INTERNATIONAL STANDARD

ISO 7187

Second edition
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Photography — Materials for direct-positive colour-print cameras — Determination of ISO speed

Photographie — Surfaces sensibles pour appareils photographiques donnant directement une épreuve positive en couleur — Détermination de la sensibilité ISO

Reference number
ISO 7187:1995(E)

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.

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.

International Standard ISO 7187 was prepared by Technical Committee ISO/TC 42, *Photography*.

This second edition cancels and replaces the first edition (ISO 7187:1983), which has been technically revised to include several new definitions (clause 3) and a distinction between speed, ISO speed and ISO speed of a product (clause 6).

Annex A of this International Standard is for information only.

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Introduction

The increased use of in-camera processed colour-print materials, often referred to as "instant print", and the introduction of equipment to permit their use in general cameras makes it desirable to establish a standard method for determining the speed of this type of product. This International Standard applies to any directly viewed reflection colour-print material made by camera exposure of the original scene onto a photosensitive material and subsequent diffusion transfer of a dye image within the same material or to a second receiver material. It also applies to any material similarly exposed, but later processed outside of the camera by a process other than diffusion transfer of the dyed image. It does not apply to copying or duplicating.

For diffusion-transfer materials, the speed and colour of prints depend on the ambient temperature during diffusion. Usually, speed problems as well as serious colour mismatches will occur in prints made at temperatures beyond the range recommended by the manufacturer. The conditions of direct viewing of reflection prints are specified in ISO 3664.

The sensitometric method specified in this International Standard gives ISO speeds that are in close agreement with film speeds obtained by making practical camera exposures. These speeds follow the *f*/16 daylight rule; that is, the ISO speed is the reciprocal of the exposure time, in seconds, which gives the best quality print when the camera lens aperture is set at *f*/16 in direct sunlight for an average front-lighted scene with a solar altitude between 35° and 50°.

When these ISO speeds are used in conjunction with exposure meters conforming to ISO 2720, resultant pictures will be of optimum exposure. For an average scene, the optimum exposure will be approximately midway between the least exposure and the greatest exposure producing satisfactory prints at normal viewing illuminance levels. The exposure latitude for satisfactory prints is approximately one half stop for underexposure and one half stop for overexposure.

Photography — Materials for direct-positive colour-print cameras — Determination of ISO speed

1 Scope

This International Standard specifies a method for determining the ISO speed of materials for direct-positive colour-print cameras when used in a camera for pictorial photography. It also applies to diffusion-transfer and conventional colour-print materials directly exposed in cameras and processed in or out of the camera.

This International Standard does not apply to materials used for copying or duplicating applications.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

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

3 Definitions

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

3.1 exposure, H[1]**:** Time integral of the illuminance on the sensitized material, measured in lux seconds.

Exposure is often expressed in $\log_{10}H$ units.

3.2 speed, S: Quantitative measure of the response of the photographic material to radiant energy for the specified conditions of exposure, processing and image measurement.

3.3 direct-positive processing: Any one-exposure photographic process which results in a positive image directly from the original subject matter.

3.4 diffusion transfer: Photographic process whereby the image moves as a consequence of development to a receiving medium to form (usually) a positive image for viewing.

3.5 reversal processing: Photographic process in which the exposed negative latent image is formed, but that, either by uniform post-exposure or by fogging process chemicals, can be made to yield a positive reproduction.

4 Sampling and storage

In determining the ISO speed of a product, it is important that the samples evaluated yield the average results obtained by users. This will require evaluating

1) CIE Publication No. 17.4 defines "luminous exposure, H". In this International Standard, "luminous exposure" is simply referred to as "exposure".

several different batches periodically under the conditions specified in this International Standard. Prior to evaluation, the samples shall be stored according to the manufacturer's recommendations for a length of time to simulate the average age at which the product is normally used. Several independent evaluations shall be made to ensure the proper calibration of equipment and processes. The basic objective in selecting and storing samples as described above is to ensure that the product characteristics are representative of those obtained by a user at the time of use.

5 Test method

5.1 Principle

Samples are exposed in a sensitometer and processed in the manner specified below. Density measurements are obtained from the resultant image to produce a sensitometric curve from which values are taken and used to determine the ISO speed.

5.2 Safelights

To eliminate the possibility of safelight illumination affecting the sensitometric results, all sensitized materials shall be handled in complete darkness during exposing and processing.

5.3 Exposure

5.3.1 Sample condition

During exposure, the samples shall be at a temperature of 23 °C ± 2 °C and a relative humidity of (50 ± 5) %. This is the recommended atmosphere and normal tolerances specified in ISO 554.

5.3.2 Type of sensitometer

The sensitometer shall be a non-intermittent, illuminance-scale type.

5.3.3 Radiant energy quality

The illuminant for the particular product type being exposed shall conform to the appropriate illuminant specified in ISO 7589.

5.3.4 Filters

ISO speed shall be specified for use without a filter in front of the camera lens. If a product is used with a colour filter in front of the camera lens, an "equivalent" speed number may be used to determine the exposure of the product with the filter. ISO speed does not apply to the filtered condition.

5.3.5 Modulation

The total range of spectral diffuse transmission density with respect to the film plane of each area of the light modulator throughout the wavelength interval from 400 nm to 700 nm shall not exceed 5 % of the average density obtained over the same interval or 0,03 density, whichever is the greater. In the interval from 360 nm to 400 nm, 10 % of this same average density or 0,06 density, whichever is the greater, shall not be exceeded.

If a stepped modulator is used, the logarithm to the base 10 of the exposure increment shall not be greater than 0,15. The width and length of a single step shall be adequate to obtain a uniform density within the reading aperture specified for densitometry.

If a continuously variable modulator is used, the logarithm to the base 10 of the change in exposure with distance along the test strip shall be uniform and not be greater than 0,04 per millimetre.

An area of the product shall be given sufficient exposure to produce the minimum density possible.

5.3.6 Exposure time

Exposure time shall be between 5 s and 1/1 000 s, typical of the usage practice for the sensitized material tested. Typical exposure times are 1/1 000 s to 1/25 s for a daylight-type print material and 1/100 s to 5 s for exposure with tungsten illumination. Since the speed of the sensitized material can be dependent on the exposure time because of reciprocity law failure, the exposure time used in determining the ISO speed should be specified in the instructions for use.

5.4 Processing

5.4.1 Conditioning of samples

In the time interval between exposure and processing, the samples shall be kept at a temperature of 23 °C ± 2 °C and a relative humidity of (50 ± 5) %.

For products designed for in-camera processing, the processing shall be initiated within 2 min after exposure.

For products requiring conventional processing in separate equipment, processing should be initiated within 2 h after exposure.

5.4.2 Processing specifications

The temperature for processing products designed for in-camera processing shall be 23 °C ± 0,5 °C.

The temperature for processing products designed for conventional processing using separate equipment shall be that recommended by the manufacturers.

No additional processing specifications are described in this International Standard in recognition of the wide range of chemicals and equipment used. ISO speed provided by sensitized product manufacturers

generally applies to the product when it is processed in accordance with their recommendations to produce the photographic characteristics specified for the process. Process information shall be available from the manufacturers or others who quote ISO speed values. This shall specify the chemicals, times, temperatures, agitation, equipment and procedure used for each of the processing steps, and any additional information required to obtain the sensitometric results described. The values for speed obtained using various processing procedures can differ significantly. Although different speeds for a particular product can be achieved by varying the process, the user should be aware that other sensitometric and physical changes can also accompany the speed changes.

5.5 Densitometry

ISO standard visual reflection density of the processed images shall be measured using a densitometer complying with the geometric requirements specified in ISO 5-4 and the spectral requirements specified in ISO 5-3. Readings shall be made in a uniform area of the image.

Density measurements shall be made 24 h ± 4 h after processing. During this interval, the samples shall be stored at a temperature of 23 °C ± 2 °C and a relative humidity of (50 ± 5) %.

5.6 Evaluation

5.6.1 Sensitometric curve

The ISO standard visual reflection density values shall be plotted against the logarithm to the base 10 of the corresponding exposures (H), expressed in lux seconds, to obtain a sensitometric curve similar to that illustrated in figure 1.

5.6.2 Minimum density

The minimum density shall be determined from a sample of the material adequately exposed to produce the minimum density possible and processed simultaneously with the sample exposed for determining the sensitometric curve.

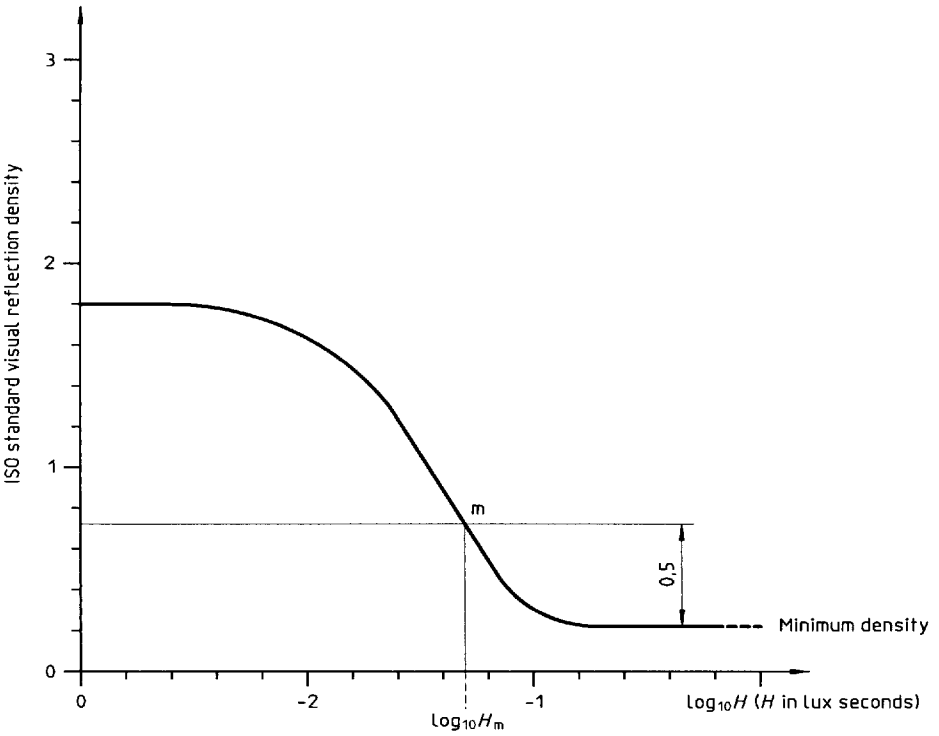

Figure 1 — Sensitometric curve

6 Product classification

6.1 Speed calculation

Raw speed values are derived from the formula:

$$S = \frac{9}{H_m}$$

where H_m is the exposure, in lux seconds, required to produce a density of 0,50 above the minimum density.

6.1.1 ISO speed

The ISO speed shall be obtained directly from $\log_{10}H_m$ by use of table 1, which effectively translates it to one of the designated ISO speeds in the ISO speed scale. The procedure is to first determine $\log_{10}H_m$ as in figure 1. The appropriate $\log_{10}H_m$ range is then selected from the two columns on the left side of table 1 and the corresponding ISO speed is found in the right-hand column of table 1.

6.1.2 ISO speed of a product

The ISO speed of a product (as distinguished from that of a specific sample) shall be based on the arithmetic mean of the $\log_{10}H_m$ values determined from several batches of the product when selected, stored and tested as specified in clause 4 and subclauses 5.4 and 5.5. The ISO speed of a product with proper rounding is then determined from the average value of $\log_{10}H_m$ by use of table 1.

6.2 Accuracy

The calibration of the equipment and processes involved in determining product speed shall be adequate to ensure that the absolute value of the error in $\log_{10}H_m$ is less than 0,05.

7 Product marking and labelling

The speed of a product determined by the method specified in this International Standard and expressed on the scale given in table 1 may be designated the ISO speed and denoted in the form "ISO 100".

Since the ISO speed is dependent on the exposure and processing conditions, these should be indicated when quoting ISO speed values.

Table 1 — ISO speed scale

$\log_{10}H_m$		ISO speed
from	to	
− 2,60	− 2,51	3 200
− 2,50	− 2,41	2 500
− 2,40	− 2,31	2 000
− 2,30	− 2,21	1 600
− 2,20	− 2,11	1 250
− 2,10	− 2,01	1 000
− 2,00	− 1,91	800
− 1,90	− 1,81	640
− 1,80	− 1,71	500
− 1,70	− 1,61	400
− 1,60	− 1,51	320
− 1,50	− 1,41	250
− 1,40	− 1,31	200
− 1,30	− 1,21	160
− 1,20	− 1,11	125
− 1,10	− 1,01	100
− 1,00	− 0,91	80
− 0,90	− 0,81	64
− 0,80	− 0,71	50
− 0,70	− 0,61	40
− 0,60	− 0,51	32
− 0,50	− 0,41	25
− 0,40	− 0,31	20
− 0,30	− 0,21	16
− 0,20	− 0,11	12
− 0,10	− 0,01	10
0,00	0,09	8
0,10	0,19	6
0,20	0,29	5
0,30	0,39	4

Annex A
(informative)

Bibliography

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

[2] ISO 2720:1974, *Photography — General purpose photographic exposure meters (photoelectric type) — Guide to product specification.*

[3] ISO 3664:1975, *Photography — Illumination conditions for viewing colour transparencies and their reproductions.*

[4] CIE Publication No. 17.4:1987, *International Lighting Vocabulary.*

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