ANSI/IES LM-81-20

Illuminating ENGINEERING SOCIETY

APPROVED METHOD:
PHOTOMETRIC TESTING OF SKYLIGHTS AND TUBULAR DAYLIGHTING DEVICES UNDER HEMISPHERICAL SKY CONDITIONS

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Prepared by:
IES Testing Procedures Committee

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CONTENTS

1.0 Introduction and Scope 1
1.1 Introduction 1
1.2 Scope 1

2.0 Test Distance 1

3.0 Goniophotometer Basic Construction 2
3.1 Small Aperture (Tubular) Goniophotometer 2
3.2 Skylight Goniophotometer 2
3.3 Electrical/Electronic System 3
3.4 Amplifier Box 4
3.5 Electronic Interface Box 4
3.6 Computer Interface Board 4
3.7 Vertical Angular Planes (Step Motor) 4
3.8 Data Collection Speed 5
3.9 Automated Goniophotometer 5

4.0 Photometer Structure 5

5.0 Calibration 6
5.1 Periodic Calibration and Accuracy 6
5.2 Data Reduction 7
5.3 Stray Light 7

6.0 Sky Conditions 8

7.0 Testing Procedures 8
7.1 General Test Conditions 8
7.2 Daylight Device Positioning 9
7.3 Sun Angles 9
7.4 Selection of Angles for Photometric Measurements 10
7.4.1 Angles of Measurement 10
7.4.2 Planes for Measurement 10
7.5 Testing Start Time in Relation to Sun Angle Times 10
7.6 Reporting 11

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8.0 Testing Procedure **12**

9.0 Limitations of Skylight Photometry **12**

Annex A – Accuracy of the Quadrant Testing Method **13**
Annex B – The Testing of Transparent Skylights **1**
Annex C – Accuracy Analysis of Reflections from Black Card **1**
Annex D – Calculation of Standard Time for Different Solar Elevations **15**

Additional Reading **17**
References **17**

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1.0 Introduction and Scope

1.1 Introduction

Unlike electric luminaires, which require only one photometric test, skylights require a separate test to characterize their performance at different sun angles as well as a separate measurement to determine the sky conditions. Skylights are very often large; some exceed the size capabilities of typical intensity distribution goniophotometers. Therefore, a method was developed to quickly and accurately measure daylight data and place the results in a standardized photometric file format such as ANSI/IES LM-63-19.[1] The collection of results can then be used by lighting design software programs to simulate how skylights under the desired test conditions will fill a space with daylight. This equipment tested also proved to be accurate with regard to the effects of test distance.[6]

This is only one method of achieving luminous intensity distribution curves and efficiency data for skylights and tubular daylighting devices with diffusing properties. In addition, this method mirrors the proven method used to measure electric lights but includes many adjustments because of the very intense, movable light source, the sun. Since 2002, this method has proven to produce consistent repeatable results for measuring skylights and tubular daylighting devices under actual sky conditions.

The procedures contained in this document are a benefit to the lighting industry in characterizing the performance of daylighting products and are backed by significant experience using this measurement method. However, daylight photometry is in infancy stages of research, and further development of these methods will continue. In addition, further research is being conducted to compare measurements to simulation methods. Simulations of daylight system performance use predicted sky models from either the International Commission on Illumination (CIE) or IES and allow for the rapid comparisons of multiple design options or sky conditions. Further research will also be conducted to methods of achieving accurate luminous intensity distribution curves and efficiency data.

1.2 Scope

This Lighting Measurement (LM) document provides the IES recommended uniform method for determining and reporting the photometric characteristics of skylights and tubular daylighting devices that incorporate a means to diffuse the natural hemispherical daylight as the daylight passes through the daylighting system. It describes the procedures followed and the precautions observed in obtaining uniform and reproducible measurements of tubular daylighting devices and skylights with glass or plastic glazing. This document identifies the components and the structure type needed to adequately measure daylighting devices. The procedures, calibration of the equipment, and determination of sun angles and sky conditions are also discussed. This method is not recommended for daylight devices with clear glazing (see **Annex B**).

Additional information on subjects covered in this document may be found in:

- Illuminating Engineering Society. ANSI/IES LS-4-20[2]
- Illuminating Engineering Society. ANSI/IES LM-63-19[1]

2.0 Test Distance

The goniophotometer and the building enclosure should be set up to measure the largest desirable device. The distance between the daylight luminaire and the photodetector should be sufficiently large that the inverse-square law (ISL) can be applied at the distance needed for the largest daylight luminaire to be tested by the goniophotometer. Smaller daylight luminaires can also be tested. It is required that the distance from the daylight luminaire to the photo detector be at least five times the largest luminous dimension of the daylighting luminaire.

For example, when measuring the luminous intensity of a 610 mm x 610 mm (24 in. x 24 in.) skylight, the longest distance would be the 864-mm (35-in.) diagonal. Therefore, the minimum test distance needs to be 5 times 864 mm (5 x 35 in.), which is 4.45 m (14.6 ft). For a tubular daylighting device with a circular daylight opening of 533 mm (21 in.) the minimum test distance would be 2.67 m (8.75 ft). (See **Figure 2-1**.)

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