IEC 63207

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Measurement methods of blue light characteristics and related optical performance for visual display terminals

Méthodes de mesure des caractéristiques de la lumière bleue et des performances optiques associées des terminaux à écran de visualisation

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MEASUREMENT METHODS OF BLUE LIGHT CHARACTERISTICS AND RELATED OPTICAL PERFORMANCE FOR VISUAL DISPLAY TERMINALS

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The text of this International Standard is based on the following documents:

Draft	Report on voting
100/3798/FDIS	100/3819/RVD

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 International Standard 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.

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INTRODUCTION

Nowadays, visual display terminals (VDTs) are everywhere in daily life, in devices such as TVs, monitors, tablets and mobile phones. Most people will watch VDTs for a long time every day for various reasons. However, there are three undesirable effects caused by the blue light from VDTs.

The first one is a possibility of injury to human retina [1][1]. The energy of blue light emitting from VDTs is weak. However, the effects of long-term exposure (30 years or more) to weak energy from the blue light of VDTs are unknown.

The second is a disturbance to the biological (circadian) clock [2], [3]. The blue light emitted from VDTs at night-time can also cause disturbance to the biological clock.

The third is eye strain [4], [5].

To reduce these three issues, the demand of blue-light-reduced VDTs by the market is dramatically increasing. In consequence, the industry of VDTs comprising well-known companies is enthusiastic in promoting blue-light-reduced VDTs. On the other hand, the reduction of blue light will certainly have drawbacks on the visual experience.

To address the defects above under the scope of IEC TC 100, this document contributes to developing a set of novel measurement methods for VDTs, including methods to integrate both the considerations of luminance-independent indicators of blue light characteristics (BLCs).

NOTE This document only provides objective measurement methods for measuring BLCs of VDTs, the action of defining threshold values or assessment methods are out of the scope of this document. If necessary, manufacturers can define their own threshold values and/or assessment methods in accordance with this document.

[1] Numbers in square brackets refer to the Bibliography.

MEASUREMENT METHODS OF BLUE LIGHT CHARACTERISTICS AND RELATED OPTICAL PERFORMANCE FOR VISUAL DISPLAY TERMINALS

1 Scope

This document specifies measurement methods for optical performance (luminance) and blue light characteristics (BLCs) of visual display terminals (VDTs), excluding displays for outdoor use only.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

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/
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3.1 Terms and definitions

3.1.1
spectral radiance (L_λ)
for a wavelength interval dλ, in a given direction at a given point, quotient of the spectral radiant power, d$\Phi_\lambda(\lambda)$, passing through an infinitely small area enclosing that point and propagating within the solid angle, dΩ, in the given direction, to the product of the wavelength interval, dλ, and the area of a section of that beam on a plane perpendicular to this direction (dA cosΘ) containing the given point and to the solid angle, dΩ

Note 1 to entry: unit: $W \cdot m^{-2} \cdot nm^{-1} \cdot sr^{-1}$

[SOURCE: CIE S 017:2014, 17-1228]

3.1.2
blue light
portion of visible light spectrum whose wavelength range is specified between 400 nm and 500 nm

3.1.3
blue light radiance
L_{Blue}
radiance in which the integrated spectral radiance is in the blue light range

$$L_{Blue} = \int_{400}^{500} L_{e,\lambda} d\lambda$$

where:

$L_{e,\lambda}$ is spectral radiance.

Note 1 to entry: Unit: $W \cdot m^{-2} \cdot sr^{-1}$

3.1.4
radiance of the full white signal
$\boldsymbol{L_W}$
radiance in which the integrated spectral radiance is in the visible radiation range

$$L_W = \int_{380}^{780} L_{e,\lambda} d\lambda$$

where:

$L_{e,\lambda}$ is spectral radiance.

Note 1 to entry: Unit: $W \cdot m^{-2} \cdot sr^{-1}$

3.1.5
blue light radiance per luminance
$\boldsymbol{R_{BlueV}}$
ratio of blue light radiance L_{Blue} to luminance L_V

$$R_{BlueV} = \frac{L_{Blue}}{L_V}$$

Note 1 to entry: Unit: $W \cdot lm^{-1}$

3.1.6
blue light radiance per radiance of the full white signal
$\boldsymbol{R_{Blue}}$
ratio of blue light radiance L_{Blue} to luminance L_W

$$R_{Blue} = \frac{L_{Blue}}{L_W} \times 100$$

Note 1 to entry: Unit: %

3.1.7
narrow band blue light
wavelength range of blue light portion between 415 nm and 455 nm

3.1.8
narrow band blue light radiance
$\boldsymbol{L_{nBlue}}$
radiance in which the integrated spectral radiance is in the narrow band blue light range

$$L_{nBlue} = \int_{415}^{455} L_{e,\lambda} d\lambda$$

where:

$L_{e,\lambda}$ is spectral radiance.

Note 1 to entry: Unit: $W \cdot m^{-2} \cdot sr^{-1}$

3.1.9
narrow band blue light radiance per blue light radiance
R_{nBlue}
ratio of narrow blue light radiance L_{nBlue} to blue light radiance L_{Blue}

$$R_{nBlue} = \frac{L_{nBlue}}{L_{Blue}} \times 100$$

Note 1 to entry: Unit: %

3.2 Abbreviated terms

BLC blue light characteristic

LMD light-measurement device

MF measurement field

VDT visual display terminal

4 Measurement conditions

4.1 Environmental conditions

The measurement shall be performed in a dark room and not be affected by electromagnetic interference. If electromagnetic interference affects the results, the measurement shall be carried out in a dark and shielded room.

The illuminance of stray light on the VDT's screen shall be ≤ 1 lx. It means the illuminance on the VDT's screen shall be ≤ 1 lx when the VDT has been shut down in a dark room.

Measurements shall be carried out under the following temperature, humidity and atmospheric pressure:

Temperature: 25 °C ± 3 °C;

Humidity: 20 %RH to 80 %RH;

Atmospheric pressure: 86 kPa to 106 kPa.

When different environmental conditions are applied, they shall be noted in the measurement report.

4.2 Power supply

The measurement of VDTs shall be performed under rated power supply. The fluctuation of the power supply voltage shall be no more than ±2 %. When using built-in batteries, the remaining battery power shall be no less than 80 %; when using an AC power supply, the fluctuation of power frequency shall be no more than ±2 %, and the fluctuation of harmonic components shall be no more than ±5 %.

4.3 Stabilized condition of VDT

To stabilize the performance of the VDT before measurement, the VDT shall be turned on for at least 30 min (under standard environmental conditions) until repeated measurements of the display show a variation in luminance of no more than 2 % per minute for short-term stability, and 5 % per hour for long-term stability.

4.4 Light-measurement device

4.4.1 Spectral radiance meter

For measurement of luminance and spectral radiance of the VDT's screen, a spot-type spectral radiance meter shall be used. Characteristics of the spectral radiance meter are defined in IEC 61966-4:2000.

NOTE Since there is no international/regional/national standard for imaging (2D) spectral radiance meters, an imaging (2D) spectral radiance meter is not recommended for measurement of luminance.

4.4.2 Luminance meter

A conventional spot type luminance meter shall be also used for luminance measurement of the VDT's screen. However, the following characteristics shall be maintained:

a) a conventional spot-type luminance meter with a general $V(\lambda)$ mismatch index f'_1 of less than 6 %;

b) the periodical calibration shall be performed by a calibration laboratory; local regulations can apply with regard to traceability.

NOTE Since there is no international/regional/national standard for conventional spot type luminance colorimeters, the luminance colorimeter is not recommended for measurement of luminance.

4.4.3 Illuminance meter

The illuminance meter shall be used for measurement of stray light on the VDT's screen. The following characteristics shall be maintained:

a) a conventional filter-type illuminance meter with a general $V(\lambda)$ mismatch index f'_1 (see ISO/CIE 19476:2014) of less than 6 %;

b) the periodical calibration shall be performed by a calibration laboratory; local regulations can apply with regard to traceability.

4.5 Test settings

The LMD shall be focused on the image plane of the display and generally aligned perpendicular to the display surface at the centre of the active display area, unless stated otherwise.

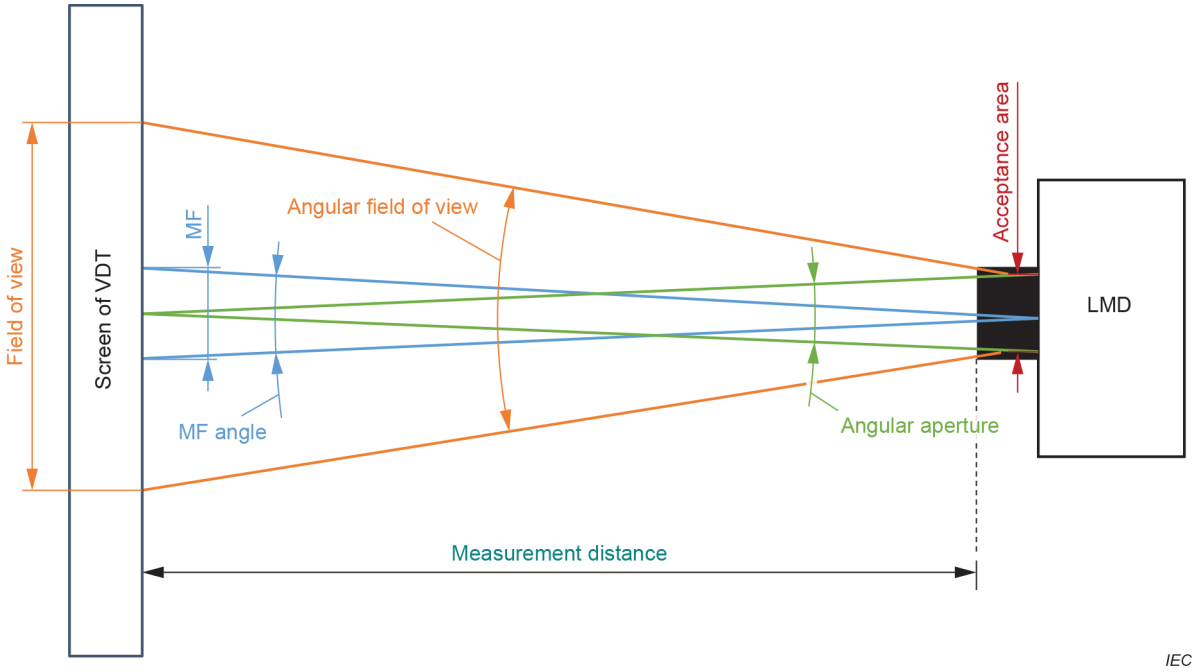

Figure 1 – Layout diagram of measurement setup with terminology

When measuring matrix displays, the spectral radiance or luminance shall be measured over 500 pixels or more in the field of view of the LMD, minimizing the influence of an unusually dim or bright pixel in the measurement area. If smaller measurement areas (< 500 pixels) are required, photometric equivalence to 500 pixels shall be confirmed and noted in the test report.

The LMDs shall be set positioned relative to the screen of the tested VDT.

Setup for testing is shown in Figure 1 (see IEC 61747-30-1:2012).

Except the specified requirement, luminance and spectral radiance at the centre point of the VDT tested (P_0, in Figure 2) shall be measured.

The measurement distance between the screen of the tested VDT and the nearest point of the LMD to the screen of the tested VDT shall be 50 cm. Other specified measurement distance by manufacturers is allowed (e.g. the measurement distance is 1,5 times the height of the screen for 4K UHD TVs). The measurement distance shall be reported in the test report.