ISO/TS 17321-4:2022(E)

ISO TC 42~~/JWG 20~~

Date: 2022-~~09-07~~xx

Graphic technology and photography — Colour characterization of digital still cameras (DSCs) — Part 4: Programmable light emission system

~~*Élément introductif — Élément central — Partie 4: Élément complémentaire*~~

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Technologie graphique et photographie — Caractérisation de la couleur des appareils photonumériques — Partie 4: Système d'émission de lumière programmable

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Contents

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see ~~www.iso.org/directives~~www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see ~~www.iso.org/patents~~www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see ~~www.iso.org/iso/foreword.html~~www.iso.org/iso/foreword.html.

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

This second edition cancels and replaces the first edition (ISO/TS 17321-4:2016), which has been technically revised.

The main changes are as follows:

— reorganized introduction and ~~clause~~Clause 4~~.~~:

— ~~clause~~Clause 4 is concentrated on the hardware evaluation of programmable light emission system (PLES). ~~And new annexes~~New Annexes B and C ~~are~~were added to the second edition~~.~~:

— ~~added~~ a new ~~clause~~Clause 5 and a new ~~annex~~Annex A using VSA (Vector Space Arithmetic) formulation for simpler-conceptual explanation of spectral match for PLES~~.~~ were added:

— removed unnecessary explanations on spectral generation (~~annexes~~Annexes A, B, C, D, E, F and explanation of spectral match in ~~clause~~Clause 4), accordingly.

A list of all parts in the ISO 17321 series can be found on the ISO website.

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~~www.iso.org/members.html.

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Introduction

This ~~part of ISO 17321~~document describes a programmable light emission system. This system may be used to create spectra that are arbitrary combinations of the lights contained within or may be used to create a spectral match to a target reference spectrum. Unless the lights are of high dimensionality (ideal spectral shape at each wavelength) such a match will generally be only approximate. Therefore, evaluation methods for the spectra generated by the system are also described.

An example hardware description of a programmable light emission system is presented in ~~clause~~Clause 4. While any programmable light emission system that meets the tolerances specified may be utilized, this document considers systems comprised of light emitting devices such as inorganic or organic LEDs, quantum dots, and laser diodes (if equipped with suitable spatial filtering).

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Graphic technology and photography — Colour characterization of digital still cameras (DSCs) — Part 4: Programmable light emission system

1 Scope

This ~~part of ISO 17321~~document describes a programmable light emission system to produce various spectral radiance distributions, intended for DSC colour characterization applications.

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.

~~<std>ISO 7589, *Photography — Illuminants for sensitometry — Specifications for daylight, incandescent tungsten and printer*</std>~~

~~<std>ISO 12646:2015, *Graphic technology — Displays for colour proofing — Characteristics*</std>~~

~~<std>ISO/CIE 11664-5:2016, *Colorimetry — Part 5: CIE 1976 L*u*v* colour space and u', v' uniform chromaticity scale diagram*</std>~~

~~<unknown>CIE S 017:2020, *ILV: International Lighting Vocabulary, 2nd Edition*</unknown>~~

ISO 7589, *Photography — Illuminants for sensitometry — Specifications for daylight, incandescent tungsten and printer*

ISO/CIE 11664-5, *Colorimetry — Part 5: CIE 1976 L*u*v* colour space and u', v' uniform chromaticity scale diagram*

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~~https://www.iso.org/obp

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

3.1
colour-matching functions
tristimulus values (3.5) of monochromatic stimuli of equal radiant flux

[SOURCE: CIE S 017:2020, 17-23-039]

3.2

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digital still camera
DSC
device which incorporates an image sensor, and which produces a digital signal representing a still picture

Note 1 to entry: A digital still camera is typically a portable, hand-held device. The digital signal is usually recorded on a removable memory, such as a solid-state memory card or magnetic disk.

[SOURCE: ISO 17321-1:2012, 3.2]

3.3
light-emitting diode
LED
semiconductor diode that emits non coherent optical radiation through stimulated emission resulting from the recombination electrons and photons, when excited by an electric current

Note 1 to entry: ~~See~~For an example of LED, CIE S 017:2020, 17-27-050 shall be referred to.

[SOURCE: IEC 60050-521:2002, 521-04-39]

3.4
programmable light emission system
PLES
system that produces various spectral radiance distributions using light emitting devices

3.5
tristimulus values
amounts of the reference colour stimuli, in a given trichromatic system, required to match the colour of the stimulus considered

Note 1 to entry: See *colour matching functions* (3.1).

[SOURCE: CIE S 017:2020, 17-23-038]

4 Description

4.1 General

Figure 1 shows a cross-section of an example of a programmable light emission system (PLES). An integrating sphere in the Figure 1 is utilized to ensure good spatial uniformity for the light emission. Light emitting devices are placed at the bottom and an output window is placed on the side to allow the mixed light to be emitted. The ability to measure absolute XYZ values is a requirement. A tele-spectrophotometer is one of such measurement methods to obtain these values and used to verify the accuracy of the generated spectra.

There are many kinds of light emitting devices. For example, if LEDs are used for the light emitting devices, the LEDs are electrically modulated and the emitted flux will be mixed (integrated) by multiple reflections from the inner surface of the sphere, in order to produce a required spectral distribution of light flux.

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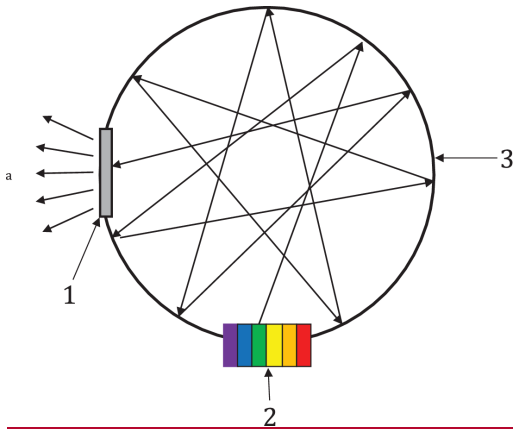

Key

1 output window
2 light emitting device array
3 integrating sphere
[a] Uniform light emission on the output window.

Figure 1 — Schematic configuration of the programmable light emission system (PLES)

Annex B shows LED driving methods of the PLES.

As a more compact alternative to integrating sphere, flat panel diffusers can also be designed to produce near-uniform output by the light levels of the individual LED modules.

4.2 Operating condition

The light emitting system shall be designed to operate consistently under the ranges described in Table 1.

Table 1 — Operating conditions

Operating condition	Range
Temperature	18 °C to 28 °C
Relative humidity	15 % to 80 %

NOTE The temperature ~~requires~~requirements were taken from ISO 12646 ~~Displays for colour proofing — Characteristics~~.

4.3 Description of the system

4.3.1 General

This clause describes the PLES. An example for the PLES conditions ~~are~~is described in Annex C.

Warm-up time shall be chosen to be long enough so that the system has reached stable state and stabilized at the desired operating temperature after power-on of the PLES. ~~And it~~It is recommended that a default spectral distribution is outputted during warm-up time in order to reduce warm-up time. This warm-up time is applied to all of spectral distribution measurement.

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