ANSI/IES LM-78-20

Illuminating Engineering Society

APPROVED METHOD:
TOTAL LUMINOUS FLUX MEASUREMENT OF LAMPS USING AN INTEGRATING SPHERE PHOTOMETER

AN AMERICAN NATIONAL STANDARD

Approved American National Standard ANSI

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Foreword

This document is one of a continuing series of IES Approved Methods prepared to define a baseline for acceptable photometric procedures leading to improved agreement among laboratories. This Approved Method document explains a particular technique for total flux measurement of all types of lamps and luminaires using integrating spheres. The main improvement in this document compared to IES LM-78-2007 is the addition of spectral measurements. While most statements are written using *lamp*, they apply to lamps and luminaires.

1.0 Introduction and Scope

1.1 Introduction

Total luminous flux is the angularly integrated, photopically weighted, total light output from a lamp. Total luminous flux is one of the most important parameters for non-directional, general lighting products. While luminous intensity and beam angle are typically more important for directional lamps, such as reflector lamps, and luminaires, total luminous flux is still an important quantity. Regulations are usually based on luminous efficacy (lm/W), which is the total luminous flux divided by the electrical input power of the light-emitting device. This document describes techniques for measuring the total flux of lamps and luminaires. One method is exclusive to total luminous flux measurements: an integrating sphere system using a photometer. The second method described, an integrating sphere system using a spectroradiometer, is used to measure a variety of angularly integrated quantities. The integrating sphere system has the advantage of fast measurements and does not require a dark room. Air movement is minimized and temperature within the sphere is not subject to the fluctuations potentially present in a temperature-controlled room. The approved method is based on the comparison of the total luminous flux or total spectral radiant flux of a test lamp or luminaire to the total luminous flux or total spectral radiant flux of a standard lamp in an integrating sphere system.

While photometric and spectral integrating sphere measurement systems are very similar, they each have positive and negative aspects. Photometric measurement systems use a $V(\lambda)$-corrected photometer head, which suffers from spectral mismatch errors. Spectral mismatch errors occur because relative spectral responsivity of the integrating sphere photometric system deviates from the $V(\lambda)$ function. The spectral integrating sphere measurement system does not have spectral mismatch errors. Spectral integrating sphere measurement systems are capable of measuring the integrated color quantities of a light-emitting device; however, they are susceptible to spectral stray light and stability concerns. The two measurement techniques are compared and contrasted in this document along with the techniques required to make high quality measurements.

1.2 Scope

This approved method describes the procedures to be followed and precautions to be observed in performing reproducible measurements of total flux of lamps and luminaires using integrating sphere measurement systems. Two types of integrating sphere systems are presented, one employing a $V(\lambda)$-corrected photometer head, and another employing a spectroradiometer as the detector. In addition to the specifics of the two measurement systems, the common qualities and measurement techniques are discussed along with calibration and uncertainty analysis considerations.

2.0 Normative References

Illuminating Engineering Society. LS-1-20, Lighting Science: Nomenclature and Definitions for Illuminating Engineering. New York: IES; 2020.

3.0 Nomenclature and Definitions

3.1 total luminous flux

While the luminous flux (Φ_v) is defined in the International Lighting Vocabulary (ILV; CIE 2011) as the quantity derived from the radiant flux, Φ_v by evaluating the