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Photography — Digital cameras — Shading measurements

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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).

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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword — Supplementary information.

The committee responsible for this document is ISO/TC 42, *Photography*.

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Introduction

One common type of image phenomenon seen in digital cameras is a systematic intensity variation across an image known as luminance shading. There are several causes of luminance shading in a digital camera: pixels having non-uniform sensitivity across a sensor array, illumination non-uniformity, lens shading, pixel geometry, and electronic non-uniformity. Characteristics of lens shading include symmetry about the optical sensor, uniformity across each colour plane, and variation as a function of $\cos^{n}\Theta$. Luminance shading only affects intensity falloff.

Colour variations within the image can be induced by several factors, all of which will cause varying degrees of non-neutrality within an ideal uniform-gray exposure. Some of the primary factors include, (a) a mismatch between the CMOS micro-lens optical acceptance angle and the lens' chief ray angle over the field of view, (b) spatially varying spectral transmittance differences from the infrared rejection filter (usually most significant at the cutoff wavelength), and (c) inherent spectral sensitivity differences across the array. Consistent, systematic variations can be reduced through correction via image processing, but there might remain residual colour variations.

The information that follows defines the recommended approach for creating a test scene to use for the evaluation of luminance shading and colour variations, as well as specifying the conditions for illumination and exposure. The currently proposed analysis approach to quantify the magnitude of colour variations is described. It is important to understand that this specification is related to the degree of colour variations that are apparent in the image, not the specific colour accuracy. Thus, an image that appeared pink but was uniformly pink over the entire image would be equivalent to a perfectly uniform gray field relative to this colour non-uniformity specification.

Some part of this International Standard is based on the work done by the Camera Phone Image Quality group (CPIQ) within the International Imaging Industry Association (I3A), now part of the Institute of Electrical and Electronics Engineers (IEEE), whose contribution is greatly acknowledged.

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Photography — Digital cameras — Shading measurements

1 Scope

This International Standard defines a method for measuring shading for digital cameras (including camera phones). The method includes procedures for measuring colour and luminance signal components separately.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

ISO 11664-2/CIE, *S 014-2/E: Joint ISO/CIE Standard: Colourimetry — Part 2: CIE Standard Illuminants for Colourimetry*

ISO 11664-4/CIE, *S 014-4/E: Joint ISO/CIE Standard: Colourimetry — Part 4: CIE 1976 L*a*b* Colour Space*

ISO 12231, *Photography — Electronic still picture imaging — Vocabulary*

IEC 61966-2-1:1999+A1:2003: *Multimedia systems and equipment — Colour measurement and management — Part 2-1: Colour management – Default RGB colour space — sRGB*

CIE 15:2004, *Colourimetry*

3 Terms and definitions

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

3.1
luminance shading
luminance non-uniformity
gradual variation of the luminance signal components within the image field

3.2
colour shading
colour non-uniformity
gradual variation of the chrominance signal components within the image field

4 Test conditions and methods

4.1 General

The following measurement conditions should be used as nominal conditions when measuring the shading of a digital camera. If it is not possible or appropriate to achieve these nominal operating conditions, the actual operating conditions shall be listed along with the reported results.

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