

Frequently Asked Questions

Lumens and Mesopic Vision

How do lumens change in the area of mesopic vision?

There are two types of receptors on the retina of the eye: rods and cones. The rods operate at low light levels, the cones operate at high light levels, and both operate over a range at intermediate light levels. Rod vision does not provide color response or high visual acuity. In fact, there is no rod vision along the line of sight; in looking for a very faint signal light on a dark night, one must look about 15 degrees to the side of it. The cones are responsible for color vision and the high acuity necessary for reading and seeing small details.

Figure 1 indicates the approximate ranges for rod and cone operation. Since these depend on the luminance ("brightness") in the field of view rather than on illuminance (footcandles or lux), typical lighting conditions at which these luminances occur are indicated across the top of the chart. Rod vision is known as *scotopic* vision, cone vision is known as *photopic* vision, and the region where both rods and cones contribute to vision is called *mesopic* vision. Light (lumens) is radiant power in watts weighted at each wavelength by a luminous efficiency value, i.e., by the eye's brightness response to power at that wavelength. We can derive the lumen value of a light by this spectral weighting process using the photopic or the scotopic response function. Figure 2 shows the standardized spectral weighting functions for photopic and scotopic lumens. The change in response functions is known as the *Purkinje shift*.

In the mesopic region as the light level decreases from photopic to scotopic vision, the spectral response gradually changes from the photopic to the scotopic curve. There is a continuous range of mesopic curves changing in both shape and maximum sensitivity, and the appropriate curve depends on such factors as the light level and the distribution of light in the field of view. Because of this and a range of other problems, there is no agreement, either within the United States or internationally, on a standard method for computing lumens in the mesopic region. A review of the issues and of various methods for estimating mesopic vision can be found in *Mesopic Photometry: History, Special Problems and Practical Solutions* (CIE Publication No. CIE 81, 1989).

Various research is ongoing related to evaluating light in mesopic vision and on the influence of the scotopic curve in photopic vision through its effect on pupil size. However, in order to conform to standard practice in the United States and to provide unbiased data, OSRAM SYLVANIA INC. reports photopic lumens for all light sources in accord with the internationally accepted CIE definition found in *The Basis of Physical Photometry* (CIE Publication No. 18.2, 1983).

FIGURE 1 - RANGES OF VISION

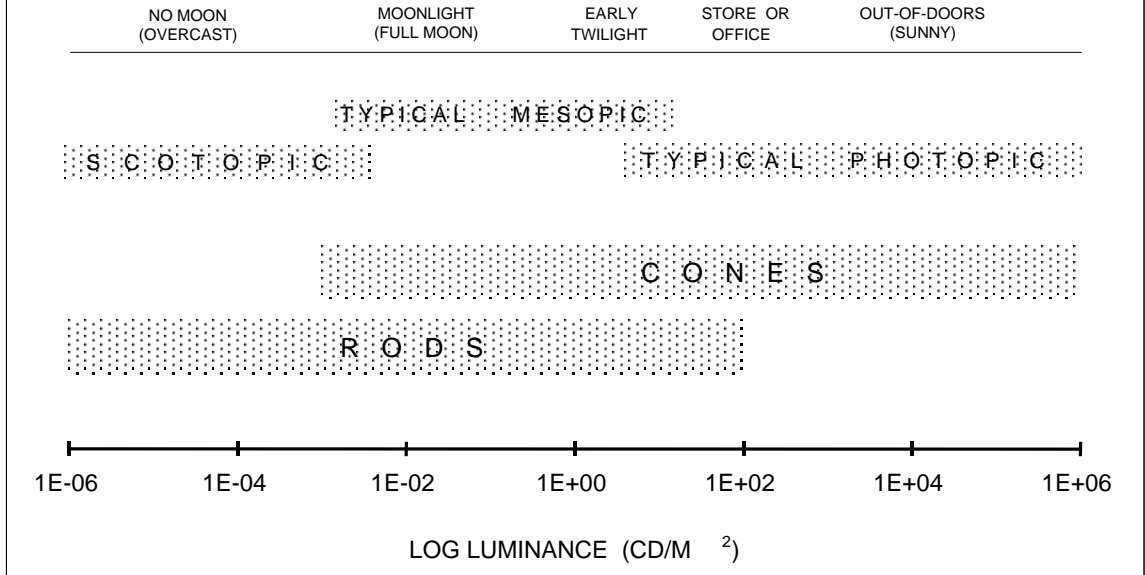


FIGURE 2 - SPECTRAL LUMINOUS EFFICIENCY FUNCTION

