

**Nanomanufacturing - Key control characteristics - Part
3-1: Luminescent nanomaterials - Quantum efficiency**

EESTI STANDARDI EESSÕNA

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English Version

**Nanomanufacturing - Key control characteristics - Part 3-1:
Luminescent nanomaterials - Quantum efficiency
(IEC 62607-3-1:2014)**

Nanofabrication - Caractéristiques de contrôle clé Partie 3-1:
1: Nanomatériaux luminescents - Rendement quantique
(CEI 62607-3-1:2014)

Nanofertigung - Schlüsselmerkmale - Teil 3-1:
Lumineszierende Nanomaterialien - Quanteneffizienz
(IEC 62607-3-1:2014)

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Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of document 113/214/FDIS, future edition 1 of IEC 62607-3-1, prepared by TC 113 "Nanotechnology standardization for electrical and electronic products and systems" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62607-3-1:2014.

The following dates are fixed:

- latest date by which the document has to be (dop) 2015-03-26
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publication of an identical national
standard or by endorsement
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standards conflicting with the
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Annex ZA
(normative)

**Normative references to international publications
with their corresponding European publications**

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here:
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<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
CIE S 017/E	2011	ILV: International Lighting Vocabulary	-	-

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INTRODUCTION

One of the principal drivers of solid-state lighting (SSL) is the potential efficiency of the illumination devices to convert electricity into light. Incandescent and fluorescent lighting devices are only about 5 % to 30 % efficient, with incandescent lighting having the lowest efficiency. Since a significant portion of all electricity consumed is used in providing lighting, increasing the efficiency of lighting devices will have a huge impact on the world's energy consumption. The luminous efficiency of SSL devices is a critical measurement of their overall efficiency, and standard methods to perform these measurements have been established and were essential to producing reliable product information for manufacturers and consumers. The same is true of the luminescent materials on which these light-emitting diode (LED) manufacturers rely; however, no such standard currently exists. This standard provides SSL manufacturers a universal means for comparing luminescent nanomaterials from different suppliers, and potentially for luminescent materials for LEDs in general.

The most common SSL devices are composed of a blue light-emitting diode (LED) and a luminescent material. The blue LED optically excites the luminophore, which will radiate light of the appropriate colour or colours to yield the desired white spectrum. This device, termed a phosphor-converted light emitting diode (or pc-LED), converts the electricity indirectly into white light by first creating blue light and then converting the blue light into broad-band visible radiation. Currently, quantum dots (QDs) or nanophosphors are one option for the photoluminescent material that converts the blue LED wavelength to broad spectrum visible light. QDs and nanophosphors are of interest in this application for several reasons including their greater colour flexibility, narrowband emission spectrum, broadband absorption, near-infinite flocculation time, reduced bleaching, and lower scattering compared to conventional phosphors which are typically larger than 5 μm . QD-enabled pc-LEDs have been shown to have the best possible combination of colour rendering, correlated colour temperature, and luminous efficiency of any other pc-LED on the market.

A critical measurement parameter for luminescent materials used in the lighting industry is quantum efficiency, which is defined in this standard as the number of photons emitted into free space by a luminescent nanoparticle divided by the number of photons absorbed by the nanoparticle. Suppliers of QDs and luminescent nanomaterials typically measure only relative quantum efficiency (or alternatively, quantum yield) in the solution phase due to the ease of such measurements and the applicability of such measurements to biomedical imaging (a widespread use of QDs in R&D). These measurements are often taken at low concentrations where effects such as nanoparticle agglomeration and re-absorption are minimized. However, in end-use applications, the actual concentration of luminescent nanomaterials may be significantly different. For example, concentrated luminescent nanoparticle formulations (in either solid or liquid state) may be required to achieve a desired luminous flux and correlated colour temperature in a SSL device. This standard codifies that method for the first time, and establishes an absolute quantum efficiency test method for both solid (e.g., luminescent nanoparticles embedded in polymer matrices, coated on glass optics, applied directly to light emitted diodes, and other form factors) and solution samples (e.g., colloidal suspensions of luminescent nanoparticles), enabling suppliers and purchasers to compare the performance of one material to another, both in their raw (solution) phase as well as their technologically relevant (solid) phase of matter.