IEC TS 62876-4-1

Edition 1.0 2025-02

TECHNICAL SPECIFICATION

Nanomanufacturing – Reliability assessment –
Part 4-1: Nanophotonic products – Optical stability test of quantum dot enabled light conversion films: Temperature, humidity and light exposure

IEC TS 62876-4-1:2025-02(en)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ICS 07.120

ISBN 978-2-8327-0165-2

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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IEC TS 62876-4-1 has been prepared by IEC technical committee 113: Nanotechnology for electrotechnical products and systems. It is a Technical Specification.

The text of this Technical Specification is based on the following documents:

Draft	Report on voting
113/866/DTS	113/886/RVDTS

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Specification is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 62876 series, published under the general title *Nanomanufacturing – Reliability assessment*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

INTRODUCTION

Quantum dots (QDs), as luminescent nanomaterials, exhibit broad absorption spectra and narrow emission spectra. Using the same excitation source to excite QDs of different particle size, it is possible to emit spectra with different peak wavelengths. Based on the above characteristics, QDs are used in display products, which can greatly improve the display colour gamut.

Nowadays, as a typical product of quantum dot technology application, quantum dot enabled light conversion film (Q-LCF) is widely used in the display field. Under normal working conditions, Q-LCF in a backlight module will be continuously irradiated by high-energy excitation light (such as blue light) to emit converted light. Under the combined action of water vapour and oxygen from the environment, the optical properties of the QDs in Q-LCF will slowly deteriorate. In order to ensure the quality and stability of Q-LCF products, it is essential to scientifically design a reliability test standard to evaluate product quality. Reliability assessment can be used, for example, to authorize advancement to the next step in product development, or to authorize progress payments, or to proceed with delivery and acceptance of products.

This document provides reliability test and evaluation criteria for Q-LCF. In this document, Q-LCFs are used as the test objects. Accelerated aging tests containing stress factors of temperature, humidity, light are imposed on the test objects to obtain performance shift data and change trend.

NANOMANUFACTURING – RELIABILITY ASSESSMENT –

Part 4-1: Nanophotonic products – Optical stability test of quantum dot enabled light conversion films: Temperature, humidity and light exposure

1 Scope

This part of IEC 62876, which is a Technical Specification, establishes a general reliability testing programme to verify the reliability of the performance of quantum dots nanomaterials, and quantum dot enabled light conversion films (Q-LCFs).

The Q-LCF is used as subassemblies for the fabrication of nano-enabled photoelectrical display devices, mainly liquid crystal display (LCD) currently, with other components.

This testing programme defines standardized aging conditions, methodologies and data assessment for Q-LCF product.

The results of these tests define a stability under standardized aging conditions for quantitative evaluation of the reliability of the Q-LCF.

The procedures specified in this document were designed for Q-LCF but can be extended to serve as a guideline for other kinds of light conversion films or related subassemblies as well.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-2-1:2007, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-27:2008, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-78:2012, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC TS 62565-4-4:2025, *Nanomanufacturing – Product specifications – Part 4-4: Nanophotonic products – Blank detail specifications: Quantum dot enabled light conversion films*

IEC 62595-2-1:2016, *Display lighting unit – Part 2-1: Electro-optical measuring methods of LED backlight unit*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1.1
quantum dot
QD
crystalline nanoparticle that exhibits size-dependent properties due to quantum confinement effects on the electronic states

[SOURCE: ISO/TS 27687:2008, 4.7]

3.1.2
quantum dot enabled light conversion film
Q-LCF
optical film based on quantum dots that converts high energy light at a particular wavelength into low energy light at another wavelength

3.1.3
invalid edge
edge of Q-LCF with a significant decline in optical performance, failing to function

3.2 Abbreviated terms

BLU	backlight unit
FWHM	full width at half maxima
LCE	light conversion efficiency
QD	quantum dot
Q-LCF	quantum dot enabled light conversion film
λ_p	peak wavelength
L_v	luminance

4 General requirements

4.1 Q-LCF

The Q-LCF is typically an individual subassembly which will be used by an assembler to fabricate display panel product to be sold to the end user. The purpose of this document is to assess the reliability of the Q-LCF. The test samples shall be selected randomly from a group of films cut from a big Q-LCF in a clean environment such that test samples are representative for the ensemble film. The physical size of the samples shall be no less than 18 cm × 18 cm. The samples shall not show visible curling, cracking, damage, wrinkles, and no scratches or dirt on the surface.