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Date: 12 March 2025

Origin: International

Latest date for receipt of comments: 02 April 2025

Project No. 2023/02831

Responsible committee: EPL/100 Audio-visual equipment

Interested committees:

Title: Draft BS IEC 63145-201-10 ED1 BS IEC 63145-201-10 Eyewear display. Part 201-10: Measurement methods for VR type – Optical properties of a singlet lens used for eyepieces.

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

PROJECT NUMBER:

IEC 63145-201-10 ED1

DATE OF CIRCULATION:

2025-03-07

CLOSING DATE FOR COMMENTS:

2025-05-02

SUPERSEDES DOCUMENTS:

110/1673/CD, 110/1703A/CC

IEC TC 110 : ELECTRONIC DISPLAYS

SECRETARIAT:

Japan

SECRETARY:

Mr Yoshi SHIBAHARA

OF INTEREST TO THE FOLLOWING COMMITTEES:

HORIZONTAL FUNCTION(S):

ASPECTS CONCERNED:

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TITLE:

Eyewear display – Part 201-10: Measurement methods for VR type – Optical properties of a singlet lens used for eyepieces

NOTE FROM TC/SC OFFICERS:

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

EYEWEAR DISPLAY –

Part 201-10: Measurement methods for VR type – Optical properties of a singlet lens used for eyepieces

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IEC 63145-201-10 has been prepared by IEC technical committee 110: Electronic displays. It is an International Standard.

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

Draft	Report on voting
XX/XX/FDIS	XX/XX/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.

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.

EYEWEAR DISPLAY –

Part 201-10: Measurement methods for VR type – Optical properties of a singlet lens used for eyepieces

1 Scope

This part of IEC 63145 specifies the standard measurement conditions and measuring methods for determining the optical properties of a singlet lens used for eyepieces of VR eyewear displays to form a virtual image from a real display image at the designed eye-point.

NOTE This standard assumes that the singlet lens is positioned within the mechanical tolerance of the designed position and tilt angle of the singlet lens relative to the display. The design position, tilt angle, and eye-point of the lens are assumed to be provided by the manufacturer or optical designer. It is preferable to use interferometric measurements to supplement the measurement methods outlined in this standard.

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 63145-1-2 *Eyewear Display – Part 1-2: Generic - Terminology*

IEC 63145-20-10:2019 *Eyewear Display – Part 20-10: Fundamental measurement methods – Optical properties*

IEC 63145-20-20 *Eyewear Display – Part 20-20: Fundamental measurement methods – Image quality*

ISO 9039 *Optics and photonics – Quality evaluation of optical systems – Determination of distortion*

ISO 9335 *Optics and photonics – Optical transfer function – Principles and procedures of measurement*

ISO 12233 *Photography – Electronic still picture imaging – Resolution and spatial frequency responses*

ISO 15795 *Optics and optical instruments – Quality evaluation of optical systems – Assessing the image quality degradation due to chromatic aberrations*

ISO 13653 *Optics and optical instruments – General optical test methods – Measurement of relative irradiance in the image field*

3 Terms, definitions, abbreviations and letter symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 63145-1-2, IEC 63145-20-10, IEC 63145-20-20, ISO 9241-302 and the following 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>

NOTE 1 Terms related to eyewear display will be defined in specific projects.

NOTE 2 Some terms can be referred in IEC TR 63145-1-1[1]¹.

3.1.1

device under test

DUT

product undergoing testing

Note 1 to entry: In this document, DUT refers to a singlet lens in a VR eyewear display.

3.1.2

eye point of DUT

design position of the human eye pupil for a DUT

3.1.3

field of view of DUT

FOV of DUT

angular viewing range imaged by a DUT which achieves a specified performance threshold

Note 1 to entry: The FOV of only a singlet lens is not limited by a test target size.

3.1.4

Virtual image distance

focal distance from a DUT to the virtual image as given by the virtual image condition defined by the manufacturer or supplier

3.1.5

Reference maximum luminance

maximum measured luminance of a non-black part of a grille target reaching asymptotic values with lower spatial frequencies measured along the optical axis

3.1.6

Reference minimum luminance

minimum measured luminance of a black part of a grille target reaching asymptotic values with lower spatial frequencies measured along the optical axis

3.1.7

Reference Michelson contrast

Michelson contrast calculated with the reference maximum luminance and the reference minimum luminance measured along the optical axis

3.2 Abbreviations

CPD	line-pair Cycles Per Degree
CTF	Contrast Transfer Function
DFT	Discrete Fourier Transform
ESF	Edge Spread Function
FOV	Field Of View
LMD	Light Measuring Device
LSF	Line Spread Function
MTF	Modulation Transfer Function
PSF	Point Spread Function
VR	Virtual Reality

3.3 Letter symbols (quantity symbols/unit symbols)

The letter symbols are shown in Table 1.

¹ Numbers in square brackets refer to the Bibliography

88

Table 1 – Letter symbols (symbols for quantities and units)

Quantities	Symbol	Unit
Measuring point ($i = 0$ at the centre)	P_i	
Maximum luminance	L_{vM}	$\text{cd}\cdot\text{m}^{-2}$
Minimum luminance	L_{vm}	$\text{cd}\cdot\text{m}^{-2}$
Reference maximum luminance	$L_{vM,ref}$	$\text{cd}\cdot\text{m}^{-2}$
Reference minimum luminance	$L_{vm,ref}$	$\text{cd}\cdot\text{m}^{-2}$
Spatial frequency	f_{CPD}	lp/degree
Michelson contrast	C_m	
Reference Michelson contrast	$C_{m,ref}$	
Contrast transfer function	C_{CTF}	
Modulation transfer function	$F_{MTF, abs}$	
Discrete Fourier transform	F_{DFT}	
Line spread function	F_{LSF}	
Normalized modulation transfer function	F_{MTF}	
Object height	h_{obj}	mm
Maximum Object height	h_{max}	mm
Rotation angle of LMD in one direction	θ	degree
Object distance	a	mm
Moving distance of test target along z-axis	d	mm
Distortion	δ	%
Test target position	Z_T	mm
Test target position for best focus	$Z_{T,max}$	mm
Longitudinal (Axial) chromatic aberration	G_{ACA}	μm
Lateral (Transverse) chromatic aberration	G_{TCA}	μm
Relative longitudinal (Axial) chromatic aberration	$G_{ACA,Rel}$	%
Relative lateral (Transverse) chromatic aberration	$G_{TCA,Rel}$	%
Illuminance	E_v	lx
Relative illuminance	E_{Rel}	%

89 4 Standard measurement conditions

90 4.1 Standard environment conditions

91 Unless otherwise specified, all tests and measurements for optical components of VR eyewear
 92 displays shall be carried out after sufficient warm-up time (see 4.3) for the LMD and the test
 93 target (an illumination source or a display), under the following standard environmental
 94 conditions:

- 95 – temperature of 22°C to 28°C,
- 96 – relative humidity of 25 % to 85 %, and
- 97 – atmospheric pressure of 86 kPa to 106 kPa.

98 When different environmental conditions are used, they shall be reported in detail in the
 99 specification.

4.2 Power supply

In order to stabilize the performances of the LMD and the test target (an illumination source or a target display), the power supply for driving them shall be adjusted according to the specification of them.

4.3 Warm-up time

The test target (an illumination source or a target display) are affected by the transient temperature behaviour of the devices. It takes a certain time for the luminance output of them to achieve a steady state. If the luminance output is not within a ± 3 % variation, it shall be reported. All measuring conditions shall be kept constant during the measurements.

4.4 Dark room condition

The luminance contribution reflected from the test room background into the measurement space shall be less than 1/20 of minimum luminance output from the test target assembly. The test target assembly may consist of a combination of a filter, a mask, and an illumination source, or a display. If this condition is not satisfied, then background luminance may be subtracted, and the result shall be reported.

5 Measurement systems

5.1 Standard coordinate system

To indicate the size and position of a virtual image, a spherical coordinate system of elevation (latitude) and azimuth (longitude) shall be used in the measurements; the polar axis is vertically oriented as shown in Figure 1. The angles measured in the vertical half planes of the data are elevation angles, denoted as α , and the horizontal angles to the half plane are azimuth angles, denoted as ψ . The origin direction ($\alpha = 0$, $\psi = 0$) of the spherical coordinate system shall be coincident with the optical axis of the DUT.

To indicate the positional relationship among the test target, the DUT, the entrance pupil of the LMD and other relevant components, a three-dimensional Cartesian coordinate system (x , y , z) shall be used, as shown in Figure 2. The eye point of the DUT, which is determined by the manufacturer or supplier, is the same as the eye point of the complete VR eyewear display to which the DUT belongs. Unless otherwise specified, the eye point of the DUT is positioned at the centre of the entrance pupil of the eye, which is located at the centre of the iris. The manufacturer or supplier of the DUT shall specify the position of the eye point. The eye point defines the origin of the coordinate system. The origin of spherical coordinate system shall be located at the eye point.

For the eyeball rotation measurement, the origin of the Cartesian coordinate system shall be located at the eye point, while the origin of the spherical coordinate system is positioned at the centre of the eyeball, 10 mm behind the pupil.

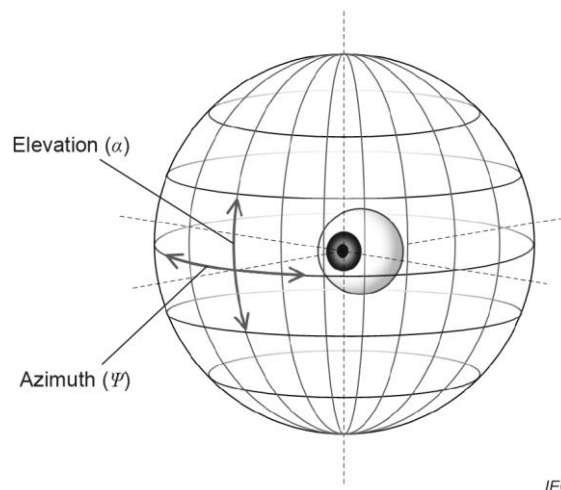
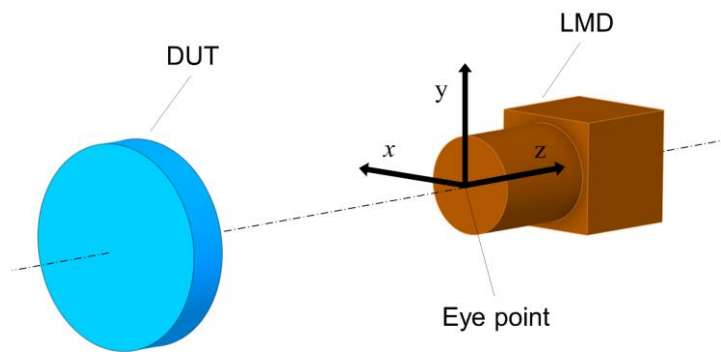


Figure 1 – Spherical coordinate system

IEC



NOTE This figure illustrates an example of a two-dimensional Cartesian coordinate system with the eye point set as the origin.

Figure 2 – Three-dimensional Cartesian coordinate system

5.2 Measurement equipment

5.2.1 General

The configurations and operating conditions of the equipment should comply with the structures specified in each item. To ensure repeatable measurements, the requirements shall comply with IEC 63145-20-10. Otherwise, the differences shall be noted in the report.

5.2.2 Light measuring device (LMD)

The LMDs shall comply with the requirements in IEC 63145-20-10, unless otherwise specified for each item. The 2D imaging LMD shall satisfy the requirements specified in IEC 63145-20-20 and have the necessary FOV to perform the measurement. The LMD shall have sufficient performance (e.g., resolution, stray light rejection, sensitivity) to ensure reproducible results. The wavefront aberration of the LMD should be small compared to the expected wavefront aberration of the DUT (e.g., by a factor of 1/10, as specified in ISO 9335:2015). In other words, the LMD should be as close as possible to diffraction-limited. Since the LMD and DUT form a coherent coupled system, the effect of a non-diffraction-limited DUT can introduce both negative and positive errors concerning resolution measurements in terms of CTF or MTF.

5.2.3 Stage conditions

5.2.3.1 General

The stage for the LMD shall be used to implement the coordinate system specified in 5.1. The stage should be constructed with components equivalent to a biaxial goniometer and an orthogonal three-axis translation stage. This may include complex positioning systems, such as a multi-axis robotic arm. For aligning the DUT, a three-axis translation stage with a biaxial goniometer may be used.

5.2.3.2 Goniometer

Refer to Clause 5.2.2.2 in IEC 63145-20-10.

5.2.3.3 Translation stage

Refer to Clause 5.2.2.3 in IEC 63145-20-10.

5.2.4 Setup conditions

Examples of a measuring setup are shown in Figure 3. The DUT shall be mounted on a stable platform to ensure light or image stability. The placement of the DUT which is determined by the manufacturer or supplier shall be consistent with the intended placement use case, including the specified tip/tilt angles, relative translations, and alignment with the optical axis of the LMD. Adjustments of the DUT shall be made using a biaxial goniometer and an orthogonal three-axis translation stage. Unless otherwise specified, the entrance pupil of the LMD shall be positioned at the eye point of the DUT. The manufacturer or supplier of the DUT shall specify the position of the eye point. The origins of both the three-axis Cartesian coordinate system and spherical coordinate system shall be located at the eye point. Therefore, the eye point of the DUT and