Instructions and Directions for Luminous Flux Measurement

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Light Emitting Diode

1. Introduction

This document describes instructions and directions for an integrating sphere to measure the luminous flux of Nichia's LEDs.

2. Optical Measurement Equipment

The luminous flux of LEDs is, in general, measured with integrating spheres.

The integrating spheres vary in size from several inches to one hundred and several inches. Nichia usually uses 10 to 20-inch spheres to measure the luminous flux of LED packages (i.e. unmounted LEDs).

To measure the flux of LED arrays or modules, the integrating spheres are to be selected according to the size of the test samples. For 4п geometry, in accordance with LM79 which is the measurement standard of the illumination apparatus, the total area of LED arrays or modules shall be less than 2% of the sphere's, and the strip of the board shall be 2/3 or less in length than the diameter of the sphere. About 4п geometry ,please refer to the 3 page clause 7 intensity of solid angle and luminous intensity of our technical data 「Optical Unit and Calculation」.

Figure 1 shows the integrating sphere incorporated in Nichia test system used to measure the luminous flux of LED packages.

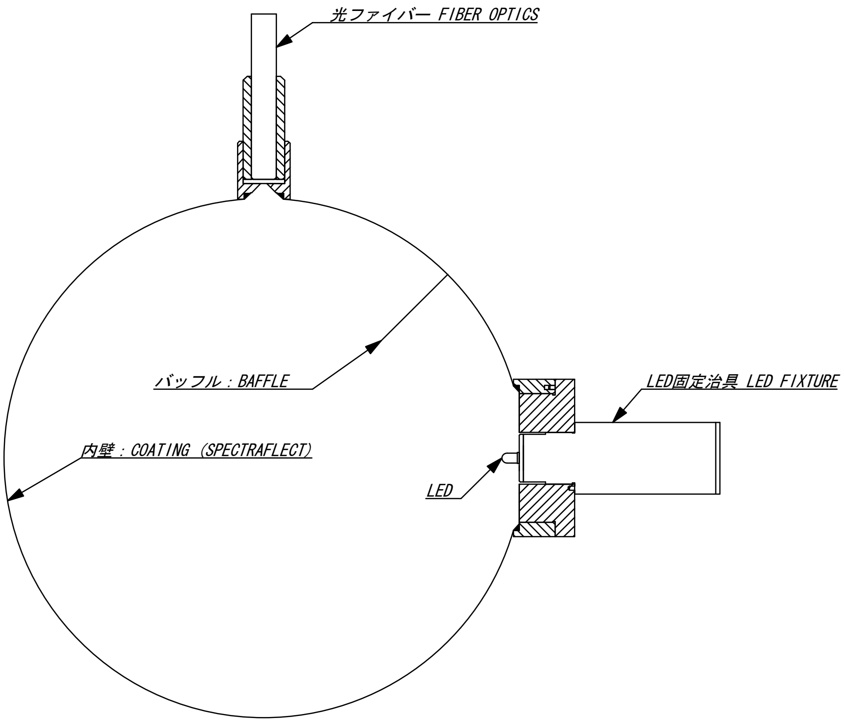


Figure 1 Integrating Sphere in Nichia Test System

3. Points to Note

It is necessary to ensure the following to obtain exact measurement results that correlate with Nichia:

1) To calibrate the measuring instrument and apparatus (To ensure traceability)
2) To determine the correction coefficients for the boards or housings
3) To set the same Tj as Nichia's

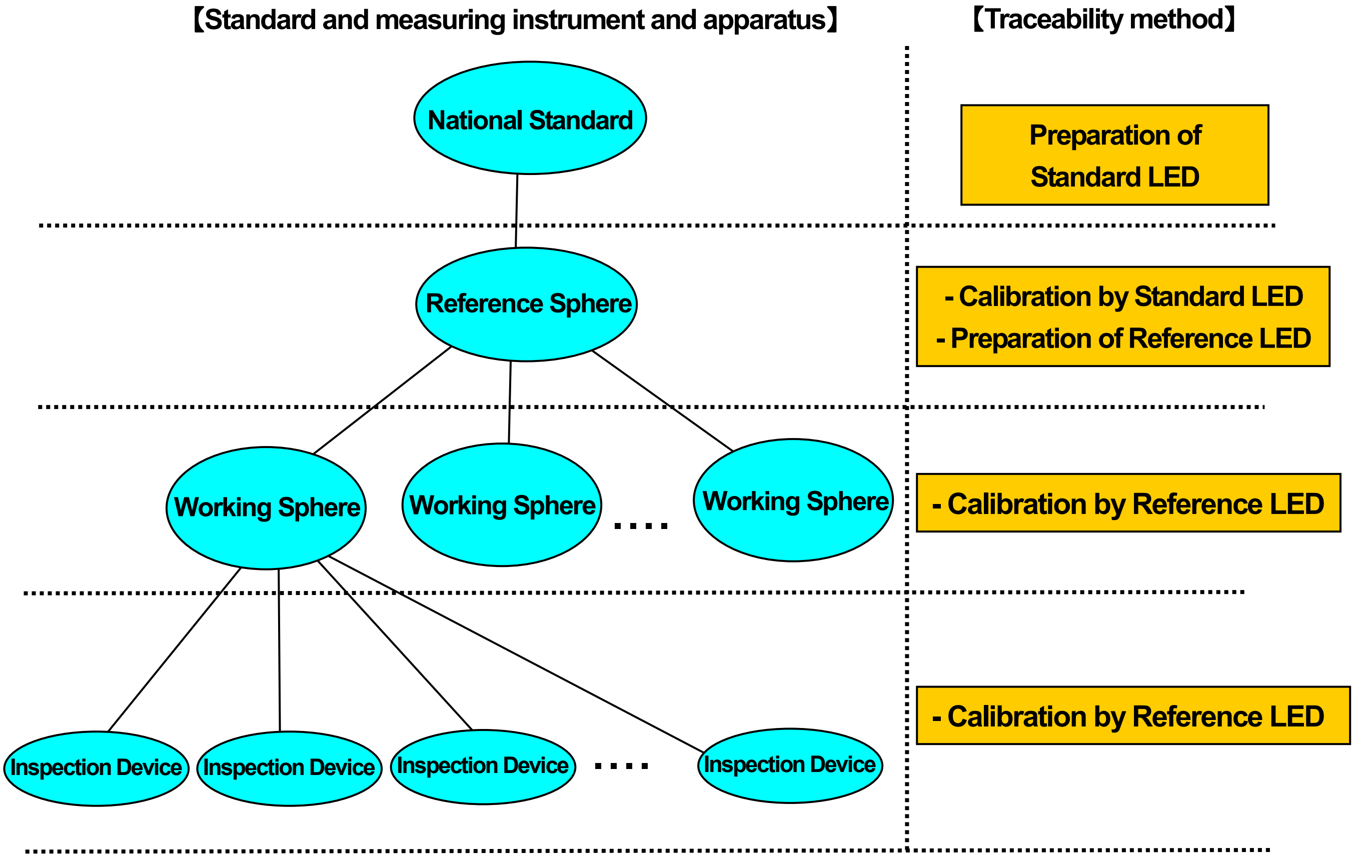
3-1. To calibrate the measuring instrument and apparatus (To ensure traceability)

Traceability is defined as "the property of a result of a measurement or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons all having stated uncertainties." (cf. VIM "International Vocabulary of basic and general terms in Metrology": 1993 / JIS Z 8103)

To put it simply, traceability refers to the ability to prove that there is little difference in the measurement data such as spectral distribution, chromaticity, luminous intensity, radiant flux, and luminous flux between at the customer site and the national or international standards.

Appropriate calibration can enable the correlation among the measurement results / the references at the customer site, and Nichia's references.

Figure 2 shows the calibration system for the integrating spheres in Nichia.



* **Uncertainty: Quantitative term that represents a range of values wherein the true value may lie. Measurement results always have a certain range of uncertainty due to the following parameters:**
1. Measurement equipment (variation, drift, noise, etc.) 2. Measuring object (Stability, Reproducibility, etc.)
3. Measurement process (setups, procedures, etc.) 4. Inappropriate calibration 5. Measurement environment (temperature, humidity, and pressure)

Figure 2
Nichia's Calibration System for Integrating Spheres

3-2. To determine the absorption correction factors for the boards or housings

When a device under test is of different size and shape than the reference LED, resulting in the difference in the light absorption between them, the luminous flux measurements made in the integrating sphere require a self-absorption correction specific to each device. Without multiplication of the self-absorption correction factors, the accurate throughput of the integrating sphere cannot be achieved.

To measure the luminous flux of an LED mounted on a board, the measurements require a self-absorption correction factor for the overall item at the aperture such as the LED, board, array, and so on, since these materials absorb the light within the sphere.

Figure 3 shows an integrating sphere used to measure the luminous flux. Please refer to Figure 4 for the relation among the diameters of the sphere and the aperture and the absorption correction factors. The graph shows that the absorption correction factors are increased as the diameter of the aperture is increased in each size of the sphere.

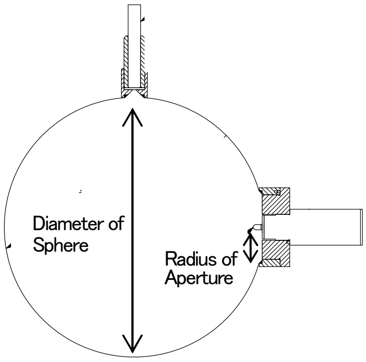


Figure 3

Integrating Sphere

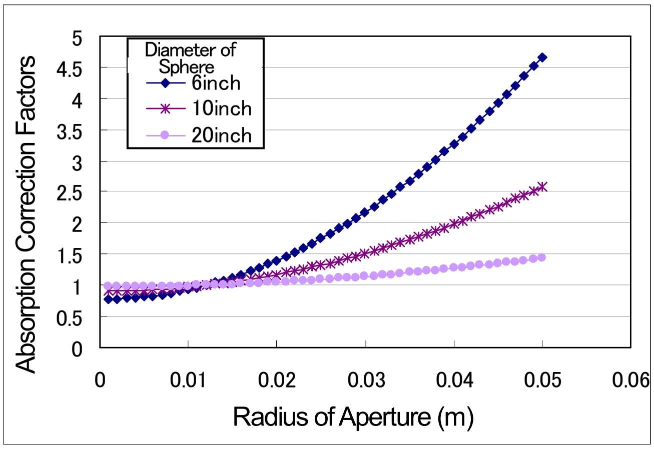


Figure 4

Relation among Diameter of the Sphere / Aperture and Absorption Correction Factor

* Please use these measurement data just for your reference.

3-3. To set the same Tj as Nichia's

As the exposure time is increased, the luminous flux is changed due to the elevation of Tj under the influence of the heat generated from the LEDs, according to the temperature characteristics specific to LEDs.

Nichia generally measures the luminous flux under the conditions where the LEDs are insusceptible to the heat generated from the LEDs themselves. Figure 4 shows the Nichia's conditions of measurements of luminous flux.

項目 Item	記号 (単位) Symbol (Unit)	Power LED	Other LED
パルス幅 Pulse Width	t_p [μs]	50	100
周期 Period	T [μs]	5000	1000
デューティー Duty	$D=t_p/T$	1/100	1/10

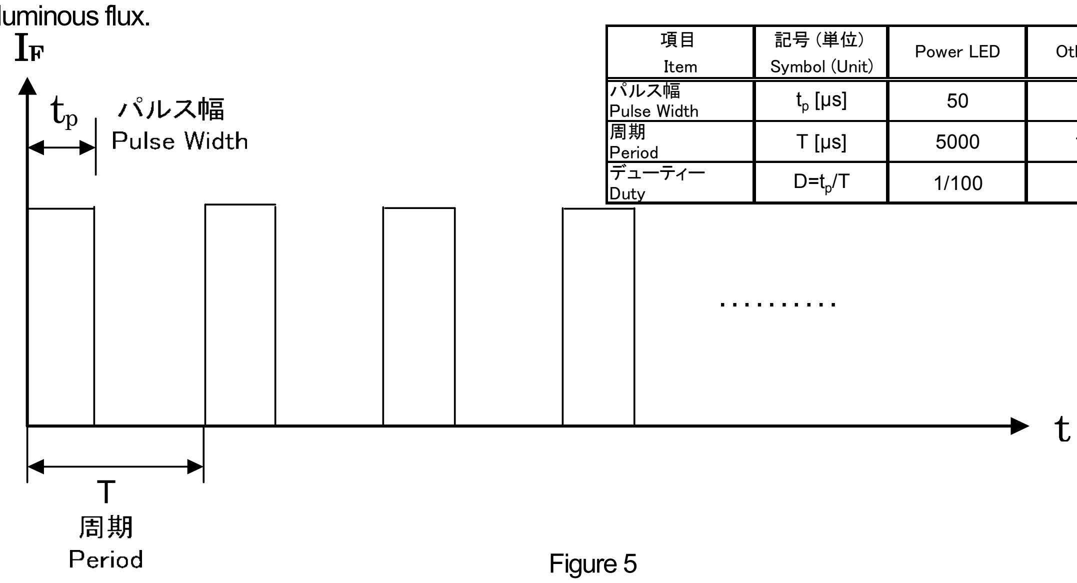


Figure 5

Nichia's Conditions of Measurements of Luminous Flux

The higher the input power is applied to LEDs, the more the luminous flux is changed, as the exposure time is increased.

For reference, Figures 6 to 11 show the evaluation results of the relative luminous flux and soldering temperature at the input power of 0.2, 1.0, and 2.0 [W] with DC.

0.2W LED IF=50mA

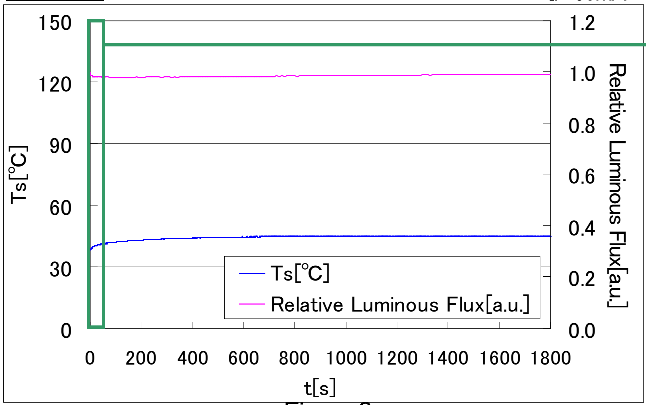


Figure 6
Evaluation Result of Relative Luminous Flux

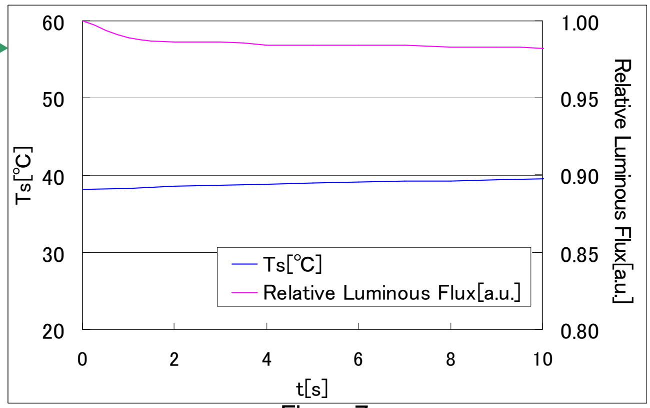


Figure 7
Evaluation Result of Relative Luminous Flux

1.0W LED IF=350mA

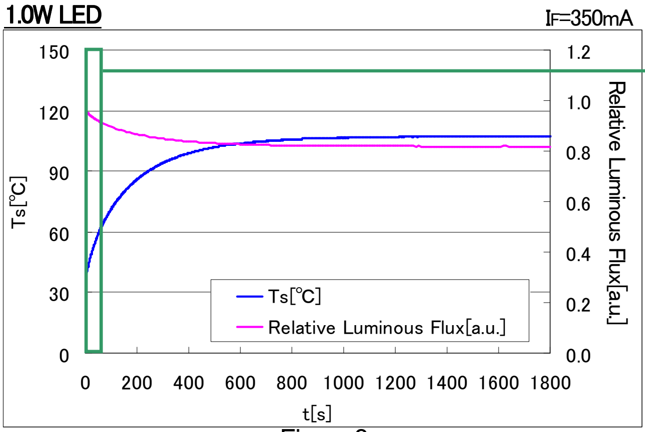


Figure 8
Evaluation Result of Relative Luminous Flux

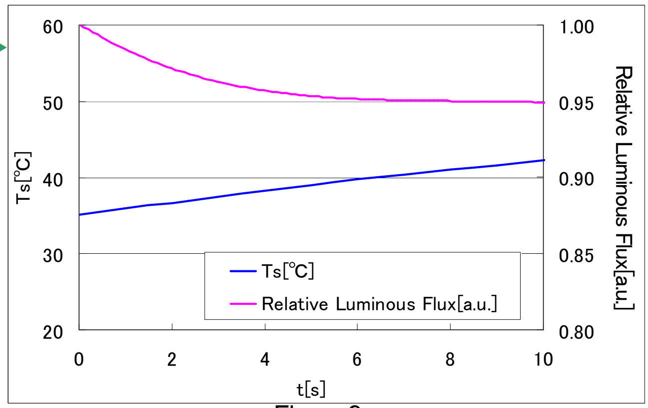


Figure 9
Evaluation Result of Relative Luminous Flux

2.0W LED IF=700mA

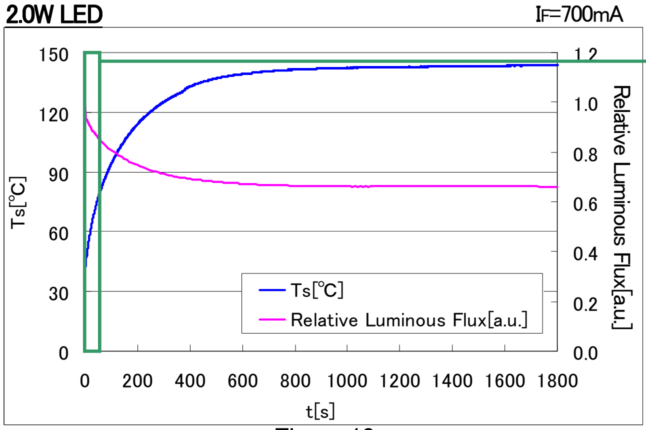


Figure 10
Evaluation Result of Relative Luminous Flux

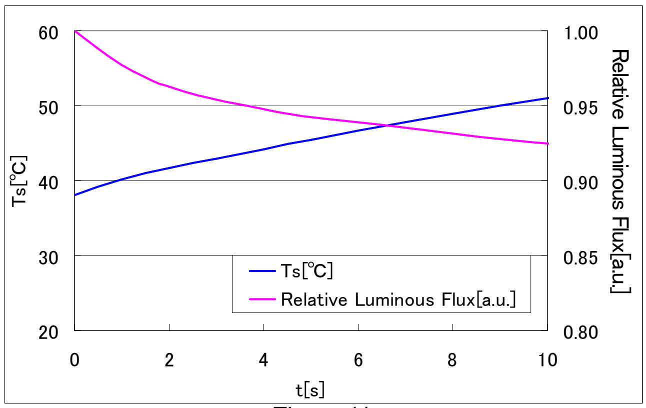


Figure 11
Evaluation Result of Relative Luminous Flux

* Please use these measurement data just for your reference.

List of References

- IES LM-79
- JIS Z8103:2000 “Glossary of terms used in measurement”
- VIM (International Vocabulary of Metrology)
- JIS C 8152