ANSI/IES LM-75-19

Illuminating ENGINEERING SOCIETY

APPROVED METHOD: GUIDE TO GONIOMETER MEASUREMENTS AND TYPES, AND PHOTOMETRIC COORDINATE SYSTEMS

AN AMERICAN NATIONAL STANDARD

Approved American National Standard ANSI

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CONTENTS

Foreword

This document is an update of LM-75-2001, which was reaffirmed in 2012. The document has been updated to reflect current use of goniophotometers in industry, including calibration methods and methodologies for correction of stray light. Updated in this document are definitions of goniophotometer types and coordinate systems for photometric measurement of light sources. This document supersedes any angular conventions presented in LM-72-1997. This document does not cover near-field goniometers.

1.0 Introduction and Scope

1.1 Introduction

A goniophotometer is a photometer for measuring the directional light distribution characteristics of sources, luminaires, media and surfaces. A goniophotometer records photometric readings at a series of spherical coordinates to define a web of photometric data surrounding the item under test. Goniophotometric data are presented using various angular coordinate systems, and acquired using instruments of various constructions. In addition to goniophotometers, goniocolorimeters exist, which use three- or four-channel colorimeters to measure color properties at a series of spherical coordinates, and goniospectroradiometers exist, which use array spectrometers to measure spectral properties at a series of spherical coordinates. Historically, each type of goniophotometer was developed to measure a light source used in a specific application. Conventionally, measurement results for each type of light source were presented using a coordinate system that matched the specific application. Many current IES documents mention goniophotometers and coordinate systems. This document offers a complete explanation and provides harmonious definitions.

For luminaires, goniophotometers are used to measure luminous intensity distributions using either the relative or absolute photometry method. Using relative photometry, the luminous intensity in each direction is derived by normalizing the indicated luminous intensity of the luminaire and then scaling it to the rated initial lumens of the bare lamp(s) used in the luminaire; thus, absolute photometric calibration of the goniophotometer is not necessary using this method. However, relative photometry does not work for certain solid-state lighting (SSL) products, where the source(s) cannot be separated from the luminaire. For such products, absolute photometry, which requires a calibrated goniophotometer, shall be used.

This document provides definitions of goniophotometer types, spherical coordinate systems, and a general guide to goniophotometer calibration. Definitions presented herein are generally consistent with those in corresponding CIE publications [CIE 102[1] and CIE 121[2]]. Differences or inconsistencies are noted.

1.2 Scope

This document provides definitions of spherical coordinate systems and goniophotometer types used to measure light sources. It does not address the use of goniophotometers to measure media or surfaces. The operating principles behind each type of goniophotometer are addressed, and a general guide to goniophotometer calibration, stray light elimination, and stray light correction is presented. A methodology for zeroing data when measuring upward light is also provided. In addition, the correspondences between relevant IES and CIE definitions are described.

2.0 Normative References

Illuminating Engineering Society. ANSI/IES RP-16-17, Nomenclature and Definitions for Illuminating Engineering. New York: IES; 2017. Online: www.ies.org/standards/definitions/. (Accessed 2019 Jul 26).

3.0 Definitions, Including Spherical Coordinates

3.1 apolar angle

In a spherical coordinate system,[3,4] an angle measured from the positive pole; with the circumpolar angle, one of two