Illuminating
ENGINEERING SOCIETY

IES LM-81-10

Approved Method: **Photometric Testing of Skylights and Tubular Daylighting Devices under Hemispherical Sky Conditions**

IES LM-81-10

Approved Method for Photometric Testing of Skylights and Tubular Daylighting Devices under Hemispherical Sky Conditions

Publication of this report
has been approved by IES.
Suggestions for revisions
should be directed to IES.

Prepared by:
The Skylight and Light Pipe Subcommittee
of the IES Testing Procedures Committee

Approved by the IES Board of Directors, August 23 , 2010, as a Transaction of the Illuminating Engineering Society of North America.

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

IES Standards and Guides are developed through committee consensus and produced by the IES Office in New York. Careful attention is given to style and accuracy. If any errors are noted in this document, please forward them to Rita Harrold, Director of Technology, at the above address for verification and correction. The IES welcomes and urges feedback and comments.

ISBN # 978-0-87995-242-6

Printed in the United States of America.

Prepared by the Subcommittee on Skylight and Light Pipe of the Testing Procedures Committee

Skylight and Light Pipe Subcommittee

Bruce Mosher, Chair

M. Andersen
R. Berger
C. Condit
K. Kopitzke
W.McCluney
K. Papamichael

Testing Procedures Committee

Michael, Grather, Chair

C. K. Andersen
L. M. Ayers*
R. C. Berger
R. P. Bergin*
R. S. Bergman
K. Broughton*
R. C. Dahl*
R. O. Daubach*
D. Ellis
A.M. Foy*
P. J. Franck*
R. V. Heinisch*
T. T. Hernandez*
R. E. Horan
D. E. Husby**
S. Hutton*
J. Hospodarsky
D. Jenkins*
J. Jiao
M. A. Kalkas
D. Karambelas
R. Kelley*
M. Kotrebai
K.K. Krueger
B. Kuebler*
E. Ladouceur*
J. Lawton*
L. E. Leetzow*
K. C. Lerbs*
R. E. Levin*
I. Lewin
R. Low*
J. P. Marella
G. McKee
S. W. McKnight**
C. C. Miller
B. Moshe
W. A. Neiland
Y. Ohno*
D. N. Randolph
E. Richman*
M. Riebling
J. Ronquillo Urmatan*
M. P. Sapose
J. Schutz*
D. C. Smith*
R. C. Speck**
L. Stafford*
G. A. Steinberg
J. Welch*
J. Yon*
J. X. Zhang

* Advisory Member
** Honorary Member

Contents

1.0 SCOPE AND PURPOSE

This guide provides the IES required 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 guide 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**).

Unlike electric luminaires, that 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, and the sky conditions are always changing. Therefore, a method was developed to quickly and accurately measure daylight data and place the results in a standardized photometric file format such as IESNA LM 63-02 (R2008).[1] The collection of results can 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.[2]

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 proved 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 proved 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 research and development of these and other methods will continue. In addition, further research is being conducted to compare measurement methods to simulation methods. Simulations of daylight system performance use predicted sky models from either the CIE or IES and allow for the rapid comparisons of multiple design options or sky conditions. Further research will also be conducted to improve methods of achieving accurate skylight luminous intensity distribution curves and efficiency data.

2.0 GENERAL LIGHTING CHARACTERISTICS

For additional information on subjects covered in this guide consult the following publications:

- IESNA Lighting Handbook[3]
- IESNA Guide for Reporting General Lighting Equipment Engineering Data for Indoor Luminaires[4]
- IESNA Standard File Format for Electronic Transfer of Photometric Data[1]

3.0 TEST DISTANCE

Set up the goniophotometer and the building enclosure to measure the largest desirable product. Determine a distance between the daylight luminaire and the photodetector that is sufficiently large to use the inverse square law (ISL) applied at the distance needed for the largest daylight luminaire tested by the goniophotometer. Smaller daylight luminaries can also be tested. It is required that the distance from the daylight luminaire to the photodetector must be at least five time the largest luminous opening dimension of the daylighting luminaire.

For example, when measuring the luminous intensity of a 609.6 mm x 609.6 mm (24 in x 24 in) skylight, the longest distance would be the 863.8 mm (35 in) diagonal. Therefore, the minimum test distance needs to be 5 times the 863.8 mm (35 in), which is 4.45 m (14.58 ft). For a tubular daylighting device with a circular daylight opening of 533.4 mm (21 in), the minimum test distance would be 2.67 m (8.75 ft).

4.0 GONIOPHOTOMETER BASIC CONSTRUCTION

When performing photometry of electric luminaires, a rotating mirror goniophotometer is commonly used. This turns the light path to near-horizontal and substantially reduces space. However, a rotating mirror system cannot be used with a skylight because