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MEASUREMENT OF LEDS

SUMMARY

This report is an update of the previously published CIE Technical Report CIE 127-1997.

There are significant differences between LEDs and other light sources which made it necessary for the CIE to introduce new quantities for their characterization with precisely defined measurement conditions. New quantities introduced here are "Averaged LED Intensity" and "Partial LED Flux".

The report describes in detail the measurement conditions for ALI (Averaged LED Intensity), Total and Partial LED Flux and Spectral Power Distribution. It is shown that measurements by substitution method using LED standards can be simpler; however it is important to compare similar coloured LEDs or use colour correction on the measurement results. The standard LEDs need to be calibrated by National Metrology Laboratories or a laboratory traceable to National Metrology Laboratories.

MESURE DES DIODES ELECTROLUMINESCENTES (LED)

RESUME

Ce rapport est une actualisation du rapport technique CIE 127-1997 publié antérieurement par la CIE. Il y existe des différences significatives entre les LED et les autres sources de lumière qui ont nécessité, pour la CIE, l'introduction de nouvelles grandeurs avec des conditions de mesure précisément définies pour leur caractérisation. Les nouvelles grandeurs définies ici sont "l'intensité moyennée d'une LED" et "le flux partiel d'une LED".

Le rapport décrit en détail les conditions de mesure de l’intensité moyennée d’une LED "ALI" (Averaged LED Intensity), le flux total et le flux partiel d'une LED, et la distribution spectrale de puissance. Il est montré que les mesures par une méthode de substitution utilisant une LED étalon peuvent être plus simples; cependant il est important de comparer des LED de couleur similaire ou d'appliquer une correction de couleur aux résultats des mesures. Les LED étalons doivent être étalonnées par un laboratoire national de métrologie ou un laboratoire traçable à un laboratoire national de métrologie.

MESSUNG VON LEDS

ZUSAMMENFASSUNG

Dieser Technische Bericht ist eine Aktualisierung des früher publizierten Technischen Berichtes der CIE der Nummer 127-1997.

Es gibt signifikante Unterschiede zwischen LEDs und anderen Lichtquellen; diese erfordern von der CIE die Einführung neuer Größen zur Charakterisierung von LEDs unter genau festgelegten Messbedingungen. Die hier neu eingeführten Größen sind die "mittlere LED-Lichtstärke" und der "LED-Teillichtstrom". Dieser Technische Bericht beschreibt im Detail die Messbedingungen für die "mittlere LED-Lichtstärke", den "LED-Teillichtstrom", den LED-Gesamtlichtstrom und die spektrale Strahlungsverteilung von LEDs. Es wird gezeigt, dass Messungen nach der Substitutionsmethode unter Verwendung von LED-Normalen einfacher sein können; hierbei ist es wichtig, LEDs ähnlicher Farbe zu vergleichen oder aber die Messergebnisse bezüglich spektraler Fehlanpassung zu korrigieren. Die LED-Normale müssen bei den jeweiligen Nationalen Metrologischen Instituten oder einem Labor, das rückführbar ist auf die Nationalen Metrologischen Institute, kalibriert werden.

1. INTRODUCTION

This report is a revision of CIE 127-1997 (Measurement of LEDs) and supersedes it. CIE 127 was produced before high power LEDs became commonly available. Since CIE 127 was published, there has been much progress in the development of the LEDs, especially of high power LEDs in a wide range of colours including white, there have been many changes in common practice in measurement of LEDs, and also some new knowledge has become available. This revision reflects such changes, and updates the recommendations for more reproducible and improved measurements of LEDs.

1.1 Scope

Semiconductor devices which emit optical radiation can be divided into two distinct groups, luminescent diodes, usually known as Light Emitting Diodes or LEDs, and laser diodes. The present report is concerned only with the first group, LEDs. This report deals with measurement of individual LEDs only and does not cover clusters or arrays of LEDs, fixtures using LEDs, nor large area surface emitters such as organic light emitting diodes (OLEDs). This report covers measurement of photometric, radiometric, and colorimetric quantities of LEDs, to be performed in calibrating laboratories; it does not cover measurement procedures in production lines which require other considerations. It is the responsibility of the manufacturers and users to ensure that, after obtaining well characterised working standards from their laboratory, the test set-up used for production control will measure the defined quantities properly. The production line measurement recommendations will be dealt with in another report. The deviations from laboratory measurement conditions and possible sources of error have to be carefully examined when the test equipment is designed and installed.

1.2 Terminology

Strictly speaking, the term LED should only be applied to those diodes that emit visible light. Those which emit radiation in the near infrared should, more correctly, be called IREDs (Infrared Emitting Diodes). In general, however, both groups of diodes are widely referred to as LEDs and, since most of the measurement techniques and characterisations are common for the two groups, the term LED is used throughout this report to cover both types. This also applies to diodes emitting ultraviolet (UV) radiation. The sections relating to photometric and colorimetric quantities clearly apply only to those devices emitting visible light, but if there is any confusion this will be made clear at the appropriate point.

Several terms not defined in the CIE Vocabulary are used in this document as:

- Averaged LED Intensity;
- Partial LED Flux.

Please see document for exact definitions.

1.3 Purpose of the report

LEDs are produced in enormous quantities and in a wide range of different types to meet the very different specifications of a variety of applications. When a wide range of different types of LEDs is measured, the multi-dimensional properties of the emitted optical radiation must be considered during a measurement, not only in relation to the emitting diode but also as they affect the receiving detector. The range of possible influences on the result of a measurement is considerable and the related measurement uncertainty becomes correspondingly high. The low level of the radiant power emitted by some LEDs can limit the resolution of the spectral and spatial distribution measurements; in order to increase the signal of the detector, it has become common practice to measure, for example, the luminous intensity of LEDs at relatively short distances at a fairly large solid angle of the radiation coming from the LED. In this case LEDs are not measured as a point source and measured results vary depending on the geometrical conditions used. To minimize such variation of results, this report standardizes such geometrical conditions so that measured values can be comparable and reproducible among different users.