a classification.
- Highway and Street lighting design shall be restricted as much as possible to the roadway area.
- However, it may be desirable to extend the lighting to adjacent areas such as:
 - Sidewalks, utilizing the proper maintained illuminance values for walkways
 - Building verticals, for security

This should be a predetermined agreement with the responsible local authorities.

- Off-road lighting installations shall take into consideration any adjacent Highways or Streets so as not to create any safety issues to drivers.

4.1 Highway Lighting - Add after Table 2:

The reader may notice that the luminance criterion for expressways is higher than that for either of the freeway types, even though the expressway speed limits tend to be lower. The reason is the additional complexity inherent in expressways, as manifested in an increase in points of conflict due to the presence of intersections and even driveways.

4.2.1 Pedestrian Areas and Bikeways

The values in the following tables do not consider areas with increased crime and vandalism. IES G-1-16, *Security Lighting Guidelines for People, Property, and Critical Infrastructure*, offers excellent guidance for this. Definitions for conflict areas can be found in Section 2.2. **The recommended values also include reflected light from the sidewalk surface, which can be a significant contributor. Semi-cylindrical illuminance can also be considered as a design method. Additional information on this metric can be found in CIE 115:2010 Lighting of Road for Motor and Pedestrian Traffic.**

High Pedestrian Conflict Areas: