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**Photography — Electronic still-picture  
cameras — Methods for measuring  
opto-electronic conversion functions  
(OECFs)**

*Photographie — Appareils de prises de vue électroniques — Méthodes de  
mesure des fonctions de conversion opto-électroniques*



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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 14524 was prepared by Technical Committee ISO/TC 42, *Photography*.

Annex A forms a normative part of this International Standard. Annexes B to C are for information only.

## Introduction

This International Standard was prepared by Technical Committee ISO/TC 42, *Photography*, Working Group 18, *Electronic still picture imaging*. It establishes standard methods for measuring the functional relationship between the focal-plane log exposures or scene luminances, and the digital output levels of a digital camera. This information is required for the development and testing of digital cameras, is used in other electronic still-picture camera measurement standards, and may be helpful in the processing of digital image data.

An opto-electronic conversion function (OECF) measurement standard is required for several reasons.

- a) Well-established measurement methods have been used to determine the characteristic curves for television cameras, where the characteristic curve is known as the "gamma correction" curve, and for silver halide photography, where the characteristic curve is known as the "H&D" or "DlogH" curve. However, these methods cannot be easily or unambiguously applied to the characterization of electronic still-picture cameras.
- b) The sampling and quantization processes found in digital systems present fundamental issues that need to be addressed in a standardized manner.
- c) The flexibility of digital systems complicates the determination and presentation of the functional relationship between the camera's optical input and digital output levels. This International Standard attempts to account for all the variables and assure that results are presented in a consistent fashion.

The OECF of a digital camera may appear to be the analogue of the characteristic curve used in photography and television, but this observation is only partly true. Characteristic curves show the relationship between a physical input, such as log exposure or reflectance, and a physical output, such as density or volts. The OECF, on the other hand, shows the relation between a similar physical input and a digital code value assigned to the physical response produced by that input. Since this assignation can be arbitrary, digital values themselves do not have physical meaning or units. For example, a change of a factor of two in digital values could correspond to a doubling of the physical response to the input, to an order of magnitude change, or to something else, depending on how the code values are assigned.

In digital photography applications, it is generally not necessary to know the physical response produced in a digital camera. It is sufficient to know what digital values will be produced by a variety of inputs. Consequently, this International Standard does not specify how to measure the true characteristic curve of a digital camera. Rather, it specifies how to measure the relationship between the input to a digital camera and the digital code values produced. These values are only absolutely meaningful in that they represent information. The graphical reporting formats specified in this International Standard support this viewpoint by allowing OECFs to be reported with either digital code values or bits on the vertical axis. This is the convention in information theory. Users of this International Standard should be aware that the actual physical response of a digital camera, or of a complete digital photography system, can be linear, logarithmic, or something else, regardless of the form of the OECF plot and whether digital code values or bits are reported on the vertical axis.

**NOTE** Users of this International Standard in English-speaking countries should be aware that commas are used instead of periods as the decimal radix to conform to ISO procedures.



# Photography — Electronic still-picture cameras — Methods for measuring opto-electronic conversion functions (OECFs)

## 1 Scope

This International Standard specifies methods for the measurement of opto-electronic conversion functions (OECFs) of electronic still-picture cameras whose output is encoded as a digital image file. The OECF is defined as the relationship between the focal plane log exposures or scene log luminances, and the digital output levels of an opto-electronic digital image capture system.

This International Standard applies to both monochrome and colour electronic still-picture cameras.

## 2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 5-1:1984, *Photography — Density Measurements — Part 1: Terms, symbols and notations.*

ISO 5-2:1991, *Photography — Density Measurements — Part 2: Geometric conditions for transmission density.*

ISO 5-3:1995, *Photography — Density Measurements — Part 3: Spectral conditions.*

ISO 5-4:1995, *Photography — Density Measurements — Part 4: Geometric conditions for reflection density.*

ISO 516:1999, *Photography — Camera shutters — Timing.*

ISO 554:1976, *Standard atmospheres for conditioning and/or testing — Specifications.*

ISO 7589:1984, *Photography — Illuminants for sensitometry — Specifications for daylight and incandescent tungsten.*

## 3 Terms and definitions

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

### 3.1

#### **camera opto-electronic conversion function**

#### **camera OECF**

relationship between input scene log luminances (units:  $\log_{10}$  candela per square metre) and digital output levels for an opto-electronic digital image capture system

See **opto-electronic conversion function** (3.11), **focal plane opto-electronic conversion function** (3.5)