Illuminance Meters and LED Luminaires

A certain amount of confusion has built up regarding the use of illuminance meters when measuring light levels in an installation that contains LED product. This has led to claims that current illuminance meters are not suitable for such measurements. At the outset a few basic points on the relationship between the eye and illuminance meters should be considered;

- The human eye has not changed and its operation is technology independent.
- The eye detects a relatively narrow band of electromagnetic radiation, which is termed light.
- The eye is not equally sensitive to all wavelengths of light (red light has a relatively long wavelength and blue light has a relatively short wavelength). The response curve of a light adapted eye is known as the V(λ) curve and is shown in figure 1. It may be seen from this that the eye is more sensitive to yellow/green light than red or blue light.
- An illuminance meter measures spectral power, that is the power of electromagnetic emissions at wavelengths within the visible band, and then applies a conversion based upon the eye V(λ) curve. It therefore simulates the operation of the eye but produces a number instead of an image.

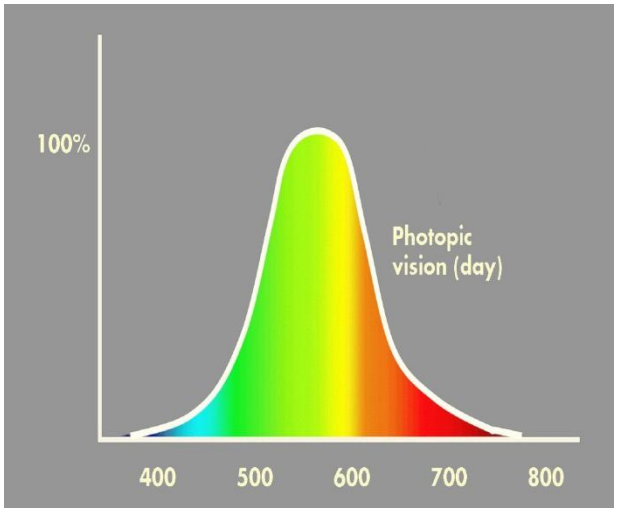

Figure 1: The light adapted eye response curve

The accuracy of any piece of measurement equipment is quantified by assessing any sources of error in a measurement and for each possible source assigning a measurement tolerance. However quantifying this can be complex and needs defined methods. It also needs criteria to decide if a tolerance is acceptable or not. This is where standards are used, and for illuminance meters, the relevant standard is BS 667:2005 Illuminance meters – Requirements and test methods. This covers a wide number of aspects of the meter such as non-linearity between meter ranges and across wide ranges of illuminance, accuracy of correction to the V(λ) curve, infra-red and ultra-violet response, cosine correction (the effect of light falling on the photometer head at oblique angles), temperature effects, etc.

This standard specifies the performance requirements for two types of illuminance meter

- Laboratory illuminance meters, designated Type L, which are generally retained in a laboratory or standardizing area, and against which other equipment may be calibrated and the highest precision readings obtained. Such meters may not be suitable for site or field measurements
- Field illuminance meters, designated Type F, which are for use in the field, on site and in the working environment. Some accuracy may have to be sacrificed in the interests of the ease of use, robustness and versatility of field meters

A correctly maintained and calibrated laboratory illuminance meter will have an accuracy of ±4% whilst a correctly maintained and calibrated field illuminance meter will have an accuracy of ±6%.
These accuracies will be larger for highly coloured (non-white) light sources such as saturated red, green, amber or blue LEDs.

Therefore, to measure the illuminance for a lighting installation containing LED products a calibrated type F illuminance meter is adequate.

It should be remembered that the calibration of an illuminance meter is time limited and the manufacturer's instructions or calibration certificate should indicate the valid calibration period. After this period has elapsed, the illuminance meter will need re-calibrating to maintain accuracy.

Note that when a meter is calibrated it is both the meter and photometer head (photocell) that are calibrated. Therefore, any calibration is only valid using the correct photometer head and use of a different photocell can result in significant errors. In addition the V(λ) response of the photometer head should be checked as part of the calibration as any deviation of the photometer V(λ) response from the eye response can result in a measurement error, especially in sources rich in red or blue spectral content.

In addition, if a meter experiences particularly rough handling, it may need re-calibrating even though it is still within the manufacturer's stated calibration period. Therefore, an illuminance meter should be treated as an item of laboratory equipment (which is what it is) according to the manufacturer's recommendations.