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Approved Method: **Electrical and Photometric Measurements of Solid-State Lighting Products**

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IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products

Foreword

This approved method is a guide developed for the measurement of solid state lighting (SSL) products. While many other standards for photometric measurements of light sources and luminaires are available, these standards are separated for measurement of lamps or luminaires. Since the current SSL products are in the forms of luminaires or lamps, and LED light sources in the luminaires are not easily separated as replaceable lamps, these existing standards cannot be applied directly to SSL products. This necessitates the use of absolute photometry. See the annex in this document for a description of how absolute photometry varies from relative photometry, which has historically been the lighting industry standard. Thus, this standard provides test methods addressing the requirements for measurement of SSL products. Since SSL technologies are still at their early stages, requirements for measurement conditions and appropriate measurement techniques may be subject to change at any time as the SSL technologies advance.

1.0 INTRODUCTION

1.1 Scope

This approved method describes the procedures to be followed and precautions to be observed in performing reproducible measurements of total luminous flux, electrical power, luminous intensity distribution, and chromaticity, of solid-state lighting (SSL) products for illumination purposes, under standard conditions. This approved method covers LED-based SSL products with control electronics and heat sinks incorporated, that is, those devices that require only AC mains power or a DC voltage power supply to operate. This document does not cover SSL products that require external operating circuits or external heat sinks (e.g., LED chips, LED packages, and LED modules). This document covers SSL products in a form of luminaires (fixtures incorporating light sources) as well as integrated LED lamps (see **section 1.3 f**). This document does not cover fixtures designed for SSL products sold without a light source. This document describes test methods for individual SSL products, and does not cover the determination of the performance rating of products, in which individual variations among the products should be considered.

1.2 General

SSL products as defined in this document utilize LEDs (including inorganic and organic LEDs) as the optical radiation sources to generate light for illumination purposes. An LED is a p-n junction semiconductor device that emits incoherent optical radiation when biased in the forward direction. White light is produced by LEDs using two methods: visible spectra of two or more colors produced by LEDs are mixed, or the emission (in the blue or ultraviolet region) from LEDs is used to excite one or more phosphors to produce broadband emission in the visible region (Stokes emission). A general description of LEDs and lighting is available in Ref. 1. Although constant current control is typical for stand alone LEDs, this document deals with integrated SSL products incorporating the semiconductor device level current control, thus the electrical parameters of interest are the SSL product's input electrical parameters.

For special purposes, it may be useful to determine the characteristics of SSL products when they are operated at other than the standard conditions described in this approved method. Where this is done, such results are meaningful only for the particular conditions under which they were obtained and these conditions shall be stated in the test report.

The photometric information typically required for SSL products is total luminous flux (lumens), luminous efficacy (lm/W), luminous intensity (candelas) in one or more directions, chromaticity coordinates, correlated color temperature, and color rendering index. For the purpose of this approved method, the determination of these data will be considered photometric measurements.

The electrical characteristics measured for AC-powered SSL products are input RMS AC voltage, input RMS AC current, input AC power, input voltage frequency and power factor. For DC-powered SSL products, measured electrical characteristics are input DC voltage, input DC current, and input power. For the purpose of this approved method, the determination of these data will be considered electrical measurements.

1.3 Nomenclature and Definitions

a) Units of electrical measurement are the volt, the ampere and the watt.
b) Units of photometric measurement are the lumen and the candela[2]. Chromaticity coordinates are specified in terms of the CIE recommended systems[3], the (x, y) or (u', v') chromaticity coordinates. To specify tolerance of chromaticity independent