

**IESNA Approved
Method
for
Total Luminous Flux
Measurement
of
Lamps
Using an Integrating
Sphere Photometer**

Publication of this Committee Report has been approved by the IESNA.
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Prepared by The Photometry of
Light Sources Subcommittee of the
IESNA Testing Procedures Committee



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Approved by the IESNA Board of Directors, January 28, 2007, as a Transaction of the Illuminating Engineering Society of North America.

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Published by the Illuminating Engineering Society of North America, 120 Wall Street, New York, New York 10005.

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Printed in the United States of America.

ISBN-13: 978-0-87995-218-1

ISBN-10: 0-87995-218-0

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Prepared by the Photometry of Light Sources Subcommittee of the IESNA Testing Procedures Committee

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10/04/2014 04:19:41 MDT

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IESNA Approved Method for Total Luminous Flux Measurement of Lamps Using an Integrating Sphere Photometer

FOREWORD

This document is one of a continuing series of IESNA Approved Methods prepared to define a baseline for acceptable photometric procedures leading to improved agreement among laboratories. This Approved Method explains a particular technique for total luminous flux measurement of all types of lamps using integrating spheres.

1.0 INTRODUCTION

1.1 General

Total luminous flux is the spatially integrated, photopically weighted, total light output from a lamp. Total luminous flux is an important parameter for non-directional, general lighting products. For directional lamps such as reflector lamps, intensity and beam angle are important parameters. The lamp total luminous flux divided by the lamp electrical power is the luminous efficacy (lm/W) of a lamp. This approved method describes a technique for measuring the total luminous flux of lamps using an integrating-sphere photometer employing $V(\lambda)$ -corrected photometer head. The approved method is based on the comparison of the total luminous flux of a test lamp to the total luminous flux of a standard lamp in an integrating sphere photometer.

1.2 Nomenclature and Definitions

(a) Luminous flux (Φ): the time rate of flow of radiant energy evaluated in terms of a standardized visual response:

$$\Phi = K_m \int_{\lambda} \Phi_{e,\lambda}(\lambda) V(\lambda) d\lambda \quad (1)$$

where: $\Phi_{e,\lambda}(\lambda)$ is the spectral concentration of radiant flux (e.g., in watts per nanometer), λ is the wavelength (e.g., in nanometer), $V(\lambda)$ is the spectral luminous efficiency in photopic vision, and K_m is the maximum photopic luminous efficacy of radiation, equal to 683 lm/W. The unit of luminous flux is lumen (symbol: lm).

(b) Total luminous flux (Φ): the cumulative luminous flux of a lamp for the solid angle of 4π steradians. It is also often called "luminous flux" in photometry practice. The unit of total luminous flux is lumen.

(c) Integrating-sphere photometer: a hollow sphere with an internal diffuse reflecting coating equipped with a photometer head and configured to measure the total luminous flux of a lamp contained in the sphere.

(d) Sphere efficacy: the ratio (E_d/Φ) of the illuminance E_d at the detector port to the total luminous flux Φ of a source in the sphere.

(e) Sphere responsivity: the ratio (y_d/Φ) of the photometer signal y_d to the total luminous flux Φ of a source in the sphere.

Note: The definitions of terms used in this document follow References 1 and 2. The use of the photometric quantities and units in this document are in accordance with the 1979 definition of the candela and other definitions given in international recommendations.^{3,4}

2.0 AMBIENT CONDITIONS

The integrating sphere efficacy can be slightly affected by changes in temperature or humidity. The responsivity of the photometer head on the integrating sphere is also affected by changes of temperature (typically on the order of 0.1 percent/°C). Thus, it is preferred to place the integrating sphere in a controlled environment.

The ambient conditions are more critical for measurements of particular types of discharge lamps. For example, fluorescent lamps are required to be operated in an ambient temperature of $25^\circ \pm 1^\circ\text{C}$. Refer to the appropriate IESNA Lighting Measurement (LM) documents for the required ambient conditions for each lamp type to be measured.⁵