BS ISO 20793:2024

BSI Standards Publication

Photography — Lenticular print for changing images — Measurements of image quality

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National foreword

This British Standard is the UK implementation of ISO 20793:2024. It supersedes PD ISO/TS 20793:2019, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee CPW/42, Photography.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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Published by BSI Standards Limited 2024

ISBN 978 0 539 26478 4

ICS 37.040.01; 37.040.10

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 May 2024.

Amendments/corrigenda issued since publication

Date	Text affected

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International Standard

ISO 20793

Photography — Lenticular print for changing images — Measurements of image quality

Photographie — Impression lenticulaire pour images changeantes — Mesurages de la qualité des images

First edition
2024-05

Reference number
ISO 20793:2024(en)

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Foreword

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This document was prepared by Technical Committee ISO/TC 42, *Photography*.

This first edition of ISO 20793 cancels and replaces the first edition of ISO/TS 20793:2019, which has been technically revised.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

Lenticular printing is a technology wherein lenticular lenses are used to produce printed images with an illusion of depth, i.e. three-dimensional (3D) effect, or the ability to change or move as the image is viewed from different angles. Lenticular prints for displaying changing images are built up with a lenticular lens sheet and a printed sheet that contains at least two images, interleaved with the same spatial frequency as the lenticular lens sheet.

In this context, lenticular lenses generally take the form of arrays of cylindrical lenses, each acting as a magnifying lens. Widespread applications of lenticular printing are signage, display posters, business cards, multilingual message boards, packages with changing images or 3D effects, and secure documents.

It has been reported that the market size of lenticular prints is over 100 million m^2 and that the market is growing. Furthermore, the potential image qualities of lenticular printing have dramatically improved, and further improvements are expected in the future. While production of lenticular sheets with a lens frequency of 100 lpi (lines per inch) is routine, products with a 200 lpi frequency are also currently available.

Although the potential image quality of lenticular prints is high as described above, the quality of images is not always good in the market due to various causes, e.g., due to the misalignment of the lenticular lens and lenticular printed images. This is a critical problem for lenticular printing.

To improve the image quality of lenticular prints, image quality measurements are essential. This document provides standard measurement methods and the specifications for the image quality of lenticular prints.

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Photography — Lenticular print for changing images — Measurements of image quality

1 Scope

This document specifies the measurement methods and specification of image quality of lenticular prints that are used for changing images. This document does not cover lenticular prints that are used for 3D images.

NOTE Lenticular prints for 3D images can be measured with the same types of procedures. However, it needs more information, such as the dependence of the measurement distance, to evaluate the 3D performance.

This document specifically describes measurement methods for crosstalk, viewing angle range, angular misalignment from the designed viewing angle and the uniformity of the image within the printing area of the lenticular print images. These are critical for the image quality of lenticular prints for changing images.

This document is applicable to lenticular prints produced by printing technologies that include impact and non-impact printing. Examples of the former are off-set, gravure and flexography, while the examples of the latter are silver halide, inkjet, dye diffusion thermal transfer and electrophotography. The multiple laser images (MLI) and changeable laser images (CLI) process of using a laser to write through a lenticular screen at different angles to create two monochrome images is also used.

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.

ISO 5-3, *Photography and graphic technology — Density measurements — Part 3: Spectral conditions*

ISO 5-4, *Photography and graphic technology — Density measurements — Part 4: Geometric conditions for reflection density*

3 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:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1 Terms

3.1.1
lenticular lens
array of magnifying semi-cylindrical lenses, designed to produce a desired perception, such as 3D, motion or morphing, to the underlying interlaced image

EXAMPLE This technique is widely used in lenticular printing, wherein the lenticular lens is used to provide an illusion of depth, change or motion to an underlying interlaced image when viewed from different angles.

[SOURCE: ISO/TS 20328:2016, 3.1, modified — Note 1 to entry has been removed.]

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3.1.2
lenticular print
print combined with lenticular lenses which produces printed images with an illusion of depth, i.e. three-dimensional (3D) effect, or the ability to change or move as the image is viewed from different angles

Note 1 to entry: The detailed explanation of lenticular print is provided in Annex A.

Note 2 to entry: Lenticular prints to display changing images are built up with a lenticular lens sheet and a printed sheet that contains at least two images, interleaved with the same spatial frequency as the lenticular lens sheet.

3.2 Abbreviations

CIE commission internationale de l'éclairage (International Commission on Illumination)

CLI changeable laser image

CTP computer to plate

LMD light measuring device

MLI multiple laser image

RGB red, green, blue

4 Standard environmental conditions

4.1 Temperature and humidity

The standard environmental conditions shall be applied for the measurements of lenticular prints. The standard environmental conditions shall be a temperature of 23 °C ± 3 °C and a humidity of 50 % RH ± 15 % RH.

4.2 Ambient illumination conditions

For standard dark room conditions, the ambient illuminance at any position on the lenticular print is below 0,3 lx in all directions or the illuminance shall at least be less than a level that does not influence the measurement results.

When directional illumination is used, standard dark room conditions shall be applied unless the instrumentation used is effective in suppressing background illumination.

When the sample is set in an integrated sphere, a dark room may not be required.

5 Measurement conditions

5.1 General

For the measurements, the lenticular print samples shall be illuminated with hemispherical diffuse lighting. Directional illumination can also be used when it is appropriate for simulating the use application.

The reflected light from the print sample shall be measured using a spectroradiometer or a radiometer with photopic response (V_λ - filter).

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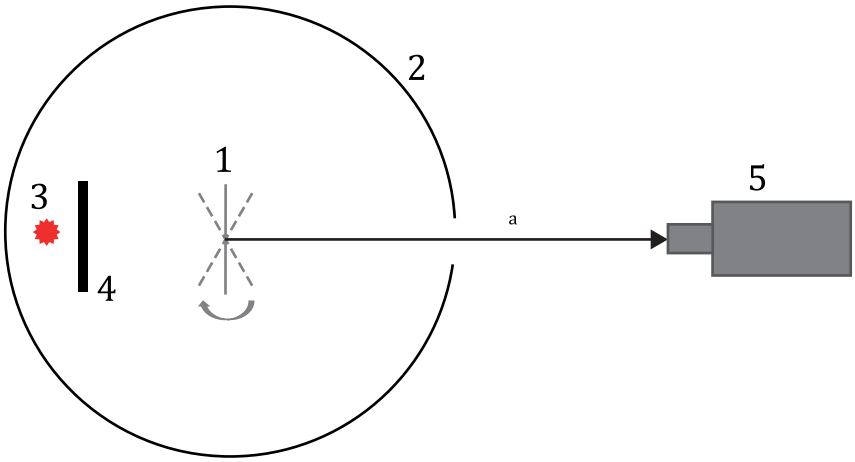
5.2 Geometry of measurements

5.2.1 Standard conditions with hemispherical illumination

Uniform hemispherical diffuse illumination is generally realized by using an integrating sphere. The lenticular print sample shall be placed in the centre of an integrating sphere as shown in Figure 1. For the calibration, the reflection standard, i.e. a standard white board, shall be placed at the same position of the lenticular print sample. Best practices for integral sphere design and measurements are described in References [2] and [3].

When the viewing direction dependence is measured, the print sample shall be rotated around the axis parallel to the direction of the array of lenticular lens.



Key

1 lenticular print
2 integration sphere
3 light source
4 baffle
5 light measurement device
a Reflected light from sample.

Figure 1 — Geometry of measurement with hemispherical illumination

NOTE A colorimetric conoscopic measurement device with diffuse illumination through the optical system gives similar information but not equivalent results.

5.2.2 Standard conditions with directional illumination

For samples that are not laser engraved, the directional light shall be illuminated at an angle of 45° from the normal, and the reflected light shall be detected from the direction normal to the print as shown in Figure 2. The light source and the detector shall be placed in the same plane. The lenticular print shall first be set normal to the detector, and it shall be rotated from the normal direction in order to measure the viewing angle dependence.

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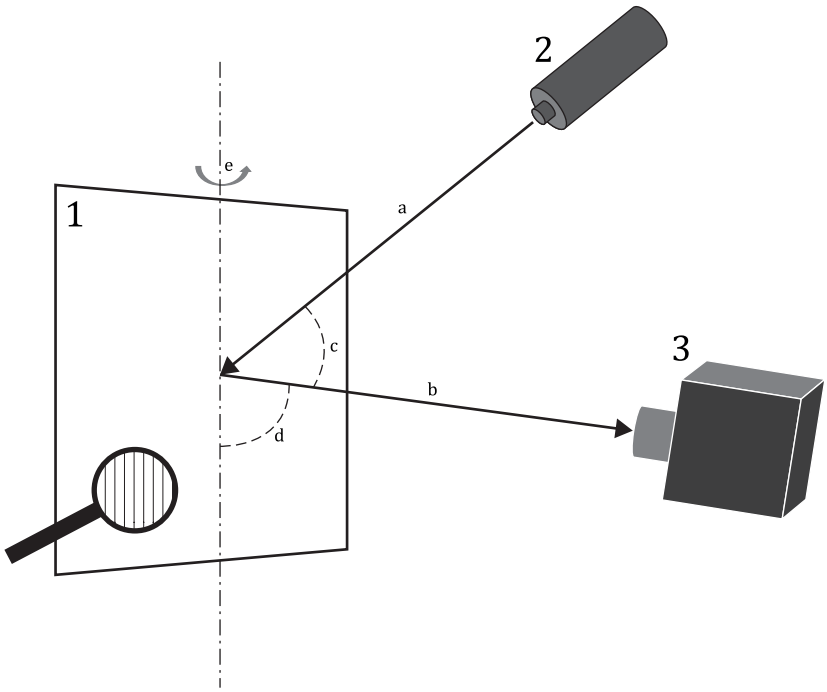

Key

1 lenticular print
2 light source — directional
3 detector
a Incident light.
b Reflected light.
c Angle of the incident light = 45°.
d Angle of the detection = 90°.
e Angle of rotation of the print.

Figure 2 — Geometry of measurement with directional illumination

NOTE A colorimetric conoscopic measurement device with directed illumination through the optical system gives similar information but not equivalent results.

Laser-engraved, lenticular prints with small sample sizes, such as those used in security printing are illuminated most effectively with 0°/45° directional illumination, with the illumination perpendicular to the lenticular screen.

5.3 Light source

For the standard conditions, hemispherical illumination shall be applied. The illumination spectra shall be a stable and spectrally continuous broadband visible light source, for example, an incandescent lamp defined as CIE Standard Illuminant A.

5.4 Light measuring device (LMD)

The light reflected from the lenticular print shall be measured. Illuminant D50 shall be applied. The following requirements are given for measurement instrument:

a) The spectroradiometer shall be capable of measuring spectral radiance over at least the 380 nm to 780 nm wavelength range, with a maximum bandwidth of 10 nm for smooth broadband spectra.

   Care shall be taken to ensure that the LMD has enough sensitivity and dynamic range to perform the required task. The measured LMD signal shall be at least ten times greater than the dark level (noise floor) of the LMD, and no greater than 85 % of the saturation level.

b) The LMD shall be focused on the image plane of the print and aligned perpendicular to its surface, unless stated otherwise.

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