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Photography and graphic technology — Density measurements —

Part 1: Geometry and functional notation

Photographie et technologie graphique — Mesurages de la densité —

Partie 1: Géométrie et notation fonctionnelle

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
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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.

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The main task of technical committees is to prepare International Standards. 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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 5-1 was prepared by ISO/TC 42, *Photography*, and ISO/TC 130, *Graphic technology*, in a Joint Working Group.

This second edition cancels and replaces the first edition (ISO 5-1:1984), which has been technically revised. In the course of this technical revision, all parts of ISO 5 have been reviewed together, and the terminology, nomenclature and technical requirements have been made consistent across all parts.

ISO 5 consists of the following parts, under the general title *Photography and graphic technology — Density measurements*:

— *Part 1: Geometry and functional notation*

— *Part 2: Geometric conditions for transmittance density*

— *Part 3: Spectral conditions*

— *Part 4: Geometric conditions for reflection density*

Introduction

The measurement of the transmission and reflection characteristics of objects is essential to the science of photography and graphic arts. When light, or other radiant energy, is incident upon an object, it is either absorbed or propagated. Propagation can involve reflection, transmission, refraction, diffraction, scattering, fluorescence, and polarization. The propagated light is distributed in various directions about the object. In most practical applications it is neither necessary nor desirable to consider the light distributed in every direction, but only that which leaves the object in the direction for which there is response by a receiver, such as the eye.

The object modulates the flow of radiant energy from the illuminator to the receiver. The time rate of flow of radiant energy is called radiant flux, or simply flux. This part of ISO 5 provides methods to describe the measurements of the flux modulation in any system. To specify such a system accurately, geometric characteristics of the system, the spectral distribution of the flux incident on the object to be measured, and the spectral responsivity of the receiver need to be given. If the reflection characteristics of the illuminator or receiver affect the measurement, as they do in transmission measurements by the opal glass method, they need to be specified.

The area under consideration is defined by a sampling aperture, the dimensions of which can be important in some applications and need to be specified if the object has appreciable non-uniformity. If the measurement is to quantify the way the object would modulate flux in a given practical application, such as viewing or contact printing, the geometric and spectral conditions of measurement need to simulate those conditions in the practical application.

Modulation is measured and expressed as a dimensionless ratio of fluxes; that is, the flux propagated in the direction of the receiver and that part of the spectrum of interest divided by some reference flux. The reference flux can be the incident flux or the flux propagated through the system when the object is replaced by an ideal object. For some purposes, a logarithmically scaled measure of modulation is more useful than the measured arithmetic ratio. In such cases, it is customary to use optical density defined as the negative logarithm to base 10 of the ratio.

Most geometric arrangements used in photographic and graphic arts optical systems can be conveniently and adequately described in terms of uniform rays of flux bounded by right circular cones. A point on the object is often illuminated by such a conic distribution, and the geometric form of the pencil of rays reaching the receiver is generally conic. The pupil of the eye, for example, subtends a conic solid angle at an object point. In projection systems, the projection lens subtends a conic solid angle at the specimen point. This part of ISO 5 specifies a conic distribution by the half-angle of the cone and the direction of its axis.

A working knowledge of radiometry is generally required to obtain primary standard measurements of transmittance and reflectance. In good radiometric practice, for example, the effects of stray light are minimized by the use of appropriate baffles and proper blackening of certain surfaces. Because the principles and practice of radiometry are well known and are fully described in the *Handbook of Applied Photometry*[10], it is considered unnecessary to provide a detailed specification of radiometric procedures in this part of ISO 5.