



Illuminating
ENGINEERING SOCIETY

**APPROVED METHOD:
GUIDE TO GONIOMETER
MEASUREMENTS AND TYPES, AND
PHOTOMETRIC COORDINATE SYSTEMS**
AN AMERICAN NATIONAL STANDARD

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ANSI/IES LM-75-19

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CONTENTS

Foreword	1
1.0 Introduction and Scope	1
1.1 Introduction.....	1
1.2 Scope	1
2.0 Normative References	1
3.0 Definitions, including spherical coordinates	1
3.1 apolar angle.....	1
3.2 attitude, application	2
3.3 attitude, design	2
3.4 attitude, measurement.....	2
3.5 azimuth angle.....	2
3.6 CIE (A, α) Coordinate System	2
3.7 CIE (B, β) Coordinate System	2
3.8 CIE (C, γ) Coordinate System	2
3.9 circumpolar angle (azimuth angle)	2
3.10 coordinate system.....	2
3.11 datum axis	2
3.12 datum half-plane.....	3
3.13 elevation angle.....	3
3.14 first axis (of a light source)	3
3.15 frame of reference.....	3
3.16 frame of reference, application.....	3
3.17 frame of reference, goniometer	3
3.18 frame of reference, laboratory	3
3.19 frame of reference, source.....	3
3.20 half-plane of data	3
3.21 half-plane, goniometric	3
3.22 handedness (of a coordinate system).....	3
3.23 IES Coordinate System A (Y, X).....	3
3.24 IES Coordinate System B (H, V)	4
3.25 IES Coordinate System C (V, L)	4
3.26 left-handed coordinate system.....	4
3.27 light source	4
3.28 photometric center (of a light source)	4

3.29	planar angle (angle in plane)	4
3.30	right-handed coordinate system	4
3.31	second axis (of a light source)	4
3.32	spherical coordinates	4
3.33	test axis (of a source)	5
3.34	third axis (of a light source)	5
3.35	tilt, measurement (of a source)	5
3.36	zenith angle	5
4.0	Laboratory, Goniometer, and Source frames of reference	5
4.1	Frames of Reference Applicable to Goniophotometry	5
4.1.1	Source Frame of Reference	5
4.1.2	Goniometer Frame of Reference	6
4.1.3	Laboratory Frame of Reference	6
4.1.4	Application Frame of Reference	6
4.2	Orientation with Respect to Gravity	6
5.0	Coordinate Systems	7
5.1	Spherical Coordinate Systems	7
5.2	Defining a Spherical Coordinate System	7
5.3	Example: The Geographic Coordinate System	8
5.4	Standard Goniophotometric Coordinate Systems	9
5.4.1	IES Coordinate System A (IES-A)	9
5.4.2	IES Coordinate System B (IES-B)	10
5.4.3	IES Coordinate System C (IES-C)	10
6.0	Goniophotometers	11
6.1	Type A Goniophotometer	11
6.1.1	Instrument Design and Setup	11
6.1.2	Instrument Operation	11
6.1.3	Applications	12
6.2	Type B Goniophotometer	12
6.2.1	Instrument Design and Setup	12
6.2.2	Instrument Operation	12
6.2.3	Applications	13
6.3	Type C Goniophotometer	13
6.3.1	Instrument Design and Setup	13
6.3.2	Instrument Operation	14
6.3.3	Applications	14
6.3.4	Design Variations	14

6.4	Type D Goniophotometer	16
6.4.1	Instrument Design and Setup	16
6.4.2	Instrument Operation	16
6.4.3	Applications	16
7.0	Calibration	16
7.1	Relative Photometry Method	16
7.2	Absolute Photometry Method	16
7.2.1	Luminous Intensity Calibration	18
7.2.2	Illuminance Calibration	19
7.2.3	Total Luminous Flux Calibration	20
8.0	Integrated Measurements	21
8.1	Method of Calculation	21
8.2	Angular Frequency of Data Points	21
9.0	Stray Light Elimination and Correction	22
9.1	Stray Light and Its Sources	22
9.2	Stray Light Elimination Techniques	22
9.2.1	Limiting Field of View	22
9.2.2	Reducing Reflected Light	22
9.2.3	Use of a Light Trap	22
9.3	Stray Light Correction Methodologies	22
9.3.1	Using a Mask	23
9.3.2	Handling of Negative Luminous Intensity Values	23
9.4	Stray Light and Uplight Measurement	23
9.4.1	Uplight Detection Threshold	23
9.4.2	Criteria for Zeroing Uplight Readings	24
9.4.3	Stray Uplight Test Setup	24
9.4.4	Stray Uplight Test Procedure	25
9.5	Reporting Zeroed Stray Uplight	25
Annex A	Coordinate System Conversion	26
Annex B	Zonal Constant Calculations	27
Annex C	Informative References	28

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, goniospectrometers 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 102¹ and CIE 121²]. 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